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RESISTORS,
HIGH RELIABILITY,
SPACE USE,
GENERAL SPECIFICATION FOR

JAXA
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: December 28, 2021

Revision Log		
Revision	Date	Description
NC	31 March 2004	Original
A	20 Sept. 2007	(1) Revised to reflect the changes associated with revision from JAXA-QTS-2000B to JAXA-QTS-2000C. • Changed “NASDA ****” to “JAXA ****” in the part number definition. (2) Changed the requirements of film chip resistors to cover the added types.(Appendix E) • Table E-3 Added a symbol indicating resistance temperature characteristics. • Paragraph E.1.3.3 Changed to represent the nominal resistance by 3 digits for F deviation (±1.0%). • Table E14 Changed the voltage to measure resistance. (3) Added requirements on jumper resistors.(Appendix E) • Paragraph E.1.3 Added the part number definition. • Paragraph E.3 Added specific requirements • Paragraph E.4.2 Specified inspection items and sample sizes for qualification conformance inspection. • Figures E-1 through E-4 Specified the dimensions of board for installation. • Paragraph E.4.4.5 to E.4.4.8 Specified load conditions for each test. (4) Clarified the inspection lots for qualification conformance inspection (Appendixes A, B, E and F) (5) Other changes for clarification and consistency of the requirements. • Paragraph 2.2 Reflected the revision of NASDA Parts Application Handbook from NASDA-HDBK-4 to JERG-0-035. • Added “In-Process Inspection”, “Long-Term Storage”, “Change of Tests and Inspections”, “Preparation for Delivery” and “Note” in each appendix.
B	23 June 2009	(1) Reflected the required specification including the additional styles for chip fixed film resistor (Appendix E) • Table E-2: Changed the rated power for the style "CRK". • Table E-3: Added symbols indicating resistance temperature characteristics. • E.4.3.1: Changed inspection lot selection for quality conformance inspection. • E.4.4.2: Added a glass woven base epoxy resin base material copper-clad laminate, printed wiring board for usable material in the test. (2) Clarified the test conditions in Life and Power conditioning in each appendix. (3) Clarified the description of inspection lot for quality conformance inspection (H.4.3.1) (4) Other changes: Corrected errors.
C	12 July 2010	(1) Added required specification (Appendix J) of Chip fixed metal film resistor.

Revision Log

Revision	Date	Description
D	11 June 2013	(1) Reflected the contents of Notification of Change 1 to the main text (Appendix E and J) (2) Reviewed the requirements of RESISTOR NETWORKS, FIXED, FILM (Appendix D) · Paragraph 1.3: Modified the part number · Paragraph 3.3.1: Modified the marking on the product · Tables D-10, D-12 and D-13: Modified the quantity of allowable defects · Paragraph D.4.3.1: Clarified the definition of inspection lot of Quality conformance inspection
E	29 June 2021	(1) Cover: Changed corporate name. (2) Paragraph 4.4.3: As for sample size, added that the samples had to include all types of construction and materials used for products, which were within the qualification coverage. Furthermore, added description that manufacturer had to take counsel with JAXA to select sample to typify qualification coverage. (3) Deleted paragraphs 3.1.3 and 3.1.4. (4) Paragraph 3.1.5: changed paragraph number as “3.1.3 Change of Qualification Coverage”. (5) Reconsidered requirement specification of power type, wire wound, fixed resistors (Appendix G). · Paragraph G.1.3: Specified the part number except for RWS. · Paragraph G.1.3.1: Added description that the configuration except for RWS had to be specified in detail specification. · Paragraph G.1.3.4 Table G-5 and Table G-6: Added tolerance of resistance value ±0.1% (symbol B). · Paragraph G.3.2.4.2: Added description that solderability test was not applicable to weldable terminals. · Paragraphs G.3.3, G.4.4.2 and Table G-7: Added “mass” in item name. · Paragraph G.3.4 b): Changed average winding pitch from five times to four times. Furthermore, added provision when the average winding pitch was equal to or more than four times. · Paragraphs G.3.4.2, G.4.4.3.2, and Table G-7 and Table G-8: Added radiographic inspection as requirement. · Paragraphs G.3.6.1 and G.4.4.4.1: Clarified confirmation items after tests. · Paragraphs G.3.7.3, G.4.4.5.3,and Table G-7 and Table G-9: Added resistance to soldering heat test as requirement. · Table G-7 Note(^{2}): As for sample size, specified that the size had to be judged on the basis of acceptable quality level (AQL) 1.0% or 10 samples, whichever was greater. · Table G-7 Note(^{3}): Deleted. · Table G-7 Note(^{5}): Added description that in-process inspection could be replaced by radiograph inspection records. · Table G-8: Added Notes (^{1}) and (^{5}). · Paragraph G.4.4.1: Added d) magnification of external visual inspection as common requirement for test methods. · General: Clarified magnification of visual inspection as 5x to 20x. Furthermore, clarified provision in case of conflict.

		· Paragraphs G.4.4.2.1 and G.4.4.2.2: Reconsidered requirements for c) dimensions and defined that provision of qualification test was identical to that of quality conformance inspection. · Paragraphs G.4.4.2.1 and G.4.4.2.2: Reconsidered inspection method of d) mass and defined that provision of qualification test was identical to that of quality conformance inspection. · Paragraph G.4.4.3.1: Changed “DPA manual” to “DPA procedures et al, which compose of quality assurance program documents”. · Paragraph G.4.4.3.1 b): On the basis of MIL-PRF-39007 requirements, added provision of “close adhesion state of external coating” and “connection state of cap and lead wire”. · Paragraph G.4.4.5.1.2: Added plating criteria to e) inspection after tests of torsion test of cable terminals. · Paragraph G.4.4.6.5: Clarified that solvent types had to be in accordance with Test Method 215 of MIL-STD-202 and clarified that solvents had to be specified in detail specification when the solvent type was limited.

Contents

RESISTORS,
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, fixed resistors (hereinafter referred to as "resistors") used for electronic equipment installed on spacecrafts. This specification complies with JAXA-QTS-2000 (Common Parts/Materials, Space Use, General Specification for) which was recently established to transition to the qualified manufacturing line system and replaces the following specifications.

a) NASDA-QTS-55182G Resistors, Fixed, Film, High Reliability, Space Use, General Specification for
b) NASDA-QTS-39017C Resistors, Fixed, Film (Insulated Small), High Reliability, Space Use, General Specification for
c) NASDA-QTS-83401A Resistor Networks, Fixed, Film, High Reliability, Space Use, General Specification for
d) NASDA-QTS-55342A Resistors, Fixed, Film, Chip, High Reliability, Space Use, General Specification for
e) NASDA-QTS-1059 Resistor Networks, Chip, High Reliability, Space Use, General Specification for
f) NASDA-QTS-39007B Resistors, Fixed, Wire Wound (Power Type), High Reliability, Space Use, General Specification for
g) NASDA-QTS-39009A Resistors, Fixed, Wire-Wound (Power Type, Chassis-Mounted), High Reliability, Space Use, General Specification for

1.2 Terms and Definitions

The definitions for terms used herein are as follows and as specified in JAXA-QTS-2000.

a) Resistance-temperature characteristics
The relative change (average coefficient) in the resistance between two specified temperatures divided by the temperature difference. Generally expressed in ppm per degree (10^{-6}/°C).

$$\alpha = \frac{R_2 - R_1}{R_1 \times \Delta\theta}$$

Where: Δθ: Typical difference between reference temperature and test temperature expressed in degrees Celsius.

R_1: Resistance at reference temperature

R_2: Resistance at test temperature

1.3 Classification

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

1.4 Part Number

The part number shall be in accordance with paragraph A.3.1.4 of JAXA-QTS-2000. The details shall be in accordance with each appendix.

Table 1. Classification

Classification	Style	Appendix	Corresponding QPL Specification
Resistors, Fixed, Film	RNS 50, 55, 60, 65, 70 RNS 90C, 90P	A	NASDA-QTS-55182G
Resistors, Fixed, Film (Insulated Small)	RLS 05C, 07C, 20C, 32C,42C RLS 05T, 07T, 20T, 32T, 42T	B	NASDA-QTS-39017C
Resistor Networks, Fixed, Film	---	D	NASDA-QTS-83401A
Resistors, Chip, Fixed, Film	RMS 06, 10, 12, 15, 20, 35 CRK 2H, 4H, 8H, 10H, 16H SCR 16, 20,32, 35, 50 WCR 32, 50, 64	E	NASDA-QTS-55342A
Resistor Networks, Chip,	RZCS 16	F	NASDA-QTS-1059
Resistors, Fixed, Wire Wound, Power Type	RWS 80, 81, 83, 84, 89	G	NASDA-QTS-39007B
Resistors, Fixed, Wire Wound (Power Type, Chassis-Mounted)	RES 40, 50, 60, 65, 70, 75	H	NASDA-QTS-39009A
Resistor, Chip, Fixed, Metal Film	1005, 1608, 2012, 3216, 3225	J	–

2. APPLICABLE DOCUMENTS

2.1 Applicable Documents

The documents listed below form a part of this specification to the extent specified herein. These documents are 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) JIS B 7502 Micrometer Callipers
c) JIS B 7507 Vernier, Dial and Digital Callipers
d) JIS B 7601 Trip Balances
e) JIS C 5201-1 Fixed Resistors for Use in Electronic Equipment – Part 1: Generic Specification
f) JIS K 8839 2-Propanol
g) JIS Z 3197 Testing Method for Soldering Fluxes
h) JIS Z 9015-1 Sampling Procedures for Inspection by Attributes – Part 1: Sampling Plans Indexed by Acceptable Quality Level (AQL) for Lot-by-Lot Inspection
i) MIL-STD-202 Test Method Standard, Electronic and Electrical Component Parts
j) MIL-STD-1276 Interface Standard, Leads for Electronic Component Parts

k) ASTM E595 Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment

2.2 Reference Documents

Following document is a reference document.

a) JERG-0-0035 NASDA Parts Application Handbook

2.3 Order of Precedence

In the event of a conflict between the text of this specification and the applicable documents, the following order of precedence shall be applied.

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 style and performance of the resistors are specified in each detail specification.
The detail specification shall be prepared and implemented by a manufacturer in accordance with Section A.4 of JAXA-QTS-2000. The detailed specification shall also be registered and issued to 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: JAXA-QTS-2050 / A □□□ □

This specification number	Appendix letter	Individual identification	Revision letter

2.4.2 Revision Letter of the Detail Specification

A revision letter in the detail specification number is 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 in accordance with paragraph 2.4.1.

2.4.4 Format of Detail Specification

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

3. REQUIREMENTS

3.1 Certification

3.1.1 Qualification Coverage

Qualification coverage shall be as specified in each appendix.

3.1.2 Initial Qualification

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

3.1.3 Change of Qualification Coverage

To change the qualification coverage, the manufacturer shall perform procedures for re-qualification 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, the manufacturer 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 manufacturer shall generate 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 certification status in compliance with this specification, the manufacturer shall form and operate the Technical Review Board (TRB) in accordance with paragraph 3.3.5 of JAXA-QTS-2000.

3.3 Materials

Materials used for manufacturing the resistors shall be in accordance with this specification. A material not specified shall satisfy the requirements of this specification and shall be specified in the manufacturing conditions of the quality assurance program.

3.3.1 Outgassing

Unless otherwise specified, organic materials used for resistors 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

3.4 Design and Construction

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

3.5 Externals, Dimensions and Marking

The externals, dimensions, mass, marking and other requirements shall be in accordance with each appendix.

3.6 Workmanship

The workmanship of the resistors shall be in accordance with each appendix.

3.7 Rating

The rating of the resistors shall be in accordance with each appendix.

3.8 Electrical Performance

Electrical performance of the resistors shall be in accordance with each appendix.

3.9 Mechanical Performance

Mechanical performance of the resistors shall be in accordance with each appendix.

3.10 Environmental Performance

Environmental performance of the resistors shall be in accordance with each appendix.

3.11 Durability

Durability of the resistors shall be in accordance with each appendix.

4. QUALITY ASSURANCE PROVISIONS

4.1 General Requirements

The manufacturer 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

The manufacturer shall perform the in-process inspections during the manufacturing process 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. The examples of the in-process inspections are shown below.

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

4.4 Qualification Test

4.4.1 Sample

Samples shall be manufactured in accordance with the process and control as specified in the quality assurance program and shall also typify the qualification coverage.

4.4.2 Manufacturing Records

The manufacturer, who intends to acquire certification status, shall archive material certification, receiving inspection data or test data of materials used, 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, order of tests, number of samples and sampling method shall be in accordance with each appendix.
Samples shall include all types of construction and materials used for products within qualification coverage at minimum resistance value, critical resistance value and maximum resistance value. The manufacturer shall take counsel with JAXA to select sample to typify qualification coverage.

4.4.4 Criteria for Pass/Fail

A failure of any test in the qualification tests specified in each appendix shall constitute failure of the qualification tests. If the observed number of defects are less than or equal to the specified acceptance number, but the failure mode of the defect is catastrophic such as open or short circuit where the function of the resistor might be lost, the resistor fails the qualification test.

4.4.5 Disposition after Tests

The samples used in the qualification test shall not be delivered. The products in the same inspection lot that have passed the qualification test may be delivered if they passed the Group A quality conformance inspections.

4.5 Quality Conformance Inspection

4.5.1 Quality Conformance Inspection (Group A)

All products shall be subjected to Group A inspections at the time of production.

4.5.1.1 Sample

Selection of test samples for Group A inspection lots shall be defined as part of the manufacturing conditions of the quality assurance program.

4.5.1.2 Inspection Items and Sample Size

The inspection items, inspection order, the number of samples and sampling method in Group A inspections shall be in accordance with each appendix.

4.5.1.3 Criteria for Pass/Fail

A failure of any test in Group A inspections specified in each appendix shall constitute failure of the Group A inspections. If the observed number of defects are less than or equal to the specified acceptance number, but the failure mode of the defect is catastrophic such as open or short circuit where the function of the resistor might be lost, the resistor fails the Group A inspection. Details shall be specified in each appendix.

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 C)

Group B and C inspections shall be performed in accordance with the following schedule.

a) The Group B inspection shall be performed using samples from the first products manufactured within the certification period.
b) The Group C inspection shall be performed prior to the restart of production if no products were manufactured within the previous certification period and recertification is granted without performing a quality conformance inspection.

4.5.2.1 Sample

Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections.

4.5.2.2 Inspection Items and Sample Size

Items, order, and the number of samples of Group B and C inspection shall be in accordance with each appendix. Sampling method shall be constant sampling from the resistors of arbitrary shape and resistance or shall be in accordance with JIS Z 9015-1.

4.5.2.3 Criteria for Pass/Fail

A failure of any inspection in Group B or C inspection specified in each appendix shall constitute failure of the quality conformance inspection of each group. If the observed number of defects are less than or equal to the specified acceptance number, but the failure mode of the defect is catastrophic such as open or short circuit where the function of the resistor might be lost, the resistor fails the quality conformance inspection.

4.5.2.4 Disposition after Inspections

The samples used for the Group B and 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 defect and take corrective actions on applicable materials and/or manufacturing processes. Delivery of the products shall be suspended until JAXA confirms the outcome of corrective actions.

4.6 Method for Test or Inspection

4.6.1 Externals, Dimensions and Marking

The externals, dimensions, marking and other requirements of the resistors shall be tested in accordance with each appendix.

4.6.2 Workmanship

The workmanship of the resistors shall be tested in accordance with each appendix.

4.6.3 Electrical Performance

The electrical performance of the resistors shall be tested in accordance with each appendix.

4.6.4 Mechanical Performance

The mechanical performance of the resistors shall be tested in accordance with each appendix.

4.6.5 Environmental Performance

The environmental performance of the resistors shall be tested in accordance with each appendix.

4.6.6 Durability

The durability of the resistors shall be tested in accordance with each appendix.

4.7 Long-Term Storage

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

When products have been stored at the manufacturer’s site for 24 months or longer after the Group A inspection, the manufacturer shall perform 100% inspection for externals and resistance prior to delivery. Only the resistors which have passed such tests can be shipped as products.

4.7.2 Storage by Purchasers

Storage conditions and the storage time limit shall be in accordance with the detail specification.

4.8 Change of Tests and Inspections

Any change in the in-process inspection and quality conformance inspection specified 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 in accordance with paragraph 5 of JAXA-QTS-2000.

5.1 Packaging

The resistors shall be appropriately packaged as high reliability parts for delivery from the manufacturer to the purchaser.

a) Unit packaging
   Each resistor shall be packaged separately using appropriate case materials.
b) Whole packaging
   Individually packaged resistors shall be placed in a container with cushioning materials to protect the products. Additional requirements for packaging shall be specified in procurement documents, if required.

5.2 Marking on Package

The following shall be marked on the unit package or the whole package.

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 Compatibility

To acquire certification of a resistor qualified by other manufacturers, the new resistor shall be fully compatible with the qualified resistor including the packaging specification.

6.2 Notes for Acquisition Officers

Detailed product data and notes shall be specified in the application data sheet.

6.2.1 Items to be Specified for Procurement

To purchase resistors 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) Test data or source inspection results shall be submitted for delivery
e) Others

As mentioned in 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 manufacturer shall not indicate that the resistor complies with this specification.

APPENDIX A

RESISTORS, FIXED, FILM

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: December 28, 2021

APPENDIX A

RESISTORS, FIXED, FILM

A.1. General

A.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the fixed film resistors (hereinafter referred to as "resistors").

A.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table A-1.

Table A-1. Classification

Construction	Style and termination type	Terminal type
Mold type	RNS50, 55, 60, 65, 70	Lead
Mold type	RNS90C	Lead
Mold type	RNS90P	Square lead

A.1.3 Part Number

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

Example 1: Part number for all resistor types except for RNS90

JAXA[(1)]	RNS55	-	J	-	1001	-	F
	Style and termination type		Characteristic		Nominal resistance		Resistance tolerance
	(A.1.3.1)		(A.1.3.2)		(A.1.3.3)		(A.1.3.4)

Example 2: Part number for RNS90

JAXA[(1)]	RNS90	-	C	-	100k00	-	A	-	Y
	Style and termination type		Device structure		Nominal resistance		Resistance tolerance		Characteristic
	(A.1.3.1)		(A.1.3.5)		(A.1.3.3)		(A.1.3.4)		(A.1.3.2)

Note: [(1)] "JAXA" indicates the common part for space use and may be abbreviated to "J". "NASDA" used in the detail specification may be abbreviated to "N".

A.1.3.1 Style and Termination Type

The style and termination type shall be identified by a three letter symbol, “RNS”, and a two-digit number. The “RNS” indicates the high reliability, fixed, film resistors of the terminal type shown in Table A-2. The two-digit number indicates the power rating and physical size of the resistors.

Table A-2. Terminal Type

Symbol	Terminal
RNS	Solderable and weldable

A.1.3.2 Characteristics

The resistance-temperature characteristic is identified by a single letter symbol in accordance with Table A-3.

Table A-3. Resistance-Temperature Characteristic

Unit: $x10^{-6}/°C$

Symbol	Resistance-temperature characteristic (referenced:25°C)				
	-55°C or more and less than -15°C	-15°C to +65°C	More than +65°C to +125°C	More than +125°C to +150°C	More than +150°C to +175°C
S	±2.5	±2.5	±2.5	±3.5	±4.5
A	±5	±2.5	±5	±6	±7
Y	±5	±5	±5	±10	±10
B	±10	±10	±10	±10	±10
J	±25	±25	±25	±25	±25
H	±50	±50	±50	±50	±50
K	±100	±100	±100	±100	±100

A.1.3.3 Nominal Resistance

The nominal resistance is identified in ohms (Ω) by 4 digits or 6 alphanumeric characters.

a) Resistance identified by 6 alphanumeric characters

The resistance identified by 6 characters applies to RNS90 type with resistance tolerance of ±0.005%(V), ±0.01% (T), ±0.02%(Q), ±0.05%(A), or ±0.1% (B). The five digits represent significant figures.

1) For resistors of nominal resistance greater than 10ohms but less than 1kilohm, the letter “R” shall represent a decimal point.
Example: 10R000= 10.000Ω
100R00=100.000Ω

2) For resistors of nominal resistance greater than 1kilohm but less than 1megohm, the letter “k” shall represent a decimal point. The unit shall be kilohm.
Example: 1k2100= 1,210.0Ω= 1.2100kΩ
100k00=100,000 Ω=100.00 kΩ

b) Resistance identified by 4 digits
The resistance identified by 4 digits applies to resistors with resistance tolerances of ±0.1% (B), ±0.25% (C), ±0.5% (D), ±1.0% (F), or ±2.0% (G). The first three digits represent the significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.
Example: 97R6= 97.6 Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω=150 kΩ

A.1.3.4 Resistance Tolerance

The resistance tolerance is identified by a single capital letter in accordance with Table A-4.

Table A-4. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance	Symbol	Resistance tolerance
V	±0.005	C	±0.25
T	±0.01	D	±0.5
Q	±0.02	F	±1.0
A	±0.05	G	±2.0
B	±0.1		

A.1.3.5 Device Structure

The device structure of RNS90 style is identified by a single capital letter following the symbol “RNS90” in accordance with Table A-5.

Table A-5. Device Structure

Symbol	Device structure
C	Cylinder type with more than two internal connecting points
P	Plate type with two internal connecting points

A.2. Applicable Documents

A.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

A.2.2 Reference Documents

The following is a reference document.

a) MIL-PRF-55182 Resistors, Fixed, Film, Nonestablished Reliability, Established Reliability, and Space Level, General Specification for

A.3. Requirements

A.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs A.3.2 to A.3.9. The qualification coverage shall be represented by samples that have passed the qualification test.
Characteristics and resistance tolerance of the resistors to be qualified shall be classified as specified in Tables A-6 and A-7. 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.

Table A-6. Characteristics Qualification

Characteristic submitted	Characteristic qualified	Characteristic submitted	Characteristic qualified
S	S, A, Y, B	J	J, H, K
A	A, Y, B	H	H, K
Y	Y, B	K	K
B	B		

Table A-7. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
V	V, T, Q, A, B, C, D, F, G
T	T, Q, A, B, C, D, F, G
Q	Q, A, B, C, D, F, G
A	A, B, C, D, F, G
B	B, C, D, F, G
C	C, D, F, G
D	D, F, G
F	F, G
G	G

A.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

A.3.2.1 Base Substance (Core)

The volume resistivity of the base substance shall be $10^8\Omega\cdot$cm or more at a temperature of 300°C.

A.3.2.2 Copper Wire

Copper wire used as a resistor terminal shall be made of materials which conform to MIL-STD-1276, or its equivalent.

A.3.2.3 Flux

The manufacturer shall completely remove corrosive substances after soldering or use noncorrosive flux. When non-corrosive flux is used, the water extract resistivity test shall be performed in accordance with paragraph 4.9 of JIS Z 3197, and it shall be verified that the water extract resistivity is not less than 100kΩ·cm. When resin flux cored solder is used, the mass ratio range of resin to solder shall be between 1 and 3%.

A.3.3 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph A.4.4.2.

A.3.3.1 Externals and Marking

There shall be no blistering or film blemishes on the surface of the resistors. The following shall be clearly marked in such a manner to ensure legibility. As a rule, the marking shall remain legible at the completion of any test.

a) Part number
   The marking of “JAXA” may be omitted. When the physical size of the resistor precludes inclusion of the complete part number, nominal resistance shall be marked as a minimum.
b) Year and week manufactured
   The number of the last two digits of the calendar year and the number of the week of the calendar year beginning with January shall be marked.
c) Manufacturer name or its abbreviation.

A.3.3.2 Construction, Dimensions and Mass

Resistors shall be constructed of a film resistor element and external terminals. The resistor element shall be molded to protect it from moisture or mechanical damage. The dimensions and mass shall satisfy the requirements as specified in each detail specification.

A.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1 in this specification.

a) Resistor films
Resistor films shall be uniformly deposited. The resistor films shall not exhibit blisters, thin spots, incomplete adhesion to substrate, discolored spots, or other blemishes likely to cause flaking or a nonuniform ribbon when spiraled (helixed). Where one turn or more of spiraling is used, the spiraling shall occupy no less than 70% of resistor-element effective length. The resistor-element effective length shall be defined as 80% of the distance between terminals or the distance between terminals minus 1.2mm, whichever is longer.

b) Terminal leads
The resistor's terminal leads shall be securely connected electrically and mechanically. The length and diameter of the lead wires shall comply with requirements. The width, thickness and length of the lead wires for the RNS90P style shall satisfy the standards. If any lead wire is contaminated by nonconductive matter or an impurity, the length of the contaminated portion shall be within 2.5mm from the root. The solderable and weldable lead wires shall be suitably treated to satisfy the requirements of solderability.

c) Protection against moisture
The resistor element shall be protected against moisture by an external coating of moisture-resistant insulating material. The external coating shall not be applied to any portion intended for electric terminal connections or any portion exceeding 2.5mm from the root of the lead wire. The external coating shall not be readily flaked and shall be uniformly applied to be free from voids, blemishes or other detrimental marks.

A.3.4.1 Radiographic Inspection

When resistors are tested as specified in paragraph A.4.4.3.1, the radiographs shall prove that no foreign particles are on the resistor elements, that all portions are properly aligned, and that there is no defect in details of workmanship. If pass/fail results are not conclusive, the resistors shall be rotated 90 degrees and be tested again.

A.3.4.2 DPA

When resistors are tested as specified in paragraph A.4.4.3.2, processes such as terminal connections, helical cutting, and external coating shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program. However, the helical cutting requirements do not apply to RNS90P style resistors.

A.3.5 Ratings

A.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined in relation to the resistance tolerance and shall be as specified in Table A-8. The minimum and maximum resistances shall satisfy the requirements of the detail specification.

Table A-8. Standard Resistance Values (1/2)

Resistance tolerance and symbols (%)									
B (±0.1)		B (±0.1)		B (±0.1)		B (±0.1)		B (±0.1)	
C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)
D (±0.5)		D (±0.5)		D (±0.5)		D (±0.5)		D (±0.5)	
10.0	10.0	13.3	13.3	17.8	17.8	23.7	23.7	31.6	31.6
10.1	-	13.5	-	18.0	-	24.0	-	32.0	-
10.2	10.2	13.7	13.7	18.2	18.2	24.3	24.3	32.4	32.4
10.4	-	13.8	-	18.4	-	24.6	-	32.8	-
10.5	10.5	14.0	14.0	18.7	18.7	24.9	24.9	33.2	33.2
10.6	-	14.2	-	18.9	-	25.2	-	33.6	-
10.7	10.7	14.3	14.3	19.1	19.1	25.5	25.5	34.0	34.0
10.9	-	14.5	-	19.3	-	25.8	-	34.4	-
11.0	11.0	14.7	14.7	19.6	19.6	26.1	26.1	34.8	34.8
11.1	-	14.9	-	19.8	-	26.4	-	35.2	-
11.3	11.3	15.0	15.0	20.0	20.0	26.7	26.7	35.7	35.7
11.4	-	15.2	-	20.3	-	27.1	-	36.1	-
11.5	11.5	15.4	15.4	20.5	20.5	27.4	27.4	36.5	36.5
11.7	-	15.6	-	20.8	-	27.7	-	37.0	-
11.8	11.8	15.8	15.8	21.0	21.0	28.0	28.0	37.4	37.4
12.0	-	16.0	-	21.3	-	28.4	-	37.9	-
12.1	12.1	16.2	16.2	21.5	21.5	28.7	28.7	38.3	38.3
12.3	-	16.4	-	21.8	-	29.1	-	38.8	-
12.4	12.4	16.5	16.5	22.1	22.1	29.4	29.4	39.2	39.2
12.6	-	16.7	-	22.3	-	29.8	-	39.7	-
12.7	12.7	16.9	16.9	22.6	22.6	30.1	30.1	40.2	40.2
12.9	-	17.2	-	22.9	-	30.5	-	40.7	-
13.0	13.0	17.4	17.4	23.2	23.2	30.9	30.9	41.2	41.2
13.2	-	17.6	-	23.4	-	31.2	-	41.7	-

Table A-8. Standard Resistance Values (2/2)

Resistance tolerance and symbols (%)						
B (±0.1)		B (±0.1)		B (±0.1)		
C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)	C (±0.25)	F (±1.0)	G (±2.0)
D (±0.5)		D (±0.5)		D (±0.5)		
42.2	42.2	56.2	56.2	75.0	75.0	10
42.7	-	56.9	-	75.9	-	11
43.2	43.2	57.6	57.6	76.8	76.8	12
43.7	-	58.3	-	77.7	-	13
44.2	44.2	59.0	59.0	78.7	78.7	15
44.8	-	59.7	-	79.6	-	16
45.3	45.3	60.4	60.4	80.6	80.6	18
45.9	-	61.2	-	81.6	-	20
46.4	46.4	61.9	61.9	82.5	82.5	22
47.0	-	62.6	-	83.5	-	24
47.5	47.5	63.4	63.4	84.5	84.5	27
48.1	-	64.2	-	85.6	-	30
48.7	48.7	64.9	64.9	86.6	86.6	33
49.3	-	65.7	-	87.6	-	36
49.9	49.9	66.5	66.5	88.7	88.7	39
50.5	-	67.3	-	89.8	-	43
51.1	51.1	68.1	68.1	90.9	90.9	47
51.7	-	69.0	-	92.0	-	51
52.3	52.3	69.8	69.8	93.1	93.1	56
53.0	-	70.6	-	94.2	-	62
53.6	53.6	71.5	71.5	95.3	95.3	68
54.2	-	72.3	-	96.5	-	75
54.9	54.9	73.2	73.2	97.6	97.6	82
55.6	-	74.1	-	98.8	-	91

A.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +175°C unless otherwise specified.

A.3.5.3 Power Rating

Resistors shall have a power rating as specified in the detail specification. The rated ambient temperature shall be 125°C unless otherwise specified.

A.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure A-1. In no case shall the applied voltage be greater than the applicable maximum operating voltage specified in the detail specification.

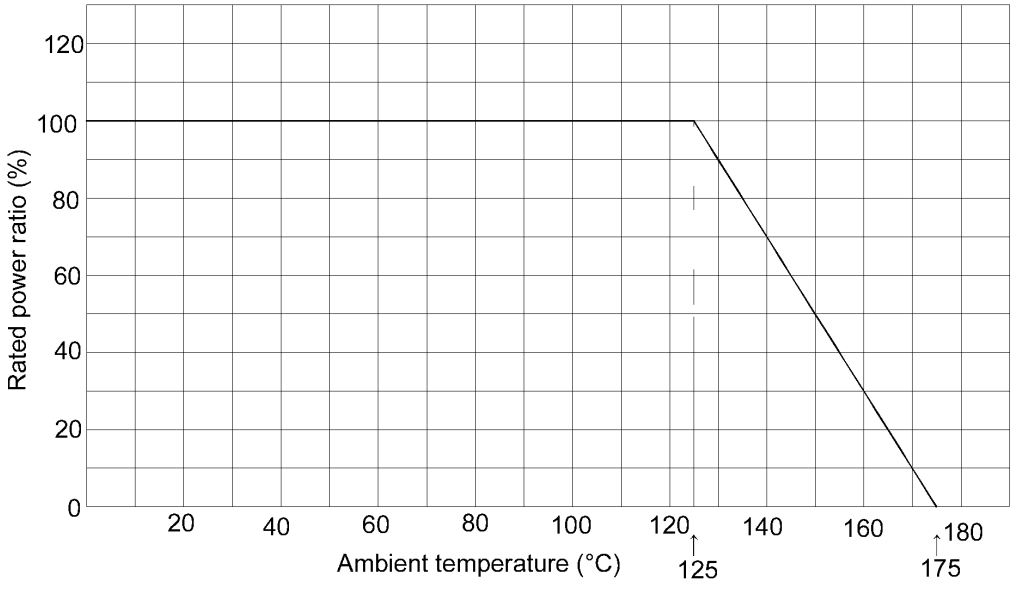


Figure A-1. Derating Curve

A.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage specified in the detail specification, the maximum operating voltage shall be the rated voltage.

$$E = \sqrt{P \cdot R}$$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

A.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

A.3.6.1 Overload

When resistors are tested as specified in paragraph A.4.4.4.1, the change in resistance before and after the test of paragraph A.4.4.6.3.1 shall satisfy the

requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

A.3.6.2 Resistance

When resistors are tested as specified in paragraph A.4.4.4.2 under the standard conditions (paragraph A.4.4.1), the resistance shall be within the specified tolerance of the nominal resistance.

A.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph A.4.4.4.3, the resistance-temperature characteristic, at each of the temperatures specified in Table A-16, shall be as specified in Table A-3.

A.3.6.4 Dielectric Withstanding Voltage

When tested as specified in paragraph A.4.4.4.4, resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

A.3.6.5 Insulation Resistance

When resistors are tested as specified in paragraph A.4.4.4.5, the insulation resistance shall satisfy the requirements of the detail specification.

A.3.6.6 Voltage Coefficient

When the resistors of nominal resistance of 1kΩ or more are tested as specified in paragraph A.4.4.4.6, the voltage coefficient shall satisfy the requirements of the detail specification.

A.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

A.3.7.1 Terminal Strength

When resistors are tested as specified in paragraph A.4.4.5.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of breaking or loosening of terminals, chipping of coating, or other evidence of mechanical damage after the completion of the test.

A.3.7.2 Mechanical Shear

When the RNS50 resistors are tested as specified in paragraph A.4.4.5.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.7.3 Solderability

When resistors are tested as specified in paragraph A.4.4.5.3, a minimum 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.3.7.4 Resistance to Soldering Heat

When resistors are tested as specified in paragraph A.4.4.5.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

A.3.8.1 Vibration

A.3.8.1.1 High Frequency Vibration

When resistors are tested as specified in paragraph A.4.4.6.1.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

A.3.8.1.2 Random Vibration

When resistors are tested as specified in paragraph A.4.4.6.1.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

A.3.8.2 Shock

When resistors are tested as specified in paragraph A.4.4.6.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

A.3.8.3 Thermal Shock

A.3.8.3.1 Thermal Shock [I]

When resistors are tested as specified in paragraph A.4.4.6.3.1, there shall be no evidence of mechanical damage. For the RNS90P style, the change in resistance before and after the test shall satisfy the requirements of the detail specification.

A.3.8.3.2 Thermal Shock [II]

When resistors are tested as specified in paragraph A.4.4.6.3.2, the change in resistance before and after the test shall satisfy the requirements of the detail

specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 100 cycles.

A.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph A.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. In addition, the dielectric withstanding voltage shall be as specified in paragraph A.3.6.4, and the insulation resistance shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph A.4.4.6.5, the marking shall remain legible. The details shall be as defined in the detail specification.

A.3.8.6 Low Temperature Storage

When resistors are tested as specified in paragraph A.4.4.6.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.8.7 Low Temperature Operation

When resistors are tested as specified in paragraph A.4.4.6.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.8.8 Stability

When resistors are tested as specified in paragraph A.4.4.6.8, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The change in resistance before this test and after the withstanding voltage test shall also satisfy the requirements of the detail specification. The insulation resistance after the test shall not be less than 1,000MΩ. There shall be no evidence of mechanical damage after the completion of the test.

A.3.9 Durability

Resistors shall satisfy the following durability requirements.

A.3.9.1 Life (125°C)

When resistors are tested as specified in paragraph A.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

A.3.9.2 Life (70°C)

When resistors are tested as specified in paragraph A.4.4.7.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

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-2050.

A.4.2 Qualification Test

The qualification test shall be in accordance with paragraph 4.4 of JAXA-QTS-2050 and as provided below.

A.4.2.1 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table A-9.

The number of samples shall be 555: 185 each for minimum resistance, maximum resistance, and critical resistance or nearest to critical resistance. Each resistor style and characteristic specified in Table A-6 shall be qualified separately. Two additional sample units shall be subjected to the I-6, DPA, of Table A-9, and 12 samples selected at random shall be subjected to the Group II tests. Ten samples of the maximum resistance shall be subjected to the Group X test.

If the critical resistance is not specified, the samples shall be equally divided between the minimum and maximum resistance.

To qualify samples of higher ranked characteristic or resistance tolerance, the I-4 (resistance) and III-1 (resistance-temperature characteristic) tests shall be performed with an additional 10 samples exhibiting the highest ranked characteristic and resistance tolerance manufactured for each resistor style. For the purpose of this specification, “select” means to select the appropriate samples from those which passed the Group I test of Table A-9 in order to qualify as the requested higher ranked characteristic or resistance tolerance.

Tests within each group shall be performed in the order listed in Table A-9. Upon completion of Group I tests, Group III through X tests shall be performed using samples allocated to the appropriate group tests.

Table A-9. Qualification Test (1/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed (1)
I	1	Externals, dimensions and marking (2)	A.3.3	A.4.4.2	100% (3)	0
	2	Thermal shock [I]	A.3.8.3.1	A.4.4.6.3.1		
	3	Overload	A.3.6.1	A.4.4.4.1		
	4	Resistance	A.3.6.2	A.4.4.4.2		
	5	Radiographic inspection	A.3.4.1	A.4.4.3.1		
	6	DPA(4)	A.3.4.2	A.4.4.3.2	2 or 3	0
II	1	Solderability	A.3.7.3	A.4.4.5.3	12(3) Any resistance	0
	2	Resistance to solvents	A.3.8.5	A.4.4.6.5		
III	1	Resistance-temperature characteristic	A.3.6.3	A.4.4.4.3	30 { 10 Highest resistance; 10 Critical resistance; 10 Lowest resistance }	1
	2	Low temperature storage	A.3.8.6	A.4.4.6.6		
	3	Low temperature operation	A.3.8.7	A.4.4.6.7		
	4	Terminal strength	A.3.7.1	A.4.4.5.1		
IV	1	Dielectric withstanding voltage	A.3.6.4	A.4.4.4.4	30 { 10 Highest resistance; 10 Critical resistance; 10 Lowest resistance }	1
	2	Insulation resistance	A.3.6.5	A.4.4.4.5		
	3	Resistance to soldering heat	A.3.7.4	A.4.4.5.4		
	4	Moisture resistance	A.3.8.4	A.4.4.6.4		
V	1	Shock	A.3.8.2	A.4.4.6.2	30 { 10 Highest resistance; 10 Critical resistance; 10 Lowest resistance }	1
	2	High frequency vibration	A.3.8.1.1	A.4.4.6.1.1		
	3	Thermal shock [II]	A.3.8.3.2	A.4.4.6.3.2		
VI	1	Random vibration	A.3.8.1.2	A.4.4.6.1.2	30 { 10 Highest resistance; 10 Critical resistance; 10 Lowest resistance }	1
VII	1	Life (125°C)	A.3.9.1	A.4.4.7.1	231 { 77 Highest resistance; 77 Critical resistance; 77 Lowest resistance }	0
VIII	1	Life (70°C)	A.3.9.2	A.4.4.7.2	102 { 34 Highest resistance; 34 Critical resistance; 34 Lowest resistance }	1

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
IX	1	Stability	A.3.8.8	A.4.4.6.8	102(5): 34 Highest resistance; 34 Critical resistance; 34 Lowest resistance	1
X	1	Voltage coefficient	A.3.6.5	A.4.4.4.6	10 Highest resistance	0
	2	Mechanical shear	A.3.7.2	A.4.4.5.2		
-	1	Materials	A.3.2	-	(6)	

Notes:

(1) When a sample has failed to pass 2 or more tests of one group, it shall be counted as a single defective.

(2) For dimensions and mass, sample size shall be 4.0% of the acceptable quality level (AQL) in "Special Inspection Level S-4" specified in JIS Z 9015-1.

(3) The samples for the Group II test shall not be subjected to the Group I test.

(4) The DPA test for RNS90 style shall be performed with 3 samples; other styles shall be tested with 2 samples.

(5) After the stability test, the 10 random samples shall be selected for each resistance (30 samples total) and subjected to dielectric withstanding voltage test (at atmospheric pressure) and the insulation resistance test.

(6) Data to certify compliance with design specifications shall be submitted.

A.4.3 Quality Conformance Inspection

The quality conformance inspection shall be 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 inspection shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for each shape. Resistors with the critical resistance or closest to the critical resistance and the highest grade of characteristics shall be selected. If the design criteria are identical and the materials and the structures are similar, the inspection lot may be represented by one of the shapes specified in the detail specification.

A.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be as specified in Tables A-10, A-11 and A-12, respectively. Group tests shall be performed in the group order and the inspections within each group shall be performed in the specified order. The sampling plan used for the Group A inspection shall be in accordance with Appendix 1 of JIS Z 9015-1. "General Inspection Level II" and "Special Inspection Level S-4" specified therein

shall apply to the Group A2 and A5 inspections, respectively. For Group B and C inspections, a pre-defined quantity of samples shall be selected from each category shown in Table A-1. The samples in each category shall be in the same form that can be arbitrary selected.
If the selected products for the higher ranked characteristic and resistance tolerance are shipped, the products shall be those which have been selected from the samples which passed the tests of Group A1. The products shall be marked with their identification code as specified, and re-examined for the resistance.

A.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table A-10, A-11 or A-12 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table A-10, but the failure mode of a defect is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

A.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed the Group A2 or A5 inspection, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped.

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

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
A1	1	Thermal shock [I]	A.3.8.3.1	A.4.4.6.3.1	100%	0
	2	Overload	A.3.6.1	A.4.4.4.1		
	3	Resistance	A.3.6.2	A.4.4.4.2		
A2	1	Externals, dimensions and marking	A.3.3	A.4.4.2	AQL 4.0%	
A3	1	Radiographic inspection (1)	A.3.4.1	A.4.4.3.1	100%	0
A4	1	DPA (2)	A.3.4.2	A.4.4.3.2	2 or 3	0
A5	1	Resistance-temperature characteristic	A.3.6.3	A.4.4.4.3	AQL 2.5%	
	2	Dielectric withstanding voltage (atmospheric pressure)	A.3.6.4	A.4.4.4.4.1		
	3	Insulation resistance	A.3.6.6	A.4.4.4.5		

Notes:
(1) When radiographic inspection has been performed as a part of the in-process inspection in the manufacturing process, the inspection record may be substituted for the quality conformance inspection.
(2) The DPA test for RNS90 style shall be performed with 3 samples; other styles shall be tested with 2 samples.

Table A-11. Quality Conformance Inspection (Group B)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
B1	1	Resistance-temperature characteristic	A.3.6.3	A.4.4.4.3	10	0
	2	Dielectric withstanding voltage	A.3.6.4	A.4.4.4.4		
	3	Insulation resistance	A.3.6.5	A.4.4.4.5		
	4	Resistance to soldering heat	A.3.7.4	A.4.4.5.4		
	5	Moisture resistance	A.3.8.4	A.4.4.6.4		
B2	1	Solderability	A.3.7.3	A.4.4.5.3	5	0
	2	Resistance to solvents	A.3.8.5	A.4.4.6.5		
B3	1	Low temperature storage	A.3.8.6	A.4.4.6.6	10	0
	2	Low temperature operation	A.3.8.7	A.4.4.6.7		
	3	Terminal strength	A.3.7.1	A.4.4.5.1		
B4	1	Life (125°C)	A.3.9.1	A.4.4.7.1	10	0
B5	1	Life (70°C)	A.3.9.2	A.4.4.7.2	10	0
B6	1	Stability	A.3.8.8	A.4.4.6.8	10	0

Table A-12. Quality Conformance Inspection (Group C)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
C1	1	Shock	A.3.8.2	A.4.4.6.2	10	0
	2	High frequency vibration	A.3.8.1.1	A.4.4.6.1.1		
C2	1	Thermal shock [II]	A.3.8.3.2	A.4.4.6.3.2	10	0
C3	1	Random vibration	A.3.8.1.2	A.4.4.6.1.2	10	0
C4	1	Voltage coefficient	A.3.6.5	A.4.4.4.6	10	0
	2	Mechanical shear(1)	A.3.7.2	A.4.4.5.2		

Note (1) This test is applied to RNS50 style resistors.

