



Federal Aviation Administration

Memorandum

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To: Manager, All Aircraft Certification Offices

From: *For* David W. Hempe, Manager, Aircraft Engineering Division, AIR-100 *Sym Cohen*

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Subject: Designated Engineering Representative (DER) Authority for Complex Electronic Hardware Approval and Special Delegation for TSO Complex Electronic Hardware

References: 1) FAA Order 8110.37D Designated Engineering Representative (DER) Guidance Handbook,
2) FAA Order 8100.8C Designee Management Handbook, AIR100 Policy Memo 2001-01 Use of DERs in the TSOA Process,
3) FAA Advisory Circular 20-152 RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, and
4) RTCA, Inc., Document RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware

Purpose

This memorandum prescribes policy for Designated Engineering Representative (DER) authority in the complex electronic hardware technical area and for DER use in Technical Standard Order (TSO) authorizations involving complex electronic hardware. In this Policy Memo, and to be consistent with Advisory Circular 20-152, complex electronic hardware refers to custom micro-coded devices such as programmable logic devices and application specific integrated circuits. The qualifications and limitations of DERs with authority for complex electronic hardware are described in this Policy Memo. For a DER with a delegation of Complex Electronic Hardware approval, the applicant must meet the following specialized technical appointment criteria in addition to the requirements of Table 4-2 of Order 8100.8C. The contents of this Policy Memo will be incorporated in future revisions to Order 8110.37D and Order 8100.8C.

Delegated organizations should use this Policy Memo as guidance when appointing Authorized Representatives (AR) or Unit Members. Qualifications and limitations for delegated organization ARs and Unit Members are the same as those specified in this Policy Memo for DERs.

Delegated Functions and Authorized Areas

Appendix 2 of Order 8110.37D provides the delegated functions and authorization areas for DERs. For example, software is a delegated function in Charts B (powerplants), C1 (mechanical equipment), C2 (electrical equipment), E (engines), and F (propellers). Similarly, this memo establishes “complex electronic hardware” as a delegated function for charts B, C1, C2, E, and F. Until the charts can be changed, the authority for this function will be defined in the DER’s authorization letter and recorded in the “Limitations” field in the Designee Information Network, Chart Summary/Other Information page.

Qualifications for Complex Electronic Hardware DERs

A DER qualified to approve complex electronic hardware must meet the specialized technical appointment criteria in Order 8100.8C, Table 4-2, and the following:

- (1) **Thorough working knowledge** and understanding of RTCA/DO-254[] (where [] indicates the latest revision of the document), “Design Assurance Guidance for Airborne Electronic Hardware”
- (2) **Understanding of and experience** with RTCA/DO-254[] hardware life cycle data needed to demonstrate that the objectives of RTCA/DO-254 are fully met (for example, Plan for Hardware Aspects of Certification, Hardware Accomplishment Summary, Hardware Process Assurance Plan, Hardware Configuration Management Plan, Hardware Design Plan, Hardware Verification Plan, Hardware Validation Plan, Hardware Design Standards, Traceability data, etc.). The DER should also demonstrate the ability to assess the quality of hardware life cycle data and the development team’s adherence to approved plans, standards and procedures.
- (3) **Familiarity** with the systems safety assessment process, specifically, those portions that establish the hardware design assurance levels.
- (4) **A demonstrated knowledge** of the rationale for, and the significance of, each process and activity in the hardware life cycle, as well as its supporting standards, procedures, and documentation. The DER should be able to identify and to evaluate the critical aspects and contents of each of the documents in RTCA/DO-254[].
- (5) **Ability** to distinguish between complex and simple electronic hardware. This should include the ability to evaluate the classification of the device as “simple” and its justification, assess the test and analysis strategy, and evaluate the test and analysis results to confirm verification coverage required for the “simple” classification of the electronic hardware.
- (6) **Experience** gained from participation in some technically responsible capacity over a complete complex electronic hardware life cycle. This qualification may be satisfied by an aggregate of involvement in different complex electronic hardware development programs and various roles in those programs.
- (7) **Experience** interacting with the phases of complex electronic hardware development and testing processes addressed by RTCA/DO-254[], including use of the associated configuration management and process assurance. This experience should include significant responsible involvement in several of those phases.

