Space Passive Component Days, 1st International Symposium

Hideki Yoshino

25th September, 2013

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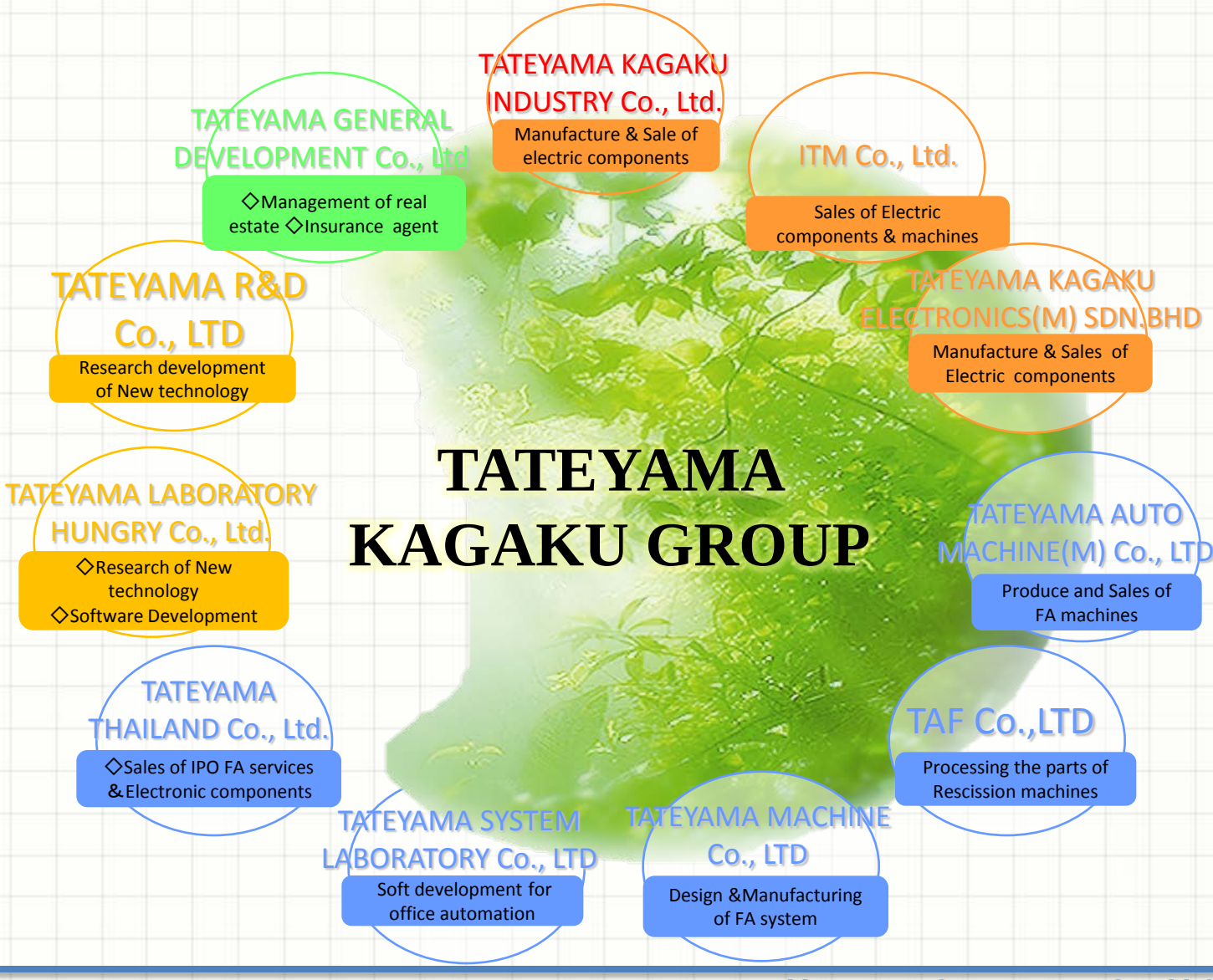
- Group & Company Profile
- Business of Tateyama
- Products for Space Applications
- Solid Body type fuse

The Group


TATEYAMA KAGAKU NDUSTRY Co., Ltd.
Manufacture & Sale of electric components
TATEYAMA GENERAL DEVELOPMENT Co., Ltd
◇Management of real estate ◇Insurance agent
ITM Co., Ltd.
Sales of Electric components & machines
TATEYAMA R&D Co., LTD
Research development of New technology
TATEYAMA KAGAKU ELECTRONICS(M) SDN.BHD
Manufacture & Sales of Electric components
TATEYAMA KAGAKU GROUP
TATEYAMA LABORATORY HUNGRY Co., Ltd.
◇Research of New technology
◇Software Development
TATEYAMA AUTO MACHINE(M) Co., LTD
Produce and Sales of FA machines
TATEYAMA THAILAND Co., Ltd.
◇Sales of IPO FA services &Electronic components
TAF Co.,LTD
Processing the parts of Rescission machines
TATEYAMA SYSTEM LABORATORY Co., LTD
Soft development for office automation
TATEYAMA MACHINE Co., LTD
Design &Manufacturing of FA system

