SAE INTERNATIONAL

TECHNICAL REPORT

EIA-933 REV. B

Issued 2002-12
Revised 2015-03

Superseding EIA-933A

(R) Requirements for a COTS Assembly Management Plan

RATIONALE

ANSI/GEIA 933-A was published in August 2011. It is out of date due to technology progress.

FOREWORD

This document defines the requirements for developing a Commercial-Off-The-Shelf (COTS) Assembly Management Plan (CAMP) to integrate COTS electronic assemblies into aerospace, defense, and high-performance (ADHP) electronic equipment and systems, in such a manner that the performance and reliability of the ADHP equipment and systems are assured. This is accomplished by documenting and implementing the processes required in Clause 3 of this document.

In this document, a COTS assembly is defined as: *"An assembly developed by a supplier for multiple customers, whose design and configuration is controlled by the supplier's or an industry specification."* Therefore, the organization that integrates the COTS assembly into the ADHP equipment or system is the owner of the CAMP, hereinafter called the Plan. It is the responsibility of the Plan owner to develop and implement a Plan that satisfies the requirements of this document. The requirements of Clause 3 are not intended to be levied on the COTS assembly supplier; rather they are the responsibility of the organization that integrates the COTS assembly into the ADHP equipment or system (hereinafter called the System). See Figure 1 for an illustration of the aerospace supply chain, with respect to COTS assemblies.

This document is intended for use by ADHP equipment and system integrators, manufacturers, subcontractors, maintenance facilities, etc., to develop and implement their own Plans. It also is intended for use by regulatory and certification agencies to evaluate applications for certification of Systems containing COTS assemblies.

This document states objectives to be accomplished, in the form of documented processes to satisfy the requirements for COTS assemblies in Systems. This document does not specify how tasks are to be performed, specific tests to be performed, data to be collected, or reports to be issued. Those who prepare Plans in compliance with this document are encouraged to document processes that are the most efficient and effective for them and their customers to accomplish the objectives of this document. To allow flexibility in implementing, maintaining, and updating the documented processes, Plan owners are encouraged to refer to their own internal processes, as opposed to including the detailed process descriptions within their Plans.

The Plan documents the processes that the Plan owner has available to address the requirements of this document. For each instance of COTS assembly integration into a System, the Plan owner selects which of the documented processes will be used, based on the System requirements and the application of the COTS assembly in the System. The Plan owner then prepares a COTS Assembly Integration Report, using the format of Appendix A, or an equivalent.

A Plan owner may prepare a single Plan, and use it for all relevant products supplied by the Plan owner; alternatively, the Plan owner may prepare a separate Plan for each relevant product, program, market segment, or customer.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/EIA933B

1. SCOPE

This document applies to the development of Plans for integrating and managing COTS assemblies in electronic equipment and Systems for the commercial, military, and space markets; as well as other ADHP markets that wish to use this document.

For purposes of this document, COTS assemblies are viewed as small electronic assemblies such as printed wiring assemblies, relays, disk drives, LCD matrices, VME circuit cards, servers, printers, laptop computers, etc. There are many ways to categorize COTS assemblies[1], including the following spectrum:

- At one end of the spectrum are COTS assemblies whose design, internal parts[2], materials, configuration control, and qualification methods are at least partially controlled, or influenced, by aerospace customers (either individually or collectively). An example at this end of the spectrum is a VME circuit card assembly. While the design, internal parts, materials, configuration control, and qualification methods are controlled by the assembly suppliers, the assemblies are targeted for ADHP applications, and thus the manufacturers expend considerable effort to understand their customers' needs; and they design, produce, and qualify their products accordingly. VME assembly suppliers are sensitive to feedback from their customers, and are willing to make changes in response to that feedback. The response is only general, however, and it is not likely that a specific change will be made unless the supplier determines it to be beneficial to the product's market performance.

- At the other end of the spectrum are COTS assemblies whose design, internal parts, materials, configuration control, and qualification methods are not controlled, or controllable, in any way by ADHP customers (either individually or collectively). An example is a disk drive targeted for an industry other than aerospace. Aerospace customers are not likely to obtain any information beyond the published data sheet; furthermore, the data sheet, and other important information, may be changed without notice. Typically, it is not possible for aerospace customers to purchase these assemblies to a specific issue of a data sheet.

