



Page 1 of 11

**REQUIREMENTS AND GUIDELINES FOR THE
PROCESS IDENTIFICATION DOCUMENT (PID) FOR
MANUFACTURING LINES OF HERMETIC HYBRID
MICROCIRCUITS UNDER PROCESS CAPABILITY
APPROVAL**

ESCC Basic Specification No. 2276000

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TABLE OF CONTENTS

1	PURPOSE	5
2	RELATED DOCUMENTS	5
3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	5
4	REQUIREMENTS	5
4.1	GENERAL	5
4.2	PID STRUCTURE	6
4.2.1	PID Section 1 - General	6
4.2.2	PID Section 2 - Manufacturing Organization	6
4.2.3	PID Section 3 - Manufacturing and Testing	6
4.2.4	PID Section 4 – Process Capability Domain and Boundaries Description	8
4.2.5	PID Section 5 - Control Documentation	10
4.2.6	PID Section 6 - Manufacturing, Inspection and Test Equipment	10
4.2.7	PID Section 7 - Process Capability Approval By Similarity and Specification of Test Structures	10
4.2.8	PID Section 8 - Hybrid Microcircuit Types Produced within the Process Capability Domain	11

1 **PURPOSE**

This specification, to be read in conjunction with ESCC Basic Specification No. 22700, contains additional specific requirements for the Process Identification Document (PID) for Manufacturing Lines of Hermetic Hybrid Microcircuits under ESCC Process capability Approval (PCA).

2 **RELATED DOCUMENTS**

The following documents form part of this specification and shall be read in conjunction with it:

Applicable Documents:

- (a) ESCC Basic Specification No. 22700, Requirements And Guidelines For The Process Identification Document (PID)
- (b) ESCC Basic Specification No 25600 Requirements for Process Capability Approval
- (c) ESCC Basic Specification No.2566000 , Requirements for the PCA for manufacturing lines of hermetic hybrid microcircuits

Reference Documents:

- (d) ISO 14644-1, Cleanrooms And Associated Controlled Environments -- Part 1: Classification Of Air Cleanliness
- (e) FED-STD-209, Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones
- (f) ECSS-Q-ST-60-05, Generic Procurement Requirements For Hybrids

3 **TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

In addition, the additional terms, definitions and abbreviation introduced in ESCC Basic specification No. draft 102, specifically related to the manufacturing and test of hybrid microcircuits, also apply in the rest of this document.

4 **REQUIREMENTS**

4.1 **GENERAL**

A PID for the process capability domain to be approved shall be prepared per ESCC 22700 and as specified in this document for the case of manufacturing lines of Hermetic Hybrid microcircuits.

Regarding materials, the PID shall contain:

- The selection and approval of materials used.
- A list of procurement specifications for selected materials and associated supplier(s)
- List of incoming inspection procedures and other documents used to ensure the consistent quality of materials used
- Procedures for traceability and control of limited shelf-life items.

Regarding processes, the PID shall describe the processes within the process capability domain. It shall also give reference to the documents specifying the processes. At least the following areas shall be covered including a statement on the equipment used:

- Substrate and carrier preparation
- Conductor, termination and wire bonding process
- Thick film, thin film circuit processes
- Package assembly and encapsulation processes
- Rework procedures

The PID shall also contain a list of all package types and sizes with type of pin/connectors/transitions and their number to be included in the process capability domain, The package with the largest mechanical dimensions of each type represents a boundary of the process capability domain (both for add-ons and the hybrid package itself).

4.2 PID STRUCTURE

The information recorded in the PID shall be grouped into sections as per ESCC 22700 and the following paragraphs. The following paragraphs are not necessarily exhaustive and are intended to give the Manufacturer and ESCC Executive a guide to the minimum mandatory information to be included in the PID.