Group overview

SLOGAN: Quality is our life blood

Established :	**May, 1958**
President :	**Syoichirou Mizuguchi**
Capital :	**USD 13.4 million** (As of March 2013')
Turnover :	**USD 295million** (As of March 2013')
Employees :	**1,297** (As of March, 2013')
Headquarter :	**Toyama, Japan**

Location of Tateyama Kagaku Group

TATEYAMA EUROPE Laboratory

HONGKONG BRANCH

THAILAND CO., LTD

TATEYAMA Electronics Malaysia

TATEYAMA AUTOMACHINE Malaysia

OVERSEAS OFFICE & PLANTS

HEADQUARTER & PLANTS

TOYAMA Headquarter

TOKYO Sales Office

NAGOYA Sales Office

OSAKA Sales Office

DOMESTIC OFFICE

Group combination


Security system,
Call center

Advanced technology
R&D

Europe

TATEYAMA
Malaysia

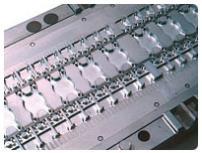
TATEYAMA
System

TATEYAMAKAGAKU
Group

TATEYAMA
KAGAKU INC

TATEYAMA
MACHINE

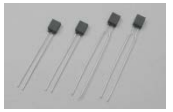
TAF
(Automation
factory

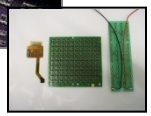




FA system equipment components

Variety of sensors, Assembly





Temp. sensor, Protective circuit components
Module, Equipment, Substrate mounting,
Vehicle Assy

Semiconductor industry

ウェハマニュファクチュアリングシステム

ウェハ外観検査装置

Flat panel display industry

液晶露光装置

液晶ガラス厚さ測定装置

Production and Inspection machinery

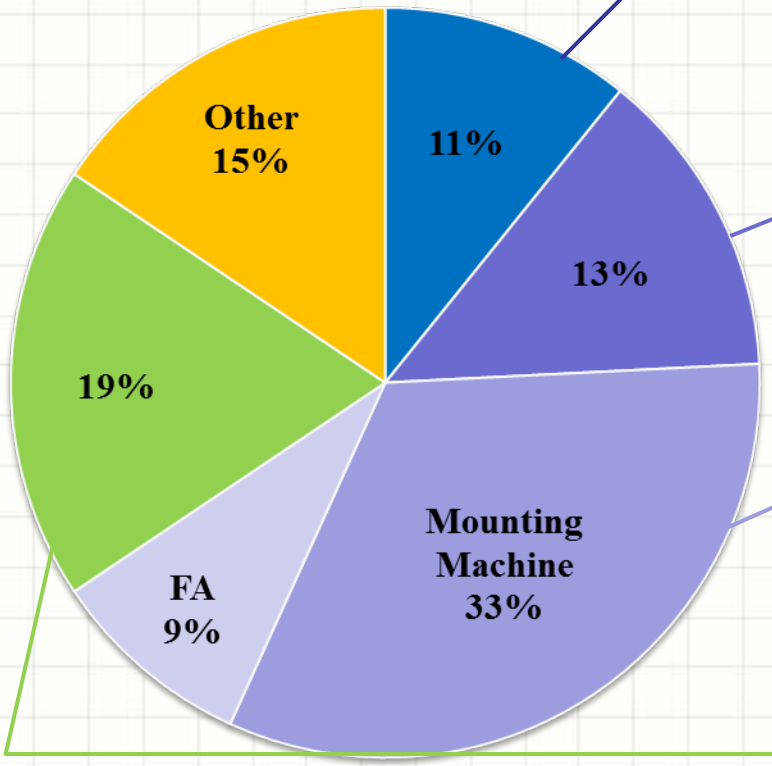
Precision machinery industry


シャフト測定機

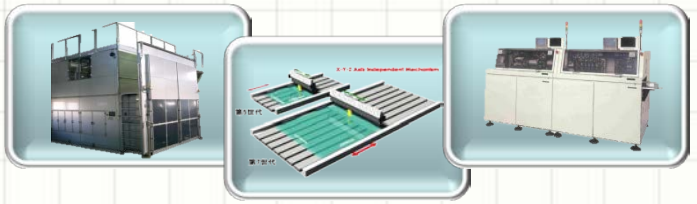
Car industry


カム・リンク組付装置　自動車部品溶接装置

Business field for Group



LCD Semiconductor



Electronics *RF, Sensor network, RFID*

Machine & FA

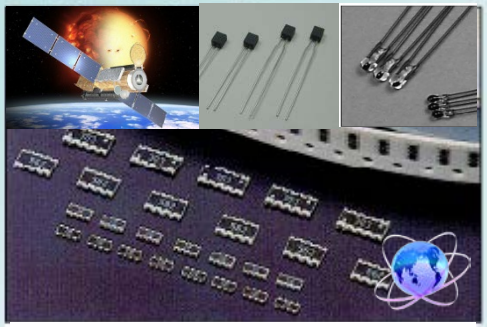
Electronic component *SMD components, Sensor*

