



## **ESCC QUALIFIED MANUFACTURERS LIST (QML)**

**ESCC/RP/QML006-19**

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### DOCUMENTATION CHANGE NOTICE

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

DCR No.	CHANGE DESCRIPTION
1269	<p><b>Removed certificates:</b> 312B rev1, Microchip Technology 342 rev1, Microchip Technology</p> <p><b>New certificates:</b> 357, Microchip Technology Integrated Circuits based on ATC18RHA ASIC family. Certificate 357 supersedes previous certificate 312B Rev1. New certificate reflects significant changes in the supply chain. 359, Microchip Technology Integrated Circuits based on ATMX150RHA ASIC family. Certificate 359 supersedes previous certificate 342 Rev1. New certificate reflects significant changes in the supply chain.</p>

## 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.

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**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 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	357
	Digital C-MOS: ATMX150RHA	Microchip Technology Nantes	359
10 Resistors	Chip	Vishay SA, Sfernice	287F
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	<p>Process flow NORSF-C1 on purchased SAW-grade surface polished wafers.</p> <p><u>Wafer materials:</u> Quartz (SiO<sub>2</sub>), Lithium niobate (LiNbO<sub>3</sub>), Lithium tantalate (LiTaO<sub>3</sub>), Langasite (La<sub>3</sub>Ga<sub>5</sub>SiO<sub>14</sub>)</p> <p><u>Wafer dimensions:</u> 3" diameter 0.5 mm thick 3" diameter 1.0 mm thick 4" diameter 1.5 mm thick</p>
Assembly	<p>Process flow NORSF-A1.</p> <p>Crystal dimensions: from 1.7 mm x 3.1 mm up to 8 mm x 76 mm.</p> <p>Packages:</p> <ul style="list-style-type: none"> <li>-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 <u>Package dimensions:</u> From 8 mm x 8 mm up to 85 mm x 12 mm.</li> <li>-Gold plated Fe-Ni-Co-alloy flat packs with Cu-W base, 4 or 6 leads and ceramic feedthroughs. <u>Package dimensions:</u> From 11 mm x 11 mm up to 7 mm x 21 mm.</li> <li>-Gold plated ceramic Leadless Chip Carrier (LCC) package, 10 solder pads. <u>Package dimension:</u> 5 mm x 7 mm.</li> </ul>

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

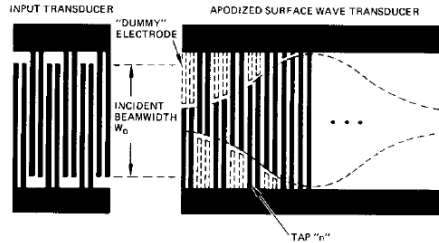
5.1.1.5 Technology Flow definition

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.

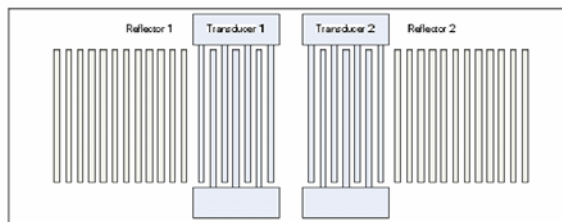
**Transversal band pass SAW filters**

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 1/4 wide etched grooves or metal fingers. The same software is used for simulation of the transducers and reflectors.

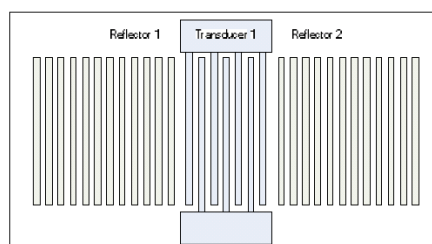


### SAW Notch filters

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, LiNbO<sub>3</sub>, LiTaO<sub>3</sub> and La<sub>3</sub>Ga<sub>5</sub>SiO<sub>14</sub> (langasite)
- Externally purchased SAW wafers
- SAW wafer thickness between 0.5 mm and 1.5 mm
- Photolithography with line widths down to 0.3 μm. 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. N <sub>2</sub> 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 LiNbO<sub>3</sub>, LiTaO<sub>3</sub> and Langasite.

Qualified wafer materials: Quartz, LiNbO<sub>3</sub>. LiTaO<sub>3</sub>, Langasite (La<sub>3</sub>Ga<sub>5</sub>SiO<sub>14</sub>)

5.2 MICROCIRCUITS (08)

5.2.1 MICROCHIP ATMEL, France: ATC18RHA

5.2.1.1 Contact Information

Address	ESCC Chief Inspector
Microchip Technology Nantes 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
357	May 2019	Integrated Circuits, Silicon, Monolithic, CMOS, Cell-Based Array, based on Type ATC18RHA

Certificate 357 supersedes previous certificate 312B Rev1. New certificate reflects significant changes in the supply chain.

