ESCC QUALIFIED MANUFACTURERS LIST (QML)

ESCC/RP/QML006-17

ISSUE 17

Updated January 2019

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

Legal Disclaimer and Copyright

The European Space Agency disclaims any liability or responsibility, to any person or entry, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without prior permission of the European Space Agency and provided it is not used for a commercial purpose, may be:

- Copied in whole, or in any medium, without alteration or modification.
- Copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.

DOCUMENTATION CHANGE NOTICE

(Refer to https://escies.org for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
	New qualification: -356, Exxelia SAS Technology Flow for Molded SMD Custom Magnetics Components, Toroidal (TO) and Linear (CCM) Winding Technology **Certificate removal:** -278Erev2, Microchip Technology The Digital C-MOS MH1RT process has been removed from the QML. -Certificate numbers 345, 354, 346, 341A, 349, 332A, 343 and 351 from Airbus Defence and Space, RHe Microsystems, Safran Electronics and Defense, Tesat Spacecom, Thales Alenia Space, Thales Alenia Space, Thales Alenia Space, 3Dplus These certificates have been removed from QML document and moved into the first issue of the ESCC Hybrid Process Capability Approval List (HPCL).

FOREWORD

This document contains a list of qualified manufacturers that have been certified by the European Space Agency for technology flows to the rules of the ESCC system with principle reference to ESCC Basic Specification no. 25400.

The qualified electronic components produced from the technology flows are intended for use in ESA and other spacecraft and associated equipment in accordance with the requirements of the ECSS standard ECSS-Q-ST-60.

Each technology flow qualification and its subsequent maintenance is monitored and overseen by the ESCC executive. ESA certifies the qualification upon receipt of a formal application from the executive stating that all applicable ESCC requirements have been met by the pertinent manufacturer. The qualified status of a technology flow is noted by an entry in this document, a corresponding entry in the European space components information exchange system, ESCIES, and the issue of a certificate to the qualified manufacturer.

TABLE OF CONTENTS

1 PROMOTION 7
2 PROCURER'S RESPONSIBILITY 7
3 QML ORGANISATION 7
3.1 TECHNOLOGY FLOWS and process capability approvals (PCA) 7
3.2 QUALIFIED COMPONENTS 7
3.3 TYPE DESIGNATION 7
3.4 COMPONENT CHARACTERISTICS 7
3.5 MANUFACTURER 7
4 TABLE OF QUALIFIED COMPONENT TECHNOLOGY 8
5 QUALIFIED TECHNOLOGY FLOWs 9
5.1 FILTERS (05) 9
5.1.1 KONSBERG NORSPACE, Norway: SAW FILTERS 9
5.1.1.1 Contact Information 9
5.1.1.2 Qualification 9
5.1.1.3 List of Qualified Components 9
5.1.1.4 Technology Flow Abstract 10
5.1.1.5 Technology Flow definition 11
5.2 MICROCIRCUITS (08) 14
5.2.1 MICROCHIP ATMEL, France: ATC18RHA 14
5.2.1.1 Contact Information 14
5.2.1.2 Qualification 14
5.2.1.3 List of Qualified Components 14
5.2.1.4 Technology Flow Abstract 15
5.2.1.5 Technology Flow Definition 17
5.2.1.6 Manufacturing sites 18
5.2.2 MICROCHIP ATMEL, FRANCE: ATMX150RHA 19
5.2.2.1 Contact Information 19
5.2.2.2 Qualification 19
5.2.2.3 List of Qualified Components 19
5.2.2.4 Technology Flow Abstract 19
5.2.2.5 Technology Flow Definition 21
5.2.2.6 Manufacturing sites 22
5.3 resistors (08) 23
5.3.1 VISHAY S.A. Fance: Chip resistors 23
5.3.1.1 Contact Information 23
5.3.1.2 Qualification 23

5.3.1.3 List of Qualified Components 23
5.3.1.4 Technology Flow Abstract 26
5.3.1.5 Technology Flow definition 28

5.4 TRANSFORMERS (08) 29

5.4.1 Exxelia SAS: Custom magnetics: linear and toroidal technology 29
5.4.1.1 Contact Information 29
5.4.1.2 Qualification 29
5.4.1.3 List of Qualified Components 29
5.4.1.4 Technology Flow abstract 31
5.4.1.5 Technology Flow definition 32
5.4.1.6 Manufacturing site 32

1 PROMOTION

It is permitted to advertise the ESCC qualification status of a component provided such publicity or advertisement does not state or imply that the component is the only qualified one of that particular type, range or family.

2 PROCURER'S RESPONSIBILITY

When procuring ESCC qualified components, the procurer is responsible for ensuring that the qualification status is valid and that delivered components fulfil the specified requirements of the applicable ESCC specifications. The procurer is advised to utilise the ESCC non- conformance system, per ESCC Basic Specification No. 22800, in the event that a qualified manufacturer delivers non-conforming components.

3 QML ORGANISATION

3.1 TECHNOLOGY FLOWS AND PROCESS CAPABILITY APPROVALS (PCA)

The individual Technology Flows and PCA and are listed in this document by manufacturer in alphabetical order. They may also be found on the ESCIES web site, https://escies.org. A Technology Flow Abstract is provided to describe the main features of the qualified Technology Flow.

3.2 QUALIFIED COMPONENTS

Under each technology flow a list of the qualified components is provided.

