Introduction of JAXA Qualified Passive Components and Their Qualification Requirement in Compasiron with ESCC Qualification Requirement

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Japan Aerospace Exploration Agency

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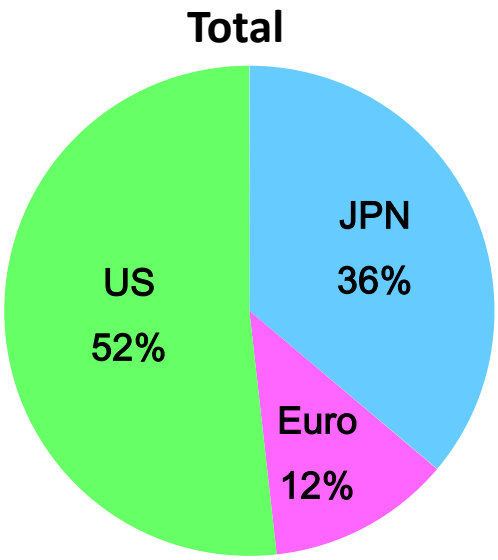
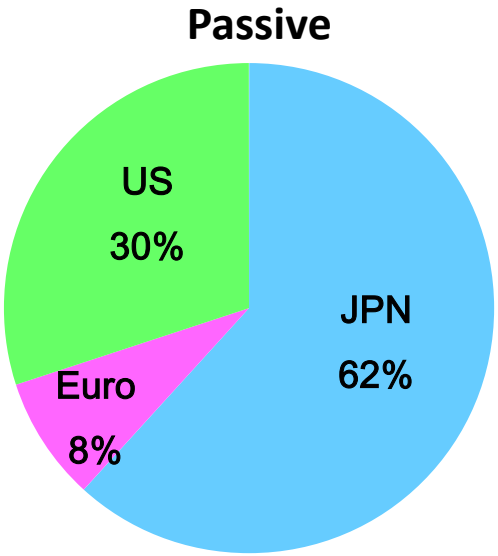
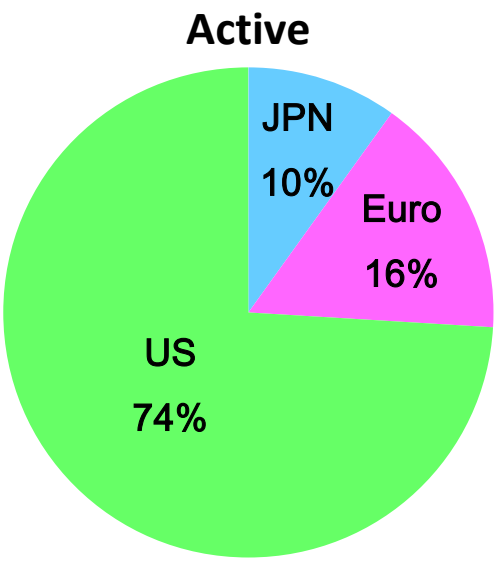
Contents

0. Components used in JAXA projects

While most of active components are imported, around 60 % of passive components come from domestic manufacturers







Calculated in terms of component type

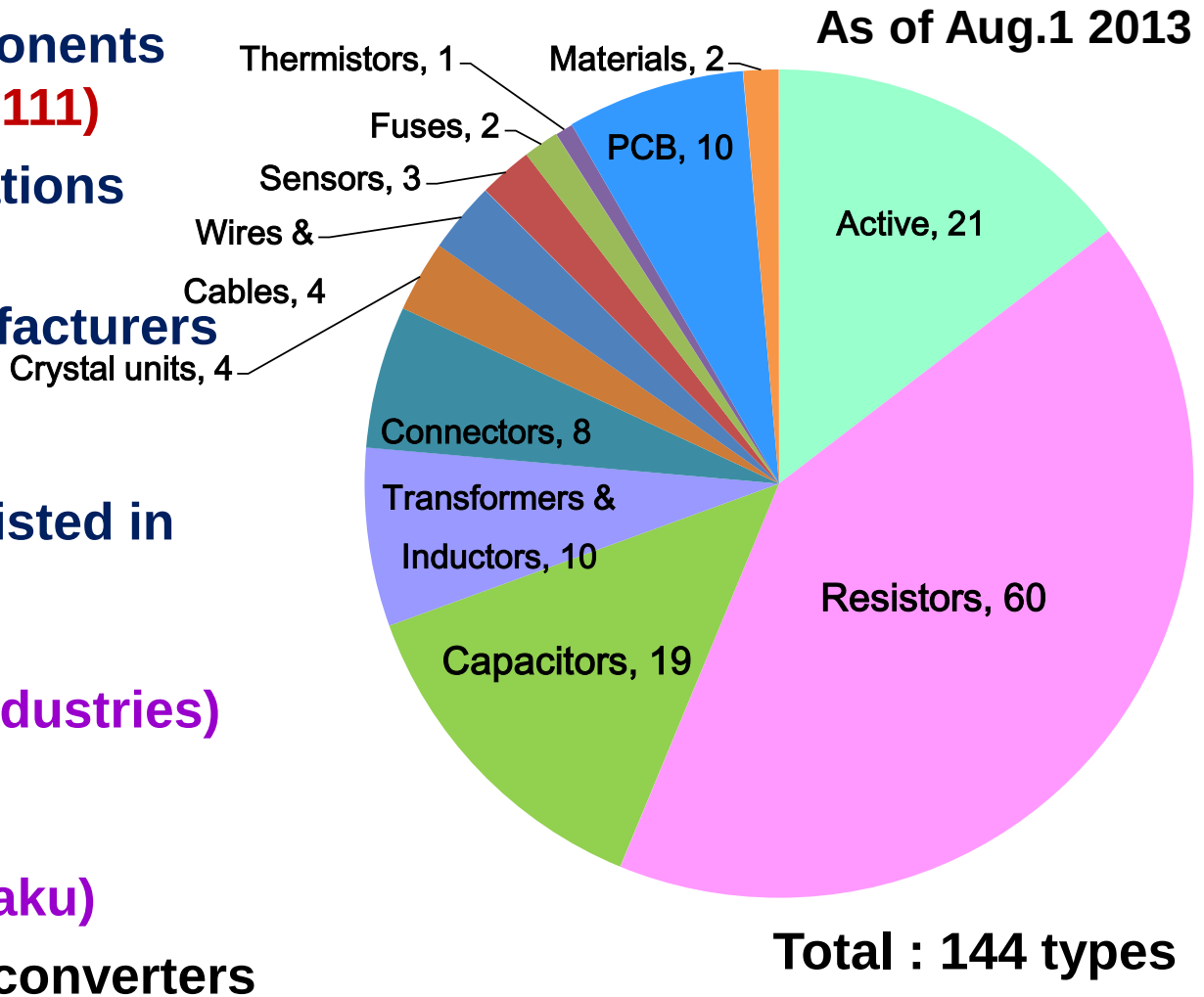
- **70 - 80 % of capacitors are domestic components**
- **70 % of resistors are domestic components**