Applicable documents:

ESCC Generic Specification No. [9000](#); ESCC Detail Specification No. [9202/080](#)

ATC18RHA Process Identification Document PID 0032 Rev D, MMT assembly PID 1G-QM-0105 and HCM columns manufacturing and assembly PID 11 issue E.

5.2.1.3 List of Qualified Components

For each ASIC design an ASIC Sheet is produced by Microchip 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
<a href="#">9512/004</a>	Integrated Circuits, Silicon, 32-bit SPARC Processor, based on Type AT697F
<a href="#">9304/165</a>	Integrated Circuits, Silicon, monolithic, CMOS digital, Field Programmable Gate Array, 280000 gates, based on type ATF280F

#### 5.2.1.4 Technology Flow Abstract

##### **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 M gates 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 mm<sup>2</sup>
- Periphery power supply 3.3V and 2.5V
- 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 :
  - No Single Event Latch-Up below a LET Threshold of 80 MeV/mg/cm<sup>2</sup> at high temperature
  - SEU hardened DFF's to 30 MeV/mg/cm<sup>2</sup>
  - Tested up to 300 krad (Si), Radiation Level is 100 krad (Si).

**Component Types**

Device Types as per ESCC Detail Specification 9202/080 and individual custom ESCC ASIC Sheets.

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	CQFP-F256	1M
ATC18RHA_216	2.5V or 3.3V/1.8V	216	CQFP-F196	1M
ATC18RHA_216	2.5V or 3.3V/1.8V	216	CQFP-F160	1M
AT697F	3.3V/1.8V		CQFP-F256	0.85M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CQFP-T352	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F256	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F196	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F160	2.2 M
ATC18RHA_324	2.5V or 3.3V/1.8V	324	CLGA-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	CQFP-T352	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	CQFP-F256	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	CLGA-472	3.5 M
ATC18RHA_404	2.5V or 3.3V/1.8V	404	CLGA-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	CQFP-T352	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CQFP-F256	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CLGA-625	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CLGA-472	5.5 M
ATC18RHA_504	2.5V or 3.3V/1.8V	504	CLGA-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	CLGA-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 the design in the Microchip Technology Nantes associated Design Centers (Nantes-France, Milan-Italy, Garching-Germany and Winnersh-UK).

- 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 0.18 $\mu$ m CMOS, 6 metal, Ti, TiN and AlCu process.

##### 3. **Assembly**

The assembly of ATC18RHA devices is performed in MMT, Thailand, with the following capabilities:

- Die attach Cyanate Ester (JM7000)
- Wire bond Ultrasonic Wedge, 25 and 32  $\mu$ m Al
- Lid sealing Brazed with Au/Sn alloy or seam welded
- Leads/pads Gold plated (CQFP and CLGA)

The assembly of columns is performed in SERMA HCM, La Rochelle, with the following capabilities:

- Columns 85Pb15Sn with Tinned Copper ribbon, 0.38 mm diameter

##### 4. **Control and Test**

The control and test of ATC18RHA devices is performed in Microchip technology 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 CQFP 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 CQFP 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:

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

#### 5.2.1.6 Manufacturing sites

##### **Design:**

Microchip Technology Nantes, BP70602, 44306 Nantes Cedex 3, France

##### **Wafer Fabrication:**

UMC Fab 8S, Hsin-Chu, Taiwan

##### **Die Assembly:**

MMT, Microchip Technology (Thailand) Co., Ltd. 17/2 Moo 18 Suwintawong Road, Saladang, Bangnumpruiw Chachoengsao, Thailand 24000

##### **CCGA column assembly:**

HCM SYSTREL, 34 Av. Joliot Curie, ZI Perigny, 17185 Perigny Cedex, France

##### **Control and Test:**

Microchip Technology 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 Technology 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
359	May 2019	Integrated Circuits, Silicon, Monolithic, CMOS, Cell-Based Array, based on Type ATMX150RHA – Ph2 Digital only 22 M gates 5ML + Thick Metal MMT assy

Certificate 359 supersedes previous certificate 342 Rev1. New certificate reflects significant changes in the supply chain.

**Applicable documents:**

ESCC Generic Specification No. [9000](#); ESCC Detail Specification No. [9202/083](#)

Microchip Process Identification Document PID 37 Rev D, MMT PID 1G-QM-0105, HCM columns manufacturing and assembly PID 11 issue E.

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 standard cells family is designed with a 0.15µm radiation-hardened CMOS technology. This offer is based on a 5 metal layers with an optional 6th thick metal layer technology,

dedicated for large ASIC's to avoid voltage drop issues. The core is supplied at 1.8V +/-0.15V and the periphery at 3.3V +/-0.3V or 2.5V +/- 0.2V. This family features arrays with up to 22 M gates and more than 700 pads. With its high-speed performance, its low supply current and its radiation hardening level, the ATMX150RHA is suitable for digital applications working in radiation intensive environment.

