REQUIREMENTS FOR THE CAPABILITY APPROVAL OF ELECTRONIC COMPONENT TECHNOLOGIES FOR SPACE APPLICATION

ESCC Basic Specification No. 24300

Issue 2	September 2012

Document Custodian: European Space Agency - see https://escies.org

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DCR No.	CHANGE DESCRIPTION
585, 721	Policy and Editorial Changes per DCR

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1. PURPOSE

The prevailing qualification approval procedures require completion of a test programme that is defined in the Generic Specification governing the component technology and detailed in the particular specification associated with the component under review. Subsequently, quality conformance procedures must be conducted on a lot-by-lot basis for the components to be released to a Customer. This procedure is well suited to components of a standard design which are manufactured on a continuous basis. Some components, however, may have design features that are tailored to a particular Customer requirement; they may be required for a relatively short time and often in small quantities.

An approval programme is thus required for an established component technology that will enable both the provision of standard devices and the ability to satisfy specialised needs. Such a programme must:

(a) Embrace the variants, with defined limitations, that a Manufacturer is able to fabricate via a basic technology.
(b) Define limiting criteria for approval maintenance of the capability domain.

The procedures and requirements defined herein are designed to fulfil these requirements.

2. APPLICABLE DOCUMENTS

The following ESCC Specifications are applicable to the extent specified herein. The relevant issues shall be those in effect at the date of granting of the capability approval.

– No. 20200, Requirements for the Evaluation of a Manufacturer for the Manufacture and Supply of Standard Electronic Components.
– No. 21300,Terms, Definitions, Abbreviations, Symbols and Units.
– No. 22700, Requirements and Guidelines for the Process Identification Document (PID).
– No. 22800, ESCC Non-conformance Control System.
– No. 243XXXX, Capability Approval Requirements Documents for the Relevant Technologies.
– ESCC Generic and Detail Specifications for the Relevant Technologies.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

4. INTRODUCTION

Capability Approval is the status granted to a Manufacturer for a specified capability domain after successful completion of a capability approval programme as defined herein and in the requirements document for a capability programme in the particular electronic technology. The programme consists of four phases:

(a) Evaluation of the Manufacturer.
(b) Definition of the capability domain and its boundaries.
(c) Evaluation of the capability domain.
(d) Capability approval testing of test structures.

5. EVALUATION OF A MANUFACTURER

5.1 GENERAL

The evaluation of a Manufacturer is an exercise designed to assess the adequacy of the organisation, plant and facilities and his fitness to provide electronic components suitable for space applications. The exercise shall be performed by the ESCC Executive in accordance with the requirements of ESCC Basic Specification No. 20200 with additional, and particular, consideration given to the criteria defined in Para. 5.2 below.

5.2 REVIEW OF THE MANUFACTURER'S DESIGN FACILITIES

This review shall assess the Manufacturer's facilities for design of components within the capability domain and his methods to verify his designs. The review shall appraise all design data as appropriate to the capability domain and identify any design limitations imposed by the selected processes. The review shall also include all relevant computer tools for design including software quality assurance and configuration control.

The design rules, the hardware and software shall form a part of the capability domain and its boundaries and be included in the Process Identification Document (PID).

6. DEFINITION OF THE CAPABILITY DOMAIN

6.1 CAPABILITY ABSTRACT

The Manufacturer shall prepare a Capability Abstract to describe, in a comprehensive manner, the scope and extent of his capability domain for which approval is sought in terms of the boundaries of the technologies, circuit function and performance, construction rules, packages, design data etc. The document shall be prepared to the satisfaction of the ESCC Executive. It shall contain information suitable for publication in the ESCC Qualified Parts List and be considered, by the Manufacturer, to have no commercial sensitivity.

6.2 PROCESS IDENTIFICATION DOCUMENT (PID)

A PID for the capability domain to be approved shall be prepared by the Manufacturer to the satisfaction of the ESCC Executive. In terms of content, lay-out and configuration control the PID shall fulfil all requirements of ESCC Basic Specification No. 22700.

6.3 TEST STRUCTURES

Test structures shall be fully documented in the PID They shall be manufactured and tested in accordance with the requirements of Section 8.