A.4.4 Methods for Test and Inspection

A.4.4.1 Test Conditions

a) Standard conditions

Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table A-13. Unless specified, condition A shall apply.

Table A-13. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

A.4.4.2 Externals, Dimensions and Marking

A.4.4.2.1 Qualification Test

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. If the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured with a trip balance compliant to JIS B 7601. If the measured values are questionable, another measuring instrument may be used.

A.4.4.2.2 Quality Conformance Inspection (Group A)

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions may be measured with a dimension gauge which is set in advance, unless the measured value may be questionable. Prior to the test, it shall be proven that the dimension gauge is sufficiently functional as a measuring instrument. The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.
d) For the mass inspection, the pass/fail results shall be made by comparing the sample to the criteria samples of maximum mass for each style which is determined in advance.

A.4.4.3 Workmanship

A.4.4.3.1 Radiographic Inspection

The radiographic inspection shall be performed in accordance with Test Method 209 of MIL-STD-202. The following details and exceptions shall apply.

a) Criteria sample for radiographic inspection shall be prepared and inspection results shall be judged in accordance with the criteria sample.
b) When a test lot is evaluated as defective in the Group A quality conformance inspection, the following three consecutive lots shall be tested in two directions

turned 90 degrees before final pass or fail is determined. However, the test of the RNS 90 style shall be performed in only one direction due to its structure.

A.4.4.3.2 DPA

The resistors shall be disassembled to ensure that processes such as terminal connections, helical cutting, and external coating or enclosure shall have been successfully achieved. DPA shall be conducted in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) Protective coating or enclosure shall be removed from the resistors with a resinous solvent or by other means. The resistors shall be examined visually or by using a 5 to 50x magnifier for inspecting the areal ratio of helical cutting, state of helical cutting grooves, uniformity of helical cutting width, state of resistor films, and weld state of caps with terminal leads. This test is not applicable to the RNS90 resistors.

b) The resistors shall be embedded in a proper resin or other materials, and cut at the center along the longitudinal axis of the resistors. One cut face shall be grounded and examined visually or by using a 5x magnifier for the press fitting state of caps and voids in the external coating.

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

A.4.4.4 Electrical Performance

The electrical performance tests shall be performed as follows.

A.4.4.4.1 Overload

The resistors shall be tested under the conditions as specified in Table A-14 in succession to the test of paragraph A.4.4.6.3.1 (Thermal shock [I]). After this test, the resistors shall be left at room temperature and at no load for 30 minutes before the resistance measurement is made in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before the thermal shock [I] test and after this test. At the completion of this test, the resistors shall be examined for significant abnormality in appearance. The marking shall also be examined for legibility. This overload test shall be performed under the following conditions.

a) Method of mounting:

1) Qualification test
The resistors shall be mounted horizontally with no object closer than 75mm below the resistors, except the mounting base which shall be no closer than 50mm below the resistors. The resistors shall be mounted in still air with no air circulation other than the heat of the resistors being operated.

2) Group A quality conformance inspection
The resistors shall be mounted in any position and in the space of any size. Forced air cooling may be used to maintain a test ambient temperature range between +20 and +45°C. The average velocity of the forced air, if employed, shall not exceed 2.5m per second.

b) Test conditions

The voltage applied shall be alternating current voltage (root-mean-square value at commercial-line frequency) and waveform or direct current voltage. The test shall be performed at the load and for the duration specified in Table A-14, provided that the applied voltage shall not exceed the maximum overload voltage.

c) Visual examination after test

The resistors shall be examined visually for evidence of arcing, burning or charring.

Table A-14. Overload Test Conditions

Resistor style	Overload	Duration	Maximum overload voltage (V)
RNS50, RNS55, RNS60	Rated power × 5	1 hour	500
RNS65	Rated power × 4	1 hour	600
RNS70	Rated power × 2.25	1 hour	700
RNS90	Rated power × 6.25	5 seconds	-

A.4.4.4.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Measuring apparatus
The same measuring equipment shall be used for each test, but not necessarily for all tests.

b) Accuracy of measuring apparatus
±(0.005%±0.01Ω), but not exceeding one-fourth of the resistance tolerance or the resistance change limit for which the measurement is being made. The manufacturer may use apparatus of less accuracy, provided that limits are reduced to fully compensate for accuracy deviation.

c) Test voltage
Test voltages shall be applied in accordance with Table A-15. The voltages of category A and B shall be applied to the resistors with a rated power of less than 0. 5W and 0.5W or more, respectively.

d) Temperature
As a rule, the Group I resistance test of the qualification test and Group A1 of the Group A quality conformance inspection shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

e) To measure the resistance of the RNS90 style, the measuring terminal shall be held at a position between 9.52mm and 15.88mm from the base of the terminal.

Table A-15. Resistance Test Voltages

Unit: V_{DC}

Nominal resistance range (Ω)	A (maximum value)	B (maximum value)
Less than 1	0.1	0.1
1 or more and less than 10	0.3	0.3
10 or more and less than 100	0.3	1.0
100 or more and less than 1k	1.0	3.0
1k or more and less than 10k	3.0	10.0
10k or more and less than 100k	10.0	30.0
100k or more and less than 1M	30.0	50.0
1M or more	50.0	100.0

A.4.4.4.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following conditions shall apply.

a) Reference temperature: 25°C
b) Test temperature: As specified in Table A-16. At the quality conformance inspection, the test temperature of 125°C shall apply only to the RNS90 style.
c) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table A-16. Test Temperature for Resistance-Temperature Characteristic

Unit: °C

Order	Test temperature	
	Qualification test	Quality conformance inspection
1	25±3	25±3
2	-15±3	-55±3
3	-55±3	25±3
4	25±3	125±3
5	65±3	175±3
6	125±3	-
7	175±3	-

A.4.4.4.4 Dielectric Withstanding Voltage

A.4.4.4.4.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with paragraph A.4.4.4.5 a). However, the RNS90 style shall be mounted as shown in Figure A-2.
b) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

c) Test voltage
The test voltage shall be as specified in the detail specification. If not specified therein, test voltages of 450V_{AC} and 900V_{AC} shall be applied to the resistors of rated power of 0.125W or less and 0.25W or more, respectively. However for the RNS90 style, a test voltage of 300V_{AC} shall be applied.

d) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

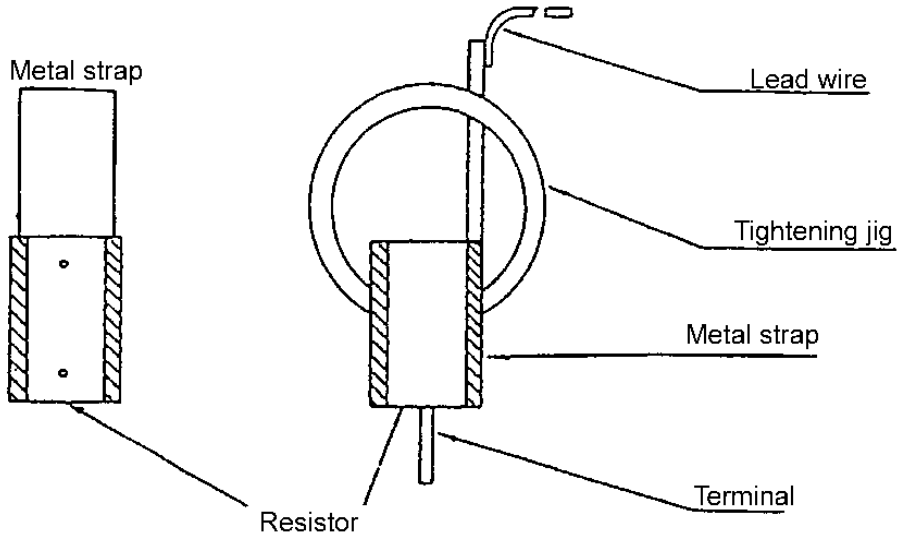


Figure A-2. RNS90 Test Jig for the Tests of Dielectric Withstanding Voltage, Insulation Resistance and Moisture Resistance (Polarization)

A.4.4.4.4.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202 and as provided below.

a) Method of mounting
The resistors shall be mounted as specified in item a), paragraph A.4.4.4.5. However, the RNS90 style shall be mounted as shown in Figure A-2.

b) Measurement before test:
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

c) Test condition: D (1.1 ± 0.1kPa)

d) Test voltage
The test voltage shall be as specified in the detail specification. If not specified therein, test voltages of 200V_{AC} and 300V_{AC} shall be applied to the resistors at power rated at 0.125W or less and 0.25W or more, respectively. However for the RNS90 style, a test voltage of 200V_{AC} shall be applied.

e) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

f) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown or mechanical damage.

A.4.4.4.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be placed on the groove of a metal V block so that the resistive-elements do not protrude from either end of the V block. The distance between the resistor terminal lead and any point of the V block shall not be smaller than the difference in radius between the resistor and terminal lead. The RNS90 style shall be mounted as shown in Figure A-2.

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

A.4.4.4.6 Voltage Coefficient

Resistors shall be tested in accordance with Test Method 309 of MIL-STD-202. This provision shall apply only to the resistors with a resistance of 1KΩ or more.

A.4.4.5 Mechanical Performance

The mechanical performance tests shall be performed as follows.

A.4.4.5.1 Terminal Strength

Resistors shall be tested in accordance with Test Method 211 of MIL-STD-202. The condition A (pull test) and D (twist test) shall apply. However, the test shall be subject to the following details and exceptions.

A.4.4.5.1.1 Pull Test (Test Condition A)

a) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

b) Load
Unless otherwise specified in the detail specification, loads of 9.8N and 24.5N shall be applied to the resistors at power rated at 0.25W or less and 0.5W or more, respectively. However for the RNS90 style, a load of 8.82N shall be applied.

c) Test method
The specified load shall be applied in the axial direction of the lead without inducing any impact. The point of application of the load shall be at the closest point to the lead edge.

d) Measurement after test
Resistance shall not be measured after the pull test since this test shall be performed in combination with the twist test specified in paragraph A.4.4.5.1.2.

e) Examination after test
The terminals shall be examined visually for evidence of mechanical damage.

A.4.4.5.1.2 Twist Test (Test Condition D)

Following the pull test, the twist test shall be performed with the same samples, unless otherwise specified.

a) Measurement before test
The resistance shall not be measured before the test.

b) Test conditions
With the center axis of the resistor's lead wire used as a rotating axis, the lead wire shall be rotated 360 degrees along a plane perpendicular to the rotating axis. This operation shall be defined as the first twist. Then, the lead wire shall be rotated 360 degrees in the opposite direction. This shall be counted as the second twist. Using this counting method, a total of five twists shall be made.

c) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

d) Examination after test
The terminals shall be examined for evidence of breaking or loosening.

A.4.4.5.2 Mechanical Shear

Resistors shall be tested in accordance with the following procedures.

a) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

b) Method of mounting
The resistors shall be mounted on the fixtures shown in Figure A-3.

c) Load: 35.28±0.098N

d) Test method
The specified load shall be applied at a constant rate to the resistors mounted in the fixtures. Duration of the load shall be 10 to 30 seconds.

e) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

f) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

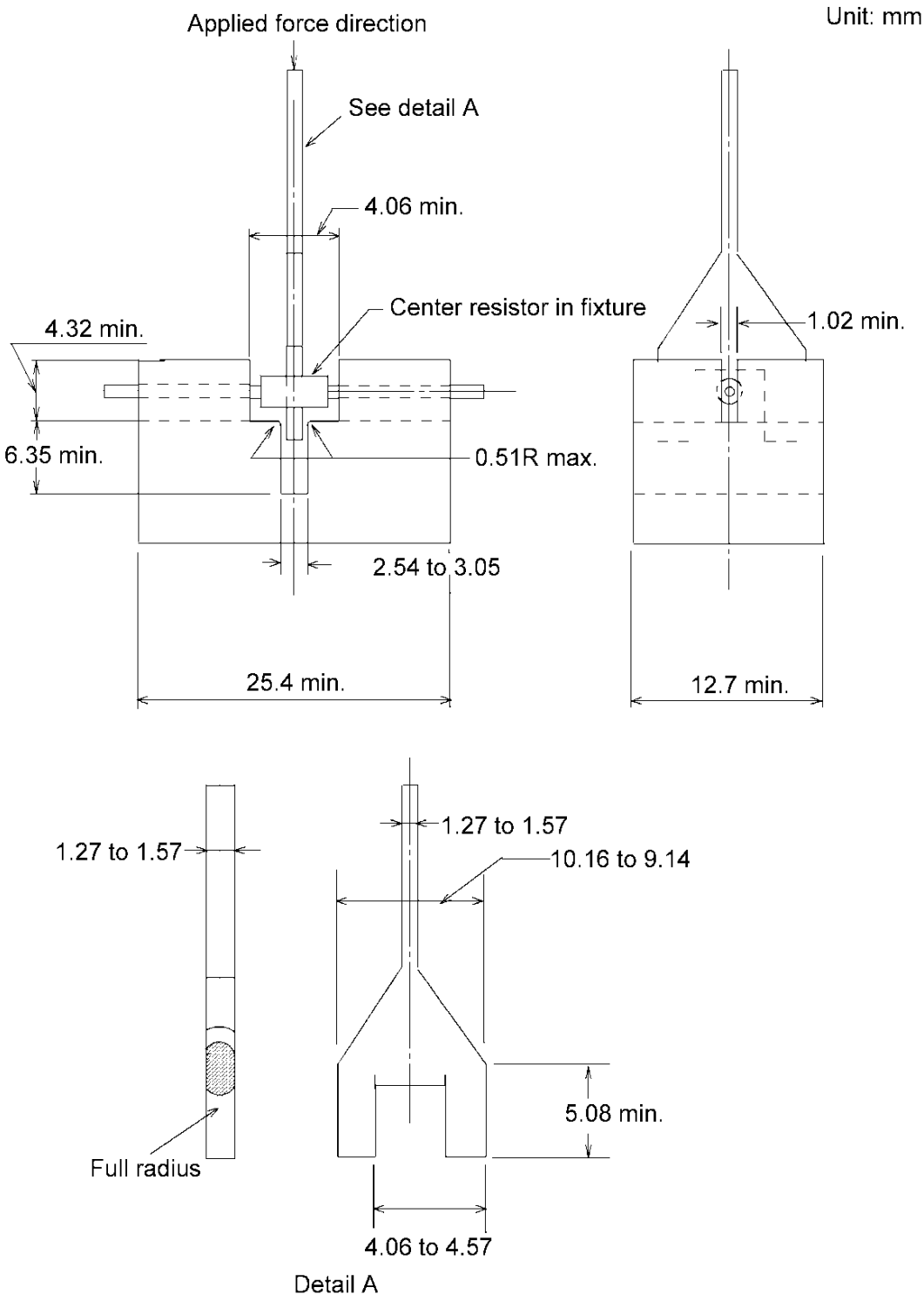


Figure A-3. Mounting Fixture for Mechanical Shear Test

A.4.4.5.3 Solderability

Resistors shall be tested in accordance with Test Method 208 of MIL-STD-202. The following details and exceptions shall apply.

a) Preparations: Shall be performed.
b) Number of terminals tested: all terminals.
c) Solder temperature: 245±5°C
d) Solder immersion time: 5±0.5 sec.
e) Solder immersion depth
The terminals shall be immersed to within 2.5mm from the base of the terminals. However, the RNS 90 style shall be within 1.3 mm.
f) Examination after test
Resistors shall be examined visually for solder wettability.

A.4.4.5.4 Resistance to Soldering Heat

Resistors shall be tested in accordance with Test Method 210 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.
b) Solder temperature: 350±10°C
c) Solder immersion time: $3^{+0.5}_{0}$ sec.
d) Solder immersion depth
Terminals shall be immersed to within 4±0.8mm from the base of the terminals.
e) Cooling time after immersion: 3 hours or more
f) Measurement after test
The terminals shall remain at room temperature for the specified time after the test before the resistance measurement is made in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.
g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

A.4.4.6 Environmental Performance

The environmental performance tests shall be performed as follows.

A.4.4.6.1 Vibration

A.4.4.6.1.1 High Frequency Vibration

Resistors shall be tested in accordance with Test Method 204 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph A.4.4.6.2. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.
b) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

c) Test condition
Test condition D (196m/s^2 p-p or 1.5mm in double amplitude, whichever is the smaller).

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Duration of vibration
Four hours in each direction for a total of 8 hours.

f) Measurement during test
Each resistor shall be monitored with specified equipment during vibration to determine no electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.3.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

A.4.4.6.1.2 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph A.4.4.6.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

c) Test condition
Test condition II-H Frequency range: 20 to 2,000Hz
Rms value of acceleration: 334m/s^{2}rms

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of application and duration of vibration
Vibration shall be applied for 2 minutes, 5 times in each direction with a total test time of 20 minutes.

f) Measurement during test
Each resistor shall be monitored with specified equipment during vibration to determine no electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

A.4.4.6.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Resistors shall be rigidly mounted on appropriate fixtures or mounted with the bodies cemented to a flat surface. The resistors shall be fixed with their leads supported approximately 6mm from the resistor body. The fixtures shall be constructed to insure that the points of the resistor mounting supports will have the same motion as the shock table. The mounting fixtures shall be constructed to preclude any resonance in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. Test lead used during this test shall be stranded wire no larger than 0.6mm in diameter, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no greater than necessary.

b) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

c) Test condition: I (980m/s^2, 6ms sawtooth).

d) Direction of applied shocks
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of applied shocks
The resistors shall be subjected to 10 shocks in each direction for a total of 20.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the shock to determine no electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

A.4.4.6.3 Thermal Shock

A.4.4.6.3.1 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Test conditions
Test conditions shall be as specified in Table A-17.

c) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2.

d) Number of test cycles: 25 cycles

e) Cycle conditions
The first five cycles shall run continuously. After the five cycles, the test may be interrupted following completion of any full cycle.

f) Measurement after test
Resistance shall not be measured because this test is combined with the overload test specified in paragraph A.4.3.4.1. For the RNS90P style, the resistors shall be at room temperature for a minimum of 30 minutes before the resistance measurement is made in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table A-17. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	-65^{0}_{-5}	15
2	150^{+3}_{0}	15

A.4.4.6.3.2 Thermal Shock [II]

After measuring resistance in accordance with paragraph A.4.3.4.2, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table A-18 and Figure A-4. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Number of test cycles: 1,000 cycles

c) Cycle conditions
The first 25 cycles shall run continuously. After 25 cycles, the test may be interrupted following completion of any full cycle.

d) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more for each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for cracks on the surface.

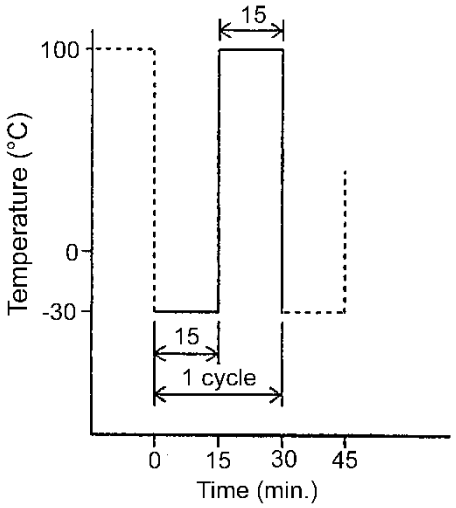
e) Measurement after test
The resistors shall be at room temperature for 30 minutes or more but 2 hours or less, and the resistance shall be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test.

f) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table A-18. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	$-30\ ^{0}_{-5}$	15
2	$100\ ^{+3}_{0}$	15

Figure A-4. Test Conditions of Thermal Shock [II]



A.4.4.6.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting

1) Where polarization is not applied

Solder both leads to rigid mounts or terminal lugs. The spacing of the mounts or terminal lugs shall be such that the length of each resistor lead is approximately 10mm when measured from the edge of the supporting terminal to the resistor body.

2) Where polarization is applied

One half of the resistors mounted as specified in 1) above shall be covered with a V-shape metal strap whose width is equal to that of the resistor body as indicated in Figure A-5. The strap shall be made from corrosion-resistant metal and shall be kept in contact with the resistor body by supporting the body as indicated in Figure A-5, with a nonconducting, noncorrosive support whose width is less than that of the resistor body. In addition, the support shall not allow condensation of moisture which could have an inverse influence on the test. An individual metal strap may be used for each resistor or one continuous metal strap for all resistors. The RNS90 style shall be mounted as shown in Figure A-2.

b) Polarization and loading voltage

1) Polarization voltage

During steps 1 through 6, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the polarizing straps.

2) Loading voltage

Loading voltage shall be applied to the resistors which are not covered with the metal strap. During the first 2 hours of steps 1 and 4, a dc test

potential equivalent to 100% rated wattage, but not exceeding the maximum operating voltage, shall be applied.

3) Measurement after test
Upon completion of step 6 of the final cycle, the resistors shall be held at a relative humidity of 90 to 95% and a temperature of 25±2°C for a period of 1 hour and 30 minutes to 3 hours and 30 minutes. Resistors shall be removed from the chamber and remain at room temperature for 1 to 2 hours. The resistance, dielectric withstanding voltage (atmospheric pressure) and insulation resistance shall then be measured in that order as specified in paragraphs A.4.4.4.2, A.4.4.4.4.1 and A.4.4.4.5 respectively. The change in resistance before and after the test shall also be calculated.

4) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

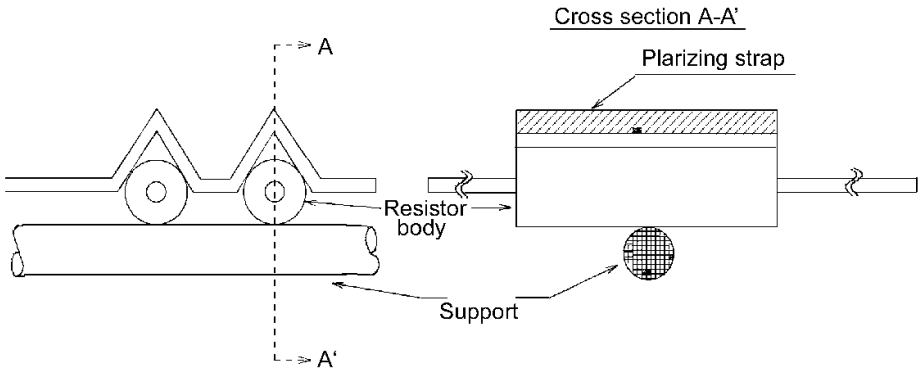


Figure A-5. Mounting Straps for Polarized Units

A.4.4.6.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion
b) Solvents to be used
1) 2-propanol (Isopropyl alcohol)
2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

A.4.4.6.6 Low Temperature Storage

The resistance shall be measured as specified in paragraph A.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of -65^{0}_{-5} °C for a period of 24±4 hours. The temperature in the chamber shall then be gradually returned to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for 2 hours or more but 8 hours or less. The resistance shall then be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after

the test. After the test, the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

A.4.4.6.7 Low Temperature Operation

The resistance shall be measured as specified in paragraph A.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a test chamber at room temperature. The temperature shall be gradually decreased to -65^{0}_{-5} °C and the resistors left for 1 hour at no load. The rated voltage shall then be applied for 45 minutes. Wait 15^{+5}_{0} minutes after the removal of voltage to gradually increase the chamber temperature to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. Unless otherwise specified, the resistors shall remain at room temperature for 1 hour or more but 2 hours or less. The resistance shall then be measured again as specified in paragraph A.4.4.4.2 to calculate the change in resistance before and after the test. After the test, the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

A.4.4.6.8 Stability

After the resistance is measured in accordance with paragraph A.4.4.4.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually increased to a test temperature of 175^{+15}_{0} °C. After stabilizing at the test temperature, the resistors shall remain at no load for $2{,}000^{+48}_{0}$ hours. When the specified test time has passed, the temperature shall gradually be returned to room temperature. The resistors shall then be removed from the test chamber and remain at a temperature of 25±5°C for 6±1hours. The resistance shall then be measured in accordance with paragraph A.4.4.4.2 to calculate the change in resistance before and after the test. The dielectric withstanding voltage test (atmospheric pressure) and insulation resistance test shall then be performed as specified in paragraphs A.4.4.4.4.1 and A.4.4.4.5, respectively. After the test the resistors shall be examined for significant abnormality.

A.4.4.7 Durability

Durability test shall be performed as follows.

A.4.4.7.1 Life (125°C)

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted on terminal lugs as shown in Figure A-6. The lead shall be soldered at a distance of 25mm from the resistor body.
b) Test temperature: 125±5°C
c) Measurement before test
After the resistors are mounted in a test fixture, the resistance shall be measured

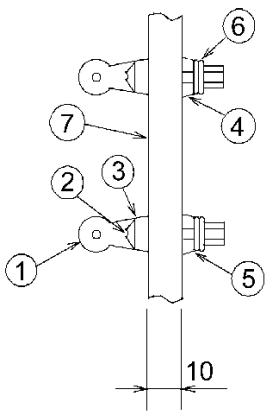
at room temperature in accordance with paragraph A.4.4.4.2. All measurements shall be performed at a temperature difference of ±2°C.

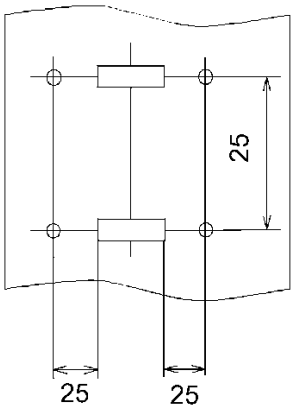
d) Measurements during and after test
After the resistors are left at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph A.4.4.4.2.

e) Test conditions
The rated dc voltage corresponding to rated power shall be applied intermittently, 90 minutes ON and 30 minutes OFF. If the rated voltage exceeds the maximum operating voltage, the maximum operating voltage shall be applied. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be $4{,}000\,^{+72}_{0}$ hours for the qualification test and $2{,}000\,^{+48}_{0}$ hours for the quality conformance inspection.

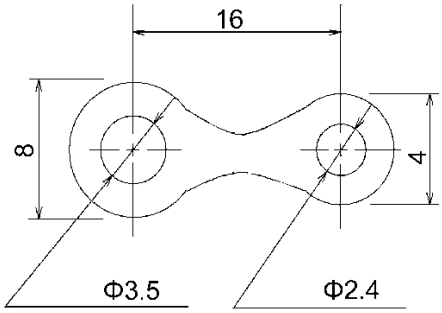
f) Measurements during test
   1) Qualification test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, $1{,}000\,^{+48}_{0}$ hours and $2{,}000\,^{+72}_{0}$ hours.
   2) Quality conformance inspection: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours and $1{,}000\,^{+48}_{0}$ hours.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage.





Unit: mm



Detail drawing

No.	Description
1	Solder lug, tinned brass
2	3mm round machine screw, 15 mm long, brass
3	Shakeproof washer, steel, parkerized
4	Flat brass washer
5	Lock brass washer
6	Hexagon nut,brass
7	Rack, phenolic

Figure A-6. Example of Recommended Mounting Fixture

A.4.4.7.2 Life (70°C)

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph A.4.4.7.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph A.4.4.4.2. During and after the test, the resistance shall be measured in accordance with item d), paragraph A.4.4.7.1.

c) Test temperature: 70±5°C

d) Test conditions
The rated dc voltage corresponding to rated power shall be applied intermittently, 90 minutes ON and 30 minutes OFF. If the rated voltage exceeds the maximum operating voltage specified in Table A-19, the maximum operating voltage shall be applied. Test voltage shall be maintained within ±5% of the rated dc voltage corresponding to the rated power specified in Table A-19. The test time shall be for $2{,}000\,^{+72}_{0}$ hours.

e) Measurements during test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, and $1{,}000\,^{+48}_{0}$ hours.

f) Examination after test
The resistors shall be examined for evidence of mechanical damage.

Table A-19. Test Conditions of Life at 70°C

Style	Rated power at 70°C (W)	Maximum operating voltage at 70°C (V_{DC})
RNS50	0.1	200
RNS55	0.125	200
RNS60	0.25	300
RNS65	0.5	350
RNS70	0.75	500
RNS90	0.6	300

A.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

A.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

A.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

A.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX B

RESISTORS, FIXED, FILM (INSULATED SMALL)

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: December 28, 2021

APPENDIX B

RESISTORS, FIXED, FILM (INSULATED, SMALL)

B.1. General

B.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the film fixed resistors (insulated, small) (hereinafter referred to as "resistors").

B.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table B-1.

Table B-1. Classification

Construction	Style and termination type
Non-molded type	RLS05, 07, 20, 32, 42C
Molded type	RLS05, 07, 20, 32, 42T

B.1.3 Part Number

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

Example:

JAXA[1]	RLS20	-	C	-	1001	-	F
	Style		Construction and terminal		Nominal resistance		Resistance tolerance
	(B.1.3.1)		(B.1.3.2)		(B.1.3.3)		(B.1.3.4)

Note: [1] "JAXA" indicates the common part for space use and may be abbreviated to “J”. “NASDA” used in the detail specification may be abbreviated to “N”.

B.1.3.1 Style

The style shall be identified by the three-letter symbol, “RLS”, followed by a two-digit number. The “RLS” indicates the high reliability, fixed, film (insulated, small) resistors. The two-digit number indicates the power rating and physical size of the resistors.

B.1.3.2 Construction and Terminal

The construction and terminal shall be identified by a single capital letter in accordance with Table B-2.

Table B-2. Construction and Terminal

Symbol	Construction and Terminal
C	Coated type, solderable and weldable
T	Molded type, solderable and weldable

B.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 3 or 4 digits.

a) Four digit resistance designation
The four digit resistance designation shall be applicable to resistance tolerance "F"(±1.0%). The first three digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter "R" shall be substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures.

Example: 97R6= 97.6Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω=150 kΩ

b) Three digit resistance designation
The three digit resistance designation shall be applicable to resistance tolerance "G"(±2.0%). The first two digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter "R" shall be substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures.

Example: 4R7= 4.7Ω
150= 15 Ω
152= 1,500 Ω= 1.50kΩ
154=150,000 Ω=150 kΩ

B.1.3.4 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table B-3.

Table B-3. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance
F	±1.0
G	±2.0

B.1.4 Characteristics

The change in resistance referred to an ambient temperature of 25°C shall not exceed $\pm 100 \times 10^{-6}$/°C.

B.2. Applicable Documents

B.2.1 Applicalble Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

B.2.2 Reference Documents

The following is a reference document.

a) MIL-PRF-39017 Resistors, Fixed, Film (Insulated), Nonestablished Reliability, and Established Reliability, General Specification for

B.3. Requirements

B.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs B.3.2 to 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.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

B.3.2.1 Base Substance (Core)

The volume resistivity of the base substance shall be $10^{8}\Omega \cdot$cm or more at a temperature of 300°C.

B.3.2.2 Copper Wire

Copper wire used as a resistor terminal shall be made of materials which conform to MIL-STD-1276 or its equivalent.

B.3.2.3 Flux

The manufacturer shall completely remove corrosive substances after soldering or use noncorrosive flux. When non-corrosive flux is used, the water extract resistivity test shall be performed in accordance with paragraph 4.9 of JIS Z 3197, and it shall be verified that the water extract resistivity is greater than 100k$\Omega \cdot$cm. When resin flux cored solder is used, the mass ratio range of resin to solder shall be between 1 and 3%.

B.3.3 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph B.4.4.2.

B.3.3.1 Externals and Marking

There shall be no blistering or film blemishes on the surface of the resistors. The following shall be clearly marked to ensure legibility. As a rule, the marking shall remain legible at the completion of any test.

a) Part number
The marking of ”JAXA” may be omitted. When the physical size of the resistor precludes inclusion of the complete part number, nominal resistance shall be marked as a minimum.

b) Year and week manufactured
The number of the last two digits of the calendar year and the number of the week of the calendar year beginning in January shall be marked.

c) Manufacturer name or its abbreviation.

B.3.3.2 Construction, Dimensions and Mass

Resistor shall be constructed of a film resistor element and external terminals. The resistor element shall be molded to protect it from moisture or mechanical damage. The dimensions and mass shall satisfy the requirements as specified in each detail specification.

B.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1.

a) Resistor films
Resistor films shall be uniformly deposited. The resistor films shall not exhibit blisters, thin spots, incomplete adhesion to substrate, discolored spots, or other blemishes likely to cause flaking or a nonuniform ribbon when spiraled (helixed). When one turn or more of spiraling is used, spiraling shall occupy no less than 70% of resistor-element effective length. The resistor-element effective length shall be defined as 80% of the distance between terminals or the distance between terminals minus 1.2mm, whichever is longer.

b) Terminal leads
The resistor’s terminal leads shall be securely connected electrically and mechanically. The lead wires shall conform to all requirements of type C of MIL-STD-1276 or its equivalent. The maximum plating thickness of the lead wires shall not be more than twice the minimum thickness at any cross section. There shall not be non-conductive impurities on the surface of lead wires in excess of the specified length between the resistance element and clean lead. For RLSxxT resistors, this length shall be within 2.5mm from the base. The terminals shall satisfy the requirements of solderability.

c) Insulating enclosure
The resistor element shall be protected against moisture by an external enclosure of moisture-resistant insulating material.

B.3.4.1 DPA

When resistors are tested as specified in paragraph B.4.4.3.1, processes such as terminal connection, helical cutting, and external coating shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program.

B.3.5 Ratings

B.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined relative to the resistance tolerance and shall be as specified in Table B-4. The minimum and maximum resistances shall be specified in the detail specification.

B.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +150°C unless otherwise specified.

B.3.5.3 Power Rating

Resistors shall have a power rating specified in the detail specification. The rated ambient temperature shall be 70°C unless otherwise specified.

B.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure B-1.

B.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage specified in the detail specification, the maximum operating voltage shall be the rated voltage.

$$E = \sqrt{P \cdot R}$$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

Table B-4. Standard Resistance Values

Resistance tolerance and symbols (%)							
G (±2.0)	F (±1.0)	G (±2.0)	F (±1.0)	G (±2.0)	F (±1.0)	G (±2.0)	F (±1.0)
10.0	10.0	-	18.7	-	33.2	-	56.2
-	10.2	-	19.1	-	34.0	-	57.6
-	10.5	-	19.6	-	34.8	-	59.0
-	10.7	20	20.0	-	35.7	-	60.4
11	11.0	-	20.5	36	-	-	61.9
-	11.3	-	21.0	-	36.5	62	-
-	11.5	-	21.5	-	37.4	-	63.4
-	11.8	22	-	-	38.3	-	64.9
12	-	-	22.1	39	-	-	66.5
-	12.1	-	22.6	-	39.2	68	-
-	12.4	-	23.2	-	40.2	-	68.1
-	12.7	-	23.7	-	41.2	-	69.8
13	13.0	24	-	-	42.2	-	71.5
-	13.3	-	24.3	43	-	-	73.2
-	13.7	-	24.9	-	43.2	75	75.0
-	14.0	-	25.5	-	44.2	-	76.8
-	14.3	-	26.1	-	45.3	-	78.7
-	14.7	-	26.7	-	46.4	-	-
15	15.0	27	-	47	-	-	80.6
-	15.4	-	27.4	-	47.5	82	-
-	15.8	-	28.0	-	48.7	-	82.5
16	-	-	28.7	-	49.9	-	84.5
-	16.2	-	29.4	51	-	-	86.6
-	16.5	30	-	-	51.1	-	88.7
-	16.9	-	30.1	-	52.3	-	90.9
-	17.4	-	30.9	-	53.6	91	-
-	17.8	-	31.6	-	54.9	-	93.1
18	-	-	32.4	56	-	-	95.3
-	18.2	33	-	-	-	-	97.6

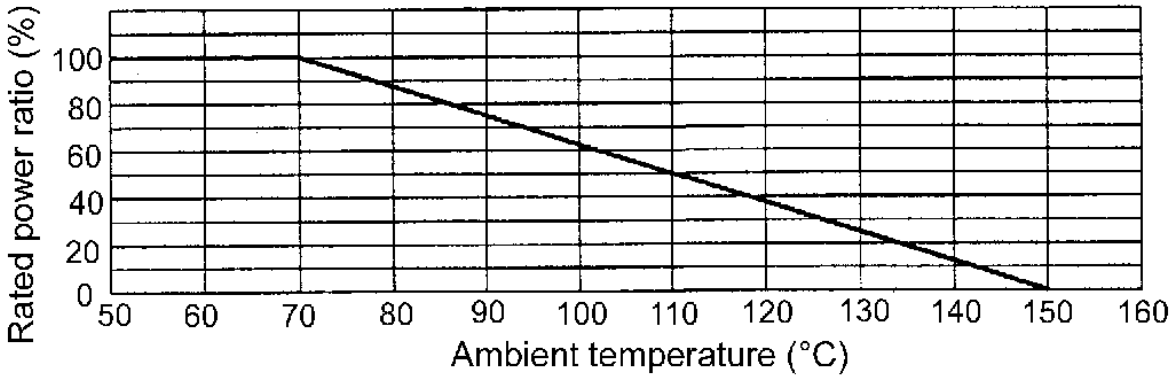


Figure B-1. Derating Curve

B.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

B.3.6.1 Voltage Aging

When resistors are tested as specified in paragraph B.4.4.4.1, the change in resistance before and after the test shall satisfy the requirement of the detail specification. After the test, the resistors shall be free from arcing, burning or charring.

B.3.6.2 Resistance

When resistors are tested as specified in paragraph B.4.4.4.2 under the standard conditions (paragraph B.4.3.1), the resistance shall be within the specified tolerance of the nominal resistance.

B.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph B.4.4.4.3, the resistance-temperature characteristic, at each of the temperatures specified in Table B-11, shall be $\pm 100 \times 10^{-6}$/°C.

B.3.6.4 Short-Time Overload

When resistors are tested as specified in paragraph B.4.4.4.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test. Leakage current shall not exceed 0.1 milliampere (mA) during the test.

B.3.6.5 Dielectric Withstanding Voltage

When resistors are tested as specified in paragraph B.4.4.4.5, resistors shall withstand the specified test voltage. The change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

B.3.6.6 Insulation Resistance

When resistors are tested as specified in paragraph B.4.4.4.6, the insulation resistance shall satisfy the requirements of the detail specification.

B.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

B.3.7.1 Terminal Strength

When resistors are tested as specified in paragraph B.4.4.5.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of breaking or loosening of terminals, chipping of coating, or other evidence of mechanical damage after the completion of the test.

B.3.7.2 Solderability

When resistors are tested as specified in paragraph B.4.4.5.2, a minimum of 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.

B.3.7.3 Resistance to Soldering Heat

When resistors are tested as specified in paragraph B.4.4.5.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

B.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

B.3.8.1 Vibration

B.3.8.1.1 High Frequency Vibration

When resistors are tested as specified in paragraph B.4.4.6.1.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

B.3.8.1.2 Random Vibration

When resistors are tested as specified in paragraph B.4.4.6.1.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

B.3.8.2 Shock

When resistors are tested as specified in paragraph B.4.4.6.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

B.3.8.3 Thermal Shock

B.3.8.3.1 Thermal Shock [I]

When resistors are tested as specified in paragraph B.4.4.6.3.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of this test.

B.3.8.3.2 Thermal Shock [II]

When resistors are tested as specified in paragraph B.4.4.6.3.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 500 cycles.

B.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph B.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. In addition, the dielectric withstanding voltage shall be as specified in paragraph B.3.6.5, and the insulation resistance shall satisfy with the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

B.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph B.4.4.6.5, the marking shall remain legible. The details shall be as defined in the detail specification.

B.3.8.6 Low Temperature Storage

When resistors are tested as specified in paragraph B.4.4.6.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

B.3.8.7 Low Temperature Operation

When resistors are tested as specified in paragraph B.4.4.6.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

B.3.8.8 Stability

When resistors are tested as specified in paragraph B.4.4.6.8, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

B.3.9 Durability

Resistors shall satisfy the following durability requirements.

B.3.9.1 Life

When resistors are tested as specified in paragraph B.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

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-2050.

B.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

B.4.2.1 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table B-5.
The number of samples shall be 453; 151 each for minimum resistance, maximum resistance, and critical resistance or nearest to critical resistance. These samples are prepared for each resistor style. Two additional sample units shall be subjected to the Group I-4 test of Table B-5, and 12 random samples shall be subjected to the Group II tests. If the critical resistance is not specified, the samples shall be equally divided between the minimum and maximum resistance.

Tests of each group shall be performed in the order listed in Table B-5. Upon completion of Group I tests, Group III through VIII tests shall be performed using samples allocated to the appropriate group tests.

Table B-5. Qualification Test

Test			Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
I	1	Externals, dimensions and marking (1)	B.3.3	B.4.4.2	100% (2)	0
	2	Voltage aging	B.3.6.1	B.4.4.4.1		
	3	Resistance	B.3.6.2	B.4.4.4.2		
	4	DPA	B.3.4.1	B.4.4.3.1	2	0
II	1	Solderability	B.3.7.2	B.4.4.5.2	12(2) Any resistance	0
	2	Resistance to solvents	B.3.8.5	B.4.4.6.5		
III	1	Thermal shock [I]	B.3.8.3.1	B.4.4.6.3.1	10 Highest resistance 10 Critical resistance 10 Lowest resistance	0
	2	Resistance-temperature characteristic	B.3.6.3	B.4.4.4.3		
	3	Low temperature storage	B.3.8.6	B.4.4.6.6		
	4	Low temperature operation	B.3.8.7	B.4.4.6.7		
	5	Short-time overload	B.3.6.4	B.4.4.4.4		
	6	Terminal strength	B.3.7.1	B.4.4.5.1		
IV	1	Dielectric withstanding voltage	B.3.6.5	B.4.4.4.5	30: 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0
	2	Insulation resistance	B.3.6.6	B.4.4.4.6		
	3	Thermal shock [I]	B.3.8.3.1	B.4.4.6.3.1		
	4	Resistance to soldering heat	B.3.7.3	B.4.4.5.3		
	5	Moisture resistance	B.3.8.4	B.4.4.6.4		
V	1	Shock	B.3.8.2	B.4.4.6.2	30: 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0
	2	High frequency vibration	B.3.8.1.1	B.4.4.6.1.1		
	3	Thermal shock [II]	B.3.8.3.2	B.4.4.6.3.2		
VI	1	Random vibration	B.3.8.1.2	B.4.4.6.1.2	30: 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0
VII	1	Life	B.3.9.1	B.4.4.7.1	231: 77 Highest resistance 77 Critical resistance 77 Lowest resistance	0
VIII	1	Stability	B.3.8.8	B.4.4.6.8	102: 34 Highest resistance 34 Critical resistance 34 Lowest resistance	0
-	1	Materials	B.3.2	—	(3)	

Notes:

(1) For dimensions and mass, sample size shall be 4.0% of the acceptable quality level (AQL) in "Special Inspection Level S-4" specified in JIS Z 9015-1.

(2) The samples for the Group II test shall not be subjected to the Group I test.

(3) Data to certify compliance with design specifications shall be submitted.

