Registration No. 1295

JAXA-QTS-2160B
18 March 2025

Superseding
JAXA-QTS-2160A
Cancelled
18 March 2025

THERMISTORS, HIGH RELIABILITY, SPACE USE, GENERAL SPECIFICATION FOR

Japan Aerospace Exploration Agency

This document is the English version of JAXA QTS/ADS which was originally written and authorized in Japanese and carefully translated into English for international users. If any question arises as to the context or detailed description, it is strongly recommended to verify against the latest official Japanese version.

The release date of the English version of this specification: 25 June 2025

Revision Record

Rev.	Date	Description
NC	4 Nov. 2009	Original
A	4 Nov. 2015	• Added Appendix B Thermistors, Lead, Negative Temperature Coefficient • Paragraph 1.2 Terms and Definitions (1) Changed the description of the following terms for clarification: Zero-power resistance, resistance ratio, resistance temperature coefficient (αT), rated power, allowable operating power, heat deposition constant, and thermal time constant (2) Added definitions Operating temperature range, storage temperature range, and rated ambient temperature • Paragraph A.3.6.3 Dielectric withstanding voltage Added the following description due to the requirement for the post-test change of zero-power resistance being omitted. “The zero-power resistance change shall not exceed the value specified in the detail specification” • Table A-7 Qualification test, Table A-8 Quality Conforming inspection (Group A) Modified the notes for clarification of the sampling plans • Others, and error corrections
B	18 Mar. 2025	• Paragraph 2.1 (Applicable Documents) Added JIS B 7601 titled "Trip balances" in order to add the requirement of the equipment to inspect the mass. • Paragraph 2.2 (Reference Documents) Added the following documents. MIL-PRF-32192 MIL-PRF-23648G S-311-P-18 Rev. M ESCC 4006 issue 4 • Appendices A and B Added the mass inspection in qualification test and group A of quality conformance inspection. • Appendix A Deleted the test requirements for high-frequency vibration, random vibration and shock considering that chip-thermistors have integral structures (no cavity inside.) • Paragraph A.4.3.2 (Inspection Items and Sample Size) Aligned the inspection order with paragraph B.4.3.2. • Figure A-1 (Test Substrate) Aligned the symbol of dimension with those drawing described (from "A" to "a".)

Rev.	Date	Description
		• Paragraphs A.4.4.5.6.1 and B.4.4.5.6.1 (Measurement by Cooling after Self-Heating) Deleted the measurement circuit diagrams for heat dissipation constant (figures A-4 and B-3) in order to apply the circuit specified in JIS C 2570-1. • Paragraphs A.4.4.5.6.2 and B.4.4.5.6.2 (Measurement by the Ambient Temperature Change) Modified the transfer velocity from the liquid bath to the air chamber in order to align the requirements specified in MIL-PRF-23648 as follows. Appendix A: from (50.8mm ± 25.4mm) per second to (50.8mm ± 6.35mm) per second. Appendix B: from (51mm ± 6mm) per second to (50.8mm ± 6.35mm) per second. • Paragraph A.4.4.5.7 (Short-Time Load) Changed the samples to be tested from to solder on the test substrates to not to use the test substrate in order to inspect all samples in group A. • Paragraph A.4.4.6.3 (Adherence) Revised the mounting method with the consideration of subsequent bending strength. • Paragraphs A.4.4.6.4 (Bending Strength), A.4.4.7.4 (Moisture Resistance), and B.4.4.7.1.1 (High Frequency Vibration) Added supplementary information on mounting methods when the samples to be tested have already been mounted on the test substrates. • Paragraph A.4.4.6.4 (Bending Strength) Added a sentence that it shall not apply if the samples have already been mounted on the test substrates, and added the soldering temperatures applied for the solder immersion and the reflow soldering respectively. • Tables A-13 and B-12 (Test conditions for Thermal Shock) Added a note that steps 2 and 4 shall not apply in case of single compartment chamber. • Table A-13 (Test conditions for Thermal Shock) Added a note that the thermal shock [l] of group A inspection shall not apply to solder the samples on the test substrates. • Paragraph A.4.4.8.1 (Load Life) Changed the mounting method for samples to be tested from not to mount on the test substrates to mount on the test substrates. • Paragraph B.4.4.5.7 (Short-Time lLad) Added "Shall not cut the lead wires" to the mounting method. • Paragraph B.4.4.6.2 (Resistance to Soldering Heat) Deleted test conditions (300 ± 10°C, 2 ± 0.5sec, 25 ± 6mm/s) (to align test conditions specified in MIL-STD-202 test method 210.)

Rev.	Date	Description
		• Paragraph B.4.4.7.1.1 (High Frequency Vibration) Added the description of the length of the thermistor in case of already mounted samples on the test substrates to be used.

Contents

THERMISTORS, HIGH RELIABILITY, SPACE USE, GENERAL SPECIFICATION FOR

1. GENERAL

1.1 Scope

This specification establishes the general requirements and quality assurance provisions for space use, high reliability thermistors (hereinafter referred to as “thermistors”) used for electronic equipment installed on space systems.

1.2 Terms and Definitions

JAXA-QTS-2000 and the following terms and definitions shall be used in this document.

a) Thermistor
Thermistor is a temperature-sensing resistor that has the main function of changing its electrical resistance in accordance with the body temperature.

b) Negative temperature characteristic (NTC) thermistors
NTC thermistor is a thermistor of which zero-power resistance decreases with the temperature rise.

c) Positive temperature coefficient (PTC) thermistors
PTC thermistor is a thermistor of which zero-power resistance increases with the temperature rise.

d) Zero-power resistance
Zero-power resistance is the DC resistance of thermistors measured at a specified temperature with the change of resistance caused by the thermistor’s self-heating kept less than 0.1% or 1/10 of a specified measurement tolerance, whichever is smaller.

e) Nominal zero-power resistance
Nominal zero-power resistance is a zero-power resistance at 25°C representing the specification value.

f) Resistance ratio
Resistance ratio is a ratio of zero-power resistance at 125°C to that of 25°C.

g) Nominal resistance ratio
Nominal resistance ratio is a resistance ratio characteristic representing a specification value.

h) Resistance-temperature characteristic
Resistance-temperature characteristic is a characteristic of the zero-power resistance of a thermistor with respect to the temperature of the thermistor body.

i) B value
B value is a value representing the change in resistance obtained by the following formula where zero-power resistance at absolute temperature of T_a (K) and T_b (K) are R_a (Ω) and R_b (Ω) respectively.

$$B = \frac{T_a \times T_b}{T_b - T_a} \cdot ln \frac{R_a}{R_b}$$

j) Nominal B value
Nominal B value is a B value at 25°C / 85°C representing the specification value.

k) Resistance temperature coefficient (α_T)
Resistance temperature coefficient (α_T) is a ratio of change, due to temperature, of zero-power resistance (R_T) at a specified temperature (T) to the zero-power resistance. Its relationship with B value is expressed in the following formula.

$$\alpha_T = \frac{1}{R_T} \cdot \frac{dR}{dT} = -\frac{B}{T^2}$$

l) Operating temperature range
Operating temperature range is the range of the thermistor's operable temperature including the temperature rise of either internal or external heat of thermistor, or both.

m) Maximum operating temperature
Maximum operating temperature is a maximum temperature of a thermistor body at which the thermistor can be continuously operated while its characteristics are held at a sufficient level. The temperature is obtained by either internal or external heating or the both and shall not exceed a specified maximum value.

n) Rated power
Rated power is a maximum power at which a thermistor can be loaded continuously at an operating temperature of 25°C or lower in the atmosphere or under atmospheric pressure.

o) Allowable operating power
Allowable operating power is a maximum power applied at which the temperature rise by self-heating is allowable in the atmosphere or under atmospheric pressure.

p) Heat disposition constant
Heat disposition constant is a constant for representing a power needed to increase the temperature of a thermistor by 1°C as it is heated by itself in heat balance state in the atmosphere or under atmospheric pressure. The constant shall be obtained in ratio of the power dissipation of the thermistor and temperature increase (unit: mW/°C).

q) Thermal time constant
Thermal time constant is a constant of time needed to change difference of an initial temperature of a thermistor body from its final temperature by 63.2% if the ambient temperature is abruptly changed when the thermistor is in zero-power state in the atmosphere or under atmospheric pressure.

r) Stability
Stability is a capability of thermistors to hold specified characteristics if the thermistors are subjected to a specified environmental performance test or electrical performance test.

s) Storage temperature range
Storage temperature range is a temperature at which the performance of a thermistor is not degraded even if the thermistor is left without any load.

t) Rated ambient temperature
Rated ambient temperature is an ambient temperature specified for each standard and is usually 25°C.

1.3 Classification

Thermistors covered by this specification shall be classified as specified in Table 1.

Table 1. Classification

Type	Appendix	Equivalent QPL specification
Negative temperature coefficient chip thermistors	A	--
Negative temperature coefficient lead thermistors	B	NASDA-QTS-23648

1.4 Part Number

The part number shall be as specified in paragraph A.3.1.4 of JAXA-QTS-2000. Details shall be specified in each appendix.

2. APPLICABLE DOCUMENTS

2.1 Applicable Documents

The documents listed below form a part of this specification to the extent specified herein. These documents shall be the latest issues available at the time of contract award or application. If it is necessary to designate an issue, the issue shall be specified in the detail specification.

a) JAXA-QTS-2000 Common Parts/Materials, Space Use, General Specification for
b) MIL-STD-202 Test Method Standard, Electronic and Electrical Component Parts
c) JIS B 7502 Micrometer calipers
d) JIS B 7507 Vernier, dial and digital calipers
e) JIS C 2570-1 Directly heated negative temperature coefficient thermistors -- Part 1: Generic specification
f) JIS Z 9015-1 Sampling procedures for inspection by attributes -- Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
g) ASTEM E595 Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
h) JIS B 7601 Trip Balances

2.2 Reference Documents

The following documents are the reference documents.

a) JERG-0-035 NASDA Parts Application Handbook
b) NASDA-QTS-23648A Thermistors, Reliability Assured, Space Development Use, General Specification For
c) MIL-PRF-32192 Resistor, Chip, Thermal (Thermistor), General Specification For
d) MIL-PRF-23648G Resistors, Thermal (Thermistor), Insulated, General

		Specification For
e)	S-311-P-18 Rev. M	Thermistor, (Thermally Sensitive Resistor), Insulated and Uninsulated, Negative Temperature Coefficient, Specification for
f)	ESCC4006 issue 4	Thermistors (Thermally Sensitive Resistors) ESCC Generic Specification

2.3 Order of Precedence

In the event of a conflict between the text of this specification and other documents, the following order of precedence shall apply:

a) Detail specification
b) This specification
c) JAXA-QTS-2000
d) Applicable documents of this specification (paragraph 2.1, except for JAXA-QTS-2000)

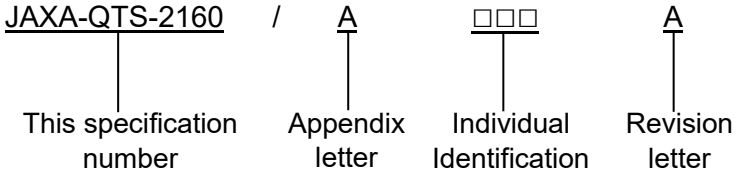
2.4 Detail Specification

Detailed requirements for the type and performance of thermistors shall be specified in each detail specification. The detail specification shall be prepared and established by a manufacturer in accordance with paragraph A.4 of JAXA-QTS-2000. The detail specification shall also be registered with the Japan Aerospace Exploration Agency (hereinafter referred to as “JAXA”)

2.4.1 Detail Specification Number

The detail specification number shall be indicated in the following form in accordance with paragraph A.2.2.2 of JAXA-QTS-2000.

(Example)



2.4.2 Revision Letter of Detail Specification

A revision letter in the detail specification number shall be assigned in accordance with paragraph A.2.2.2.4 of JAXA-QTS-2000.

2.4.3 Independency of Detail Specification

The detail specification shall be a stand-alone document with a unique number defined in accordance with paragraph 2.4.1.

2.4.4 Format of Detail Specification

The detail specification format shall be in accordance with A.6 b) of JAXA-QTS-2000 and shall specify each requirement in accordance with paragraph A.4 of JAXA-QTS-2000.

3. REQUIREMENTS

3.1 Qualification

3.1.1 Qualification Coverage

Qualification coverage shall be as specified in each appendix.

3.1.2 Initial Qualification

To acquire qualification of thermistors in compliance with this specification, manufacturers shall establish a quality assurance program in accordance with paragraph 3.2.1 of this specification, perform the qualification tests specified in paragraph 4.4, and acquire a qualification from JAXA as specified in paragraph 3.4.1 of JAXA-QTS-2000. The manufacturers shall be listed on the Qualified Manufacturer List of JAXA (JAXA QML).

3.1.3 Retention of Qualification

To continue supplying thermistors in accordance with this specification, manufacturers must apply for QML certification retention in accordance with paragraph 3.4.2.1 of JAXA-QTS-2000 commencing between 30 and 60 days prior to the expiration date of the certification period (paragraph 3.1.4).
If products were not shipped during the effective period of certification and a quality conformance inspection was not conducted, the manufacturers may apply for retention of certification without conducting the quality conformance inspection.

3.1.4 Effective Period of Certification

The effective period of certification granted in compliance with this specification shall be three years.

3.1.5 Change of Qualification Coverage

To change the qualification coverage, manufacturers shall perform procedures for re-certification in accordance with paragraph 3.4.3 of JAXA-QTS-2000.

3.2 Quality Assurance Program

3.2.1 Establishment of a Quality Assurance Program

To acquire certification in compliance with this specification, manufacturers shall be responsible for establishing a quality assurance program that satisfies the requirements specified in paragraph 3.3.1 of JAXA-QTS-2000 and this specification. The manufacturers shall prepare a Quality Assurance Program Plan in accordance with paragraph 3.3.2 of JAXA-QTS-2000 and provide the plan to JAXA for review in accordance with paragraph 3.3.6 of JAXA-QTS-2000.