3.3 TYPE DESIGNATION

Wherever possible the referenced type (style) designations are derived from industrial standards. Where no standardised type designation is applicable the manufacturer's designation is referenced.

3.4 COMPONENT CHARACTERISTICS

The precise characteristics of the qualified component are defined in the referenced ESCC Detail specifications.

3.5 MANUFACTURER

Contact information and plant locations are indicated in the individual Technology Flow listings Contact information may also be found in the ESCC QML section of the ESCIES web site, https://escies.org.

4 TABLE OF QUALIFIED COMPONENT TECHNOLOGY

Components	Sub-section	Manufacturers	Certificates
05 Filters	SAW	Kongsberg Norspace	313B
08 Microcircuits	Digital C-MOS: ATC18RHA	Microchip Technology Nantes	312Brev1
	Digital C-MOS: ATMX150RHA	Microchip Technology Nantes	342rev1
10 Resistors	Chip	Vishay SA, Sfernice	287E
14 Transformers	Custom magnetics: linear or toroidal technology	Exxelia Magnetics	356

5 QUALIFIED TECHNOLOGY FLOWS

The following technology flows are qualified.

5.1 FILTERS (05)

5.1.1 KONSBERG NORSPACE, Norway: SAW FILTERS

5.1.1.1 Contact Information

Address	ESCC Chief Inspector
Kongsberg Norspace AS Knutsrødveien 7 N-3189 Horten Norway	Mrs Cecilie Berg Tel: (+47) 3303 2700 Fax: (+47) 3303 2800 email: cecilie.berg@norspace.no

5.1.1.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
313B	Aug. 2011	SAW filters (transversal band pass/resonator/notch/low loss impedance element)

Applicable ESCC Documents:

ESCC Generic Specification No. 3502
ESCC Detail Specification Nos. 3502/002

Norspace Process Identification Documents:

PID534 SAW Device Assembly with flow NORSF-A1
PID630 SAW Crystal Manufacturing with flow NORSF-C1

5.1.1.3 List of Qualified Components

For each design, a detail specification is produced by Kongsberg Norspace. Where the SAW component is not proprietary to the customer the detail specification is published in ESCIES as a supporting document. Available detail specifications are found in the table below.

Detail Specification	Component Type
3502/002	SAW Filters, Hermetically Sealed, Surface Mount, Frequency Range 10 MHz - 4 GHz

5.1.1.4 Technology Flow Abstract

General features

The Technology Flow covers the design, fabrication, assembly, screening, in-process control and testing of the Norspace SAW filters manufactured within the NORSF-C1 and NORSF-A1 processes. The design, crystal manufacturing, assembly, screening and testing is performed in the Norspace facility at Knudsrødveien 7 in Horten, Norway.

Technology Flow	Scope
Design	Norspace specification Ko 03.00
Crystal manufacturing	Process flow NORSF-C1 on purchased SAW-grade surface polished wafers. Wafer materials: Quartz (SiO_2), Lithium niobate ($LiNbO_3$), Lithium tantalate ($LiTaO_3$), Langasite ($La_3Ga_5SiO_{14}$) Wafer dimensions: 3” diameter 0.5 mm thick 3” diameter 1.0 mm thick 4” diameter 1.5 mm thick
Assembly	Process flow NORSF-A1. Crystal dimensions: from 1.7 mm x 3.1 mm up to 8 mm x 76 mm. Packages: -Gold plated Fe-Ni-Co-alloy flat packs. From 4 up to 50 leads with ceramic or glass feedthroughs. External wings for screw attach on some types Package dimensions: From 8 mm x 8 mm up to 85 mm x 12 mm. -Gold plated Fe-Ni-Co-alloy flat packs with Cu-W base, 4 or 6 leads and ceramic feedthroughs. Package dimensions: From 11 mm x 11 mm up to 7 mm x 21 mm. -Gold plated ceramic Leadless Chip Carrier (LCC) package, 10 solder pads. Package dimension: 5 mm x 7 mm.

Technology Flow	Scope
Screening and Test	Process flow NORSF-A1. –Incoming inspection –In-process inspection –100% Wafer probe electrical test –100% Visual inspection –Final production tests –Customer Source Inspection –Screening –Burn-in and electrical measurements –Test procedures –External visual inspection –Qualification testing

Basic Information

The SAW devices are passive devices and typically require external tuning. Frequency range: From 10 MHz up to 4 GHz.

Max operating temperature range: -30 / +85 °C (maximum), -20 / +70 °C (typical).

Input power: design sensitive.

Component Types

- Transversal band pass SAW filters with frequencies up to 4 GHz.
- SAW Resonator filters
- SAW Notch filters
- Impedance element filters with low loss

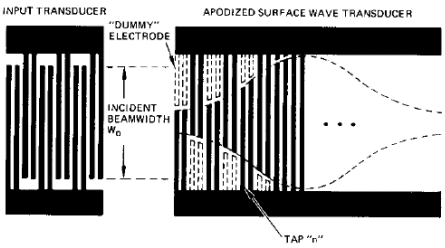
5.1.1.5 Technology Flow definition

1. **Design**

The design programs are in-house developed procedures and libraries. Each new design is custom made for the application by Norspace design engineers. The design centre is in Horten, Norway.