4.2.1 PID Section 1 - General

As specified in ESCC 22700. The PID Section 1 shall be made of:

Cover page with Title, fully referencing the type of hybrid technology, Document Number and Revision and associated date, provision shall be made for the Approval Signatures on behalf of the Manufacturer and the Approving Authority and the dates of such signatures.

Amendment record sheet(s). The revision sheet(s) shall follow normal practice and provide for the date of revision or amendment, sections and pages affected and a short description of the change(s). The tracking of the changes shall be maintained since the previous validity of the PID.

List of contents of the PID. The list of contents shall detail the sections and their content to the degree necessary for easy reference to essential items.

4.2.2 PID Section 2 - Manufacturing Organization

As specified in ESCC 22700. This section shall describe the manufacturing plant organization in relation to the different functions involved: management, engineering, production, quality assurance -as applicable to the hybrid capability domain described in the PID

4.2.3 PID Section 3 - Manufacturing and Testing

As specified in ESCC 22700 and as follows.

- (a) The manufacturing line shall be detailed by means of an overall manufacturing line lay-out and by individual detailed lay-outs for each area.
The overall manufacturing line lay-out shall detail, as a minimum, the manufacturing, inspection, testing, screening, failure analysis, incoming, and storage areas, indicating for each area its classification, in terms of cleanliness class, humidity and temperature
The detailed lay-out for each area shall detail, as a minimum, the work stations and the equipment employed.
Connected with the detailed lay-out for each area, the environmental conditions of the different areas in terms of cleanliness class, humidity and temperature shall be specified. Depending on the relevant specific technologies, the environmental recommendations are given in Table 1 below.

Furthermore an appropriate procedure for control and recording of cleanliness class, humidity and temperature shall be applicable and be referenced to in the PID.

TABLE 1

Process Step	Cleanliness Class ISO 14644-1 (old FED-STD-209)	Humidity (% RH)	Temperature (°C)
Manufacture of production masks (thick film)	7 (10000)	To be specified by Manufacturer	To be specified by Manufacturer
Manufacture of production masks (thin film)	5 (100)	To be specified by Manufacturer	To be specified by Manufacturer
Areas where wet printing paste work is performed (thick film)	7 (10000)	50 ±10	22 ±3
Photoresist preparation, application, drying, including pattern exposure and development processes (thin film)	5 (100)	50 ±10	21 ±2
Etching and cleaning processes (thin film)	5 (100)	50 ±10	21 ±2
Areas where firing (thick film)	8 (100000)	50 ±10	22 ±3
Semiconductor chip mounting, wire-bonding	7 (10000)	55 ±10	22 ±3
Mounting of encapsulated components	8 (100000)	55 ±10	22 ±3
Precap visual inspection, other control processes before final sealing	5 (100)	55 ±10	22 ±3

- (b) A flow chart showing how applicable purchase orders of flight hybrid microcircuits are processed shall be included. It shall show:
- how each department (Design, Engineering, Reliability, Product Assurance, Production, Quality Control, Purchasing, Stores) is responsible for the execution of all orders for hybrid microcircuits.
 - procurement options, variants and testing levels of hybrid microcircuits which the Manufacturer can offer.
 - if Statistical Process Control (SPC) under TRB management is used by the Manufacturer in order to control processes used for the fabrication of hybrid microcircuits. This shall be sufficiently documented in this section of the PID in terms of procedures and requirements. The minimum applicable requirements for the evaluation of a process through SPC and for the acceptable values of the related parameters are found in ECSS-Q-ST-60-05 Para. 12.2.2.1.
- (c) A specimen of a typical traveller used during manufacture and testing shall be included. Traveller logs shall include all processing details, dates and yields of major process steps and any specific technical requirement (e.g. fine leak bombing pressure and time). They shall be signed, stamped, or electronically approved on behalf of the Manufacturer's Quality Assurance Department in respect of those operations that are listed as functions of that department.
- (d) A description of the procedure in place at the manufacturing line in order to ensure an effective system for the maintenance of all fabrication and measuring equipment used for the manufacturing, test and inspection of hybrid microcircuits shall be included. For each piece of equipment, the periodicity and procedure for maintenance operations shall be documented.