It is critical for the Plan owner to (1) review and understand the design, internal parts, materials, configuration control, and qualification methods of all "as-received" COTS assemblies[3], and their capabilities with respect to their application in the System; (2) identify risks, and where necessary, (3) take additional action to mitigate the risks associated with the performance and reliability of the COTS assembly in the ADHP system.

2. REFERENCES

For dated references, only the revision cited applies. For undated references, the latest revision of the referenced document (including any amendments) applies.

1. Parts Management, MIL-STD-3018.

2. Process Management for Avionics - Preparation of an Electronic Components Management Plan, IEC TS 62239-1, International Electrotechnical Commission.

3. Standard for Preparing an Electronic Components Management Plan, ANSI/EIA-STD-4899, TechAmerica.

---

[1] The distinction between an electronic component and an electronic assembly is not always recognized or agreed upon by the various industries involved; for example, filters, contactors, power supply modules, relays, magnetic assemblies, etc., may be considered as either components or assemblies. In each application, it is a recommended practice for the user of this document to clarify this distinction.

[2] Requirements for managing the electronic components within electronic assemblies may be found in References 1-3, which describe the ADHP Electronic Management Program (ECMP). In some cases, it may be appropriate to view the COTS assembly as a component that can be managed with ECMP processes, using the requirements of References 1-3

[3] It is noted that some assemblies are completely within the control of the aerospace customer, but they are not considered COTS, and are not addressed in this document.

4. Design Assurance Guidance for Airborne Electronic Hardware, RTCA DO-254, Radio Technical Corporation of America.

5. Guidelines for Development of Civil Aircraft Systems, ARP4754A, SAE International.

6. Process management for avionics - Electronic components capability in operation - Part 1: Temperature uprating, IEC TR 62240-1, International Electrotechnical Commission.

7. Long-term Storage of Electronic Devices, TechAmerica GEIA-STD-0003.

8. Environmental Conditions and Test Procedures for Airborne Equipment, RTCA DO-160, Radio Technical Corporation of America.

9. Process Management for Avionics - Atmospheric Radiation Effects, IEC 62396, Parts 1-5, International Electrotechnical Commission.

10. Measurement and Reporting of Alpha Particle and Terrestrial Cosmic Ray-Induced Soft Errors in Semiconductor Devices, JESD89, JEDEC©.

11. Integrated Circuits - Measurement of electromagnetic emissions, integrated circuits, IEC 61967, parts 1-8, International Electrotechnical Commission.

12. Derating of Electronic Components, TechAmerica GEIA-STD-0008.

13. Application Thermal Derating Methodologies, JEP149, JEDEC.

14. Electronic Reliability Design Handbook, MIL-HDBK-338.

15. General Guidelines for Electronic Equipment, MIL-HDBK-454.

16. Failure Mechanisms and Models for Semiconductor Devices, JEP122, JEDEC©.

17. Early Life Failure Rate Calculation Procedure for Electronic Components, JESD74, JEDEC©.

18. Physics of Failure Reliability Predictions, ANSI/VITA 51.2-2011, VITA.

19. Guidelines for Preparing Reliability Assessment Plans for Electronic Engine Controls, ARP5890, SAE International.

20. Reliability Prediction of Electronic Equipment, MIL-HDBK-217.

21. Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, ARP4761, SAE International.

22. Standard Practice System Safety, MIL-STD-882.

23. Standard Best Practices for System Safety Program Development and Execution, GEIA-STD-0010, TechAmerica.

24. Configuration Management Standard, EIA-649, TechAmerica.

25. Quality Management Systems - Requirements for Aviation, Space and Defense Organizations, SAE AS9100.

26. Quality Management System - Requirements, SAI AS/NZS ISO 9001.

27. Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder, GEIA-STD-0005-1, TechAmerica.