B.4.3 Quality Conformance Inspection

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

B.4.3.1 Samples

The inspection lot configuration of group A shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for each shape. Resistors with the critical resistance or closest to the critical resistance and the highest grade of characteristics shall be selected. If the design criteria are identical and the materials and the structures are similar, the inspection lot may be represented by one of the shapes specified in the detail specification.

B.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be as specified in Tables B-6, B-7 and B-8, respectively. Group tests shall be performed in the group order and the inspections within each group shall be performed in the specified order. The sampling plan used for the Group A inspection shall be in accordance with Appendix 1 of JIS Z 9015-1. "Normal Inspection Level II" and "Special Inspection Level S-4" specified therein shall apply to the Group A2 and A3 inspections, respectively. For Group B and C inspections, quantities of samples shall be specified and the samples shall be any from one shape group for each classification of Table B-1.

B.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table B-6, B-7 or B-8 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table B-6, but the failure mode of the defects is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

B.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed Group A2-1 or Group A3 inspection of Table B-6, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped.

Table B-6. Quality Conformance Inspection (Group A)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
A1	1	Voltage aging	B.3.6.1	B.4.4.4.1	100%	0
	2	Resistance	B.3.6.2	B.4.4.4.2		
A2	1	Externals, dimensions and marking	B.3.3	B.4.4.2	AQL 4.0%	
	2	DPA	B.3.4.1	B.4.4.3.1	2	0
A3	1	Resistance-temperature characteristic	B.3.6.3	B.4.4.4.3	AQL 2.5%	
	2	Dielectric withstanding voltage (atmospheric pressure)	B.3.6.5	B.4.4.4.5.1		
	3	Thermal shock [I]	B.3.8.3.1	B.4.4.6.3.1		
	4	Short-time overload	B.3.6.4	B.4.4.4.4		

Note (1) When a sample has failed to pass 2 or more tests in one group, it shall be counted as a single defect.

Table B-7. Quality Conformance Inspection (Group B)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
B1	1	Solderability	B.3.7.2	B.4.4.5.2	8	0
	2	Resistance to solvents	B.3.8.5	B.4.4.6.5		
B2	1	Dielectric withstanding voltage	B.3.6.5	B.4.4.4.5	10	0
	2	Insulation resistance	B.3.6.6	B.4.4.4.6		
	3	Thermal shock [I]	B.3.8.3.1	B.4.4.6.3.1		
	4	Resistance to soldering heat	B.3.7.3	B.4.4.5.3		
	5	Moisture resistance	B.3.8.4	B.4.4.6.4		
B3	1	Thermal shock [I]	B.3.8.3.1	B.4.4.6.3.1	10	0
	2	Low temperature storage	B.3.8.6	B.4.4.6.6		
	3	Low temperature operation	B.3.8.7	B.4.4.6.7		
	4	Terminal strength	B.3.7.1	B.4.4.5.1		
B4	1	Life	B.3.9.1	B.4.4.7.1	10	0
B5	1	Stability	B.3.8.8	B.4.4.6.8	10	0

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

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
C1	1	Random vibration	B.3.8.1.2	B.4.4.6.1.2	10	0
C2	1	Shock	B.3.8.2	B.4.4.6.2	10	0
	2	High frequency vibration	B.3.8.1.1	B.4.4.6.1.1		
C3	1	Thermal shock [II]	B.3.8.3.2	B.4.4.6.3.2	10	0

B.4.4 Methods for Test and Inspection

B.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, the test and measurement shall be performed in accordance with condition c). The conversion shall be in compliance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3 kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table B-9. Unless specified, condition A shall apply.

Table B-9. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

B.4.4.2 Externals, Dimensions and Marking

B.4.4.2.1 Qualification Test

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. If the measured values are questionable, another measuring instrument may be used.

d) The mass shall be measured with a trip balance compliant to JIS B 7601. If the measured values are questionable, another measuring instrument may be used.

B.4.4.2.2 Quality Conformance Inspection (Group A)

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions may be measured with a dimension gauge which is set in advance, unless the measured value is questionable. Prior to the test, it shall be proven that the dimension gauge is sufficiently functional as a measuring instrument. The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.
d) For the mass inspection, the pass/fail results shall be made by comparing the sample to the criteria samples of maximum mass for each style, which is determined in advance.

B.4.4.3 Workmanship

B.4.4.3.1 DPA

The resistors shall be disassembled to ensure that processes such as terminal connections, helical cutting, and external coating shall have been successfully achieved. DPA shall be conducted in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) Protective coating or enclosure shall be removed from the resistors with a resinous solvent or by other means. The resistors shall be examined visually or by a 5 to 50x magnifier for inspecting the areal ratio of helical cutting, state of helical cutting grooves, uniformity of helical cutting width, state of resistor films, and weld state of caps with terminal leads.
b) The resistors shall be embedded in a proper resin or other materials, and cut at the center along the longitudinal axis of the resistors. One cut face shall be grounded and examined visually or by using a 5x magnifier for the engagement of caps and voids in the external coating.

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

B.4.4.4 Electrical Performance

The electrical performance tests shall be performed as follows.

B.4.4.4.1 Voltage Aging

a) Mounting method
1) Qualification test
The resistors shall be mounted horizontally with no object closer than 75mm below the resistor, except the mounting base which shall be no closer than 50mm below the resistors. The resistors shall be mounted in still air with no air circulation other than the heat of the resistors being operated.

2) Group A quality conformance inspection
The resistors shall be mounted in any position and in the space of any size. Forced air cooling may be used to maintain the test ambient temperature. The average velocity of the forced air, if employed, shall not exceed 2.5m per second.

b) Measurement before test
Resistance shall be measured as specified in paragraph B.4.4.4.2.

c) Test conditions
1) Test ambient temperature: 20 to 45°C
2) Loading power
The loading power shall be one and a half times the rated power. The maximum test voltage shall be as specified in the detail specification.
3) Nature of voltage:
Direct or alternating (root-mean-square value at commercial-line frequency) voltage
4) Loading time: 24^{+4}_{0} hours

d) Measurement after test
The load shall be removed and the resistors shall remain at room temperature for 30 minutes or more before the resistance is measured in accordance with paragraph B.4.4.4.2.

e) Examination after test
The resistors shall be examined visually for evidence of arcing, burning or charring.

B.4.4.4.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Test voltage
Test voltages shall be applied in accordance with Table B-10.

b) Test temperature
As a rule, the Group I resistance test of the qualification test and Group A1 of the Group A quality conformance inspection shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

Table B-10. Resistance Test Voltages

Unit: V_{DC}

Nominal resistance range (Ω)	Maximum voltage
1 or more and less than 10	1
10 or more and less than 100	1
100 or more and less than 1k	3
1k or more and less than 10k	10
10k or more and less than 100k	30
100k or more and less than 1M	100
1M or more	100

B.4.4.4.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Reference temperature: 25°C
b) Test temperature: As specified in Table B-11.
c) Unit of resistance-temperature characteristic: 10^{-6}/°C.

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

Unit: °C

Order	Test temperature	
	Qualification test	Quality conformance inspection
1	25±3	25±3
2	-15±3	-55±3
3	-55±3	25±3
4	25±3	125±3
5	65±3	-
6	125±3	-

B.4.4.4.4 Short-Time Overload

The resistance shall be measured as specified in paragraph B.4.4.4.2. Following this measurement, dc or ac (root-mean-square value at commercial-line frequency) test voltage shall be applied to the resistors under the conditions shown below and the resistors shall be examined for evidence of arcing or any other damage. After this test, the test voltage shall be removed and the resistors shall remain at room temperature with no load for 30 minutes before the resistance is measured in accordance with paragraph B.4.4.4.2 to calculate the change in resistance before and after the test. At the completion of this test, the resistors shall be examined for significant abnormalities. The marking shall also be examined for legibility. This test shall be performed under the following conditions.

a) Mounting method: As specified in item a), paragraph B.4.4.4.1.
b) Test temperature: 25±5°C
c) Test condition:
   A potential of 2.5 times the rated voltage shall be applied for 5±1 seconds to the resistors. The test voltage shall not exceed the maximum overload voltage as specified in the detail specification.

B.4.4.4.5 Dielectric Withstanding Voltage

B.4.4.4.5.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted on a test fixture as shown in Figure B-2.
b) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
c) Test voltage: The test voltage shall be as specified in the detail specification.
d) Points of application of test voltage
The test points shall be between the resistor terminals connected together and the test fixture.
e) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.

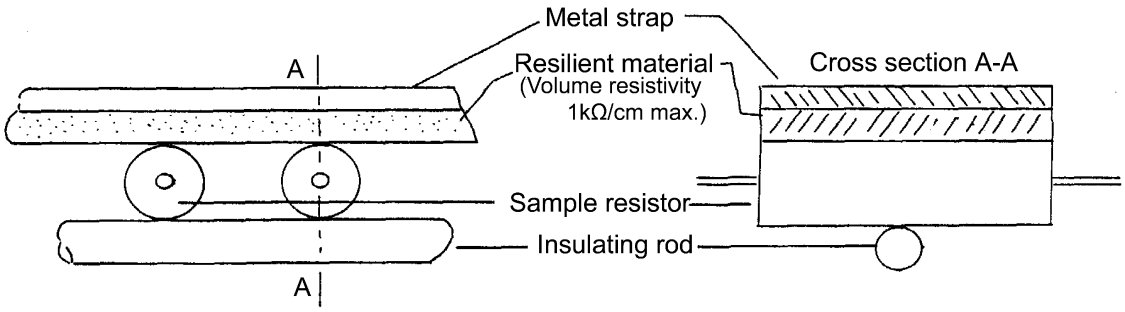


Figure B-2. Mounting Method

B.4.4.4.5.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted on a test fixture as shown in Figure B-2.
b) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
c) Test condition: D [1.1±0.1kPa]
d) Test voltage: The test voltage shall be as specified in the detail specification.
e) Points of application of test voltage: As specified in item d), paragraph B.4.4.4.5.1
f) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
g) Examination after test
The resistors shall be examined visually for evidence of flashover, arcing, insulation breakdown and mechanical damage.

B.4.4.4.6 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method: As specified in item a), paragraph B.4.4.4.5.1.
b) Test voltage: Test condition A ($100V_{DC}$±10%).

B.4.4.5 Mechanical Performance

The mechanical performance tests shall be performed as follows.

B.4.4.5.1 Terminal Strength

Resistors shall be tested in accordance with condition A (pull test) and D (twist test) specified in Test Method 211 of MIL-STD-202. The following details and exceptions shall apply.

B.4.4.5.1.1 Pull Test (Test Condition A)

a) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
b) Load
Load shall be 9.8N for the resistors with the rated power of 0.125W or less and 24.5N for 0.25W or more.
c) Duration of load applied: 5 to 10 seconds
d) Test method
The load shall be applied in the axial direction of lead wires without inducing shock. The lead wire shall be clamped at the closest point to the lead end.
e) Measurement after test
Resistance shall not be measured after the pull test since this test shall be performed in combination with the twist test specified in paragraph B.4.4.5.1.2.
f) Examination after test
The terminals shall be examined visually for evidence of mechanical damage.

B.4.4.5.1.2 Twist Test (Test Condition D)

Following the pull test, the twist test shall be performed with the same samples.

a) Measurement before test: The resistance shall not be measured before the test.
b) Test method
With the center axis of the resistor’s lead wire used as a rotating axis, the lead wire shall be rotated 360 degrees along a plane perpendicular to the rotating axis. This operation shall be defined as the first twist. The lead wire shall then be rotated 360 degrees in the opposite direction. This shall be counted as the second twist.
c) Number of twists: 5
d) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
e) Examination after test
The terminals shall be examined for evidence of breaking or loosening.

B.4.4.5.2 Solderability

Resistors shall be tested in accordance with Test Method 208 of MIL-STD-202. The following details and exceptions shall apply.

a) Preparations: Shall be performed.

b) Number of terminals tested: All terminals.
c) Solder temperature: 245±5°C
d) Solder immersion time: 5±0.5 sec.
e) Depth of immersion
Non-molded type shall be within 1.3mm from the base of the terminals.
Molded type shall be within 2.5mm from the base of the terminals.
f) Examination after test
Resistors shall be examined visually for solder wettability.

B.4.4.5.3 Resistance to Soldering Heat

Resistors shall be tested in accordance with Test Method 210 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
b) Solder temperature: 350±10°C
c) Duration of immersion: $3^{+0.5}_{0}$ seconds
d) Depth of immersion: Within 1.3mm from the base of the terminals.
e) Cooling time after immersion: 3 hours or more
f) Measurement after test
The terminals shall remain at room temperature for the specified time after the test before the resistance measurement is made in accordance with paragraph B.4.4.4.2.
g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

B.4.4.6 Environmental Performance

The environmental performance tests shall be performed as follows.

B.4.4.6.1 Vibration

B.4.4.6.1.1 High Frequency Vibration

Resistors shall be tested in accordance with Test Method 204 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted in accordance with item a), paragraph B.4.4.6.2. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.
b) Measurement before test
Resistance shall not be measured before this vibration test since this test shall be performed in combination with the shock test (specified pulse) as specified in paragraph B.4.4.6.2.
c) Test condition: D (196m/s^2 p-p or 1.5mm in double amplitude, whichever is smaller).

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.
e) Duration of vibration: Six hours in each direction for a total of 12 hours.
f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration to determine no electrical discontinuity of 0.1ms or greater.
g) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

B.4.4.6.1.2 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method: As specified in item a), paragraph B.4.4.6.2.
b) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
c) Test condition: II-H Frequency range: 20 to 2,000Hz
Rms value of acceleration: 334m/s^2 rms
d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.
e) Number of application and duration of vibration
Vibration shall be applied for 15 minutes in each direction with a total test time of 30 minutes.
f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration to determine no electrical discontinuity of 0.1ms or greater.
g) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.
h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

B.4.4.6.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method:
Resistors shall be rigidly mounted on appropriate fixtures or mounted with the bodies cemented to a flat surface. The resistors shall be fixed with their leads supported approximately 6mm from the resistor body. The fixtures shall be constructed to insure that the points of the resistor mounting supports will have the same motion as the shock table. The mounting fixtures shall be constructed to preclude any resonance in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. Test lead used

during this test shall be stranded wire no larger than 0.6mm in diameter so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no greater than necessary.

b) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.

c) Test condition: I (980m/s^2, 6ms sawtooth).

d) Direction of applied shocks
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of applied shocks
The resistors shall be subjected to 10 shocks in each direction, for a total of 20 shocks.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the shock to determine no electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

B.4.4.6.3 Thermal Shock

B.4.4.6.3.1 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted by means other than soldering or may be placed in trays of small heat inertia.

b) Test conditions
As specified in Table B-12.

c) Measurement before test
The resistance shall be measured in accordance with paragraph B.4.4.4.2.

d) Number of test cycles: 25 cycles

e) Cycle conditions
The first five cycles shall run continuously. After the five cycles, the test may be interrupted following the completion of any full cycle.

f) Measurement after test
The resistance shall be measured in accordance with paragraph B.4.4.4.2 after the resistors are at room temperature for a minimum of 30 minutes.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table B-12. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	-65^{0}_{-5}	15
2	150^{+3}_{0}	15

B.4.4.6.3.2 Thermal Shock [II]

After measuring resistance in accordance with paragraph B.4.4.4.2, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table B-13 and Figure B-3. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted by means other than soldering or may be placed in trays of small heat inertia.

b) Number of test cycles: 1,000 cycles

c) Cycle conditions
The first 25 cycles shall run continuously. After the 25 cycles, the test may be interrupted following the completion of any full cycle.

d) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more at each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+5}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for cracks on the surface.

e) Examination after test
The resistors shall be at room temperature for 30 minutes or more, and the resistance shall be measured in accordance with paragraph B.4.4.4.2 to calculate the change in resistance before and after the test.

f) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table B-13. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	$-30\ ^{0}_{-5}$	15
3	$100\ ^{+3}_{0}$	15

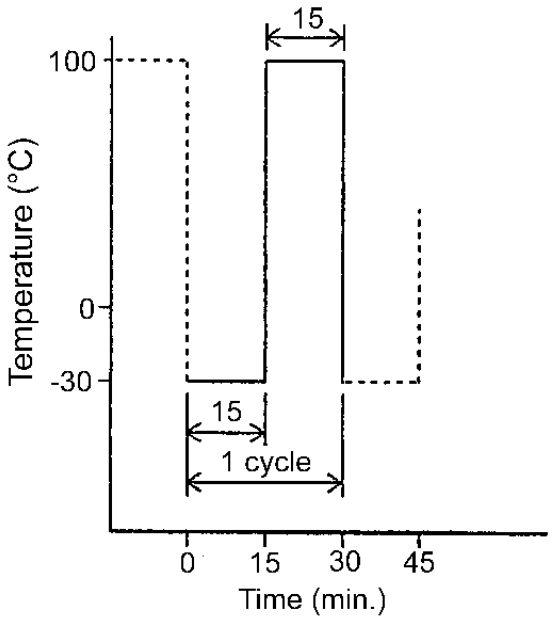


Figure B-3. Test Conditions of Thermal Shock [II]

B.4.4.6.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method

1) Where polarization is not applied

Solder both leads to rigid mounts or terminal lugs. The spacing of the mounts or terminal lugs shall be such that the length of each resistor lead is approximately 10mm when measured from the edge of the supporting terminal to the resistor body.

2) Where polarization is applied

One half of the resistors mounted as specified in 1) above shall be covered with a V-shape metal strap whose width is equal to that of the resistor body as indicated in Figure B-4. The strap shall be made from corrosion-resistant metal and shall be kept in contact with the resistor body by supporting the body as indicated in Figure B-4, with a nonconducting, noncorrosive support whose width is less than that of the resistor body. In addition, the support shall not allow condensation of moisture which could have an inverse influence on the test. An individual metal strap may be used for each resistor or one continuous metal strap may be used for all resistors.

b) Measurement before test

Following the pretreatment, the resistors shall be at room temperature for a minimum of 2 hours before the resistance is measured in accordance with paragraph B.4.4.4.2.

c) Polarization and loading voltage

1) Polarization voltage
   Polarization voltage shall be applied to the resistors covered with the metal straps. During steps 1 through 6, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the polarizing straps.
2) Loading voltage
   Loading voltage shall be applied to the resistors which are not covered with the metal strap. During the first 2 hours of steps 1 and 4, a dc test potential equivalent to 100% rated wattage, but not exceeding the maximum operating voltage, shall be applied.

d) Measurement after test
Upon completion of step 6 of the final cycle, the resistors shall be held at a relative humidity of 90 to 95% and a temperature of 25±2°C for a period of 1 hour and 30 minutes to 3 hours and 30 minutes. Resistors shall be removed from the chamber, and remain at room temperature for 1 to 2 hours. Then, the resistance, dielectric withstanding voltage (atmospheric pressure) and insulation resistance shall be measured in that order as specified in paragraphs B.4.4.4.2, B.4.4.4.5.1 and B.4.4.4.6 respectively.

e) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

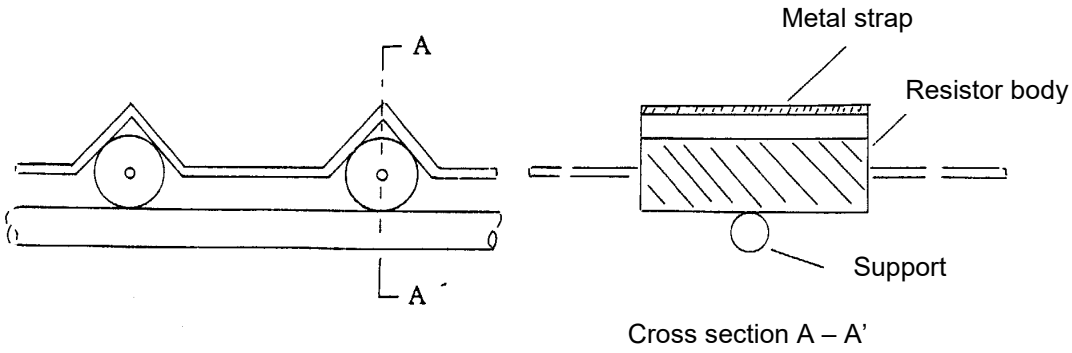


Figure B-4. Mounting Straps for Polarized Units

B.4.4.6.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion
b) Solvents to be used
   1) 2-propanol (Isopropyl alcohol)
   2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

B.4.4.6.6 Low Temperature Storage

The resistance shall be measured as specified in paragraph B.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of -65^{0}_{-5} °C for a period of 24±4 hours. The temperature in the chamber shall then be gradually returned to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall be at room temperature for 2 hours or more but less than 8 hours. The resistance shall then be measured in accordance with paragraph B.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormalities. The marking shall be examined for legibility.

B.4.4.6.7 Low Temperature Operation

The resistance shall be measured as specified in paragraph B.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a test chamber at room temperature. The temperature shall be gradually decreased to -65^{0}_{-5} °C and the resistors shall remain for 1 hour at no load. The rated voltage shall then be applied for 45^{+5}_{0} minutes. Wait 15^{+5}_{0} minutes after the removal of voltage to gradually increase the chamber temperature to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for 1 hour or more but less than 2 hours. The resistance shall then be measured again as specified in paragraph B.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormalities. The marking shall be examined for legibility.

B.4.4.6.8 Stability

After the resistance is measured in accordance with paragraph B.4.4.4.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually increased to a test temperature of 150^{+15}_{0} °C. After stabilizing at the test temperature, the resistors shall remain at no load for $2{,}000^{+48}_{0}$ hours. When the specified test time has passed, the temperature shall be gradually returned to room temperature. The resistors shall then be removed from the test chamber and remain at a temperature of 25±5°C for 6±1 hours. The resistance shall then be measured in accordance with paragraph B.4.4.4.2 to calculate the change in resistance before and after the test. After the test, the resistors shall be examined for significant abnormality.

B.4.4.7 Durability

Durability test shall be performed as follows.

B.4.4.7.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted on light weight terminals. The effective length of each terminal shall be a minimum of 12.5mm. Resistors shall be soldered to the terminals as a rule. The distance between resistors shall be a minimum of 50mm.

b) Measurement before test
After the resistors are mounted in a test fixture, the resistance shall be measured at room temperature in accordance with paragraph B.4.4.4.2. All measurements shall be performed at a temperature difference of ±2°C.

c) Test temperature: 70±5°C

d) Test conditions
The rated voltage specified in paragraph B.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be $4{,}000\,^{+72}_{0}$ hours for the qualification test and $2{,}000\,^{+48}_{0}$ hours for the quality conformance inspection.

e) Measurements during and after test
After the resistors are at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph B.4.4.4.2.

f) Measurements during test
3) Qualification test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, $1{,}000\,^{+48}_{0}$ hours and $2{,}000\,^{+72}_{0}$ hours.
4) Quality conformance inspection: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours and $1{,}000\,^{+48}_{0}$ hours.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage.

B.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

B.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

B.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

B.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX D

RESISTOR NETWORKS, FIXED, FILM

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: December 28, 2021

APPENDIX D

RESISTOR NETWORKS, FIXED, FILM

D.1. General

D.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the fixed, film resistor networks (hereinafter referred to as "resistors").

D.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table D-1.

Table D-1. Classification

Construction	Identification number
SIP	402

D.1.3 Part Number

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

Example:

JAXA([1])	2050/D	402	–	10	M	1001	F	C
		ID Number		Number of terminal (D.1.3.1)	Characteristic (D.1.3.2)	Nominal resistance (D.1.3.3)	Resistance tolerance (D.1.3.4)	Schematic (D.1.3.5)

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

D.1.3.1 Terminals

The terminals shall be identified by a two digit number as shown in table D-2.

Table D-2. Terminals

Symbol	Number of terminals
04	4
05	5
06	6
07	7
08	8
09	9
10	10

D.1.3.2 Characteristic

The characteristic shall be identified by a single capital letter in accordance with Table D-3.

Table D-3. Characteristic

(Unit: $x10^{-6}/°C$)

Symbol	Resistance-temperature characteristic (referenced:25°C)
M	±200

D.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 3 or 4 digits.

a) Resistance identified by 4 digits

The resistance identified by 4 digits applies to resistors with resistance tolerance of F(±1.0%). The first three digits represent the significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.

Example: 97R6= 97.6Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω=150 kΩ

b) Resistance identified by 3 digits
The resistance identified by 3 digits applies to resistors with resistance tolerances of J (±5.0%) or G (±2.0%). The first two digits represent significant figures and the last digit specifies the number of zeros to follow.
Example: 100= 10Ω
151= 150Ω
152= 1,500Ω= 1.50kΩ
154=150,000Ω=150 kΩ

D.1.3.4 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table D-4.

Table D-4. Resistance Tolerance

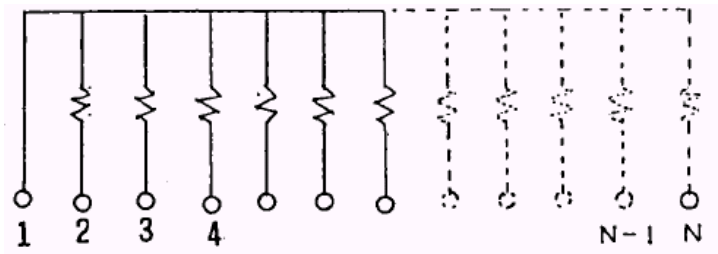
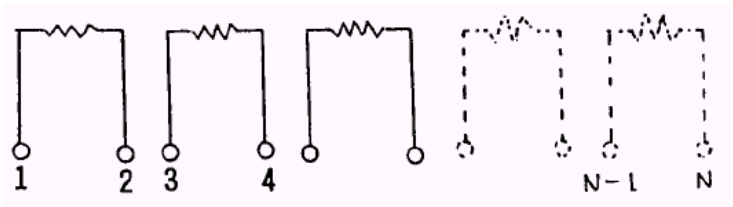
Unit: %

Symbol	Resistance tolerance
F	±1.0
G	±2.0
J	±5.0

D.1.3.5 Schematic

The schematic shall be identified by a single capital letter in accordance with Table D-5.

Table D-5. Schematic

Symbol	Schematic
C	
G	

D.2. Applicable Documents

D.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

D.2.2 Reference Documents

The following is a reference document.

a) MIL-PRF-83401 Resistors Networks, Fixed, Film, and Capacitor-Resistor Networks, Ceramic Capacitor and Fixed Film Resistors, General Specification for

D.3. Requirements

D.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs D.3.2 to D.3.9. The qualification coverage shall be represented by samples that have passed the qualification test.
Characteristics, resistance tolerance and schematics of the resistors to be qualified shall be classified as specified in Tables D-6, D-7 and D-8. 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.

Table D-6. Characteristics Qualification

Characteristic submitted	Characteristic qualified
M	M

Table D-7. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
F	F, G, J
G	G, J
J	J

Table D-8. Schematics Qualification

Schematic submitted	Schematic qualified
C	C, G
G	G

D.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

D.3.2.1 Enclosure

Resistors shall be sufficiently encapsulated to withstand the environmental tests specified.

D.3.2.2 Terminal Leads

Terminal leads shall be free of foreign material.

D.3.2.3 Flux

The manufacturer shall completely remove corrosive substances after soldering or use noncorrosive flux. When non-corrosive flux is used, the water extract resistivity test shall be performed in accordance with paragraph 4.9 of JIS Z 3197, and it shall be verified that the water extract resistivity is not less than 100kΩ·cm. When resin flux cored solder is used, the mass ratio range of resin to solder shall be between 1 and 3%.

D.3.3 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph D.4.4.2.

D.3.3.1 Externals and Marking

There shall be no defects such as cracks on the surface of the resistors. The following shall be clearly marked in such a manner to ensure legibility. As a rule, the marking shall remain legible at the completion of any test. Resistors with a small shape and physical dimensions shall be marked on its front and rear separately.

a) Part number
   The marking of “JAXA 2050D” and the hyphen between the Identification number and Number of terminal may be omitted.
b) The symbol
   “●” or “■” shall be used to identify pin no.1.
c) Year and week manufactured
   As specified in detail specification.
d) Manufacturer name or its abbreviation.

D.3.3.2 Construction, Dimensions and Mass

Resistors shall be constructed of a film resistor element and external terminals. The dimensions and mass shall satisfy the requirements specified in each detail specification.

D.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1.

D.3.4.1 DPA

When resistors are tested as specified in paragraph D.4.4.3.1, processes such as terminal connections, connection between each resistor element, helical cutting, and external coating shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program.

D.3.5 Ratings

D.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined in relation to the resistance tolerance and shall be as specified in Table D-9. The minimum and maximum resistances shall satisfy the requirements of the detail specification.

D.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +125°C.

D.3.5.3 Power Rating

Resistors shall have a power rating as specified in the detail specification. The rated ambient temperature shall be 70°C.

Table D-9. Standard Resistance Values

Resistance tolerance and symbols (%)							
F (±1.0)	G (±2.0) J (±5.0)	F (±1.0)	G (±2.0) J (±5.0)	F (±1.0)	G (±2.0) J (±5.0)	F (±1.0)	G (±2.0) J (±5.0)
10.0	10.0	18.7	-	33.2	-		
10.2	-	19.1	-	34.0	-	57.6	-
10.5	-	19.6	-	34.8	-	59.0	-
10.7	-	20.0	20	35.7	-	60.4	-
11.0	11	20.5	-	-	36	61.9	-
11.3	-	21.0	-	36.5	-	-	62
11.5	-	21.5	-	37.4	-	63.4	-
11.8	-	-	22	38.3	-	64.9	-
-	12	22.1	-	-	39	66.5	-
12.1	-	22.6	-	39.2	-	-	68
12.4	-	23.2	-	40.2	-	68.1	-
12.7	-	23.7	-	41.2	-	69.8	-
13.0	13	-	24	42.2	-	71.5	-
13.3	-	24.3	-	-	43	73.2	-
13.7	-	24.9	-	43.2	-	75.0	75
14.0	-	25.5	-	44.2	-	76.8	-
14.3	-	26.1	-	45.3	-	78.7	-
14.7	-	26.7	-	46.4	-	80.6	-
15.0	15	-	27	-	47	-	82
15.4	-	27.4	-	47.5	-	82.5	-
15.8	-	28.0	-	48.7	-	84.5	-
-	16	28.7	-	49.9	-	86.6	-
16.2	-	29.4	-	-	51	88.7	-
16.5	-	-	30	51.1	-	90.9	-
16.9	-	30.1	-	52.3	-	-	91
17.4	-	30.9	-	53.6	-	93.1	-
17.8	-	31.6	-	54.9	-	95.3	-
-	18	32.4	-	-	56	97.6	-
18.2	-	-	33	56.2	-		

D.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure D-1.

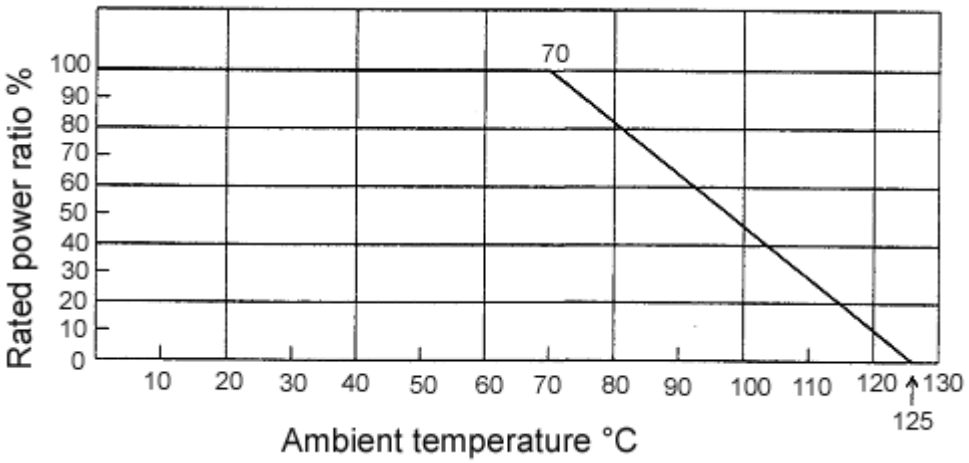


Figure D-1. Derating Curve

D.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage as specified in the detail specification, the maximum operating voltage shall be the rated voltage.

$$E=\sqrt{P \cdot R}$$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

D.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

D.3.6.1 Power Conditioning

When resistors are tested as specified in paragraph D.4.4.4.1, the change in resistance before and after this test shall satisfy the requirements of the detail specification. There shall be no mechanical damage after the completion of this test.

D.3.6.2 Resistance

When resistors are tested as specified in paragraph D.4.4.4.2, the resistance shall be within the specified tolerance of the nominal resistance and shall be stable within the specified tolerance during the measurement.

D.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph D.4.4.4.3, the resistance-temperature characteristic, at each of the temperatures specified in Table D-16, shall be as specified in Table D-3.

D.3.6.4 Short-Time Overload

When resistors are tested as specified in paragraph D.4.4.4.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

D.3.6.5 Dielectric Withstanding Voltage

When resistors are tested as specified in paragraph D.4.4.4.4, the leakage current shall satisfy the requirements of the detail specification. There shall be no mechanical damage, arcing, or insulation breakdown.

D.3.6.6 Insulation Resistance

When resistors are tested as specified in paragraph D.4.4.4.5, the insulation resistance shall satisfy the requirements of the detail specification.

D.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

D.3.7.1 Terminal Strength

When resistors are tested as specified in paragraph D.4.4.5.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage, loosening of terminals or chipping of coating after the completion of the test.

D.3.7.2 Solderability

When resistors are tested as specified in paragraph D.4.4.5.2, a minimum of 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.

D.3.7.3 Resistance to Soldering Heat

When resistors are tested as specified in paragraph D.4.4.5.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

D.3.8.1 High Frequency Vibration

When resistors are tested as specified in paragraph D.4.4.6.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification.

D.3.8.2 Shock

When resistors are tested as specified in paragraph D.4.4.6.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification.

D.3.8.3 Thermal Shock [I]

When resistors are tested as specified in paragraph D.4.4.6.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph D.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph D.4.4.6.5, the marking shall remain legible. The details shall be as specified in the detail specification.

D.3.8.6 Low Temperature Storage

When resistors are tested as specified in paragraph D.4.4.6.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.8.7 Low Temperature Operation

When resistors are tested as specified in paragraph D.4.4.6.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.8.8 Stability

When resistors are tested as specified in paragraph D.4.4.6.8, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.3.9 Durability

Resistors shall satisfy the following durability requirements.

D.3.9.1 Life

When resistors are tested as specified in paragraph D.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

D.4. Quality Assurance Provisions

D.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2050.

D.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

D.4.2.1 Test Items and Number of Samples

Test items and number of samples for the qualification test shall be as specified in Table D-10.
The number of samples shall be 180: 60 each for minimum resistance, maximum resistance, and critical resistance or closest to the critical resistance. The samples shall have the maximum number of elements shown in the schematics to be qualified. Each construction shall be separately qualified. Two additional sample units shall be subjected to the Group IB test of Table D-10, DPA, and 12 random samples shall be subjected to the Group II tests.

Tests of each group shall be performed in the order listed in Table D-10. Upon completion of Group I tests, Group III through VII tests shall be performed using samples allocated to the appropriate group tests.

Table D-10. Qualification Test

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
I	1	Thermal shock [I]	D.3.8.3	D.4.4.6.3	100%	0
	2	Power conditioning	D.3.6.1	D.4.4.4.1		
	3	Resistance	D.3.6.2	D.4.4.4.2		
IA	1	Externals, dimensions and marking (2) (3)	D.3.3	D.4.4.2		
IB	1	DPA	D.3.4.1	D.4.4.3.1	2	0
II	1	Solderability	D.3.7.2	D.4.4.5.2	12 Any resistance	0
	2	Resistance to solvents	D.3.8.5	D.4.4.6.5		
III	1	Resistance-temperature characteristic	D.3.6.3	D.4.4.4.3	10 Highest resistance 10 Critical resistance 10 Lowest resistance	0
	2	Low temperature storage	D.3.8.6	D.4.4.6.6		
	3	Low temperature operation	D.3.8.7	D.4.4.6.7		
	4	Short-time overload	D.3.6.4	D.4.4.4.6		
	5	Terminal strength	D.3.7.1	D.4.4.5.1		
IV	1	Dielectric withstanding voltage	D.3.6.5	D.4.4.4.4	30 (10 Highest resistance, 10 Critical resistance, 10 Lowest resistance)	0
	2	Insulation resistance	D.3.6.6	D.4.4.4.5		
	3	Resistance to soldering heat	D.3.7.3	D.4.4.5.3		
	4	Moisture resistance	D.3.8.4	D.4.4.6.4		
V	1	Shock	D.3.8.2	D.4.4.6.2	30 (10 Highest resistance, 10 Critical resistance, 10 Lowest resistance)	0
	2	High frequency vibration	D.3.8.1	D.4.4.6.1		
VI	1	Life	D.3.9.1	D.4.4.7.1	60 (20 Highest resistance, 20 Critical resistance, 20 Lowest resistance)	0
VII	1	Stability	D.3.8.8	D.4.4.6.8	30 (10 Highest resistance, 10 Critical resistance, 10 Lowest resistance)	0
-	1	Materials	D.3.2	—	(4)	

Notes:

(1) When a sample has failed to pass 2 or more tests of one group, it shall be counted as a single defect.

(2) For dimensions and mass, sample size shall be 1.0% of the acceptable quality level (AQL) in "Special Inspection Level S-4" specified in JIS Z 9015-1.

(3) If the critical resistance is not specified, the samples shall be equally divided between the minimum and maximum resistance.

(4) Data to certify compliance with design specifications shall be submitted.

D.4.3 Quality Conformance Inspection

D.4.3.1 Samples

The composition of the Group A inspection lot is as specified in Paragraph 4.5.1.1. Group B and C inspections shall be performed for each structure and the inspection samples used for these inspections shall be the ones passed the Group A inspection. Any number of terminal and resistance may be chosen.

D.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be as specified in Tables D-11, D-12 and D-13, respectively.

D.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table D-11, D-12 or D-13 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table D-11, but the failure mode of a defect is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

D.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed the Group A2 or A4 inspection, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped.

Table D-11. Quality Conformance Inspection (Group A)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
A1	1	Thermal shock [I]	D.3.8.3	D.4.4.6.3	100%	0
	2	Power conditioning	D.3.6.1	D.4.4.4.1		
	3	Resistance	D.3.6.2	D.4.4.4.2		
A2	1	Externals, dimensions and marking	D.3.3	D.4.4.2	AQL(2)4.0%	
A3	1	DPA	D.3.4.1	D.4.4.3.1	2	0
A4	1	Resistance-temperature characteristic	D.3.6.3	D.4.4.4.3	AQL(2) 2.5%	
	2	Dielectric withstanding voltage (atmospheric pressure)	D.3.6.5	D.4.4.4.4.1		
	3	Insulation resistance	D.3.6.6	D.4.4.4.5		
	4	Short-time overload	D.3.6.4	D.4.4.4.6		

Notes:

(1) When a sample has failed to pass 2 or more tests of one group, it shall be counted as a single defect.

(2) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Normal Inspection Level II" and "Special Inspection Level S-4" specified therein shall apply to the Group A2 and A4 inspections, respectively.

Table D-12. Quality Conformance Inspection (Group B)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
B1	1	Resistance-temperature characteristic	D.3.6.3	D.4.4.4.3	10	0
	2	Low temperature storage	D.3.8.6	D.4.4.6.6		
	3	Low temperature operation	D.3.8.7	D.4.4.6.7		
	4	Short-time overload	D.3.6.4	D.4.4.4.6		
	5	Terminal strength	D.3.7.1	D.4.4.5.1		
B2	1	Dielectric withstanding voltage	D.3.6.5	D.4.4.4.4	10	0
	2	Insulation resistance	D.3.6.6	D.4.4.4.5		
	3	Resistance to soldering heat	D.3.7.3	D.4.4.5.3		
	4	Moisture resistance	D.3.8.4	D.4.4.6.4		
B3	1	Life	D.3.9.1	D.4.4.7.1	10	0
B4	1	Solderability	D.3.7.2	D.4.4.5.2	10	0
	2	Resistance to solvents	D.3.8.5	D.4.4.6.5		
B5	1	Stability	D.3.8.8	D.4.4.6.8	10	0

Table D-13. Quality Conformance Inspection (Group C)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
C1	1	Shock	D.3.8.2	D.4.4.6.2	10	0
	2	High frequency vibration	D.3.8.1	D.4.4.6.1		

D.4.4 Methods for Test and Inspection

D.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in questionable pass/fail results, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3 kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table D-14. Unless specified, condition A shall apply.

d) Specified mounting
The resistors shall be mounted on a suitable test board of glass epoxy base nominally 1.6mm thick. Resistors must be spaced at least 13mm from apart. Since the mounting method is not specified, a pressure type contact may be used.

Table D-14. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

D.4.4.2 Externals, Dimensions and Marking

D.4.4.2.1 Qualification Test

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. If the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured with a measuring instrument which will not give a questionable pass/fail result.

D.4.4.2.2 Quality Conformance Inspection (Group A)

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions may be measured with a dimension gauge which is set in advance or a gauge of n times using a universal projector, unless the measured value could result in a questionable result. Prior to the test, it shall be proven that the dimension gauge is sufficiently functional as a measuring instrument. The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.
d) For the mass inspection, pass/fail results shall be made by comparing the sample to the criteria samples of maximum mass for each style, which is determined in advance.

D.4.4.3 Workmanship

D.4.4.3.1 DPA

The resistors shall be disassembled to ensure that processes such as terminal connections, connection between each resistor element, helical cutting, and enclosure have been successfully achieved. DPA shall be conducted in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) Protective coating or enclosure shall be removed from the resistors with a resinous solvent or by other means. The resistors shall be examined visually or by using a 5 to 50x magnifier for inspecting the areal ratio of helical cutting, connection between resistor elements, and connection of terminals to electrodes.
b) The resistors shall be embedded in a proper resin or other materials, and the electrode, terminal connections and resistance element of the resistor shall be cut in the plane including the terminals along the longitudinal axis of the resistors. One cut face shall be grounded and examined visually or by using a 5 to 50x magnifier for inspecting the terminal connection, resistor elements, electrodes, and enclosure.

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

D.4.4.4 Electrical Performance

The electrical performance tests shall be performed as follows.

D.4.4.4.1 Power Conditioning

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Test temperature: 20^{+25}_{0} °C

b) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.

c) Test duration: 100±4 hours

d) Loading condition
The rated voltage specified in paragraph D.3.5.5 shall be applied to the resistor intermittently, 90 minutes ON and 30 minutes OFF. But it shall not exceed the maximum operating voltage specified in the detail specification.

e) Measurement after test
After the resistors are at room temperature for a minimum of 30 minutes, the resistance shall be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

f) Examination after test
The resistors shall be examined for evidence of mechanical damage.

D.4.4.4.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Test voltage
Test voltages shall be applied in accordance with Table D-15.

b) Temperature:
As a rule, the Group I resistance test of the qualification test and Group A1 of the Group A quality conformance inspection shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

c) Procedure
The resistor elements shall be individually measured.