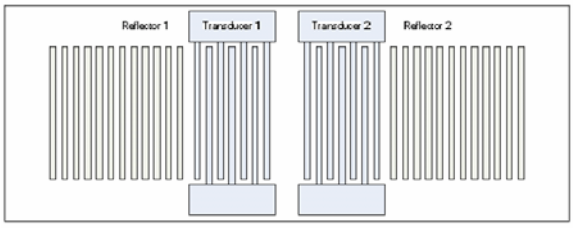
Transversal band pass SAW filters

The transversal filters consist of one input transducer and one output transducer, see figure below. The transducers are interdigital transducers formed by a metal pattern on a piezoelectric material (wafer). The transducers can be withdrawal weighted and/or length (apodization) weighted. The detailed weighting functions are calculated in a dedicated filter synthesis software and used as input to the mask layout software. The simulation of the filter response is performed by a dedicated SAW Analysis software.



Resonator filters

The resonator filter consists of input and output transducers as described above. These are normally unweighted. The transducers are backed by reflectors, see figure below. The reflectors are l/4 wide etched grooves or metal fingers. The same software is used for simulation of the transducers and reflectors.

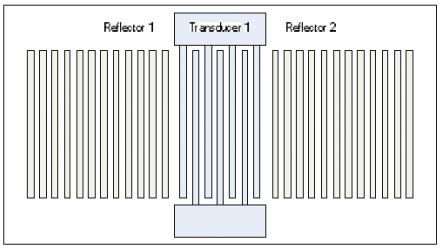


SAW Notch filters

The notch are based on single port resonator elements, so called impedance elements (see below).

Impedance element filters with low loss

Impedance element filters are constructed from one port SAW resonators. The one port SAW resonators consist of one interdigital transducer backed by one reflector on each side, as shown in the figure below.



2. **Fabrication**

The NORSF-C1 process at Norspace comprises:

-SAW crystal manufacturing on SAW grade polished single crystal wafers from quartz, LiNbO3, LiTaO3 and La3Ga5SiO14 (langasite)
-Externally purchased SAW wafers
-SAW wafer thickness between 0.5 mm and 1.5 mm
-Photolithography with line widths down to 0.3 m. No upper limit.Metallization performed with Al or Cr/Al. Metal thickness 400 to 10 000 Å.

The process can manufacture SAW elements of band pass, resonator or notch type with centre frequencies in the range 10 MHz to 4 GHz.

3. **Assembly**

Norspace assembly flow NORSF-A1 technology flow covers the following capabilities:

Package	Die Attach	Wire Bond	Lid Seal	Leads
Flatpack/LCC. Au plated. CuW base/Fe-Ni-Co alloy or ceramic with Fe-Ni-Co alloy seal ring.	Silicone rubber	Ultrasonic ball- wedge, 25 µm Au wire	Resistance seam sealing. N2 atmosphere.	Au plated

4. **Test**

Measurements are performed using a Vector Network Analyzer (VNA).

All equipment in the electrical test set-up shall have the same characteristic impedance. The S-parameters are measured on the VNA and transferred to a PC for post-processing and analysis. Before testing the VNA and its test cables must be calibrated as specified in the manual for the instrument (full 2-port calibration).

Test vehicles used for qualification: SQF-3800, SLC-4320.
Test vehicles used for maintenance: SQF-3800, SLC-3900, or similar devices.

5. **Radiation**

The devices are regarded as radiation insensitive within a small drift in centre frequency and phase allowed for in the design margins.

Radiation testing has been performed successfully up to 50 MRad(Si) for quartz and 1 MRad(Si) for LiNbO3, LiTaO3 and Langasite.

Qualified wafer materials: Quartz, LiNbO3. LiTaO3, Langasite (La3Ga5SiO1)

5.2 MICROCIRCUITS (08)

5.2.1 MICROCHIP ATMEL, France: ATC18RHA

NOTES:

1. LFoundry (LF) in Rousset ceased to supply ATC18RHA chips in December 2013
2. A second source of supply, UMC has been successfully added to the scope of Technology Flow qualification for this technology by Atmel.
3. New designs and fabrication after January 2014 make use of the UMC source.

5.2.1.1 Contact Information

Address	ESCC Chief Inspector
Microchip Atmel Nantes SAS Route de Gachet 44300 Nantes France	Ms V. Lepaludier Tel. +33 2 40 18 1633 FAX +33 2 40 18 1946 Valerie.Lepaludier@atmel.com

5.2.1.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
312B Rev 1	Aug. 2012	Integrated Circuits, Silicon, Monolithic, CMOS, Cell-Based Array, based on Type ATC18RHA

Applicable documents:

ESCC Generic Specification No. 9000; ESCC Detail Specification No. 9202/080

Atmel Process Identification Document PID 0030 (LF), PID 32 (UMC) , e2v PID DF 31S 100730 (assembly, common to both sources LF and UMC), HCM SYSTREL PID 11 (for columns attachment).

5.2.1.3 List of Qualified Components

For each ASIC design an ASIC Sheet is produced by Atmel for use in conjunction with the ESCC Detail Specification No. 9202/080. Where the ASIC is not proprietary to the customer the ASIC sheet is published in ESCIES as a supporting document.