Group Sales amount: USD295 million

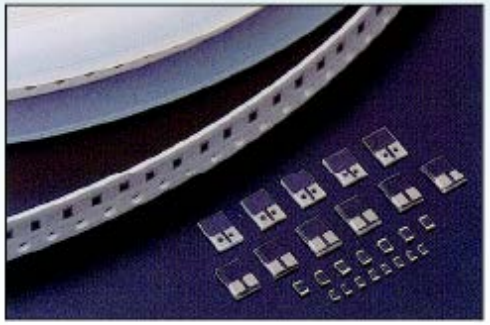
(As of March, 2013')

CONTENTS

- **Date of Establishment :** May, 1958
- **Number of Employees :** 468
- **Annual Turnover :** USD 86 million (As of March, 2013)



JAXA CRK



Thermistor & ESD varistor

Only 1 company for Temp. Sensor

High QCD

TKI main operating segment

Consumer Market

Digital Camera
Mobile/Battery Pack
Europe Washing Machine
Europe Shaver
Cooking Machine
Europe LED Lightning
PC/HDD, SSD
Printer

Industrial Market

Europe Smart Grid meter
Europe Proximity Switch
LED Lightning
Inverter
Microwave
Sensor Network

Medical Market

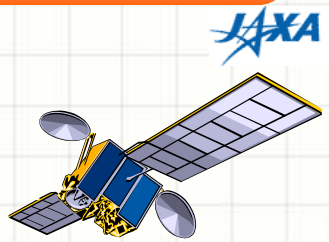
Blood Sugar Meter
Environment Instrument

Automotive Market

Europe Air Conditioning system
Climate Control
LED Head Light
Car Navigation, Antenna
Combustion Engine, IGBT

Aero Space Market

Satellite
Rocket

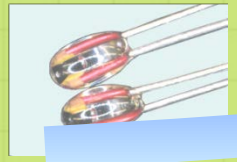


Space Business in Tateyama!

Space Applications

Chip Resistors

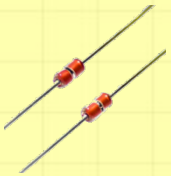
Chip Thermistors



Leaded Thermistors

Leaded Fuses

SMD fuses

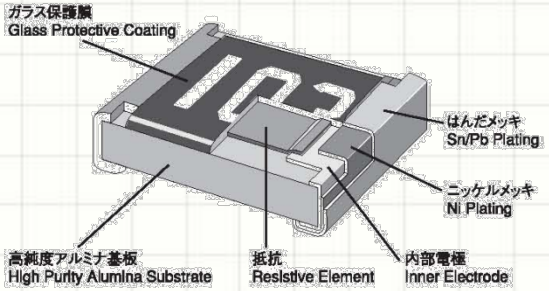


Diode

1994 2011 2012 2013 ~ 2017 Year

Thick Film Resistors for Space Use

Construction & Feature



- Satellite, Space station, Payload equipment for space.
- Superior in stability, heat resistance by glass coating.
- Using solder plating with an achievement to avoid whisker.
- 100% screening, Lot assurance inspection & periodic QCI.

Rating

項　目 / Item	CRK16H	CRK10H	CRK8H	CRK4H	CRK2H
使用温度範囲 (℃) Operating Temperature Range (℃)	−55～+125				
公称抵抗値範囲 (Ω) Resistance Range (Ω)	Max.50m, 1.0～10M				
最高使用電圧 (V) Max. Overload Voltage (V)	50	150	200	200	200
定格電力 (W) Power Rating (W)	0.1	0.125	0.25	0.33	0.5
定格電流 (A) ※2 Rated Current (A)	1.0	1.5	2.0		
最高過負荷電流 (A) ※2 Max. Overload Current (A)	2.0	3.0	4.0		
抵抗温度特性 ※1 T.C.R.	L:±200ppm/℃ (1.0～9.1Ω) K:±100ppm/℃ (10～10MΩ)				

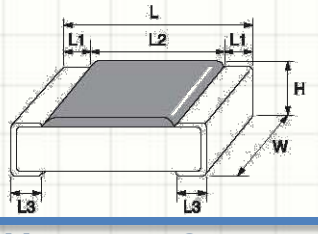
※1:ジャンパー抵抗には適用しない。　※1:Jumper:N/A
※2:ジャンパー抵抗にのみ適用。　※2:Only Jumper

Type Designation

JAXA	CRK16H	K	103	F:±1% G:±2% J:±5%	R
“JAXA”は宇宙共通部品等であることを表す。“J”と省略できる。 “JAXA” indicates that the part is for space use and may be abbreviated “J”.	形　式 Style	特　性 Characteristics	公称抵抗値 Nominal Resistance	抵抗値許容差 Resistance Tolerance	電極構造:はんだメッキ仕上げの両面電極 R:Double-sided solder plated electrode