- Personnel engaged in maintenance work shall have received credible training and certification as required.
- (e) A description of the procedures in place at the manufacturing line in order to ensure adequate controls on the introduction of new equipment or tools shall be included. Prior to introducing a new equipment or tool in to the hybrid microcircuit line, the Manufacturer shall implement a validation programme that addresses at least the following points:
- Possible Impacts on the final products (performance, reliability)
 - Validation Plan, submitted to the ESCC Executive, per the change evaluation minimum requirements described in ESCC Basic Specification No. XXXXX Para. 8.3.2 as applicable
 - Validation tests report including the certification of the equipment or tool (see Note below)
 - Cleanliness and atmospheric controls
 - Operators Training & certification
 - Calibration
 - Maintenance
 - Date of start of utilization on the manufacturing line

NOTE: During the manufacturing equipment implementation phase, the stability and reproducibility of the results obtained by the new equipment shall be evaluated by parameter survey or by a survey of results on samples. This shall be carried out during the minimum time necessary to accumulate a sufficient number of individual values.

- (f) The Manufacturer shall document in the Section 3 of the PID a requirement to keep the manufacturing records and traveller logs for a minimum of 7 years and, upon request, make them available to the ESCC Executive or its designated representative.

4.2.4 PID Section 4 – Process Capability Domain and Boundaries Description As specified in ESCC 22700 and as follows.

This section shall comprise all the information necessary to fully define the Capability Domain, object of PCA, and its boundaries. It shall include an outline of the technology involved, compositions and construction details. Drawings or photographs detailing the test structures and each of their constituent elements shall be included.

The Manufacturer shall define the extent of his process capability domain for which approval is sought in terms of construction technologies or sub-techniques (i.e. type of substrates, component mounting and interconnection techniques, encapsulation, etc.) and their associated boundaries. The process capability domain shall include, if applicable, the use of semi-finished products and/or external subcontractors.

The outline of the technology shall be made by listing:

- All sub-techniques and the associated test structures. High-resolution colour photographs of the test structures shall be included (in PID sub-section 4.1; see below)
- All materials (substrates, films, epoxies, solders, wires, packages etc.) shall be listed together with the manufacturer and supplier name, the procurement specification, and the incoming inspection specification, procedures and any other associated documentation (in PID sub-section 4.2; see below)
- The definition of and provision for allowed rework and repair processes (in PID sub-section 4.3; see below)

(a) PID Sub-Section 4.1 - Standardized Sub-Techniques List

To allow an easy and rapid check of the approved domain not only by the ESCC Executive and by the customer, but also by the hybrid microcircuits manufacturer designer, the standardized content structure of the sub-technique list shall address the elements defined in ESCC Basic Specification No. XXXXX Para. 9, as applicable, by means of tables such as the following.

EXAMPLE TABLE FOR SUB-TECHNIQUES DEFINED FOR EACH CHOICE OF SUBSTRATE TECHNOLOGY

Sub-technique (name)	Domain (characteristics)	Qualification Report No.

EXAMPLE TABLE FOR SUBSTRATE TECHNOLOGY CAPABILITY DOMAIN

(e.g. TCR, stability, power density, etc.)

Characteristics	Value	Unit	Qualification Report No.

EXAMPLE TABLES FOR SUB-TECHNIQUES DEFINED DEPENDING ON THE ASSEMBLY

(substrate attachment, passive and active components assembly)

Substrate type	Max. size (mm)	Back metallization	Attached to:	Attached by:	Interconnection	Report

(Passive) Part type	Material	Max. size	Top metal	Bottom metal / termination	Attachment	Interconnection	On	Report

(Active) Part type	Material	Max. size	Top metal	Bottom metal	Attachment	Interconnection	On	Report

EXAMPLE TABLE FOR SUB-TECHNIQUES RELATED TO THE ENCAPSULATION DOMAIN DESCRIPTION

Package type	Max. size	Base Material / Finish			Types of I/O, Nr. and pitch	Sealing by	Report
		Body	Leads	Lid			

This sub-section shall also provide details of the hybrid microcircuits marking processes with reference to the materials and/or methods employed.