ASIC Sheet	Component Type

In the case of ATC18RHA, standard components are also available. These are listed below with their full ESCC Detail Specification:

Detail Specification	Component Type
9512/004	Integrated Circuits, Silicon, 32-bit SPARC Processor, based on Type AT697F
9304/165	Integrated Circuits, Silicon, monolithic, CMOS digital, Field Programmable Gate Array, 280000 gates, based on type ATF280F

5.2.1.4 Technology Flow Abstract

See Notes under Para. 4.2

General Features

ATC18RHA standard cells family is designed with a 0.18µm radiation hard CMOS technology. This offering is based on 6 metal layers at 1.8V +/-0.15V for the core and 3.3V +/-0.3V for the periphery. This family features arrays with up to 7 Mgates and 544 pads. With its high speed performance, its low supply current and its radiation hard level, the ATC18RHA is suitable for digital applications working in radiation intensive environment.

Basic Information

- CMOS technology AT58KRHA
- 40 to 70 kgates per mm² - Up to 6.5M gates
- Double supply operation
  - Periphery power supply 3.3V
  - Core power supply 1.8V
- Low supply current :
  Operating maximum value: 85nW/gate/MHz with a duty cycle at 20%

- I/O Interfaces:
  - Cold sparing
  - High speed LVDS (655 Mps) and LVPECL
  - PCI
- 544 pads (+ 8 pads power only)
- Embedded memories: Compiled and Synthesized
- EDAC library

- Radiation (LF and UMC):
  - No Single Event Latch-Up below a LET Threshold of 80 MeV/mg/cm² at ambient & high temperature
  - SEU hardened DFF's to 30 MeV/mg/cm2
  - Tested up to 300 KRad (Si), Radiation Level is 100 KRads (Si).
- Device Types – per individual custom ASIC sheets and ESCC Detail Specification 9202/080

Component Types

This table presents the available couples (die, package) as defined in the Detail Specifications:

Die	Supply Voltage I/O / core	Max programmable I/O's	Case	Typical Routable gates
ATC18RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F256	1M
ATC18RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F196	1M
ATC18RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F160	1M
AT697F	3.3V/1.8V		MQFP-F256	0.85M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	MQFP-T352	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F256	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F196	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F160	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	LGA-349	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CCGA-349	2.2 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	MQFP-T352	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	MQFP-F256	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	LGA-472	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	LGA-349	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	CCGA-472	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	CCGA-349	3.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	MQFP-T352	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	MQFP-F256	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	LGA-625	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	LGA-472	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	LGA-349	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CCGA-625	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CCGA-472	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CCGA-349	5.5 M
ATC18RHA_544	2.5V or 3.3V/1.8V	544	LGA-625	7 M
ATC18RHA_544	2.5V or 3.3V/1.8V	544	CCGA-625	7 M

5.2.1.5 Technology Flow Definition

The Technology Flow Definition domain covers the design, fabrication, assembly and testing of the ATC18RHA standard cells family.

1. **Design**

The design manual and the ASIC library data books cover design at the Atmel Nantes Design Centre.

- ATC18RHA Design manual ATD-DE-GR-R0212
- ATC18RHA TOS manual ATD-DE-GR-R0324
- ATC18RHA Buffers library databook ATD-TS-LR-R0252
- ATC18RHA Cells library databook ATD-TS-LR-R0251
- ATC18RHA Memory cells library databook ATD-TS-LR-R0254
- ATC18RHA specific library databook ATD-TS-LR-R0253

All ASIC designs will be performed by the customer at the customer site, with Atmel supported tools (front end).

2. **Fabrication**

The ATC58KRHA, processed in UMC Taiwan, is a 0.18µm CMOS, 6 metal, Ti, TiN and AlCu process.

3. **Assembly**

The assembly of ATC18RHA devices is performed at E2V, Grenoble, with the following capabilities:

Die attach Cyanate Ester (JM7000)
Wire bond Ultrasonic Wedge, 32µm Al
Lid sealing Brazed with Au/Sn alloy
Leads Au plated (MQFP and LGA)

Columns attachment is performed in SERMA HCM, La Rochelle, with the following capabilities:
Columns 85Pb15Sn with Cu ribbon

4. **Control and Test**

The control and test of ATC18RHA devices at Atmel Nantes. It includes Lot Acceptance, Test Flows and Test Procedures, Qualification Test and Reliability Monitoring, Screening and associated electrical tests and inspections.

5. **TCVs and SEC**

The die ATC18RHA_324 is used for both test vehicles. All details are described in the ATC18RHA test chip specification, reference ADF-DE-R0561-CUP.

V41 test vehicle
The V41 is a buffer test vehicle representative of the range of buffers available for performance testing in the MQFP 256 package. It contains standard IO33 buffers, specific IO33 buffers (LVDS, PCI), a PLL, a set of ring oscillators made of different library cells and a set of interconnect lines.

V40 test Vehicle – Technology SEC
The V40 SEC is developed for performance and radiation testing in the MQFP 256 package. It contains a set of memory blocks (compiled memories with and without EDACs and synthesized (on gates) memories made with standard and hardened latches), shift registers chains and a PLL.