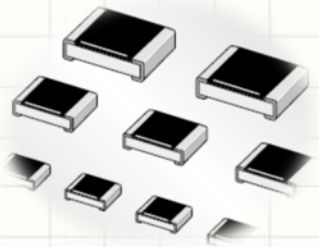
Dimension

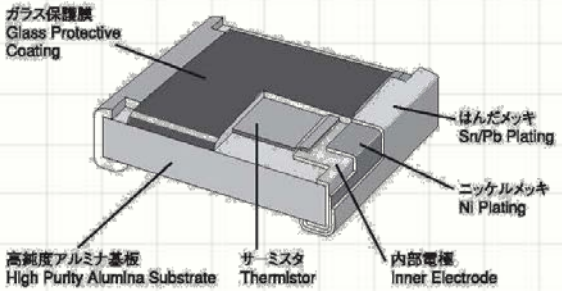
形式 Style	L	W	H	L1	L2	L3
CRK16H	1.60±0.15	0.80±0.15	0.45±0.10	0.30±0.20	1.00±0.15	0.30±0.20
CRK10H	2.00±0.20	1.25±0.20	0.50±0.10	0.40±0.20	1.30±0.15	0.40±0.20
CRK8H	3.20±0.20	1.60±0.20	0.60±0.10	0.50±0.25	2.20±0.20	0.50±0.30
CRK4H	3.20±0.20	2.60±0.20	0.60±0.10	0.50±0.20	2.00±0.20	0.50±0.30
CRK2H	5.00±0.20	2.50±0.20	0.60±0.10	0.60±0.20	3.80±0.20	0.50±0.30



NTC Chip Thermistor for Space Use On EPPL

Construction & Feature





- Satellite, Space station, Payload equipment for space.
- High mechanical strengh and reliability are available due to thermistor film and glass-coated structure on alumina substrate.
- Using solder plating with an achievement to avoid whisker.
- 100% screening, Lot assurance inspection & periodic QCI.

Rating

項　目 / Item	2012
使用温度範囲(℃) Operating Temperature Range(℃)	−25～+125℃
動作温度範囲(℃) ※1 Operating Temperature Range(℃)	−40～+125℃
保存温度範囲(℃) ※2 Storage Temperature Range(℃)	−55～+125℃
ゼロ負荷抵抗値範囲(Ω) Nominal Zero-power Resistance(Ω)	2.186k～1.388M
ゼロ負荷抵抗値許容差(%) Nominal Zero-power Resistance Tolerance(%)	J=±5%, K=±10%
公称B定数範囲(K) B-Value Range(K)	2610～4800
許容定格電力(mW) Allowable Operating Power(mW)	5
定格電力 at 25℃(mW) Rated Power at 25℃(mW)	130

※1:通電は行わせるが、ゼロ負荷抵抗値の規格を設けない温度範囲。
※2:無負荷放置された場合でも、その性能を失わない温度範囲。

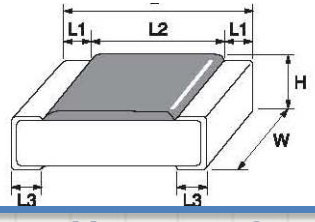
Type Designation

JAXA	2160/A101	2012	B	4100H	1002	J
"JAXA"は宇宙共通部品等であることを表す。"J"と省略できる。 "JAXA" indicates that the part is for space use and shall be abbreviated "J".		形　式 Style	端子構造:はんだメッキ仕上げの両面電極構造 B:Double-sided solder plated electrode	B定数　B定数許容差 B-Value Tolerance: 4100→4100K, G=±2%, H=±3%, J=±5%	公称抵抗値 Nominal Resistance: 1002=10kΩ	抵抗値許容差 Resistance Tolerance: J=±5%, K=±10%

Dimension

(unit:mm)

L	W	H	L1	L2	L3
2.0±0.20	1.25±0.20	0.50±0.10	0.40±0.20	1.20±0.20	0.40±0.20



Solid Body type fuses

On EPPL

1. Background

Company policy: ***Expanding space component business***

Core technology: Thick Film Printing.
Looking for a new development product with thick film printing method

Thick Film Resistors already supplied for Space use

Information:
-Difficult to obtain fuses
-Long lead time

Launch development of Fuse

Accelerate development

Obtain JAXA qualification in 2011

2. Function of fuse

2.1 Common function

Application condition with fuses mounted	Fuse operation
In Normality	Shall not be open circuit
In Abnormality	Shall be open circuit and not be reconnected

2.2 Necessary function for space use

- Resistance to vibration and shock
- Performance in vacuum environment

2.2 Necessary function for space use

2.2.1 Resistance to vibration and shock

Necessary to have resistance to vibration and shock caused by launch of rocket

Construction of fuse and Resistance to vibration and shock

Construction	Resistance to vibration and shock
Cavity-style	Fair
Solid-style	High