Table D-15. Maximum Test Voltages

Unit: V_{DC}

Nominal resistance range (Ω)	Allowable power		
	10mW	25mW - 95mW	100mW - 225mW
10 or more and less than 100	0.3	0.5	1.0
100 or more and less than 1,000	1.0	1.0	1.0
1,000 or more and less than 10,000	3.0	3.0	3.0
10,000 or more and less than 100,000	10.0	10.0	10.0
100,000 or more	30.0	30.0	30.0

D.4.4.4.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Reference temperature: 25°C
b) Test temperature: As specified in Table D-16.
c) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table D-16. Test Temperature for Resistance-Temperature Characteristic

Unit: °C

Order	Test temperature	
	Qualification test	Quality conformance inspection
1	25±3	25±3
2	-15±3	-55±3
3	-55±3	25±3
4	25±3	125±3
5	65±3	-
6	125±3	-

D.4.4.4.4 Dielectric Withstanding Voltage

D.4.4.4.4.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply

a) Mounting method
The resistor shall be secured by mounting its sides on metal plates of sufficient size to extend beyond the resistor edges. The metal plates shall avoid contact with the terminals. All resistor terminals shall be connected using appropriate conductors or conductive fixtures. An example is shown in Figure D-2.
b) Test voltage: $200V_{AC}$ (root-mean-square value at commercial-line frequency)
c) Duration of application of test voltage: 60^{+10}_{0} seconds
d) Points of application of test voltage
The test points shall be between the terminals connected together with an appropriate conductor and metal mounting plate.
e) Measurement during test
During the test, the leakage current shall be monitored and the resistors examined for evidence of arcing and breakdown.

f) Examination after test
The resistors shall be examined visually for evidence of mechanical damage, arcing and insulation breakdown.

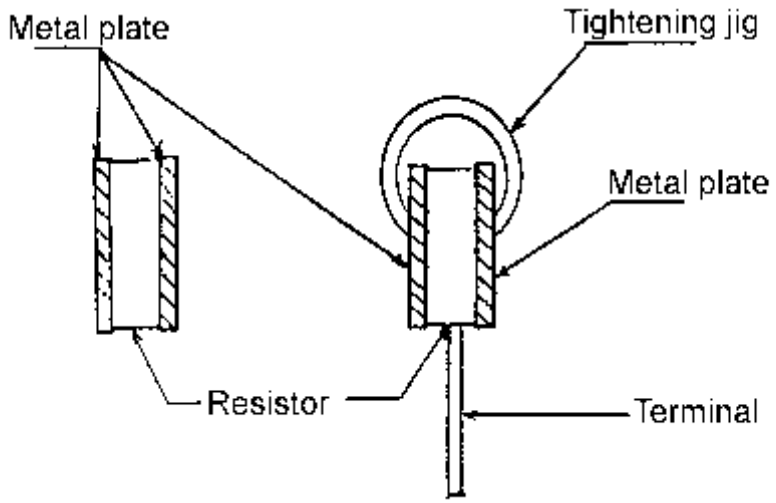


Figure D-2. Test Jig for the Dielectric Withstanding Voltage Test

D.4.4.4.4.2 Barometric Pressure (Reduced)

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item a), paragraph D.4.4.4.4.1.
b) Test voltage
$100V_{AC}$ (root-mean-square value at commercial-line frequency)
c) Test condition: D (1.1±0.1kPa)
d) Duration of application of test voltage: 60^{+10}_{0} seconds
e) Points of application of test voltage: As specified in item d), paragraph D.4.4.4.4.1.
f) Measurement during test
During the test, the leakage current shall be monitored and the resistors examined for evidence of arcing and breakdown.
g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage, arcing and insulation breakdown.

D.4.4.4.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Test condition: A ($100V_{DC}$)
b) Mounting method
The resistors shall be mounted as specified in item a), paragraph D.4.4.4.4.1.
c) Duration of application of test voltage: 120^{+10}_{0} seconds

d) Points of application of test voltage: As specified in item d), paragraph D.4.4.4.4.1.

D.4.4.4.6 Short-Time Overload

The resistance shall be measured as specified in paragraph D.4.4.4.2. A dc test potential, 2.5 times the rated voltage but not exceeding the maximum overload voltage as specified in the detail specification, shall be applied for 5±1 seconds to each resistor in the network. The following conditions shall be maintained.

a) Mounting method
Resistors are to be mounted horizontally to the fixture in still air with no circulation other than the heat of the resistor being tested.

b) Test temperature: 25^{+5}_{0} °C

c) Measurement after test
Wait 30^{+15}_{0} minutes after removal of the test potential before measuring the resistance as specified in paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

d) Examination after test
The resistors shall be examined visually for evidence of arcing, burning or charring.

D.4.4.5 Mechanical Performance

The mechanical performance tests shall be performed as follows.

D.4.4.5.1 Terminal Strength

D.4.4.5.1.1 Pull Test

The following conditions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.

b) Load: 19.6N±0.1N

c) Duration of load applied: 30±5 seconds

d) Number of terminals to be tested: Five randomly selected terminals.

e) Test method
The resistor shall be securely mounted to an appropriate fixture. The specified weight shall be applied, without shock, to each lead or terminal to be tested in a direction parallel to the axis of the lead (or terminal) and maintained for the specified test time. The tension shall be applied as close to the end of the lead (or terminal) as practical. The fixture shall be capable of enduring the specified load. Each terminal shall be tested for the specified time. The direction of the force shall be as specified in Figure D-3.

f) Measurement after test
The resistance shall be measured as specified in paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The terminals shall be examined visually for evidence of mechanical damage, chipping of the coating and loosening of the terminals.

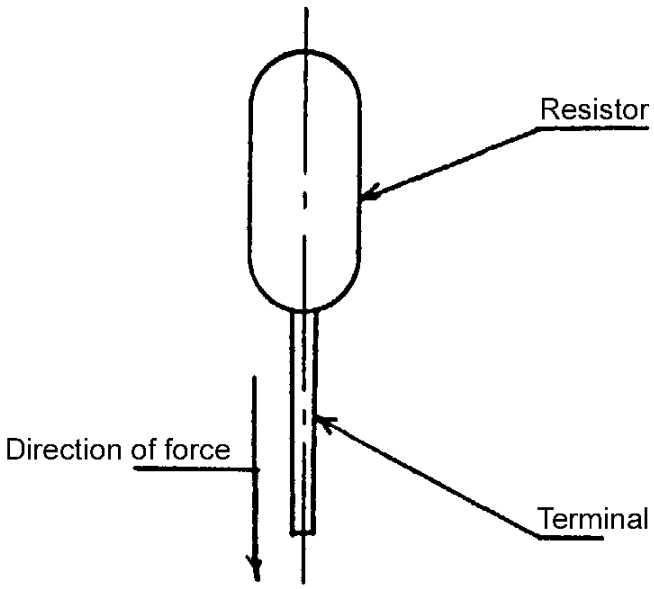


Figure D-3. Direction of Force

D.4.4.5.1.2 Bend Test

The following conditions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.

b) Number of terminals to be tested: Five randomly selected terminals.

c) Test conditions
For the test, each lead shall be bent at an angle sufficient to cause the lead to retain a permanent bend (i.e., after stress removal) of at least 15 degrees measured at the lead edges at the first bend. Upon the completion of the initial bend, the leads shall be returned to their approximate original position. This procedure shall be performed three times. The direction of the bend test may be either right or left to its axis. The terminal shall be bent in the direction specified in Figure D-4.

d) Measurement after test
The resistance shall be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

e) Examination after test
The terminals shall be examined visually for evidence of mechanical damage, chipping of the coating or loosening of the terminals.

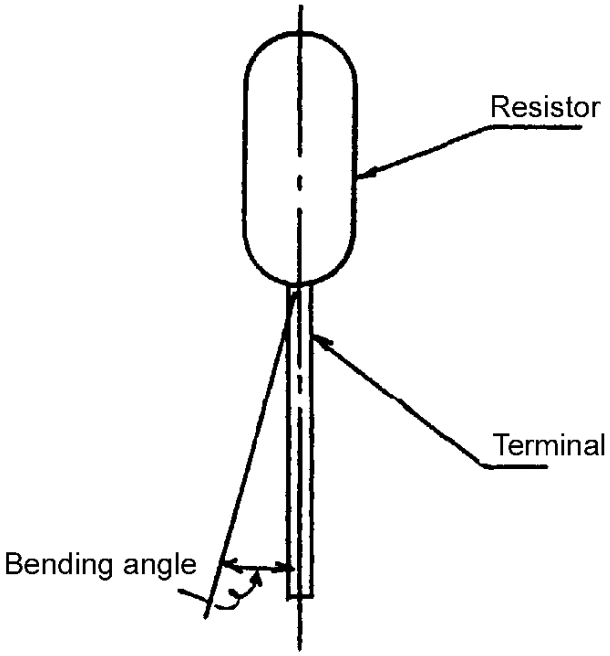


Figure D-4. Bending Direction

D.4.4.5.2 Solderability

Resistors shall be tested in accordance with Test Method 208 of MIL-STD-202. The following details and exceptions shall apply.

a) Preparations: Shall be performed.
b) Number of terminals tested: all terminals.
c) Solder temperature: 245±5°C
d) Solder immersion time: 5±0.5 seconds
e) Solder immersion depth
   The terminals shall be immersed to depth C1 in Figure D-5.
f) Examination after test
   Resistors shall be examined visually for solder wettability.

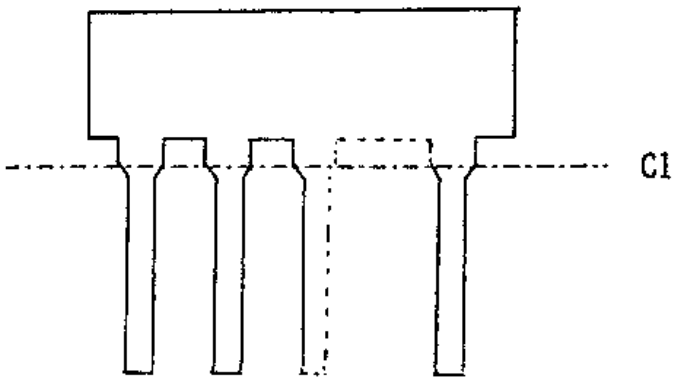


Figure D-5. Terminal Depth Immersed in Solder

D.4.4.5.3 Resistance to Soldering Heat

Resistors shall be tested in accordance with Test Method 210 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.

b) Test condition
The leads shall not have been soldered through the immediately preceding test.

c) Solder temperature: 350±10°C

d) Solder Immersion time: 3±0.5 seconds

e) Solder immersion depth
Terminals shall be immersed to within 1.6mm of the resistor body.

f) Measurement after test
The terminals shall be at room temperature for a minimum of 3 hours before the resistance measurement is made in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

D.4.4.6 Environmental Performance

The environmental performance tests shall be performed as follows.

D.4.4.6.1 High Frequency Vibration

Resistors shall be tested in accordance with Test Method 204 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
Resistors shall be mounted in accordance with item d), paragraph D.4.4.1 on an appropriate mounting fixture and attached to the vibration table through the vibration generator. The mounting fixture shall be constructed to preclude any resonance in the fixture and vibration generator when subjected to the shock test. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.

b) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.

c) Test condition: D (196.13m/s^2)

d) Direction of motion
The direction of motion shall be in each of three mutually perpendicular directions to one another and to the longitudinal axis of the resistors.

e) Duration of vibration
Four hours in each direction for a total of 12 hours.

f) Measurement after test
The resistance shall be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

D.4.4.6.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item d), paragraph D.4.4.1.
b) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.
c) Test condition: I (980.7m/s^2, 6ms sawtooth).
d) Direction of applied shocks
The shock direction shall be in each of two mutually perpendicular directions, one perpendicular and the other parallel to the terminal of the resistors.
e) Number of applied shocks
The resistors shall be subjected to 10 shocks in each direction for a total of 20.
f) Measurement after test
The resistance shall be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.
g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

D.4.4.6.3 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The mounting fixture shall ensure circulation of ambient air to each resistor.
b) Measurement before test
The resistance shall be measured in accordance with paragraph D.4.4.4.2.
c) Test conditions
Test conditions shall be as specified in Table D-17.
d) Number of test cycles: 25 cycles
e) Cycle conditions
The first five cycles shall run continuously. After the five cycles, the test may be interrupted following the completion of any full cycle.
f) Measurement after test
The resistors shall be at room temperature for a minimum of 30 minutes before the resistance measurement is made in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.
g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table D-17. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	-65^{0}_{-5}	15
2	125^{+3}_{0}	15

D.4.4.6.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
   The resistance shall be measured in accordance with paragraph D.4.4.4.2.
b) Loading voltage
   A dc voltage equivalent to 0.10 of rated wattage shall be applied to all resistor elements during the first 2 hours of steps 1 and 4.
c) Subcycle
   Step 7b shall not be applicable. Step 7a shall be performed during any five of the first nine cycles only.
d) Measurements at high humidity: None.
e) Measurement after test
   Upon completion of step 6 of the final cycle, the resistors shall be removed from the chamber and remain at room temperature for 24±4 hours. The resistance shall then be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test.
f) Examination after test
   The resistors shall be examined visually for evidence of mechanical damage.

D.4.4.6.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion
b) Solvents to be used
   1) 2-propanol (Isopropyl alcohol)
   2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

D.4.4.6.6 Low Temperature Storage

The resistance shall be measured as specified in paragraph D.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at a temperature of -65^{0}_{-5} °C for a period of 24±4 hours. The temperature in the chamber shall then be gradually returned to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for 2 hours or more but less than 8 hours. The resistance shall then be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

D.4.4.6.7 Low Temperature Operation

The resistance shall be measured as specified in paragraph D.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a test chamber at room temperature. The temperature shall then be gradually decreased to -65^{0}_{-5} °C with the resistors remaining at no load for 1 hour. The rated voltage (dc) shall then

be applied for 45 minutes. Wait 15^{+5}_{0} minutes after the removal of voltage to gradually increase the chamber temperature to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for 1 hour or more but less than 2 hours. The resistance shall then be measured again as specified in paragraph D.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

D.4.4.6.8 Stability

After the resistance is measured in accordance with paragraph D.4.4.4.2, the resistors shall be placed in a test chamber maintained at 125±5°C at no load for 100^{+4}_{0} hours. The resistors shall then be removed from the test chamber before remaining at a temperature of 25±5°C for 4 hours. The resistance shall then be measured in accordance with paragraph D.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

D.4.4.7 Durability

Durability test shall be performed as follows.

D.4.4.7.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item d), paragraph D.4.4.1 with the wiring connected to landing pads on the top and bottom of the circuit board. If forced air circulation is used, the air velocity shall not exceed 2.5m/s and there shall be no direct impingement of the forced-air supply upon the resistors.

b) Measurement before test
After the resistors are mounted in the test fixture, the resistance shall be measured at room temperature in accordance with paragraph D.4.4.4.2. All measurements shall be performed at a temperature difference of ±2°C.

c) Test temperature: 70±5°C

d) Test conditions
The rated voltage specified in paragraph D.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be $2{,}000^{+72}_{0}$ hours for the qualification test and $1{,}000^{+48}_{0}$ hours for the quality conformance inspection.

e) Measurements during and after test
After the resistors are at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph D.4.4.4.2.

f) Measurements during test

1) Qualification test: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours and 1,000 $^{+48}_{0}$ hours.

2) Quality conformance inspection: 250 $^{+48}_{0}$ hours and 500 $^{+48}_{0}$ hours.

g) Examination after test

The resistors shall be examined for evidence of mechanical damage.

D.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

D.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

D.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

D.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX E

RESISTORS, CHIP, FIXED, FILM

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: December 28, 2021

APPENDIX E

RESISTORS, CHIP, FIXED, FILM

E.1. General

E.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the fixed, film, chip resistors (hereinafter referred to as "resistors").

E.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table E-1.

Table E-1. Classification

Type	Style
Metal alloy film	RMS15, RMS20, RMS35 CRK2H, CRK4H, CRK8H, CRK10H, CRK16H SCR16, SCR20, SCR32, SCR35, SCR50 WCR32, WCR50, WCR64
Metal film	RMS06, RMS10, RMS12

E.1.3 Part Number

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

Example 1: For any resistors other than jumper resistors

JAXA[1]	RMS15	K	1000	F	C
	Style	Characteristic	Nominal resistance	Resistance tolerance	Electrode structure
	(E.1.3.1)	(E.1.3.2)	(E.1.3.3)	(E.1.3.4)	(E.1.3.5)

Example 2: For jumper resistors

JAXA[1]	CRK8H	R00	R
	Style	Nominal resistance	Electrode structure
	(E.1.3.1)	(E.1.3.3)	(E.1.3.5)

Note: [1] "JAXA" indicates the common part for space use and may be abbreviated to “J”. “NASDA” used in the detail specification may be abbreviated to “N”.

E.1.3.1 Style

Style indicates the rated power and physical size of the resistor and is as specified in Table E-2.

Table E-2. Style

Symbol	Rated power (mW)	Dimensions	Construction
RMS06	63	Dimensions shall be as specified in the detail specifications.	Rectangular, nonmetallic enclosure, surface mounted electrode, metal film
RMS10	100		
RMS12	125		
RMS15	150	Dimensions shall be as specified in the detail specifications.	Rectangular, nonmetallic enclosure, surface mounted electrode, alloy metal film
RMS20	200		
RMS35	350		
CRK2H	500	Dimensions shall be as specified in the detail specifications.	
CRK4H	330		
CRK8H	250		
CRK10H	125		
CRK16H	100		
SCR16	100	Dimensions shall be as specified in the detail specifications.	
SCR20	125		
SCR32	250		
SCR35	330		
SCR50	500		
WCR32	500	Dimensions shall be as specified in the detail specifications.	
WCR50	1000		
WCR64	2000		

E.1.3.2 Characteristics

The resistance-temperature characteristic shall be identified by a single letter symbol in accordance with Table E-3.

Table E-3. Resistance-Temperature Characteristic

(Unit: $x10^{-6}/°C$)

Symbol	Resistance-temperature characteristic (referenced:25°C)
Y	±10
E	±25
H	±50
K	±100
L	±200
M	±300
N	±500
P	–100 to +600

E.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 3 or 4 digits. Nominal resistance for jumper resistors shall be represented as “R00” and the details are specified in the detail specification.

a) Resistance identified by 3 digits
The resistance identified by 3 digits applies to resistors with resistance tolerance of ±2.0% (G) or ±5.0% (J). The first two digits represent the significant figures and the last digit specifies the number of zeros to follow. If a resistance needs to be specified in a form including a decimal point, the decimal point shall be replaced with “R.”

Example: 4R7= 4.7Ω
271= 270Ω
104= 100,000Ω=100kΩ
106=10,000,000Ω=10MΩ

b) Resistance identified by 4 digits:
The resistance identified by 4 digits applies to resistors with resistance tolerance of ±0.1% (B), ±0.5% (D) or ±1.0% (F). The first three digits represent the significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.

Example: 97R6= 97.6Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω=150 kΩ

E.1.3.4 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table E-4.

Table E-4. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance
B	±0.1
D	±0.5
F	±1.0
G	±2.0
J	±5.0

E.1.3.5 Electrode Structure

The electrode structure shall be identified by a single capital letter in accordance with Table E-5.

Table E-5. Electrode Structure

Symbol	Structure	Mounting method
C	Double-sided electrode	High temperature soldering
R	Double-sided electrode	Soldering

E.2. Applicable Documents

E.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

E.2.2 Reference Documents

The following is a reference document..

a) MIL-PRF-55342 Resistors, Chip, Fixed, Film, Nonestablished Reliability, Established Reliability, Space Level, General Specification for

b) MIL-PRF-32159 Resistors, Chip, Fixed, Film, Zero Ohm, Industrial, High Reliability, Space Level, General Specification for

c) ESCC Generic Specification No. 4001 Resistors, Fixed Film

d) ESCC Detail Specification No. 4001/026 Resistors, Fixed, Chip, Thick Film Based on Type CHP

E.3. Requirements

E.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs E.3.2 to E.3.9. The qualification coverage shall be represented by samples that have passed the qualification test. Characteristics and resistance tolerance of the resistors to be qualified shall be classified as specified in Tables E-6 and E-7. The characteristics specified in Table E-6 shall be separately qualified for each film type, metal film and alloy metal film. 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.

Table E-6. Characteristics Qualification

Characteristic submitted	Characteristic qualified
Y	Y, E, H, K, L, M, N, P
E	E, H, K, L, M, N, P
H	H, K, L, M, N, P
K	K, L, M. N, P
L	L, M, N
M	M, N
N	N
P	P

Table E-7. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
B	B, D, F, G, J
D	D, F, G, J
F	F, G, J
G	G, J
J	J

E.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

E.3.2.1 Base Substance (Core)

The resistor substrate shall be formed by a mixture of alumina and other oxides baked at high temperatures. The substrate shall be a minimum of 96% alumina.

E.3.2.2 Electrode

The electrode shall be as specified in the detail specification.

E.3.2.3 Resistance Material

The resistance material shall be as specified in the detail specification.

E.3.2.4 Insulation Material

The insulation material shall be as specified in the detail specification.

E.3.2.5 Solder

The solder material shall be as specified in paragraph E.4.4.2.

E.3.2.6 Soldering Flux

The soldering flux material shall be as specified in paragraph E.4.4.2.

E.3.3 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph E.4.4.3.

E.3.3.1 Externals and Marking

There shall be no defects such as cracks on the surface of the resistors. The following shall be clearly marked in such a manner to insure legibility. As a rule, the marking shall remain legible at the completion of any test.

a) Nominal resistance
The nominal resistance shall be marked as specified in paragraph E.1.3.3. Small size resistors may be marked as specified in the detail specification.

E.3.3.2 Construction, Dimensions and Mass

The construction, dimensions and mass of resistors shall be as specified in the detail specification and as follows.

a) Construction
The resistor element shall be completely covered with insulation materials to protect it from moisture or mechanical damage.

E.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1. The resistor body shall not have defects such as cracks, holes and scratches which may adversely affect the performance of the resistors and shall be free from other defects that will affect life, serviceability, or appearance. The resistors shall also satisfy the following requirements.

a) Resistor films
Resistor films shall be free of cracks, chipping, pin holes or deformation which may adversely affect the performance of the resistors. When the resistor films are trimmed, there shall be no residue remaining in the trimming groove.

b) Protection against moisture
The resistor element shall be protected against moisture by a coating of moisture-resistant insulating material.

c) Electrodes
The resistor electrode shall be securely connected to the resistor element and substrates, both electrically and mechanically. The electrode shall be fabricated from solderable materials.

E.3.4.1 DPA

Resistors tested as specified in paragraph E.4.4.4.1 shall confirm that the resistor films, electrode and protective coating are properly manufactured. The internal structure shall be as specified in the quality assurance program.

E.3.5 Ratings

E.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined in relation to the resistance tolerance and shall be as specified in Table E-8. The minimum and maximum resistances and resistance tolerance shall satisfy the requirements of the detail specification.

E.3.5.2 Operating Temperature Range

The operating temperature range shall be as specified in the detail specification.

E.3.5.3 Power Rating

Resistors shall have a power rating as specified in the detail specification. The rated ambient temperature shall be 70°C.

E.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve specified in the detail specification.

Table E-8. Standard Resistance Values

Resistance tolerance and symbols (%)																
B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	G (±2.0) J (V5.0)
10.0	10.0	13.3	13.3	17.8	17.8	23.7	23.7	31.6	31.6	42.2	42.2	56.2	56.2	75.0	75.0	1.0
10.1	-	13.5	-	18.0	-	24.0	-	32.0	-	42.7	-	56.9	-	75.9	-	1.1
10.2	10.2	13.7	13.7	18.2	18.2	24.3	24.3	32.4	32.4	43.2	43.2	57.6	57.6	76.8	76.8	1.2
10.4	-	13.8	-	18.4	-	24.6	-	32.8	-	43.7	-	58.3	-	77.7	-	1.3
10.5	10.5	14.0	14.0	18.7	18.7	24.9	24.9	33.2	33.2	44.2	44.2	59.0	59.0	78.7	78.7	1.5
10.6	-	14.2	-	18.9	-	25.2	-	33.6	-	44.8	-	59.7	-	79.6	-	1.6
10.7	10.7	14.3	14.3	19.1	19.1	25.5	25.5	34.0	34.0	45.3	45.3	60.4	60.4	80.6	80.6	1.8
10.9	-	14.5	-	19.3	-	25.8	-	34.4	-	45.9	-	61.2	-	81.6	-	2.0
11.0	11.0	14.7	14.7	19.6	19.6	26.1	26.1	34.8	34.8	46.4	46.4	61.9	61.9	82.5	82.5	2.2
11.1	-	14.9	-	19.8	-	26.4	-	35.2	-	47.0	-	62.6	-	83.5	-	2.4
11.3	11.3	15.0	15.0	20.0	20.0	26.7	26.7	35.7	35.7	47.5	47.5	63.4	63.4	84.5	84.5	2.7
11.4	-	15.2	-	20.3	-	27.1	-	36.1	-	48.1	-	64.2	-	85.6	-	3.0
11.5	11.5	15.4	15.4	20.5	20.5	27.4	27.4	36.5	36.5	48.7	48.7	64.9	64.9	86.6	86.6	3.3
11.7	-	15.6	-	20.8	-	27.7	-	37.0	-	49.3	-	65.7	-	87.6	-	3.6
11.8	11.8	15.8	15.8	21.0	21.0	28.0	28.0	37.4	37.4	49.9	49.9	66.5	66.5	88.7	88.7	3.9
12.0	-	16.0	-	21.2	-	28.4	-	37.9	-	50.5	-	67.3	-	89.8	-	4.3
12.1	12.1	16.2	16.2	21.5	21.5	28.7	28.7	38.3	38.3	51.1	51.1	68.1	68.1	90.9	90.9	4.7
12.3	-	16.4	-	21.8	-	29.1	-	38.8	-	51.7	-	69.0	-	92.0	-	5.1
12.4	12.4	16.5	16.5	22.1	22.1	29.4	29.4	39.2	39.2	52.3	52.3	69.8	69.8	93.1	93.1	5.6
12.6	-	16.7	-	22.3	-	29.8	-	39.7	-	53.0	-	70.6	-	94.2	-	6.2
12.7	12.7	16.9	16.9	22.6	22.6	30.1	30.1	40.2	40.2	53.6	53.6	71.5	71.5	95.3	95.3	6.8
12.9	-	17.2	-	22.9	-	30.5	-	40.7	-	54.2	-	72.3	-	96.5	-	7.5
13.0	13.0	17.4	17.4	23.2	23.2	30.9	30.9	41.2	41.2	54.9	54.9	73.2	73.2	97.6	97.6	8.2
13.2	-	17.6	-	23.4	-	31.2	-	41.7	-	55.6	-	74.1	-	98.8	-	9.1

E.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage specified in the detail

specification, the maximum operating voltage shall be the rated voltage.

$$E=\sqrt{P \cdot R}$$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

E.3.5.6 Rated Current

The rated current of jumper resistor shall be as specified in the detail specification.

E.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

E.3.6.1 Application of Pulse

When resistors are tested as specified in paragraph E.4.4.5.1, there shall be no evidence of arcing, insulation breakdown, or mechanical damage.

E.3.6.2 Resistance

When resistors are tested as specified in paragraph E.4.4.5.2 under the standard conditions (paragraph E.4.4.1), the resistance shall be within the specified tolerance of the nominal resistance in Table E-4. For jumper resistors, resistance shall not exceed the maximum resistance specified in the detail specification.

E.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph E.4.4.5.3 using room ambient temperature as the reference temperature, the resistance-temperature characteristic at each of the temperatures specified in the detail specification, shall not exceed the value specified in Table E-3. This condition shall not apply to jumper resistors.

E.3.6.4 Dielectric Withstanding Voltage

When tested as specified in paragraph E.4.4.5.4, the resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance change shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

E.3.6.5 Insulation Resistance

When resistors are tested as specified in paragraph E.4.4.5.5, the insulation resistance shall satisfy the requirements of the detail specification.

E.3.6.6 Short-Time Overload

When resistors are tested as specified in paragraph E.4.4.5.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

E.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

E.3.7.1 Solderability

E.3.7.1.1 Solderability [I]

Solderability [I] shall be applicable to electrode structure C. When resistors are tested as specified in paragraph E.4.4.6.1.1, a minimum of 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.

E.3.7.1.2 Solderability [II]

Solderability [II] shall be applicable to electrode structure R. When resistors are tested as specified in paragraph E.4.4.6.1.2, a minimum of 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.

E.3.7.2 Adhesion

When resistors are tested as specified in paragraph E.4.4.6.2, there shall be no mechanical damage.

E.3.7.3 Board Bending

When resistors are tested as specified in paragraph E.4.4.6.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no mechanical damage after the completion of the test.

E.3.7.4 Resistance to Bonding Exposure

When resistors are tested as specified in paragraph E.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. The electrode area covered by solder leaching shall be 10% or less of the total surface and the electrode shall be free from mechanical damage.

E.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

E.3.8.1 Random Vibration

When resistors are tested as specified in paragraph E.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

E.3.8.2 Shock

When resistors are tested as specified in paragraph E.4.4.7.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

E.3.8.3 Thermal Shock [II]

When resistors are tested as specified in paragraph E.4.4.7.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 500 cycles.

E.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph E.4.4.7.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

E.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph E.4.4.7.5, the marking shall remain legible. The details shall be as defined in the detail specification.

E.3.8.6 Low Temperature Operation

When resistors are tested as specified in paragraph E.4.4.7.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

E.3.8.7 Stability

When resistors are tested as specified in paragraph E.4.4.7.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The change in resistance before this test and after the withstanding voltage test shall also satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. The insulation resistance after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

E.3.9 Durability

Resistors shall satisfy the following durability requirements.

E.3.9.1 Life

When resistors are tested as specified in paragraph E.4.4.8.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. For jumper resistors, the resistance shall not exceed the maximum resistance specified in the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

E.4. Quality Assurance Provisions

E.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2050.

E.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

E.4.2.1 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table E-9.
The number of samples having minimum resistance, maximum resistance, and critical resistance or closest to critical resistance shall be prepared as specified in Table E-9. Each resistor style and characteristic shall be qualified separately. The number of samples shall be 439 to acquire certification for all electrode types. If the critical resistance is not specified, the samples shall be equally divided between the minimum and maximum resistance.
Tests that apply to all electrode structures shall be conducted with samples of electrode structure R. The number of samples shall be 385 for electrode structure R and 54 for electrode structure C. If the manufacturer requests separate approval for each resistor's electrode structure, all tests shall be conducted for each electrode structure.

If the manufacturer requests qualification of jumper resistors, samples shall be provided in accordance with "R00" of Table E-9 for each type and electrode construction. If the resistors are similar in material and structure, Group II through IV

tests, Group VI and Group VIII through XI tests may be exempted.
Tests of each group shall be performed in the order listed in Table E-9. Upon completion of Group I tests, Group II through XI tests shall be performed using samples allocated to the appropriate group tests.

Table E-9. Qualification Test (1/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail			
					Sample size			No. of defectives allowed(1)
Group	Order	Item			R	C	R00	
I	1	Application of pulse	E.3.6.1	E.4.4.5.1	100%		100%	0
	2	Resistance	E.3.6.2	E.4.4.5.2				
IA	1	Externals, dimensions and marking	E.3.3	E.4.4.3	100% (1)		100% (1)	0
IB	1	DPA	E.3.4.1	E.4.4.4.1	4 2 Highest resistance 2 Lowest resistance	4	2	0
II	1	Dielectric withstanding voltage	E.3.6.4	E.4.4.5.4	10	0	10	0
	2	Insulation resistance	E.3.6.5	E.4.4.5.5	Any resistance			
III	1	Resistance-temperature characteristic	E.3.6.3	E.4.4.5.3	30	0	–	0
	2	Low temperature operation	E.3.8.6	E.4.4.7.6	10 Highest resistance 10 Critical resistance 10 Lowest resistance		10	
	3	Short-time overload	E.3.6.6	E.4.4.5.6				
IV	1	Moisture resistance	E.3.8.4	E.4.4.7.4	30 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0	10	0
V	1	Life	E.3.9.1	E.4.4.8.1	231 77 Highest resistance 77 Critical resistance 77 Lowest resistance	0	10	0
VI	1	Stability	E.3.8.7	E.4.4.7.7	30 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0	10	0
VII	1	Resistance to bonding exposure	E.3.7.4	E.4.4.6.4	10 Any resistance	10	10	0
	2	Shock	E.3.8.2	E.4.4.7.2				
	3	Thermal shock [II]	E.3.8.3	E.4.4.7.3				
VIII	1	Random vibration	E.3.8.1	E.4.4.7.1	10 Any resistance	10	10	0

Table E-9. Qualification Test (2/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail			
					Sample size			No. of defectives allowed (1)
Group	Order	Item			R	C	R00	
IX	1	Solderability	E.3.7.1	E.4.4.6.1	10	10	10	0
	2	Resistance to solvents	E.3.8.5	E.4.4.7.5	Any resistance			
X	1	Adhesion	E.3.7.2	E.4.4.6.2	10	10	10	0
					Any resistance			
XI	1	Board bending	E.3.7.3	E.4.4.6.3	10	10	10	0
					Any resistance			
-	1	Materials	E.3.2	–	(2)			

Notes:

(1) For dimensions and mass, sample size shall be 1.0% of the acceptable quality level (AQL) in "Special Inspection Level S-4" specified in JIS Z 9015-1.

(2) Data to certify compliance with design specifications shall be submitted.

E.4.3 Quality Conformance Inspection

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

E.4.3.1 Samples

The inspection lot configuration of group A shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for all combinations of shapes and electrode structures. Resistors with the critical resistance or the closest to the critical resistance shall be selected. Further, the highest grade of characteristics shall be selected. If the design criteria are identical and the materials and the structures are similar, the inspection lot may be represented by one of the shapes specified in the detail specification.

E.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be as specified in Tables E-10, E-11 and E-12, respectively. Group tests shall be performed in subgroup order and the inspections within each group shall be performed in the specified order. The sampling plan used for the Group A inspection shall be in accordance with Appendix 1 of JIS Z 9015-1.

E.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table E-10, E-11 or E-12 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table E-10, but the failure

mode of a defect is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

E.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed test order 1 of Group A1-2 inspection or any test of Group A1-3 inspection, all products of the lot shall be subjected to the failed inspection, and only the good products shall be shipped. The samples subjected to DPA and Group A2 inspections shall not be shipped.

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

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
A1	1	1	Application of pulse	E.3.6.1	E.4.4.5.1	100%	0
		2	Resistance	E.3.6.2	E.4.4.5.2		
	2	1	Externals, dimensions and marking	E.3.3	E.4.4.3	AQL (1) 4.0%	
		2	DPA	E.3.4.1	E.4.4.4.1	4	0
	3	1	Dielectric withstanding voltage	E.3.6.4	E.4.4.5.4	AQL (1) 2.5%	
		2	Insulation resistance	E.3.6.5	E.4.4.5.5		
A2	1	1	Resistance to bonding exposure	E.3.7.4	E.4.4.6.4	AQL (1) 2.5%	
		2	Resistance-temperature characteristic	E.3.6.3	E.4.4.5.3		
		3	Low temperature operation	E.3.8.6	E.4.4.7.6		
		4	Short-time overload	E.3.6.6	E.4.4.5.6		
	2	1	Solderability	E.3.7.1	E.4.4.6.1	AQL (1) 2.5%	
	3	1	Adhesion	E.3.7.2	E.4.4.6.2	AQL (1) 2.5%	

Note: (1) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Normal Inspection Level II" specified therein shall apply to test order 1 of Group A1-2 inspection. "Special Inspection Level S-4" shall apply to the Group A1-3 and A2 inspections.

Table E-11. Quality Conformance Inspection (Group B)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
B1	1	1	Moisture resistance	E.3.8.4	E.4.4.7.4	10	0
	2	1	Life	E.3.9.1	E.4.4.8.1	10	0
	3	1	Stability	E.3.8.7	E.4.4.7.7	10	0
	4	1	Resistance to solvents	E.3.8.5	E.4.4.7.5	10	0
	5	1	Board Bending	E.3.7.3	E.4.4.6.3	5	0

Table E-12. Quality Conformance Inspection (Group C)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
C	1	1	Shock	E.3.8.2	E.4.4.7.2	10	0
		2	Thermal shock [II]	E.3.8.3	E.4.4.7.3		
	2	1	Random vibration	E.3.8.1	E.4.4.7.1	10	0

E.4.4 Methods for Test and Inspection

E.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table E-13. Unless specified, condition A shall apply.

Table E-13. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

E.4.4.2 Method of Mounting

The mounting method shall be one of the following methods as specified in paragraph E.4.4.5 to E.4.4.8.

a) Mounting method A

1) Test board
The test boards shall be alumina substrate (alumina of 95% purity or higher) with a thickness of 0.8mm±0.3mm. The dimensions shall be as specified in Figure E-1.

2) Mounting procedure
Pre-solder the sample in a nitrogen gas environment using gold-tin alloy solder (nominal gold content 80%). The sample shall then be placed on the test substrate using sheet type pellet solder of the same composition between them before heating them on a hot plate or in a tunnel oven to melt the solder. Flux shall not be used.
Soldering temperature and time shall be as follows.

2.1) Presoldering Temperature: 320±10°C
Duration: 3±0.5 seconds

2.2) Soldering Temperature: 320±10°C
Duration: 10±2 seconds

b) Mounting method B

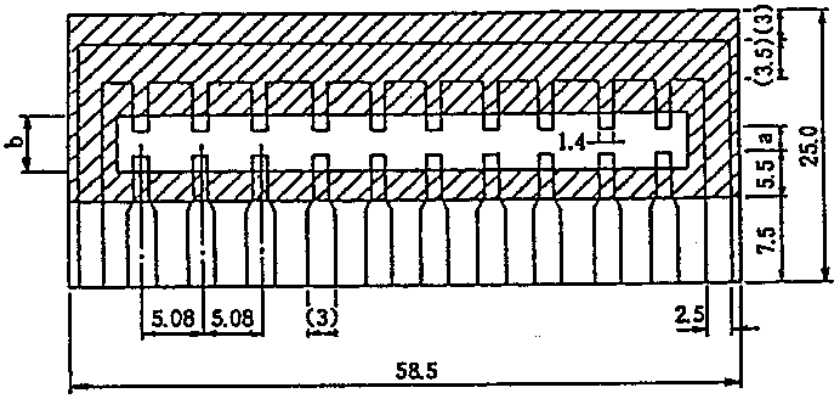
1) Test board
The test boards shall be either alumina substrate (alumina of 95% purity or higher) with a thickness of 0.8±0.3mm or glass woven base material epoxy resin copper-lad laminate board with a thickness of 1.6±0.1mm. The test board shall not affect the test or measurement. The dimensions shall be as specified in Figure E-1.

2) Mounting procedure
Mount the sample on the test substrate by reflow soldering or dip soldering using tin-lead alloy solder with nominal tin content of 60% including inactivated flux.
Soldering temperature and time shall be as follows.

2.1) Temperature: 260±5°C

2.2) Duration: 10±2 seconds

Unit: mm



Remarks:

1. Figures in parentheses are for reference.
2. The shaded area indicates the glass film or solder resist.
3. For the dimensions not specified in this figure or of the atypical resistors, the structures and the external dimensions of the resistor to be tested shall be considered and specified in detail specification.

Style	Dimensions (mm)			Style	Dimensions (mm)		
	a	b	c		a	b	c
RMS06	1.0	3.0	1.4	SCR16	0.9	2.6	0.7
RMS10	1.2	4.0	1.4	SCR20	1.35	3.45	1.1
RMS12	2.2	5.0	1.4	SCR32	2.2	4.7	1.4
RMS15	1.2	4.0	1.4	SCR35	2.2	5.2	2.15
RMS20	1.6	4.8	1.4	SCR50	3.7	6.2	1.25
RMS35	2.4	6.0	1.4	WCR32	As specified in detail specification		
CRK2H	3.7	6.2	2.15	WCR50			
CRK4H	2.2	5.2	2.15	WCR64			
CRK8H	2.2	4.7	1.4				
CRK10H	1.35	3.45	1.1				
CRK16H	0.9	2.6	0.7				

Table E-1. Test Board for Mounting Methods A and B

E.4.4.3 Externals, Dimensions and Marking

E.4.4.3.1 Qualification Test

a) The external inspection shall be performed using a 10x magnifier.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. Unless the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured with a measuring instrument which will not give a questionable pass/fail result. The number of samples shall be 10.

E.4.4.3.2 Quality Conformance Inspection (Group A)

a) The external inspection shall be performed using a 10x magnifier.
b) The marking test shall be performed visually.
c) The dimensions may be measured with a dimension gauge which is set in advance, unless the measured value may be questionable. Prior to the test, it shall be proven that the dimension gauge is functional as a measuring instrument. The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.
d) For the mass inspection, the pass/fail results shall be made by comparing the sample to the criteria samples of maximum mass for each style, which is determined in advance.

E.4.4.4 Workmanship

E.4.4.4.1 DPA

The resistors shall be disassembled to ensure that the resistor films, electrode and protective coating against moisture are properly manufactured and the internal structures are as specified in the Quality Assurance Program Plan. DPA shall be conducted in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) The resistors shall be embedded in a proper resin or other materials and cut along the line parallel to the longitudinal axis of the resistors. One cut face shall be grounded and examined by a 10 to 200x magnifier for the resistor film, electrode, thickness of protective coating, and connection of resistor film and electrodes. One resistor with a maximum resistance and one with a minimum resistance shall be subjected to the test.
b) The resistors shall be embedded in a proper resin or other materials and cut along the line perpendicular to the longitudinal axis of the resistors. One cut face shall be grounded and examined by a 10 to 200x magnifier for inspecting the protective coating. One resistor with a maximum resistance and one with a minimum resistance shall be subjected to the test.

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

E.4.4.5 Electrical Performance

The electrical performance tests shall be performed as follows.

E.4.4.5.1 Application of Pulse

A dc test voltage which is 2.5 times the rated voltage (the maximum overload current specified in detail specification for jumper resistors) shall be applied for 1 second to the resistors. The test voltage shall not exceed the maximum overload voltage specified in the detail specification. At the completion of this test, the resistors shall be examined for evidence of arcing, insulation breakdown and mechanical damage.

E.4.4.5.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Test voltage
If pass/fail results are questionable, the conditions specified in Table E-14 shall apply.

b) Temperature:
As a rule, the resistance test of Group I of the qualification test shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

Table E-14. Test Voltage

Unit: V_{DC}

Nominal resistance (Ω)	Maximum test voltage
Less than 10	0.1 as a maximum(1)
10 or more and less than 100	0.3
100 or more and less than 1k	1
1k or more and less than 10k	3
10k or more and less than 100k	10
100k or more and less than 1M	25
1M or more	30

Note(1) The power applied to the resistor shall be 10% of the rated power as a maximum.

E.4.4.5.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item b), paragraph E.4.4.2. This test shall be performed following the resistance to bonding exposure test of paragraph E.4.4.6.4 in the Group A quality conformance inspection.

b) Reference temperature: 25°C

c) Test temperature: As specified in the detail specification.

d) Unit of resistance-temperature characteristic: 10^{-6}/°C.

E.4.4.5.4 Dielectric Withstanding Voltage

E.4.4.5.4.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Mount the resistor with its insulation jacket upward on the metal plate so

that the tip of the metal block is positioned at approximately the center of the resistor's two electrodes as shown in Figure E-2, and pressurize at 1.0±0.2N.

b) Measurement before test
The resistance shall be measured in accordance with paragraph E.4.4.5.2.

c) Test voltage
The test voltages of 150±15V_{AC} (root-mean-square value at commercial-line frequency) shall be applied between the measuring point A on the metal block and measuring point B on the metal plate.

d) Duration of test: 1 minute $^{+10}_{0}$ seconds

e) Measurement during test
The leak current shall be measured throughout the test, and the resistors shall be examined for evidence of arcing and any breakage.

f) Measurement after test
The resistance shall be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 10x or greater.