6. Radiation Characteristics

The AT58KRHA family has been developed to fulfil the following characteristics in terms of radiation tolerance:

- No Single Event Latch-up below a LET Threshold of 80MeV/mg/cm^2 at high temperature
- Availability of SEU hardened flip-flops
- Total dose capability over 100Krad (Si)
-

5.2.1.6 Manufacturing sites

Design:	Atmel Nantes, BP70602, 44306 Nantes Cedex 3, France
Wafer Fabrication:	UMC Fab 8S, Hsin-Chu, Taiwan
Assembly:	e2v Grenoble, BP123, 38521 Saint-Egrève Cedex, France
	HCM SYSTREL, 34 Av. Joliot Curie, ZI Perigny, 17185 Perigny Cedex, France
Control and Test:	Atmel Nantes, BP70602, 44306 Nantes Cedex 3, France

5.2.2 MICROCHIP ATMEL, FRANCE: ATMX150RHA

5.2.2.1 Contact Information

Address	ESCC Chief Inspector
Microchip Atmel Nantes SAS Route de Gachet 44300 Nantes France	Ms V. Lepaludier Tel. +33 2 40 18 1633 FAX +33 2 40 18 1946 Valerie.Lepaludier@atmel.com

5.2.2.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
342 rev1	Aug. 2016	Integrated Circuits, Silicon, Monolithic, CMOS, Cell-Based Array, based on Type ATMX150RHA – Ph1 Digital only 7 Mgates 5ML

Applicable documents:

ESCC Generic Specification No. 9000; ESCC Detail Specification No. 9202/083

Atmel Process Identification Document PID 37, e2v PID DF 31S 100730 (assembly), HCM SYSTREL PID 11 (for columns attachment).

5.2.2.3 List of Qualified Components

For each ASIC design an ASIC Sheet is produced by Atmel for use in conjunction with the ESCC Detail Specification No. 9202/083. Where the ASIC is not proprietary to the customer the ASIC sheet is published in ESCIES as a supporting document.

ASIC Sheet	Component Type

5.2.2.4 Technology Flow Abstract

General features

The ATMX150RHA ASIC family is designed with a 0.15µm Radiation-Hardened CMOS technology, 5 metal layers, with 1.8V +/-0.15V for the core and 2.5+/-0.25V or 3.3V +/-0.3V for the periphery supplies. This family arrays up to 7 Mgates and more than 500 pads.
With its high speed performance, its low supply current and its radiation hard level, the ATMX150RHA is suitable for digital applications working in radiation intensive environment.

Basic information

CMOS technology AT77K9RHA
- 40 to 70 kgates per mm²
- Up to 7M gates
- Double supply operation:

  - Periphery power supply 2.5V & 3.3V
  - Core power supply 1.8V
- Operating maximum value of 8.8 nA/gate/MHz with a duty cycle at 20%
- I/O Interfaces:
  - Cold sparing
  - High speed LVDS (655 Mps) and LVPECL
  - PCI
- 544 pads (+ 8 pads power only)
- Compiled memory cells (ROM, SRAM, DPRAM, register files)
- Radiation:
  - No Single Event Latch-Up below an LET Threshold of 86 MeV/mg/cm² at high temperature.
  - SEU Hardened DFF's to 18 MeV/mg/ cm2
  - TID Radiation Capability of 100 kRads (Si).
- Device Types – per individual custom ASIC sheets and ESCC Detail Specification 9202/083

Component Types

This table presents the available couples (die, package) as defined in the Detail Specifications:

Die	Supply Voltage I/O / core	Max programmable I/O's	Case	Typical Routable gates
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F256	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F196	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	MQFP-F160	1M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	MQFP-T352	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F256	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F196	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	MQFP-F160	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	LGA-349	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CCGA-349	2.2 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	MQFP-T352	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	MQFP-F256	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	LGA-472	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	LGA-349	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CCGA-472	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CCGA-349	3.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	MQFP-T352	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	MQFP-F256	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	LGA-625	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	LGA-472	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	LGA-349	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CCGA-625	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CCGA-472	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CCGA-349	5.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	LGA-625	7 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CCGA-625	7 M

5.2.2.5 Technology Flow Definition

The Technology Flow covers the design, fabrication, assembly and testing of the ATMX150RHA standard cells ASIC family.

1. **Design**

The design manual and the ASIC library data books cover the design in the Atmel Nantes Design Centers:

ATMX150RHA design manual	2012_EC_054_ELE
ATMX150RHA TOS (Test Oriented Simulation) Manual	ATD-DE-GR-R0324
ATMX150RHA supply & ESD buffer databook	2012_EC_055_ELE
ATMX150RHA buffer 3.3V databook	2012_EC_051_ELE
ATMX150RHA buffer 2.5V databook	2012_EC_052_ELE
ATMX150RHA Cells library databook	2012_EC_050_ELE
ATMX150RHA memory cells library databook	2012_EC_053_ELE
ATMX150RHA power grid verification flow	2014_EC_131-ELE

All ASIC designs will be performed by customer at customer site, with Atmel supported tools (front end).

2. **Fabrication**

The AT77K9RHA, processed in UMC Taiwan, is a 0.15 µm CMOS, 5 metal, Ti, TiN and AlCu process.

3. **Assembly**

The assembly of ATMX150RHA devices is performed in e2v, Grenoble, with the following capabilities:

Die attach Cyanate Ester (JM7000)
Wire bond Ultrasonic Wedge, 32µm Al
Lid sealing Brazed with Au/Sn alloy
Leads Au plated (MQFP and LGA)

Columns attachment is performed in SERMA HCM, La Rochelle, with the following capabilities:

Columns 85Pb15Sn with Cu ribbon

4. **Control & Test**

The control and test of ATMX150RHA devices is performed in Atmel Nantes. It includes Lot Acceptance, Test Flows and Test Procedures, Qualification Test and Reliability Monitoring, Screening and associated electrical tests and inspections.