3.2.2 TRB Formation

To acquire a qualification status in compliance with this specification, manufacturers shall form and operate the Technology Review Board (TRB) in accordance with paragraph 3.3.5 of JAXA-QTS-2000.

3.3 Materials

Materials used for manufacturing thermistors shall conform to this specification. If using materials not specified in this specification, it shall meet the requirements of this specification. Those materials shall be clearly stated in a document which defines the manufacturing conditions of the quality assurance program.

3.3.1 Outgassing

Unless otherwise specified, organic materials used for thermistors shall satisfy the following requirements when tested in accordance with ASTM E 595.

a) Total Mass Loss (TML): 1.0% or less
b) Collected Volatile Condensable Material (CVCM): 0.1% or less

Note: (1) TML: Total Mass Loss
(2) CVCM: Collected Volatile Condensable Materials

3.4 Design and Construction

Design and construction shall be in accordance with each appendix. Detailed requirements shall be specified in the detail specifications.

3.5 Externals, Dimension, Mass and Marking

The externals, dimensions, mass and markings of the thermistors shall be as specified in each appendix.

3.6 Workmanship

The workmanship of the thermistors shall be as specified in each appendix.

3.7 Rating

The ratings of the thermistors shall be as specified in each appendix.

3.8 Electrical Performance

Requirements for the electrical performance of the thermistors shall be as specified in each appendix.

3.9 Mechanical Performance

Requirements for the mechanical performance of the thermistors shall be as specified in each appendix.

3.10 Environmental Performance

Requirements for the environmental performance of the thermistors shall be as specified in each appendix.

3.11 Durability Performance

Requirements for the durability performance of the thermistors shall be as specified in each appendix.

4. QUALITY ASSURANCE PROVISIONS

4.1 General Requirements

Manufacturers shall be responsible for implementing the quality assurance program specified in paragraph 3.2 and operating the TRB.

4.2 Classification of Test and Inspection

The tests and inspections shall be classified into the following three categories in accordance with paragraph 4.3 of JAXA-QTS-2000.

a) In-process inspection
b) Qualification test
c) Quality conformance inspection

4.3 In-Process Inspection

Manufacturers shall perform the in-process inspections shown below to detect any failure which could seriously affect the reliability and quality of the products, assure the workmanship and characterize properties which cannot be measured using the finished products. The manufacturing flowchart in the quality assurance program plan shall define the inspection process.

a) Internal visual inspection of semi-finished products (non-destructive, 100% or sampling inspection)
b) Physical or chemical inspection of semi-finished products (destructive or non-destructive, 100% or sampling inspection)
c) Characterization of semi-finished products (non-destructive, 100% or sampling inspection)

4.4 Qualification Test

4.4.1 Sample

Samples shall be manufactured using the process and controls specified in the quality assurance program and shall also represent the qualification coverage. Details shall be specified in each appendix.

4.4.2 Manufacturing Records

The manufacturer who intends to acquire qualification shall store and maintain the material certification, incoming inspection data or test data of used materials, work records related to sample preparation and in-process inspection data. These records shall be readily available upon request.

4.4.3 Test Items and Number of Samples

Test items, test order, sample size and sampling method shall be in accordance with each appendix.

4.4.4 Determination of Pass or Fail

A failure of any test in the qualification test specified in each appendix shall constitute failure of the qualification test. If the failure mode of the defects is catastrophic such as

an open- or short-circuiting where the function of the thermistors might be lost, the thermistors fail the qualification test.

4.4.5 Disposition after Test

The sample thermistors used for the qualification test shall not be delivered.
The products in the same inspection lot that have passed the qualification test may be delivered upon passing the group A inspections of the quality conformance inspection.

4.5 Quality Conformance Inspection

4.5.1 Quality Conformance Inspection (Group A)

Group A inspections shall be performed at the time of production for all products.

4.5.1.1 Sample

Selection of test sample lots for group A inspections shall be specified in the document defining the manufacturing conditions of the quality assurance program.

4.5.1.2 Inspection Items and Sample Size

Inspection items, inspection order, sample size and sampling method of group A inspections shall be as specified in each appendix.

4.5.1.3 Determination of Pass or Fail

A failure of any test specified in the group A inspection shall constitute failure of the quality conformance inspection. If the failure mode of the defects is catastrophic such as an open- or short-circuiting where the function of the thermistors might be lost, the thermistors fail group A of the quality conformance inspection.

4.5.1.4 Disposition after Inspections

The lots rejected in the group A inspection shall not be delivered. Details shall be specified in each appendix.

4.5.2 Quality Conformance Inspection (Group B and Group C)

Groups B and C inspections shall be performed in compliance with the following schedule.

a) The group B inspection shall be performed on the first lot manufactured within the qualification period.
b) When retention of qualification is granted, the group C inspection shall be performed prior to the restart of production when no products were manufactured within the previous qualification period and no quality conformance inspection was performed.

4.5.2.1 Sample

Inspection lots for groups B and C inspections shall consist of samples that have passed group A inspection. Details shall be specified in each appendix.

4.5.2.2 Inspection Items and Sample Size

Inspection items, inspection order and the sample size of groups B and C inspections shall be as specified in each appendix. Sampling shall be conducted by extracting constant number of samples per each type or conducted in accordance with JIS Z 9015-1.

4.5.2.3 Determination of Pass or Fail

A failure of any inspection specified in the group B or C inspections shall constitute failure of the quality conformance inspection of each group. If the failure mode of the defects is catastrophic such as an open- or short-circuiting where the function of the thermistors might be lost, the thermistor fails the group B or C inspections.

4.5.2.4 Disposition after Inspections

The samples used for the group B or C inspections shall not be delivered. If the samples fail in the group B or C inspections, the manufacturer shall conduct a failure analysis on the defects and take corrective action. Delivery of the products shall be suspended until JAXA approves the corrective actions.

4.6 Method for Test or Inspection

4.6.1 Externals, Dimension, Mass and Marking

Test methods for externals, dimensions, mass and marking of the thermistors shall be as specified in each appendix.

4.6.2 Workmanship

Test methods regarding workmanship of the thermistors shall be as specified in each appendix.

4.6.3 Electrical Performance

Test methods regarding the electrical performance of the thermistors shall be as specified in each appendix.

4.6.4 Mechanical Performance

Test methods regarding the mechanical performance of the thermistors shall be as specified in each appendix.

4.6.5 Environmental Performance

Test methods regarding the environmental performance of the thermistors shall be as specified in each appendix.

4.6.6 Durability Performance

Test methods regarding the durability performance of the thermistors shall be as specified in each appendix.

4.7 Long-Term Storage

4.7.1 Disposition of Lots Stored for a Long-Term at the Manufacturer's Site

When thermistors have been stored at the manufacturer's site for 24 months or longer after the group A inspection of the quality conformance inspection, the manufacturer shall perform 100% inspection for the inspection items specified in each appendix prior to delivery. Only the thermistors which have passed the inspections can be shipped as products.

4.7.2 Storage by Purchasers

Purchasers shall storage the thermistors in accordance with the detail specification.

4.8 Changes to Tests and Inspections

Any change in the in-process inspection and quality conformance inspection specified in this specification shall be made in accordance with paragraphs 4.4 and 6.1 of JAXA-QTS-2000.

5. PREPARATION FOR DELIVERY

Preparation for delivery shall be as follows and as specified in paragraph 5 of JAXA-QTS-2000.

5.1 Packaging

The thermistors shall be appropriately packaged as high reliability parts at time of delivery from the manufacturer to the purchaser.

a) Individual packaging:
Each thermistor shall be individually packaged using an appropriate container or packaging material.

b) Packaging:
Individually packaged thermistors shall be placed in a container with cushioning materials to protect the products. Additional requirements for packaging shall be specified in procurement documents, if necessary.

5.2 Marking on Package

Each shipping package shall have the following markings.

a) Part name
b) Part number
c) Applicable specification number
d) Lot identification code
e) Purchaser's name
f) Manufacturer's name
g) Quantity of packages
h) Date of inspection
i) Inspection result

6. NOTES

6.1 Notes for Manufacturer

6.1.1 Preparation and Registration of Application Data Sheet

The manufacturer shall prepare the Application Data Sheet in accordance with appendix G of JAXA-QTS-2000 and register it with JAXA.

6.1.2 Interchangeability

Thermistors shall be interchangeable with other thermistors with the identical part number manufactured by the previously certified manufactures.

6.2 Notes for Purchasers

Refer to the Application Data Sheet for the detailed data of the products and notes.

6.2.1 Items to be Specified for Procurement

To purchase thermistors manufactured in compliance with this specification, the purchaser shall provide the following information.

a) Part number
b) This specification number
c) Detail specification number
d) Indication of test data or source inspection results to be submitted for delivery
e) Others

For item e), requirements other than those defined in this specification may be specified for special applications. However, if the requirements conflict with the existing requirements in this specification, the purchaser shall not request the manufacturer to indicate that the thermistors comply with this specification.

APPENDIX A

THERMISTORS, CHIP,
NEGATIVE TEMPERATURE COEFFICIENT

This document is the English version of JAXA QTS/ADS which was originally written and authorized in Japanese and carefully translated into English for international users. If any question arises as to the context or detailed description, it is strongly recommended to verify against the latest official Japanese version.

The release date of the English version of this specification: 25 June 2025

APPENDIX A

THERMISTORS, CHIP, NEGATIVE TEMPERATURE COEFFICIENT

A.1. General

A.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the negative temperature coefficient chip thermistors (hereinafter referred to as "thermistors").

A.1.2 Part Number

The part number shall be indicated as follows. Refer to the detail specification for details.
(Example)

JAXA[(1)] 2160/A 101 - 2102 B 4100H 1002 J

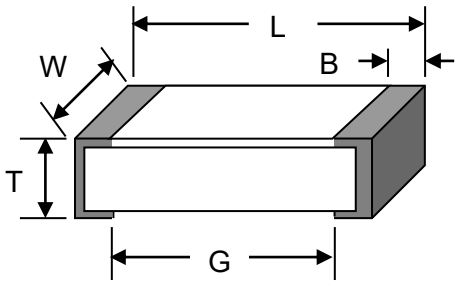
101	2102	B	4100H	1002	J
Individual identification	Style (A.1.2.1)	Terminal structure (A.1.2.2)	Characteristics (A.1.2.3)	Nominal zero-power resistance (A.1.2.4)	Resistance tolerance (A.1.2.5)

Note: [(1)] "JAXA" indicates the part is for space use and may be abbreviated “J”.

A.1.2.1 Style

The style indicates the thermistor size and shall be identified by a four-digit number as shown in Table A-1. The details of dimensions shall be described in the detail specification. The detail specification shall specify the length, width, thickness, inter-terminal distance and terminal width.

Table A-1. Style



Unit: mm

Style	External dimension				
	Length (L)	Width (W)	Thickness (T)	Inter-terminal distance (G)	Terminal width (B)
1608	1.60±0.15	0.80±0.15	0.45±0.10	As specified in detail spec.	As specified in detail spec.
2012	2.00±0.20	1.25±0.20	0.55±0.10		

A.1.2.2 Terminal Structure

The terminal structure shall be identified by a single capital letter as shown in Table A-2.

Table A-2. Terminal Structure

Symbol	Structure	Finish	Mounting method
B	Double-surface electrode	Solder plate on underlying metal barrier (Sn/Pb alloy containing 3wt% or more Pb)	Soldering

A.1.2.3 Characteristics

The resistance-temperature characteristics shall be identified by a four-digit number and a single capital letter. The first four-digit number indicates the nominal B value as specified in the detail specification. The last capital letter indicates the B value tolerance as shown in Table A-3.

Table A-3. B Value Tolerance

Unit: %

Symbol	B value tolerance
F	±1
G	±2
H	±3
J	±5

A.1.2.4 Nominal Zero-Power Resistance

The nominal zero-power resistance shall be indicated by a four-digit number and is measured in ohms (Ω). The first three digits indicate significant figures and the last digit indicates the number of zero following them.

Example: 1000: 100Ω, 1002: 10,000Ω=10kΩ, 1004: 1,000,000Ω=1MΩ

A.1.2.5 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter as shown in Table A-4.

Table A-4. Zero-Power Resistance Tolerance

Unit: %

Symbol	B value tolerance(1)
F	±1
G	±2
H	±3
J	±5
K	±10

Note: (1) Value at the temperature of 25°C.

A.2. Applicable Documents

A.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2160.

A.2.2 Reference Documents

The following documents are reference documents of this appendix.

a) MIL-PRF-32192 Resistors, Chip, Thermal (Thermistor), General Specification for

b) ESCC Generic Specification No. 4006 Thermistors (Resistors, Thermally Sensitive)

c) ESCC Detail Specification No. 4006/012 Thermistors (Thermally Sensitive Resistors) NTC, CHIP STYLE Based on Series 196-XXX XAG-001

A.3. Requirements

A.3.1 Qualification Coverage

Qualification shall be valid for thermistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs A.3.2 through A.3.9. The qualification coverage shall be represented by samples that have passed the qualification test. Within this coverage, the manufacturer is allowed to supply qualified products in accordance with the detail specification. If necessary, additional qualification coverage shall be specified in the detail specification.

A.3.1.1 Qualification Constraints

The qualification coverage of resistance shall be within the minimum and maximum nominal zero-power resistance of thermistors that have passed the qualification test. The tolerance range for B value and nominal zero-power resistance shall be as shown in Tables A-5 and A-6, respectively.

Table A-5. B value Tolerance Qualification

B value tolerance of sample	Qualified B value tolerance
F	F, G, H, J
G	G, H, J
H	H, J
J	J

Table A-6. Zero-Power Resistance Tolerance Qualification

B value tolerance of sample	Qualified resistance tolerance
F	F, G, H, J, K
G	G, H, J, K
H	H, J, K
J	J, K
K	K

A.3.2 Materials

The materials shall be as follows and as specified in paragraph 3.3 of JAXA-QTS-2160.

