

ESCC9000P: a generic specification for space plastic encapsulated microcircuits

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CONTEXT AND MOTIVATION

ESCC 9000

European standard for ceramic, hermetically sealed microcircuits for space applications.

QML-V

DLA class for hermetically sealed Microcircuits for space applications.

QML-Q

DLA class for hermetically sealed devices for military aeronautic applications.

QML-Y

DLA class for ceramic not hermetically sealed devices for space and military aeronautic applications.

NASA LEVELS

A NASA quality standard for Plastic Encapsulated Microcircuits (PEM).

ECSS

A class standard from the European Cooperation for Space Standardization.

SAE-AS6294

A Space quality standard for Plastic Encapsulated Microcircuits in Space Applications

MANUFACTURER FLOWS

Enhanced Product, packaged devices offered with extended temperature range with additional qualification and characterization

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ESCC 9000P

CONTEXT: AN EXAMPLE OF A COMPARISON OVERVIEW

FLOW CHARTS		CERAMIC										PLASTIC											
Main Process Flow Steps	Method / Condition	HERMETIC										NON-HERMETIC											
		ESCC 9000		CML-V		CML-Q		Enhanced		Standard		CML-V		"4u" NASA level			"4u" BCS Class			Enhanced		Standard	
		(Infra)	(Pip-Chip)	(Infra)	(Pip-Chip)	BT	DT	M, V, C	(Pip-Chip)	Level 1	Level 2	Level 3	Class 1	Class 2	Class 3	-4P	M, V, C						
	Specification reference	ESCC 9000	ML-PKP-0001	ML-PKP-0001	ML-PKP-0001	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE	INTERNAL PROCEDURE
Wafer Lot Acceptance	ML-STD-480 TM0007 / QW Plus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Die Sorting / Select	Internal process / ML-STD-480 TM0010 / RSCC 2040	Cond A	Cond A	Cond A	Cond A	Cond B	Cond B	Cond B	Cond B	Cond B	Cond B	Cond A	Cond A										
Die attach / cure	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Internal Visual Inspection	ML-STD-480 TM0010 / RSCC 2040	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Temp Preheat (Pip-Chip)	ML-STD-480 TM0010 / RSCC 2040	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Pip-Chip die attach / Cure	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Wire bonding	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Underfill dispense / cure / C SAM	Internal procedure / ML-STD-480 TM 2030	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
SMD reflow / reflow	Internal procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Marking / Die & Pin / Cure	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Substrate reflow / reflow	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Internal Visual Inspection	ML-STD-480 TM0010 / RSCC 2040	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Temp Preheat	ML-STD-480 TM0010 / RSCC 2040	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Heat shock attach	Internal Procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Lot report / Reeling	Internal Procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Substrates	ML-STD-480 TM1008	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
PSD test	ML-STD-480 TM0020 / A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Constant acceleration	ML-STD-480 TM0020 / B / V1 verification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Incoming Inspection	Internal Procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Marking	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Reliability Marking	Internal procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Temperature Cycling	ML-STD-480 TM1010 Cond B / +125°C / -85°C	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day										
Temperature Cycling	ML-STD-480 TM1010 Cond C / +125°C / -85°C	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day	1day										
X-ray inspection	ML-STD-480 TM 2012	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
C SAM	Internal procedure / 1 view per interface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Pre-encaps electrical	Per Device Specification (25°C)	240hrs	240hrs	240hrs	160hrs	160hrs	160hrs	160hrs	160hrs	160hrs	160hrs	240hrs	240hrs										
Dynamic Burn-In	ML-STD-480 TM1010 Cond. D (125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Intermediate-encaps. test	Per Device Specification (+125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Static Burn-In	ML-STD-480 TM1010 Cond. A or B or C (125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Post-Burn-In Electrical	Per Device Specification (+125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
DTR calculation	Internal procedure / per Device Spec.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
PCA	PCA pass temp (per Device Spec.)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%										
PCA	0% functional parameters (per Device Spec.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Extreme temp. Electrical	Per Device Specification (+125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Termination report	Internal or Subcontractor procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Final & Gross leak test	ML-STD-480 TM1014 (A) / C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Final Electrical	Per Device Specification (+125°C)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Extreme temp. Electrical	Per Device Specification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Physical dimension control	Per Device Specification	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Internal Visual	ML-STD-480 TM0008	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Final source inspection	ML-STD-480 TM0009 / A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Wipe	J-STD-033 / 125°C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Packing	J-STD-033 / Internal procedure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Certificate of Compliance	ML-PKP-0001	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										

* Courtesy of Teledyne/E2V

SCOPE AND OBJECTIVES (Terms of Reference)

*“During the PSWG88, it was decided to create a working group aiming at writing an **ESCC specification for space plastic microcircuits**.*

*This specification **should be dedicated to high demanding applications (class 1 projects)**. This generic specification ESCC9000P should stay close to the ESCC9000: it is just a small adaptation of the ESCC9000 standard to a plastic part. (hermeticity test removal, THB test addition, ...).*

In other words, low cost and/or new space applications are excluded from this working group.