1. JAXA qualified passive components
-- Overall statistics (1/2)

- **No. of qualified components**
  144 types (passive : 111)
- **No. of detail specifications**
  82 (passive : 55)
- **No. of qualified manufacturers**
  27 (passive : 15)

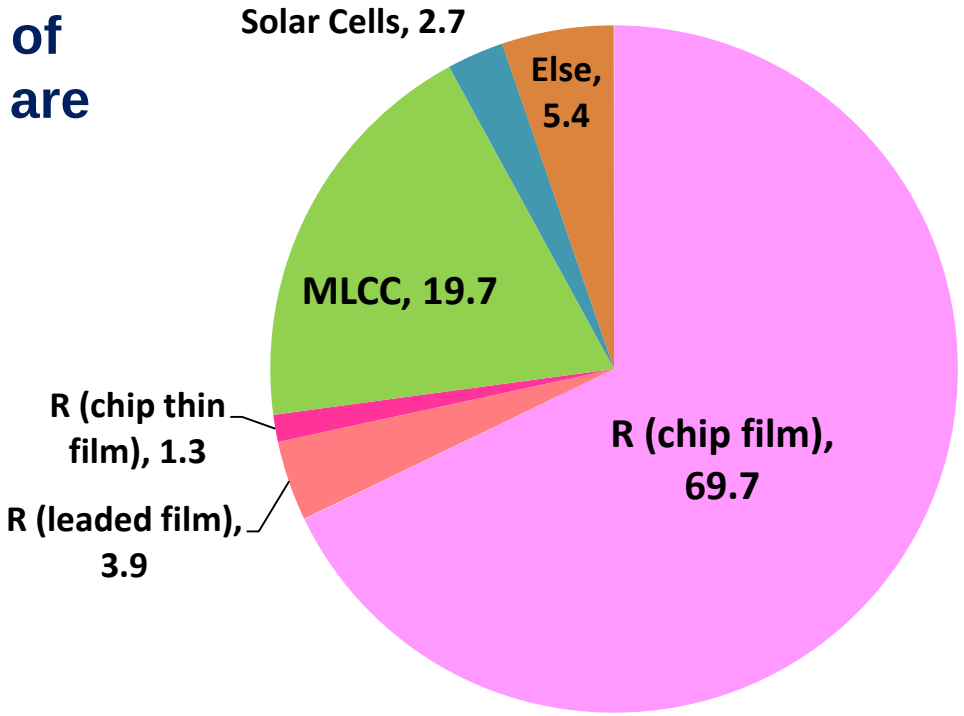
5 component types are listed in EPPL

- **Temperature sensors (Mitsubishi Heavy Industries)**
- **Thermistor (Tateyama Kagaku)**
- **Fuses (Tateyama Kagaku)**
- **Point-of-Load DC/DC converters**
- **Power MOSFETs**



1. JAXA qualified passive components
-- Overall statistics (2/2)

- More than 90 % of shipment of JAXA qualified components are passive components
  - 76 % -- resistors
  - 20 % -- capacitors



No. of shipment of JAXA qualified comps. (%)