7. EVALUATION OF A CAPABILITY DOMAIN

The evaluation of a capability domain shall verify that the chosen technology is suitable for the manufacture of high reliability components for space applications. The evaluation programme shall also help to define the final capability domain and its boundaries when updating the Process Identification Document and give a high level of confidence in a positive result of the capability approval testing. The evaluation of a capability domain shall include but not be limited to:

– The review of existing data and/or test results from components and/or test structures manufactured within the capability domain.
– The establishment of an evaluation test programme.

– The evaluation testing of components and/or test structures.
– The definition of any corrective actions that may be required and their implementation before the start of capability approval testing.
– The final definition of the capability domain and its boundaries to be contained in the Process Identification Document and the Capability Abstract.

8. CAPABILITY APPROVAL TESTING

8.1 GENERAL

Before start of capability approval testing the capability domain and its boundaries shall be fully defined in the Capability Abstract and the Process Identification Document (PID). In addition to these, all documentation essential for the production and testing of components and/or test structures used for capability approval testing shall be available and approved by the ESCC Executive. The PID or other documentation shall at least contain:

– Specifications for the test structures.
– A programme giving all tests and test sequences, sample sizes, accept/reject criteria and conditions for all test structures. This programme is intended to assess the quality, including reliability, of the constructional elements of the test structures and determine performance, under specified conditions, of manufactured devices. It shall fulfil the requirements of the ESCC Basic Specification No. 243XXXX for a capability approval of the relevant technology.
– A schedule relating all tests to the relevant areas and boundaries of the capability domain and verifying that the selected tests and test structures and components fully cover and qualify the domain. This may be accomplished by a matrix presentation of domain or parameter boundary and correlated test structure intended to demonstrate compliance with test requirements at that limit. The schedule structure shall confirm the test capability of at least one test structure for each boundary defined in the PID.

8.2 TESTING SCHEDULE

Prior to commencement of capability approval testing the Manufacturer shall compile a schedule covering the production and testing of test structures and/or components. This schedule shall show by date and duration when important production and test activities are to take place, including all major processing operations and inspections. This schedule shall be approved by the ESCC Executive prior to start of manufacture of components and/or test structures.

8.3 TEST STRUCTURES

The components and/or test structures required for the capability approval testing shall be produced strictly to the Process Identification Document. Production and screening, including burn-in, shall be to the highest level specified in the PID and shall comply with the requirements defined in the ESCC Generic Specification for the relevant technology, and the applicable Detail Specification.

The ESCC Executive shall have the right to witness the manufacturing of these test samples. The types and quantities shall be as specified in the capability approval programme.

8.4 TESTING

The Capability Approval testing shall be in accordance with the ESCC Basic Specification No. 243XXXX for the relevant technology. ESCC Executive shall have the right to witness the testing and to review the test data. The testing may be performed at the Manufacturer’s premises or at any mutually agreed facility

approved by the ESCC Executive.

8.5 TEST REPORT

On completion of the capability approval testing programme, the Manufacturer shall collect all relevant data and documentation in the form of a capability approval test report. This report shall be sent to the ESCC Executive for review.

8.6 DISPOSITION OF APPROVAL TEST LOT

The approval test lot shall be adequately identified and its disposition shall be as directed by the ESCC Executive.

9. PROCEDURES FOR GRANTING OF CAPABILITY APPROVAL

9.1 REQUEST FOR CAPABILITY APPROVAL

To obtain Capability Approval for a capability domain the Manufacturer shall submit a formal application, to the ESCC Executive, using the relevant form found in the ESCC website https://escies.org. As a minimum the application shall contain:

– A preliminary definition of the capability domain and its boundaries.
– A description of the manufacturing, inspection and test facilities.
– A description of the Manufacturer's organisation.
– A preliminary Process Identification Document including all flow charts.
– Existing data and test results from test structures and/or components manufactured within the capability domain.
– A description of the quality assurance system.