5. **TCVs and SEC**

The die ATMX150RHA_324 is used for both test vehicles. All details are described in the ATMX150RHA test chip specification, reference 2012_EC_024.

V55 test vehicle. The V55 is a buffer test vehicle representative of the range of buffers available for performance testing in the MQFP 256 package. It contains standard IO33 buffers, specific IO33 buffers (LVDS, PCI), a PLL, a set of ring oscillators made of different library cells and a set of interconnect lines

V54 test Vehicle V54 – Technology SEC. The V54 SEC is developed for performance and radiation testing in the MQFP 256 package. It contains a set of memory blocks (compiled memories with and without EDACs and synthesized (on gates) memories made with standard and hardened latches), shift registers chains and a PLL.

6. **Radiation Characteristics**

The AT77K9RHA technology has been developed to fulfil the following characteristics:
- Total dose capability over 100 kRads (Si).
- No Single Event Latchup below a LET threshold of 86 MeV/mg/cm2 at high temperature.
- Availability of SEU hardened cells.

5.2.2.6 Manufacturing sites

Design: Atmel Nantes, BP70602, 44306 Nantes Cedex 3, France
Wafer Fabrication: UMC Fab 8C, Hsin-Chu, Taiwan
Assembly: e2v Grenoble, BP123, 38521 Saint-Egrève Cedex, France
HCM SYSTREL, 34 Av. Joliot Curie, ZI Perigny, 17185 Perigny Cedex, France
Control and Test: Atmel Nantes, BP70602, 44306 Nantes Cedex 3, France

5.3 RESISTORS (08)

5.3.1 VISHAY S.A. Fance: Chip resistors

5.3.1.1 Contact Information

Address	ESCC Chief Inspector
Vishay S.A. Division SFERNICE 199, Boulevard de la Madeleine CS71159 F-06003 Nice Cedex 01 France	Mr. L. Cresson Tel: +33 4 93 37 27 88 FAX: +33 4 93 37 28 77 EMAIL: laurent.cresson@vishay.com

5.3.1.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
287E	Feb. 2009	Thin Film Technology for Chip, Wraparound, Single and Network Resistors, Fixed, Based on Types P for Single Chip, PRA and CNW for Resistor Networks

Applicable Documents

ESCC Generic Specification No. 4001

ESCC Detail Specification Nos. 4001/023, 4001/025

Vishay S.A. Process Identification Document PID PID-TFD P PRA CNW

5.3.1.3 List of Qualified Components

NOTE: the Established Reliability Level R is evaluated according to ESCC specification 26000.

Type PHR, Variants 01 to 08, 13 and 14 are qualified

Type PFRR, Variants 09 to 12 and 15 are qualified

Type PRAHR/CNWHR, Variants 01 to 42 are qualified

4001/023	PHR	High Stability and Precision Chip
4001/023	PFRR	High Stability and Precision Chip with Established Reliability Level R
4001/025	PRA/CNWHR	High Stability and Precision Surface Mount Array

Lead material is E with either Type 2 or Type 4 finish. The terminal material and finish of some of these variants makes them unsuitable for solder assembly methods. They shall be assembled using glue or wire bond techniques. See Detail specifications.

Operating Temperature Range, (°C): -55 to +155

Type PHR:

Detail Specification	Style	Critical R (kΩ)	Rated Dissipation (W)	Limiting Element Voltage (V)	Type Variant
4001/023	0402	18	0.050	30	13; 14
	0603	12.25	0.100	35	01; 05
	0805	45	0.125	75	02; 06
	1206	40	0.250	100	03; 07
	2010	45	0.500	150	04; 08

Variant	Style	Resistance Range (Note 1)		Tolerance (±%) (Note 2)	Temperature Coefficient (10^{-6}/ºC) (Note 2)	Weight (g)
		Min (Ω)	Max (MΩ)			
01, 05	0603	10	0.200 (0.160 for TC"C")	0.01; 0.02; 0.05; 0.1	±5; ±10; ±25	0.003
02, 06	0805	10	0.250	0.01; 0.02; 0.05; 0.1	±5; ±10; ±25	0.004
03, 07	1206	10	1.000	0.01; 0.02; 0.05; 0.1	±5; ±10; ±25	0.01
04,08	2010	10	3.000	0.01; 0.02; 0.05; 0.1	±5; ±10; ±25	0.03
13, 14	0402	10	0.100 (0.067 for TC"C")	0.01; 0.02; 0.05; 0.1	±5; ±10; ±25	0.002

Note 1:

Variant	Style	Critical Resistance (KΩ)
01 - 05	0603	12.25
02 - 06	0805	45
03 - 07	1206	40

04 - 08	2010	45
13 - 14	0402	18

Note 2:

Resistance (Ω)	Available Tolerances (±%)	Series
10 ≤ R < 50	0.1	Any value in the resistance range
50 ≤ R < 100	0.05 and 0.1	
100 ≤ R < 250	0.02; 0.05 and 0.1	
R ≥ 250	0.01; 0.02; 0.05 and 0.1	