A.3.2.1 Substrate

The substrate of thermistor shall be composed of the mixture of the main components of alumina (nominally more than 96%) and other oxidation products, and it shall be high-temperature fired.

A.3.2.2 Electrode

As specified in the detail specification.

A.3.2.3 Temperature Sensitive Resistor

Temperature sensitive resistors shall be the semiconducting resistor with the resistance-temperature characteristics specified in the detail specification. Details shall be as specified in the detail specification.

A.3.2.4 Insulating Material

As specified in the detail specification.

A.3.3 Externals, Dimensions, Mass and Marking

Thermistors shall meet the following requirements when tested in accordance with paragraph A.4.4.3.

A.3.3.1 Externals

There shall be no fractures or chips on the surface of the thermistors.

A.3.3.2 Dimensions and Mass

Thermistors shall meet the required dimensions and mass specified in the detail specification.

A.3.3.3 Markings

There shall be no markings on the thermistor body. However, the items specified in paragraph 5.2 of JAXA-QTS-2160 shall be marked on individual packaging or packaging.

A.3.4 Workmanship

Thermistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1 of JAXA-QTS-2160. Thermistors shall be free of any holes, cracks, chips or deformations that will affect thermistor performance, and other defects affecting usability and appearance of the thermistors. The following requirements shall be met.

a) Temperature sensitive resistor
   Temperature sensitive resistor shall be free of cracks, chips, pinholes or deformations that will affect its performance.
b) Protective coating
   Temperature sensitive resistor shall be protected against moisture with a moisture-resistant insulation material.
c) Electrode
   The electrode of thermistor shall be securely connected electrically and mechanically to the temperature sensitive resistor and electrode.

A.3.4.1 DPA

When thermistors are tested as specified in paragraph A.4.4.4.1, processes such as temperature sensitive resistor, protective coating and electrode shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program.

A.3.5 Rating

The following items shall be specified in the detail specification.

a) Operating temperature range
   Unless otherwise specified, the temperature range shall be -55°C to +125°C.
b) Nominal B value
c) B value tolerance
d) Nominal zero-power resistance
e) Zero-power resistance tolerance
f) Rated power
   The ambient temperature shall be 25°C or less. If continuously use or test the thermistors at the ambient temperature of over 25°C, its load shall be derated in accordance with the derating curve specified in the detail specification.
g) Allowable operating power (if specified)

A.3.6 Electrical Performance

Thermistors shall meet the following electrical requirements.

A.3.6.1 Zero-Power Resistance

When thermistors are tested as specified in paragraph A.4.4.5.1, the zero-power resistance shall be within the tolerance specified in the detail specification.

A.3.6.2 B Value

When thermistors are tested as specified in paragraph A.4.4.5.2, the B value shall be within the tolerance specified in the detail specification.

A.3.6.3 Dielectric Withstanding Voltage

When tested as specified in paragraph A.4.4.5.3, there shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage on thermistors after the completion of the test. The zero-power resistance change shall not exceed the value specified in the detail specification.

A.3.6.4 Insulation Resistance

When thermistors are tested as specified in paragraph A.4.4.5.4, the insulation resistance shall be 1,000MΩ as a minimum.

A.3.6.5 Heat Dissipation Constant

When thermistors are tested as specified in paragraph A.4.4.5.5, the heat dissipation constant shall be as specified in the detail specification.

A.3.6.6 Thermal Time Constant

When thermistors are tested as specified in paragraph A.4.4.5.6, the thermal time constant shall be as specified in the detail specification.

A.3.6.7 Short-Time Load

When tested as specified in paragraph A.4.4.5.7, there shall be no evidence of arcing, burnout, burnt deposit or open circuit on thermistors after the completion of the test. The amount of zero-power resistance change shall not exceed the value specified in the detail specification.

A.3.6.8 Resistance-Temperature Characterristics

When thermistors are tested as specified in paragraph A.4.4.5.8, the resistance-temperature curve shall conform to the curves specified in the detail specification and shall be within the resistance tolerance of each temperature.

A.3.7 Mechanical Performance

Thermistors shall meet the following mechanical requirements.

A.3.7.1 Solderability

When thermistors are tested as specified in paragraph A.4.4.6.1, at least 95% of the terminal surface shall be evenly covered with new solder. The existence of small pinholes or rough areas shall be acceptable, provided that they are not concentrated in one spot. The total area of the pinholes or rough areas shall be less than 5% of the solder area.

A.3.7.2 Resistance to Soldering Heat

When thermistors are tested as specified in paragraph A.4.4.6.2, there shall be no evidence of mechanical damage or terminal electrode dissolution after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.7.3 Adherence

When thermistors are tested as specified in paragraph A.4.4.6.3A.4.4.6.3, there shall be no evidence of mechanical damage after the completion of the test.

A.3.7.4 Bending Strength

When thermistors are tested as specified in paragraph A.4.4.6.4A.4.4.6.4, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.8 Environmental Performance

Thermistors shall meet the following environmental requirements.

A.3.8.1 Vibration (deleted)

A.3.8.1.1 High Frequency Vibration (deleted)

A.3.8.1.2 Random Vibration (deleted)

A.3.8.2 Shock (deleted)

A.3.8.3 Thermal Shock

When thermistors are tested as specified in paragraph A.4.4.7.3, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.8.4 Moisture Resistance

When thermistors are tested as specified in paragraph A.4.4.7.4, there shall be no evidence of electrical damage, breakage, cracks or terminal loosening after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.8.5 Immersion Cycling

When thermistors are tested as specified in paragraph A.4.4.7.5, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.8.6 Low Temperature Storage

When thermistors are tested as specified in paragraph A.4.4.7.6, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.8.7 High Temperature Exposure

When thermistors are tested as specified in paragraph A.4.4.7.7, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.3.9 Durability

Thermistors shall meet the following durability requirements.

A.3.9.1 Load Life

When thermistors are tested as specified in paragraph A.4.4.8.1, there shall be no evidence of corrosion or other mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

A.4. Quality Assurance Provisions

A.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2160.

A.4.2 Qualification Test

The qualification test shall be performed in accordance with paragraph 4.4 of JAXA-QTS-2160 and as provided below.

A.4.2.1 Samples

The samples for the qualification test shall have the tightest B value tolerance and zero-power resistance tolerance at the minimum and maximum nominal zero-power resistance of each type of thermistors.

A.4.2.2 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table A-7. Upon completion of groups I and II tests, group III and subsequent tests shall be performed using samples allocated to the appropriate test groups. Group III and subsequent tests may be performed disregarding the numerical order. The test items within each test group shall be performed in the specified order as shown in Table A-7.

Table A-7. Qualification Test

Test			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
I	1	Thermal shock [I]	A.3.8.3	A.4.4.7.3	All	0
	2	Sort-time load	A.3.6.7	A.4.4.5.7		
	3	Zero-power resistance	A.3.6.1	A.4.4.5.1		
	4	B value	A.3.6.2	A.4.4.5.2		
II	1	Externals, dimensions, mass and marking	A.3.3	A.4.4.3	All(1)	0
III	1	Resistance-temperature characteristics	A.3.6.8	A.4.4.5.8	20	0
	2	Heat dissipation constant	A.3.6.5	A.4.4.5.5		
	3	Thermal time constant	A.3.6.6	A.4.4.5.6		
	4	Insulation resistance	A.3.6.4	A.4.4.5.4		
	5	Dielectric withstanding voltage	A.3.6.3	A.4.4.5.3		
	6	Adherence	A.3.7.3	A.4.4.6.3		
	7	Bending strength	A.3.7.4	A.4.4.6.4		
IV	1	Solderability	A.3.7.1	A.4.4.6.1	12	0
V	1	Resistance to solder heat	A.3.7.2	A.4.4.6.2	20	0
	2	Thermal shock [II]	A.3.8.3	A.4.4.7.3		
	3	Moisture resistance	A.3.8.4	A.4.4.7.4		
VI	1	Shock (deleted)	-	-	20	0
	2	High frequency vibration (deleted)	-	-		
	3	Random vibration (deleted)	-	-		
	4	Thermal shock [IV]	A.3.8.3	A.4.4.7.3		
	5	Immersion cycling	A.3.8.5	A.4.4.7.5		
VII	1	Low temperature storage	A.3.8.6	A.4.4.7.6	230	0
	2	High temperature exposure	A.3.8.7	A.4.4.7.7.		
VIII	1	Load life	A.3.9.1	A.4.4.8.1	30	0
IX	1	DPA	A.3.4.1	A.4.4.4.1	2	0
-	-	Materials	A.3.2	-	(2)	

Notes: (1)The dimensions and mass of thermistors shall be inspected by using sampling plan and Special inspection level S-4 in Appendix Table 1, and 4.0% of the acceptable quality level (AQL) in Appendix Table 2-A of JIS Z 9015-1 shall apply. The acceptance level shall be (Ac, Re) =(0, 1).

(2)The data to certify compliance with design specification shall be submitted.

A.4.3 Quality Conformance Inspection

The quality conformance inspection shall be performed as specified in paragraph 4.5 of JAXA-QTS-2050 and as provided below.

A.4.3.1 Samples

The inspection lot for group A inspections shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2160. Groups B and C inspections shall be performed for each shape and the inspection lots shall be as specified in paragraph 4.5.2.1 of JAXA-QTS-2160.

A.4.3.2 Inspection Items and Sample Size

Inspection items and sample size of the groups A, B and C inspections in the quality conformance inspection shall be as specified in Tables A-8, A-9 and A-10. Group A inspections (A2 and after) and group B inspections need not to be performed in the group order however, the inspections within each group shall be performed in the specified order.

A.4.3.3 Disposition after Inspections

Products from the lot rejected in the group A quality conformance inspection shall not be delivered. If the lot has not passed the order 2 of group A1 and/or group A2 inspection, all products of the lot shall be subjected to the 100% inspection in accordance with paragraph H.3.3 of JAXA-QTS-2000, and only the good products shall be shipped. The samples used for the groups A3 and A4 inspections shall not be delivered.

Table A-8. Quality Conformance Inspection (Group A)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
A1	1	Thermal shock [I]	A.3.8.3	A.4.4.7.3	All	0
		Sort-time load	A.3.6.7	A.4.4.5.7		
		Zero-power resistance	A.3.6.1	A.4.4.5.1		
		B value	A.3.6.2	A.4.4.5.2		
	2	Externals, dimensions, mass and marking	A.3.3	A.4.4.3	All(1)	0
A2	1	Resistance-temperature characteristics	A.3.6.8	A.4.4.5.8	AQL(2) 2.5%	
	2	Insulation resistance	A.3.6.4	A.4.4.5.4		
	3	Dielectric withstanding voltage	A.3.6.3	A.4.4.5.3		
	4	Adherence	A.3.7.3	A.4.4.6.3		
	5	Bending strength	A.3.7.4	A.4.4.6.4		
A3	1	Solderability	A.3.7.1	A.4.4.6.1	5	0
	2	Thermal shock [II]	A.3.8.3	A.4.4.7.3		
A4	1	DPA	A.3.4.1	A.4.4.4.1	2	0

Notes: (1)The dimensions and mass of thermistors shall be inspected by using sampling plan and Special inspection level S-4 in Appendix Table 1, and 4.0% of the acceptable quality level (AQL) in Appendix Table 2-A of JIS Z 9015-1 shall apply. The acceptance level shall be (Ac, Re) = (0, 1).

(2)For a sampling plan, Special inspection level S-4 in Appendix Table 1, and Appendix Table 2-A of JIS Z 9015-1 shall apply. The acceptance level shall be (Ac, Re) =(0, 1).

Table A-9. Quality Conformance Inspection (Group B)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
B1	1	Heat dissipation constant	A.3.6.5	A.4.4.5.5	10	0
	2	Thermal time constant	A.3.6.6	A.4.4.5.6		
B2	1	Resistance to soldering heat	A.3.7.2	A.4.4.6.2	10	0
	2	Moisture resistance	A.3.8.4	A.4.4.7.4		
B3	1	Shock (deleted)	-	-	10	0
	2	High-frequency vibration (deleted)	-	-		
	3	Thermal shock [III]	A.3.8.3	A.4.4.7.3		
	4	Immersion cycling	A.3.8.5	A.4.4.7.5		
B4	1	Low temperature storage	A.3.8.6	A.4.4.7.6	30	0
	2	High temperature exposure	A.3.8.7	A.4.4.7.7.		
B5	1	Load life	A.3.9.1	A.4.4.8.1	10	0

Table A-10. Quality Conformance Inspection (Group C)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
C1	1	Random vibration (deleted)	-	-	10	0
	2	Thermal shock [IV]	A.3.8.3	A.4.4.7.3		

A.4.4 Test Method

A.4.4.1 Test Conditions

Tests shall be performed in accordance with paragraph 4 of MIL-STD-202 with the following conditions.

a) Standard condition
Standard condition shall be a temperature of between 15 and 35°C, relative humidity of between 25 and 75% and atmospheric pressure of between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If it is necessary to strictly control the conditions to obtain the reproducible results, the judgment condition d) shall apply.

b) Judgment condition
Judgment condition shall be a temperature of 25±2°C, relative humidity of between 45 and 55% and an atmospheric pressure of between 86 and 106kPa.

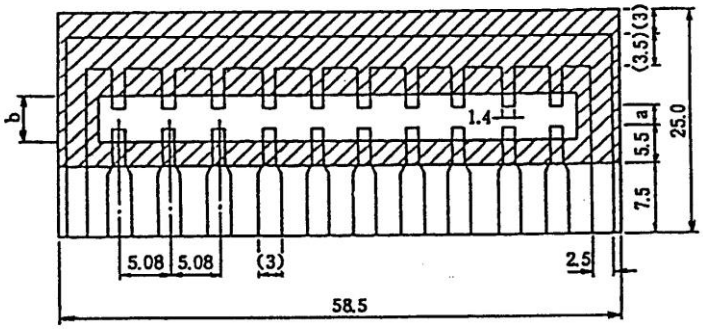
c) Precautions
Sufficient attention is required to avoid condensation of humidity on thermistors during the tests except when humidity is required as a part of a test. Use caution not to damage the thermistors by heat when soldering its electrode.

