APPLICATION FOR ESCC QUALIFICATION APPROVAL

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Component Title: **Integrated Circuits, Silicon, Monolithic, Radiation-Hardened 32-bit ARM Cortex-M7 Microcontroller (SAMRH71)**

Appl. No. 372 A

Executive Member: CNES Date: 24/03/2023

1 Components (including series and families) submitted for Qualification Approval

ESCC COMPONENT. NO.	VARIANTS	RANGE OF COMPONENTS	BASED ON	TEST VEHICLE / S	COMPONENT SIMILAR
9512/006	02	Integrated Circuits, Silicon Monolithic, Radiation-Hardened 32-bit ARM Cortex-M7 Microcontroller	SAMRH71 - ATMX150RHA technology	SAMRH71 CQFP-256	NA

2 Component Manufacturer
MICROCHIP TECHNOLOGY NANTES

3 Location of Manufacturing Plant
LA CHANTRERIE – ROUTE DE GACHET
BP70602
44306 NANTES CEDEX

4 ESCC Specification used for Qualification
Generic: ESCC9000
Issue 11
Detail/s: 9512/006
Issue 3

5 Qualification Report Reference and date:
QP-SAMRH71 Rev.D & E
Date: 01/11/2022

6 **PID** used for manufacturing Qualification Lot
Ref No: PID0040
Issue: 1
Date: 24/03/2023

7 **PID** changes since start of qualification
None ☐
Minor* ☒
Major* ☐
(* Details not published, provided in confidential annex 2.)

8 Current **PID** Verified by D. Dangla, CNES
Name of Executive Representative
Ref No: SAMRH71 PID 0040
Issue 1
Date 24/03/2023

9 Current Manufacturing facilities surveyed by:
CNES (D. Dangla) ESA (S. Hernandez) 14/09/2022
(Name of Executive Responsible) (Date)

Report Reference
DTN QE EC 2022-13648 CR-ESCC QML survey MCHP-14.15092022
Satisfactory: Yes ☒ No ☐ Explain

10 Quality and Reliability Data
Evaluation testing performed Yes ☒ No ☒
Report Ref. No.: Date:
Equivalent Data: Single Phase Qualification applies
Certification:

Failure analysis, DPA, NCCS available Yes ☒ No ☐
(supply data)

Ref Nos. and purpose:
Construction analysis report done by MCHP in ESCC evaluation report.
Construction analysis reports done by CNES: DSO/AQ/LE-2018.0010689 on multi-decks & DSO/AQ/LE-2019.0003248 on flat-substrates

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The undersigned hereby certifies on behalf of the ESCC Executive, that the above information is correct; that the appropriate documentation has been evaluated; that full compliance to all ESCC requirements is evidence except as stated in box 13; that the reports and data are available at the ESCC Executive and therefore applies for ESCC qualification status to be given to the component(s) listed herein.

Date: 24/03/2023

G. QUADRI, CNES

(Signature of the Executive Coordinator)

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Continuation of Boxes above: (Only non-confidential comments)

QP-SAMRH71 - SAMRH71 qualification report Rev. D & E
RAD-SAMRH71D - SAMRH71 rev.D radiation test report rev.8
RAD-SAMRH71E - SAMRH71 rev.E radiation test report rev.A

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Non compliance to ESCC requirements:

No.:	Specification	Paragraph	Non compliance

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Additional tasks required to achieve full compliance for ESCC qualification or rationale for acceptability of noncompliance:

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Executive Manager Disposition

Application Approval: Yes ☒ No ☐

Action / Remarks:

Date:

B. Schade: Head of the Product Assurance and Safety Department

ANNEX 1: LIST OF TESTS DONE TO SUPPORT QUALIFICATION

Tests conducted in compliance with:

- ESCC 9000 generic specification; Chart F4 (for ESCC/QPL parts);
- Or PID-TFD [redacted] (for ESCC/QML parts)

Tests vehicle identification/description:

SAMRH71 rev.D CQFP-256	SAMRH71 has been designed in compliance with ATMX150RHA design rules. Nevertheless, SAMRH71 embarks 2 specific entities not covered by the ATMX150RHA Standard Evaluation Circuit 002OP used for ATMX150RHA ESCC qualification: a NVM block and programmable I/O's. These features not mandatory for ASICs are necessary to meet customer needs for microprocessors. SAMRH71 also embarks more transistors than the maximum number covered by the ATMX150RHA SEC 002OP (97M Xtors compared to a maximum coverage of 90M Xtors). The qualification has been performed with flight models randomly chosen from 3 diffusion / inspection lots. The flight models screening is compliant with -SV requirements as described in AEQA0242 (http://ww1.microchip.com/downloads/en/Quality_ReliabilityDocs/AEQA0242_DS60001546B.pdf), with static burn-in (Mil-STD-883 TM1015A).
SAMRH71 rev.E CQFP-256	The rev.E of the SAMRH71 improves SEL and ESD performances compared to rev.D. Modifications are: 1. Pads ESD Protection (pad ring update) → *ESD+* 2. Substrate Plug Cell (Std Cell) → *SEL+* 3. DRC: Lines Widening to correct Isolated Lines This rev.E has been qualified by similarity with rev.D except following tests: 1. ESD/electrical latch-up 2. Life test 3. Radiation tests