- (8) **Experience** with the design of some different kinds of complex electronic hardware devices, such as Application Specific Integrated Circuits (ASIC), Programmable Logic Devices (PLD), Field Programmable Gate Arrays (FPGA), and other types of custom micro-coded devices.
- (9) **Familiarity** with Hardware Description Languages that are used for programming complex electronic hardware, and an understanding of the types of verification required for use of such languages.
- (10) **Familiarity** with various tools used in the design, verification, validation and configuration control of complex electronic hardware. Familiarity with typical complex electronic hardware tools available to facilitate the development, documentation, and consistency-checking processes is highly desirable.
- (11) **Demonstrated knowledge** of the sources of complex electronic hardware anomalies, the relative merits of the types of verification processes and activities that are able to detect errors and anomalies, and the characteristics of a thorough verification program.
- (12) **An understanding** of the system and hardware design techniques that may be used to assign or to reduce a hardware design assurance level such as, redundancy, built-in-test, monitoring, circuit/function isolation, dissimilarity, etc. This should include the ability to assess the acceptability of proposed mitigation techniques relative to the required system integrity and reliability.
- (13) **Experience** in addressing errors in the different processes and activities in which errors can be introduced in complex electronic hardware, e.g., handling of components, use of development tools, design, and manufacturing/fabrication process.
- (14) **Knowledge** of hardware characteristics that can impact interfaces with software and other hardware components, including safety, integrity and reliability aspects.
- (15) **Experience** with complex electronic hardware verification process activities, including reviews, analyses, simulation/emulation and testing.
- (16) **Familiarity** with post-certification complex electronic hardware processes, such as, manufacturing quality control, factory configuration control, acceptance test procedures, factory installation and test equipment, production equipment control, and installation approvals for Technical Standard Order (TSO) authorization equipment.
- (17) **Familiarity** with complex electronic hardware modification processes, including modifications to previously developed hardware, changes of aircraft installation, change of application or design environment, upgrading a design baseline, and conducting change impact analyses and regression testing and analyses.
- (18) **The FAA requires a minimum level** of successful experience before allowing a DER to approve data pertaining to complex electronic hardware. The experience to be considered in relation to complex electronic hardware design assurance levels is as follows:
 - (a) **Level A** complex electronic hardware. A DER should have demonstrated knowledge of the different design assurance considerations and strategies in RTCA/DO-254 Appendix B, including Functional Failure Path Analysis, Architectural Mitigation, Product Service Experience, and Advanced Verification Methods. A DER should have at

least one year of successful experience reviewing Level A complex electronic hardware data submittals before being designated to approve any Level A data.

(b) **Level B** complex electronic hardware. A DER should have demonstrated knowledge of the different design assurance considerations and strategies in RTCA/DO-254 Appendix B, including Functional Failure Path Analysis, Architectural Mitigation, Product Service Experience, and Advanced Verification Methods. A DER should have at least one year of successful experience reviewing Level A or Level B complex electronic hardware data submittals before being designated to approve any Level B data.

(c) **Level C** complex electronic hardware. A DER should have at least one year of successful experience reviewing Level A, Level B, or Level C complex electronic hardware data submittals before being designated to approve any Level C data.

(d) **Level D** complex electronic hardware. Per AC 20-152, if RTCA/DO-254 is the proposed means of compliance for complex electronic hardware Level D devices, then DER review of the life cycle data will not be needed. However, if a manufacturer chooses to use a design assurance practice other than RTCA/DO-254, then DER review of the life cycle processes and data may be needed to ensure that Level D devices will perform their intended functions and the alternate method is acceptable. A DER may be designated to approve Level D data if the qualification criteria (see above items (1) through (17)) for appointment as a DER with complex electronic hardware approval have been met.