Resistance (Ω)	Temperature Coefficient (ppm/ºC)	Series
10 ≤ R < 20	E: 25 (-55ºC; +155 ºC)	Any value in the resistance range
20 ≤ R < 50	Y: 10 (-55ºC; +155 ºC)	
20 ≤ R < 50	Z: 5 (+22ºC; +70 ºC)	
R ≥ 50	C: 5 (-55ºC; +155 ºC)	

Type PFRR:

Detail Specification	Style	Critical R (kΩ)	Rated Dissipation (W)	Limiting Element Voltage (V)	Type Variant
4001/023	0402	32	0.050	40	15
	0603	25	0.100	50	09
	0805	80	0.125	100	10
	1206	90	0.250	150	11
	2010	80	0.500	200	12

Style	Resistance Range (Ω)	Tolerance (±%)	Temperature Coefficient TC($\pm 10^{-6}$ /°C)
0402; 0603; 0805; 1206; 2010	From 100 to ≤ 100K	0.05; 0.1	10; 25
0603; 0805; 1206; 2010	From 100 to ≤ 261K	0.05; 0.1	10; 25
0805; 1206; 2010	From 261K to ≤ 301K	0.05; 0.1	10; 25
1206; 2010	From 301K to ≤ 1M	0.05; 0.1	10; 25
2010	From 1M to 3M01	0.05; 0.1	10; 25

Type PRAHR/CNWHR:

Detail Specification	Style	Critical R (K Ω)	Rated Dissipation (W/resistor)	Limiting Element Voltage (V/resistor)	Type Variant Same Ohmic Values	Type Variant Different Ohmic Values
4001/025	PRA100	12.25	0.100	35	01 to 07	22 to 28
	PRA135	56.25	0.100	75	08 to 14	29 to 35
	PRA182	100	0.100	100	15 to 21	36 to 42

Style	Resistance Range (Ω)	Tolerance (±%)		Temperature Coefficient TC(±10-6 /°C)	
		Absolute	Relative	Absolute	Relative
PRA100; PRA135; PRA182	From 100 to 200K	0.1; 0.5; 1	0.05; 0.1	10	3; 5
PRA135; PRA182	From 200K to 250K	0.1; 0.5; 1	0.05; 0.1	10	3; 5
PRA182	From 250K to 1M	0.1; 0.5; 1	0.05; 0.1	10	3; 5

Number of Resistors per Array: 2 to 8

NOTES:

1. Note that gold finish variants are not intended for de-golding and tinning.
2. The electrical ranges of these ESCC QML Qualified components variants are listed in the ESCC Detail Specifications and in the Qualified Part List (REP005) document available on the ESCIES website, https:// escies.org.

5.3.1.4 Technology Flow Abstract

General features

The thin film technology for chip, fixed, wraparound, single and network resistors are designed on types based on P for single chip, PRA for 2 to 8 resistors of similar value and CNW for 2 to 8 resistors with at least two different values with the same form factor as PRA.

Technology Flow	Scope	Site
Design Centre	Single resistor chips in 0402 0603, 0805, 1206 and 2010 formats 2 to 8 resistors of similar value in formats 0603, 0805 and 1206 2 to 8 resistors with at least 2 different values with the same form factor, 0603, 0805 or 1206	Vishay S.A. Division SFERNICE 199, Boulevard de la Madeleine CS71159 F-06003 Nice Cedex 01 France
Fabrication	Film deposition Photolithography Thermal treatment Passivation Thermal stabilization and control	As above
Assembly	Laser trim Protective layer Termination and Test	As above
Test	Chart F2, F3 and F4 Periodic Testing	As above

Basic Information

The technology consists of:

- Substrate: High purity alumina (99.5%)
- Resistive Layer: Nickel chromium
- Passivation Layer: Silicon Nitride
- Protection: Epoxy and Silicone
- Termination: Nickel barrier
- Processes: Thin film deposition
- Finish: SnPbAg or Au

Critical resistance by style:

- P 0402 FR:32 k
- P 0603 FR:25 k
- P 0603 HR:12.25 k
- P 0805 FR: 80k
- P 0805 HR: 45 k
- P 1206 FR: 90 k
- P 1206 HR: 40 k
- P 2010 FR: 80k
- P 2010 HR: 45 k
- PRA 100: 12.25 k
- PRA 135: 56.25 k
- PRA 182: 100 k

Component Types

The available formats are defined in the variants table in the Detail Specifications. Variants with established reliability in accordance with Basic specification No. 26000 are designated with an ''FR" suffix here for convenience. Variants 09, 10, 11 and 12 have established reliability level 'R' at 60% confidence level.

5.3.1.5 Technology Flow definition

1. **Design**

The design manuals covers the design rules and limits:

- HP-BE/001 (Maîtrise de la conception)
- HP-BE/004 (Données technologiques, Régles d'implementation, Performances)

Critical design characteristics:

- Minimum metal width: 10 µm
- Power dissipation lower than 250mW/mm^2
- Current density lower than 7000 A/mm^2
- Electrical field lower than 5V/ µm

2. **Fabrication/Assembly**

The manufacturing flows and procedures are described in section 4 of Vishay S.A.PID.

3. **Test**

Complete test sequence as detailed in ESCC Generic 4001 and the relevant Detail Specifications is conducted by Vishay S.A.