A.4.4.2 Mounting Method

a) Test substrates
Thermistors shall be soldered on a printed wiring board specified in Figure A-1. The material of the printed wiring board shall be the alumina substrate of 0.8mm±0.3mm thickness (alumina purity is 95% or more) or the glass base woven epoxy resin copper-clad laminate for printed wiring board of 1.6mm±0.1mm thickness. Those materials shall not affect the results of the tests and measurements.

b) Mounting Procedure
Samples shall be mounted on test substrates by the reflow soldering or solder immersion. The solder shall be tin-lead solder with an inactive flux whose nominal tin content is 60%. The following conditions shall apply for soldering.
1) Temperature: 260°C±5°C
2) Duration: 10±2 seconds

Unit: mm



Type	Dimension	
	a	b
1608	0.90	2.60
2012	1.35	3.45

Figure A-1. Test Substrate

A.4.4.3 Externals, Dimensions, Mass and Marking

Externals, dimensions and mass of the thermistors shall be inspected as follows.

a) The external inspection shall be performed with a magnifier of at least 10x magnitude.

b) The dimensions shall be measured with a vernier caliper of class 2 or higher as specified in JIS B 7507 or a micrometer compliant to JIS B 7502. Another

measuring instrument may be used unless the measured values are questionable.

c) The mass shall be inspected with a precision-type trip balance compliant to JIS B 7601. Another measuring instrument may be used unless the measured values are questionable.

A.4.4.4 Workmanship

A.4.4.4.1 DPA

Thermistors shall be disassembled to ensure that the temperature sensitive resistor, protective coatings and electrodes are manufactured in a reliable condition and its internal structure complies with the specification in the quality assurance program plan. DPA shall be conducted in accordance with the DPA manual specified in the quality assurance program plan.

a) Thermistors shall be embedded in a proper resin or other materials, and cut at the perpendicular place along the line parallel to the longer direction of the thermistors. The cut face shall be polished and examined with a 10x to 200x magnifier for the thickness of the temperature sensitive resistors, protective coatings and electrodes and the mating conditions of the temperature sensitive resistors and electrodes.

b) Thermistors shall be embedded in a proper resin or other materials, and cut at the perpendicular plane along the line right angle to the longer direction of the thermistors. The cut face shall be polished and examined by a 10x to 200x magnifier for the state of the protective coatings.

The above examinations a) and b) shall require the respective samples to be photographed and recorded.

A.4.4.5 Electrical Performance

The electrical performance tests shall be performed as follows.

A.4.4.5.1 Zero-Power Resistance

Thermistors shall be contained in a medium that can maintain temperature to an accuracy of ±0.05°C to measure the zero-power resistance. The following conditions shall apply.

a) Accuracy of measuring devices

1) Resistance measurement
The resistance shall be measured with a Wheatstone bridge or equivalent device and the accuracy shall be within ±0.05%.

2) Temperature measurement
The accuracy of a temperature measurement shall be within ±0.01°C, and its responsiveness shall be equivalent or higher than that of thermistors.

b) Temperature stabilization
The medium and thermistors shall be left for a sufficient time until the temperature of medium is stabilized at the specified temperature.

c) Measurement
Thermistors shall be placed in the medium of a specified temperature and measured for zero-power resistance. First, the zero point calibration of output display shall be performed with the input voltage removed. Then, the thermistors shall be connected to the power source and measured for zero-power resistance. If the output value does not return to within the resistance tolerance, which is ±0.05% of the initial zero point, the thermistors shall be rejected.

A.4.4.5.2 B Value

The B value shall be calculated by measuring the zero-power resistance at 25°C and 85°C in accordance with paragraph A.4.4.5.1.

A.4.4.5.3 Dielectric Withstanding Voltage

A.4.4.5.3.1 Standard Atmospheric Pressure

Thermistors shall be tested in accordance with Test Method 301 of MIL-STD-202 with the following conditions.

a) Thermistors shall be placed on a metal plate with the protective coating up so that the tip of metal block is placed at the center of both electrodes of the thermistors as shown in Figure A-2. Then the pressure of 1.0N±0.2N shall be applied to the thermistors.
b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.
c) Test voltage
A test voltage of $500V_{AC}$±$15V_{AC}$ (commercial frequency, effective value) shall be applied between the measurement point A on metal block and measurement point B on metal plate.
d) Test duration: 2 minutes $^{+10}_{0}$ seconds
e) Measurement during test
A leakage current shall be measured during the test, and the thermistors shall be examined for signs of arcing and breakage.
f) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.
g) Post-test examination
The thermistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage

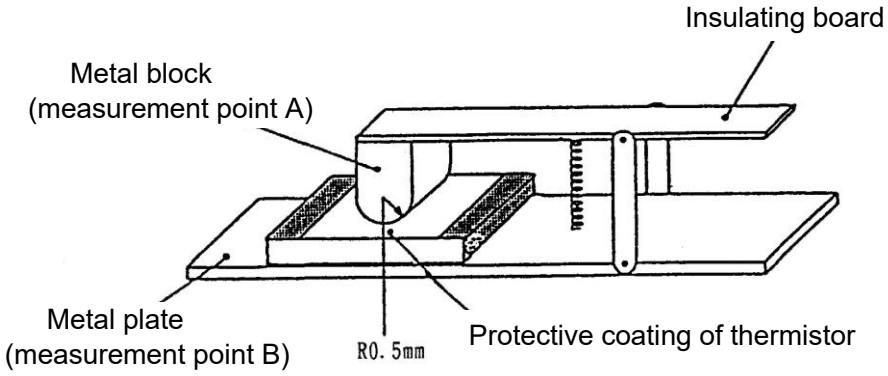


Figure A-2. Test Jig for the Dielectric Withstanding Voltage and Insulation Resistance Tests

A.4.4.5.3.2 Reduced Pressure

Thermistors shall be tested in accordance with Test Method 105 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted as specified in item a) of paragraph A.4.4.5.3.1.

b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

c) Test condition: D (1.1kPa)

d) Test voltage
A test voltage of 200VAC±15VAC (commercial frequency, effective value) shall be applied between the measurement point A on metal block and measurement point B on metal plate.

e) Test duration: 2 minutes $^{+10}_{0}$ seconds

f) Measurement during test
A leakage current shall be measured during the test, and the thermistor shall be examined for signs of arcing and breakage.

g) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

h) Post-test measurement
The thermistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage with a magnifier of at least 10x magnitude.

A.4.4.5.4 Insulation Resistance

The insulation resistance shall be measured in accordance with Test Method 302 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted as specified in item a) of paragraph A.4.4.5.3.1.

b) Test condition: A ($100V_{DC}$±$10V_{DC}$)

c) Test duration: 1 minute $^{+10}_{0}$ seconds

A.4.4.5.5 Heat Dissipation Constant

Thermistors shall be tested according to the following procedures to calculate the heat dissipation constant.

a) The zero-power resistance shall be measured at 25°C and 75°C in accordance with paragraph A.4.4.5.1.
b) The DC power supply or storage batteries shall be used as the power supply.
c) Thermistors shall be set in the test chamber (still air chamber) whose capacity is more than 1,000 times of the volume of a thermistor and its attachment. The temperature inside the test chamber shall be maintained at 25°C±1°C.
d) Load
The voltage E_{TH} and current I_{TH} shall be adjusted to be the zero-power resistance at 75°C in the test circuit shown in Figure A-3, and a load shall be applied for 15 minutes as a maximum.
e) The voltage and current shall be measured with a high-impedance voltmeter and ammeter, respectively.
f) The voltage E_{TH} and current I_{TH} shall be recorded.
g) The heat dissipation constant shall be calculated with the following formula and recorded.

$$\frac{P}{50} = \frac{E_{TH} \times I_{TH}}{75°C - 25°C} \quad \text{(mW/°C)}$$

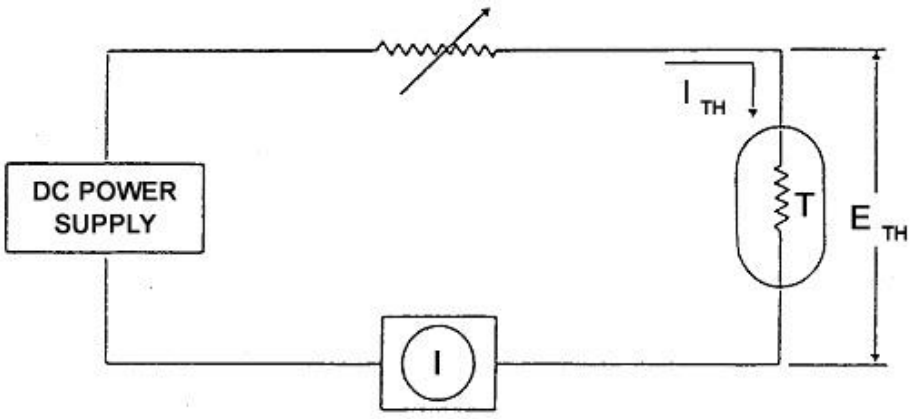


Figure A-3. Measurement Circuit for Heat Dissipation Constant

A.4.4.5.6 Thermal Time Constant

Thermistors shall be tested as specified in paragraph A.4.4.5.6.1 or A.4.4.5.6.2 to measure the thermal time constant.

A.4.4.5.6.1 Measurement by Cooling after Self-Heating

Thermistors shall be tested according to the following procedures.

a) The zero-power resistance shall be measured at 43.4°C and 75°C in accordance with paragraph A.4.4.5.1, and the results shall be recorded.
b) The DC power supply or storage batteries shall be used as the power supply.
c) Thermistors shall be set in the test chamber (still air chamber) whose capacity is more than 1,000 times of the volume of a thermistor and its attachment. The temperature inside the test chamber shall be maintained at 25°C±1°C.
d) The test circuit shall be specified in "Figure 12 - Thermal time constant measurement circuit" of JIS C 2570-1 "Directly heated negative temperature coefficient thermistors - Part 1: General specification". The voltage and current applied to the thermistors shall be adjusted so that the zero-power resistance value reach to at 75°C, and leave the thermistor for a maximum of 15 minutes until it stabilizes.
e) The resistance measuring device shall be adjusted to zero by using the zero-power resistance at 43.4°C measured by the above procedure a).
f) The time from the moment when the interlock switch, which is specified in Figure 12 of JIS C 2570-1, is turned to the BB side until the value on the resistance measuring device reaches zero shall be measured and recorded.

Figure A-4. Measurement Circuit for Thermal Time Constant (deleted)

A.4.4.5.6.2 Measurement by the Ambient Tempereture Change

Thermistors shall be tested according to the following procedures.

a) The zero-power resistance shall be measured at 43.4°C and 75°C in accordance with paragraph A.4.4.5.1 and recorded.
b) The test circuit shown in Figure A-5 shall be used.
c) The bridge shall be adjusted to zero by using the zero-power resistance at 43.4°C measured by the above procedure a).
d) Thermistors shall be immersed completely in a low-viscosity liquid (1mm^2/s max) in a constant-temperature bath of 75°C±1°C. The liquid shall not evaporate from the thermistor surface when the thermistors are removed from the bath.
e) A still air chamber shall be placed on the constant-temperature liquid bath. The still air chamber shall have the capacity of more than 1,000 times of the volume of a thermistor and its attachment, and shall be maintained at 25°C±1°C. The thermistors shall be removed from the liquid bath and transferred to the air chamber at a constant rate of 50.8mm±6.35mm per second by using a drive mechanism or other means.
f) The time measurement shall be started as soon as the thermistors are taken out from the surface of the liquid. The time from the moment when the thermistors are taken out from the liquid until when the bridge reaches to zero shall be measured and recorded.

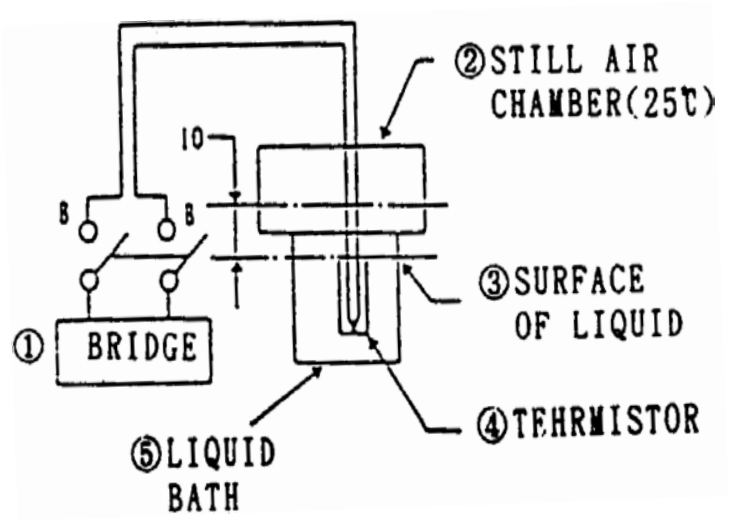


Figure A-5. Measurement Circuit for Thermal Time Constant

A.4.4.5.7 Short Time Load

After the zero-power resistance is measured at 25°C in accordance with paragraph A.4.4.5.1, the voltage E_{TH} and current I_{TH} necessary to apply rated power shall be calculated from the heat dissipation constant and thermal time constant specified in the detail specification. The voltage E_{TH} and current I_{TH} of the circuit shown in Figure A-3 shall be adjusted at the calculated value and the circuit shall be connected to the thermistors. Five minutes of energization and ten minutes of disconnection shall be repeated for ten cycles. The following conditions shall apply.

a) Mounting method
Thermistors shall be tested without being attached to a test board. The thermistors are positioned so that the temperature generated by one thermistor does not affect the temperatures of other thermistors.

b) The DC power supply or storage batteries shall be used as the power supply.

c) Test condition
The test shall be performed in the standard condition. However, air circulation other than that caused by the heat from the operating thermistors.

d) Post-test examination
The thermistors shall be examined for the evidence of arcing, burnout or burnt deposit.

e) Post-test measurement
60 minutes after removing from the test circuit, the zero-power resistance of the thermistors shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

A.4.4.5.8 Resistance-Temperature Characteristics

Thermistors shall be stabilized at the temperature specified in Table A-11. After leaving the thermistors for a period of time equivalent to ten times or more of the thermal time constant, the zero-power resistance shall be measured at each specified temperature in accordance with paragraph A.4.4.5.1.