This new specification aims at defining the procurement specification of plastic parts with bondings. Flip Chip parts are not in the scope of this Working Group. However, if the specification does not depend on the fact that the part is a flip-chip or a part with bondings, flip chip parts can be incorporated in the scope of this Working Group.”

Working Group Membership (at the beginning)

Member	Affiliation	Representing	contact
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Jean Francois VADROT	STM	Manufacturers	
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Working Group Active Membership (today)

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Growing interest!
with the arrival of
new
manufacturers!!!

Schedule (initial one)

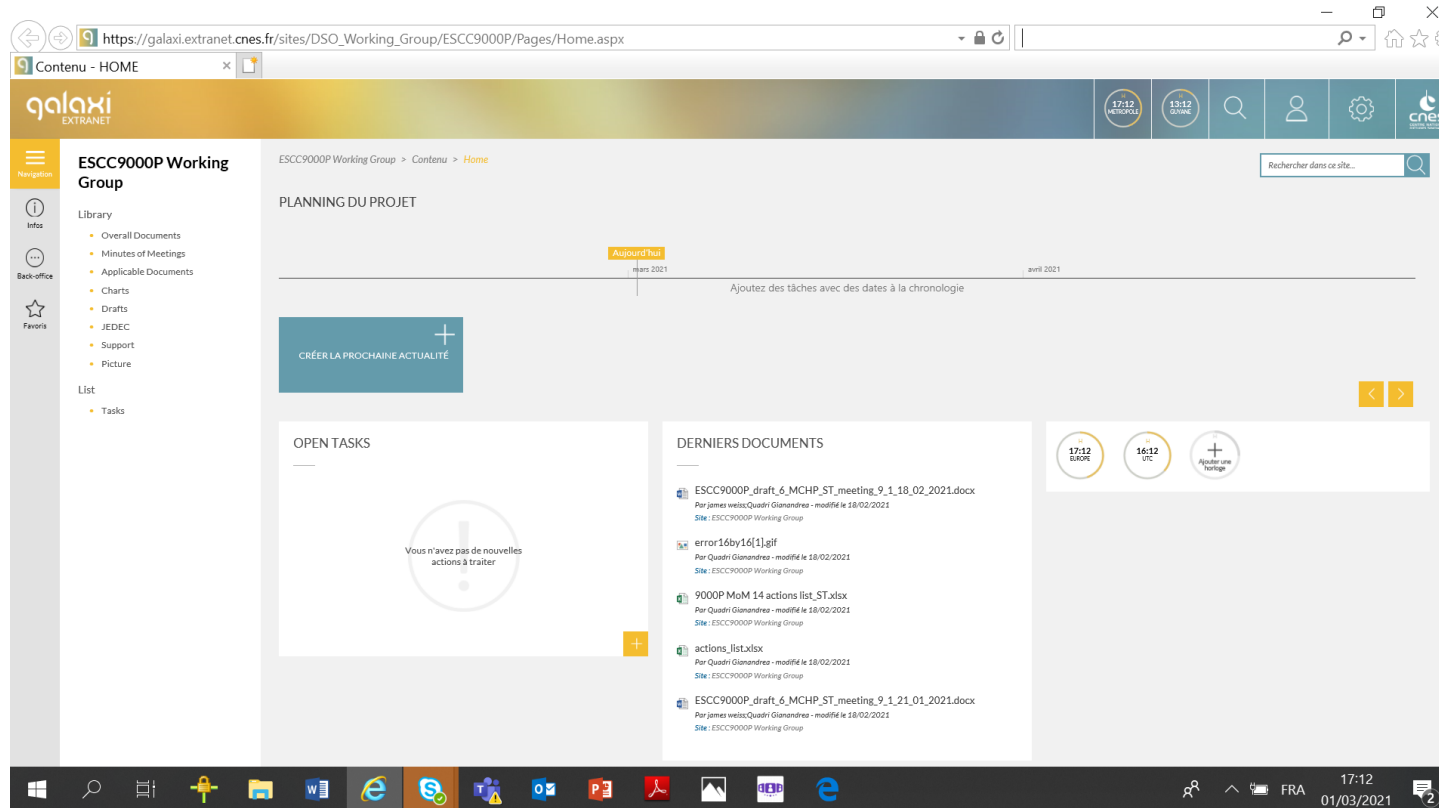
- November 2019: kick-off + Comments about the evaluation chart (F4) + TOR approval.
- January 2019: screening chart to be commented.
- March/April 2020: generic specification draft issued
- June 2020: first detailed specification
- September 2020: approval by PSWG. ESCC system ready to qualify the first plastic parts.