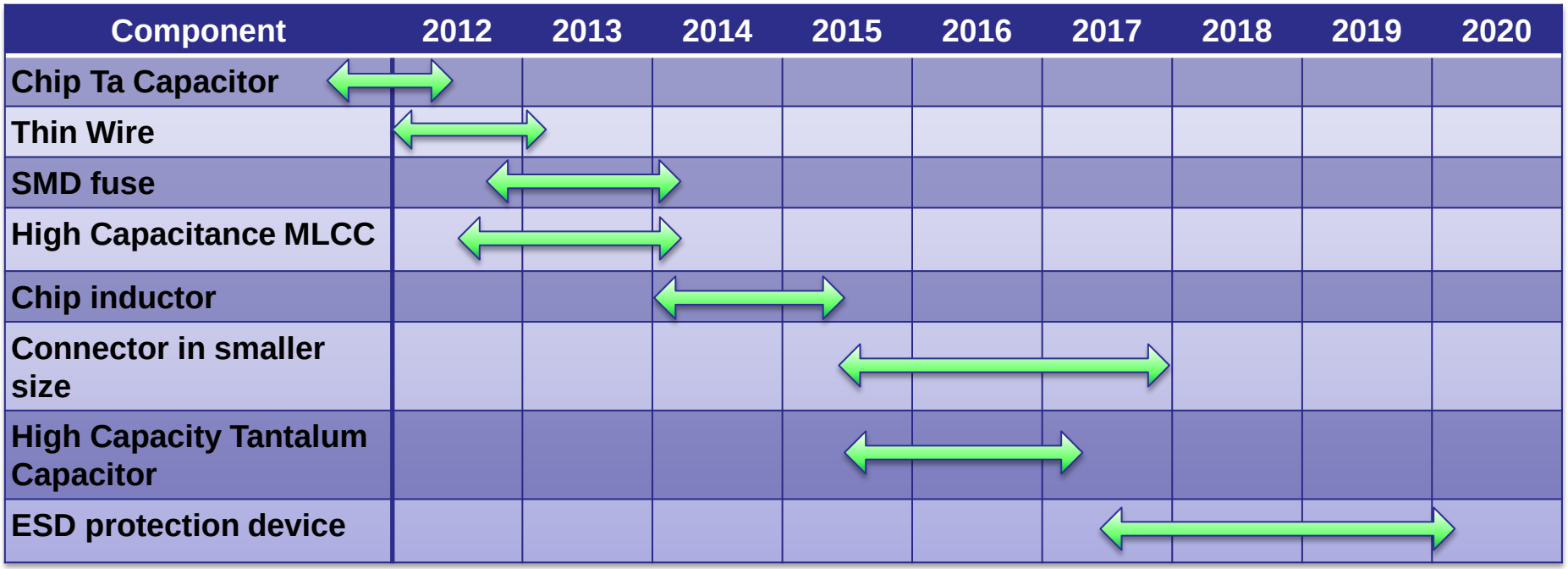
- Market size of JAXA qualified components in 2012 is roughly 3 billion ¥ (23 M€)
- Roughly 40 % of them are for passive components

1. JAXA qualified passive components
-- Lineup of JAXA qualified passive components

Comp. family	Description	Detail spec.	Manufacturer
Capacitors	Mica	4	Soshin Electric
	MLCC	3	Murata
	Chip, Solid, Electrolytic, Tantalum	1	Matsuo Electric
Resistors	Chip, Thick Film	3	Tateyama Kagaku
			Hokuriku Electric
	Wire-Wound (Power Type)	3	Seiden Techno
			Tama Electric
	Film	5	Tama Electric
	Networks, Film	2	Tama Electric
	Chip, Thin Film	1	Tama Electric
Thermistors	Chip, Negative Temperature Coefficient	1	Tateyama Kagaku
Fuses	Subminiature, Current-Limiting	1	Tateyama Kagaku
Temp. Sensors	Platinum	3	MHI*
Osc. Crystals	Quartz Crystal Units	4	Nihon Dempa Kogyo
Transformers and Inductors	Power	3	Tamura
	Others	7	Tamura
Wires and Cables	Fluoroplastic, Polyimide Insulated Wires	4	Hitachi Metals
	Differential Transmission Cables	2	Junkosha
Connectors	Rectangular, Miniature	2	JAE**
			Nihon Maruko
	Rectangular, Miniature, High Density	2	JAE**
			Nihon Maruko
	Rectangular, Microminiature	1	JAE**
	Rectangular Miniature Mixed	1	JAE**
	Coaxial, RF	2	Waka Manufacturing

* MHI=Mitsubishi Heavy Industries ** JAE=Japan Aviation Electonics Industry

1. JAXA qualified passive components
-- Recent / future development in JAXA



- **For most cases JAXA qualified passive components are developed by manufacturers themselves, based on commercial technology**
  - → Rather small development activity in JAXA with shorter develoment period (a few years)
- **Future development plan has not been confirmed yet**

2. JAXA qualification system
-- Qualification method

ESCC qualification system

- Component Qual. ⇨
- Technology Flow Qual. ⇨
- Capability Approval ⇨

<total>

36 manuf., 122 certificates
(reported for 2012)