(b) PID Sub-Section 4.2 - Standardized Materials List

The standardized content structure of the list of materials shall address the elements defined in ESCC Basic Specification No. XXXXX Para. 9.1, as applicable, and make use of a table such as the following:

EXAMPLE TABLE FOR MATERIAL LIST

Material name	Manufacturer & Supplier	Chemical composition	Application	Procurement specification	Incoming inspection	Report

(c) PID Sub-Section 4.3 - Rework and Repair

The rework and repair definitions, procedures and limitations applied during the process capability approval program, as approved by the ESCC Executive, shall be listed in this sub section. Provision for rework and repair shall detail how, when, the number of times and according to what procedure rework and repair is permitted. The associated processes and limits shall be according to the general rules as specified in the ECSS-Q-ST-60-05 clause 10.

4.2.5 PID Section 5 - Control Documentation

As specified in ESCC 22700 and as follows.

(a) PID Sub-Section 5.1 - List of Specifications

This list shall include: procurement specifications, incoming inspection procedures, traceability procedures, stock control procedures including procedures for control of limited shelf-life items, process procedures, workmanship standards, in-line inspection specifications, test procedures, operator training documentation, and hybrid microcircuits related quality assurance procedures.

A separate list of manufacturing procedures, testing procedures, inspection procedures employed by subcontractor(s) is required.

Each specification shall be identified by title, document number, issue status and date.

(b) PID Sub-Section 5.2 - Production Flow Chart

The production flow chart shall clearly indicate any customer inspection points. In addition all the subcontracted tasks shall be identified.

(c) PID Sub-Section 5.3 – Wafer Lot Acceptance

(applicable to manufacturers who also fabricate the semiconductor components used in the hybrid microcircuits)

As specified in ESCC 22700.

(d) PID Sub-Section 5.4 - Collection of Specifications delivered to the ESCC Executive

The Manufacturer and the ESCC Executive shall agree jointly the list of the specifications that are to be part of the PID to be delivered to the ESCC Executive. If in-house test, inspection or screening specifications have been accepted in lieu of the applicable ESCC or MIL Specifications, such documents shall be included in this collection of specifications.

4.2.6 PID Section 6 - Manufacturing, Inspection and Test Equipment

As specified in ESCC 22700 and as follows.

In addition to the list of the Manufacturer's in-house equipment, a separate similar list shall be produced for any equipment used at subcontractor premises during the manufacture and testing of hybrid microcircuits produced within the process capability domain. This list shall indicate the name and location of the subcontractor.

4.2.7 PID Section 7 - Process Capability Approval By Similarity and Specification of Test Structures

As specified in ESCC 22700 and as follows.

This section shall contain any similarity rules, if used by the Manufacturer for the purpose of Circuit Type Approval, in accordance with ECSS-Q-ST-60-05.

4.2.8 PID Section 8 - Hybrid Microcircuit Types Produced within the Process Capability Domain
As specified in ESCC 22700 and as follows.

Records of all hybrid microcircuits lots processed in accordance with the PID within the process capability domain shall be maintained. For each lot, as a minimum, the records shall include details of the delivered part type reference, the project or programme, the lot number, the data package reference, the quantity delivered and the applicable quality level. The information contained in this section shall be arranged in tabular form such as follows.

ProjectTypePart NumberQuantityQuality LevelDate Code / Lot No.Certificate of Conformance Nr.

Project	Type	Part Number	Quantity	Quality Level	Date Code / Lot No.	Certificate of Conformance Nr.

This section shall be updated at least every 2 years.