28. Process Management for Avionics - Aerospace and Defence Electronic Systems Containing Lead-free Solder - Part 1: Preparation of a Lead-free Control Plan, IEC TS 62647-1, International Electrotechnical Commission.

29. Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition, AS5553, SAE International.

30. Counterfeit Material; Assuring Acquisition of Authentic and Conforming Material, AS6174, SAE International.

31. Standard for Preparing a DMSMS Management Plan, ANSI/TechAmerica STD-0016, TechAmerica.

3. REQUIREMENTS

A COTS Assembly Management Plan compliant to this document includes documented processes that are available for use by the Plan Owner to accomplish steps (a) through (d), listed below, for each of the requirements in sub-clauses 3.1 through 3.16:

a. Understand the System requirements allocated to the COTS assembly;

b. Understand the capability of the "as-received" COTS assembly, with respect to the allocated System requirements;

c. Prepare a System risk analysis, based on a comparison of (a) and (b), above; and

d. Document appropriate risk mitigation methods[4] available for use to assure that the COTS assembly accomplishes its allocated System requirements reliably throughout the specified system lifetime.

The above steps correspond to the columns labeled (a) through (d) in Appendix A, which is a format that can be used for each instance of COTS Assembly integration to demonstrate compliance to this Standard.

(The requirements in this Clause can be satisfied only by the Plan owner, and are not intended to be flowed down to a supplier, subcontractor, or other organization that is not responsible for the integration of the COTS assembly into the System.)

(It is acknowledged that not all the requirements listed below will be applicable for all programs. See the note in Appendix A for further information.)

3.1 Functionality

The documented processes shall assure that the COTS assembly performs the function(s) allocated to it by the System design, reliably throughout the specified System lifetime, using appropriate risk mitigations as required. Allocated functions include, but are not limited to, inputs and outputs for electrical, mechanical, optical, hydraulic, and pneumatic signals, duty cycle, etc.

(See References 4 and 5 for guidance on design and development of aerospace electronic Systems, including allocation of System requirements.)

[4] The intent of this Clause is for the Plan owner to document the risk mitigation methods available to the Plan owner; with the understanding that the risk mitigation methods actually employed on a given System depend on the application and the criticality of the System. Examples of risk mitigation methods include modification of the COTS assembly, redundancy and other System design methods, modification of the COTS assembly's local operating environment, increased maintenance, planned replacement, etc. More detail regarding these methods is included in Appendix B.

3.2 Operating, Storage, and Transportation Environmental Stresses

The documented processes shall assure that the COTS assembly accomplishes its allocated System requirements with respect to each of the operating, storage, and transportation stresses listed below, using appropriate risk migrations as required.

	Stress	Application Consideration	Applicable Standards (Ref. No.)
3.2.1	Temperature limits	Damage can occur when specified maximum or minimum temperature limits are exceeded during operation, storage, or transport	IEC TR 62240 (6) GEIA-STD-0003 (7) RTCA DO-160 (8)
3.2.2	Temperature variations	Temperature cycling over long periods of time can cause damage due to mismatches of thermal coefficients of expansion of COTS assembly materials	
3.2.3	Heat dissipation and cooling	Proper heat dissipation and cooling methods may be required to prevent damage to COTS assemblies.	
3.2.4	Mechanical shock	Mechanical stress limits may be exceeded when COTS assemblies are exposed to mechanical shock	
3.2.5	Mechanical vibration	Damage can occur due to long term exposure to certain mechanical vibration profiles.	
3.2.6	Natural radiation	Radiation due to cosmic rays, neutrons, heavy ions, etc., may cause Single Event Effects (SEE)	IEC 62396 series (9) JESD89A (10)
3.2.7	Induced radiation	Damage can result from exposure to nuclear radiation	
3.2.8	Moisture and corrosion	Damage can result from exposure to moist and/or corrosive environments	
3.2.9	Electromagnetic capability	Assemblies can produce electromagnetic noise through electrical transitions, and assemblies can be susceptible to electromagnetic interference	IEC 61967 series (11)
3.2.10	Other relevant stresses		

3.3 Derating

The documented processes shall assure that the de-rating criteria and methods used for the COTS assembly are appropriate for the application, using appropriate risk mitigations as required.