The Manufacturer shall commit to the following undertakings with respect to the application:

(a) He will perform any actions arising from the subsequent evaluation and capability approval testing phases, which are considered necessary by the ESCC Executive for the proper capability approval of the capability domain.
(b) He will maintain production capability for an approved capability domain for a minimum of 5 years after the initial capability approval certification, or as agreed with the ESCC Executive.
(c) He will provide the ESCC Executive and all his customers with a minimum of 6 months prior notice of the last order acceptance date, in the event of a planned discontinuation of a capability approval or an individual component qualified within an approved capability domain.

The ESCC Executive will review the application and the delivered documents. If considered necessary the Manufacturer may be requested to provide further information and/or test structures. When the submitted items are deemed to be satisfactory, and the ESCC Executive agrees to support the application, the evaluation phase (see Section 7) will be initiated.

9.2 CERTIFICATE

When it has reviewed the capability approval test report (see Para 8.5) and associated data and found it satisfactory, that ESCC Executive will formally request the approval of ESA for the capability domain, using the relevant form found in the ESCC website https://escies.org.

ESA will review the request and if found acceptable will give the formal Capability Approval of the capability domain and issue a certificate.

9.3 CAPABILITY APPROVAL LISTING

When ESA has granted a capability approval to a Manufacturer for a capability domain this domain shall be listed in the ESCC Qualified Parts List (ESCC QPL). In the ESCC QPL the domain

and its boundaries shall be described (in non-confidential information) in enough detail to give an understanding of the components manufactured within the domain.

Component types verified to be manufactured within the domain, and qualified in accordance with Section 10 may form part of the ESCC QPL.

9.4 VALIDITY OF CAPABILITY APPROVAL

9.4.1 General

The maintenance of the capability approval is the responsibility of the Manufacturer. He shall notify the ESCC Executive immediately of any matter liable to affect the validity of the capability approval or result in its lapse or loss.

A capability approval established in accordance with this specification, and the relevant ESCC Basic Specification No. 243XXXX shall be valid for two years from the date of certification, or for such period as determined by ESA.

9.4.2 Conditions for Validity

The following conditions for validity of capability approval shall be fulfilled:

– The manufacture of components to ESCC requirements shall be fully and only within the capability domain and strictly in accordance with the production and control documents approved by the ESCC Executive in the PID.
– Detailed records of each component type and test structure, including detailed information about each production lot, shall be available for the ESCC Executive review.
– On receipt of an alert from the ESCC Executive concerning the approved capability domain or a component type manufactured within the domain, the Manufacturer shall, as a matter of urgency, carry out the necessary investigations and inform the ESCC Executive of his findings and suggested corrective actions.

9.4.3 Extension of Capability Approval Validity

The capability approval validity may be extended for a further period of two years if:

– All changes to the Process Identification Document (PID), if any, have been approved by the ESCC Executive.
– All test and test sequences as defined in Section 8 for components and test structures have been successfully performed during the period.

If components have been manufactured and tested within the capability domain, having a complexity covering the domain boundaries or part of them, these tests may be substituted for corresponding tests in the capability programme.

All the relevant documentation including records of components manufactured shall be reviewed by the ESCC Executive and if found acceptable the ESCC Executive will formally request approval of ESA for the extension of the capability approval of the domain.

9.5 LAPSE OF CAPABILITY APPROVAL

A capability approval shall be considered to be lapsed from the day following the expiry date of the existing capability approval certificate, if a certificate extending the approval has not been issued.

When a capability approval has lapsed, all components manufactured in the period from the lapse date until the granting of a capability approval extension or requalification shall be considered as unqualified and shall not bear the ESCC Qualified Components Symbol.

9.5.1 Renewal After Lapse of Capability Approval

Following the lapse of capability approval, a renewal of approval can be affected within a reasonable time period. Provided the Manufacturer can demonstrate that the original evaluation of the capability domain is still valid, this renewal procedure shall comprise a destructive physical analysis of sample test structures and/or components, a Manufacturer audit and a survey of test records generated in the lapse period. If this survey shows that the Manufacturer's data, equivalent to Testing Level 'B' and Lot Acceptance Level 1 are available and acceptable, the ESCC Executive may take such data into consideration for renewal of the capability approval. Where such data is not available or not acceptable, the testing of a limited number of test structures and/or components to Testing Level 'B' and Lot Acceptance Level 1 will be required for the renewal. Failure to satisfy the ESCC Executive regarding the validity of the original evaluation of a capability domain or component will necessitate a completely new capability approval.