**Basic information**

- CMOS technology AT77K9RHA
- 40 to 70 kgates per mm<sup>2</sup>
- Periphery power supply 3.3V and 2.5V
- Core power supply 1.8V
- Low supply current: Operating maximum value: 8.8 nA/gate/MHz with a duty cycle at 20%
- I/O Interfaces:
  - Cold sparing
  - High speed LVDS (655 Mps) and LVPECL
  - PCI
- 704 pads (+ 8 pads power only)
- Compiled memory cells (ROM, SRAM, DPRAM, register files)
- Radiation:
  - No Single Event Latchup to a LET threshold of 67.7 MeV.cm<sup>2</sup>/mg, and up to 78. 2 MeV.cm<sup>2</sup>/mg, 30°-tilted at high temperature.
  - SEU Hardened DFF's to 18 MeV/mg/ cm<sup>2</sup>
  - TID Radiation Capability of 100 kRads (Si).

**Component Types**

Device Types as per ESCC Detail Specification [9202/083](#) and individual custom ESCC ASIC Sheets:

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	CQFP-F256	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	CQFP-F196	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	CQFP-F160	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	CQFP-F132	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	CLGA-349	1M
ATMX150RHA_216	2.5V or 3.3V/1.8V	216	CCGA-349	1M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CQFP-T352	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F256	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F196	2.2 M

Die	Supply Voltage I/O / core	Max programmable I/O's	Case	Typical Routable gates
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F160	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CQFP-F132	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CLGA-472	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CLGA-349	2.2 M
ATMX150RHA_324	2.5V or 3.3V/1.8V	324	CCGA-472	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	CQFP-T352	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CQFP-F256	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CQFP-F196	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CLGA-625	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CLGA-472	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CLGA-349	3.5 M
ATMX150RHA_404	2.5V or 3.3V/1.8V	404	CCGA-625	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	CQFP-T352	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CQFP-F256	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CLGA-625	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CLGA-472	5.5 M
ATMX150RHA_504	2.5V or 3.3V/1.8V	504	CLGA-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	CQFP-T352	6.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CQFP-F256	6.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CLGA-625	6.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CLGA-472	6.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CCGA-625	6.5 M
ATMX150RHA_544	2.5V or 3.3V/1.8V	544	CCGA-472	6.5 M
ATMX150RHA_604	2.5V or 3.3V/1.8V	604	CQFP-T352	7.5 M
ATMX150RHA_604	2.5V or 3.3V/1.8V	604	CLGA-896	7.5 M
ATMX150RHA_604	2.5V or 3.3V/1.8V	604	CLGA-625	7.5 M
ATMX150RHA_604	2.5V or 3.3V/1.8V	604	CCGA-896	7.5 M
ATMX150RHA_604	2.5V or 3.3V/1.8V	604	CCGA-625	7.5 M
ATMX150RHA_644	2.5V or 3.3V/1.8V	644	CQFP-T352	8.7 M
ATMX150RHA_644	2.5V or 3.3V/1.8V	644	CLGA-896	8.7 M
ATMX150RHA_644	2.5V or 3.3V/1.8V	644	CLGA-625	8.7 M
ATMX150RHA_644	2.5V or 3.3V/1.8V	644	CCGA-896	8.7 M
ATMX150RHA_644	2.5V or 3.3V/1.8V	644	CCGA-625	8.7 M
ATMX150RHA_704	2.5V or 3.3V/1.8V	704	CQFP-T352	10.4 M
ATMX150RHA_704	2.5V or 3.3V/1.8V	704	CLGA-896	10.4 M
ATMX150RHA_704	2.5V or 3.3V/1.8V	704	CLGA-625	10.4 M
ATMX150RHA_704	2.5V or 3.3V/1.8V	704	CCGA-896	10.4 M
ATMX150RHA_704	2.5V or 3.3V/1.8V	704	CCGA-625	10.4 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 Microchip Technology Nantes associated Design Centers (Nantes and Rousset-France, Milan-Italy, Garching-Germany and Winnersh-UK).

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  $\mu\text{m}$  CMOS, 5-metal with an optional 6th thick metal, Ti, TiN and AlCu process.

#### 3. **Assembly**

The assembly of ATC18RHA devices is performed in MMT, Thailand, with the following capabilities:

- Die attach Cyanate Ester (JM7000)
- Wire bond Ultrasonic Wedge, 25 and 32  $\mu\text{m}$  Al
- Lid sealing Brazed with Au/Sn alloy or seam welded
- Leads/pads Gold plated (CQFP and CLGA)

Both Multi-decks and Flat-substrate package options are available. For details, see the ESCC Detail Specification [9202/083](#).