Table A-11. Temperature for the Resistance-Temperature Test

Unit: °C

Order	Test Temperature	
	Qualification test	Quality conformance inspection
1	-55	-55
2	-15	25
3	0	85
4	25	125
5	50	-
6	75	-
7	85	-
8	100	-
9	125	-

A.4.4.6 Mechanical Performance

The mechanical performance tests shall be performed as follows.

A.4.4.6.1 Solderability

Thermistors shall be tested in accordance with Test Method 208 of MIL-STD-202 with the following conditions.

a) Type of solder
   The solder shall be tin-lead solder with an inactive flux whose nominal tin content is 60%.
b) Temperature of Solder: 245°C±5°C
c) Immersion time: 5±0.5 seconds
d) Method for immersion
   Both electrodes shall be immersed at the same time
e) Post-test examination
   The wettability of solder shall be examined with a magnifier of at least 10x magnitude.

A.4.4.6.2 Resistance to Soldering Heat

Thermistors shall be tested in accordance with Test Method 210 of MIL-STD-202 with the following conditions.

a) Pre-test measurement
   The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.
b) Mounting method
   Thermistors shall be mounted as specified in paragraph A.4.4.2.
c) Test condition: J (2 cycles)
d) Post-test measurement
   The thermistors shall be left until they are stabilized at ambient temperature

and measured for the zero-power resistance at 25°C in accordance with paragraph A.4.4.5.1.

e) Post-test examination
The thermistors shall be examined for mechanical damage or terminal electrode dissolution with a magnifier of at least 10x magnitude.

A.4.4.6.3 Adherence

Thermistors shall be tested in accordance with paragraph 4.28 of JIS C 2570-1 with the following conditions.

a) Mounting method
Thermistors shall be mounted as specified in item a) of paragraph A.4.4.6.4.
b) Load
The load shall be applied as specified in Figure A-12.
c) Test duration: 30±1 seconds
d) Post test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

Table A-12. Loads for Adherence Test

Unit: N

Type	Load
1608	10±1
2012	20±2

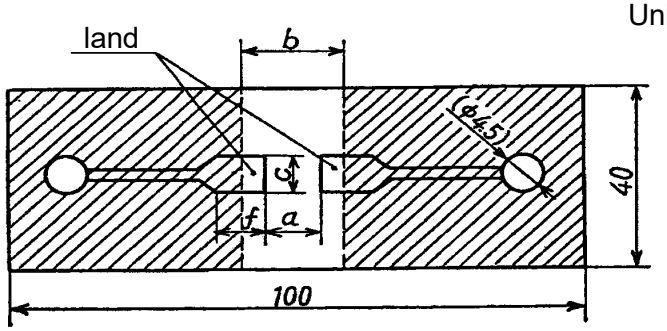
A.4.4.6.4 Bending Strength

Thermistors shall be tested in accordance with paragraph 4.29 of JIS C 2570-1 with the following conditions.

a) Mounting method
Thermistors shall be mounted as specified in paragraph A.4.4.2 using the substrate shown in Figure A-6. This does not apply if the thermistor has already been mounted when performing tests specified in the same test group.
1) Solder immersion: 260°C±5°C
2) The soldering temperature shall be 235°C±5°C.
b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.
c) Flexure: 2mm
d) Test duration: 10 seconds
e) Number of tests: 1
f) Measurement during test
The zero-power resistance shall be measured 25°C in accordance with paragraph A.4.4.5.1 with the substrate bended.

g) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

Unit: mm



Type	Dimension			
	a	b	c	f
1608	1.0	3.0	1.2	3.5
2012	1.2	4.0	1.65	3.0

Notes: 1. Material shall be glass base woven epoxy resin.
Thickness: 1.6mm
Copper foil: 0.035mm
2. A solder resist (solder heat resistant resin) shall be applied to the shaded area.
3. The value in parenthesis in above figure is a reference value.

Figure A-6. Test Substrate for Bending Strength

A.4.4.7 Environmental Performance

The environmental performance tests shall be performed as follows.

A.4.4.7.1 Vibration (deleted)

A.4.4.7.1.1 High Frequency Vibration (deleted)

A.4.4.7.1.2 Random Vibration (deleted)

A.4.4.7.2 Shock (deleted)

A.4.4.7.3 Thermal Shock

Thermistors shall be tested in accordance with Test Method 107 of MIL-STD-202 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

b) Test condition
Test condition shall be as specified in Table A-13.

c) Post-test measurement
The zero-power resistance shall be measured at 25°C within 1 to 24 hours after the test in accordance with paragraph A.4.4.5.1.

d) Post test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

Table A-13. Test Conditions

Test type(1)	Step(2)	Temperature (°C)	Time (min.)	No of cycles
Thermal shock [I]	1	$-55\ ^{0}_{-5}$	15	10
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [II]	1	$-65\ ^{0}_{-5}$	15	25
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$150\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [III]	1	$-55\ ^{0}_{-5}$	15	100
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [IV]	1	$-55\ ^{0}_{-5}$	15	1,000
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	

Notes (1) The specimen shall be attached to the test board using the attachment method in paragraph A.4.4.2 and then tested. However, for thermal shock [I], the board shall not be mounted.
(2) Stapes 2 and 4 shall not apply in case of single compartment chamber.

A.4.4.7.4 Moisture Resistance

Thermistors shall be tested in accordance with Test Method 106 of MIL-STD-202 with the following conditions.

a) Mounting method
Thermistors shall be mounted as specified in paragraph A.4.4.2. This does not apply if the thermistor has already been mounted when performing tests specified in the same test group.

b) Pre-test measurement
More than an hour and a half after the thermistors are removed from a dryer,

the zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

c) Load
The test voltage to maintain the rated power specified in the detail specification shall be applied to a half of the thermistors to be tested for the first two hours of step 2. The rest shall be tested without the application of voltage.

d) Post-test measurement
After completion of the final test cycle of step six, the thermistors shall be kept in high humidity condition of 25°C±2°C for 1.5 to 3.5 hours. The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1 within 24 hours after the thermistors are removed from the test chamber. The measurement shall not be performed in a forced circulated air.

e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

A.4.4.7.5 Immersion Cycling

Thermistors shall be tested in accordance with Test Method 104 of MIL-STD-202 with the following conditions.

a) Test condition: B

b) Measurement and examination after final test cycle

1) Measurement of resistance
The zero-power resistance shall be measured within 24 hours after the final cycle

2) External examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

A.4.4.7.6 Low Ttemperature Storage

Thermistors shall be tested in accordance with paragraph 4.23 of JIS C 2570-1 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

b) Test temperature: -65°C±3°C

c) Test duration: 3^{+1}_{0} hours

d) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

A.4.4.7.7 High Temperature Exposure

Thermistors shall be tested in accordance with paragraph 4.24 of JIS C 2570-1 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

b) Test temperature
Test shall be performed at the maximum operating temperature specified in the detail specification.

c) Test duration
1) Qualification test: $4{,}000^{+48}_{0}$ hours
2) Quality conformance inspection: $2{,}000^{+24}_{0}$ hours

d) Measurement during and after test
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1 after a lapse of 250±12, 500±12, 1,000±12, $2{,}000^{+24}_{0}$ and $4{,}000^{+48}_{0}$ hours.

e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

A.4.4.8 Durability

A.4.4.8.1 Load Life

Thermistors shall be tested in accordance with Test Method 108 of MIL-STD-202 with the following conditions.

a) Mounting method
See paragraph A.4.4.2. Thermistors should be positioned so that the temperature generated by one thermistor does not affect the temperatures of other thermistors. Do not expose the thermistors to wind.

b) Test temperature: 25^{+5}_{0} °C

c) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.

d) Test circuit: Figure A-3

e) Operating conditions
The rated voltage specified in the detail specification shall be applied intermittently, 90 minutes on and 30 minutes off.

f) Test conditions
1) Qualification test: $4{,}000^{+48}_{0}$ hours
2) Quality conformance inspection: D

g) Measurement during and after test
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1 at the end of each intermittent period after 250±12, 500±12, 1,000±12, $2{,}000^{+24}_{0}$ and $4{,}000^{+48}_{0}$ hours have passed.

h) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x of magnitude.

A.4.5 Long-Term Storage

The following inspections shall be conducted for all the thermistors that have been stored for a long period of time in accordance with paragraph 4.7.1 of JAXA-QTS-2160.

a) Externals, dimensions and marking (paragraph A.3.3)
b) Zero-power resistance (paragraph A.3.6.1)

In addition to above 100% inspections, a sampling inspection shall be conducted as specified in Table A-8 for solderability. The data of reinspection shall be marked on the package or storage box. The lots rejected in the solderability inspection shall not be delivered.

A.4.6 Changes to Tests and Inspections

Any change to tests and inspections shall be made in accordance with paragraph 4.8 of JAXA-QTS-2160.

A.5. Preperation for Delivery

Preparation for delivery shall be as specified in paragraph 5 of JAXA-QTS-2160.

A.6. Notes

Refer to the paragraph 6 of JAXA-QTS-2160.

APPENDIX B

THERMISTORS, LEAD,
NEGATIVE TEMPERATURE COEFFICIENT

This document is the English version of JAXA QTS/ADS which was originally written and authorized in Japanese and carefully translated into English for international users. If any question arises as to the context or detailed description, it is strongly recommended to verify against the latest official Japanese version.

The release date of the English version of this specification: 25 June 2025

APPENDIX B

THERMISTORS, LEAD, NEGATIVE TEMPERATURE COEFFICIENT

B.1. General

B.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the negative temperature coefficient lead thermistors (hereinafter referred to as "thermistors").

B.1.2 Part Number

The part number shall be indicated as follows. Refer to the detail specification for details.

(Example)

JAXA(1) 2160/B 101 - □□□□ S 4150F 1002 F

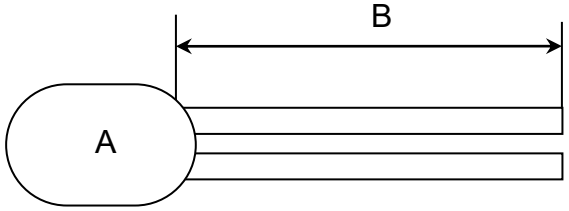
101	□□□□	S	4150F	1002	F
Individual identification	Style (B.1.2.1)	Lead type (B1.2.2)	Characteristics (B.1.2.3)	Nominal zero-power resistance (B.1.2.4)	Resistance tolerance (B.1.2.5)

Note: (1) "JAXA" indicates the part is for space use and may be abbreviated “J”.

B.1.2.1 Style

Style indicates the shape and the length of the lead terminal of the thermistor and shall be identified by a four-digit number as shown in Table B-1. The details shall be specified in the detail specification.

Table B-1. Style



Unit: mm

Style	A	B
	Style: identified by the first digit number	Lead terminal length: identified by the last three digit numbers
□□□□	1. Resin-sealed type	The first two digits indicate the significant figures and the last digit indicates the number of the digit. Example: 800 : 80mm 501 : 500mm 102 : 1,000mm

B.1.2.2 Lead Type

The lead terminal shall be identified by a single capital letter as shown in Table B-2.

Table B-2. Lead Terminal

Symbol	Lead terminal
C	Either Solder or welding can be applied.
S	Solder can be applied.
W	Welding can be applied.

B.1.2.3 Characteristics

The resistance-temperature characteristics shall be identified by a four-digit number and a single capital letter. The first four-digit number indicates the nominal B value as specified in the detail specification. The last capital letter indicates the B value tolerance as shown in Table B-3.

Table B-3. B Value Tolerance

Unit: %

Symbol	B value tolerance
F	±1
G	±2
H	±3
J	±5

B.1.2.4 Nominal Zero-Power Resistance

The nominal zero-power resistance shall be indicated by a four-digit number and is measured in ohms (Ω). The first three digits indicate significant figures and the last digit indicates the number of zero following them.

Example: 1000: 100Ω, 1002: 10,000Ω=10kΩ, 1004: 1,000,000Ω=1MΩ

B.1.2.5 Resistance Tolerance

The zero-power resistance tolerance shall be identified by a single capital letter as shown in Table B-4.

Table B-4. Zero-Power Resistance Tolerance

Unit: %

Symbol	Resistance tolerance(1)
F	±1
G	±2
H	±3
J	±5
K	±10

Note: (1) Value at the temperature of 25°C.

B.2. Applicable Documents

B.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2160.

B.2.2 Reference Documents

The following documents are reference documents of this appendix.

a) MIL-PRF-23648 Resistors, Thermal (Thermistor), Insulated, General Specification for

b) ESCC Generic Specification No. 4006 Thermistors (Resistors, Thermally Sensitive)

c) S-311-P-18 Thermistors (Thermally Sensitive Resistors) Insulated and Uninsulated, Negative Temperature Coefficient, Specification for

B.3. Requirements

B.3.1 Qualification Coverage

Qualification shall be valid for thermistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs B.3.2 through B.3.9. The qualification coverage shall be represented by samples that have passed the qualification test. Within this coverage, the manufacturer is allowed to supply qualified products in accordance with the detail specification. If necessary, additional qualification coverage shall be specified in the detail specification.