But in reality....

- Issue of the generic specification expected by june 2021
- First detailed specifications issued by june 2021: ST Microelectronics and Microchip are the first candidates
- Covid 19 did not help....but the motivation and the participation of the members is remarkable!
- Bimonthly two hours duration meetings are ongoing by january 2021 with limited topics

A dedicated tool: an interactive platform of exchange

https://galaxi.extranet.cnes.fr/sites/DSO_Working_Group/ESCC9000P/Pages/Home.aspx



The screenshot displays the 'Home' page of the ESCC9000P Working Group on the Galaxi Extranet. The browser address bar shows the URL: https://galaxi.extranet.cnes.fr/sites/DSO_Working_Group/ESCC9000P/Pages/Home.aspx. The page features a navigation menu on the left with options like 'Navigation', 'Info', 'Back-office', 'Favoris', and 'List'. The main content area is titled 'ESCC9000P Working Group' and includes a 'PLANNING DU PROJET' section with a timeline for March and April 2021. A button labeled 'Ajouter une tâche' is present. Below the timeline is a section for 'CRÉER LA PROCHAINE ACTUALITÉ'. The 'OPEN TASKS' section shows a message: 'Vous n'avez pas de nouvelles actions à traiter'. The 'DERNIERS DOCUMENTS' section lists several documents, including 'ESCC9000P_draft_6_MCHP_ST_meeting_9_1_18_02_2021.docx', 'error16by16[1].gif', '9000P MoM 14 actions list_ST.xlsx', 'actions_list.xlsx', and 'ESCC9000P_draft_6_MCHP_ST_meeting_9_1_21_01_2021.docx'. The bottom of the page shows a Windows taskbar with various application icons and a system clock indicating 17:12 on 01/03/2021.

Which categories are concerned by the generic?

- ☐ Monolithic Microcircuits, wire-bonded, lead frame, plastic encapsulated
- ☐ Monolithic Microcircuits, wire-bonded, organic substrate, plastic encapsulated
- ☐ Monolithic Microcircuits, flip-chip, organic substrate

Some tricky points....

- ❑ Applicability and perimeter of internal visual inspection criteria with respects to the ESCC20400:
 - Analysis performed by each manufacturer
 - Three main optical inspection gates (1st at wafer level, 2nd after sawing, 3rd before molding)
 - Different approaches between small and high volume assembly houses (and even between high volume ones)

And their agreed solutions by the working group....

INTERNAL VISUAL INSPECTION

« ESCC Basic Specification No. 20400 applies on 100% of the die.

Prior to molding/encapsulation, 100% internal visual inspection shall be performed according to ESCC Basic Specification No. 20400.

As an alternative, internal visual inspection shall be performed according to the internal manufacturer specifications (criteria and sampling size). In this case, after encapsulation, a decapsulation strategy must be done on a number of parts according to inspection level AQL S4 with no defect allowed, except those artefacts resulting from the decapsulation process itself. Decapsulation methods according to the ESCC 25300 and/or JESD 22B116 and acceptable artefacts resulting from decapsulation process itself shall be agreed between qualifying agencies and manufacturers. »

Conclusion and Perspectives

- ❑ The consolidated draft of the generic is expected by june 2021
- ❑ Next Steps:
 - Test Methods (CSAM, X rays....) definition and review of their perimeter of applicability
 - Review and matching with respects the charts (In process control, screening, qualification and maintenance of qualification)
- ❑ Evaluation standard (ESCC2269000P) to be developped as well
- ❑ Enhanced Commercial Qualified Level (ECQL): a further possibility for the manufacturers...



THANKS FOR YOUR ATTENTION!!



THANKS AS WELL TO THE ESCC9000P WG MEMBERS!!!