Detail Specification reference: 9512/006 issue 3

Qualification results – Environmental/Mechanical subgroup
Initial qualification with SAMRH71 rev.D (Certificate n°372 May 2021)

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Chart F4	Test	Tick when done	Conditions	Assembly lot datecode	Tested Qty	No. of Rejects	Comments if not performed. Comments on Rejection
Environmental/Mechanical Subgroup	Mechanical Shock	☒	MIL-STD-883, Test Method 2002B	A68AN00000 DC1952 + A68ARA25UH DC2005 + A68AQ00000 DC2004 30# (10# from each assembly lot)	15	0	5+45 pulses
	Vibration	☒	MIL-STD-883, Test Method 2007A		(15)	0	12+108 sweeps
	Constant Acceleration	☒	MIL-STD-883, Test Method 2001E		(15)	0	Y1
	Seal (Fine and Gross Leak)	☒	MIL-STD-883, Test Method 1014		(15)	0	
	Intermediate and End-Point Electrical Measurements	☒	3 Temperature Electrical Test		(15)	0	
	External Visual Inspection	☒	MIL-STD-883, Test Method 2007		(15)	0	
	Thermal Shock	☒	MIL-STD-883. Test Method 1011C		15	0	15+85 cycles
	Temperature Cycling	☒	MIL-STD-883. Test Method 1010C		(15)	0	100 cycles
	Moisture Resistance	☒	MIL-STD-883, Test Method 1004		(15)	0	
	Seal (Fine and Gross Leak)	☒	MIL-STD-883, Test Method 1014		(15)	0	
	Intermediate and End-Point Electrical Measurements	☒	3 Temperature Electrical Test		(15)	0	
	External Visual Inspection	☒	MIL-STD-883, Test Method 1010		(15)	0	

Periodical (6-months) qualification for Flat-Substrate CQFP family since initial qualification with SAMRH71 rev.D

Chart F4	Test	Tick when done	Conditions	Assembly lot Datecode package	Tested Qty	No. of Rejects	Comments if not performed. Comments on Rejection
Environmental/Mechanical Subgroup	Mechanical Shock	☒	MIL-STD-883, Test Method 2002B	DGR5SA2842 DC2031 CQFP-256 A84PKFBT34 DC2104 CQFP-144 QQFGSA25W7 DC2120 CQFP-144 S8Q72A25WS DC2146 CQFP-144 A84PNA282P DC2220 CQFP-064 30# for each assembly lot	15	0	5 pulses
	Vibration	☒	MIL-STD-883, Test Method 2007A		(15)	0	12 sweeps
	Constant Acceleration	☒	MIL-STD-883, Test Method 2001E		(15)	0	Y1
	Seal (Fine and Gross Leak)	☒	MIL-STD-883, Test Method 1014		(15)	0	
	Intermediate and End-Point Electrical Measurements	☒	3 Temperature Electrical Test		(15)	0	
	External Visual Inspection	☒	MIL-STD-883, Test Method 2007		(15)	0	
	Thermal Shock	☒	MIL-STD-883. Test Method 1011C		15	0	15 cycles
	Temperature Cycling	☒	MIL-STD-883. Test Method 1010C		(15)	0	100 cycles
	Moisture Resistance	☒	MIL-STD-883, Test Method 1004		(15)	0	
	Seal (Fine and Gross Leak)	☒	MIL-STD-883, Test Method 1014		(15)	0	
	Intermediate and End-Point Electrical Measurements	☒	3 Temperature Electrical Test		(15)	0	
	External Visual Inspection	☒	MIL-STD-883, Test Method 1010		(15)	0	

Endurance subgroup with SAMRH71 rev.E

Note: 4000 hrs/Vccmax/125°C life test has been performed on the SAMRH71 rev.D

Chart F4	Test	Tick when done	Conditions	Diffusion Lot Assembly lot Date code	Tested Qty	No. of Rejects	Comments if not performed. Comments on Rejection
Endurance Subgroup	Operating Life	☒	MIL-STD-883, Test Method 1005	DKRS1.1 A5XGWA2879 DC2214 + DKRS2.1 A5XGXA287B DC2214 + DKRS3.1 A5XGYA287D DC2214 45# (15 # from each assembly lot)	45	0	1000 hrs/Vccmax/125°C
	Intermediate and End-Point Electrical Measurements	☒	Intermediate and End-Point Electrical Measurements in the Detail Specification		(45)	0	
	External Visual Inspection	☒	ESCC Basic Specification No. 20500		(45)	0	

Assembly capability group with SAMRH71 rev.E (done on each assembly lot)