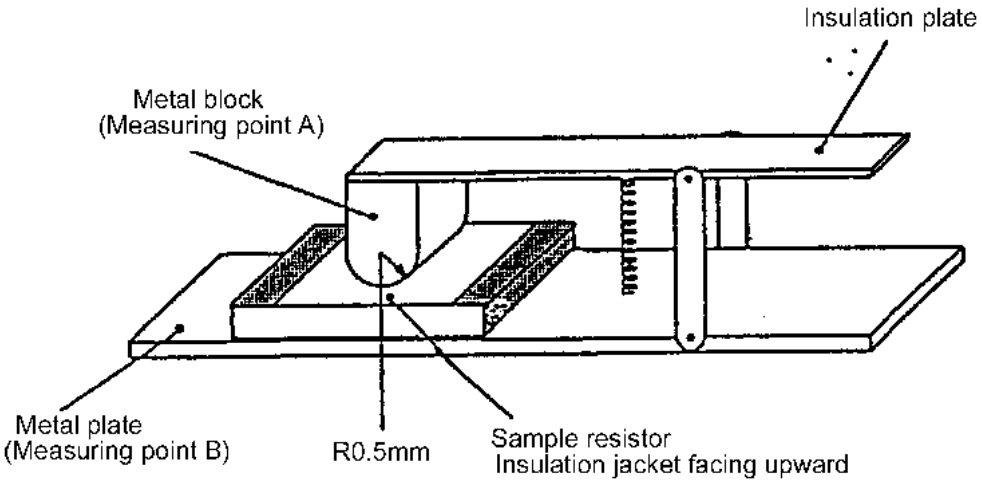


Figure E-2. Test Method for the Dielectric Withstanding Voltage and Insulation Resistance Tests

E.4.4.5.4.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item a), paragraph E.4.4.5.4.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph E.4.4.5.2.
c) Test voltage
75±7.5V_{AC} (root-mean-square value at commercial-line frequency)
d) Test condition: D (1.1kPa)
e) Duration of application of test voltage: 1 minute $^{+10}_{0}$ seconds
f) Measurement during test
The leak current shall be measured throughout the test, and the resistors shall be examined for evidence of arcing or any breakage.
g) Measurement after test
The resistance shall be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.
h) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 10x or greater.

E.4.4.5.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.
a) Mounting method
The resistors shall be mounted as specified in item a), paragraph E.4.4.5.4.1.
b) Test voltage: 100±10V_{DC}
c) Duration of application of test voltage: 1 minute

E.4.4.5.6 Short-Time Overload

The short-time overload test shall be performed in accordance with the low temperature operation test of paragraph E.4.4.7.6. The resistance shall be measured as specified in paragraph E.4.4.5.2. Following this measurement, dc test voltage of 2.5 times the rated voltage shall be applied to the resistors for 5±1 seconds. The test voltage shall not exceed the maximum overload voltage specified in the detail specification. The following conditions shall apply.
a) Mounting method: As specified in item b), paragraph E.4.4.2.
b) Test temperature
The test temperature shall be at 25±3°C in still air, with no circulation other than the heat of the resistors being operated.
c) Measurement after test
The resistors shall remain at room temperature for 30 minutes or more after the test voltage is removed before the resistance is measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.
d) Examination after test
The resistors shall be examined for evidence of arcing, burning, and charring using a magnifier of 10x or greater.

E.4.4.6 Mechanical Performance

The mechanical performance tests shall be performed as follows.

E.4.4.6.1 Solderability

E.4.4.6.1.1 Solderability [I]

The solderability [I] test shall be applied to electrode structure C resistors. The test procedure shall be in accordance with paragraph 4.17 of JIS C 5201-1. However, the following conditions shall apply.

a) Solder type
   Gold-tin alloy solder (nominal gold content 80%) shall be used.
b) Solder temperature: 300±10°C
c) Solder immersion time: 5±0.5 seconds
d) Procedure
   Both electrodes shall be immersed into the solder at the same time. The test shall be performed in a nitrogen gas environment. Flux shall not be used.
e) Examination after test
   Resistors shall be examined for solder wettability using a magnifier of 10x or greater.

E.4.4.6.1.2 Solderability [II]

The solderability [II] test shall be applied to electrode structure R resistors. The test procedure shall be in accordance with paragraph 4.17 of JIS C 5201-1. However, the following conditions shall apply.

a) Solder type
   Tin-lead alloy solder with nominal tin content of 60% including inactivated flux shall be used.
b) Solder temperature: 245±5°C
c) Solder immersion time: 5±0.5 seconds
d) Procedure
   Both electrodes shall be immersed into the solder at the same time.
e) Examination after test
   Resistors shall be examined for solder wettability using a magnifier of 10x or greater.

E.4.4.6.2 Adhesion

The adhesion test shall be performed in accordance with paragraph 4.32 of JIS C 5201-1. The following conditions shall apply.

a) Mounting method.
   The resistors shall be mounted as specified in item a), paragraph E.4.4.2 for electrode structure C and item b), paragraph E.4.4.2 for electrode structure R.
b) Load: 5±0.5N
c) Duration of application of the load: 10±1 seconds

d) Examination after test.
The resistors shall be examined for mechanical damage using a magnifier of 10x or greater.

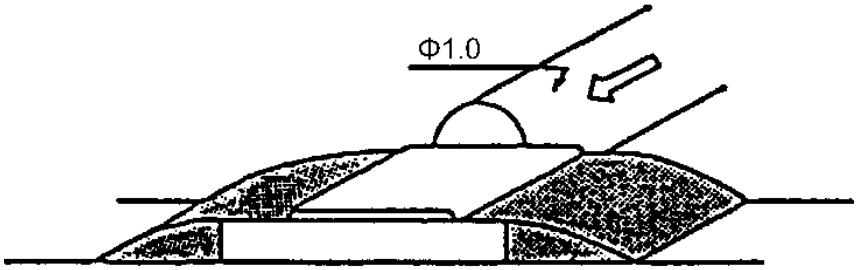


Figure E-3. Test Method for the Adhesion Test

E.4.4.6.3 Board bending

This test shall be performed in accordance with paragraph 4.33 of JIS C 5201-1. The following conditions shall apply.

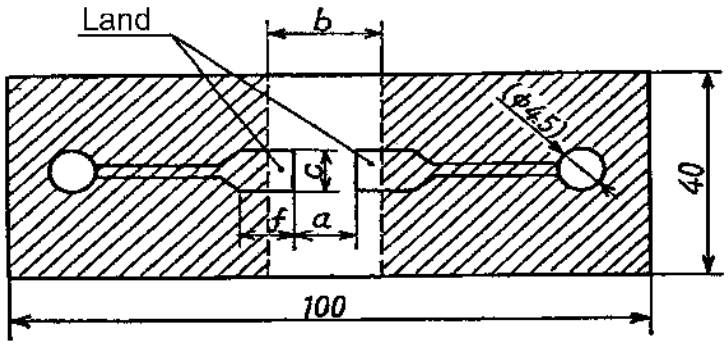
a) Mounting method
The resistors shall be mounted on a test board as shown in Figure E-4 as specified in item b), paragraph E.4.4.2. The test temperature shall be 235±5°C.
b) Measurement before test
The resistance shall be measured in accordance with paragraph E.4.4.5.2.
c) Deflection: 2mm
d) Number of bending: 1
e) Measurement during test:
The resistance shall be measured with the test board bent in accordance with paragraph E.4.4.5.2.
f) Examination after test
The resistors shall be examined for mechanical damages using a magnifier of 10x or greater.

E.4.4.6.4 Resistance to Bonding Exposure

The resistance shall be measured as specified in paragraph E.4.4.5.2. The resistor shall be mounted on an alumina test board. The test board, with resistors mounted, shall remain at room temperature for 4 to 12 hours. The following conditions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item a), paragraph E.4.4.2 for electrode structure C and item b), paragraph E.4.4.2 for electrode structure R.
b) Measurement after test
The resistance shall be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.
c) Examination after test
The resistors shall be examined for mechanical damage and solder leaching using a magnifier of 10x or greater.

Unit: mm



	Dimensions (mm)			
	a	b	c	f
RMS06	1.0	3.0	1.2	(2.0)
RMS10	1.2	4.0	1.65	(3.0)
RMS12	2.2	5.0	2.0	(2.5)
RMS15	1.23	4.0	1.4	(3.0)
RMS20	1.87	4.67	1.4	(2.5)
RMS35	3.14	5.94	1.4	(2.5)
CRK2H	3.6	7.0	3.0	(3.0)
CRK4H	2.2	5.0	3.0	(3.0)
CRK8H	2.2	5.0	2.0	(2.5)
CRK10H	1.2	4.0	1.65	(3.0)
CRK16H	1.0	3.0	1.1	(2.0)
SCR16	1.0	3.0	1.2	(2.0)
SCR20	1.2	4.0	1.65	(3.0)
SCR32	2.2	5.0	2.0	(2.5)
SCR35	2.2	5.0	2.9	(2.5)
SCR50	3.2	6.6	3.0	(2.5)
WCR32	0.65	2.65	3.2	(7.0)
WCR50	1.30	7.0	5.5	(1.85)
WCR64	1.45	6.0	6.4	(1.7)

Remarks:

1. The material shall be glass base woven epoxy resin.
   Thickness 1.6mm
   Copper foil 0.035mm
2. The solder resist (soldering heat resistance resin) shall be applied to the shaded area in the figure.
3. The values in parentheses in the figure and table above are for reference.

Figure E-4. Test Board for the Board Bending Test

E.4.4.7 Environmental Performance

The environmental performance tests shall be performed as follows.

E.4.4.7.1 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item b), paragraph E.4.4.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph E.4.4.5.2.

c) Test condition: II-H Frequency range: 50 to 2,000Hz
Rms value of acceleration: 334m/s^{2}rms

d) Direction of motion: In each of three mutually perpendicular directions.

e) Number of application and duration of vibration
Vibration shall be applied for 3 minutes in each direction with a total test time of 9 minutes.

f) Measurement during test
Each resistor shall be monitored for evidence of electrical discontinuity of 0.1ms or greater during the vibration.

g) Measurement after test
The resistance shall be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

E.4.4.7.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
In the qualification test, this test shall be performed in accordance with the resistance to bonding exposure test of paragraph E.4.4.6.4. For the quality conformance inspection, the resistors shall be mounted on the test plate as specified in item b), paragraph E.4.4.2.
The test board shall be rigidly mounted on appropriate fixtures. The mounting fixtures shall be constructed to preclude any resonance in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. A shielded cable which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.

b) Measurement before test
The resistance shall be measured in accordance with paragraph E.4.4.5.2.

c) Test condition: I (980m/s^2, 6ms sawtooth).

d) Direction of applied shocks: In each of three mutually perpendicular directions.

e) Number of applied shocks
The resistors shall be subjected to 5 shocks in each direction, for a total of 15.

f) Measurement during test
Each resistor shall be monitored during the shock for evidence of electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

E.4.4.7.3 Thermal Shock [II]

After measuring resistance in accordance with paragraph E.4.4.5.2, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table E-15 and Figure E-5. The following details and exceptions shall apply.

a) Method of mounting
This test shall be performed following the shock test specified in paragraph E.4.4.7.2.

b) Number of test cycles: 1,000 cycles

c) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more at each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for cracks on the surface.

d) Measurement after test
The resistors shall be at room temperature for 30 minutes or more before the resistance is measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.

e) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

Table E-15. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	-30^{0}_{-5}	15
2	100^{+5}_{0}	15

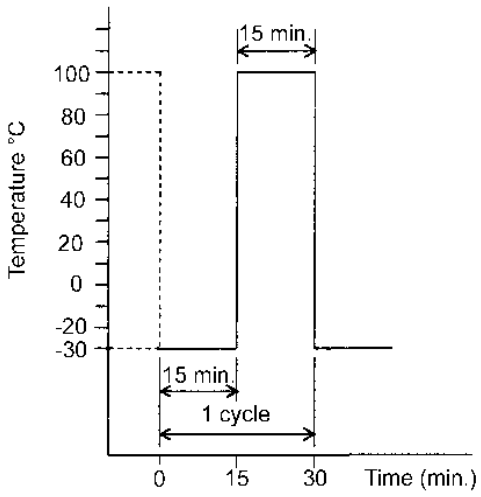


Figure E-5. Test Conditions of Thermal Shock [II]

E.4.4.7.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting: As specified in item b), paragraph E.4.4.2.
b) Measurement before test
   The resistance shall be measured in accordance with paragraph E.4.4.5.2.
c) Polarization and loading voltage
   No voltage shall be applied.
d) Subcycle
   Step 7b shall not be applicable. Step 7a shall only be performed during any five of the fist nine cycles.
e) Measurements at high humidity: None.
f) Measurement after test
   Upon completion of step 6 of the final cycle, the resistors shall be removed from the chamber and maintained at room temperature for 30 minutes or more. The resistance shall then be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test.
g) Examination after test
   The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

E.4.4.7.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion
b) Solvents to be used
   1) 2-propanol (Isopropyl alcohol)
   2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

E.4.4.7.6 Low Temperature Operation

This test shall be performed in accordance with the resistance-temperature characteristic test specified in paragraph E.4.4.5.3. The resistance shall be measured when mounted on a test board as specified in paragraph E.4.4.5.2. Within 1 hour after this measurement, the resistors shall be placed in a test chamber at room temperature. The temperature shall be gradually decreased to the temperature specified in the detail specification. The resistors shall remain at no load for 1 hour. The rated dc voltage (the rated current for jumper resistors) shall then be applied for 45 minutes. Wait 15^{+15}_{0} minutes after the removal of voltage to gradually increase the chamber temperature to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall be left at room temperature for 1 hour or more but less than 2 hours. The resistance shall then be measured again as specified in paragraph E.4.4.5.2 to calculate the change in resistance before and after the test. After the test, the resistors shall be examined for significant

abnormality using a magnifier of 10x or greater. The marking shall be examined for legibility.

E.4.4.7.7 Stability

After the resistors are mounted on a test board as specified in item b), paragraph E.4.4.2 and the resistance is measured in accordance with paragraph E.4.4.5.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually increased to the test temperature specified in the detail specification. After stabilizing at the test temperature, the resistors shall remain at no load for $2{,}000\,^{+72}_{0}$ hours. When the specified test time has passed, the temperature shall gradually be returned to room temperature. The resistors shall then be removed from the test chamber and maintained at a temperature of 25±5°C for 6±1hours. The resistance shall then be measured in accordance with paragraph E.4.4.5.2 to calculate the change in resistance before and after the test. The dielectric withstanding voltage test (atmospheric pressure) and insulation resistance test shall then be performed as specified in paragraphs E.4.4.5.4.1 and E.4.4.5.5, respectively. After the test, the resistors shall be examined for significant abnormality using a magnifier of 10x or more.

E.4.4.8 Durability

The durability test shall be performed as follows.

E.4.4.8.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted on a test board as specified in item b), paragraph E.4.4.2. If forced air circulation is employed, the air velocity shall not exceed 2.5m/s and there shall be no direct impingement of the forced-air supply upon the resistors.

b) Test temperature: 70±5°C

c) Measurement before test
Measurements may be taken inside or outside the chamber. The resistance shall be measured in accordance with paragraph E.4.4.5.2.

1) Inside chamber
The resistor shall be placed in the chamber. A pre-test measurement shall be performed 8 hours after the temperature inside the chamber is stabilized at the test temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

2) Outside chamber
The resistors shall be mounted in the test fixture. A pre-test measurement shall be performed at room temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

d) Test conditions

The rated voltage (the rated current for jumper resistors) specified in paragraph E.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be 4,000 $^{+72}_{0}$ hours for the qualification test and 2,000 $^{+72}_{0}$ hours for the quality conformance inspection.

e) Measurements during test

1) Qualification test: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours, 1,000 $^{+48}_{0}$ hours and 2,000 $^{+72}_{0}$ hours.

2) Quality conformance inspection: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours and 1,000 $^{+48}_{0}$ hours.

f) Measurements during and after test

1) Inside chamber

At the end of the final 30 minute off time, the resistance shall be measured in accordance with paragraph F.4.4.5.2.

2) Outside chamber

After the resistors are at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph E.4.4.5.2

g) Examination after test

The resistors shall be examined for evidence of mechanical damage using a 10x magnifier.

E.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

E.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

E.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

E.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX F

RESISTOR NETWORKS, CHIP

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: December 28, 2021

APPENDIX F

RESISTOR NETWORKS, CHIP

F.1. General

F.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the chip resistor networks (hereinafter referred to as "resistors").

F.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table F-1.

Table F-1. Classification

Material	Style and type of construction	Construction
Metal alloy film	RZCS	4512

F.1.3 Part Number

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

Example:

JAXA(1)	RZCS	16	K	1001	F	A	C
	Style and type of construction (F.1.3.1)	Number of terminals (F.1.3.2)	Characteristic (F.1.3.3)	Nominal resistance (F.1.3.4)	Resistance tolerance (F.1.3.5)	Schematics (F.1.3.6)	Electrode structure (F.1.3.7)

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

“NASDA” used in the detail specification may be abbreviated to “N”.

F.1.3.1 Style and Type of Construction

The style and type of construction shall be identified by a four letter symbol, “RZCS” shown in Table F-2. The “RZ” indicates the high reliability, chip, resistor networks and the “CS” indicates the type of construction.

Table F-2. Style and Type of Construction

Symbol	Type of construction
RZ	CS

F.1.3.2 Number of Terminals

The number of terminals shall be identified by a two-digit number as shown in Table F-3.

Table F-3. Number of Terminals

Symbol	Number of terminals
16	16

F.1.3.3 Characteristics

The resistance-temperature characteristic shall be identified by a single letter symbol in accordance with Table F-4.

Table F-4. Resistance-Temperature Characteristic

(Unit: $x10^{-6}/°C$)

Symbol	Resistance-temperature characteristic (referenced: 25°C)
M	±200
K	±100

F.1.3.4 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 3 or 4 alphanumeric characters.

a) Resistance identified by 3 digits
The resistance identified by 3 digits applies to resistors with resistance tolerance of ±2.0%(G), ±5.0% (J). The first two digits represent significant figures and the last digit specifies the number of zeros to follow.
Example: 150= 15Ω
152= 1,500Ω= 1.50kΩ
154=150,000Ω=150 kΩ

b) Resistance identified by 4 digits
The resistance identified by 4 digits applies to resistors with resistance tolerance of ±1.0% (F). The first three digits represent the significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.
Example: 97R6= 97.6Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω=150 kΩ

F.1.3.5 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table F-5.

Table F-5. Resistance Tolerance

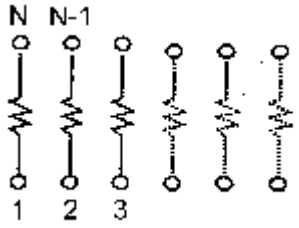
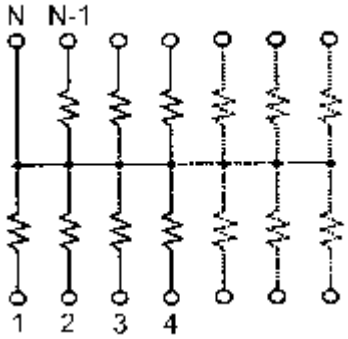
Unit: %

Symbol	Resistance tolerance
F	±1.0
G	±2.0
J	±5.0

F.1.3.6 Schematic

The schematic shall be identified by a single capital letter in accordance with Table F-6.

Table D-6. Schematic

Symbol	Schematic
A	
B	

F.1.3.7 Electrode Structure

The electrode structure shall be identified by a single capital letter in accordance with Table F-7.

Table F-7. Electrode Structure

Symbol	Structure	Mounting method
C	Double-sided electrode	High temperature soldering
R	Double-sided electrode	Soldering

F.2. Applicable Documents

F.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

F.2.2 Reference Documents

The following is a list of reference documents.

a) MIL-PRF-83401 Resistor Networks, Fixed, Film, and Capacitor-Resistor Networks, Ceramic Capacitor and Fixed Film Resistors, General Specification for

b) MIL-PRF-55342 Resistors, Chip, Fixed, Film, Nonestablished Reliability, Established Reliability, Space Level, General Specification for

F.3. Requirements

F.3.1 Qualification

F.3.1.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs F.3.2 to F.3.9. The qualification coverage shall be represented by samples that have passed the qualification test.
Characteristics and resistance tolerance of the resistors to be qualified shall be classified as specified in Tables F-8 and F-9. 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.

Table F-8. Characteristics Qualification

Characteristic submitted	Characteristic qualified
K	K, M
M	M

Table F-9. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
F	F, G, J
G	G, J
J	J

F.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

F.3.2.1 Base Substance (Core)

The resistor substrate shall be formed by a mixture of alumina and other oxides baked at high temperatures. The substrate shall be a minimum of 96% alumina.

F.3.2.2 Electrode

The electrode shall be as specified in the detail specification.

F.3.2.3 Resistance Material

The resistance material shall be as specified in the detail specification.

F.3.2.4 Insulation Material

The insulation material shall be as specified in the detail specification.

F.3.3 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph F.4.4.3.

F.3.3.1 Externals and Marking

There shall be no defects such as cracks on the surface of the resistors. The following shall be clearly marked in such a manner to ensure legibility. As a rule, the marking shall remain legible at the completion of any test.

a) Characteristics
   Examples: M, K
b) Nominal resistance
   The nominal resistance shall be marked as specified in paragraph F.1.3.4.
c) Resistance Tolerance
   Examples: F, G, J
d) Schematics
   Examples: A, B

When the marking space is limited, the order of precedence to omit markings shall be as specified in the detail specification. The marking items, other than those described above, shall be marked on the individual package board or box.

F.3.3.2 Construction, Dimensions and Mass

The construction, dimensions and mass of resistors shall be as specified in the detail specification.

F.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1. The following requirements shall also apply.

a) Resistor films
Resistor films shall be free of cracks, chipping, pin holes or deformation which may adversely affect the performance of the resistors. When the resistor films are trimmed, there shall be no residue remaining in the trimming groove.

b) Protection against moisture
The resistor element shall be protected against moisture by an external coating of moisture-resistant insulating material.

c) Electrodes
The resistor electrode shall be securely connected to the resistor element and substrates, both electrically and mechanically. The electrode shall be made of solderable materials.

F.3.4.1 DPA

When resistors are tested as specified in paragraph F.4.4.4.1, it shall be verified that the resistor films, electrode and protective coating have been properly manufactured. The internal structure shall be as specified in the quality assurance program.

F.3.5 Ratings

F.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined relative to the resistance tolerance and shall be as specified in Table F-10. The minimum and maximum resistances and resistance tolerance shall satisfy the requirements of the detail specification.

F.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +125°C.

F.3.5.3 Power Rating

Resistors shall have a power rating as specified in the detail specification. The rated ambient temperature shall be 70°C.

F.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure F-1.

F.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the

power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage specified in the detail specification, the maximum operating voltage shall be the rated voltage.

$E = \sqrt{P \cdot R}$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

Table F-10. Standard Resistance Values

Resistance tolerance and symbols (%)				
F (±1.0)				G (±2.0) J (±5.0)
10.0	17.8	31.6	56.2	1.0
10.2	18.2	32.4	57.6	1.1
10.5	18.7	33.2	59.0	1.2
10.7	19.1	34.0	60.4	1.3
11.0	19.6	34.8	61.9	1.5
11.3	20.0	35.7	63.4	1.6
11.5	20.5	36.5	64.9	1.8
11.8	21.0	37.4	66.5	2.0
12.1	21.5	38.3	68.1	2.2
12.4	22.1	39.2	69.8	2.4
12.7	22.6	40.2	71.5	2.7
13.0	23.2	41.2	73.2	3.0
13.3	23.7	42.2	75.0	3.3
13.7	24.3	43.2	76.8	3.6
14.0	24.9	44.2	78.7	3.9
14.3	25.5	45.3	80.6	4.3
14.7	26.1	46.4	82.5	4.7
15.0	26.7	47.5	84.5	5.1
15.4	27.4	48.7	86.6	5.6
15.8	28.0	49.9	88.7	6.2
16.2	28.7	51.1	90.9	6.8
16.5	29.4	52.3	93.1	7.5
16.9	30.1	53.6	95.3	8.2
17.4	30.9	54.9	97.6	9.1

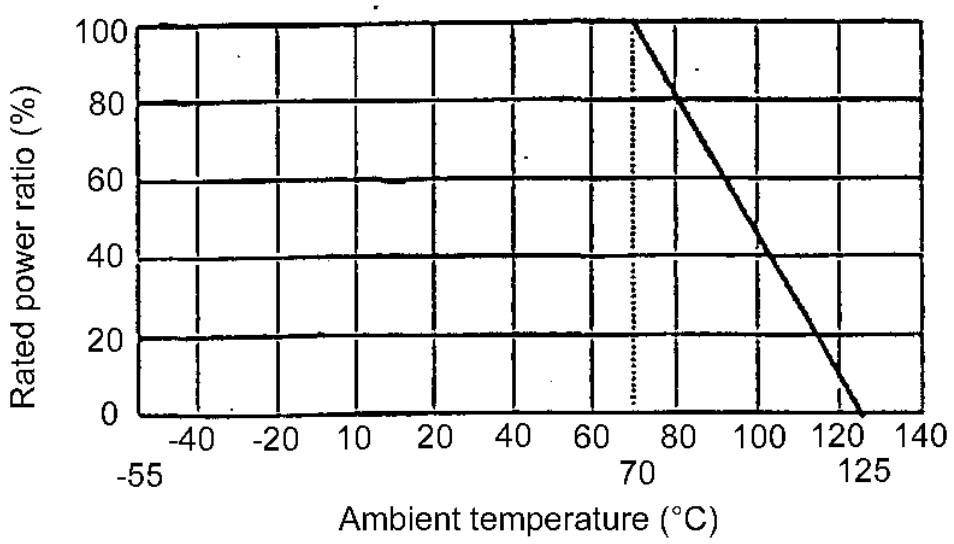


Figure F-1. Derating Curve

F.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

F.3.6.1 Application of Pulse

When resistors are tested as specified in paragraph E.4.4.5.1, there shall be no evidence of arcing, insulation breakdown, or mechanical damage.

F.3.6.2 Resistance

When resistors are tested in accordance with paragraph F.4.4.5.2 under the standard conditions (paragraph F.4.4.1), the resistance shall be within the tolerance (specified in Table F-5) of the nominal resistance.

F.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph F.4.4.5.3, the resistance-temperature characteristic shall not exceed the value specified in Table F-4 for each of the temperatures specified in Table F-17.

F.3.6.4 Dielectric Withstanding Voltage

When tested as specified in paragraph F.4.4.5.4, resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall be within the value specified in the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

F.3.6.5 Insulation Resistance

When resistors are tested as specified in paragraph F.4.4.5.5, the insulation resistance shall be equal to or more than the value specified in the detail specification.

F.3.6.6 Short-Time Overload

When resistors are tested as specified in paragraph F.4.4.5.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

F.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

F.3.7.1 Solderability

F.3.7.1.1 Solderability [I]

Solderability [I] shall be applicable to the electrode structure C. When resistors are tested as specified in paragraph F.4.4.6.1.1, a minimum of 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.

F.3.7.1.2 Solderability [II]

Solderability [II] shall be applicable to the electrode structure R. When resistors are tested as specified in paragraph F.4.4.6.1.2, a minimum of 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.

F.3.7.2 Adhesion

When resistors are tested as specified in paragraph F.4.4.6.2, there shall be no mechanical damage.

F.3.7.3 Board Bending

When resistors are tested as specified in paragraph F.4.3.6.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no mechanical damage after the completion of the test.

F.3.7.4 Resistance to Bonding Exposure

When resistors are tested as specified in paragraph F.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The electrode area covered by solder leaching shall be 10% or less of the total surface and the electrode shall be free from mechanical damage.

F.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

F.3.8.1 Random Vibration

When resistors are tested as specified in paragraph F.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

F.3.8.2 Shock

When resistors are tested as specified in paragraph F.4.4.7.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

F.3.8.3 Thermal Shock [II]

When resistors are tested as specified in paragraph F.4.4.7.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 500 cycles.

F.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph F.4.4.7.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

F.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph F.4.4.7.5, the marking shall remain legible. The details shall be as defined in the detail specification.

F.3.8.6 Low Temperature Operation

When resistors are tested as specified in paragraph F.4.4.7.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

F.3.8.7 Stability

When resistors are tested as specified in paragraph F.4.4.7.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The change in resistance before this test and after the withstanding voltage test shall also satisfy the requirements of the detail specification. The insulation resistance after the test shall be more than the value specified in the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

F.3.9 Durability

Resistors shall satisfy the following durability requirements.

F.3.9.1 Life

When resistors are tested as specified in paragraph F.4.4.8.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

F.4. Quality Assurance Provisions

F.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2050.

F.4.2 Qualification Test

The qualification test shall be in accordance with paragraph 4.4 of JAXA-QTS-2050 and as provided below.

F.4.2.1 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table F-11.
When the materials differ greatly due to the resistance range, the samples shall be prepared for minimum resistance, maximum resistance, and critical resistance or closest to critical resistance of each material. The required tests shall be performed for the number of samples specified for each material. When the critical resistance is close to the maximum or the minimum value which is determined by the material, one of the tests may be exempted.
If the manufacturer applies for QML certification for both schematics A and B and the materials of protective coating, resistor elements and electrodes, structures of electrodes, processes and quality levels are the same for both schematics, tests for one of the schematics shall be substituted for the other for test Group II, IV, VI and VIII to XI tests. In addition, if the widths of the resistor bodies are the same in both schematics and the group VII tests are conducted using the schematics with worse conditions, the tests for the other schematic type may be excluded. Tests common to all electrode structures shall be conducted with samples of electrode structure R.
The number of samples for each electrode shall be as specified in Tables F-11.1 and F-11.2. However, if the manufacturer requests to have the resistors approved separately for each electrode structure, all tests common to all electrode structures shall be conducted for each electrode type.

The order of tests and number of samples shall be in accordance with Tables F-11.1 and F-11.2 and the tests of each group shall be performed in the order listed. Upon completion of Group I and IA tests, Group II through XI tests of Tables F-11.1 and F-11.2 shall be performed using samples allocated to the appropriate group tests.

Table F-11.1. Qualification Test (Applicable to Schematic A) (1/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail		
					Sample size for each electrode structure [1]		No. of defectives allowed
Group	Order	Item			R	C	
I	1	Application of pulse	F.3.6.1	F.4.4.5.1	100%		0
	2	Resistance	F.3.6.2	F.4.4.5.2			
IA	1	Externals, dimensions and marking	F.3.3	F.4.4.3	AQL[2] 1.0%		
IB	1	DPA	F.3.4.1	F.4.4.4.1	4 2 Highest resistance 2 Lowest resistance	4	0
II	1	Dielectric withstanding voltage	F.3.6.4	F.4.4.5.4	10 (R=80)	0	0
	2	Insulation resistance	F.3.6.5	F.4.4.5.5	Any resistance		
III	1	Resistance-temperature characteristic	F.3.6.3	F.4.4.5.3	6 (R=48)	0	0
	2	Low temperature operation	F.3.8.6	F.4.4.7.6	2 Highest resistance 2 Critical resistance 2 Lowest resistance		
	3	Short-time overload	F.3.6.6	F.4.4.5.6			
IV	1	Moisture resistance	F.3.8.4	F.4.4.7.4	6 (R=48) 2 Highest resistance 2 Critical resistance 2 Lowest resistance	0	0
V	1	Life	F.3.9.1	F.4.4.8.1	30 (R=240) 10 Highest resistance 10 Critical resistance 10 Lowest resistance	0	0
VI	1	Stability	F.3.8.7	F.4.4.7.7	6 (R=48) 2 Highest resistance 2 Critical resistance 2 Lowest resistance	0	0
VII	1	Resistance to bonding exposure	F.3.7.4	F.4.4.6.4	10	10	0
	2	Shock	F.3.8.2	F.4.4.7.2	Any resistance		
	3	Thermal shock [II]	F.3.8.3	F.4.4.7.3			

Table F-11.1. Qualification Test (Applicable to Schematic A) (2/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail		
					Sample size for each electrode structure (1)		No. of defectives allowed
Group	Order	Item			R	C	
VIII	1	Random vibration	F.3.8.1	F.4.4.7.1	10 (R=80) Any resistance	10 (R=80)	0
IX	1	Solderability	F.3.7.1	F.4.4.6.1	10 (R=80)	10 (R=80)	0
	2	Resistance to solvents	F.3.8.5	F.4.4.7.5	Any resistance		
X	1	Adhesion	F.3.7.2	F.4.4.6.2	10 Any resistance	10	0
XI	1	Board bending	F.3.7.3	F.4.4.6.3	10 (R=80) Any resistance	10 (R=80)	0
-	1	Materials	F.3.2	-	(3)		

Notes:

(1) The number of samples shall be the number of packages (Schematic A: 8 elements/package). The numbers in parentheses indicates the number of resistor elements to be tested.

(2) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Special Inspection Level S-4" shall apply to each electrode structure.

(3) Data to certify compliance with design specifications shall be submitted.

Table F-11.2. Qualification Test (Applicable to Schematic B) (1/2)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail		
					Sample size (1)		No. of defectives allowed
Group	Order	Item			R	C	
I	1	Application of pulse	F.3.6.1	F.4.4.5.1	100%		0
	2	Resistance	F.3.6.2	F.4.4.5.2			
IA	1	Externals, dimensions and marking	F.3.3	F.4.4.3	AQL(2) 1.0%		0
IB	1	DPA	F.3.4.1	F.4.4.4.1	4 2 Highest resistance 2 Lowest resistance	4	0
II	1	Dielectric withstanding voltage	F.3.6.4	F.4.4.5.4	10 (R=150)	0	0
	2	Insulation resistance	F.3.6.5	F.4.4.5.5	Any resistance		
III	1	Resistance-temperature characteristic	F.3.6.3	F.4.4.5.3	3 (R=45)	0	0
	2	Low temperature operation	F.3.8.6	F.4.4.7.6	1 Highest resistance 1 Critical resistance 1 Lowest resistance		
	3	Short-time overload	F.3.6.6	F.4.4.5.6			
IV	1	Moisture resistance	F.3.8.4	F.4.4.7.4	3 (R=45) 1 Highest resistance 1 Critical resistance 1 Lowest resistance	0	0
V	1	Life	F.3.9.1	F.4.4.8.1	18 (R=270) 6 Highest resistance 6 Critical resistance 6 Lowest resistance	0	0
VI	1	Stability	F.3.8.7	F.4.4.7.7	3 (R=45) 1 Highest resistance 1 Critical resistance 1 Lowest resistance	0	0
VII	1	Resistance to bonding exposure	F.3.7.4	F.4.4.6.4	10	10	0
	2	Shock	F.3.8.2	F.4.4.7.2	Any resistance		
	3	Thermal shock [II]	F.3.8.3	F.4.4.7.3			

Table F-11.2. Qualification Test (2/2) (Applicable to Schematic B)

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail		
					Sample size (1)		No. of defectives allowed
Group	Order	Item			R	C	
VIII	1	Random vibration	F.3.8.1	F.4.4.7.1	10 (R=150)	10 (R=150)	0
					Any resistance		
IX	1	Solderability	F.3.7.1	F.4.4.6.1	10	10	0
	2	Resistance to solvents	F.3.8.5	F.4.4.7.5	Any resistance		
X	1	Adhesion	F.3.7.2	F.4.4.6.2	10	10	0
					Any resistance		
XI	1	Board bending	F.3.7.3	F.4.4.6.3	10 (R=150)	10 (R=150)	0
					Any resistance		
-	1	Materials	F.3.2	-	(3)		

Notes:

(1) The number of samples shall be the number of packages (Schematic B: 15 elements/package.) The numbers in parentheses indicates the number of resistor elements to be tested.

(2) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Special Inspection Level S-4" shall apply to each electrode structure.

(3) Data to certify compliance with design specifications shall be submitted.

F.4.3 Quality Conformance Inspection

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

F.4.3.1 Samples

The inspection lot configuration of group A shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for all combinations of schematic types and electrode structures. Resistors with the maximum resistance, minimum resistance and critical resistance shall be selected. Further, the highest grade of characteristics shall be selected. If the design criteria are identical and the schematic types and the structures are similar, the inspection lot may be represented by one of the shapes specified in the detail specification.

F.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be specified in Tables F-12, F-13 and F-14, respectively. Group tests shall be performed in subgroup order and the inspections within each group shall be performed in the specified order. The sampling plan used

for the Group A inspection shall be in accordance with Appendix 1 of JIS Z 9015-1. "General Inspection Level II" and "Special Inspection Level S-4" specified therein shall apply to test order 1, Group A1-2 and Group A1-3 inspections, respectively. For Groups B and C inspections, a pre-defined quantity of samples shall be selected from each category shown in Table F-1 regardless of circuit type and electrode structure.

F.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table F-12, F-13 or F-14 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table F-12, but the failure mode of the defect is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

F.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed the A1 inspection, the lot shall be treated as a rejected lot. The samples subjected to the DPA of the Group A inspection shall not be shipped as products.
If the lot has not passed the sampling test other than the DPA, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped.

Table F-12. Quality Conformance Inspection (Group A)

(Applicable to Schematics A and B)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
A1	1	1	Application of pulse	F.3.6.1	F.4.4.5.1	100%	0
		2	Resistance	F.3.6.2	F.4.4.5.2		
	2	1	Externals, dimensions and marking	F.3.3	F.4.4.3	AQL (1) 4%	
		2	DPA	F.3.4.1	F.4.4.4.1	4	0
	3	1	Dielectric withstanding voltage	F.3.6.4	F.4.4.5.4	AQL (1) 4%	
		2	Insulation resistance	F.3.6.5	F.4.4.5.5		

Note:(1) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Normal Inspection Level II" specified therein shall apply to test order 1 of Group A1-2 inspection. "Special Inspection Level S-4" shall apply to the Group A1-3 inspections.

Table F-13.1. Quality Conformance Inspection (Group B) (Applicable to Schematic A)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
B	1	1	Resistance to bonding exposure	F.3.7.4	F.4.4.6.4	2 (R=16)	0
		2	Resistance-temperature characteristic	F.3.6.3	F.4.4.5.3	2 (R=16)	0
			Low temperature operation	F.3.8.6	F.4.4.7.6		
			Short-time overload	F.3.6.6	F.4.4.5.6		
	2	1	Moisture resistance	F.3.8.4	F.4.4.7.4	2 (R=16)	0
	3	1	Life	F.3.9.1	F.4.4.8.1	2 (R=16)	0
	4	1	Stability	F.3.8.7	F.4.4.7.7	2 (R=16)	0
	5	1	Shock	F.3.8.2	F.4.4.7.2	2 (R=16)	0
	6	1	Solderability	F.3.7.1	F.4.4.6.1	5	0
		2	Resistance to solvents	F.3.8.5	F.4.4.7.5		
	7	1	Adhesion	F.3.7.2	F.4.4.6.2	5	0
	8	1	Board bending	F.3.7.3	F.4.4.6.3	5 (R=40)	0

Note:(1) The number of samples shall be the number of packages (Schematic A: 8 elements/package).

Table F-13.2. Quality Conformance Inspection (Group B) (Applicable to Schematic B)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
B	1	1	Resistance to bonding exposure	F.3.7.4	F.4.4.6.4	2 (R=30)	0
		2	Resistance-temperature characteristic	F.3.6.3	F.4.4.5.3	2 (R=30)	0
			Low temperature operation	F.3.8.6	F.4.4.7.6		
			Short-time overload	F.3.6.6	F.4.4.5.6		
	2	1	Moisture resistance	F.3.8.4	F.4.4.7.4	1 (R=15)	0
	3	1	Life	F.3.9.1	F.4.4.8.1	1 (R=15)	0
	4	1	Stability	F.3.8.7	F.4.4.7.7	1 (R=15)	0
	5	1	Shock	F.3.8.2	F.4.4.7.2	1 (R=15)	0
	6	1	Solderability	F.3.7.1	F.4.4.6.1	5	0
		2	Resistance to solvents	F.3.8.5	F.4.4.7.5		
	7	1	Adhesion	F.3.7.2	F.4.4.6.2	5	0
	8	1	Board bending	F.3.7.3	F.4.4.6.3	5 (R=75)	0

Note:(1) The number of samples shall be the number of packages (Schematic B: 15 elements/package).

Table F-14. Quality Conformance Inspection (Group C)

(Applicable to Schematics A and B)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
C	1	1	Random vibration	F.3.8.1	F.4.4.7.1	5 (R=40, 75)	0
	2	1	Thermal shock [II]	F.3.8.3	F.4.4.7.3	2	0

Note:(1) The number of samples shall be the number of packages (Schematic A: 8 elements/package, Schematic B: 15 elements/package).

F.4.4 Methods for Test and Inspection

F.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3 kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B as specified in Table F-15. Unless specified, condition A shall apply.

Table F-15. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

F.4.4.2 Method of Mounting

The mounting method shall be one of the following as specified in paragraph F.4.4.5 to F.4.4.8.

a) Mounting method A

1) Test board
The test boards shall be alumina substrate (alumina of 95% purity or higher) with a nominal thickness of 0.8mm. The dimensions shall be as specified in Figure F-2.

2) Mounting procedure
Pre-solder the sample in a nitrogen gas environment, using gold-tin alloy solder (nominal gold content 80%). The sample shall be placed on the test substrate using a sheet type pellet solder of the same composition between them before heating them on a hot plate or in a tunnel oven to melt the solder. Flux shall not be used.
Soldering temperature and time shall be as follows.
2.1) Presoldering Temperature: 320±10°C
Duration: 3±0.5 seconds

2.2) Soldering Temperature: 320±10°C
Duration: 10±2 seconds

b) Mounting method B

1) Test board
The test boards shall be alumina substrate (alumina of 95% purity or higher) with a nominal thickness of 0.8mm. The dimensions shall be as specified in Figure F-2.

2) Mounting procedure
Mount the sample on the test substrate by reflow soldering or dip soldering using tin-lead alloy solder with nominal tin content of 60% including inactivated flux.
Soldering temperature and time shall be as follows.
2.1) Temperature: 260±5°C
2.2) Duration: 10±2 seconds

Unit: mm

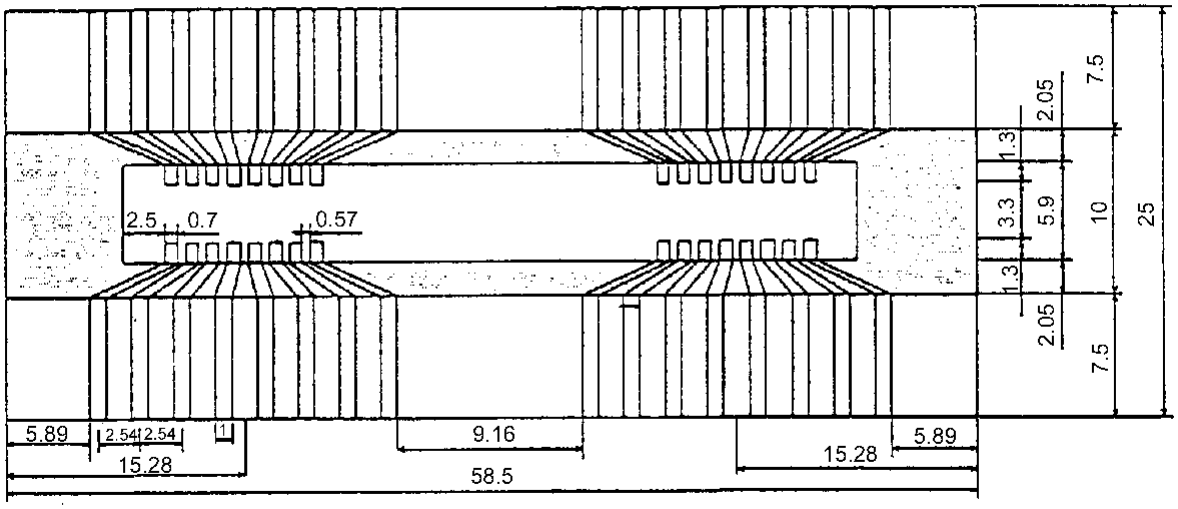


Table F-2. Test Board for Mounting Methods A and B

F.4.4.3 Externals, Dimensions and Marking

a) The external inspection shall be performed using a 10x magnifier.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. If the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured in the qualification test, delivery inspection and the Group A quality conformance inspection. The number of samples inspected shall be 10.