(See References 12-15 for additional guidance about de-rating.)

3.4 Compatibility with System Assembly Processes

The documented processes shall assure that the COTS assembly is compatible with System assembly processes, including repair and rework, using appropriate risk mitigations as required.

3.5 Ageing

The documented processes shall include provisions to satisfy the ageing requirements of the System, with the integrated COTS assembly, using appropriate risk mitigations as required. This includes an application-appropriate understanding of all relevant life-limiting or wear-out failure mechanisms of the COTS assembly and its internal parts, including advanced technology semiconductor devices and other parts susceptible to early wear-out.

(References 16-18 provide information that can be used to satisfy this requirement.)

3.6 Reliability

The documented processes shall assure that the Plan owner understands the reliability of the as-received COTS assembly in the System, based on (1) credible data from testing the COTS assembly, or from use of similar assemblies in similar environments; and (2) analysis comparing the available data to the System application; and that appropriate risk mitigations are used as required.

(See References 14, 18-20 for guidance on reliability analysis.)

3.7 Safety

The documented processes shall assure that safety analyses include the impact of the COTS assembly.

(See References 21-23 for guidance on System safety analyses.)

3.8 Maintainability and Testability

The documented processes shall assure that the maintainability and testability of the System are consistent with the System requirements, using appropriate risk mitigations as required.

3.9 Qualification

The documented processes shall assure that the COTS assembly is qualified for the System application, using appropriate additional qualification processes, tests, or data (beyond those conducted on the as-received COTS assembly) as required.

3.10 Configuration Control

The documented processes ***shall*** assure that the configuration control processes and requirements used for the as-received COTS assembly, including all internal parts and materials, are consistent with System requirements, using appropriate additional processes as required.

(See References 4, 5, and 24 for guidance on configuration management.)

3.11 COTS Assembly Design

All COTS assemblies used in the System shall be associated with published data sheets describing the as-received COTS assembly's performance capabilities[5].

3.12 Quality Assurance

The documented processes shall assure that the quality of the COTS assembly is assured according to the supplier's documented Quality Management System, compliant to the relevant parts of ISO 9001 (Reference 25), AS9100, (Reference 26), or equivalent.

[5] As noted earlier in this document, published data sheets for COTS assemblies may or may not be associated with any given specific COTS assembly; however, it is the responsibility of the Plan owner to associate the given COTS assembly to a published data sheet that, as closely as possible, represents its capabilities.

3.13 Materials

The documented processes shall assure that the materials used in the as-received COTS assembly (including material changes throughout the production life) are consistent with System requirements, including prohibited materials, hazardous materials, environmentally sensitive materials, foreign object debris, fungus resistance, flammability, etc., with appropriate risk mitigations where required.

The documented processes shall assure that the use of lead-free part termination and assembly materials are controlled according to the requirements of References 27 or 28, or equivalent.

3.14 Internal Parts

The documented processes shall give preference to COTS assembly suppliers whose processes for selecting the internal parts are consistent with ADHP industry standards such as References 1-3, or equivalent.

3.15 Counterfeit Parts and Materials

The documented processes shall assure that potential counterfeit parts and materials are controlled according to the requirements of Reference 29 or 30, or equivalent.

3.16 Obsolescence Management

The documented processes shall assure that the COTS assembly performs the function(s) allocated to it by the System design, reliably throughout the specified System lifetime, using appropriate risk mitigations as required. Allocated functions include, but are not limited to, inputs and outputs for electrical, mechanical, optical, hydraulic, and pneumatic signals, duty cycle, etc.

(See References 4 and 5 for guidance on design and development of aerospace electronic Systems, including allocation of System requirements.)

4. PLAN ADMINISTRATION

4.1 Plan Content and Organization

The Plan ***shall*** be organized in such a manner that each of the requirements of Clause 3 is addressed clearly, concisely, and unambiguously, stating:

- What the Plan owner does to satisfy each requirement, preferably in the form of documented processes;
- How the Plan owner demonstrates compliance to the Plan; and
- The evidence that is available to show that the requirements are satisfied.