2.2 Necessary function for space use

2.2.2 Performance in vacuum environment

Fuse shall show same performance in both vacuum and non-vacuum environment (Non-influence by atmospheric pressure)

Effect of vacuum environment

a) Change of pre-arcing time by reduction of heat radiation

b) Open circuit by reduction of vapor pressure

2.2.2 Performance in vacuum environment

Effect of vacuum environment

a) Change of pre-arcing time

Balance between self-heating and heat radiation

Joule heat by current	≦	Heat Radiation	⇒	Get to thermal balance Keep current-carrying
Joule heat by current	>	Heat Radiation	⇒	Temperature rise Lead to fusion (open)

2.2.2 Performance in vacuum environment

Effect of vacuum environment

a) Change of pre-arcing time

$$\left(\begin{array}{c}\text{Heat}\\ \text{Radiation}\end{array}\right) = \left(\begin{array}{c}\text{Radiation}\\ \text{from the surface}\\ \text{of fuse-element}\end{array}\right) + \left(\begin{array}{c}\text{Radiation}\\ \text{from fuse-element}\\ \text{to electrode}\end{array}\right)$$

In case that fuse-element is exposed to the air,

“radiation from fuse-element” decrease or is lost in vacuum environment

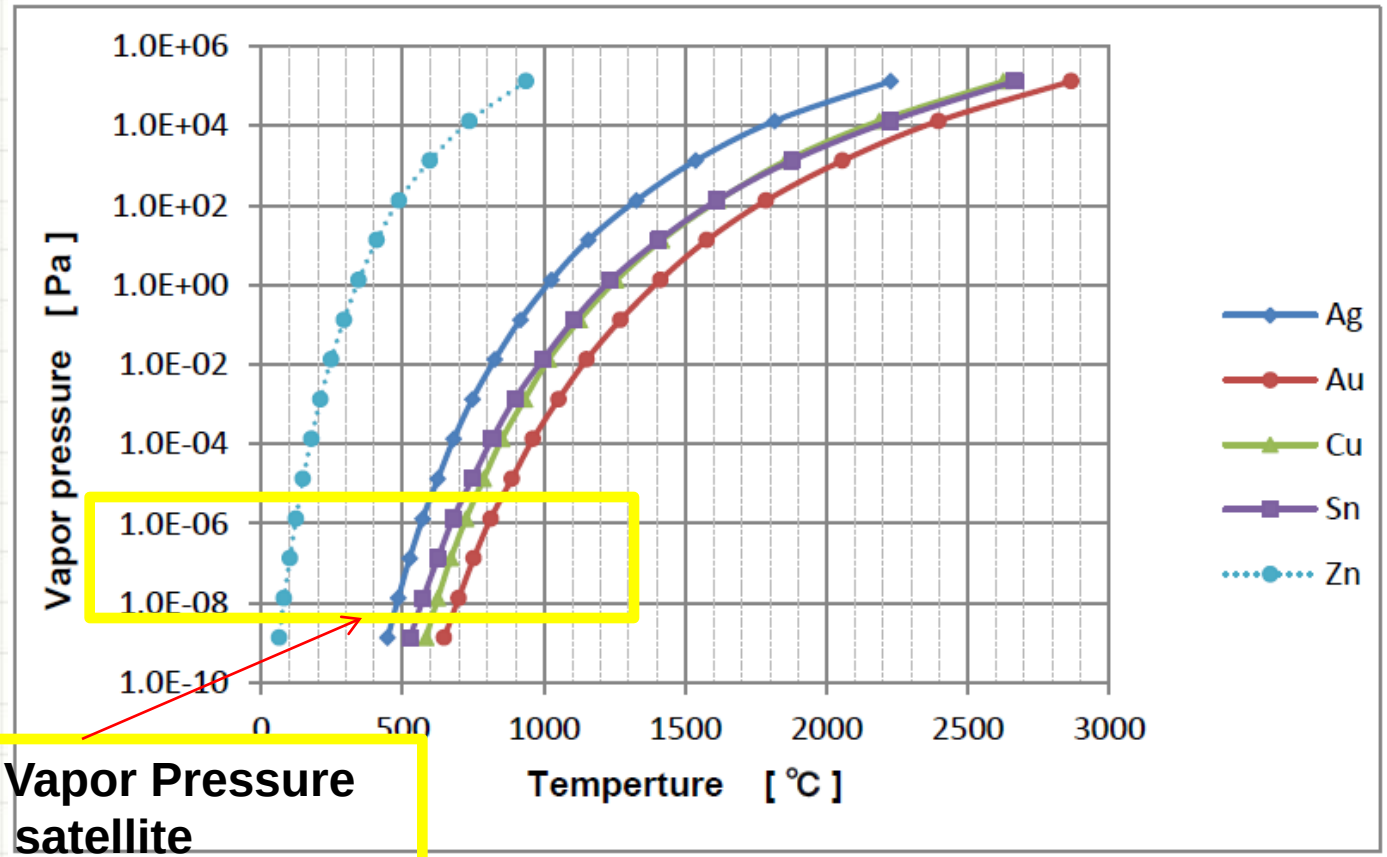
- Change of pre-arcing time (become shorter)