All applicants for the delegated function of complex electronic hardware must complete the sheet in Attachment 1 of this memo as part of their DER application for expansion per FAA Order 8100.8C. The applicant must attach supporting evidence of their experience and familiarity in each required area. If the applicant was previously authorized for a delegated function of complex electronic hardware approval, then supporting evidence of their experience/familiarity in each required area may not be needed if the Aircraft Certification Office (ACO) agrees.

Limitations for Complex Electronic Hardware DERs

As with the software authorization, complex electronic hardware delegations will typically have some limitations. The appointing ACO will determine what limitations will be placed on the DER's authority. These limitations should be expressed in the terms used in RTCA/DO-254 and must be defined in the DER's authorization letter. In addition, certain data approvals should be reserved for approval by the ACO: the Plan for Hardware Aspects of Certification, Top Level Drawing or Hardware Configuration Index, and the Hardware Accomplishment Summary. For some systems and complex electronic hardware requiring design assurance Level A or B, the verification and validation data may also be reserved for approval by the ACO.

Use of Designated Engineering Representatives in the Technical Standard Order (TSO) Authorizations Involving Complex Electronic Hardware

To be consistent with previous policy issued on software authorization, this policy allows DERs with the delegation of "Complex Electronic Hardware Approval" to be authorized to approve specific technical data in support of a manufacturer's request for Technical Standard Order

authorization (TSOA). This will assist ACOs in issuing the TSOA when complex electronic hardware is part of the TSO article. This expanded use of the designee system should increase the ACO's confidence in the TSOA applicant's design submittal, thus reducing the ACO's review time necessary for granting a TSOA. This policy applies immediately to all ACOs and to all DERs with a delegation of complex electronic hardware approval.

In order to use a DER with complex electronic hardware authorization in the TSOA process the DER must first be granted the special delegation to make findings of compliance in support of 14 CFR § 21.601(b)(2). This special delegation will be identified in the DER's authority as "TSO Complex Electronic Hardware". This special delegation may only be granted by the DER's appointing ACO as part of the DER's letter of authorization. The Designee Information Network (DIN) will be modified in the future to add "TSO Complex Electronic Hardware Approval" as a special delegation that can be authorized to DERs with the delegation of "Complex Electronic Hardware Approval." In the interim, offices must use the "Limitations" text field, on the Designee Information Network, Chart Summary/Other Information page, for this special function until it can be added to the "Special Functions" list.

The decision to allow the use of DERs to approve complex electronic hardware data on behalf of a TSO applicant is up to the ACO managing the project. If an applicant desires to use a DER to approve some of the data, the DER should be identified early in the project so the ACO can decide whether or not they will accept DER approved data. The ACO will also determine the suitability of the proposed DER, and identify the specific data that may be approved by the DER for the project. The ACO will also identify the data reserved for ACO approval. The DER's data approval capability in support of TSOA will be limited to findings of compliance to RTCA Document DO-254[], "Design Assurance Guidance for Airborne Electronic Hardware", when complex electronic hardware is incorporated in the TSO article. Compliance with RTCA/DO-254 will be shown on FAA form 8110-3. The "purpose of data" block will state "In support of TSO CXXX authorization". The "applicable requirements" block will include the statement "In support of 14 CFR § 21.601(b)(2) and RTCA/DO-254". The authorized DER should also add "TSO Complex Electronic Hardware" to the Classification(s)" block in addition to their DER type.

Installation aspects for any TSO authorized article will still need to be addressed by the Type Certificate (TC), Supplemental Type Certificate (STC), or amended TC applicant, or for a Field Approval or Return to Service; however, under most circumstances, the RTCA/DO-254 data will not require re-evaluation unless there is some installation-specific issue to be addressed by the RTCA/DO-254 data.

Attachment 1

DER/DER Applicant must complete this sheet in addition to 8100.8 requirements when requesting Complex Electronic Hardware as a Delegated Function and provide supporting evidence of their experience/familiarity in each required area.