JAXA qualification system

- QPL (4 manuf. 35 comp.)
- QML (24 manuf. 109 comp.)
- ---

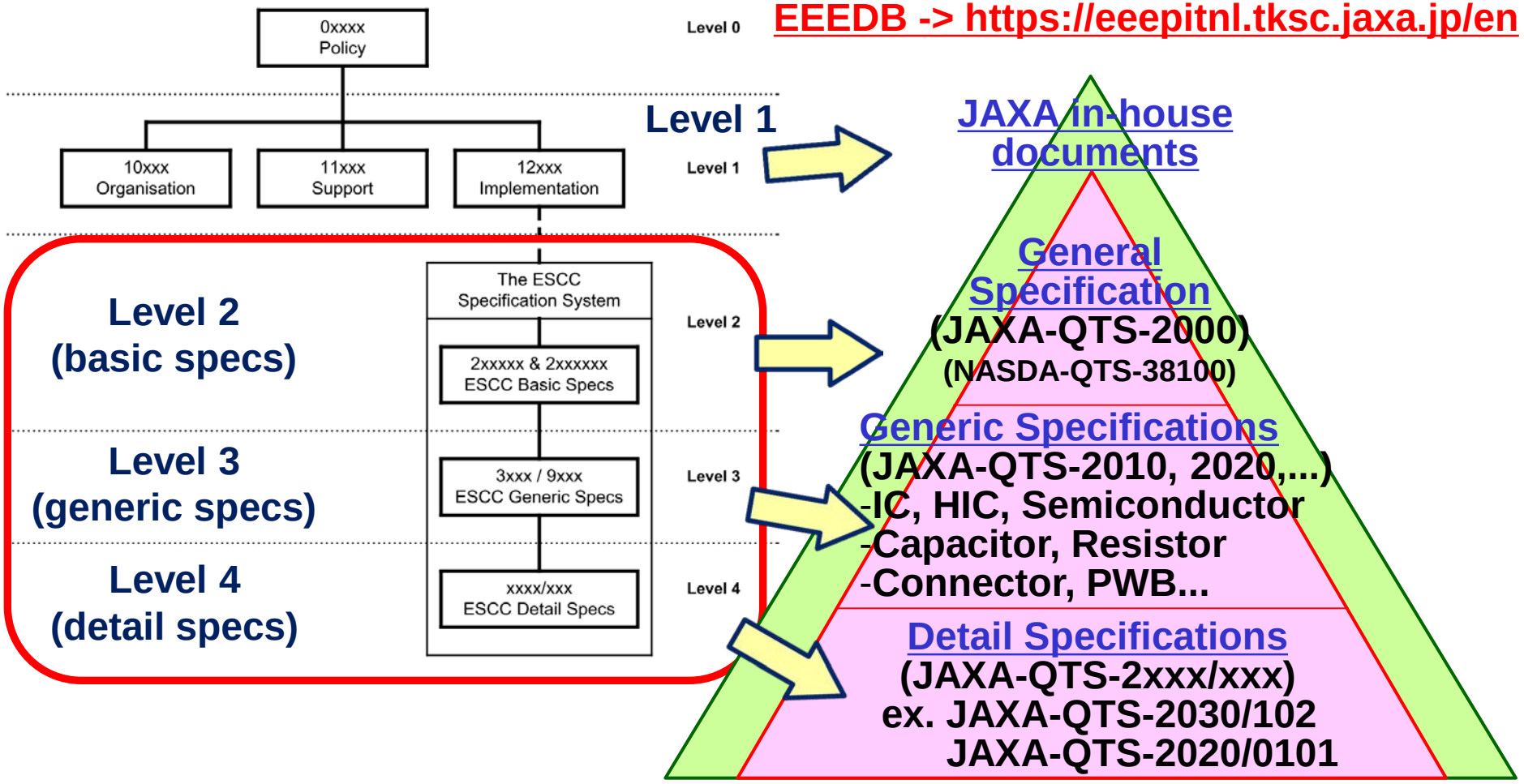
<as of Aug.1, 2013>

JAXA is considering maintaining only QML system in the future

2. JAXA qualification system
-- QPL vs QML (vs ESCC)

	JAXA-QPL (NASDA-QTS-38100) <ESCC Comp. Qual.> ESCC20100	JAXA-QML (JAXA-QTS-2000) <ESCC Tech. Flow Qual.> ESCC25400
Subject	Parts <same as JAXA system>	Manufacturing line <manufacturing technology>
Effective period	1 year <2 years>	3 years <2 years>
Manufacturing line	Dedicated lines for space parts <commercial lines may be used>	Commercial lines may be used <same as JAXA system>
Change control of QA program	Review and approval by JAXA <same as JAXA system>	Decision can be made by TRB (shall be reported to JAXA) <same as JAXA system>
Test optimisation	-Restricted -Review and approval by JAXA <same as JAXA system>	-Decision can be made by TRB (shall be reported to JAXA) -Change must be described with rationale in the detail spec. <same as JAXA system>

2. JAXA qualification system
-- Document tree



- Same document tree from Level 2 to Level 4
- Only 2 documents on Level 2 in JAXA system (each for QML and QPL)
- Generic specifications are aimed to be used for qualified components
- There is no specification for test method in JAXA system

3. Requirement of JAXA qualification system -- JAXA-QTS-2000 vs ESCC documents (1/2)

JAXA-QTS-2000 Common Parts / Materials, Space Use, General Specification for	ESCC (No. 20000, 20100 / 25400)
1. General	
2. Applicable Documents	
3. Requirements 3.1 General Requirements 3.2 Detail Requirements 3.3 Requirements for a Quality Assurance Program (QA program plan, QA manager, Registered Inspector, and TRB) 3.4 QML Certification Requirements (Initial qual., retention of qual., requalification, certification and de-certification) 3.5 Part Number and Marking 3.6 Nonconformance	 20200, 22600, 22700 20100 / 25400 21700 22800
4. Quality Assurance Provisions 4.1 Implementation of Quality Assurance Program 4.2 Change Control for the Quality Assurance Program 4.3 Requirements for Tests and Inspections (QT, in-process inspection, QCI, products stored for long term) 4.4 Changes to Tests and Inspections	20100 / 25400