B.3.1.1 Qualification Constraints

The qualification coverage of nominal zero-power resistance shall be within the minimum and maximum nominal zero-power resistance of thermistors that have passed the qualification test. The tolerance range for B value and nominal zero-power resistance shall be as shown in Tables B-5 and B-6, respectively.

Table B-5. B value Tolerance Qualification

B value tolerance of sample	Qualified B value tolerance
F	F, G, H, J
G	G, H, J
H	H, J
J	J

Table B-6. Zero-Power Resistance Tolerance Qualification

B value tolerance of sample	Qualified resistance tolerance
F	F, G, H, J, K
G	G, H, J, K
H	H, J, K
J	J, K
K	K

B.3.2 Materials

The materials shall be as follows and as specified in paragraph 3.3 of JAXA-QTS-2160.

B.3.2.1 Temperature Sensitive Resistor

Temperature sensitive resistors shall be the semiconducting resistor with the resistance-temperature characteristics specified in the detail specification. Details shall be as specified in the detail specification.

B.3.2.2 Electrode

As specified in the detail specification.

B.3.2.3 Exterior Packaging

As specified in the detail specification.

B.3.2.4 Lead Connection Material

As specified in the detail specification.

B.3.2.5 Lead Terminal

As specified in the detail specification.

B.3.2.6 Heat Shrinkable Tube

As specified in the detail specification.

B.3.3 Externals, Dimensions, Mass and Marking

Thermistors shall meet the following requirements when tested in accordance with paragraph B.4.4.3.

B.3.3.1 Externals

Thermistors shall not have any cracks or nicks on the surface.

B.3.3.2 Dimensions and Mass

Thermistors shall meet the required dimensions and mass specified in the detail specification.

B.3.3.3 Markings

The following items at a minimum shall be marked on the surface of the thermistors in such a way that the marking are not easily vanished. If marking is difficult due to the shape or size of the thermistor, a part or all of the marking may be omitted.

The marking shall be legible after any test. The items specified in paragraph 5.2 of JAXA-QTS-2160 shall be marked on individual packaging or packaging.

a) Rating
   As specified in the detail specification.
b) Serial number
   As specified in the detail specification.

B.3.4 Workmanship

Thermistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1 of JAXA-QTS-2160. Thermistors shall be free of any holes, cracks, chips or deformations that will affect thermistor performance, and other defects affecting usability and appearance of the thermistors. The following requirements shall be met.

a) Temperature sensitive resistor
   Temperature sensitive resistors shall be free of cracks, chips, pinholes or deformations that will affect its performance.
b) Exterior packaging
   Temperature sensitive resistors shall be protected against moisture with a moisture-resistant insulation material.
c) Lead connecting material
   The lead connecting material shall be securely connected electrically to the temperature sensitive resistor and lead terminal.

B.3.4.1 DPA

When thermistors are tested as specified in paragraph B.4.4.4.1, processes such as temperature sensitive resistor, exterior packaging and electrode shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program.

B.3.5 Rating

The following items shall be specified in the detail specification.

a) Operating temperature range
   Unless otherwise specified, the temperature range shall be -55°C to +150°C.
b) Storage temperature range

c) Rated ambient temperature
d) Nominal zero-power resistance
e) Zero-power resistance tolerance
f) Nominal B value
g) B value tolerance
h) Allowable operating power (if specified)
i) Rated power
The operating temperature shall be 25°C or less. If the thermistor is continuously operated or tested at the operating temperature more than 25°C, the rated power shall be derated in accordance with the derating curve specified in the detail specification.

B.3.6 Electrical Performance

Thermistors shall meet the following electrical performance requirements.

B.3.6.1 Zero-Power Resistance

When thermistors are tested as specified in paragraph B.4.4.5.1, the zero-power resistance shall be within the tolerance specified in the detail specification.

B.3.6.2 B Value

When thermistors are tested as specified in paragraph B.4.4.5.2, the B value shall be within the tolerance specified in the detail specification.

B.3.6.3 Dielectric Withstanding Voltage

When tested as specified in paragraph B.4.4.5.3, there shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage on thermistors after the completion of the test. The zero-power resistance change shall not exceed the value specified in the detail specification.

B.3.6.4 Insulation Resistance

When thermistors are tested as specified in paragraph B.4.4.5.4, the insulation resistance shall be 100MΩ as a minimum.

B.3.6.5 Heat Dissipation Constant

When thermistors are tested as specified in paragraph B.4.4.5.5, the heat dissipation constant shall be as specified in the detail specification.

B.3.6.6 Thermal Time Constant

When thermistors are tested as specified in paragraph B.4.4.5.6, the thermal time constant shall be as specified in the detail specification.

B.3.6.7 Short-Time Load

When tested as specified in paragraph B.4.4.5.7, there shall be no evidence of arcing, burnout, burnt deposit or open circuit on thermistors after the completion of the test.

The amount of zero-power resistance change shall not exceed the value specified in the detail specification.

B.3.6.8 Resistance-Temperature Characterristics

When thermistors are tested as specified in paragraph B.4.4.5.8, the resistance-temperature curve shall conform to the curves specified in the detail specification and shall be within the resistance tolerance of each temperature.

B.3.7 Mechanical Performance

Thermistors shall meet the following mechanical requirements.

B.3.7.1 Solderability

When thermistors are tested as specified in paragraph B.4.4.6.1, at least 95% of the lead terminal surface shall be evenly covered with new solder. The existence of small pinholes or rough areas shall be acceptable, provided that they are not concentrated in one spot. The total area of the pinholes or rough areas shall be less than 5% of the solder area.

B.3.7.2 Resistance to Soldering Heat

When thermistors are tested as specified in paragraph B.4.4.6.2, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.7.3 Radiography

When thermistors are tested as specified in paragraph B.4.4.6.3, there shall be no void crossing over the lead terminals, or the void more than Φ0.30mm on the exterior package and lead connecting material.

B.3.7.4 Terminal Strength

When thermistors are tested as specified in paragraph B.4.4.6.4, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.7.5 Resistance to Solvents

When thermistors are tested as specified in paragraph B.4.4.6.5, there shall be no evidence of mechanical damage after the completion of the test. The marking shall be legible visually.

B.3.8 Environmental Performance

Thermistors shall meet the following environmental requirements.

B.3.8.1 Vibration

B.3.8.1.1 High Frequency Vibration

When thermistors are tested as specified in paragraph B.4.4.7.1.1, there shall be no electrical discontinuity of 0.1ms or greater duration during the test and no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.1.2 Random Vibration

When thermistors are tested as specified in paragraph B.4.4.7.1.2, there shall be no electrical discontinuity of 0.1ms or grater duration during the test and no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.2 Shock

When thermistors are tested as specified in paragraph B.4.4.7.2, there shall be no electrical discontinuity of 0.1ms or grater duration during the test and no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.3 Thermal Shock

When thermistors are tested as specified in paragraph B.4.4.7.3, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.4 Moisture Resistance

When thermistors are tested as specified in paragraph B.4.4.7.4, there shall be no evidence of electrical or mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.5 Immersion Cycling

When thermistors are tested as specified in paragraph B.4.4.7.5, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.6 Low Temperature Storage

When thermistors are tested as specified in paragraph B.4.4.7.6, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.8.7 High Temperature Exposure

When thermistors are tested as specified in paragraph B.4.4.7.7, there shall be no evidence of mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.3.9 Durability

Thermistors shall meet the following durability requirements.

B.3.9.1 Load Life

When thermistors are tested as specified in paragraph B.4.4.8.1, there shall be no evidence of corrosion or other mechanical damage after the completion of the test. The change in zero-power resistance shall not exceed the value specified in the detail specification.

B.4. Quality Assurance Provisions

B.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2160.

B.4.2 Qualification Test

The qualification test shall be performed in accordance with paragraph 4.4 of JAXA-QTS-2160 and as provided below.

B.4.2.1 Samples

The samples for the qualification test shall have the tightest B value tolerance and zero-power resistance tolerance at the minimum and maximum zero-power resistance of each style of thermistors.

The samples with the same style and different lead terminal length can be considered the same samples.

B.4.2.2 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table B-7. Upon completion of groups I and II tests, group III and subsequent tests shall be performed using samples allocated to the appropriate test groups. Group III and subsequent tests may be performed disregarding the numerical order. The test items within each test group shall be performed in the specified order as shown in Table B-7.

Table B-7. Qualification Test

Test			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
I	1	Thermal shock [I]	B.3.8.3	B.4.4.7.3	All	0
	2	High temperature exposure [I]	B.3.8.7	B.4.4.7.7		
	3	Sort-time load	B.3.6.7	B.4.4.5.7		
	4	Zero-power resistance	B.3.6.1	B.4.4.5.1		
	5	B value	B.3.6.2	B.4.4.5.2		
II	1	Externals, dimensions, mass and marking	B.3.3	B.4.4.3	All(1)	0
III	1	Resistance-temperature characteristics	B.3.6.8	B.4.4.5.8	20	0
	2	Heat dissipation constant	B.3.6.5	B.4.4.5.5		
	3	Thermal time constant	B.3.6.6	B.4.4.5.6		
	4	Insulation resistance	B.3.6.4	B.4.4.5.4		
	5	Dielectric withstanding voltage	B.3.6.3	B.4.4.5.3		
	6	Radiography	B.3.7.3	B.4.4.6.3		
	7	Terminal strength	B.3.7.4	B.4.4.6.4		
IV	1	Solderability	B.3.7.1	B.4.4.6.1	12	0
	2	Resistance to solvents	B.3.7.5	B.4.4.6.5		
V	1	Resistance to soldering heat	B.3.7.2	B.4.4.6.2	20	0
	2	Thermal shock [II]	B.3.8.3	B.4.4.7.3		
	3	Moisture resistance	B.3.8.4	B.4.4.7.4		
VI	1	Shock	B.3.8.2	B.4.4.7.2	20	0
	2	High frequency vibration	B.3.8.1.1	B.4.4.7.1.1		
	3	Random vibration	B.3.8.1.2	B.4.4.7.1.2		
	4	Thermal shock [IV]	B.3.8.3	B.4.4.7.3		
	5	Immersion cycling	B.3.8.5	B.4.4.7.5		
VII	1	Low temperature storage	B.3.8.6	B.4.4.7.6	230	0
	2	High temperature exposure [III]	B.3.8.7	B.4.4.7.7		
VIII	1	Load life [II]	B.3.9.1	B.4.4.8.1	30	0
IX	1	DPA	B.3.4.1	B.4.4.4.1	2	0
-	-	Materials	B.3.2	—	(2)	

Notes: (1)The dimensions and mass of thermistors shall be inspected by using sampling plan and Special inspection level S-4 in Appendix Table 1, and 4.0% of the acceptable quality level (AQL) in Appendix Table 2-A of JIS Z 9015-1 shall apply.
The acceptance level shall be (Ac, Re) =(0.1).
(2) The data to certify compliance with design specification shall be submitted.

B.4.3 Quality Conformance Inspection

The quality conformance inspection shall be performed as specified in paragraph 4.5 of JAXA-QTS-2160 and as provided below.

B.4.3.1 Samples

The inspection lot for group A inspections shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2160. Groups B and C inspections shall be performed for each style and the composition of the inspection lots shall be as specified in paragraph 4.5.2.1 of JAXA-QTS-2160. The samples with the same style and different lead terminal length can be considered the same samples.

B.4.3.2 Inspection Items and Sample Size

Inspection items and sample size of the groups A, B and C inspections in the quality conformance inspection shall be as specified in Tables B-8, B-9 and B-10, respectively. Group A inspections (A2 and after) and group B inspections need not to be performed in the group order however, the inspections within each group shall be performed in the specified order.

B.4.3.3 Disposition after Inspections

Products from the lot rejected in the group A quality conformance inspection shall not be delivered. If the lot has not passed the order 6 of group A1 and/or group A2 inspection, all products of the lot shall be subjected to the 100% inspection in accordance with paragraph H.3.3 of JAXA-QTS-2000, and only the good products shall be shipped. The samples used for the groups A3 and A4 inspections shall not be shipped.

Table B-8. Quality Conformance Inspection (Group A)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
A1	1	Thermal shock [I]	B.3.8.3	B.4.4.7.3	All	0
	2	High temperature exposure [I]	B.3.8.7	B.4.4.7.7		
	3	Sort-time load	B.3.6.7	B.4.4.5.7		
	4	Zero-power resistance	B.3.6.1	B.4.4.5.1		
	5	B value	B.3.6.2	B.4.4.5.2		
	6	Externals, dimensions, mass and marking	B.3.3	B.4.4.3	All(1)	0
A2	1	Resistance-temperature characteristics	B.3.6.8	B.4.4.5.8	AQL(2) 2.5%	
	2	Insulation resistance	B.3.6.4	B.4.4.5.4		
	3	Dielectric withstanding voltage	B.3.6.3	B.4.4.5.3		
	4	Radiography	B.3.7.3	B.4.4.6.3		
	5	Terminal strength	B.3.7.4	B.4.4.6.4		
A3	1	Solderability	B.3.7.1	B.4.4.6.1	5	0
	2	Thermal shock [II]	B.3.8.3	B.4.4.7.3		
A4	1	DPA	B.3.4.1	B.4.4.4.1	2	0

Notes: (1)The dimensions and mass of thermistors shall be inspected by using sampling plan and Special inspection level S-4 in Appendix Table 1, and 4.0% of the acceptable quality level (AQL) in Appendix Table 2-A of JIS Z 9015-1 shall apply. The acceptance level shall be (Ac, Re) =(0, 1).

(2)For a sampling plan, Special inspection level S-4 in Appendix Table 1, and Appendix Table 2-A of JIS Z 9015-1 shall apply. The acceptance level shall be (Ac, Re) =(0, 1).