The deletion of the Third Harmonic Control requirement from ESCC Detail Specification No. 4001/023 for thin film wraparound technology is documented in reference report MAT/ 3HC/07.02 revision 3 dated 2007-06-20.

For variants with established reliability the efficiency of the Overload Test is increased with the implementation of a resistance change rejection criteria of 500 ppm and approved by TRB decisions on 2007-04-04.

4. **Radiation Characteristics**

The resistors covered in this technology domain is considered insensitive to radiation effects.

5.4 TRANSFORMERS (08)

5.4.1 Exxelia SAS: Custom magnetics: linear and toroidal technology

5.4.1.1 Contact Information

Address	ESCC Chief Inspector
Exxelia SAS 16, Parc d'Activités du Beau Vallon F-57970 Illange France	Mr. D. Martin Tel: +33 3 82 59 17 35 EMAIL: dominique.martin@exxelia.com

5.4.1.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
356	February 2019	Molded SMD custom magnetic components, toroidal (TO) or linear (CCM) winding technology

Applicable Documents

ESCC Generic Specification No.3201

ESCC Detail Specification Nos. 3201/011 (CCM technology), 3201/012 (TO technology)

Exxelia. Process Identification Document PID 100 (TO technology) and PID 101 (CCM technology)

5.4.1.3 List of Qualified Components

The component type variants and range of magnetic components applicable to the toroid TO technology are as follows:

Variant Number	Type	Design Domain	Electrical Characteristics	No. of Terminals	Terminal Finish	Weight Max (g)
01	TO10	Note 1	Note 2	10	Sn60Pb40	3.1
02	TO12	Note 1	Note 2	10	Sn60Pb40	5.9
03	TO16	Note 1	Note 2	12	Sn60Pb40	11.6
04	TO20	Note 1	Note 2	14	Sn60Pb40	21.8
05	TO25	Note 1	Note 2	18	Sn60Pb40	41.2
06	TO30	Note 1	Note 2	22	Sn60Pb40	80.4
07	TO36	Note 1	Note 2	24	Sn60Pb40	172.1

The component type variants and range of magnetics components applicable to the linear CCM technology are as follows:

Variant Number	Type	Design Domain	Electrical Characteristics	Total Power Max (W)	No. of Terminals (3)	Terminal Finish (4)	Weight Max (g)
01	CCM4	Note 1	Note 2	≤ 18	12	Sn60Pb40	5.1
02	CCM5	Note 1	Note 2	≤ 40	16	Sn60Pb40	7.4
03	CCM6	Note 1	Note 2	≤ 50	16	Sn60Pb40	12.1
04	CCM20	Note 1	Note 2	≤ 120	16	Sn60Pb40	21.4
05	CCM25	Note 1	Note 2	≤ 150	20	Sn60Pb40	44.2

NOTE 1

The design domain for components produced in accordance with these specifications includes the following items:

- Development of customized electrical functions:
  - Single or multi-coupled inductors
  - Common mode chokes
  - Power transformers (flyback, forward, push-pull, half/full bridge, specific architectures)
  - Signal transformers
  - Pulse transformers
  - Current/voltage measurement transformers
  - Specific magnetic functions within environment and thermal requirements
- Temperature range: -55°C +125°C

- Power, losses, and component heating:

    - Maximum power depends on component heating. The heating is calculated from losses and thermal resistances for each Variant according to the electrical function. The thermal resistances are given in Maximum Rating.
    - The maximum temperature rise at Tamb = +100°C is +25°C.
    - Examples of maximum power per Variant are given above.

- Dielectric strength:

    - Single insulation: 500Vrms
    - Reinforced insulation for CCM technology: 1000Vrms

NOTE 2

All electrical characteristics applicable to a particular component design are specified in the document: Specific Component Design Sheet provided by the manufacturer.

5.4.1.4 Technology Flow abstract

General features

The Technology Flow covers the design, manufacturing, assembly, in-process inspection, screening and testing of custom magnetic components at Exxelia, Illange, France.

These SMD inductors, chokes and transformers use toroidal winding (TO technlogy) or linear winding (CCM technology) assembled on a lead frame and molded with epoxy resin.

Basic information

Leads: Brass with copper layer and SnPb finish

Molding: Epoxy resin

Wire: 180 °C magnet wire

Magnetic core: Chosen during design phase to meet customer requirements

Formats component types: See Details specifications 3201/011 and 3201/012

5.4.1.5 Technology Flow definition

1. **Design**

The magnetic components are designed according to design rules and following a design process both described in the Exxelia documents PID 100 and PID 101.

The design rules ensure maximum operating temperature below 125°C and dielectric strength

2. **Manufacturing process**

The manufacturing process is described in the documents PID 100 (TO technology) and PID 101 (CCM technology)

Process summary:

- Toroidal winding for TO technology
- Linear winding for CCM technology
- High temperature soldering on the lead frame
- Transfer molding
- Magnetic core assembly for CCM technology
- Leads forming
-

3. **Control and testing**
The control and test are performed in Exxelia Illange.

They are performed according to the document Specific Component Design Sheet and the generic ESCC specification 3201 and the ESCC detail specification 3201/011 and 3201/012.

4. **Radiation characteristics**
TO and CCM magnetics components are not sensitive to radiations.

5.4.1.6 Manufacturing site

Exxelia 16 Parc d'Activités du Beau Vallon F57970 Illange France