3. Requirement of JAXA qualification system -- JAXA-QTS-2000 vs ESCC documents (2/2)

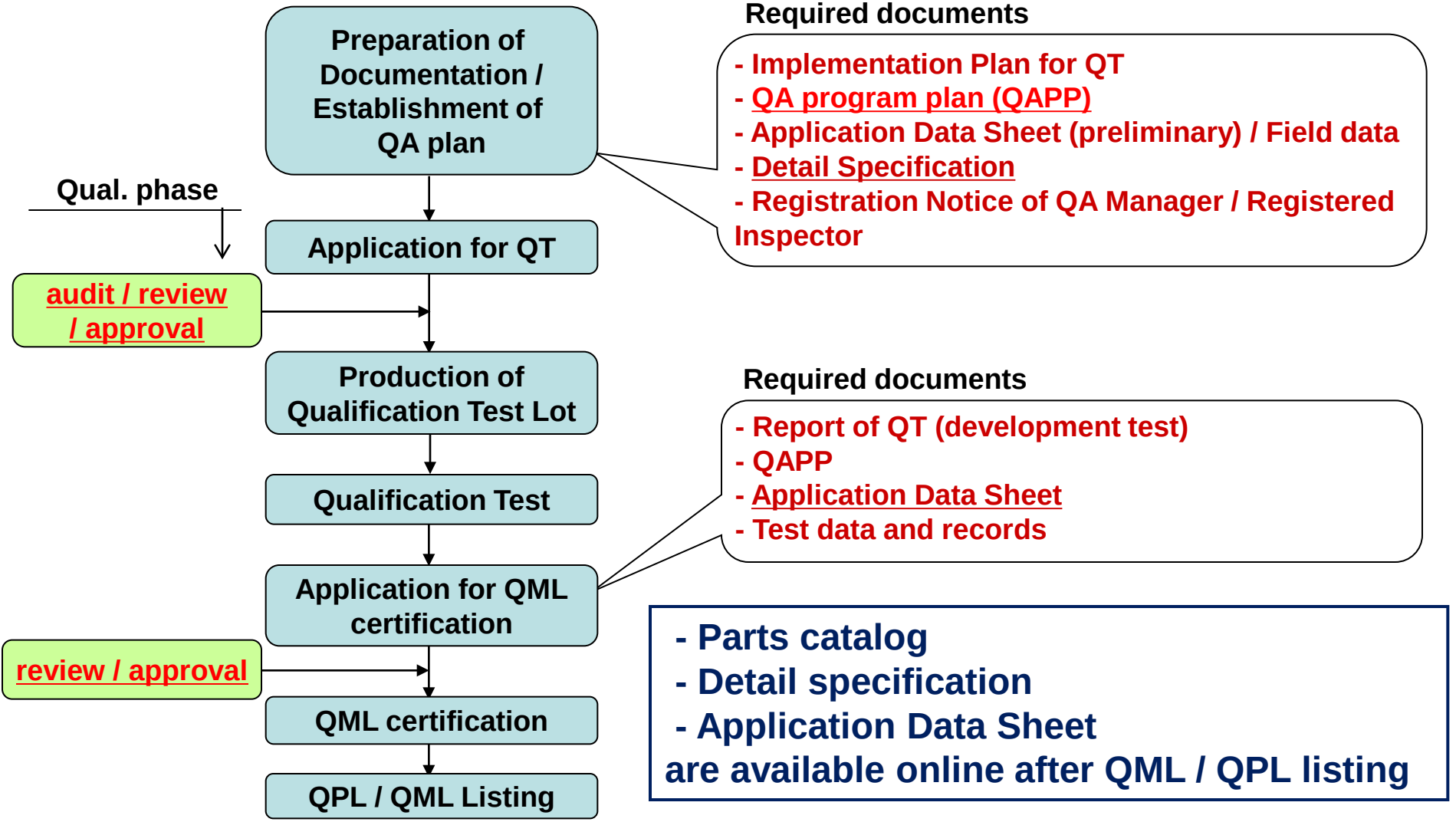
5. Preparation for Delivery	20600
6. Control of Applicable Specifications 6.1 Establishment and Revision of Detail Specifications 6.2 Changes 6.3 Cancellation of Applicable Specification 6.4 Registration Publication	20800
7. Terminology	21300
Appendix Appx A Preparation of Applicable Specifications Appx C Requirements for Quality Assurance Program Appx D Quality Assurance Manager and Registered Inspector Appx E Certification Procedure Appx F Application Form and Procedures Appx G Preparation of Application Data Sheet Appx H Supplementary Requirements for Tests and Inspections Appx K TRB Guidelines (Appendix B and J are cancelled)	 20800, 21700 21500, 22700, 24600, 24900 20100 / 25400 ESCIES 25400

Both systems are based on ISO 9001
Overall requiments are the same in both qualification systems