The Plan ***shall*** include a matrix that demonstrates compliance to the requirements of this document. The format of Appendix C is recommended.

The requirements of this Plan ***shall*** apply to all COTS assemblies integrated into the System, whether the COTS assembly is obtained from the COTS assembly manufacturer, a distributor, or other supplier or subcontractor.

4.2 Plan Terms, Definitions, Abbreviations, Initials, and Acronyms

The terms, definitions, abbreviations, initials, and acronyms used in the Plan ***shall*** be those of Clause 5 of this document, unless they are clearly defined otherwise in the Plan.

4.3 Plan Focal Point

The Plan ***shall*** identify, within the Plan owner's organization, a focal point for the Plan to:

- Serve as the primary interface between the Plan owner and outside parties in matters pertaining to the Plan; and
- Assure that the Plan is reviewed and updated as necessary.

4.4 Plan References

The Plan ***shall*** include a list of all the documents referred to in the Plan, including this document, other industry and government documents, and the Plan owner's internal documents.

4.5 Plan Applicability

The Plan ***shall*** document all the COTS assembly types or technologies and the range of systems to which the Plan applies.

4.6 Plan Implementation

The Plan owner ***shall*** be able to provide objective evidence that the requirements of this document are satisfied, and that the Plan is implemented.

4.7 Plan Acceptance

The Plan ***shall*** be accepted when the Plan owner and the customer agree that the Plan is compliant to this document. Certification by an accredited assessment body such as IECQ may be used as evidence that the Plan satisfies the requirements of this document.

4.8 Plan Modifications

A process ***shall*** be in place to notify all affected parties, when a Plan is modified.

5. PLAN TERMS, DEFINITIONS, ABBREVIATIONS, INITIALS, AND ACRONYMS

ADHP: Aerospace, Defense, and High Performance

AS-RECEIVED COTS ASSEMBLY: The COTS assembly that is received by the Plan owner for integration into the System. The as-received COTS assembly may be in the form produced by the COTS assembly manufacturer, or as modified by a subcontractor.

COTS: Commercial-off-the-shelf

COTS ASSEMBLY: An assembly developed by a supplier for multiple customers, whose design and configuration is controlled by the supplier's or an industry specification.

COTS ASSEMBLY INTEGRATOR: The organization that integrates the COTS assembly into the ADHP system; the owner of the COTS Assembly Management Plan.

COTS ASSEMBLY MANUFACTURER: The organization that produces the COTS assembly, and controls its design and configuration.

COTS ASSEMBLY MANAGEMENT PLAN (CAMP): A Plan, compliant to this document, prepared by the organization that integrates COTS assemblies into ADHP equipment or systems.

COTS ASSEMBLY MANAGEMENT PLAN OWNER: The organization that is responsible for preparing an implementing the COTS Assembly Management Plan.

COTS ASSEMBLY SUPPLIER: The organization responsible for the COTS assembly design, qualification, and configuration; not within aerospace control.

DIMINISHING MANUFACTURING SOURCES AND MATERIALS SHORTAGES (DMSMS): Another term for obsolescence.

EEE PART (ELECTRICAL, ELECTRONIC OR ELECTROMECHANICAL PART): A component designed and built to perform a specific functions, not subject to disassembly without destruction or impairment of design use; examples of electrical parts include resistors, capacitors, inductors, transformers, and connectors; examples of electronic parts include active devices, monolithic microcircuits, hybrid microcircuits, diodes, and transistors; electromechanical parts have electrical inputs with mechanical outputs, or mechanical inputs with electrical outputs, or combinations of each; examples of electromechanical parts are motors, synchros, servos, and some relays

EMC: Electromagnetic compatibility

EQUIPMENT: Intermediate- or lower-level item into which the COTS assembly is integrated by the Plan Owner; may in turn be integrated into higher-level Equipment or a System.

FUNCTIONALITY: The ability to provide a certain capability to a system; functional characteristics include electrical parameters, mechanical strength, size, weight, and other similar requirements.