Chart F4	Test	Tick when done	Conditions	Date Code Diffusion Lot	Tested Qty	No. of Rejects	Comments if not performed. Comments on Rejection
Assembly Capability Subgroup	Permanence of Marking	☒	ESCC Basic Specification No. 24800	A5XGWA2879 DC2214 - A5XGXA287B DC2214 - A5XGYA287D DC2214 12# (4# from each assembly lot)	3*3#	0	MIL-STD-883, Test Method 2015
	Terminal Strength	☐	MIL-STD-883, Test Method 2004				Done every 6-months (MIL GroupD)
	Internal Visual Inspection	☒	ESCC Basic Specification No. 20400		3*4#	0	
	Bond Strength	☒	MIL-STD-883 Test Method 2011		3*4#	0	Total = 3*44 wires
	Die Shear or Substrate Attach Strength	☒	MIL-STD-883 Test Method 2019 or 2027		3*3#	0	TM2027

Additional tests with SAMRH71 rev.E

Chart F4	Test	Tick when done	Conditions	Date Code Diffusion Lot	Tested Qty	No. of Rejects	Comments if not performed. Comments on Rejection
Additional Tests	Dimension check	☒	MIL-STD-883 Test Method 2016	A5XGWA2879 DC2214 - A5XGXA287B DC2214 - A5XGYA287D DC2214	3*5#	0	
	Solderability test	☒	MIL-STD-883 Test Method 2003		3*3#	0	
	HBM ESD	☒	ANSI/ESDA/JEDEC JS-001	DH80SA25W8 DC2213	3#	0	<1500V <250V on PB14 pin for which no ESD protection applies due to internal Power-On-Reset connection.

	CDM ESD	☒	ANSI/ESDA/JEDEC JS-002	DH80SA25W8 DC2213	3#	0	<1000V <125V on PB14 pin for which no ESD protection applies due to internal Power-On-Reset connection.
	Electrical latch-up	☒	JESD78	DH80SA25W8 DC2213	6#	0	Class II 125°C ambient temp.
	TID	☒	ESCC22900	DKRS1.1 (9 parts) - DKRS2.1 (9 parts) - DKRS3.1 (9 parts)	27#	0	22 biased, 5 unbiased
	SEL	☒	JESD57, ESCC25100	DH80S.1	5#	0	

NOTES ON THE COMPLETION OF THE APPLICATION FORM FOR ESCC QUALIFICATION APPROVAL

ENTRIES

Form Heading	shall indicate:— the title of the component as given in its detail specification or the name of the series or family; — the entering date; — the serial number and the suffix of the form.
Box 1	shall provide details given in table; in particular there shall be listed - the variants or range of variants; the range of components by using the ESCC code for values tolerances, etc.; the designation given in detail specification as 'based on'; —under Test Vehicle enter either a cross or the specific characteristic capable to identify the component tested; — under component similar enter a cross.
Box 2 and 3	Manufacturer's name and location of plant where the components were manufactured and tested.
Box 4	Generic and detail specifications used during qualification program.
Box 5	Reference to test report(s) submitted in support of application.
Box 6	Enter details to identify the PID that was applicable at the time the qualification lot was manufactured.
Box 7	If the PID was evolved after qualification lot manufacture, adequate details of such evolution shall be provided together with reasons for changes. Major changes shall be clearly marked.
Box 8	The box serves to identify the current PID and the Executive Representative that has verified it together with the date of this occurrence.
Box 9	This box can be completed only after a physical visit to the plant to confirm that the practices, procedures, materials, etc. used in manufacturing the components are as described in the PID. This survey shall be carried out in accordance with the requirements of ESCC Basic Specification No. 20200 and its findings shall be recorded.
Box 10	Details entered shall be sufficient to evidence that an evaluation program according to ESCC Basic Specification No. 22600 has been performed and that the results thereof are summarized in the survey and test reports. If the evaluation program has not been carried out according to established ESCC documents, the applicant Executive Representative shall provide alternative data and declare its assessed degree of satisfactory compliance with the ESCC basic requirements. Reference shall be made to the reports on Destructive Physical Analysis (DPA), Failure Analysis and Non conformance (NCCS) issued during the Evaluation and/or Qualification Phase.
Box 11	Enter the name of the Executive Coordinator and the signature.
Box 12	To be used when there is a need to expand any of the boxes from 1 through 10. Identify box affected and reference the Box 12 in the relevant Box. Box 12 can be broken into 12a, 12b, etc. if several Boxes have to be expanded.
Box 13	Fill table as requested.
Box 14	Fill in any additional tasks required to achieve full compliance.
Box 15	All Executive recommendations on the application itself, special conditions or restrictions, modifications of the QPL or ESCC QML entry, letters to the manufacturer, etc. shall be entered clearly in Box 15, signed by the ESA Representative.
Box 16	Fill in Table as requested.
Box 17	Confidential details of PID changes shall be provided.
Box 18	State noncompliance with reference to specification(s) and paragraph(s). To simplify reference in Box 18 each nonconformance shall be sequentially numbered. If relevant state 'None'
Box 19	Any additional action deemed necessary by the Executive Representative to bring the submitted data to a standard likely to be accepted by the ESCC Executive should be listed herein or the reason(s) to accept the nonconformance.
Box 20	Additional Comments