2.2.2 Performance in vacuum environment

Effect of vacuum environment

b) Open circuit by reduction of vapor pressure

- Vapor pressure curve

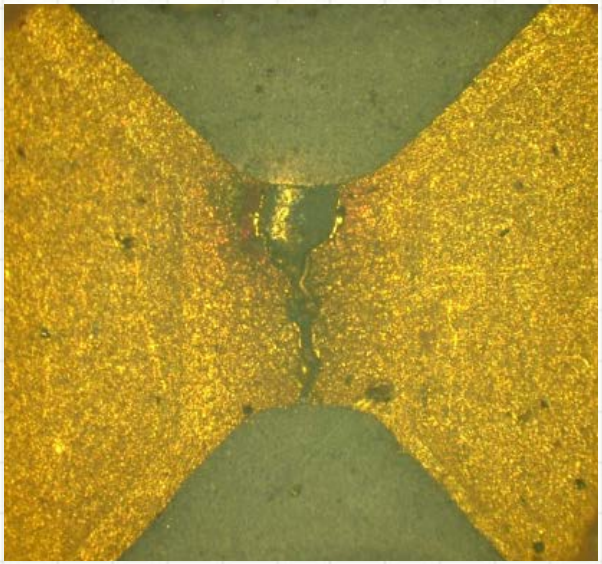


Estimated Vapor Pressure in artificial satellite

2.2.2 Performance in vacuum environment

Example of effect of vacuum environment

b) Open circuit by reduction of vapor pressure



In case that fuse-element is exposed in the air, fuse-element is sublimated to the gas and open in vacuum environment

Product with element exposed
(Status after 5 minutes in 80% current flowing in vacuum)

Construction:

: **Non-exposing construction of the element**

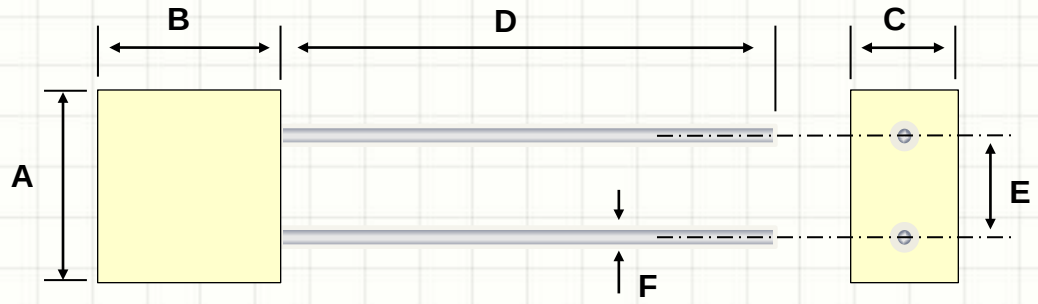
3. JAXA qualified product; Leaded Fuse

Rating

Rating			Pre-arcing time (m sec)			Operating Temperature	Maximum breaking capacity [DC]	Style
Voltage (V)	Current (A)	Resistance Max (m ohm)	250%	400%	600%			
72	1.0	220	10.0 ~ 300	1.00 ~ 15.0	0.15 ~ 3.00	-55℃ ~ +125℃	1,000A	J1
72	1.5	163						
72	2.0	75.0						
72	3.0	43.8						
72	5.0	22.5						
72	7.5	13.8						
72	10.0	10.7						
72	15.0	7.00						
126	1.0	270	10.0 ~ 300	0.75 ~ 15.0	0.10 ~ 3.00			J2
126	3.0	95.0						
126	5.0	40.0						