9.5.2 Notification of Lapse of Capability Approval

Within 6 months of a lapse of capability approval, the ESCC QPL which is maintained electronically on the internet shall be updated at the Secretariat from information supplied by the ESCC Executive, in the form of an explanatory statement added to the relevant ESCC QPL entry. Examples of the statements to be used are as follows:

(a) Renewal activities completed.
(b) Renewal activities ongoing.
(c) Renewal pending open non-conformance.
(d) No renewal activities initiated.
(e) Will not be renewed. The qualification entry will be removed from the ESCC QPL by mm/yy.

Within 12 months of a lapse of capability approval, a review shall be performed by the ESCC Executive and a decision made as to whether a renewal/requalification can be made or not. This decision is to be immediately notified to the Secretariat who will take one of the following actions:

(a) If capability approval is to be renewed, a statement is to be added to the ESCC QPL entry of when renewal is expected.
(b) If capability approval is not to be renewed, a statement as to when the capability approval entry will be removed from the ESCC QPL shall be added in the following form:
" Capability approval entry will be removed from the ESCC QPL by mm/yy".

NOTES:

All capability approvals which have been lapsed for longer than 18 months shall be automatically removed from the ESCC QPL by the Secretariat.

9.6 LOSS OR SUSPENSION OF CAPABILITY APPROVAL

Loss of capability approval occurs and formal approval will be withdrawn when a Manufacturer is no longer able to meet the original requirements pertaining to capability approval.

The Manufacturer's Chief Inspector shall always immediately notify the ESCC Executive of any fault likely

to affect the capability approval. If any aspect of the capability approval becomes deficient, the approval may be either suspended or allowed to continue with the approval of ESA provided the release of components is restricted to the remaining areas of the capability not affected by the deficiency. The approval shall be withdrawn:

(a) If the deficiency is not corrected within three months.
(b) At the Manufacturer's request.

When the capability approval is restricted or suspended, the ESCC QPL will be modified accordingly.

9.7 REDUCTION EXTENSION AND CHANGE OF CAPABILITY DOMAIN

When an approved Manufacturer wishes to reduce, extend or change his capability domain or its boundaries it is the responsibility of the ESCC Executive to decide whether the reduction, extension or change is minor or major. A major change is a change which affects the quality, reliability or function of components manufactured within the capability domain.

In the case of a major change the Manufacturer shall support the change with testing on components and/or test structures following the principles defined in Sections 7 and 8.

In the case of a minor change it will be recorded and approved by the ESCC Executive.

The Process Identification Document shall be updated accordingly as required in ESCC Basic Specification No. 22700.

10. QUALIFICATION OF A COMPONENT TYPE

10.1 GENERAL

A component type which is defined by an appropriate ESCC Detail Specification, is manufactured within an approved capability domain by an approved Manufacturer and which has passed the relevant type approval test, may be released as a ESCC qualified item.

10.2 VERIFICATION OF MANUFACTURE WITHIN AN APPROVED CAPABILITY DOMAIN

To verify that a component is manufactured within the capability domain the Manufacturer shall supply to the ESCC Executive a document giving the information necessary to fully define the component and its construction. It shall include an outline of the technologies involved, piece parts composition and construction details. It shall also give reference to pertinent specifications, process flow charts and other data included in the approved PID. Drawings and photographs detailing the component and each of its constituent elements shall be included.

10.3 COMPONENT TYPE APPROVAL TEST

The component type approval testing shall constitute those tests defined in the ESCC Basic Specification No. 243XXXX for the relevant technology.

After completion of the type approval test the Manufacturer shall issue a component type approval test report.

10.4 QUALIFICATION

The verification of manufacture and the component type approval test report shall be reviewed by the ESCC Executive and when found acceptable submitted to ESA for approval. ESA will review the request

and if found acceptable add it to the ESCC Qualified Parts List in the list of component types manufactured within the capability domain.