F.4.4.4 Workmanship

F.4.4.4.1 DPA

The resistors shall be disassembled to ensure that the resistor films, electrode and protective coating against moisture are properly manufactured and the internal structures are as specified in the Quality Assurance Program Plan. DPA shall be conducted in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) The resistors shall be embedded in a proper resin or other materials and cut along the line parallel to the longitudinal axis of the resistors. One cut face shall be grounded and examined using a 10 to 200x magnifier for the resistor film, electrode, thickness of protective coating, and connection of resistor film and electrodes.

b) The resistors shall be embedded in a proper resin or other materials and cut along the line perpendicular to the longitudinal axis of the resistors. One cut face shall be grounded and examined using a 10 to 200x magnifier for inspecting the protective coating.

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

F.4.4.5 Electrical Performance

The electrical performance tests shall be performed as follows.

F.4.4.5.1 Application of Pulse

A dc test voltage, 2.5 times the rated voltage shall be applied for 1 second to the resistors. The test voltage shall not exceed the maximum overload voltage specified in the detail specification. At the completion of this test, the resistors shall be examined for evidence of arcing, insulation breakdown and mechanical damage.

F.4.4.5.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Test voltage
If pass/fail results are questionable, the conditions specified in Table F-16 shall apply.

b) Temperature
As a rule, the resistance test of Group I specified in Table F-11.1 and F-11.2 shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

Table F-16. Test Voltage

Unit: V_{DC}

Nominal resistance (Ω)	Maximum test voltage
10 or more and less than 1k	1.0
1k or more and less than 10k	3.0
10k or more and less than 100k	10.0
100k or more	30.0

F.4.4.5.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item b), paragraph F.4.4.2. This test shall be performed following the resistance to bonding exposure test of paragraph F.4.4.6.4 in the quality conformance inspection.
b) Reference temperature: 25°C
c) Test temperature: As specified in Table F-17.
d) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table F-17. Test Temperature for Resistance-Temperature Characteristic

Unit: °C

Order	Temperature	
	Qualification test	Quality conformance inspection
1	Room temperature	Room temperature
2	-15±3	-55±3
3	-55±3	Room temperature
4	Room temperature	125±3
5	65±3	-
6	125±3	-

F.4.4.5.4 Dielectric Withstanding Voltage

F.4.4.5.4.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Mount the resistor with its insulation jacket upward on the metal plate

so that the tip of the metal block is positioned at approximately the center of the resistor's two electrodes as shown in Figure F-3, and pressurize at 1.0±0.2N.

b) Measurement before test
The resistance shall be measured in accordance with paragraph F.4.4.5.2.

c) Test voltage
The test voltages of 100±10V_{AC} (root-mean-square value at commercial-line frequency) shall be applied between the measuring point A on the metal block and measuring point B on the metal plate.

d) Duration of test: 1 minute $^{+10}_{0}$ seconds

e) Measurement during test
The leak current shall be monitored during the test, and the resistors are examined for evidence of arcing or any breakage.

f) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 10x or greater.

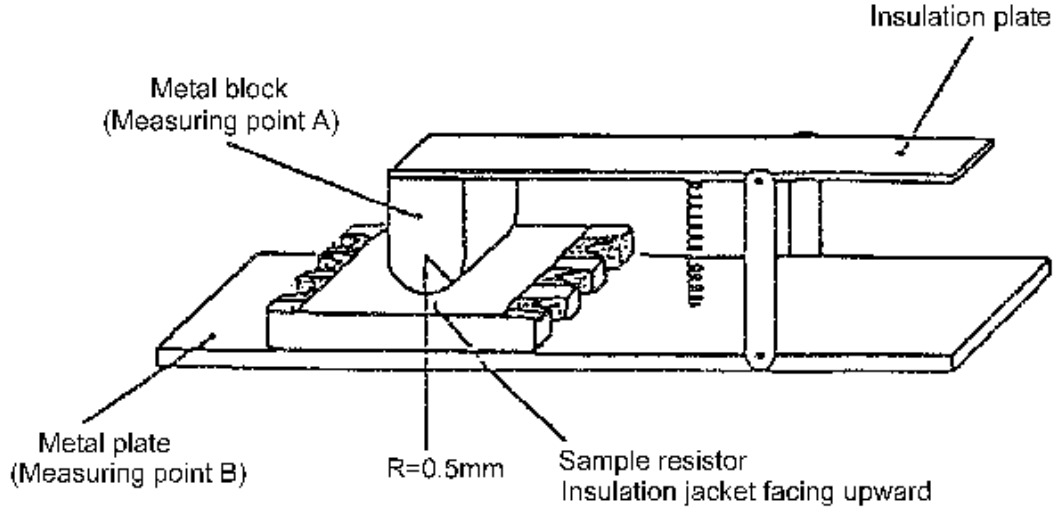


Figure F-3. Test Method for the Dielectric Withstanding Voltage and Insulation Resistance Tests

F.4.4.5.4.2 Barometric Pressure (Reduced)

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item a), paragraph F.4.4.5.4.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph F.4.4.5.2.

c) Test voltage
$75V_{AC}±7.5V_{AC}$ (root-mean-square value at commercial-line frequency)
d) Test condition: D (1.1kPa)
e) Duration of application of test voltage: 1 minute $^{+10}_{0}$ seconds
f) Measurement during test
The leak current shall be measured throughout the test, and the resistors are examined for evidence of arcing or any breakage.
g) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.
h) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 10x or greater.

F.4.4.5.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item a), paragraph F.4.4.5.4.1.
b) Test voltage: $100±10V_{DC}$
c) Duration of application of test voltage: 1 minute

F.4.4.5.6 Short-Time Overload

The short-time overload test shall be performed in accordance with the low temperature operation test of paragraph F.4.4.7.6. The resistance shall be measured as specified in paragraph F.4.4.5.2. Following this measurement, dc test voltage of 2.5 times the rated voltage shall be applied to the resistors for 5±1 seconds. The test voltage shall not exceed the maximum overload voltage specified in the detail specification. The following conditions shall apply.

a) Mounting method
This test shall be performed in accordance with the low temperature operation test of paragraph F.4.4.7.6.
b) Test temperature
The test temperature shall be at 25±5°C in still air, with no circulation other than the heat of the resistors being operated.
c) Measurement after test
The resistors shall remain at room temperature for 30 minutes or more after the test voltage is removed before the resistance is measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.
d) Examination after test
The resistors shall be examined for evidence of arcing, burning, or charring using a magnifier of 10x or greater.

F.4.4.6 Mechanical Performance

The mechanical performance tests shall be performed as follows.

F.4.4.6.1 Solderability

F.4.4.6.1.1 Solderability [I]

The solderability [I] test shall be applied to electrode structure C resistors. The test procedure shall be in accordance with paragraph 4.17 of JIS C 5201-1. However, the following conditions shall apply.

a) Solder type
   Gold-tin alloy solder (nominal gold content of 80%) shall be used.
b) Solder temperature: 300±10°C
c) Solder immersion time: 5±0.5 seconds
d) Procedure
   Both electrodes shall be immersed into the solder at the same time. The test shall be performed in a nitrogen gas environment. Flux shall not be used.
e) Examination after test
   Resistors shall be examined for solder wettability using a magnifier of 10x or greater.

F.4.4.6.1.2 Solderability [II]

The solderability [II] test shall be applied to electrode structure R resistors. The test procedure shall be in accordance with paragraph 4.17 of JIS C 5201-1. However, the following conditions shall apply.

a) Solder type
   Tin-lead alloy solder with nominal tin content of 60% including inactivated flux shall be used.
b) Solder temperature: 245±5°C
c) Solder immersion time: 5±0.5 seconds
d) Procedure
   Both electrodes shall be immersed into the solder at the same time.
e) Examination after test
   Resistors shall be examined for solder wettability using a magnifier of 10x or greater.

F.4.4.6.2 Adhesion

This test shall be performed in accordance with paragraph 4.32 of JIS C 5201-1. The following conditions shall apply.

a) Mounting method
   The resistors shall be mounted as specified in item a), paragraph F.4.4.2 for electrode structure C and item b), paragraph F.4.4.2 for electrode structure R.
b) Load: 5±0.5N
c) Duration of application of the load: 10±1 seconds
d) Examination after test
   The resistors shall be examined for mechanical damage.

F.4.4.6.3 Board Bending

This test shall be performed in accordance with paragraph 4.33 of JIS C 5201-1. The following conditions shall apply.

a) Mounting method
The resistors shall be mounted on a test board shown in Figure F-4 as specified in item b), paragraph F.4.4.2. The test temperature shall be 235±5°C.

b) Measurement before test
The resistance shall be measured in accordance with paragraph F.4.4.5.2.

c) Deflection: 2mm

d) Number of bending: 1

e) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

Material: glass epoxy base board Thickness: 1.6mm

Unit: mm

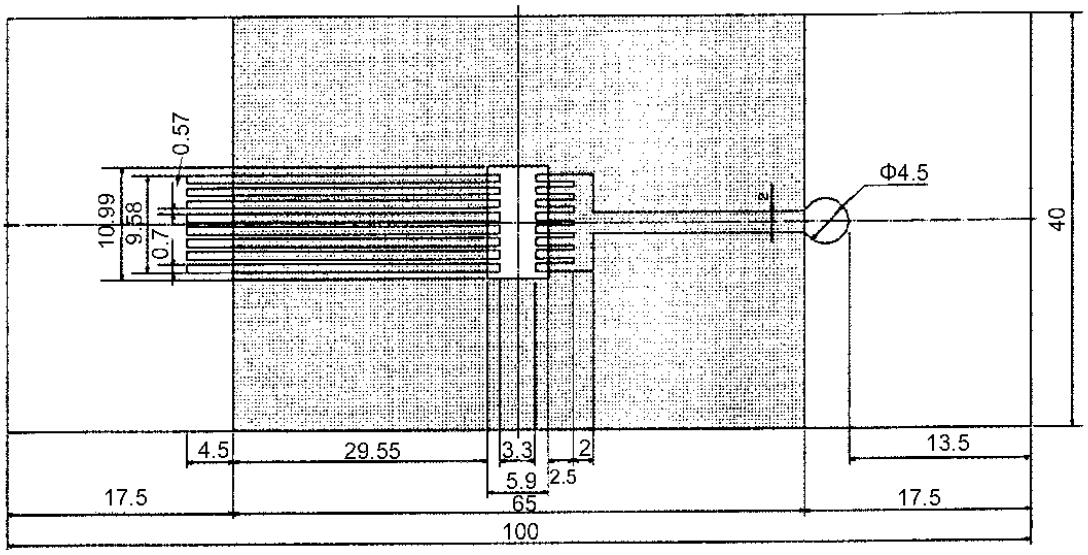


Figure F-4. Test Board for Board Bending Test

F.4.4.6.4 Resistance to Bonding Exposure

After the resistance is measured as specified in paragraph F.4.4.5.2, the resistor shall be mounted on a test board. The test board, with resistors mounted, shall remain at room temperature for 4 to 12 hours. The following conditions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item a), paragraph F.4.4.2 for electrode structure C and item b), paragraph F.4.4.2 for electrode structure R.

b) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

c) Examination after test
The resistors shall be examined for mechanical damage and soldering corrosion using a magnifier of 10x or greater.

F.4.4.7 Environmental Performance

The environmental performance tests shall be performed as follows.

F.4.4.7.1 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item b), paragraph F.4.4.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph F.4.4.5.2.

c) Test condition: II-H Frequency range: 50 to 2,000Hz
Rms value of acceleration: 334m/s^{2}rms

d) Direction of motion: In each of three mutually perpendicular directions.

e) Number of application and duration of vibration
Vibration shall be applied for 3 minutes in each direction with a total test time of 9 minutes.

f) Measurement during test
Each resistor shall be monitored for electrical discontinuity of 0.1ms or greater during this test.

g) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

F.4.4.7.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
For the qualification test, this test shall be performed in accordance with the resistance to bonding exposure test of paragraph F.4.4.6.4. For the quality conformance inspection, the resistors shall be mounted on the test plate as specified in F.4.4.2 b).
The test board shall be rigidly mounted on appropriate fixtures. The mounting fixtures shall be constructed to preclude any resonance in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.

b) Measurement before test
The resistance shall be measured in accordance with paragraph F.4.4.5.2.

c) Test condition: I (980m/s^2, 6ms sawtooth).

d) Direction of applied shocks
In each of three mutually perpendicular directions.

e) Number of applied shocks:
The resistors shall be subjected to 5 shocks in each direction, for a total of 15 shocks.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the shock for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

F.4.4.7.3 Thermal Shock [II]

After measuring resistance in accordance with paragraph F.4.4.5.2, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table F-18 and Figure F-5. The following details and exceptions shall apply.

a) Method of mounting
This test shall be performed following the shock test specified in paragraph F.4.4.7.2.

b) Number of test cycles: 1,000 cycles

c) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more for each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for cracks on the surface.

d) Measurement after test
The resistors shall be at room temperature for 30 minutes or more, and the resistance shall be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

e) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

Table F-18. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	$-30\ ^{0}_{-5}$	15
2	$100\ ^{+5}_{0}$	15

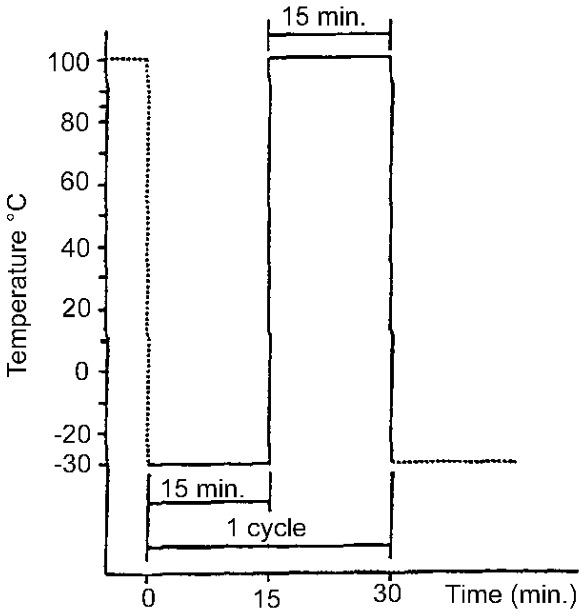


Figure F-5. Test Conditions of Thermal Shock [II]

F.4.4.7.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting: As specified in item b), paragraph F.4.4.2.
b) Measurement before test
   The resistance shall be measured in accordance with paragraph F.4.4.5.2.
c) Polarization and loading voltage: No voltage shall be applied.
d) Subcycle
   Step 7b shall not be applicable. Step 7a shall only be performed during any five of the first nine cycles.
e) Measurements at high humidity: None.
f) Measurement after test
   Upon completion of step 6 of the final cycle, the resistors shall be removed from the chamber, and maintained at room temperature for 30 minutes or more. The resistance shall then be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.
g) Examination after test
   The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

F.4.4.7.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion
b) Solvents to be used:
   1) 2-propanol (Isopropyl alcohol)

2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

F.4.4.7.6 Low Temperature Operation

The resistance shall be measured as specified in paragraph F.4.4.5.2. The rated dc voltage shall then be applied to the resistors at the specified test voltage for 45 minutes. The following details and exceptions shall apply.

a) Method of mounting
This test shall be performed in accordance with the resistance-temperature characteristic test of paragraph F.4.4.5.3.

b) Test temperature: As specified in Figure F-6.

c) Measurement after test
The resistance shall then be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

d) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

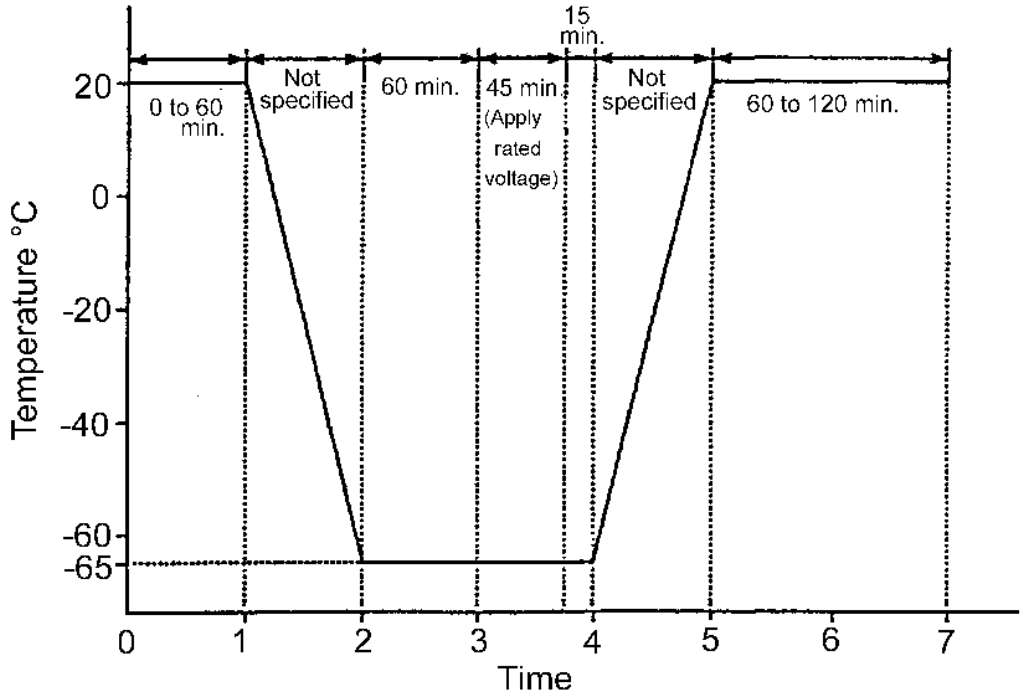


Figure F-6. Test Temperature for the Low Temperature Operation Test

F.4.4.7.7 Stability

After the resistance is measured as specified in paragraph F.4.4.5.2, the resistors shall remain at the specified test temperature at no load. The following details and exceptions shall apply.

a) Method of mounting: As specified in item b), paragraph F.4.4.2.

b) Test temperature: 125±5°C

c) Duration of test: 2,000 $^{+72}_{0}$ hours

d) Measurements during test: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours and 1,000 $^{+48}_{0}$ hours.

e) Measurement after test
The resistors shall be at 25±5°C for 6±1 hours. The resistance shall then be measured in accordance with paragraph F.4.4.5.2 to calculate the change in resistance before and after the test.

f) Dielectric withstanding voltage (atmospheric pressure)
Following the measurement specified in e) above, the dielectric withstanding voltage test shall be performed in accordance with paragraph F.4.4.5.4.1.

g) Insulation resistance
Following the dielectric withstanding voltage test specified in f) above, the insulation resistance test shall be performed in accordance with paragraph F.4.4.5.5.

h) Examination after test:
The resistors shall be examined for evidence of mechanical damage using a magnifier of 10x or greater.

F.4.4.8 Durability

Durability test shall be performed as follows.

F.4.4.8.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted on a test board as specified in item b), paragraph F.4.4.2. If forced air circulation is employed, the air velocity shall not exceed 2.5m/s and there shall be no direct impingement of the forced-air supply upon the resistors.

b) Test temperature: 70±5°C

c) Measurement before test
Measurements may be taken inside or outside the chamber. The resistance shall be measured in accordance with paragraph F.4.4.5.2.

1) Inside chamber
When measurements are taken inside the chamber, the before the test resistance measurement shall be taken 8 hours after the temperature inside the chamber is stabilized at the test temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

2) Outside chamber
When measurements are taken outside the chamber, the resistors shall be mounted in the test fixture and the before the test resistance measurement shall be measured at room temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

d) Test conditions
The rated voltage specified in paragraph F.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be

$4{,}000\,^{+72}_{0}$ hours for the qualification test and $2{,}000\,^{+72}_{0}$ hours for the quality conformance inspection.

e) Measurements during test

1) Qualification test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, $1{,}000\,^{+48}_{0}$ hours and $2{,}000\,^{+72}_{0}$ hours.

2) Quality conformance inspection: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours and $1{,}000\,^{+48}_{0}$ hours.

f) Measurements during and after test

1) Inside chamber
The resistance shall be measured as specified in paragraph F.4.4.5.2. at the end of the OFF period after specified cycling time.

2) Outside chamber
After the resistors are at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph F.4.4.5.2.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using a 10x magnifier.

F.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

F.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

F.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

F.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX H

RESISTORS, FIXED, WIRE WOUND, POWER TYPE, CHASSIS MOUNTED

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: December 28, 2021

APPENDIX H

RESISTORS, FIXED, WIRE WOUND, POWER TYPE, CHASSIS MOUNTED

H.1. General

H.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the chassis mounted, power type, wire wound, fixed resistors (hereinafter referred to as "resistors").

H.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table H-1.

Table H-1. Classification

Construction	Style and termination type
Chassis mounted type	RES60, 65, 70, 75
	RES40, 50

H.1.3 Part Number

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

Example:

JAXA[(1)]	RES65	-	F	-	1001
	Style		Resistance tolerance		Nominal resistance
	(H.1.3.1)		(H.1.3.2)		(H.1.3.3)

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

H.1.3.1 Style

The style shall be identified by a three letter symbol, “RES” and a two-digit number. The “RES” indicates the high reliability, wire wound, fixed resistors (power type, chassis mounted). The two-digit number indicates the power rating and physical size of the resistors.

H.1.3.2 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table H-2.

Table H-2. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance
F	±1.0

H.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 4 alphanumeric characters. The first three digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter "R" shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.

Example: 1R00= 1.00Ω
10R0= 10.0 Ω
1000= 100 Ω
1001= 1,000 Ω = 1kΩ
1002=10,000 Ω = 10kΩ

H.2. Applicable Documents

H.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

H.2.2 Reference Documents

The following is the reference document.

a) MIL-PRF-39009 Resistors, Fixed, Wire Wound, (Power Type, Chassis Mounted), Nonestablished Reliability, Established Reliability, General Specification for

H.3. Requirements

H.3.1 Qualification Coverage

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

H.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

H.3.2.1 Resistance Wire

Resistance wire shall not include impurities or other factors that may cause local weak points. The minimum diameter of the resistance wires shall be as specified in the detail specification.

H.3.2.2 Base Substance

The volume resistivity of the base substance shall be $10^8\Omega\cdot$cm or greater at a temperature of 300°C.

H.3.2.3 Sealing Material

Sealing materials used for fixing resistors shall be ceramic powder, inorganic adhesives, or other material, and shall have good thermal conductivity.

H.3.2.4 Protective Coating, Enclosure or Housing

The coating or enclosure to protect the resistor shall be free from cracks, crazing, chipping, distortion or corrosion at any temperature up to and including +275°C, regardless of the mounting position of the resistors.

H.3.2.5 Terminals

Terminals shall be treated to facilitate soldering. When a lead coating containing tin is used, the tin content shall be between 40 and 70%.

H.3.2.6 Flux

The manufacturer shall completely remove corrosive substances after soldering, or use noncorrosive flux. When non-corrosive flux is used, the water extract resistivity test shall be performed in accordance with paragraph 4.9 of JIS Z 3197, and it shall be verified that the water extract resistivity is not less than 100kΩ·cm. When resin flux cored solder is used, the mass ratio of resin to solder shall be between 1 and 3%.

H.3.3 Externals, Dimensions and Marking

Resistors shall meet the following requirements when tested in accordance with paragraph H.4.4.2.

H.3.3.1 Externals and Marking

There shall be no defects such as surface cracks on the resistors. The following shall be clearly marked in such a manner to ensure legibility. The marking shall remain legible at the completion of any test.

a) Part number
   The marking of ”JAXA” may be excluded. When the physical size of the resistor precludes inclusion of the complete part number, nominal resistance shall be marked as a minimum.
b) Year and week manufactured
   The number of the last two digits of the calendar year and the week of the calendar year beginning with January shall be marked.
c) Manufacturer name or its abbreviation.

H.3.3.2 Construction, Dimensions and Mass

Resistors shall be constructed of a wounded resistance element and terminals for mounting on a chassis. The dimensions and mass shall satisfy the requirements specified in each detail specification.

H.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1. The design of the resistors shall preclude shorting of turns and shall obtain a minimum voltage drop between the adjacent turns. Resistors shall be wound with a single layer of resistance wire. When applicable, in order to minimize inductance, resistors shall be wound by an Ayrton-Perry or a double-layer reverse winding. In addition, resistors shall satisfy the following requirements.

a) Resistance wire
The resistance wires shall have no joints, welds or knots, except at end terminals.

b) Pitch
For round wire, the average winding pitch shall not exceed five times the wire diameter. When the resistance value is less than 1ohm, the winding pitch shall not be less than 1.5 times the wire diameter.

c) Effective winding coverage
The effective winding coverage shall be the area between the starting and end points where the wires are wound in a uniform winding pitch. The effective winding coverage shall cover a minimum of 80% of the overall winding area.

d) Protective coating, enclosure or housing
The resistor enclosure or housing shall be made from an aluminum alloy, and shall protect against corrosion. All fasteners shall be properly plated. Unplated copper bear metals shall not be used in direct contact with aluminum.

e) Sealing material
The sealing material used for fixing and heat radiation for resistors shall not impair performance.

f) Terminals
The resistor’s terminal leads shall be securely connected electrically and mechanically.

H.3.4.1 DPA

When resistors are tested as specified in paragraph H.4.4.3.1, processes such as terminal connections, and protective coating, enclosure or housing shall have been successfully achieved. The internal structure shall be as specified in the quality assurance program.

H.3.5 Ratings

H.3.5.1 Nominal Resistance

As a rule, standard values of nominal resistance shall be defined relative to the resistance tolerance and shall be as specified in Table H-3. The minimum and maximum resistances shall satisfy the requirements of the detail specification.

Table H-3. Standard Resistance Values

Resistance tolerance F(±1.0%)					
1.00	1.47	2.15	3.16	4.64	6.81
1.02	1.50	2.21	3.24	4.75	6.98
1.05	1.54	2.26	3.32	4.87	7.15
1.07	1.58	2.32	3.40	4.99	7.32
1.10	1.62	2.37	3.48	5.11	7.50
1.13	1.65	2.43	3.57	5.23	7.68
1.15	1.69	2.49	3.65	5.36	7.87
1.18	1.74	2.55	3.74	5.49	8.06
1.21	1.78	2.61	3.83	5.62	8.25
1.24	1.82	2.67	3.92	5.76	8.45
1.27	1.87	2.74	4.02	5.90	8.66
1.30	1.91	2.80	4.12	6.04	8.87
1.33	1.96	2.87	4.22	6.19	9.09
1.37	2.00	2.94	4.32	6.34	9.31
1.40	2.05	3.01	4.42	6.49	9.53
1.43	2.10	3.09	4.53	6.65	9.76

H.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +275°C, unless otherwise specified.

H.3.5.3 Power Rating

Resistors shall have a power rating specified in the detail specification. The rated ambient temperature shall be 25°C unless otherwise specified.

H.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure H-1.

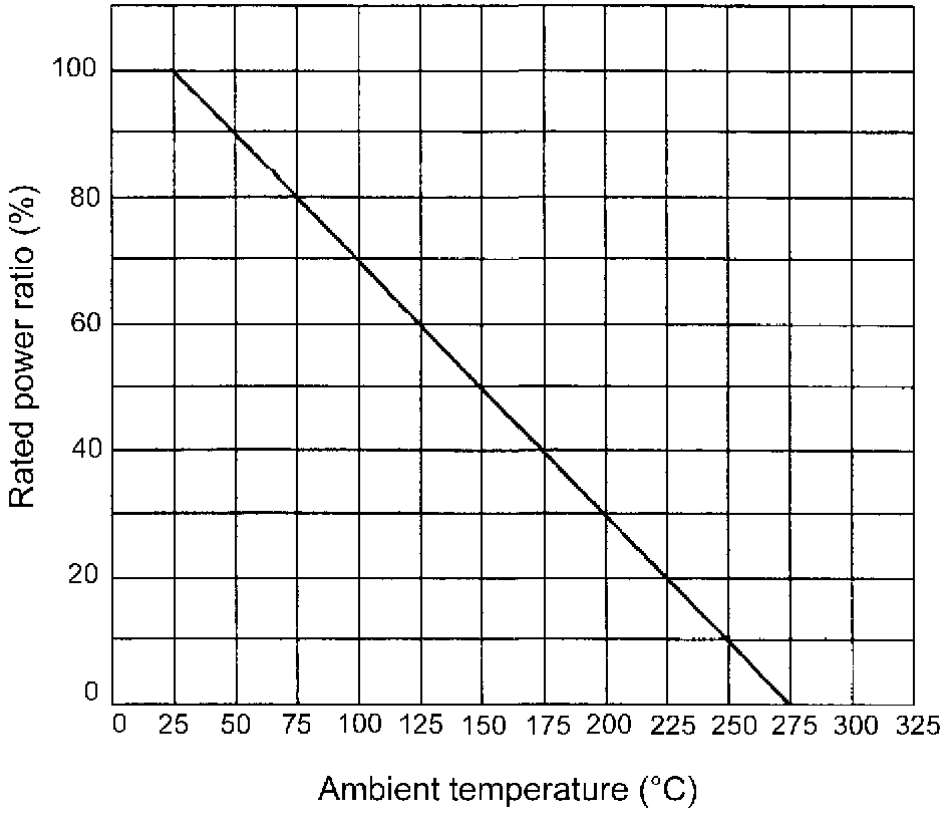


Figure H-1. Derating Curve

H.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula.

$E = \sqrt{P \cdot R}$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

H.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

H.3.6.1 Resistance

When resistors are tested in accordance with paragraph H.4.4.4.1 under the standard conditions (paragraph H.4.4.1), the resistance shall be within the specified tolerance for the nominal resistance.

H.3.6.2 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph H.4.4.4.2, the resistance-temperature characteristic shall satisfy the requirements as specified in the detail specification.

H.3.6.3 Power Conditioning

When resistors are tested as specified in paragraph H.4.4.4.3, there shall be no mechanical damage. The change in resistance before and after the test shall satisfy the requirements of the detail specification.

H.3.6.4 Dielectric Withstanding Voltage

When tested as specified in paragraph H.4.4.4.4, resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

H.3.6.5 Insulation Resistance

When resistors are tested as specified in paragraph H.4.4.4.5, the insulation resistance shall satisfy the requirements of the detail specification.

H.3.6.6 Short-Time Overload

When resistors are tested as specified in paragraph H.4.4.4.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

H.3.6.7 Reactance

When resistors are tested as specified in paragraph H.4.4.4.7, the reactance shall satisfy the requirements of the detail specification.

H.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

H.3.7.1 Terminal Strength

When resistors are tested as specified in paragraph H.4.4.5.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.3.7.2 Solderability

When resistors are tested as specified in paragraph H.4.4.5.2, a minimum of 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 in one spot. The total area of the pinholes or rough areas shall be less than 5% of the solder area.

H.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

H.3.8.1 Vibration

H.3.8.1.1 High Frequency Vibration

When resistors are tested as specified in paragraph H.4.4.6.1.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

H.3.8.1.2 Random Vibration

When resistors are tested as specified in paragraph H.4.4.6.1.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

H.3.8.2 Shock

When resistors are tested as specified in paragraph H.4.4.6.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

H.3.8.3 Heat Resistance

When resistors are tested as specified in paragraph H.4.4.6.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.3.8.4 Thermal Shock

H.3.8.4.1 Thermal Shock [I]

When resistors are tested as specified in paragraph H.4.4.6.4.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.3.8.4.2 Thermal Shock [II]

When resistors are tested as specified in paragraph H.4.4.6.4.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 100 cycles.

H.3.8.5 Moisture Resistance

When resistors are tested as specified in paragraph H.4.4.6.5, the change in resistance before and after the test shall satisfy the requirements of the detail specification. In addition, the insulation resistance shall satisfy the requirements of the detail specification. There shall be no evidence of breakage, cracks, loosening of terminals or corrosion after the completion of the test.

H.3.8.6 Resistance to Solvents

When resistors are tested as specified in paragraph H.4.4.6.6, the marking shall remain legible. The details shall be as specified in the detail specification.

H.3.8.7 Low Temperature Storage

When resistors are tested as specified in paragraph H.4.4.6.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.3.8.8 Stability

When resistors are tested as specified in paragraph H.4.4.6.8, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.3.9 Durability

Resistors shall satisfy the following durability requirements.

H.3.9.1 Life

When resistors are tested as specified in paragraph H.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

H.4. Quality Assurance Provisions

H.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2050.

H.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

H.4.2.1 Test Items and Number of Samples

Test items and number of samples of the qualification test shall be as specified in Table H-4.

The number of samples for each style shall be as specified in Table H-4. The samples shall be divided for each test group as specified in Table H-4. Tests within each group shall be performed in the order specified in Table H-4. Upon completion of Group I and IA tests in that order, Group IB through VII tests shall be performed using samples allocated to the appropriate group tests. Group IB through VII tests are not required to be performed in the order of the group number.

Table H-4. Qualification Test

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
I	1	Externals, dimensions and marking (2)	H.3.3	H.4.4.2	100%	0
IA	1	Power conditioning	H.3.6.3	H.4.4.4.3		
	2	Resistance	H.3.6.1	H.4.4.4.1		
IB	1	DPA	H.3.4.1	H.4.4.3.1	2	0
II	1	Reactance (3)	H.3.6.7	H.4.4.4.7	24 (12 Highest resistance; 12 1Ω or lowest resistance, whichever is greater)	1
	2	Resistance-temperature characteristic	H.3.6.2	H.4.4.4.2		
	3	Heat resistance	H.3.8.3	H.4.4.6.3		
	4	Low temperature storage	H.3.8.7	H.4.4.6.7		
	5	Dielectric withstanding voltage	H.3.6.4	H.4.4.4.4		
	6	Insulation resistance	H.3.6.5	H.4.4.4.5		
	7	Thermal shock [I]	H.3.8.4.1	H.4.4.6.4.1		
	8	Short-time overload	H.3.6.6	H.4.4.4.6		
	9	Moisture resistance	H.3.8.5	H.4.4.6.5		1
	10	Terminal strength	H.3.7.1	H.4.4.5.1		
III	1	Shock	H.3.8.2	H.4.4.6.2	20 (10 Highest resistance; 10 1Ω or lowest resistance, whichever is greater)	1
	2	High frequency vibration	H.3.8.1.1	H.4.4.6.1.1		
	3	Thermal shock [II]	H.3.8.4.2	H.4.4.6.4.2		
IV	1	Random vibration	H.3.8.1.2	H.4.4.6.1.2	20 (10 Highest resistance; 10 1Ω or lowest resistance, whichever is greater)	1
V	1	Life	H.3.9.1	H.4.4.7.1	231 (77 Highest resistance; 77 1kΩ; 77 1Ω or lowest resistance, whichever is greater)	0
VI	1	Stability	H.3.8.8	H.4.4.6.8	27 (9 Highest resistance; 9 1kΩ; 9 1Ω or lowest resistance, whichever is greater)	1
VII	1	Solderability	H.3.7.2	H.4.4.5.2	10 Any resistance	0
	2	Resistance to solvents	H.3.8.6	H.4.4.6.6		
-	1	Materials	H.3.2	—	(4)	

Notes:
(1) When a sample has failed to pass 2 or more tests of one group, it shall be counted as a single defect.
(2) For dimensions and mass, the sample size shall be 1.0% of the acceptable quality level (AQL) in "Normal Inspection Level II" specified in JIS Z 9015-1.
(3) The reactance test is applicable to noninductive resistors only.
(4) Data to certify compliance with design specifications shall be submitted.

H.4.3 Quality Conformance Inspection

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

H.4.3.1 Samples

The inspection lot configuration of group A shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for each shape. Resistors with any resistance value shall be selected. If the design criteria are identical and the materials and the structures are similar, the inspection lot may be represented by one of the shapes.

H.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the groups A, B and C inspections of the quality conformance inspection shall be as specified in Tables H-5, H-6 and H-7, respectively. Group tests shall be performed in the group order and the inspections within each group shall be performed in the order specified. The sampling plan for Group A shall be "Special Inspection Level S-4" in accordance with Appendix 1 of JIS Z 9015-1. The pass or fail result shall be in accordance with "Normal Inspection, single sampling" specified in Appendix 2-A. However, the constant sampling shall apply to the Group A3 and A4 inspections. The Group A4 inspections shall be performed with the samples having the highest resistance value.

H.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table H-5, H-6 or H-7 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table H-5, but the failure mode of the defects is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

H.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the group A quality conformance inspection shall not be shipped. If the lot has not passed the group A2 inspection, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped.

The products that were subjected to DPA shall not be shipped.

Table H-5. Quality Conformance Inspection (Group A)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(2)
A1	1	Power conditioning	H.3.6.3	H.4.4.4.3	100%	0
	2	Resistance	H.3.6.1	H.4.4.4.1		
A2	1	Externals, dimensions and marking (3)	H.3.3	H.4.4.2		
A3(1)	1	DPA	H.3.4.1	H.4.4.3.1	2	0
A4(1)	1	Reactance(4)	H.3.6.7	H.4.4.4.7	10	0
	2	Resistance-temperature characteristic	H.3.6.2	H.4.4.4.2		
	3	Dielectric withstanding voltage	H.3.6.4	H.4.4.4.4		
	4	Insulation resistance	H.3.6.5	H.4.4.4.5		
	5	Thermal shock [I]	H.3.8.4.1	H.4.4.6.4.1		

Notes:

(1) The constant sampling shall apply to Group A3 and A4 inspections. The Group A4 inspections shall be performed using the samples with the highest resistance value.

(2) When a sample has failed to pass 2 or more tests of one group, it shall be counted as a single defect.

(3) The acceptance or rejection of the physical dimensions and mass shall be based on 1.0% of the acceptable quality level (AQL) in "Normal Inspection Level II" specified in JIS Z 9015-1.

(4) The reactance test is applicable to noninductive resistors only.

Table H-6. Quality Conformance Inspection (Group B)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
B1	1	Heat resistance	H.3.8.3	H.4.4.6.3	10	0
	2	Low temperature storage	H.3.8.7	H.4.4.6.7		
	3	Short-time overload	H.3.6.6	H.4.4.4.6		
	4	Moisture resistance	H.3.8.5	H.4.4.6.5		
	5	Terminal strength	H.3.7.1	H.4.4.5.1		
B2	1	Life	H.3.9.1	H.4.4.7.1	10	0
B3	1	Stability	H.3.8.8	H.4.4.6.8	10	0
B4	1	Solderability	H.3.7.2	H.4.4.5.2	8	0
	2	Resistance to solvents	H.3.8.6	H.4.4.6.6		

Table H-7. Quality Conformance Inspection (Group C)

Inspection			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
C1	1	Random vibration	H.3.8.1.2	H.4.4.6.1.2	10	0
C2	1	Shock	H.3.8.2	H.4.4.6.2	10	0
	2	High frequency vibration	H.3.8.1.1	H.4.4.6.1.1		
	3	Thermal shock [II]	H.3.8.4.2	H.4.4.6.4.2		

H.4.4 Methods for Test and Inspection

H.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15°C and 35°C, relative humidity between 25% and 75% and atmospheric pressure between 86kPa and 106kPa. All tests and measurements shall be performed under the standard conditions. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be at 25°C and an atmospheric pressure of 101.3kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B as specified in Table H-8. Unless specified, condition A shall apply.

Table H-8. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

H.4.4.2 Externals, Dimensions and Marking

a) The external inspection shall be performed visually.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. If the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured with a trip balance compliant to JIS B 7601. If the measured values are questionable, another measuring instrument may be used.

H.4.4.3 Workmanship

H.4.4.3.1 DPA

The resistors shall be disassembled to ensure that the internal structure has been properly manufactured and the processes such as welding and soldering have been successfully achieved. DPA shall be conducted in accordance with the DPA manual referenced in the Quality Assurance Program Plan.

a) The resistors shall be embedded in a proper resin or other materials, and cut at the center along the longitudinal axis of the resistors. One cut face shall be ground and examined visually or by using a 5 to 50x magnifier for the length of effective winding coverage, nominal diameter of the resistance wire, uniformity of the winding pitch, foreign inclusions, fitting of the inlet terminal with the winding core and voids in filling or undercoating.

The sample shall be photographed and recorded.

H.4.4.4 Electrical Performance

The electrical performance tests shall be performed as follows.

H.4.4.4.1 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Limit of error of measuring apparatus: ±(0.1%+0.002Ω)
b) Test voltage
   Test voltages shall be applied in accordance with Table H-9.

Table H-9. Test Voltages

Unit: V_{DC}

Nominal resistance range (Ω)	Maximum test voltage
Less than 1	0.1
1 or more and less than 10	0.3
10 or more and less than 100	0.3
100 or more and less than 1k	1
1k or more and less than 10k	3
10k or more and less than 100k	10

H.4.4.4.2 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Reference temperature: 25°C
b) Test temperature: As specified in Table H-10.
c) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table H-10. Test Temperature for Resistance-Temperature Characteristic

Unit: °C

Order	Test temperature	
	Qualification test	Quality conformance inspection (Group A)
1	25±3	25±3
2	-15±3	-55±3
3	-55±3	25±3
4	25±3	275±3
5	125±3	-
6	200±3	-
7	275±3	-

H.4.4.4.3 Power Conditioning

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be supported by their terminal leads and not mounted on the chassis.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test temperature: 25^{+15}_{0} °C

d) Duration of test: 100^{+16}_{-4} hours

e) Test condition
The rated voltage specified in H.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF for the applicable number of hours.

f) Measurement after test
After the resistors are at room temperature (25°C) for 30 minutes, the resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

H.4.4.4.4 Dielectric Withstanding Voltage

H.4.4.4.4.1 Ambient Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Resistors shall be securely mounted on a metal plate using normal mounting hardware. The size of the plate shall extend beyond the resistor extremities.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test voltage
The test voltages shall be an ac supply (root-mean-square value at commercial-line frequency) and as specified in Table H-11.

d) Points of application of test voltage
The test points shall be between the resistor terminals tied together with an appropriate conductor and the mounting plate.

e) Duration of test: 1 minute

f) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage.

Table H-11. Test Voltage (Atmospheric Pressure)

Unit: V_{AC}

Style	Test voltage
RES60, RES40	1,000
RES65	
RES70, RES50	
RES75	2,000

H.4.4.4.4.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item a), paragraph H.4.4.4.4.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test condition: C (4.4±0.2kPa)

d) Test voltage
The test voltages shall be an ac supply (root-mean-square value at commercial-line frequency) and as specified in Table H-12.

e) Points of application of test voltage: As specified in item d), paragraph H.4.4.4.4.1.

f) Duration of test: 1 minute

g) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage.