3. Requirement of JAXA qualification system -- Requirement of JAXA-QTS-2000

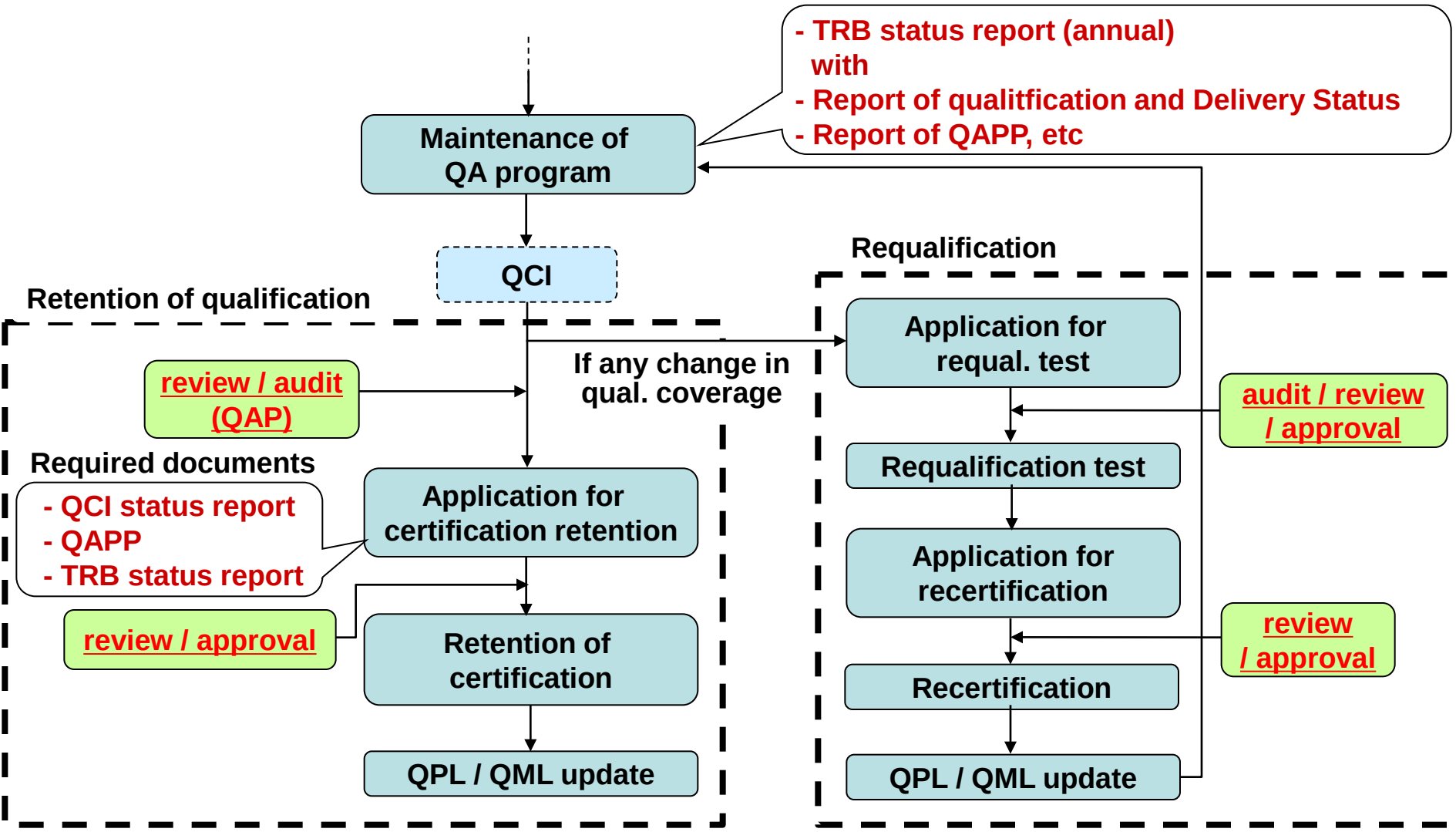
- **Establishment and maintenance of a Quality Assurance Program (QAP)**
- **Establishment and operation of TRB**
- **Requirement for qualification**
  - Initial qualification / Retention of qualification / Requalification
- **Requirement for tests and inspections**
  - In-process inspections / Screening tests / Qualification tests / Quality conformance inspections
- **Test items**
  - Screening / Electrical performance / Mechanical performance / Environmental performance / Durability
- **Disposition of nonconformance**

3. Requirement of JAXA qualification system -- JAXA-QML initial qualification flow



Evaluation test is performed before QT, however it is out of the official procedure of qualification in JAXA system

3. Requirement of JAXA qualification system -- JAXA-QML MoQ / requalification flow



Certification is granted without performing QCI when there was no production during the effective certificaiton period

3. Requirement of JAXA qualification system -- Quality Assurance Program Plan

Quality Assurance Program Plan

Document to ensure that a manufacturer can continuously produce components / materials with a consistent quality

QAP plan = PID + Quality Management Plan (Technology Flow)

QAP plan	PID (Process Id. Doc.)
1. Scope	Section 1
2. Organizational structure	Section 2, QM plan
3. Quality assurance system	Section 3
4. Applicable documents and standards constituting the quality assurance program	Section 5
5. Education and training	QM plan
6. Design control	-
7. Control of production processes	Section 3, QM plan
8. Management of production facilities	Section 6
9. Management system of measuring instruments	QM plan
10. Procurement management of materials	Section 5
11. Nonconformance disposition system	QM plan
12. Failure analyses and corrective actions	QM plan
13. Packaging, storage and delivery	-
14. Change control of quality assurance program	QM plan
15. Design and construction	Section 4
16. Formats and examples of completed formats	Section 3

Similar document is required and prepared in both systems

4. Generic specification of JAXA system
-- List of JAXA Generic Specifications

JAXA-QTS-2010	ICs <9xxx>	JAXA-QTS-2120	Wires & Cables <390x>
JAXA-QTS-2020	HICs <Q-60-05>	JAXA-QTS-2130	Solar Cells <E-20-08>
JAXA-QTS-2030	Semiconductor Devices <5xxx>	JAXA-QTS-2140	Printed Wiring Boards <Q-70-10>
JAXA-QTS-2040	Capacitors <30xx>	JAXA-QTS-2150	Latching Valves
JAXA-QTS-2050	Resistors <400x>	JAXA-QTS-2160	Thermistors <4006>
JAXA-QTS-2060	Connectors <340x>	-	Heaters <4009>
JAXA-QTS-2070	Crystal Units <350x>	JAXA-QTS-2180	Temp. Sensors, Platinum
JAXA-QTS-2080	Filters <310x>	JAXA-QTS-2190	Thermal Control Materials <Q-70>
-	Relays <360x>	JAXA-QTS-2200	Adhesive Materials <Q-70>
-	Switches <370x>		
JAXA-QTS-2110	Transformers & Coils <320x>	JAXA-QTS-2210	Fuses <4008>

Mechanical components, materials, solar cells and hybrids are included in JAXA system (they are covered by ECSS system, not in ESCC system)

JAXA Generic Specifications for passive comp.