10.5 MAINTENANCE OF QUALIFICATION

A component listed as qualified under a capability domain remains qualified as long as the capability domain is approved. If a change to the domain or its boundaries affects the component, the qualification will be lost.

11. QUALITY CONFORMANCE REQUIREMENTS

11.1 CERTIFICATE OF CONFORMITY

A certificate of conformity shall be completed for, and shall accompany, each delivery or part-delivery of components manufactured within the capability domain.

The certificate may be the standard company certificate but must contain, as a minimum, the information given in Appendix A of this specification. At the discretion of the Manufacturer, for qualified components, the certificate may also contain the ESCC Qualified Component Symbol and/or the Valid Qualification Certificate number and date of expiry.

11.2 RECORDS

The Manufacturer shall maintain detailed records of each production lot of a qualified component and/or test structure and these shall be readily available to the ESCC Executive. A record of all components found to be defective during testing by the Manufacturer shall be maintained.

When requested by the ESCC Executive the Manufacturer shall perform failure analysis to the depth necessary to identify such defects as due to design, workmanship or mishandling, misuse etc.

When requested by the Orderer the Manufacturer shall undertake similar failure analysis of components failing while in use. Any repetitive defect occurring during manufacture shall be brought immediately to the attention of the ESCC Executive by the Manufacturer; failure to do so may lead to suspension of capability approval.

11.3 ALERT PROCEDURE

The alert procedure is a procedure for urgently notifying the ESCC Executive, and other interested parties, for consideration of the impact on capability approval, of any problem concerning a test, material, design, part or process which could result in unsafe conditions or adversely affect a component's reliability. When any such problem is brought to the attention of a Manufacturer, he shall, as a matter of urgency, carry out the necessary action or investigation. Information about the problem, together with the Manufacturer's response, shall be circulated, as and if required, to any organisation using the qualified components.

11.4 ESCC NON-CONFORMANCE SYSTEM

In the case of non-conformance, the Manufacturer shall initiate the non-conformance control system in accordance with ESCC Basic Specification No. 22800.

12. PRINCIPAL REQUIREMENTS FOR CAPABILITY APPROVAL OF PARTICULAR TECHNOLOGIES

Ancillary specifications numbered in the ESCC 243XXXX series, to be read in conjunction with this

specification, define the capability approval requirements for a particular technology and supplement the tests and procedures in the relevant ESCC Generic Specification.

They address the following topics:

(a) Capability domain
Definition of design rules, materials, technology and processes known to be employed.

(b) Capability boundaries
Definition of those parameters and fabrication techniques, which test structures will be required to demonstrate.

(c) Capability approval programme
Definition of test procedures, test structure quantities and pass/fail criteria that constitute the capability approval test programme.

(d) Type Approval Test Programme
Definition of the test procedures, sample sizes and accept/reject criteria required to enable a device, manufactured within the capability domain, to be included as a qualified component on the ESCC QPL.

For adequate definition of these requirements, it is recognised that consultation with the Manufacturer may be undertaken.

13. ANCILLARY SPECIFICATIONS

The following ancillary specifications in the ESCC 24300 series have been issued for use in conjunction with this specification:

– ESCC No. 2439000, Requirements for Capability Approval of Monolithic Microcircuit Technologies.
– ESCC No. 2439010, Requirements for Capability Approval of Monolithic Microwave Integrated Circuits (MMIC's).

APPENDIX A CERTIFICATE OF CONFORMITY

The following minimum information shall appear on an ESCC Certificate of Conformity:

– "ESCC Certificate of Conformity"

– Name of Company

– Address

– Component type

– Component number

– Lot identification

– Quantity

– Order number

– "This is to certify that the above mentioned components fulfil the requirements of the following Generic and Detail specifications of the ESCC System:" Generic and Detail Specification numbers and issues as applicable

– "The components subject to this Certificate of Conformity were manufactured at our plant located at:" Plant location

– "Certified by:" Name and Title, the latter to be either the "ESCC Chief Inspector" or "Deputy ESCC Chief Inspector"

– Date

NOTES:
The text above in quotations is intended for literal use on the ESCC Certificate of Conformity.