Table H-12. Test Voltage (Reduced Barometric Pressure)

Unit: V_{AC}

Style	Test voltage
RES60, RES40	500
RES65	
RES70, RES50	
RES75	

H.4.4.4.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting and points of application of test voltage: As specified in item a) of paragraph H.4.4.4.4.1.
b) Test voltage: Test condition A ($100V_{DC}$)
c) Duration of test: 2 minutes

H.4.4.4.6 Short-Time Overload

After the resistance is measured in accordance with paragraph H.4.4.4.1, the short-time overload test shall be performed under the following conditions. The resistor's resistance shall be measured after waiting at least 30 minutes after the test in accordance with paragraph H.4.4.4.1 to calculate the change in the resistance before and after the test. The resistors shall then be examined for evidence of arcing, burning, and charring.

a) Mounting method
Resistors shall be mounted as specified in item a), paragraph H.4.4.7.1.
b) Test conditions
1) Terminals
One resistor terminal shall be grounded to the resistor housing during the test.
2) Nature of voltage: ac supply (root-mean-square value at commercial-line frequency)
3) Test voltage
The test voltage shall be five times the rated wattage, but shall not exceed the voltage specified in Table H-13.
4) Duration of test: 5 seconds

Table H-13. Maximum Overload Voltage

Unit: V_{AC}

Style	Test voltage
RES60, RES40	1,000
RES65	
RES70, RES50	
RES75	2,000

H.4.4.4.7 Reactance

The series inductance and parallel capacitance of the resistors shall be measured as follows.

a) Measuring instrument
The YHP 4194A RF impedance analyzer or its equivalent shall be used.

b) Measuring frequency: 1MHz

c) Measuring method

1) Preparation for measurement
The analyzer shall be automatically calibrated for the desired measuring frequency range using one reference termination types: 0Ω, 0S[(1)], 50Ω.
Note: [(1)] "S" indicates siemens, unit of conductance.

2) Measurement
The analyzer shall be set to a measuring frequency of 1MHz, and the series impedance or parallel capacitance shall be measured.

H.4.4.5 Mechanical Performance

The mechanical performance tests shall be performed as follows.

H.4.4.5.1 Terminal Strength

Resistors shall be tested in accordance with Test Method 211 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

b) Test conditions
One-half of the samples submitted shall be subjected to the pull test and the remaining half to the torque test.

1) Test condition A
With the resistor body securely clamped, the load as specified in Table H-14 shall be applied to the hole of each terminal for at least 30 seconds, one terminal at a time, in a direction away from the resistor and parallel to the longitudinal axis.

2) Test condition E
With the resistor body securely clamped, a torque of 5.7N·cm {0.58kgf·cm} shall be applied clockwise and then counterclockwise in a

plane perpendicular to the axis of the terminal. The torque shall be applied to one terminal at a time. The force shall be gradually applied to the terminal and maintained for a period of 5 to 15 seconds.

c) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

d) Examination after test
The terminals shall be examined visually for evidence of mechanical damage.

Table H-14. Applied Force

Unit: N {kgf}

Style	load
RES60, RES40	24.5{2.5}
RES65	
RES70, RES50	
RES75	44.1{4.5}

H.4.4.5.2 Solderability

Resistors shall be tested in accordance with Test Method 208 of MIL-STD-202. The following details and exceptions shall apply.

a) Number of terminals tested: all terminals.
b) Solder temperature: 245±5°C
c) Solder immersion time: 5±0.5 seconds
d) Solder immersion depth
The terminals shall be immersed to a depth sufficient to cover the flattened portion of the terminal (see Figure H-2).
e) Examination after test
Resistors shall be examined visually for solder wettability.

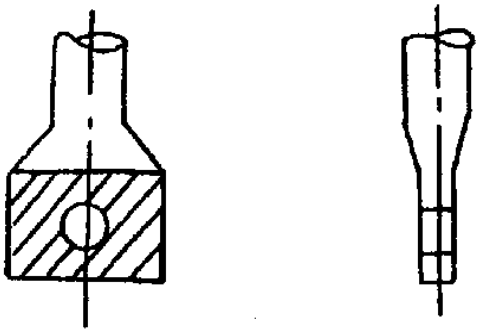


Figure H-2. Flattened Portion of Terminal (Shaded area)

H.4.4.6 Environmental Performance

The environmental performance tests shall be performed as follows.

H.4.4.6.1 Vibration

H.4.4.6.1.1 High Frequency Vibration

Resistors shall be tested in accordance with Test Method 204 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph H.4.4.6.2. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test condition:
D (196m/s^2 p-p or 1.5mm in double amplitude, whichever is smaller).

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Duration of vibration
Six hours in each direction for a total of 12 hours.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage.

i) The resistors shall be subjected to the dielectric withstanding voltage test (at atmospheric pressure) as specified in paragraph H.4.4.4.4.1.

H.4.4.6.1.2 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting:
The resistors shall be mounted in accordance with item a), paragraph H.4.4.6.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test condition
Test condition II-H Frequency range: 20 to 2,000Hz
Rms value of acceleration: 334m/s^{2}rms

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of application and duration of vibration
Vibration shall be applied for 3 minutes in each direction for a total test time of 6 minutes.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

i) The resistors shall be subjected to the dielectric withstanding voltage test (at atmospheric pressure) as specified in paragraph H.4.4.4.4.1.

H.4.4.6.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Resistors shall be securely mounted on appropriate fixtures. The fixtures shall be constructed to insure that the resistors will have the same motion as the shock table. The mounting fixtures shall be constructed to preclude any resonances in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. Test lead used during this test shall be stranded wire no larger than 0.6mm in diameter so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no greater than necessary.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test condition: I (980m/s^2, 6ms sawtooth).

d) Direction of applied shocks
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of applied shocks
The resistors shall be subjected to 5 shocks in each direction, for a total of 10 shocks.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the shock for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

H.4.4.6.3 Heat Resistance

After the resistance is measured as specified in paragraph H.4.4.4.1, the resistors shall be placed in a test chamber at 275^{+5}_{0} °C for 2 hours at no load. The temperature in the chamber shall be gradually returned to room temperature (25°C) and the resistors shall then be removed from the chamber. The resistors shall remain at room temperature for at least 1 hour or more but less than 2 hours. The resistance shall then be measured again as specified in paragraph H.4.4.4.1 to calculate the change in resistance before and after the test. After the test, the resistors shall be examined visually for evidence of mechanical damage.

H.4.4.6.4 Thermal Shock

H.4.4.6.4.1 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Measurement before test
The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test conditions
   1) Test conditions shall be as specified in Table H-15.
   2) Load
   The voltage corresponding to 50% of the rated power shall be applied to the resistors at the temperature specified in step 2 of Table H-15 below.

d) Number of test cycles: 25 cycles

e) Cycle conditions
The first five cycles shall run continuously. After five cycles, the test may be interrupted following the completion of any full cycle.

f) Measurement after test
The resistors shall remain at room temperature (25°C) for a minimum of 30 minutes. The resistance shall then be measured in accordance with paragraph H.4.3.4.1 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table H-15. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	-65^{0}_{-5}	15
2	150^{+3}_{0}	15

H.4.4.6.4.2 Thermal Shock [II]

After measuring resistance in accordance with paragraph H.4.4.4.1, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table H-16 and Figure H-3. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Load conditions
Load
The dc voltage corresponding to 50% of the rated power shall be applied to the resistors at the temperature specified in step 2 of Table H-16.

c) Number of test cycles: 1,000 cycles

d) Cycle conditions
The first 5 cycles shall run continuously. After 5 cycles, the test may be interrupted following the completion of any full cycle.

e) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature (25°C) for 30 minutes or more at each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for cracks on the surface.

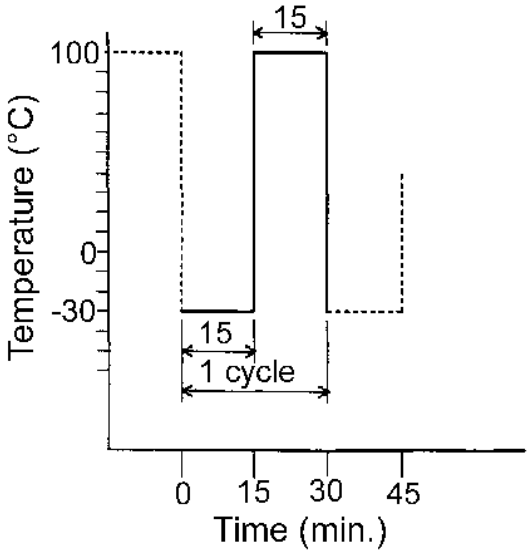
f) Measurement after test
The resistors shall be at room temperature (25°C) for at least 30 minutes before the resistance is measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

Table H-16. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	-30^{0}_{-5}	15
2	100^{+5}_{0}	15

Figure H-3. Test Conditions of Thermal Shock [II]



H.4.4.6.5 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
   1) 100% load
      The resistors shall be mounted as specified in item a), paragraph H.4.4.7.1.
   2) Polarization
      The resistors shall be mounted as specified in item a), paragraph H.4.4.4.4.1.

b) Measurement before test
   The resistance shall be measured in accordance with paragraph H.4.4.4.1.

c) Test conditions
   One-half of the resistors shall be subjected to load and the remaining half to polarization.

d) Load and Polarization
   1) 100% load
      During the first 2 hours of step 1 and step 4, the rated dc voltage, derated to the temperature attained at the end of the two hours period, shall be applied to the resistors. The negative terminals shall be electrically grounded to the mounting surface.
   2) Polarization
      During steps 2, 3, 5 and 6, a 100 volt dc potential shall be applied to the resistors mounted on the metal plate. The positive lead shall be connected to the resistor terminals tied together, and the negative lead connected to the mounted side.

e) Measurement after test
   Upon completion of step 6 of the final cycle, the resistors shall be held at a relative humidity between 90 and 98% and at 25±2°C for a period between 90 minutes and 210 minutes. Resistors shall then be removed from the chamber. Within 30±15 minutes, the resistance and insulation resistance shall be measured as specified in paragraphs H.4.4.4.1 and H.4.4.4.5, respectively. The resistors shall not be wiped or dried with forced air prior to these measurements.

f) Examination after test
   The resistors shall be examined for evidence of breaking, loosening of terminals, and corrosion.

H.4.4.6.6 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion

b) Solvents to be used
   1) 2-propanol (Isopropyl alcohol)
   2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

H.4.4.6.7 Low Temperature Storage

The resistance shall be measured as specified in paragraph H.4.4.4.1. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at -65^{0}_{-3} °C for 24±4 hours. The temperature in the chamber shall then be gradually returned to room temperature (25°C), and the resistors shall be removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for at least 2 hours or more but less than 8 hours. The resistance shall then be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormality. The marking shall be examined for legibility.

H.4.4.6.8 Stability

After the resistance is measured in accordance with paragraph H.4.4.4.1, the resistors shall be put in a test chamber maintained at room temperature (25°C). The temperature in the chamber shall then be gradually increased to a test temperature of 275±7°C. After stabilizing at the test temperature, the resistors shall remain at no load for $2{,}000^{+48}_{0}$ hours. When the specified test time has passed, the temperature shall gradually be returned to room temperature. The resistors shall then be removed from the test chamber, and remain at 25±5°C for 6±1hours. Then, the oxidized surface of the lead wire to be measured shall be ground with an appropriate jig, and the resistance shall be measured in accordance with paragraph H.4.4.4.1 to calculate the change in resistance before and after the test. The resistors shall then be examined visually for significant abnormality.

H.4.4.7 Durability

Durability test shall be performed as follows.

H.4.4.7.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting

Resistors shall be mounted, by normal mounting means, to an aluminum chassis with the specified dimensions. The resistors shall be mounted at the center of the chassis such that the longitudinal axes of the resistor and the chassis are parallel to each other. The chassis shall be horizontally supported using a material with low thermal conductivity. Resistors shall be arranged to ensure that the temperature of any one resistor shall not influence the temperature of any other resistor. There shall be no excessive air circulation over the resistors.

b) Test temperature: 25±5°C

c) Test conditions

The rated voltage specified in H.3.5.5. shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be

4,000 $^{+96}_{0}$ hours for the qualification test and 2,000 $^{+72}_{0}$ hours for the quality conformance inspection.

d) Number of shocks applied
The resistance shall be measured as specified in paragraph H.4.4.4.1 before, during and after the test. The change in the resistance shall be calculated using the measurement before the test and the mean values of each measuring point.

e) Measurements during test
1) Qualification test: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours, 1,000 $^{+48}_{0}$ hours and 2,000 $^{+72}_{0}$ hours.
2) Quality conformance inspection: 250 $^{+48}_{0}$ hours, 500 $^{+48}_{0}$ hours and 1,000 $^{+48}_{0}$ hours.

f) Examination after test
The resistors shall be examined visually for evidence of mechanical damage.

H.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

H.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

H.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

H.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX J

RESISTORS, CHIP, FIXED, METAL FILM

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: December 28, 2021

APPENDIX J

RESISTORS, CHIP, FIXED, METAL FILM

J.1. General

J.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the fixed, metal film, chip resistors (hereinafter referred to as "resistors").

J.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table J-1.

Table J-1. Classification

Construction	Designation number
Square shape, non-metal externals and surface mount terminals	401

J.1.3 Part Number

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

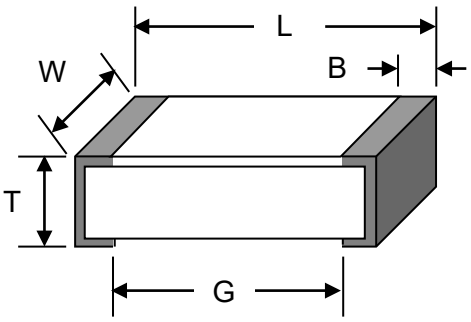
JAXA[(1)] 2050/J	401	–	1608	A	1002	B	B	Z
	Designation number		Style (J.1.3.1)	Characteristic (J.1.3.2)	Nominal resistance (J.1.3.3)	Resistance tolerance (J.1.3.4)	Terminal structure (J.1.3.5)	Screening option (J.1.3.6)

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

J.1.3.1 Style

Style indicates the physical size of the resistor and is identified by 4 digit number as specified in Table J-2. The dimension of the resistor shall be in accordance with in detail specification. The length, thickness, distance between terminals and terminal width shall be specified in detail specification.

Table J-2. Style



Unit: mm

Style	External dimension				
	Length (L)	Width (W)	Thickness (T)	Distance between terminals (G)	Terminal width (B)
1005	1.0±0.1	0.5 ±0.05	0.35±0.05	As specified in detail specification	As specified in detail specification
1608	1.6±0.2	0.8 ±0.1	0.45±0.1		
2012	2.0±0.2	1.25±0.2	0.5 ±0.1		
3216	$3.2^{+0.2}_{-0.3}$	1.6 ±0.2	0.6 ±0.1		
3225	$3.2^{+0.2}_{-0.3}$	2.5 ±0.2	0.6 ±0.1		

J.1.3.2 Characteristics

The resistance-temperature characteristic shall be identified by a single capital letter in accordance with Table J-3.

Table J-3. Resistance-Temperature Characteristics

(Unit: $x10^{-6}$/°C)

Symbol	Resistance-temperature characteristic (referenced:25°C)
A	±5
Y	±10
E	±25
H	±50

J.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 4 digits number. The first three digits represent the significant figures and the last digit specifies the number of zeros to follow. When fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.

Example: 97R6= 97.6 Ω
1500= 150 Ω
1501= 1,500 Ω= 1.50kΩ
1503=150,000 Ω= 150kΩ

J.1.3.4 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table J-4.

Table J-4. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance
B	±0.1
D	±0.5
F	±1.0

J.1.3.5 Electrode Structure

The electrode structure shall be identified by a single capital letter in accordance with Table J-5.

Table J-5. Electrode Structure

Symbol	Structure	Finish	Mounting method
B	Double-sided electrode	Solder plating on top of underlying metal barrier (Sn/Pb alloy with 3wt% min. Pb)	Soldering

J.1.3.6 Screening Options

Screening options shall be the optional test contents which can be added to the screening test and identified by a single capital letter as specified in Table J-6.

Table J-6. Optional Screening

Symbol	Test item	Test condition		
		Temperature (°C)	Load	Time (hr)
A	Power conditioning A	85^{+5}_{0}	Rated voltage	168^{+24}_{0}
B	Power conditioning B	85^{+5}_{0}	Equivalent to 1.5 times of rated voltage	100±4
Z	Not specified			

J.2. Applicable Documents

J.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

J.2.2 Reference Documents

The followings are reference document.

a) MIL-PRF-55342 Resistors, Chip, Fixed, Film, Nonestablished Reliability, Established Reliability, Space Level, General Specification for

b) ESCC Generic Specification No. 4001 (Issue 3) Resistors, Fixed Film

c) ESCC Detail Specification No. 4001/023 (Issue 6) Resistors, Fixed, Chip, Thick Film Based on Type PHR and PFRR

J.3. Requirements

J.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance specified in paragraphs J.3.2 through J.3.10. 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.

J.3.1.1 Restriction for Qualification Test

The coverage of the resistors to be qualified shall be between the maximum and minimum nominal resistances which are passed in the qualification test. Characteristics and resistance tolerance of the resistors to be qualified shall be classified as specified in Tables J-7 and J-8.

Table J-7. Characteristics Qualification

Sample characteristic	Characteristic to be qualified
A	A, Y, E, H
Y	Y, E, H
E	E, H
H	H

Table J-8. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
B	B, D, F
D	D, F
F	F

J.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

J.3.2.1 Base Substance

The resistor substrate of the resistors shall be formed by a mixture of alumina and other oxides baked at high temperatures. The substrate shall be a minimum of 96% alumina.

J.3.2.2 Terminals

The materials for terminals shall be as specified in the detail specification. The barrier metal shall be a minimum of 1.27μm Nickel.

J.3.2.3 Resistive Element

The resistive element shall be as specified in the detail specification.

J.3.2.4 Insulation Material

The insulation material shall be as specified in the detail specification.

J.3.3 Designing and Construction

The resistive elements shall be covered by the moisture resistance insulation material in order to protest the resistive element from any moisture and mechanical damages. The electrode shall be securely connected with both resistive element and base substance electrically and mechanically.

J.3.4 Externals, Dimensions and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph J.4.4.3.

J.3.4.1 Externals

a) Base substance
   (1) There shall be no cracks more than 76.2μm or within 25.4μm from the resistive element. on the surface of the resistors.
   (2) There shall be no crack which is 25.4μm or more and generated towards the resistive element.
   (3) There shall be no junction parts of adjacent materials including resistance materials left in the split materials.
   (4) Any cracks of 76.2μm or less generated on the edge shall be acceptable.

b) Terminals
   (1) There shall be no scratches where any materials in the lower layer is exposed.
   (2) There shall be no lifting, flaking or blisters.
   (3) There shall be no stains, corrosion, discoloration and tachetic metals.
   (4) There shall be no protrusions of metal material exceeding 0.08mm from the average thickness of terminal surface.

c) Resistive elements
   (1) There shall be no scratches of 25.4μm or more within the resistance patterns.
   (2) There shall be no voids or erosions where the thickness becomes 50% or less of the resistance pattern thickness.
   (3) There shall not be any evidences of lifting, flaking or blisters in the resistance film.

(4) There shall be no chips or cracks in the resistive elements.
(5) There shall not be any evidences of local stains, corrosions or discoloration in the resistance patterns. However, any discoloration caused by the annealing treatment shall be acceptable.
(6) There shall be no conductive bridges, between the adjacent resistance patterns, which is generated by the photolithography failure.
(7) There shall be no partial bridge which is 50% or less of the design value of the distance between the adjacent resistance patterns.
(8) There shall be no residues of resistance films in the trimming ditch.
(9) The minimum conductor width after trimming shall be 50% or more of the line width in the identical resistance patterns.
(10) The cut end of the conductive link shall not touch the resistance patterns.
(11) Any discoloration of the cut edge of laser or surrounding area shall not be acceptable.
(12) There shall be no discontinuous cuts on the resistive elements after trimming.
(13) There shall be no voids, cracks or similar damages caused by trimming which would affect the materials in the lower layer.
(14) There shall be no intentional burn in the resistive elements caused by laser beam or its unnecessary reflective light.
(15) The width of the cut area of conductive link and ladder shall be 50% or more of each width. The cut width of the conductive link can be 100% of its width.

d) Other
(1) Material that can not be removed with a soft bristled brush or a nominal gas blow of dry nitrogen or air is considered to be attached. Reject attached foreign material that reduces the gap between conductors to be 2.54μm or less or attached foreign material occupying 5% or more on the surface.
(2) There shall be no heavy metals with the length exceeding 254μm on the surface of base materials or protective film.
(3) There shall not be 5 or more heavy metals with the length between 76.2 and 254μm on the resistance surface. However, if the distance between the heavy metal dots is less than 76.2μm, the length of the metals shall be considered as series of dots (a line or an area).

J.3.4.2 Dimensions and Mass

The dimensions and mass of resistors shall meet the requirements specified in the detail specification.

J.3.4.3 Markings

The markings of resistors shall include the following at a minimum and it shall be applied in such a matter that it is not come off easily. The marking shall be legible after any tests.

a) Nominal resistance
The marking shall be shown as specified in paragraph J.1.3.3. For small parts, the method specified in detail specification can be applied.

J.3.5 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1. The resistor body shall not have defects such as cracks, holes and scratches which may adversely affect the performance of the resistors and shall be free from other defects that will affect life, serviceability, or appearance.

J.3.5.1 DPA

Resistors tested as specified in paragraph J.4.4.4.1 shall confirm that the resistor materials, design, construction and workmanship are properly manufactured as specified in detail specification and quality assurance program and shall satisfy the requirements specified in paragraph J.3.4.1.

J.3.6 Ratings

The following items shall be specified in detail specification.

(a) Nominal resistance and resistance tolerance
As a rule, standard values of nominal resistance shall be defined in relation to the resistance tolerance and shall be as specified in Table J-9.

(b) Operating Temperature Range
Unless otherwise specified, the operating temperature range shall be between -55 and +125°C.

(c) Power Rating
The rated ambient temperature of the resistor shall be 85°C as a maximum. If the resistor is operated or tested continuously at the temperature exceeding 85°C, the power rating shall be derated in accordance with the derating curve shown in Figure J-1.

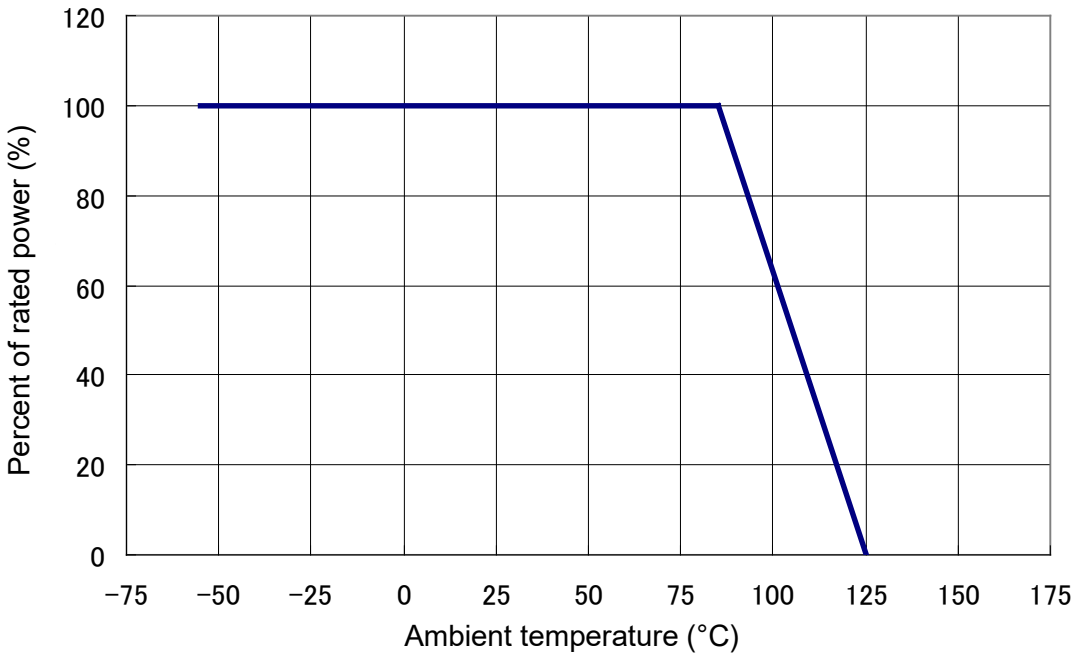


Figure J-1. Derating Curve

Table J-9. Standards of Nominal Resistance

Resistance tolerance (%)															
B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)	B (±0.1) D (±0.5)	F (±1.0)
10.0	10.0	13.3	13.3	17.8	17.8	23.7	23.7	31.6	31.6	42.2	42.2	56.2	56.2	75.0	75.0
10.1	—	13.5	—	18.0	—	24.0	—	32.0	—	42.7	—	56.9	—	75.9	—
10.2	10.2	13.7	13.7	18.2	18.2	24.3	24.3	32.4	32.4	43.2	43.2	57.6	57.6	76.8	76.8
10.4	—	13.8	—	18.4	—	24.6	—	32.8	—	43.7	—	58.3	—	77.7	—
10.5	10.5	14.0	14.0	18.7	18.7	24.9	24.9	33.2	33.2	44.2	44.2	59.0	59.0	78.7	78.7
10.6	—	14.2	—	18.9	—	25.2	—	33.6	—	44.8	—	59.7	—	79.6	—
10.7	10.7	14.3	14.3	19.1	19.1	25.5	25.5	34.0	34.0	45.3	45.3	60.4	60.4	80.6	80.6
10.9	—	14.5	—	19.3	—	25.8	—	34.4	—	45.9	—	61.2	—	81.6	—
11.0	11.0	14.7	14.7	19.6	19.6	26.1	26.1	34.8	34.8	46.4	46.4	61.9	61.9	82.5	82.5
11.1	—	14.9	—	19.8	—	26.4	—	35.2	—	47.0	—	62.6	—	83.5	—
11.3	11.3	15.0	15.0	20.0	20.0	26.7	26.7	35.7	35.7	47.5	47.5	63.4	63.4	84.5	84.5
11.4	—	15.2	—	20.3	—	27.1	—	36.1	—	48.1	—	64.2	—	85.6	—
11.5	11.5	15.4	15.4	20.5	20.5	27.4	27.4	36.5	36.5	48.7	48.7	64.9	64.9	86.6	86.6
11.7	—	15.6	—	20.8	—	27.7	—	37.0	—	49.3	—	65.7	—	87.6	—
11.8	11.8	15.8	15.8	21.0	21.0	28.0	28.0	37.4	37.4	49.9	49.9	66.5	66.5	88.7	88.7
12.0	—	16.0	—	21.2	—	28.4	—	37.9	—	50.5	—	67.3	—	89.9	—
12.1	12.1	16.2	16.2	21.5	21.5	28.7	28.7	38.3	38.3	51.1	51.1	68.1	68.1	90.9	90.9
12.3	—	16.4	—	21.8	—	29.1	—	38.8	—	51.7	—	69.0	—	92.0	—
12.4	12.4	16.5	16.5	22.1	22.1	29.4	29.4	39.2	39.2	52.3	52.3	69.8	69.8	93.1	93.1
12.6	—	16.7	—	22.3	—	29.8	—	39.7	—	53.0	—	70.6	—	94.2	—
12.7	12.7	16.9	16.9	22.6	22.6	30.1	30.1	40.2	40.2	53.6	53.6	71.5	71.5	95.3	95.3
12.9	—	17.2	—	22.9	—	30.5	—	40.7	—	54.2	—	72.3	—	96.5	—
13.0	13.0	17.4	17.4	23.2	23.2	30.9	30.9	41.2	41.2	54.9	54.9	73.2	73.2	97.6	97.6
13.2	—	17.6	—	23.4	—	31.2	—	41.7	—	55.6	—	74.1	—	98.8	—

d) Voltage rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula. However, if the calculated rated voltage exceeds the maximum operating voltage specified in the detail specification, the maximum operating voltage shall be the rated voltage.

$$E=\sqrt{P \cdot R}$$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

J.3.7 Electrical Performance

Resistors shall satisfy the following electrical requirements.

J.3.7.1 Application of Pulse

When resistors are tested as specified in paragraph J.4.4.5.1, there shall be no evidence of arcing, insulation breakdown, or mechanical damage.

J.3.7.2 Resistance

When resistors are tested as specified in paragraph J.E.4.4.5.2, the resistance shall be within the specified tolerance of the nominal resistance in Table J-4.

J.3.7.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph J.4.4.5.3 using room ambient temperature of 25°C as the reference temperature, the resistance-temperature characteristic at each of the temperatures specified in Table J-17 shall not exceed the value specified in Table J-3.

J.3.7.4 Dielectric Withstanding Voltage

When tested as specified in paragraph J.4.4.5.4, the resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test.

J.3.7.5 Insulation Resistance

When resistors are tested as specified in paragraph J.4.4.5.5, the insulation resistance shall satisfy the requirements of the detail specification.

J.3.7.6 Short-Time Overload

When resistors are tested as specified in paragraph J.4.4.5.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

J.3.7.7 Power Conditioning (if specified)

When resistors are tested as specified in paragraph J.4.4.5.7, the change in resistance before and after the test shall satisfy the requirements of the detail

specification. There shall be no evidence of arcing, insulation breakdown, or mechanical damage after the completion of this test.

J.3.8 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

J.3.8.1 Solderability

When resistors are tested as specified in paragraph J.4.4.6.1, a minimum of 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.

J.3.8.2 Adhesion

When resistors are tested as specified in paragraph J.4.4.6.2, there shall be no mechanical damage on the resistors.

J.3.8.3 Board Bending

When resistors are tested as specified in paragraph J.4.4.6.3, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no mechanical damage after the completion of the test.

J.3.8.4 Resistance to Bonding Exposure

When resistors are tested as specified in paragraph J.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The electrode area covered by solder leaching shall be 10% or less of the total surface and the electrode shall be free from mechanical damages.

J.3.9 Environmental Performance

Resistors shall satisfy the following environmental requirements.

J.3.9.1 Random Vibration

When resistors are tested as specified in paragraph J.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

J.3.9.2 Shock

When resistors are tested as specified in paragraph J.4.4.7.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

J.3.9.3 Thermal Shock

J.3.9.3.1 Thermal Shock [I]

When resistors are tested as specified in paragraph J.4.4.7.3.1, there shall be no evidence of mechanical damage after the completion of this test.

J.3.9.3.2 Thermal Shock [II]

When resistors are tested as specified in paragraph J.4.4.7.3.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of resistors shall be acceptable only when subjected to more than 500 cycles.

J.3.9.4 Moisture Resistance

When resistors are tested as specified in paragraph J.4.4.7.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

J.3.9.5 Resistance to Solvents

When resistors are tested as specified in paragraph J.4.4.7.5, there shall be no evidence of mechanical damage after the completion of the test and the marking shall remain legible.

J.3.9.6 Low Temperature Operation

When resistors are tested as specified in paragraph J.4.4.7.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

J.3.9.7 Stability

When resistors are tested as specified in paragraph J.4.4.7.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. The insulation resistance after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

J.3.10 Durability

Resistors shall satisfy the following durability requirements.

J.3.10.1 Life

When resistors are tested as specified in paragraph J.4.4.8.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

J.4. Quality Assurance Provisions

J.4.1 In-Process Inspection

The in-process inspection for resistors shall be performed per each manufacturing lot as specified in Table J-10. A manufacturer may perform in-process inspection other than the ones specified in Table J-10 as long as the inspection is in accordance with paragraph 4.3 of JAXA-QTS-2050.

Table J-10. In-process Inspection

Item No.	Test item	Requirement paragraph	Test method paragraph	Sample size
1	Application of pulse	J.3.7.1	J.4.4.5.1	100%
2	Resistance	J.3.7.2	J.4.4.5.2	100%
3	External inspection	J.3.4.1	J.4.4.3	100%

J.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

J.4.2.1 Samples

The inspection lot for qualification test shall be consisting of samples that have passed the in-process inspection. The samples with minimum resistance, maximum resistance and critical resistance (or the closest to the critical resistance) to be qualified shall be selected for each style, characteristic, resistance tolerance and terminal construction. The characteristics and resistance tolerance of the samples shall be selected with consideration of Tables J-7 and J-8.

J.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 J-11. If the critical resistance is not specified, the samples shall be equally divided between the minimum and maximum resistance.
Tests of each group shall be performed in the order listed in Table J-11. Upon completion of Group I tests, Group II through XI tests shall be performed using samples allocated to the appropriate group tests.

Table J-11. Qualification Test

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail		
Group	Order	Item			Sample size		No. of defectives allowed
I	1	Resistance	J.3.7.2	J.4.4.5.2	100% (1)		0
	2	Externals, dimensions and marking	J.3.5	J.4.4.3			
	3	DPA	J.3.5.1	J.4.4.4.1	2 Lowest resistance 2 Highest resistance	4	0
II	1	Dielectric withstanding voltage	J.3.7.4	J.4.4.5.4	Any resistance	10	0
	2	Insulation resistance	J.3.7.5	J.4.4.5.5			
III	1	Resistance-temperature characteristic	J.3.7.3	J.4.4.5.3	10 Highest resistance 10 Critical resistance 10 Lowest resistance	30	0
	2	Low temperature operation	J.3.9.6	J.4.4.7.6			
	3	Short-time overload	J.3.7.6	J.4.4.5.6			
IV	1	Moisture resistance	J.3.9.4	J.4.4.7.4	10 Highest resistance 10 Critical resistance 10 Lowest resistance	30	0
V	1	Life	J.3.10.1	J.4.4.8.1	77 Highest resistance 77 Critical resistance 77 Lowest resistance	231	0
VI	1	Stability	J.3.9.7	J.4.4.7.7	10 Highest resistance 10 Critical resistance 10 Lowest resistance	30	0
VII	1	Resistance to bonding exposure	J.3.8.4	J.4.4.6.4	Any resistance	10	0
	2	Shock	J.3.9.2	J.4.4.7.2			
	3	Thermal shock [II]	J.3.9.3	J.4.4.7.3.2			
VIII	1	Random vibration	J.3.9.1	J.4.4.7.1	Any resistance	10	0
IX	1	Solderability	J.3.8.1	J.4.4.6.1	Any resistance	10	0
	2	Resistance to solvent	J.3.9.5	J.4.4.7.5			0
X	1	Adhesion	J.3.8.2	J.4.4.6.2	Any resistance	10	0
XI	1	Board bending	J.3.8.3	J.4.4.6.3	Any resistance	10	0
-	1	Materials	J.3.2	-	(2)		

Notes:

(1) For dimensions and mass, the sample size shall be 1.0% of the acceptable quality level (AQL) in "Special Inspection Level S-4" specified in JIS Z 9015-1.

(2) Data to certify compliance with design specifications shall be submitted.

J.4.3 Quality Conformance Inspection

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

J.4.3.1 Samples

The inspection lot configuration of group A shall be as specified in paragraph 4.5.1.1 of JAXA-QTS-2050. Inspection lots for Group B and C inspections shall consist of samples that have passed Group A inspections. Unless otherwise specified, Group B and C inspections shall be performed for all combinations of shapes and terminal structures. Resistors with the critical resistance or the closest to the critical resistance shall be selected. Further, the highest grade of characteristics shall be selected.

J.4.3.2 Inspection Items and Number of Samples

The items and number of samples of the Group A, B and C inspections of the quality conformance inspection shall be as specified in Tables J-12, J-13 and J-14, respectively. Group tests shall be performed in subgroup order and the inspections within each group shall be performed in the specified order.

J.4.3.3 Criteria for Pass/Fail

A failure of any test specified in Table J-12, J-13 or J-14 shall constitute failure of each inspection group of the quality conformance inspection. When the number of defects does not exceed the permitted number specified in Table J-12, but the failure mode of a defect is catastrophic, such as open- or short-circuit where the function of the resistor may be lost, the resistor fails the Group A inspections.

J.4.3.4 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed test order 1 of Group A1-2 inspection or any test of Group A1-3 inspection, all products of the lot shall be subjected to the failed inspection, and only the good products shall be shipped. The samples subjected to DPA and Group A2 inspections shall not be shipped.

Table J-12. Quality Conformance Inspection (Group A)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
A1	1	1	Thermal shock (I)	J.3.9.3.1	J.4.4.7.3.1	100%	0
		2	Power conditioning (if specified)	J.3.7.7	J.4.4.5.7		
		3	Resistance	J.3.7.2	J.4.4.5.2		
	2	1	Externals, dimensions and marking	J.3.4	J.4.4.3	AQL (1) 4.0%	
		2	DPA	J.3.5.1	J.4.4.4.1	4	0
	3	1	Dielectric withstanding voltage	J.3.7.4	J.4.4.5.4	AQL (1) 2.5%	
		2	Insulation resistance	J.3.7.5	J.4.4.5.5		
A2	1	1	Resistance to bonding exposure	J.3.8.4	J.4.4.6.4	AQL (1) 2.5%	
		2	Resistance-temperature characteristic	J.3.7.3	J.4.4.5.3		
		3	Low temperature operation	J.3.9.6	J.4.4.7.6		
		4	Short-time overload	J.3.7.6	J.4.4.5.6		
	2	1	Solderability	J.3.8.1	J.4.4.6.1	AQL (1) 2.5%	
	3	1	Adhesion	J.3.8.2	J.4.4.6.2	AQL (1) 2.5%	

Note:(1) The sampling plan shall be in accordance with Appendix 1 of JIS Z 9015-1. "Normal Inspection Level II" specified therein shall apply to test order 1 of Group A1-2 inspection. "Special Inspection Level S-4" shall apply to the Group A1-3 and A2 inspections.

Table J-13. Quality Conformance Inspection (Group B)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
B1	1	1	Moisture resistance	J.3.9.4	J.4.4.7.4	10	0
	2	1	Life	J.3.10.1	J.4.4.8.1	10	0
	3	1	Stability	J.3.9.7	J.4.4.7.7	10	0
	4	1	Resistance to solvents	J.3.9.5	J.4.4.7.5	10	0
	5	1	Board bending	J.3.8.3	J.4.4.6.3	5	0

Table J-14. Quality Conformance Inspection (Group C)

Inspection				Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Sub-group	Order	Item			Sample size	No. of defectives allowed
C1	1	1	Shock	J.3.9.2	J.4.4.7.2	10	0
		2	Thermal shock [II]	J.3.9.3.2	J.4.4.7.3		
	2	1	Random vibration	J.3.9.1	J.4.4.7.1	10	0

J.4.4 Methods for Test and Inspection

J.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be a temperature of 25°C and an atmospheric pressure of 101.3kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table J-15. Unless specified, condition A shall apply.

Table J-15. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

J.4.4.2 Method of Mounting

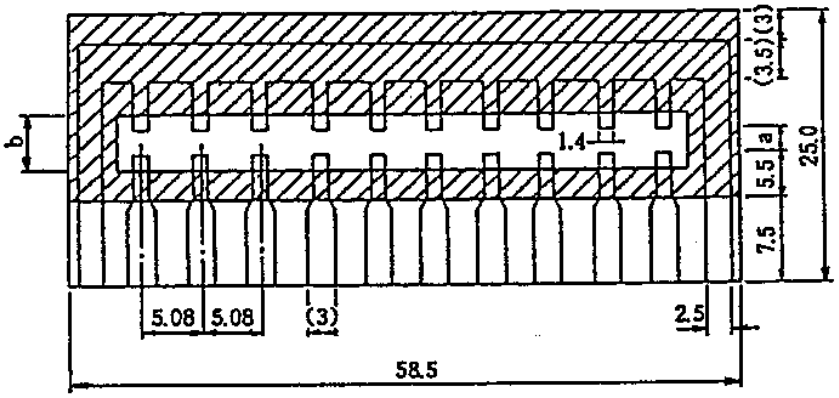
If the mounting is required in this specification, the resistor shall be mounted in accordance with the following methods. If the mounting is not required, resistor may not be mounted on the test board in any other appropriate methods.

a) Test board
Resistor shall be mounted on an appropriate printed wiring boards shown in Figure J-2. The printed wiring boards shall be either an alumina substrate (alumina of

95% purity or higher) with a thickness of 0.8mm±0.3mm or glass woven epoxy resin copper-clad laminate board with a thickness of 1.6mm±0.1mm. Either shall not inversely affect the tests or measurements.

b) Mounting procedure
Mount the sample on the test substrate by reflow soldering or dip soldering using tin-lead alloy solder with nominal tin content of 60% including inactivated flux. Soldering temperature and time shall be as follows.
1) Temperature: 260±5°C
2) Duration: 10±2 seconds

Unit: mm



Style	Dimensions (mm)		
	a	b	c
1005	0.5	1.6	0.6
1608	1.0	3.0	1.2
2012	1.2	4.0	1.65
3216	2.2	5.0	2.0
3225	2.2	5.0	2.9

Remarks:
1. Figures in parentheses are for reference.
2. The shaded area indicates the glass film or solder resist.
3. For the dimensions not specified in this figure or of the atypical resistors, the structures and the external dimensions of the resistor to be tested shall be considered and specified in detail specification.

Figure J-2. Test Board for Mounting

J.4.4.3 Externals, Dimensions and Marking

a) The external inspection shall be performed using a 20x magnifier.
b) The marking test shall be performed visually.
c) The dimensions shall be measured with a vernier caliper or micrometer compliant to JIS B 7507 and JIS B 7502, respectively. Unless the measured values are questionable, another measuring instrument may be used.
d) The mass shall be measured with a measuring instrument which will not give a questionable pass/fail result.

J.4.4.4 Workmanship

J.4.4.4.1 DPA

The following items shall be inspected in accordance with the DPA manual cited in the Quality Assurance Program Plan.

a) The resistors shall be embedded in a proper resin or other materials and cut along the line parallel to the longitudinal axis of the resistors. The cut face

shall be polished and examined by a 20 to 200x magnifier for the resistor film, electrode, thickness of protective coating, and connection of resistor film and electrodes.

b) The protective film of resistor shall be dissolved by a chemical and inspected by a 20 to 200x magnifier for the condition of the resistor pattern.

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

J.4.4.5 Electrical Performance

The test for electrical performances shall be conducted as follows.

J.4.4.5.1 Application of Pulse

A dc test voltage which is 2.5 times the rated voltage or the equivalent pulse shall be applied for 1 second to the resistors. The test voltage shall not exceed 2 times the maximum overload voltage specified in the detail specification. At the completion of this test, the resistors shall be visually examined for evidence of arcing, insulation breakdown and mechanical damage.

J.4.4.5.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following conditions shall apply.

a) Applied voltage

If pass/fail results are questionable, the conditions specified in Table J-16 shall apply.

b) Temperature:

As a rule, the resistance test of Group I of the qualification test and Group A1-1 of Group A test shall be performed at 25±2°C. Unless otherwise specified, the temperature at which subsequent and final resistance measurements are made shall be within ±2°C of the temperature at which the initial measurement was made.

Table J-16. Applied Voltage

Unit: V_{DC}

Nominal resistance (Ω)	Maximum test voltage
Less than 10	0.1 as a maximum(1)
10 or more and less than 100	0.3
100 or more and less than 1k	1
1k or more and less than 10k	3
10k or more and less than 100k	10
100k or more and less than 1M	25
1M or more	30

Note(1) The power applied to the resistor shall be 10% of the rated power as a maximum.