3. JAXA qualified product; Leaded Fuse

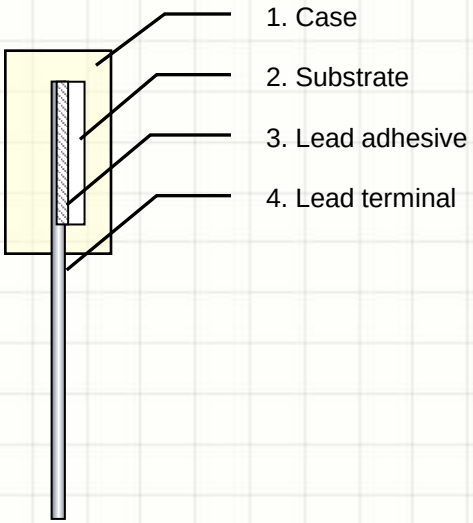
Style and Dimension

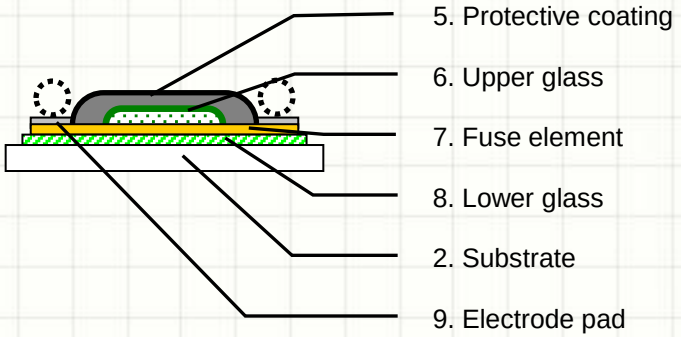


Style	Dimension（mm）					
	A	B	C	D（Min）	E	F
J1	7.0	5.4	3.5	40	4.0	0.60
J2	9.0	9.3	5.0	57	5.0	1.20

3. JAXA qualified product; Leaded Fuse

Construction





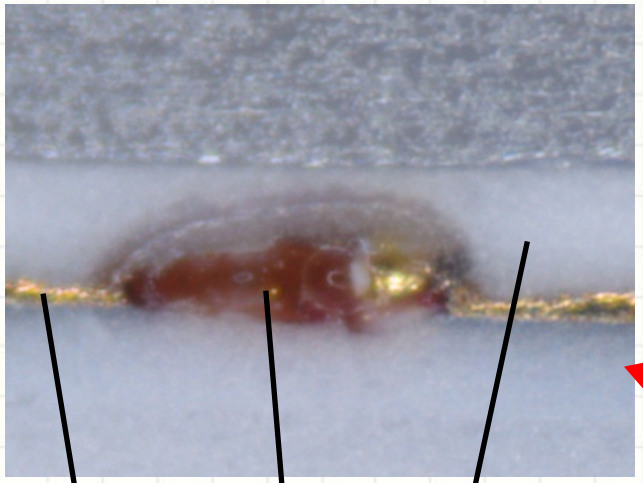
- Special Feature
  Upper-glass layer on fuse-element and solid

4. Feature of JAXA qualified product; Leaded Fuse

☐ Upper-glass layer

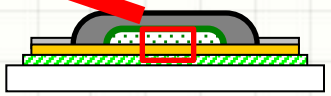
Function of “upper-glass layer”

- Safely shutting current down
  Absorbing shock made by arc at clearing action
- Electric insulation after firing
  Getting electric insulation caused by compound made by clearing action



Mechanism of clearing action

- Self-heating by overload current
- Fuse-element melts and changes to gas
- Gas diffuses into upper-glass
- Upper-glass melted by heat and make compound
- Made compound shows electric insulation



5. Assurance of pre-arcing time characteristic

Quality conformance inspection Group A (JAXA-QTS-2210)

Group	Examination or Test	Number of units (/Lot)
A1	X-ray inspection	ALL
A2	Thermal shock (5 cycle) Burn-in (168h) Resistance	ALL
A3	Externals, dimensions and marking	AQL 1.0%
A4	Current-carrying capacity Dielectric strength **Overload interrupt** Insulation resistance	**21**
A5	Terminal strength	4
A6	Solderability	4
A7	DPA	3

5. Assurance of pre-arcing time characteristic

☐ Pre-arcing time

Measurement of pre-arcing time = Destruction test
But, impossible to make measurement of pre-arcing time directly on the shipping products

Set up an original checking process on product characteristics as in-process inspection

※Assurance by measurement of alternative parameter on all products

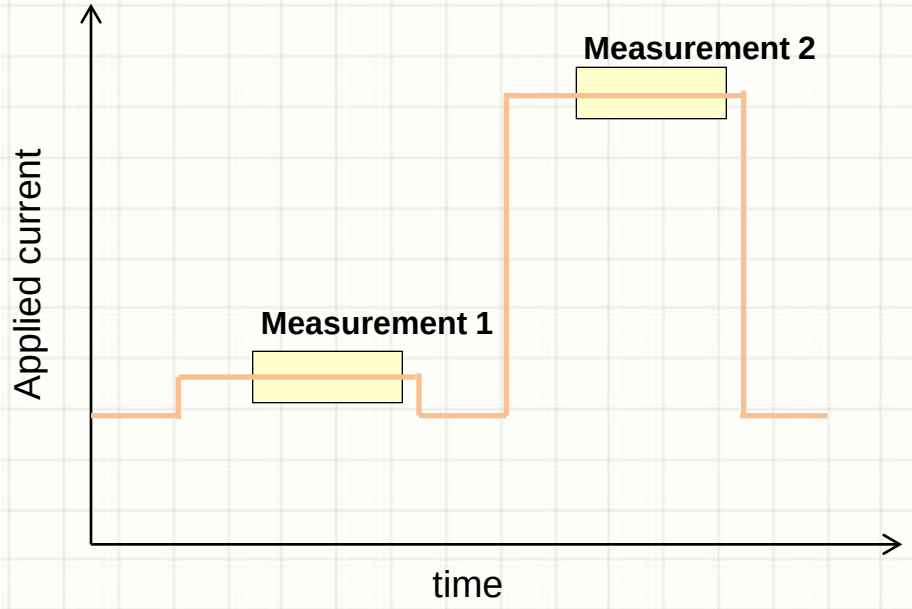
5. Assurance of pre-arcing time characteristic