JAXA-QTS-2040 (Capacitors)

Appx. A	Fixed, Ceramic Dielectric (Temp. Compensating)
B	Fixed, Ceramic Dielectric
C	Chip, Multiple Layer, Fixed Ceramic Dielectric
F	Fixed, Mica Dielectric
G	Fixed, Plastic Film
H	Fixed Electrolytic (Solid Electrolyte), Tantalum
J	Fixed, Electrolytic (Non-Solid Electrolyte), Tantalum
K	Chip, Solid, Electrolytic, Tantalum
L	Chip, Fixed, Fine Ceramic Dielectric (Temp. Stable and General Purpose)
M	Miniature, High-Capacity, Surface Mount, Fine Ceramic Dielectric

JAXA-QTS-2050 (Resistors)

Appx. A	Fixed, Film
B	Fixed, Film (Insulated Small)
D	Resistor Networks, Fixed, Film
E	Chip, Fixed, Film
F	Networks, Chip
G	Fixed, Wire Wound, Power Type
H	Fixed Wire Wound, Power Type, Chassis Mounted
J	Chip, Fixed, Metal Film

JAXA-QTS-2060 (Connectors)

Appx. B	Circular
C	Rectangular Miniature
D	Rectangular, Miniature, High Density
F	Accessories for Rectangular Connectors
G	Rectangular, Microminiature
H	Rectangular, Miniature, Composite

JAXA-QTS-2110 (Transformers & Inductors)

Appx. A	Inductors, Low Frequency, Transformers, Power And Low Frequency
B	Inductors, Power Transformers, Power (For Manned Missions)

JAXA-QTS-2080 (Filters)

Appx. A	Feed-Thru, LC Type

JAXA-QTS-2120 (Wires & Cables)

Appx. A	Coaxial Cables, Radio Frequency, Fluorine Resin Insulated
B	Wires, Electric, Fluorinated Ethylene Propylene (FEP) Insulated, Polyimide Covering
C	Wires, Electric, Fluorine Resin/Polyimide Insulated
D	Differential Transmission Cables

5. Test / Inspection requirement of JAXA system

Following tests / inspections are required to verify the functionality, performance and QA requirements of the components:

- In-Process Inspection
- Qualification Test (QT)
- Quality Conformance Inspection (QCI) <periodical>

Details are described in a generic specification and a detail specification

Next some slides give an overview of those tests / inspections with some example of Tantalum capacitors and others

Generic specification for Tantalum capacitors

JAXA-QTS-2040 Appendix K (ESCC 3012)

Appendex K : Chip, Solid, Electrolytic, Tantalum

5. Test / Inspection requirement of JAXA system -- In-process inspection

- General specification (JAXA-QTS-2000) requires the following in-process inspection
  - Internal visual inspection of semi-finished products (non-destructive, 100 % or sampled inspection)
  - Physical or chemical inspection of semi-finished products (destructive or non-destructive, 100 % or sampled inspection)
  - Characterization of semi-finished products (non-destructive, 100 % or sampled inspection)
- Detail shall be defined in the production process flow chart of the QAPP
- Specific inspections are required for some component family, which are decribed in the generic specification

ESCC: - Detail shall be defined in PID
- Requirement for special in-process controls in some generic specifications

5. Test / Inspection requirement of JAXA system -- In-process inspection <Examples>

Example of Ta capacitors

There is no additional requirement in in-process inspection in generic specification, however some in-process inspections are specified in the detail specification

JAXA-QTS-2040/K201

- **a) Anode weld strength**
- **b) Cathode adhesion strength**
- **c) Pre-seal internal visual inspection**
- **d) Plate acceptance inspection**

ESCC 3012: Outgassing requirement for non-metallic materials (special in-process control)

Example of fuses (JAXA-QTS-2210 / ESCC4008)

Following inspections are specified in generic specification:

Resistance, Pre-cap visual, Fusing characteristics, External visual

ESCC 4008 : Dimension, weight, cold resistance, resistance to soldering heat, fusion characterisation (special in-process control)

5. Test / Inspection requirement of JAXA system -- Qualification Test (QT)

- **QT consists of several test groups such as :**
  - **Basic and other charactristics (100 % or sampled)**
    Electrical characteristics, dimension, marking... etc.
  - **DPA**
  - **Environmental tests**
    Random vibration, shock, themal shock (~ 1000 cyc.), etc.
  - **Life test**
  - **Assembly / capability tests**
    Terminal strength, solderability, adhesion etc.
- **Tests in severe condition are required for most case such as :**
  - **Thermal shock up to 1000 cycles**
  - **Life test up to 4000 hr / 2000 hr**
  - **Random vibration**
  - **Shock up to 1500 G (depends on devices)**

5. Test / Inspection requirement of JAXA system -- QT <Example of Ta capacitors> (1/2)

Group	Test order	Test item	Pass/fail
I	1	Reflow conditioning	100 % (0)
	2	Thermal Shock	
	3	Surge current	
	4	Voltage aging	
	5	Leakage current	
	6	Capacitance	
	7	Dissipation factor (tan δ)	
	8	Equivalent series resistance	
	9	Externals, constructions, dimensions, mass and marking	
II	1	Radiography	100 % (0)
	2	DPA	3 (0)
III	1	High-frequency vibration	12 (0)
	2	Thermal shock (I)	
IV	1	Resistance to soldering heat	18 (0)
	2	Detach strength	
	3	Moisture resistance	

Covered in QT phase in ESCC 3012

Covered in final production tests or burn-in/electrical measurements in ESCC 3012

Covered in evaluation phase in ESCC 3012

Red letter : Different sample size

5. Test / Inspection requirement of JAXA system -- QT <Example of Ta capacitors> (2/2)

Group	Test order	Test item	Pass/fail
V	1	Stability at low and high temperatures	12 (0)
	2	Surge voltage	
VI	1	Life (+125 degC)	24 (0)
VII	1	Life (+85 degC)	206 (0)
VIII	1	Solderability	18 (0)
	2	Resistance to solvents	
IX	1	Random vibration	12 (0)
	2	Shock	
X	1	Thermal shock (II) (1000 cycles)	12 (0)
XI	1	Substrate bending	6 (0)
XII	1	Shear	6 (0)
XIII	1	Body strength	6 (0)
-	1	Materials	-