GEIA: Government Electronic Industries Association

IEC: International Electrotechnical Commission

ISO: International Standards Organization

JEDEC: Semiconductor industry standards alliance

PLAN OWNER: The organization that prepares and implements the COTS assembly Management Plan; the organization that integrates the COTS assembly into the System.

QUALIFICATION: The process used to demonstrate that the COTS assembly is capable of satisfying the intended application specifications for all the required conditions and environments; typically, the COTS assembly application specifications are different from those of the ADHP specifications.

SHALL: Indicates a mandatory requirement.

SYSTEM: Higher-level item into which the COTS assembly is integrated by the Plan owner; may be a higher level assembly, electronics equipment, or an entire ADHP System.

TARGET MARKET: The market for which the COTS assembly is designed and qualified; typically other than ADHP.

USEFUL LIFE: The time for which a System or Equipment is expected to operate successfully, with agreed-upon maintenance and other support actions; also called Serviceable Life.

VME (VERSA MODULE EUROPA): A flexible open-ended bus system which makes use of the Eurocard standard.

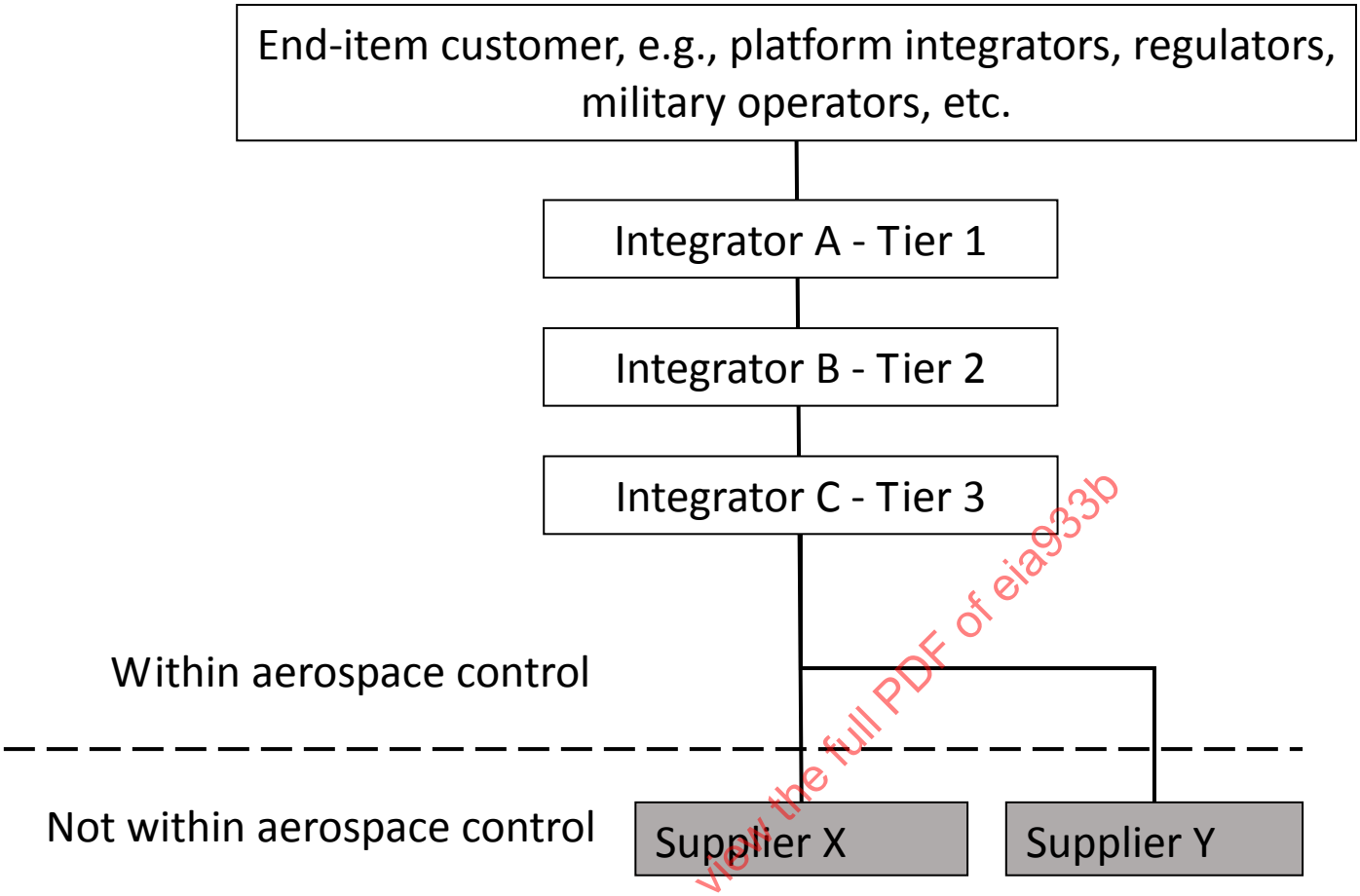

Figure 1 - An illustration of the aerospace industry supply chain. COTS assembly integrators are shown above the dashed line; COTS assembly suppliers are shown below the dashed line, and are not subject to aerospace control.

6. NOTES

6.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications nor in documents that contain editorial changes only.

APPENDIX A - COTS ASSEMBLY INTEGRATION REPORT

(This form is to be used for each instance of a COTS assembly integration into a System. It is acknowledged that, for any given program, not all of the requirements of Clause 3 may apply; in such cases, it is acceptable to list the requirement as Not Applicable (N/A.) It also is acceptable to state that the System Risk is small and no mitigation is used, if that is indeed the case. However, each line of the form should contain at least one entry.)

System Description: _____ COTS Assembly Description: _____

Written by: _____ Approved by: _____ Date: _____

EIA-933 Requirement No.	(a) System Requirement Allocated to COTS Assembly	(b) COTS Assembly Capability	(c) System Risk	(d) Risk Mitigation Method(s)
3.1				
3.2				