☐ Sorting pre-arcing time process (in-process inspection)

Measurement 1 ; Resistance value which is free from the influence of self-heating

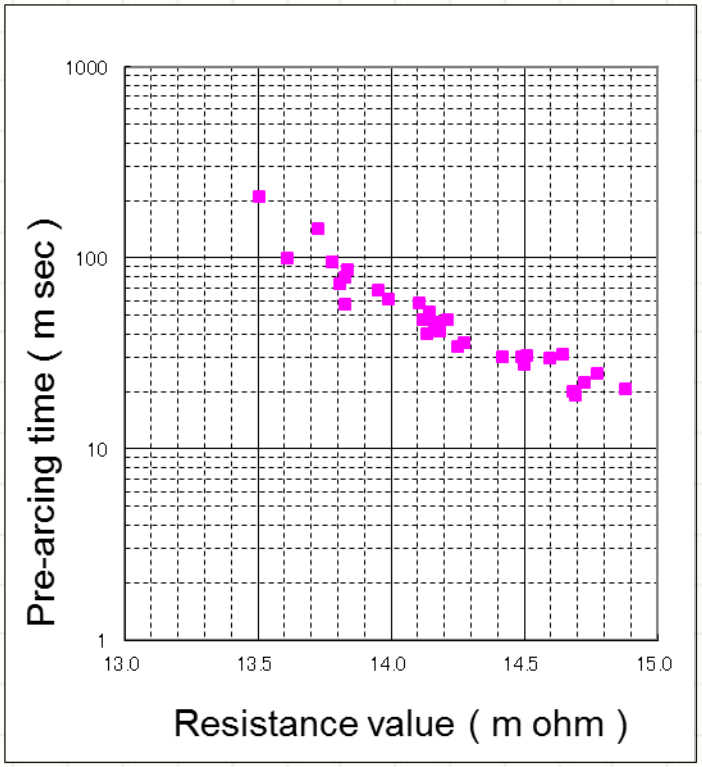
Measurement 2 ; Resistance value at the time of temperature rise by self-heating

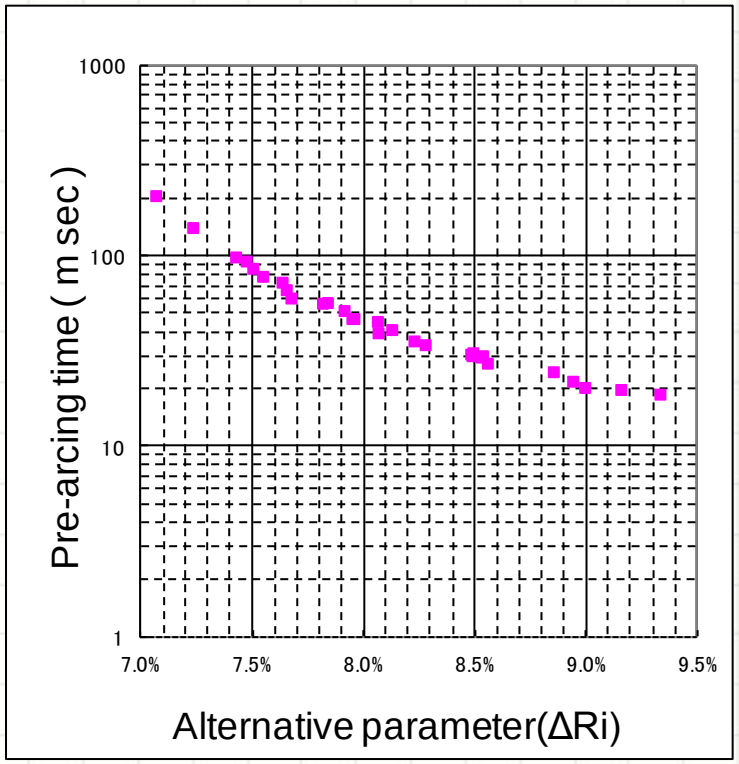
●Making a prediction of pre-arcing time by change of resistance value (alternative parameter)



5. Assurance of pre-arcing time characteristic

- Pre-arcing time at 250% rated current





Conclusion

-Tateyama Fuse: Solid body type
Superior resistance to vibration and shock and keep performance in vacuum environment.

-Set up an original checking process on pre-arcing time

- As our company strategy,
we are expanding space business in the future under our company slogan, “Quality is our life blood”

Thank you very much !