Table B-9. Quality Conformance Inspection (Group B)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
B1	1	Heat dissipation constant	B.3.6.5	B.4.4.5.5	10	0
	2	Thermal time constant	B.3.6.6	B.4.4.5.6		
B2	1	Resistance to solvents	B.3.7.5	B.4.4.6.5	10	0
B3	1	Resistance to soldering heat	B.3.7.2	B.4.4.6.2	10	0
	2	Moisture resistance	B.3.8.4	B.4.4.7.4		
B4	1	Shock	B.3.8.2	B.4.4.7.2	10	0
	2	High-frequency vibration	B.3.8.1.1	B.4.4.7.1.1		
	3	Thermal shock [III]	B.3.8.3	B.4.4.7.3		
	4	Immersion cycling	B.3.8.5	B.4.4.7.5		
B5	1	Low temperature storage	B.3.8.6	B.4.4.7.6	30	0
	2	High temperature exposure [II]	B.3.8.7	B.4.4.7.7		
B6	1	Load life [I]	B.3.9.1	B.4.4.8.1	10	0

Table B-10. Quality Conformance Inspection (Group C)

Inspection			Requirement paragraph	Test method paragraph	Pass/fail	
Group	Order	Item			Number of samples	Quantity of allowable defects
C1	1	Random vibration	B.3.8.1.2	B.4.4.7.1.2	10	0
	2	Thermal shock [IV]	B.3.8.3	B.4.4.7.3		

B.4.4 Test Method

B.4.4.1 Test Conditions

Tests shall be performed in accordance with paragraph 4 of MIL-STD-202 with the following conditions.

a) Standard condition
Standard condition shall be a temperature of between 15 and 35°C, relative humidity of between 25 and 75% and atmospheric pressure of between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If it is necessary to strictly control the conditions to obtain the reproducible results, the judgment condition d) shall apply.

b) Judgment condition
Judgment condition shall be a temperature of 25±2°C, relative humidity of between 45 and 55% and an atmospheric pressure of between 86 and 106kPa.

c) Precautions
Sufficient attention is required to avoid condensation of humidity on thermistors during the tests except when humidity is required as a part of a test. Use caution not to damage the thermistors by heat when soldering the lead terminal.

B.4.4.2 Mounting Method

a) The thermistor shall be mounted by the anti-corrosive clip which is attached to the 3.2mm diameter brass rod. The lead terminal which is located at the point of 25.4±1.6mm from the edge of the sealed section of the thermistor shall be pinched for measuring the resistance.
Instead of using a clip, a thermistor can be soldered onto the printed wiring board as necessary. The material of the printed wiring board shall be the glass base woven epoxy resin copper-clad laminate for printed wiring board of 1.6mm±0.1mm thickness. Those materials shall not affect the results of the tests and measurements.
Samples shall be mounted on test substrates by hand soldering with tin-lead solder with an inactive flux whose nominal tin content is 60%. Use great caution not to affect the products. The lead terminal length and the space between thermistors shall be determined for each test.

B.4.4.3 Externals, Dimensions, Mass and Marking

Externals, dimensions and mass of the thermistors shall be inspected as follows.

a) The external inspection shall be performed with a magnifier of at least 10x magnitude.
b) The dimensions shall be measured with a vernier caliper of class 2 or higher as specified in JIS B 7507 or a micrometer compliant to JIS B 7502. Another measuring instrument may be used unless the measured values are questionable.
c) Marking shall be inspected visually.
d) The mass shall be inspected with a precision-type trip balance compliant to JIS B 7601. Another measuring instrument may be used unless the measured values are questionable.

B.4.4.4 Workmanship

B.4.4.4.1 DPA

Thermistors shall be disassembled to ensure that the temperature sensitive resistors, exterior packaging and electrodes are manufactured in a reliable condition and its internal structure complies with the specification in the quality assurance program plan. DPA shall be conducted in accordance with the DPA manual specified in the quality assurance program plan.

a) Thermistors shall be embedded in a proper resin or other materials, and cut at the perpendicular place along the line parallel to the longer direction of the thermistors. The cut face shall be polished and examined with a 10x to 200x magnifier for the thickness of the temperature sensitive resistors, exterior packaging and electrodes and the mating conditions of the temperature sensitive resistors and electrodes.
b) Thermistors shall be embedded in a proper resin or other materials, and cut at the perpendicular plane along the line right angle to the longer direction of the thermistors. The cut face shall be polished and examined by a 10x to 200x magnifier for the state of the exterior packaging.

The above examinations a) and b) shall require the respective samples to be photographed and recorded.

B.4.4.5 Electrical Performance

The electrical performance tests shall be performed as follows.

B.4.4.5.1 Zero-Power Resistance

Thermistors shall be contained in a medium that can maintain temperature to an accuracy of ±0.05°C to measure the zero-power resistance. The following conditions shall apply.

a) Accuracy of measuring devices
   1) Resistance measurement
      The resistance shall be measured with a Wheatstone bridge or equivalent device and the accuracy shall be within ±0.05%.

2) Temperature measurement
The accuracy of a temperature measurement shall be within ±0.01°C, and its responsiveness shall be equivalent or higher than that of thermistors.

b) Temperature stabilization
The medium and thermistors shall be left for a sufficient time until the temperature of medium is stabilized at the specified temperature.

c) Measurement
Thermistors shall be placed in the medium of a specified temperature and measured for zero-power resistance. First, the zero point calibration of output display shall be performed with the input voltage removed. Then, the thermistors shall be connected to the power source and measured for zero-power resistance. If the output value does not return to within the resistance tolerance, which is ±0.05% of the initial zero point, the thermistors shall be rejected.

B.4.4.5.2 B Value

The B value shall be calculated by measuring the zero-power resistance at 25°C and 85°C in accordance with paragraph B.4.4.5.1.

B.4.4.5.3 Dielectric Withstanding Voltage

B.4.4.5.3.1 Standard Atmospheric Pressure

Thermistors shall be tested in accordance with Test Method 301 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted securely on a right-angular cut-out metal block which is big enough for the thermistor not to go beyond the end of the V-shape cutout metal block as shown in Figure B-1. The applied force is such that the thermistor can keep the moderate contact with the surface of the cutout metal block. The thermistor shall be placed on the block in such a way that the distance between the lead terminal of the thermistor and the V-shape metal block is at a minimum the radius of the lead terminal.

b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

c) Test voltage
A test voltage of $500V_{AC}$±$15V_{AC}$ (commercial frequency: 50Hz or 60Hz, effective value) shall be applied between the thermistor and the V-shape metal block.

d) Test duration: 2 minutes $^{+10}_{0}$ seconds

e) Measurement during test
A leakage current shall be measured during the test, and the thermistors shall be examined for signs of arcing and breakage.

f) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

g) Post-test examination
The thermistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage.

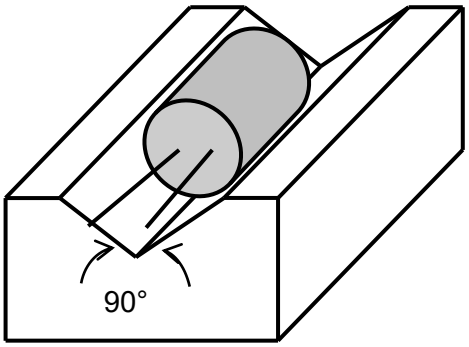


Figure B-1. Test Jig for the Dielectric Withstanding Voltage and Insulation Resistance Tests

B.4.4.5.3.2 Reduced Pressure

Thermistors shall be tested in accordance with Test Method 105 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted as specified in item a) of paragraph B.4.4.5.3.1.

b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

c) Test condition: C (4.39kPa)

d) Test voltage
A test voltage of $200V_{AC}\pm15V_{AC}$ (commercial frequency: 50Hz or 60Hz, effective value) shall be applied between the thermistor and the V-shape metal block.

e) Test duration: 2 minutes $^{+10}_{0}$ seconds

f) Measurement during test
A leakage current shall be measured during the test, and the thermistor shall be examined for signs of arcing and breakage.

g) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

h) Post-test examination
The thermistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage with a magnifier of at least 10x magnitude.

B.4.4.5.4 Insulation Resistance

The insulation resistance shall be measured in accordance with Test Method 302 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted as specified in item a) of paragraph B.4.4.5.3.1.
b) Test condition: A ($100V_{DC}$±$10V_{DC}$)
c) Test duration: 1 minute $^{+10}_{0}$ seconds

B.4.4.5.5 Heat Dissipation Constant

Thermistors shall be tested according to the following procedures to calculate the heat dissipation constant.

a) The zero-power resistance shall be measured at 25°C and 75°C in accordance with paragraph B.4.4.5.1.
b) The DC power supply or storage batteries shall be used as the power supply.
c) Thermistors shall be set in the test chamber (still air chamber) whose capacity is more than 1,000 times of the volume of a thermistor and the mounting jig. The temperature inside the test chamber shall be maintained at 25°C±1°C.
d) Load
The voltage E_{TH} and current I_{TH} shall be adjusted to be the zero-power resistance at 75°C in the test circuit shown in Figure B-2, and a load shall be applied for 15 minutes as a maximum.
e) The voltage and current shall be measured with a high-impedance voltmeter and ammeter, respectively.
f) The voltage ETH and current ITH shall be recorded.
g) The heat dissipation constant shall be calculated with the following formula and recorded.

$$\frac{P}{50} = \frac{E_{TH} \times I_{TH}}{75°C - 25°C} \quad \text{(mW/°C)}$$

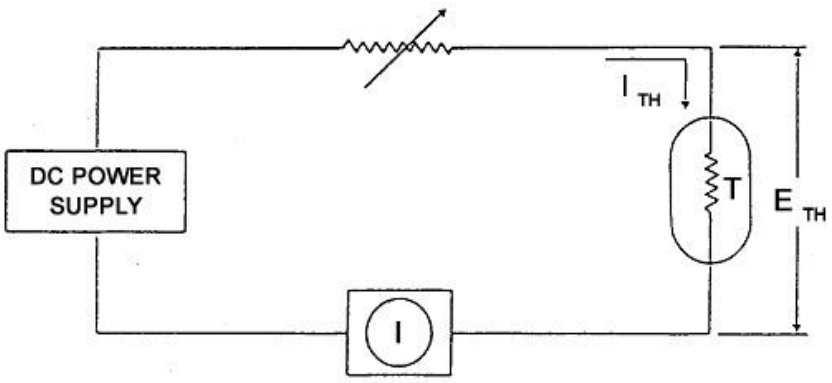


Figure B-2. Measurement Circuit for Heat Dissipation Constant

B.4.4.5.6 Thermal Time Constant

Thermistors shall be tested as specified in paragraph B.4.4.5.6.1 or B.4.4.5.6.2 to measure the thermal time constant.

B.4.4.5.6.1 Measurement by Cooling after Self-Heating

Thermistors shall be tested according to the following procedures.

a) The zero-power resistance shall be measured at 43.4°C and 75°C in accordance with paragraph B.4.4.5.1, and the results shall be recorded.
b) The DC power supply or storage batteries shall be used as the power supply.
c) Thermistors shall be set in the test chamber (still air chamber) whose capacity is more than 1,000 times of the volume of a thermistor and the mounting jig. The temperature inside the test chamber shall be maintained at 25°C±1°C.
d) The test circuit shall be specified in "Figure 12 - Thermal time constant measurement circuit" of JIS C 2570-1 "Directly heated negative temperature coefficient thermistors - Part 1: General specification". The voltage and current applied to the thermistors shall be adjusted so that the zero-power resistance value reach to at 75°C, and leave the thermistor for a maximum of 15 minutes until it stabilizes.
e) The bridge shall be adjusted to zero by using the zero-power resistance at 43.4°C measured by the above procedure a).
f) The time from the moment when the interlock switch, which is specified in Figure 12 of JIS C 2570-1, is turned to the BB side until the value on the resistance measuring device reaches zero shall be measured and recorded.

Figure B-3. Measurement Circuit for Thermal Time Constant (deleted)

B.4.4.5.6.2 Measurement by the Ambient Tempereture Change

Thermistors shall be tested according to the following procedures.

a) The zero-power resistance shall be measured at 43.4°C and 75°C in accordance with paragraph B.4.4.5.1 and recorded.
b) The test circuit shall be applied as specified in Figure B-4.
c) The bridge shall be adjusted to zero by using the zero-power resistance at 43.4°C measured by the above procedure a).
d) Thermistors shall be immersed completely in a low-viscosity liquid (1mm^2/s max) in a constant-temperature bath of 75°C±1°C. The liquid shall not evaporate from the thermistor surface when the thermistors are removed from the bath.
e) A still air chamber shall be placed on the constant-temperature liquid bath. The still air chamber shall have the capacity of more than 1,000 times of the volume of a thermistor and its jig, and shall be maintained at 25°C±1°C. The thermistors shall be removed from the liquid bath and transferred to the air chamber at a constant rate of 50.8mm±6.35mm per second by using a drive mechanism or other means.
f) The time measurement shall be started as soon as the thermistors are taken out from the surface of the liquid. The time from the moment when the thermistors are taken out from the liquid until when the bridge reaches to zero shall be measured and recorded.