The assembly of columns on CLGA is performed in SERMA HCM, La Rochelle, with the following capabilities:

- Columns 85Pb15Sn with Tinned Copper ribbon, 0.38 mm diameter

#### 4. **Control & Test**

The control and test of ATMX150RHA devices is performed in Microchip Technology 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**

##### **002NY test vehicle**

The 002NY is a buffer test vehicle representative of the range of buffers available for performance testing in the CQFP-352 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.

##### **002OP test Vehicle – Technology SEC**

The 002OP SEC is developed for radiation testing, process stability, reliability monitoring and performance characterization, it is assembled in the CQFP-352 package. It contains a set of memory blocks (compiled memories with and without EDACs), shift registers chains, high speed LVDS, PCI buffers and a PLL. It uses the thick-metal layer option.

##### **002MS test Vehicle – Technology SEC**

The 002MS has the same characteristics than the 002OP, without the thick-metal layer option. 002MS will be embarked on MPW (Multi-Project Wafer) instead of 002OP when MPW ASIC's do not need thick metal layer. When so, 002MS shall be used for reliability quarterly monitoring.

#### 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 to a LET threshold of 67.7 MeV.cm<sup>2</sup>/mg, and up to 78.2 MeV.cm<sup>2</sup>/mg, 30° tilted at high temperature.
- Availability of SEU hardened cells.

##### 5.2.2.6 Manufacturing sites

###### **Design:**

Microchip Technology Nantes, BP70602, 44306 Nantes Cedex 3, France

###### **Wafer Fabrication:**

UMC Fab 8S, Hsin-Chu, Taiwan

###### **Die Assembly:**

MMT, Microchip Technology (Thailand) Co., Ltd. 17/2 Moo 18 Suwintawong Road, Saladang, Bangnumpriew Chachoengsao, Thailand 24000

###### **CCGA column assembly:**

HCM SYSTREL, 34 Av. Joliot Curie, ZI Perigny, 17185 Perigny Cedex, France

###### **Control and Test:**

Microchip Technology Nantes, BP70602, 44306 Nantes Cedex 3, France

5.3 RESISTORS (08)

5.3.1 VISHAY S.A. France: 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: <a href="mailto:laurent.cresson@vishay.com">laurent.cresson@vishay.com</a>

5.3.1.2 Qualification

Current Qualification Certificate No.	In QML since:	Type Designation
287F	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 <sup>-6</sup> /°C) (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 ( $\Omega$ )	Available Tolerances ( $\pm\%$ )	Series
$10 \leq R < 50$	0.1	Any value in the resistance range
$50 \leq R < 100$	0.05 and 0.1	
$100 \leq R < 250$	0.02; 0.05 and 0.1	
$R \geq 250$	0.01; 0.02; 0.05 and 0.1	

Resistance ( $\Omega$ )	Temperature Coefficient (ppm/ $^{\circ}\text{C}$ )	Series
$10 \leq R < 20$	E: 25 (-55 $^{\circ}\text{C}$ ; +155 $^{\circ}\text{C}$ )	Any value in the resistance range
$20 \leq R < 50$	Y: 10 (-55 $^{\circ}\text{C}$ ; +155 $^{\circ}\text{C}$ )	
$20 \leq R < 50$	Z: 5 (+22 $^{\circ}\text{C}$ ; +70 $^{\circ}\text{C}$ )	
$R \geq 50$	C: 5 (-55 $^{\circ}\text{C}$ ; +155 $^{\circ}\text{C}$ )	

**Type PFRR:**

Detail Specification	Style	Critical R (k $\Omega$ )	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 ( $\Omega$ )	Tolerance ( $\pm\%$ )	Temperature Coefficient TC( $\pm 10^{-6}$ / $^{\circ}\text{C}$ )
0402; 0603; 0805; 1206; 2010	From 100 to $\leq 100\text{K}$	0.05; 0.1	10; 25
0603; 0805; 1206; 2010	From 100 to $\leq 261\text{K}$	0.05; 0.1	10; 25
0805; 1206; 2010	From 261K to $\leq 301\text{K}$	0.05; 0.1	10; 25
1206; 2010	From 301K to $\leq 1\text{M}$	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	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](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, Règles d'implémentation, Performances)

Critical design characteristics:

- Minimum metal width: 10  $\mu\text{m}$
- Power dissipation lower than 250mW/mm<sup>2</sup>
- Current density lower than 7000 A/mm<sup>2</sup>
- Electrical field lower than 5V/  $\mu\text{m}$

#### 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: <a href="mailto:dominique.martin@exxelia.com">dominique.martin@exxelia.com</a>

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  $T_{amb} = +100^{\circ}\text{C}$  is  $+25^{\circ}\text{C}$ .
  - 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 technology) 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