Additional Application Requirements for a Delegated Function of Complex Electronic Hardware Approval:

Circle One (Applicant/DER indicates knowledge/ability/experience possessed – attach substantiation)

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| Yes | No | (1) Thorough working knowledge and understanding of RTCA Document DO-254 [] Design Assurance Guidance for Airborne Electronic Hardware. |
| Yes | No | (2) Understanding of and experience with DO-254 [] hardware life cycle needed to demonstrate that the objectives of RTCA/DO-254 are fully met (for example, Plan for Hardware Aspects of Certification, Hardware Accomplishment Summary, Hardware Process Assurance Plan, Hardware Configuration Management Plan, Hardware Design Plan, Hardware Verification Plan, Hardware Validation Plan, Hardware Design Standards, Traceability data, etc.). The DER also should demonstrate the ability to assess the quality of all hardware life cycle data and the development team's adherence to approved plans, standards and procedures. |
| Yes | No | (3) Familiarity with the systems safety assessment process, specifically, those portions that establish the hardware design assurance levels. |
| Yes | No | (4) A demonstrated knowledge of the rationale for, and the significance of, each process and activity in the hardware life cycle, as well as its supporting standards, procedures, and documentation. The DER should be able to identify and to evaluate the critical aspects and contents of each of the documents mentioned in DO-254 []. |
| Yes | No | (5) Ability to distinguish between complex and simple electronic hardware. |
| Yes | No | (6) Experience gained from participation in some technically responsible capacity over a complete complex electronic hardware development program hardware life cycle. This qualification may be satisfied by an aggregate of involvement in different hardware development programs and various roles in those programs. |
| Yes | No | (7) Experience interacting with all phases of complex electronic hardware development and testing processes addressed by DO-254 [], including use of the associated configuration management and process assurance. This experience should include significant responsible involvement in several of those phases. |
| Yes | No | (8) Experience with different kinds of complex electronic hardware design, such as Application Specific Integrated Circuits (ASIC), Programmable Logic Devices (PLD), and Field Programmable Gate Arrays (FPGA) design. |
| Yes | No | (9) Familiarity with Hardware Description Languages that are used for programming complex electronic hardware, and an understanding of the types of verification required for use of such languages. |
| Yes | No | (10) Familiarity with assessing the role of design, verification, and coverage tools in the context of the hardware life cycle. Familiarity with typical complex electronic hardware tools available to facilitate the development, documentation, and consistency-checking processes is highly desirable |
| Yes | No | (11) Demonstrated knowledge of the sources of complex electronic hardware anomalies, the relative merits of the types of verification processes and activities that are able to detect errors and anomalies, and the characteristics of a thorough verification program. |
| Yes | No | (12) An understanding of the techniques that may be employed to assign complex electronic hardware design assurance levels, such as system architecture and partitioning. This should include the ability to assess the adequacy of a proposed technique relative to the system integrity required. |
| Yes | No | (13) Experience in addressing errors in the different processes and activities in which errors can be introduced in complex electronic hardware, e.g., handling of components, use of development tools, design, and manufacturing/fabrication process. |
| Yes | No | (14) Knowledge of hardware characteristics that can impact interfaces with software and other hardware components, including safety, integrity and reliability aspects. |
| Yes | No | (15) Experience with complex electronic hardware verification process activities, including reviews, analyses, simulation and testing. |
| Yes | No | (16) Familiarity with post-certification complex electronic hardware processes, such as, manufacturing quality control, factory configuration control, acceptance test procedures, factory installation and test equipment, production equipment control, and installation approvals for Technical Standard Order (TSO) authorization equipment. |
| Yes | No | (17) Familiarity with complex electronic hardware modification processes, including determination of change impact analyses, upgrading previously developed complex electronic hardware, and regression analyses and testing. |
| Yes | No | (18) Demonstrated knowledge of the different design assurance considerations and strategies in RTCA/DO-254 [] Appendix B, including Functional Failure Path Analysis, Architectural Mitigation, Product Service Experience, and Advanced Verification Methods that may be used for Level A and B complex electronic hardware." |