3.2.1				
3.2.2				
3.2.3				
3.2.4				
3.2.5				
3.2.6				
3.2.7				
3.2.8				
3.2.9				
3.2.10				
3.3				
3.4				
3.5				
3.6				
3.7				
3.8				
3.19				
3.10				
3.11				
3.12				
3.13				
3.14				
3.15				
3.16				

APPENDIX B - MITIGATION METHODS

Cocooning/Isolation - Modify the COTS assembly by placing it a local environment that reduces its exposure to mechanical, thermal, or other stresses; also called ruggedization.

Configuration Control Data Acquisition - Develop alternate methods of obtaining configuration data from the COTS assembly provider; periodically perform destructive or non-destructive analyses, as needed, to understand the configuration of the COTS assembly.

Electrical Stress Reduction - Modify the System design to limit the electrical inputs to the COTS assembly to levels within the specified limits of the COTS assembly.

Maintenance Processes - Increase the frequency of specific maintenance actions or inspections, plan replacement of COTS assemblies that are subject to limited lifetimes in expected environmental or operating conditions, etc.

Mechanical Stress Reduction - Modify the System design or the COTS assembly by shock mounting or reducing the mechanical stresses to which the COTS assembly is exposed.

Radiation Mitigation - Modify the system design by the methods described in Reference 9.

Reliability Improvement Methods - Modify the System design to reduce thermal or electrical stresses on the COTS assembly, plan replacement of COTS assemblies that contain life-limited semiconductor devices or other parts.

Storage Environment Control - Modify the storage conditions to reduce thermal or mechanical stresses, humidity, severity of atmospheric conditions, etc.

Thermal Stress Reduction - Modify the System operating, storage, and transportation environments to levels within the specified limits of the COTS assembly by thermal insulation, active or passive cooling, changing the operating conditions, changing the duty cycle, or other similar methods.

Transportation Environment Control - Modify the transportation methods or conditions to reduce thermal or mechanical stresses, humidity, severity of atmospheric conditions, etc.

Uprating - Use the methods of Reference 6 to assure operation of the COTS assembly in beyond its specified conditions.

Upscreening - Test the COTS assembly in environmental or operating conditions that exceed its specifications.