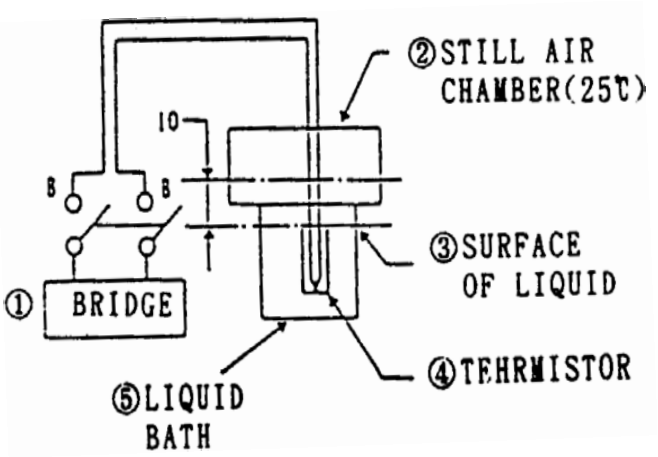


Figure B-4. Measurement Circuit for Thermal Time Constant

B.4.4.5.7 Short Time Load

After the zero-power resistance is measured at 25°C in accordance with paragraph B.4.4.5.1, the voltage E_{TH} and current I_{TH} necessary to apply rated power shall be calculated from the heat dissipation constant and thermal time constant specified in the detail specification. The voltage E_{TH} and current I_{TH} of the circuit shown in Figure B-2 shall be adjusted at the calculated value and the circuit shall be connected to the thermistors. Five minutes of energization and ten minutes of disconnection shall be repeated for ten cycles. The following conditions shall apply.

a) Mounting method
   Thermistors shall be mounted as specified in item a) of paragraph B.4.4.2. However, do not cut the lead wires.
b) The DC power supply or storage batteries shall be used as the power supply.
c) Test condition
   The test shall be performed in the standard condition. However, air circulation other than that caused by the heat from the operating thermistors.
d) Post-test examination
   The thermistors shall be examined for the evidence of arcing, burnout or burnt deposit.
e) Post-test measurement
   60 minutes after removing from the test circuit, the zero-power resistance of the thermistors shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

B.4.4.5.8 Resistance-Temperature Characteristics

Thermistors shall be stabilized at the temperature specified in Table B-11. After leaving the thermistors for a period of time equivalent to ten times or more of the thermal time constant, the zero-power resistance shall be measured at each specified temperature in accordance with paragraph B.4.4.5.1. If the thermistor needs to be measured at a temperature other than the ones listed in Table B-11, specify in the detail specification.

Table B-11. Temperature for the Resistance-Temperature Test

Unit: °C

Order	Test Temperature	
	Qualification test	Quality conformance inspection
1	-55	-55
2	-15	25
3	0	85
4	25	150
5	50	-
6	75	-
7	85	-
8	100	-
9	125	-
10	150	-

B.4.4.6 Mechanical Performance

The mechanical performance tests shall be performed as follows.

B.4.4.6.1 Solderability

Thermistors shall be tested in accordance with Test Method 208 of MIL-STD-202 with the following conditions.

a) Type of solder
   The solder shall be tin-lead solder with an inactive flux whose nominal tin content is 60%.
b) Temperature of Solder: 245°C±5°C
c) Immersion time: 5±0.5 seconds
d) Method for immersion
   Both lead terminals shall be immersed at the same time
e) Post-test examination
   The wettability of solder shall be examined with a magnifier of at least 10x magnitude.

B.4.4.6.2 Resistance to Soldering Heat

Thermistors shall be tested in accordance with Test Method 210 of MIL-STD-202 with the following conditions.

a) Pre-test measurement
   The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
b) Test condition: Condition B
c) Immersion depth
   A depth at 3.2 to 4.8mm from the sealed section of the thermistor.
d) Post-test measurement
   The thermistors shall be left until they are stabilized at ambient temperature and measured for the zero-power resistance at 25°C in accordance with paragraph B.4.4.5.1.

e) Post-test examination
The thermistors shall be examined for mechanical damage or terminal electrode dissolution with a magnifier of at least 10x magnitude.

B.4.4.6.3 Radiography

Thermistors shall be tested in accordance with Test Method 202 of MIL-STD-202 with the following conditions.

a) Radiography shall have a sufficient quality to project a clear and sharp image using a penetrometer.
b) A sample shall be placed on the point where the outline of the image is clear.
c) Photographing shall be performed from the vertical direction of the long axis of the thermistor's sealed section.
d) The film of the radiography shall have a sufficient sensitivity to clearly detect Φ 0.10mm lead particles. By the manufacturer's choice, double-sided emulsion film can be used. If the technique which a film is not used is applied, the following conditions shall be met.
   1) The record shall have a resolution equivalent to the radiography film, and shall be stored in reproducible electronic medium.
   2) Compared with the technique using radiographic film, the equipment shall have a performance which will have an equivalent quality results. The digital image shall be inspected by using a display monitor which can magnify the image higher than the magnification for the film inspection. Moreover, the radiographic image shall satisfy the quality criteria specified in a) above, and do not magnify the image until the feature of the flaw becomes unclear.
e) The image from the penetrometer shall be included in each film.
f) The radiography shall be examined with a magnifier of at least 10x magnitude.

B.4.4.6.4 Terminal Strength

Thermistors shall be tested in accordance with Test Method 211 of MIL-STD-202 with the following conditions.

a) Mounting method
The sealed section of the thermistors shall be fixed and the load shall be applied to the end of the lead terminal. The length of the lead terminal shall be 25.4±1.6mm.
b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
c) Test condition and applied force: Condition A, 2.2N {224gf}
d) Test duration: 5 to 10 seconds
e) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
f) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

B.4.4.6.5 Resistance to Solvents

Thermistors shall be tested in accordance withTest Method 215 of MIL-STD-202 with the following conditions.

a) Applied area: Marking area
b) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude. The marking shall be legible by visual examination.

B.4.4.7 Environmental Performance

The environmental performance tests shall be performed as follows.

B.4.4.7.1 Vibration

B.4.4.7.1.1 High Frequency Vibration

Thermistors shall be tested in accordance with Test Method 204 of MIL-STD-202 with the following conditions.

a) Mounting method
Thermistors shall be mounted on a jig which could control the movement of the thermistor and support the lead located at 6.4mm from the edge of the sealed section of the thermistor. Thermistor may be fixed by adhesives. Thermistor shall be mounted on the vibration table in such a way that the same amount of vibration applied on the vibration table will be applied to the thermistor. The lead wire used shall be no larger than AWG22. This shall not apply if the thermistor has already been mounted on the test substrates to perform tests specified in the same group.
b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
c) Test condition: Condition D
Amplitude: [whichever is smaller of196m/s2 {20G} p-p or total amplitude of 1.5mm]
Frequency range: 10 to 2,000Hz
Sweep time: The entire frequency range and return shall be traversed in 20 minutes.
Direction: 12 times in each of three directions; a longitudinal direction of the thermistor sealed section, and two mutually perpendicular directions.
d) Measurement during test
The thermistors shall be monitored using a method that can monitor or automatically record the electrical discontinuity of 0.1ms or greater duration to judge the electrical discontinuity.
e) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
f) Post-test examination
The thermistors shall be examined for mechanical and electrical damage with a magnifier of at least 10x magnitude.

B.4.4.7.1.2 Random Vibration

Thermistors shall be tested in accordance with Test Method 214 of MIL-STD-202 with the following conditions.

a) Mounting Method
Thermistors shall be mounted as specified in item a) of paragraph B.4.4.7.1.1.

b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

c) Test condition: Condition H-II Frequency range: 50Hz to 2,000Hz
Total effective acceleration: 334m/s^2 {34.02G}

d) Vibration direction
In each of three directions; a longitudinal direction of the thermistor sealed section, and two mutually perpendicular directions.

e) Frequency and duration
Vibration shall be applied for two minutes, five times in each direction with total test duration of 30 minutes.

f) Measurement during test
The thermistors shall be monitored using a method that can monitor or automatically record the electrical discontinuity of 0.1ms or greater duration to judge the electrical discontinuity.

g) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

h) Post-test examination
The thermistors shall be examined for mechanical and electrical damage with a magnifier of at least 10x magnitude.

B.4.4.7.2 Shock

Thermistors shall be tested in accordance with Test Method 213 of MIL-STD-202 with the following conditions.

a) Mounting method
Thermistors shall be mounted as specified in item a) of paragraph B.4.4.7.1.1.

b) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

c) Test condition: Condition C [980m/s^2 {100g's}, 6ms, half sine wave]
Number of cycles: 10 times in each of three directions; a longitudinal direction of the thermistor sealed section, and two mutually perpendicular directions.

d) Measurement during test
The thermistors shall be monitored using a method that can monitor or automatically record the electrical discontinuity of 0.1ms or greater duration to judge the electrical discontinuity.

e) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

f) Post-test examination
The thermistors shall be examined for mechanical and electrical damage with a magnifier of at least 10x magnitude.

B.4.4.7.3 Thermal Shock

Thermistors shall be tested in accordance with Test Method 107 of MIL-STD-202 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

b) Test condition
Test condition shall be as specified in Table B-12.

c) Measurement during and after test
The zero-power resistance shall be measured at 25°C within 1 to 24 hours after the test in accordance with paragraph B.4.4.5.1. The condition of Thermal shock [IV] includes the measurement of zero-power resistance after 100 cycles and after 500 cycles as intermediate measurements.

d) Post test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

Table B-12. Test Conditions (Thermal Shock)

Test type	Step(1)	Temperature (°C)	Time (min.)	No of cycles
Thermal shock [I]	1	$-55\ ^{0}_{-5}$	15	10
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [II]	1	$-65\ ^{0}_{-5}$	15	25
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$150\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [III]	1	$-55\ ^{0}_{-5}$	15	100
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	
Thermal shock [IV]	1	$-55\ ^{0}_{-5}$	15	1,000
	2	$25\ ^{+10}_{-\ 5}$	5 max	
	3	$125\ ^{+3}_{0}$	15	
	4	$25\ ^{+10}_{-\ 5}$	5 max	

Note: ([1]) Steps 2 and 4 shall not apply in case of single compartment chamber.

B.4.4.7.4 Moisture Resistance

Thermistors shall be tested in accordance with Test Method 106 of MIL-STD-202 with the following conditions.

a) Mounting method
The space around the thermistor shall be at least 25.4mm, and a lead terminal shall be soldered to the terminal on the insulation board.
Lead wires of the thermistor shall be cut so that the total length is within 25.4mm.

b) Pre-test measurement
More than an hour and a half after the thermistors are removed from a dryer, the zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

c) Load
The test voltage to maintain the rated power specified in the detail specification shall be applied to a half of the thermistors to be tested for the first two hours of step 2 and step 5. The rest shall be tested without the application of voltage.

d) Post-test measurement
After completion of the final test cycle of step six, the thermistors shall be kept in high humidity condition of 25°C±2°C for 1.5 to 3.5 hours. The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1,

and insulation resistance in accordance with paragraph B.4.4.5.4 within 24 hours after the thermistors are removed from the test chamber. The measurement shall not be performed in a forced circulated air.

e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

B.4.4.7.5 Immersion Cycling

Thermistors shall be tested in accordance with Test Method 104 of MIL-STD-202 with the following conditions.

a) Test condition: B
b) Measurement and examination after final test cycle
1) Measurement of resistance
The zero-power resistance shall be measured within 24 hours after the final cycle as specified in paragraph B.4.4.5.1.
2) External examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

B.4.4.7.6 Low Temperature Storage

Thermistors shall be tested in accordance with paragraph 4.23 of JIS C 2570-1 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
b) Test temperature: -55°C±3°C
c) Test duration: 3^{+1}_{0} hours
d) Post-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.
e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

B.4.4.7.7 High Temperature Exposure

Thermistors shall be tested in accordance with paragraph 4.24 of JIS C 2570-1 with the following conditions.

a) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph A.4.4.5.1.
b) Test temperature
Test shall be performed at the maximum operating temperature specified in the detail specification.
c) Test duration
As specified in Table B-13.

d) Measurement during and after test
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1 after a lapse of 100^{+4}_{0} , 250±12, 500±12, 1,000±12, $2{,}000^{+24}_{0}$ and $4{,}000^{+48}_{0}$ hours.

e) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x magnitude.

Table B-13. Test condition (High Temperature Exposure)

Type	Time
High temp. exposure [I]	100^{+4}_{0} hours
High temp. exposure [II]	$2{,}000^{+24}_{0}$ hours
High temp. exposure [III]	4000^{+48}_{0} hours

B.4.4.8 Durability

B.4.4.8.1 Load Life

Thermistors shall be tested in accordance with Test Method 108 of MIL-STD-202 with the following conditions.

a) Mounting method
The thermistor shall be mounted as specified in item a) of paragraph B.4.4.2. The thermistors shall be placed to prevent that the generated heat of thermistors affects the temperature of other thermistors. The thermistors shall not be exposed to wind.

b) Test temperature: 25^{+5}_{0} °C

c) Pre-test measurement
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1.

d) Test circuit: Figure B-2

e) Operating conditions
The rated voltage specified in the detail specification shall be applied intermittently, 90 minutes on and 30 minutes off.

f) Test conditions
As specified in Table B-14.

g) Measurement during and after test
The zero-power resistance shall be measured at 25°C in accordance with paragraph B.4.4.5.1 at the end of each intermittent period after 250±12, 500±12, 1,000$^{+24}_{0}$, 2,000$^{+24}_{0}$ and 4,000$^{+48}_{0}$ hours have passed.

h) Post-test examination
The thermistors shall be examined for mechanical damage with a magnifier of at least 10x of magnitude.

Table B-14. Test condition (Load Life)

Type	Time
Load life [I]	$1{,}000^{+24}_{0}$ hours
Load life [II]	4000^{+48}_{0} hours

B.4.5 Long-Term Storage

The following inspections shall be conducted for all the thermistors that have been stored for a long period of time in accordance with paragraph 4.7.1 of JAXA-QTS-2160.

a) Externals, dimensions and marking (paragraph B.3.3)
b) Zero-power resistance (paragraph B.3.6.1)

In addition to above 100% inspections, a sampling inspection shall be conducted as specified in Table B-8 for solderability. The data of reinspection shall be marked on the package or storage box. The lots rejected in the solderability inspection shall not be delivered.

B.4.6 Changes to Tests and Inspections

Any change to tests and inspections shall be made in accordance with paragraph 4.8 of JAXA-QTS-2160.

B.5. Preperation for Delivery

Preparation for delivery shall be as specified in paragraph 5 of JAXA-QTS-2160.

B.6. Notes

Refer to the paragraph 6 of JAXA-QTS-2160.