Covered in QT phase in ESCC 3012

Covered in final production tests or burn-in/electrical measurements in ESCC 3012

Covered in evaluation phase in ESCC 3012

Red letter : Different sample size

5. Test / Inspection requirement of JAXA system -- Quality Conformance Inspection (QCI)

➢ QCI consists of 3 groups

- Group A <for every production lot>

This test group plays a role of screening tests

Basic characteristic (100%), dimensions, DPA and some other tests

- Group B <for the first production of the certification period>

As far as certification is retained, tests in this group are perfermed every 3 years

Some characteristic tests, life test and environment tests

- Group C <when restarting the production>

Some environment tests and others

This inspection is not required as long as components are manufactured at least once in every effective period of certification

When there was no production during the certification period, no QCI is required just for the retention of certification. However Group A, B and C inspections have to be performed when restarting the production, which almost corresponds to performing full QT

QCI = LVT / LAT in ESCC system

5. Test / Inspection requirement of JAXA system -- QCI Grour A <Example of Ta capacitors>

Group A : Required for every production lot

SG	Test order	Test item	Pass/fail
A1	1	Radiography	100 % (-)
A2	1	Reflow conditioning	100 % (0)
	2	Thermal Shock	
	3	Surge current	
	4	Voltage aging	
	5	Leakage current	
	6	Capacitance	
	7	Dissipation factor (tan δ)	
	8	Equivalent series resistance	
A3	1	Externals, constructions, dimensions, mass and marking	100 % (0)
A4	1	DPA	3 (0)
A5	1	Stability at low and high temperatures	12 (0)
	2	Surge voltage	
A6	1	Solderability	18 (0)

Covered in LAT phase in ESCC 3012

Covered in final production tests or burn-in/electrical measurements in ESCC 3012

Covered in evaluation phase in ESCC 3012

Red letter : Different sample size

5. Test / Inspection requirement of JAXA system -- QCI Grour B / C <Example of Ta capacitors>

Group B : Required for every production lot

SG	Test order	Test item	Pass/fail
B1	1	Resistance to soldering heat	18 (0)
	2	Detach strength	
	3	Resistance to solvents	
	4	Moisture resistance	
B2	1	Life (+85 degC)	24 (0)
B3	1	Random vibration	6 (0)
	2	Shock	

Group C : When restarting the production

SG	Test order	Test item	Pass/fail
C1	1	High-frequency vibration	12 (0)
	2	Thermal shock (I)	
C2	1	Thermal shock (II) (1000 cycles)	12 (0)
C3	1	Substrate bending	6 (0)
C4	1	Shear	6 (0)
C5	1	Body strength	6 (0)

Covered in LAT phase in ESCC 3012

Covered in final production tests or burn-in/electrical measurements in ESCC 3012

Covered in evaluation phase in ESCC 3012

Red letter : Different sample size

6. Export control of JAXA qualified components <1/2>

"Law concerning JAXA" states that what JAXA do shall be in line with the peaceful use of outer space as stipulated by Article 2 of Basic Space Law of Japan. As long as the components are to be used for peaceful purposes, their export to overseas is subject only to export control in Japan, under the control of METI (Ministry of Economy, Trade and Industry).

<Legislation – Foreign Exchange and Foreign Trade Act>

- Japanese export control list complies with the international export control regimes such as NSG (nuclear), AG (biological and chemical), MTCR (missile) and WA (conventional weapons) control lists
- There are two controls -- List control and Catch-all control

  List control -> Applied to exports to all countries

  Catch-all control -> Applied to exports to countries other than 27 countries that have severe export control system (US, most European countries, Australia, etc.)

NSG : Nuclear Supplier Group AG : Australia Group WA : Wassenaar Arrangement
MTCR : Missile Technology Control Regime WMD : Weapon of Mass Destruction

Reference (METI): http://www.meti.go.jp/policy/anpo/englishpage/overview.pdf

6. Export of JAXA qualified components <2/2>

List control

- A wide range of dual-use items are listed, which are based on international export control regimes
- An export license is required for the export of a listed item
- Applied to exports to all countries

Catch-all control

- Exporters have to apply for an export license in cases where the item or technology is not on the control lists but could conceivably contribute to WMD proliferation programs
- Applied to exports to countries other than 27 countries (US, most European countries, Australia, etc.)

- No JAXA qualified components fall under the items in the control list except for some active components and materials
  -> Only review and approval are required for the export to 27 countries including most of European countries
- Information on intended use and end users (at the best of purchaser's knowledge) shall be provided for an approval or a license

7. Summary

- Overall introduction of JAXA qualified passive comonents was made including the followoing information :
  - Some statistics
  - Lineup
  - Development plan
- JAXA qualification system was explained including test / inspection requirement for passive components
- Comparison work of test / inspection requirement between JAXA-QTS and ESCC is in progress to show the overall equivalence of both specifications
- Three JAXA qualified manufacturers are attending this conference. Enjoy thier presentations and visit our exhibition booth!
  - Murata (MLCC)
  - Tateyama (Fuse, thermistor and chip resistor)
  - Mitsubishi Heavy Industries (temperature sensor)

Appendix Difference in terminology

ESCC	JAXA
<component> part	<component> subsystem / equipment
basic specification	general specification
<periodical test> LAT (lot acceptance test) / LVT (lot validation test)	<periodical test> QCI (quality conformance inspection)
extension of qualification	retention of qualification
lapse of qualification	de-certification
chief inspector	registered inspector