J.4.4.5.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following conditions shall apply.

a) Mounting method
The resistors shall be mounted as specified in paragraph J.4.4.2.
b) Reference temperature: 25°C
c) Test temperature: As specified in table J-17.
d) Test : The resistance shall be measured at each temperature after the resistor reaches a condition of thermal equilibrium. The temperature shall be maintained within the temperature tolerance specified in Table J-17.
e) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table J-17. Resistance-Temperature Characteristic

Unit: °C

Order	Temperature
1	25±3
2	Minimum operating temperature ±3
3	25±3
4	Maximum operating temperature ±3

J.4.4.5.4 Dielectric Withstanding Voltage

J.4.4.5.4.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Mount the resistor with its insulation jacket upward on the metal plate so that the tip of the metal block is positioned at approximately the center of the resistor's two electrodes as shown in Figure J-3, and pressurize at 1.0±0.2N.
b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.
c) Test voltage
The test voltages of 150±15V_{AC} (root-mean-square value at commercial-line frequency) shall be applied between the measuring point A on the metal block and measuring point B on the metal plate.
d) Duration of test: 1 minute $^{+10}_{0}$ seconds
e) Measurement during test
The leak current shall be measured throughout the test, and the resistors shall be examined for evidence of arcing and any breakage.
f) Measurement after test
The resistance shall be measured in accordance with paragraph J.4.4.5.2 to measure the resistance after the test.

g) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 20x or greater.

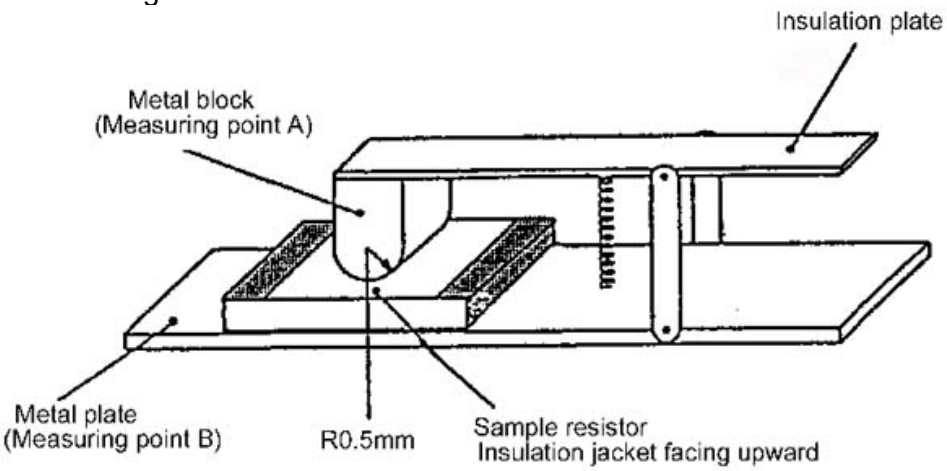


Figure J-3. Test Method for Dielectric Withstanding Voltage and Insulation Resistance Tests

J.4.4.5.4.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item a), paragraph J.4.4.5.4.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

c) Test voltage
$75 \pm 7.5 V_{AC}$ (root-mean-square value at commercial-line frequency)

d) Test condition: D (1.1kPa)

e) Duration of application of test voltage: 1 minute $^{+10}_{0}$ seconds

f) Measurement during test
The leak current shall be measured throughout the test, and the resistors shall be examined for evidence of arcing or any breakage.

g) Measurement after test
The resistance shall be measured in accordance with paragraph J.4.4.5.2 after the test.

h) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using a magnifier of 20x or greater.

J.4.4.5.5 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
The resistors shall be mounted as specified in item a), paragraph J.4.4.5.4.1.
b) Test voltage: 100±10V_{DC} (direct-current voltage)
c) Duration of application of test voltage: About 1 minute

J.4.4.5.6 Short-Time Overload

The resistance shall be measured as specified in paragraph J.4.4.5.2. Following this measurement, dc test voltage of 2.5 times the rated voltage shall be applied to the resistors for 5±1 seconds. The test voltage shall not exceed 2 times the maximum overload voltage specified in the detail specification. The following conditions shall apply.

a) Mounting method: As specified in paragraph J.4.4.2.
b) Test temperature
The test temperature shall be at 25±3°C in still air, with no circulation other than the heat of the resistors being operated.
c) Measurement after test
The resistors shall remain at room temperature for 30 minutes or more after the test voltage is removed before the resistance is measured in accordance with paragraph J.4.4.5.2.
d) Examination after test
The resistors shall be examined for evidence of arcing, burning, and charring using a magnifier of 20x or greater.

J.4.4.5.7 Power Conditioning

The power conditioning test shall be performed in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Test temperature: 85^{+5}_{0} °C
b) Measurement after test
The resistance shall be measured in accordance with paragraph J.4.4.5.2. The measurement may be performed inside or outside of the chamber.
1) Measurement inside the chamber
Place the resistor inside the chamber and stabilize the chamber temperature at the test temperature for 8 hours. Then the measurement before the test shall be performed. This fist measurement temperature shall be used as a reference for all other subsequent measurements under the same condition.
2) Measurement outside the chamber
The measurement before the test shall be performed at room temperature after the resistor is mounted on the test jig. This fist measurement temperature shall be used as a reference for all other subsequent measurements under the same condition.
c) Operating condition
1) Option A
The rated voltage specified in d) of paragraph J.3.6 shall be applied to the resistor intermittently, 90 minutes ON and 30 minutes OFF for the applicable number of hours. This cycle shall be repeated for the entire test duration. The tolerance for applied voltage shall be within ±5%.

2) Option B
The DC or AC (root-mean-square value at commercial-line frequency) voltage which is 1.5 times the rated voltage shall be applied to the resistor intermittently, 90 minutes ON and 30 minutes OFF for the applicable number of hours. This voltage shall not exceed the maximum operating voltage specified in detail specification. The temperature of the resistive element shall not exceed the maximum operating temperature specified in detail specification at any time during the test. If necessary to fulfill this purpose, the ambient temperature can be adjusted. The tolerance for applied voltage shall be within ±5%.

d) Test duration
1) Option A: 168^{+24}_{0} hours
2) Option B: 100±4 hours

e) Measurement after test
1) Measurement inside the chamber
The resistance shall be measured as specified in paragraph J.4.4.5.2. at the end of the OFF period after specified cycling time.
2) Measurement outside the chamber
The resistor shall be left outside the chamber for 45 minuets or longer and then measured as specified in paragraph J.4.4.5.2.

f) Examination after test
The resistors shall be examined for evidence of mechanical damages using a magnifier of 20x or greater.

J.4.4.6 Mechanical Performance

The mechanical performance tests of the resistor shall be performed as follows.

J.4.4.6.1 Solderability

The test procedure shall be in accordance with paragraph 4.17 of JIS C 5201-1. However, the following conditions shall apply.

a) Solder type
Tin-lead alloy solder with nominal tin content of 60% including inactivated flux shall be used.
b) Solder temperature: 245±5°C
c) Solder immersion time: 5±0.5 seconds
d) Procedure
Both electrodes shall be immersed into the solder at the same time.
e) Examination after test
Resistors shall be examined for solder wettability using a magnifier of 20x or greater.

J.4.4.6.2 Adhesion

The adhesion test shall be performed in accordance with paragraph 4.32 of JIS C 5201-1. The following conditions shall apply.

a) Mounting method.
The resistors shall be mounted as specified in paragraph J.4.4.2.

b) Load: 5±0.5N
c) Duration of application of the load: 10±1 seconds
d) Examination after test.
The resistors shall be examined for mechanical damage using a magnifier of 20x or greater.

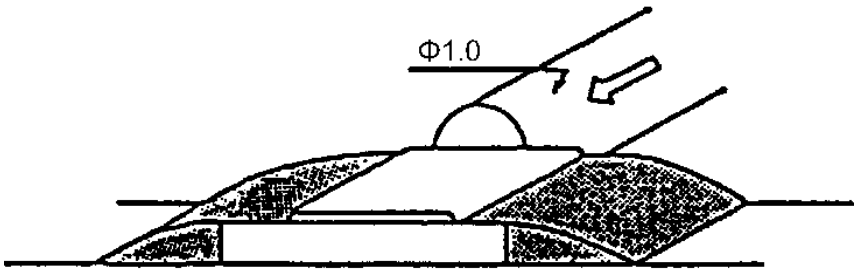


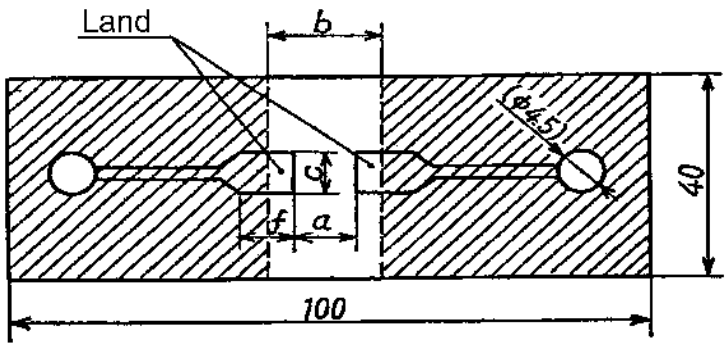
Figure J-4. Test Method for the Adhesion Test

J.4.4.6.3 Board Bending

This test shall be performed in accordance with paragraph 4.33 of JIS C 5201-1. The following conditions shall apply.

a) Mounting method
The resistors shall be mounted on a test board as shown in Figure J-5 as specified in paragraph J.4.4.2. The test temperature shall be 235±5°C.
b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.
c) Deflection: 2mm
d) Number of bending: 1
e) Measurement during test
The resistance shall be measured with the test board bent in accordance with paragraph J. 4.4.5.2.
f) Measurement after test
The resistors shall be examined for mechanical damage using a magnifier of 20x or greater.

Unit: mm



Style	Dimension			
	a	b	c	f
1005	0.5	1.6	0.6	(1.5)
1608	1.0	3.0	1.2	(2.0)
2012	1.2	4.0	1.65	(3.0)
3216	2.2	5.0	2.0	(2.5)
3225	2.2	5.0	2.9	(2.5)

Remarks:
1. The material shall be glass base woven epoxy resin.
Thickness 1.6mm

Copper foil 0.035mm

2. The solder resist (solder heat resistance resin) shall be applied to the shaded area in the figure.

3. The values in parentheses in the figure and table above are for reference.

Figure J-5. Test Board for Board Bending Test

J.4.4.6.4 Resistance to Bonding Exposure

The resistance shall be measured as specified in paragraph J.4.4.5.2. The resistor shall be mounted on a test board as specified in paragraph J.4.4.2 and shall remain at room temperature for 4 to 12 hours.
After the test, the resistance shall be measured in accordance with paragraph J.4.4.5.2 and the resistor shall be examined for mechanical damage and solder leaching using a magnifier of 20x or greater.

J.4.4.7 Environmental Performance

The environmental performance tests shall be performed as follows.

J.4.4.7.1 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202.
The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with paragraph J.4.4.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

c) Test condition: II-H Frequency range: 50 to 2,000Hz
Rms value of acceleration: 334m/s^2 rms

d) Direction of motion: In each of three mutually perpendicular directions.

e) Number of application and duration of vibration
Vibration shall be applied for 3 minutes in each direction with a total test time of 9 minutes.

f) Measurement during test
Each resistor shall be monitored for evidence of electrical discontinuity of 0.1ms or greater during the vibration.

g) Measurement after test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 20x or greater.

J.4.4.7.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202.
The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with paragraph J.4.4.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

c) Test condition: I (980m/s^2, 6ms sawtooth).
d) Direction of applied shocks: In each of three mutually perpendicular directions.
e) Number of applied shocks
The resistors shall be subjected to 5 shocks in each direction, for a total of 15.
f) Measurement during test
Each resistor shall be monitored during the shock for evidence of electrical discontinuity of 0.1ms or greater.
g) Measurement after test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.
h) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 20x or greater.

J.4.4.7.3 Thermal Shock

J.4.4.7.3.1 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Test condition
The test condition shall be in accordance with Table J-18.
b) Number of test cycles: 5 cycles
c) Measurements before and after test: None
d) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 20x or greater.

Table J-18. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	Minimum operating temperature $^{0}_{-5}$	15
2	25 $^{+10}_{-5}$	5 max.
3	Maximum operating temperature $^{+5}_{0}$	15
4	25 $^{+10}_{-5}$	5 max.

J.4.4.7.3.2 Thermal Shock [II]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with paragraph J.4.4.2.
b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.
c) Test condition
The test condition shall be in accordance with Table J-19.
d) Number of test cycles: 1,000 cycles

e) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more at each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles, 500^{+10}_{0} cycles and $1{,}000^{+10}_{0}$ cycles.

1) Resistance measurement
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

2) External examination
The resistors shall be examined for evidence of mechanical damage using a magnifier of 20x or greater.

Table J-19. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	-30^{0}_{-5}	15
2	25^{+10}_{-5}	5 max.
3	100^{+5}_{0}	15
4	25^{+10}_{-5}	5 max.

J.4.4.7.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
As specified in paragraph J.4.4.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph J.4.4.5.2.

c) Polarization and loading voltage
No voltage shall be applied.

d) Subcycle
Step 7b shall not be applicable. Step 7a shall only be performed during any five of the first nine cycles.

e) Measurements at high humidity: None

f) Measurement after test
Upon completion of step 6 of the final cycle, the resistors shall be removed from the chamber and maintained at room temperature for 30 minutes or more. The resistance shall then be measured in accordance with paragraph J.4.4.5.2.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using a magnifier of 20x or greater.

J.4.4.7.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. The following details and exceptions shall apply.

a) Application area: Marked portion

b) Solvents to be used

1) 2-propanol (Isopropyl alcohol)
2) 42 parts by volume of water, one part by volume of propylene glycol monomethyl ether and one part by volume of monoethanolamine.

c) Examination after test

The resistors shall be examined for evidence of mechanical damage and marking legibility.

J.4.4.7.6 Low Temperature Operation

After the resistors are mounted on a test board as specified in paragraph J.4.4.2 and the resistance is measured in accordance with paragraph J.4.4.5.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually decreased to the minimum operating temperature specified in the detail specification. After stabilizing at the specific temperature, the resistors shall remain at no load for 1 hour. The rated dc voltage shall then be applied for 45 minutes. Wait 15^{+15}_{0} minutes after the removal of voltage to gradually increase the chamber temperature to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall be left at room temperature for 1 hour or more but less than 2 hours. The resistance shall then be measured again as specified in paragraph J.4.4.5.2. After the test, the resistors shall be examined for significant abnormality using a magnifier of 20x or greater.

J.4.4.7.7 Stability

After the resistors are mounted on a test board as specified in paragraph J.4.4.2 and the resistance is measured in accordance with paragraph J.4.4.5.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually increased to the maximum operating temperature specified in the detail specification. After stabilizing at the specific temperature, the resistors shall remain at no load for $2{,}000^{+72}_{0}$ hours. When the specified test time has passed, the temperature shall gradually be returned to room temperature. The resistors shall then be removed from the test chamber and maintained at a temperature of 25±5°C for 6±1hours. The resistance shall then be measured in accordance with paragraph J.4.4.5.2 to calculate the change in resistance before and after the test. The dielectric withstanding voltage test (atmospheric pressure) and insulation resistance test shall then be performed as specified in paragraphs J.4.4.5.4.1 and J.4.4.5.5, respectively. After the test, the resistors shall be examined for significant abnormality using a magnifier of 20x or greater.

J.4.4.8 Durability

The durability test shall be performed as follows.

J.4.4.8.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted on a test board as specified in paragraph J.4.4.2. If forced air circulation is employed, the air velocity shall not exceed 2.5m/s and there shall be no direct impingement of the forced-air supply upon the resistors.

b) Test temperature: 85±5°C

c) Measurement before test
Measurements may be taken inside or outside the chamber. The resistance shall be measured in accordance with paragraph J.4.4.5.2.

1) Inside chamber
The resistor shall be placed in the chamber. A pre-test measurement shall be performed 8 hours after the temperature inside the chamber is stabilized at the test temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

2) Outside chamber
The resistors shall be mounted in the test fixture. A pre-test measurement shall be performed at room temperature. This measurement shall be used as the reference temperature for all subsequent measurements under the same condition.

d) Test conditions
The rated voltage specified in paragraph J.3.6 d) shall be applied intermittently, 90 minutes on and 30 minutes off. The test voltage shall be regulated and controlled to maintain ±5% of the rated voltage. The test duration shall be $4{,}000\,^{+72}_{0}$ hours for the qualification test and $2{,}000\,^{+72}_{0}$ hours for the quality conformance inspection.

e) Measurements during test

1) Qualification test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, $1{,}000\,^{+48}_{0}$ hours and $2{,}000\,^{+72}_{0}$ hours.

2) Quality conformance inspection: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours and $1{,}000\,^{+48}_{0}$ hours.

f) Measurements during and after test

1) Inside chamber
At the end of the final 30 minute off time, the resistance shall be measured in accordance with paragraph J.4.4.5.2.

2) Outside chamber
After the resistors are at room temperature for a minimum of 45 minutes at no load, the resistance shall be measured in accordance with paragraph J.4.4.5.2

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using a 20x magnifier.

J.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7.1 of JAXA-QTS-2050. The products stored as specified in paragraph 4.7.1 shall be subjected to the following inspections for total number of the products.

a) External inspection (J.3.4.1) b) Resistance (J.3.7.2)

For solderability and resistance to bonding exposure, sampling inspection for each terminal structure shall be performed in accordance with table J-12. The re-examination date shall be marked on the package or the storage box. If the products did not pass the inspection of solderability or resistance to bonding exposure, they shall not be shipped.

J.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

J.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

J.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.

APPENDIX G

RESISTORS, FIXED, WIRE WOUND, POWER TYPE

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: December 28, 2021

APPENDIX G

RESISTORS, FIXED, WIRE WOUND, POWER TYPE

G.1. General

G.1.1 Scope

This appendix establishes the general requirements and quality assurance provisions for the power type, wire wound, fixed resistors (hereinafter referred to as "resistors").

G.1.2 Classification

Resistors covered by this specification shall be classified as specified in Table G-1.

Table G-1. Classification

Construction	Style
Non-molded type	RWS80, 81, 83, 84, 89 or detail specification

G.1.3 Part Number

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

Example 1:

JAXA[1]	RWS80	S	1000	F	A
	Style	Terminal type	Nominal resistance	Resistance tolerance	Identification code
	(G.1.3.1)	(G.1.3.2)	(G.1.3.3)	(G.1.3.4)	(G.1.3.5)

Example 2:

JAXA[1]	2050/G	***[2]	****[3]
		Individual number	Identifier indicating part characteristics

Note: [1] "JAXA" indicates the common part for space use and may be abbreviated to “J”. “NASDA” used in the detail specification may be abbreviated to “N”.

Note: [2] Individual number “***” shall be designated in accordance with JAXA-QTS-2000, paragraph A.2.2.2.3.

Note: [3] Identifier indicating part characteristics shall be specified in detail specification.

G.1.3.1 Style

The style shall be identified by a three letter symbol, “RWS”, and a two-digit number. The “RWS” indicates the high reliability, power type, wire wound, fixed resistors. The two-digit number indicates the power rating and physical size of the resistors.

The style except for RWS shall be specified in detail specification.

G.1.3.2 Terminal Type

The terminal type shall be identified by a single letter symbol in accordance with Table G-2.

Table G-2. Terminal Type

Symbol	Terminal
S	Solderable
W	Weldable

G.1.3.3 Nominal Resistance

The nominal resistance shall be identified in ohms (Ω) by 4 alphanumeric characters. The first three digits represent significant figures and the last digit specifies the number of zeros to follow. When the value of resistance is less than 100 ohms, or when fractional values of an ohm are required, the letter “R” shall be substituted for one of the significant digits to represent a decimal point, and the succeeding digits of the group represent significant figures.

Example: 1R00= 1.00Ω
10R0= 10.0 Ω
1000= 100 Ω
1001= 1,000 Ω = 1kΩ
1002=10,000 Ω = 10kΩ

G.1.3.4 Resistance Tolerance

The resistance tolerance shall be identified by a single capital letter in accordance with Table G-3.

Table G-3. Resistance Tolerance

Unit: %

Symbol	Resistance tolerance
B	±0.1
D	±0.5
F	±1.0
G	±2.0
J	±5.0

G.1.3.5 Identification Code

The identification code shall be a single capital letter as specified in the detail specification. The indication of the identification code shall be agreed upon by the qualified manufacturer and JAXA.

G.2. Applicable Documents

G.2.1 Applicable Documents

The applicable documents shall be as specified in paragraph 2.1 of JAXA-QTS-2050.

G.2.2 Reference Documents

The following is a reference document.

a) MIL-PRF-39007 Resistors, Fixed, Wire Wound (Power Type), Nonestablished Reliability, Established Reliability, and Space Level, General Specification for

G.3. Requirements

G.3.1 Qualification Coverage

Qualification shall be valid for resistors that are produced by the manufacturing line that conforms to materials, designs, constructions, specifications and performance as specified in paragraphs G.3.2 to G.3.9. The qualification coverage shall be represented by samples that have passed the qualification test.
Terminal types and resistance tolerance of the resistors to be qualified shall be classified as specified in Tables G-4 and G-5. Within this coverage, the manufacturer shall be allowed to supply qualified products in accordance with the detail specification. If necessary, additional qualification coverage shall be specified in the detail specification.

Table G-4. Terminals Qualification

Terminal submitted	Terminal qualified
S	S
W	W
S	S, W (Additional submission of 32 type “W” resistors and four uncoated or unenclosed resistors)
W	W, S (Additional submission of 32 type “S” resistors and four uncoated or unenclosed resistors)

Table G-5. Resistance Tolerance Qualification

Resistance tolerance submitted	Resistance tolerance qualified
B	B, D, F, G, J
D	D, F, G, J
F	F, G, J
G	G, J
J	J

G.3.2 Materials

The materials shall be specified as follows and as specified in paragraph 3.3 of JAXA-QTS-2050.

G.3.2.1 Resistance Wire

Materials used for resistance wires shall not include impurities or other factors that may cause local weak points. The minimum diameter of the resistance wires shall be as specified in the detail specification.

G.3.2.2 Base Substance

The volume resistivity of the base substance shall be $10^8\Omega\cdot$cm or more at a temperature of 300°C.

G.3.2.3 Protective Coating or Enclosure

The protective coating shall not crack, craze, chip, distort or form globules at any temperature up to and including +275°C, which could have an inverse influence on characteristics, regardless of the mounting position of the resistors. The material shall provide adequate protection against the effects of prolonged exposure to high humidity. The protective coating or enclosure shall minimize leakage paths between the terminals as a result of moisture film collecting on the resistor's exterior surface.

G.3.2.4 Terminals

The terminals shall be formed from conducting wires with the specified length and diameter.

G.3.2.4.1 Solderable Terminals

Solderable leads shall be suitably treated to satisfy the requirements of solderability. When a lead coating containing tin is used, the tin content shall range between 40 and 70%.

G.3.2.4.2 Weldable Terminals

Weldable terminals shall satisfy the requirements of type N-1 of MIL-STD-1276. Solderability test, which is specified in paragraph G.3.7.2, shall not be applicable to weldable terminals.

G.3.2.5 Flux

The manufacturer shall completely remove corrosive substances after soldering or use noncorrosive flux. When non-corrosive flux is used, the water extract resistivity test shall be performed in accordance with paragraph 5 (paragraph 8.1.1) of JIS Z 3197, and it shall be verified that the water extract resistivity is greater than 100kΩ·cm. When resin flux cored solder is used, the mass ratio range of resin to solder shall be between 1 and 3%.

G.3.3 Externals, Dimensions, Mass and Marking

Resistors shall satisfy the following requirements when tested in accordance with paragraph G.4.4.2.

G.3.3.1 Externals and Marking

There shall be no cracks on the surface of the resistors which may adversely affect the performance of the resistors. The following shall be clearly marked in such a manner to ensure legibility.

a) Part number
The marking of ”JAXA” may be excluded. When the physical size of the resistor precludes inclusion of the complete part number, nominal resistance shall be marked as a minimum.
b) Year and week manufactured:
The number of the last two digits of the calendar year and the week of the calendar year beginning with January shall be marked.
c) Manufacturer name or its abbreviation.

G.3.3.2 Construction, Dimensions and Mass

The resistor element shall be protected from moisture by a protective coating or enclosure. The dimensions and mass shall satisfy the requirements specified in each detail specification.

G.3.4 Workmanship

Resistors shall be manufactured based on good design practices and in accordance with the quality assurance program defined in paragraph 3.2.1.

a) Resistance wire
The resistance wires shall have no joints, welds or knots, except at end terminals.
b) Pitch
The average winding pitch shall not exceed four times the wire diameter.
When the average winding pitch is equal to or exceeds four times the wire diameter, the average winding pitch shall be established on the basis of technical rationale.
c) Effective winding coverage
The effective winding coverage shall be the area between the starting and end points where the wires are wound in a uniform winding pitch. The effective winding coverage shall cover a minimum of 80% of the overall winding area.
d) Protective coating or enclosure
Resistor assemblies shall be protected by a coating of moisture resistant insulating material which shall completely cover the exterior of the resistance element, including connections or termination.
e) Terminals
The resistor terminal leads shall be securely connected electrically and mechanically.

G.3.4.1 DPA

When resistors are tested as specified in paragraph G.4.4.3.1, processes such as terminal connections and protective coating or enclosure shall have been successfully

achieved. The internal structure and the materials shall be as specified in the quality assurance program.

G.3.4.2 Radiographic Inspection

When resistors are tested as specified in paragraph G.4.4.3.2, the resistors shall not have foreign materials, welding or soldering scattering, inadequate connection of terminals and caps, caps tilting 5 degrees or more to core, void exceeding 50% of thickness of exterior coating, winding pitch equal to or more than 400% or less than 200%, and extreme deviation of exterior coating.

If resistors fail to meet criteria from the point of view of design and construction of parts, if tests are exempted, and if other methods can substitute radiographic inspection at part design and process design, manufacturer shall clarify criteria, reason for the exemption and alternative methods in detail specification.

G.3.5 Ratings

G.3.5.1 Nominal Resistance

As a rule, the standard values of nominal resistance shall be defined relative to the resistance tolerance and shall be as specified in Table G-6. The minimum and maximum resistances shall satisfy the requirements of the detail specification.

Table G-6. Standard Resistance Values (1/2)

Series name	E192						E96					
Resistance tolerance and symbols	B (±0.1%) D (±0.5%)						F (±1.0%)					
Standard resistance value (significant figures without unit)	10.0	14.7	21.5	31.6	46.4	68.1	10.0	14.7	21.5	31.6	46.4	68.1
	10.1	14.9	21.8	32.0	47.0	69.0						
	10.2	15.0	22.1	32.4	47.5	69.8	10.2	15.0	22.1	32.4	47.5	69.8
	10.4	15.2	22.3	32.8	48.1	70.6						
	10.5	15.4	22.6	33.2	48.7	71.5	10.5	15.4	22.6	33.2	48.7	71.5
	10.6	15.6	22.9	33.6	49.3	72.3						
	10.7	15.8	23.2	34.0	49.9	73.2	10.7	15.8	23.2	34.0	49.9	73.2
	10.9	16.0	23.4	34.4	50.5	74.1						
	11.0	16.2	23.7	34.8	51.1	75.0	11.0	16.2	23.7	34.8	51.1	75.0
	11.1	16.4	24.0	35.2	51.7	75.9						
	11.3	16.5	24.3	35.7	52.3	76.8	11.3	16.5	24.3	35.7	52.3	76.8
	11.4	16.7	24.6	36.1	53.0	77.7						
	11.5	16.9	24.9	36.5	53.6	78.7	11.5	16.9	24.9	36.5	53.6	78.7
	11.7	17.2	25.2	37.0	54.2	79.6						
	11.8	17.4	25.5	37.4	54.9	80.6	11.8	17.4	25.5	37.4	54.9	80.6
	12.0	17.6	25.8	37.9	55.6	81.6						
	12.1	17.8	26.1	38.3	56.2	82.5	12.1	17.8	26.1	38.3	56.2	82.5
	12.3	18.0	26.4	38.8	56.9	83.5						
	12.4	18.2	26.7	39.2	57.6	84.5	12.4	18.2	26.7	39.2	57.6	84.5
	12.6	18.4	27.1	39.7	58.3	85.6						
	12.7	18.7	27.4	40.2	59.0	86.6	12.7	18.7	27.4	40.2	59.0	86.6
	12.9	18.9	27.7	40.7	59.7	87.6						
	13.0	19.1	28.0	41.2	60.4	88.7	13.0	19.1	28.0	41.2	60.4	88.7
	13.2	19.3	28.4	41.7	61.2	89.8						
	13.3	19.6	28.7	42.2	61.9	90.9	13.3	19.6	28.7	42.2	61.9	90.9
	13.5	19.8	29.1	42.7	62.6	92.0						
	13.7	20.0	29.4	43.2	63.4	93.1	13.7	20.0	29.4	43.2	63.4	93.1
	13.8	20.3	29.8	43.7	64.2	94.2						
	14.0	20.5	30.1	44.2	64.9	95.3	14.0	20.5	30.1	44.2	64.9	95.3
	14.2	20.8	30.5	44.8	65.7	96.5						
	14.3	21.0	30.9	45.3	66.5	97.6	14.3	21.0	30.9	45.3	66.5	97.6
	14.5	21.3	31.2	45.9	67.3	98.8						

Table G-6. Standard Resistance Values (2/2)

Name of series	E24
Resistance tolerance and symbols	G (±2.0%) J (±5.0%)
Standard resistance value (significant figures without unit)	10 11 12 13 15 16 18 20 22 24 27 30 33 36 39 43 47 51 56 62 68 75 82 91

G.3.5.2 Operating Temperature Range

The operating temperature range shall be between -55 and +275°C.

G.3.5.3 Power Rating

Resistors shall have a power rating as specified in the detail specification. The rated ambient temperature shall be 25°C.

G.3.5.4 Maximum Power

The maximum power at or below the rated ambient temperature shall be equal to the power rating. For temperatures in excess of the rated ambient temperature, the maximum power shall be determined by derating the power rating in accordance with the derating curve shown in Figure G-1.

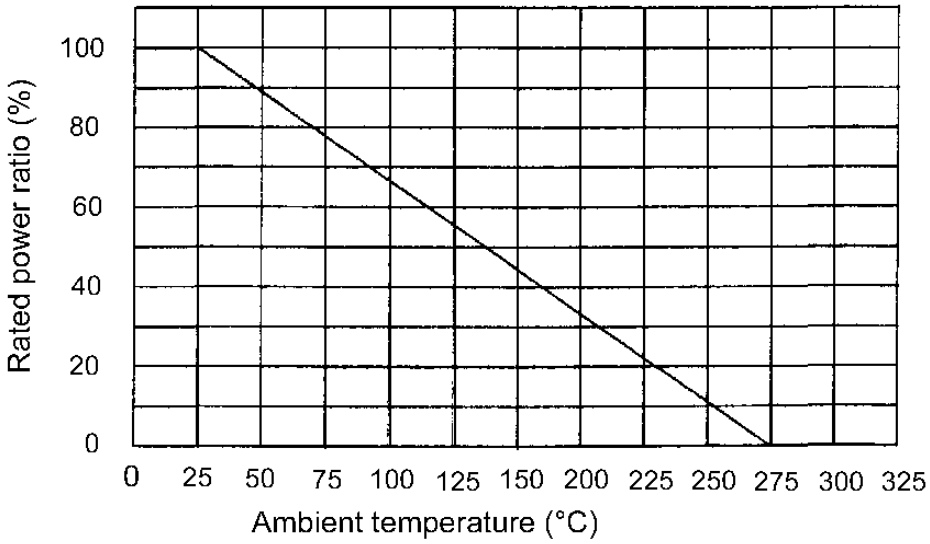


Figure G-1. Derating Curve

G.3.5.5 Voltage Rating

Resistors shall have a rated direct current (DC) continuous operating voltage or an approximate sine wave root-mean-square (rms) alternating current (AC) continuous operating voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula.

$E = \sqrt{P \cdot R}$

Where:
E = Voltage rating (V)
P = Power rating (W)
R = Nominal resistance (Ω)

G.3.6 Electrical Performance

Resistors shall satisfy the following electrical requirements.

G.3.6.1 Voltage Aging

When resistors are tested as specified in paragraph G.4.4.4.1, the change in resistance before and after the test shall satisfy the requirement of the detail specification. There shall be no evidence of mechanical damage, arcing, burning or charring after the completion of the test.

G.3.6.2 Resistance

When resistors are tested in accordance with paragraph G.4.4.4.2 under the standard conditions (paragraph G.4.4.1), the resistance shall be within the specified tolerance of the nominal resistance.

G.3.6.3 Resistance-Temperature Characteristic

When resistors are tested as specified in paragraph G.4.4.4.3 using room ambient temperature as the reference temperature, the resistance-temperature characteristic

for each of the temperatures specified in Table G-13 shall satisfy the requirements specified in the detail specification.

G.3.6.4 Dielectric Withstanding Voltage

When tested as specified in paragraph G.4.4.4.5, resistors shall withstand the specified test voltage, and the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of flashover or arcing, insulation breakdown or mechanical damage after the completion of the test. The leakage current during the test shall satisfy the requirements of the detail specification.

G.3.6.5 Insulation Resistance

When resistors are tested as specified in paragraph G.4.4.4.6, the insulation resistance shall satisfy the requirements of the detail specification.

G.3.6.6 Short-Time Overload

When resistors are tested as specified in paragraph G.4.4.4.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of arcing, burning, or charring after the completion of this test.

G.3.7 Mechanical Performance

Resistors shall satisfy the following mechanical requirements.

G.3.7.1 Terminal Strength

When resistors are tested as specified in paragraph G.4.4.5.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of breaking or loosening of terminals, or other evidence of mechanical damage after the completion of the test.

G.3.7.2 Solderability

When resistors are tested as specified in paragraph G.4.4.5.2, a minimum of 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.

G.3.7.3 Resistance to Soldering Heat

When resistors are tested as specified in paragraph G.4.4.5.3, the change in resistance before and after the test shall satisfy requirements specified in detail specification. Resistors shall not have mechanical damages after the completion of the test.

G.3.8 Environmental Performance

Resistors shall satisfy the following environmental requirements.

G.3.8.1 Vibration

G.3.8.1.1 High Frequency Vibration

When resistors are tested as specified in paragraph G.4.4.6.1.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

G.3.8.1.2 Random Vibration

When resistors are tested as specified in paragraph G.4.4.6.1.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

G.3.8.2 Shock

When resistors are tested as specified in paragraph G.4.4.6.2, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no electrical discontinuity of 0.1ms or longer during the test and no evidence of mechanical damage after the completion of the test.

G.3.8.3 Thermal Shock

G.3.8.3.1 Thermal Shock [I]

When resistors are tested as specified in paragraph G.4.4.6.3.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of this test.

G.3.8.3.2 Thermal Shock [II]

When resistors are tested as specified in paragraph G.4.4.6.3.2, the change in resistance before and after the test shall satisfy the requirements of the detail

specification. There shall be no evidence of mechanical damage after the completion of the test. Fine cracks on the surface of the resistors shall be acceptable only when subjected to more than 100 cycles.

G.3.8.4 Moisture Resistance

When resistors are tested as specified in paragraph G.4.4.6.4, the change in resistance before and after the test shall satisfy the requirements of the detail specification. In addition, the dielectric withstanding voltage shall be as specified in paragraph G.3.6.4, and the insulation resistance shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

G.3.8.5 Resistance to Solvents

When resistors are tested as specified in paragraph G.4.4.6.5, the marking shall remain legible. The details shall be as defined in the detail specification.

G.3.8.6 Low Temperature Storage

When resistors are tested as specified in paragraph G.4.4.6.6, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

G.3.8.7 Stability

When resistors are tested as specified in paragraph G.4.4.6.7, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

G.3.9 Durability

Resistors shall satisfy the following durability requirements.

G.3.9.1 Life

When resistors are tested as specified in paragraph G.4.4.7.1, the change in resistance before and after the test shall satisfy the requirements of the detail specification. There shall be no evidence of mechanical damage after the completion of the test.

G.4. Quality Assurance Provisions

G.4.1 In-Process Inspection

The in-process inspection shall be as specified in paragraph 4.3 of JAXA-QTS-2050.

G.4.2 Qualification Test

The qualification test shall be as specified in paragraph 4.4 of JAXA-QTS-2050 and as provided below.

G.4.2.1 Test Items and Number of Samples

The number of samples of the qualification test shall be as specified in Table G-7. Each resistor style and terminal type shall be qualified separately. When terminal type “S” in a style is submitted, qualification for type “W” shall be granted with the added submission of 32 type “W” resistors to Group I, IA, and III tests and 4 type “W” resistors to Group VI test of Table G-7. The samples shall be divided into groups to separately undergo each test group as specified in Table G-7. When terminal type “W” in a style is submitted, qualification for type “S” shall be granted with the added submission of 32 type “S” resistors to Group I, IA, and III tests and 4 type “S” resistors to the Group VI test of Table G-7. The samples shall be divided into groups to separately undergo each test group as specified in Table G-7.

Tests within each group shall be performed in the order specified in Table G-7. Upon completion of Group I and IA tests in that order, Group IB through VIII tests shall be performed using samples allocated to the appropriate group tests. Group IB through VIII tests are not required to be performed in the group number.

Table G-7. Qualification Test

Test			Require-ment paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed(1)
I	1	Voltage aging	G.3.6.1	G.4.4.4.1	100%	0
	2	Resistance	G.3.6.2	G.4.4.4.2		
IA	1	Externals, dimensions, mass and marking (2)	G.3.3	G.4.4.2		
	2	Radiographic inspection (5)	G.3.4.2	G.4.4.3.2		
IB	1	DPA	G.3.4.1	G.4.4.3.1	2	0
II	1	Solderability	G.3.7.2	G.4.4.5.2	12 Any resistance	0
	2	Resistance to solvents	G.3.8.5	G.4.4.6.5		
III	1	Thermal shock [I]	G.3.8.3.1	G.4.4.6.3.1	32 (16 Highest resistance / 16 Lowest resistance)	1
	2	Resistance-temperature characteristic	G.3.6.3	G.4.4.4.3		
	3	Low temperature storage	G.3.8.6	G.4.4.6.6		
	4	Short-time overload	G.3.6.6	G.4.4.4.4		
	5	Dielectric withstanding voltage	G.3.6.4	G.4.4.4.5		
	6	Insulation resistance	G.3.6.5	G.4.4.4.6		1
	7	Resistance to soldering heat	G.3.7.3	G.4.4.5.3		
	8	Moisture resistance	G.3.8.4	G.4.4.6.4		
	9	Terminal strength	G.3.7.1	G.4.4.5.1		
IV	1	Shock	G.3.8.2	G.4.4.6.2	32 (16 Highest resistance / 16 Lowest resistance)	1
	2	High frequency vibration	G.3.8.1.1	G.4.4.6.1.1		
	3	Thermal shock [II]	G.3.8.3.2	G.4.4.6.3.2		
V	1	Random vibration	G.3.8.1.2	G.4.4.6.1.2	32 (16 Highest resistance / 16 Lowest resistance)	0
VI	1	Externals and construction (uncoated or unenclosed)	G.3.3	G.4.4.2	4 (2 Highest resistance / 2 Lowest resistance)	0
VII	1	Life	G.3.9.1	G.4.4.7.1	230 (115 Highest resistance / 115 Lowest resistance)	0
VIII	1	Stability	G.3.8.7	G.4.4.6.7	102 (51 Highest resistance / 51 Lowest resistance)	1
-	1	Materials	G.3.2	-	(4)	

Notes:

(1) When a sample has failed to pass one or more tests of one group, it shall be counted as a single defective.

(2) For dimensions and mass, sample size shall be 1.0% of the acceptable quality level (AQL) in "Normal Inspection Level II" specified in Appendix 1 of JIS Z 9015-1 or 10 samples, whichever is greater.

(3) This note(3) is deleted.

(4) Data to certify compliance with design specifications shall be submitted.

(5) When radiographic inspection has been performed as a part of in-process inspection in the manufacturing process, the inspection record may be substituted for qualification test.

G.4.3 Quality Conformance Inspection

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

G.4.3.1 Inspection Items and Number of Samples

The items and number of samples of the Group A, B, and C inspections of the quality conformance inspection shall be specified in Tables G-8, G-9 and G-10, respectively. Group tests shall be performed in the group order and the inspections within each group shall be performed in the specified order. The sampling plan used for the Group A inspection shall be in accordance with JIS Z 9015-1. "General Inspection Level II" and "Special Inspection Level S-4" specified therein shall apply to the Group A2 and A4 inspections, respectively. The constant sampling shall be applied to the Group A3 inspection.

G.4.3.2 Criteria for Pass/Fail

A failure of any test specified in Table G-8, G-9 or G-10 shall constitute failure of each inspection group of the quality conformance inspection.

When the number of defects does not exceed the permitted number specified in Table G-8, but the failure mode of the defect is catastrophic, such as open- or short-circuit where the function of the resistor might be lost, the resistor fails the Group A inspections.

G.4.3.3 Post-Test Disposition of Sample

Products from the lot rejected in the Group A quality conformance inspection shall not be shipped. If the lot has not passed the Group A2 or A4 inspection, all products of the lot shall be subjected to the failed inspection item, and only the good products shall be shipped. The samples which have been soldered or subjected to the DPA inspection shall not be delivered.

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

Inspection			Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
A1	1	Voltage aging	G.3.6.1	G.4.4.4.1	100%	0
	2	Resistance	G.3.6.2	G.4.4.4.2		
A2	1	Externals, dimensions, mass and marking (1)	G.3.3	G.4.4.2	AQL (2) 4.0%	
A3	1	Radiographic inspection(5)	G.3.4.2	G.4.4.3.2	100%	0
A4	1	DPA	G.3.4.1	G.4.4.3.1	2	0
A5	1	Thermal shock [I]	G.3.8.3.1	G.4.4.6.3.1	AQL(2) 2.5%	
	2	Short-time overload	G.3.6.6	G.4.4.4.4		
	3	Dielectric withstanding voltage (3) (4)	G.3.6.4	G.4.4.4.5		
	4	Insulation resistance	G.3.6.5	G.4.4.4.6		

Notes:(1) Sample fails the test only when marking is illegible. Marking shall be clearly legible at the completion of all tests.

(2) The sampling plan shall be in accordance with JIS Z 9015-1. "General Inspection Level II" and "Special Inspection Level S-4" specified therein shall apply to the Group A2 and A4 inspections, respectively.

(3) Only the leakage current shall be tested, and the resistance shall not be measured before and after the test.

(4) The test shall be performed at ambient pressure only.

(5) When radiographic inspection has been performed as a part of in-process inspection in the manufacturing process, the inspection record may be substituted for the quality conformance inspection.

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

Inspection			Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
B1	1	Thermal shock [I]	G.3.8.3.1	G.4.4.6.3.1	10	0
	2	Resistance-temperature characteristic	G.3.6.3	G.4.4.4.3		
	3	Low temperature storage	G.3.8.6	G.4.4.6.6		
	4	Short-time overload	G.3.6.6	G.4.4.4.4		
	5	Dielectric withstanding voltage	G.3.6.4	G.4.4.4.5		
	6	Insulation resistance	G.3.6.5	G.4.4.4.6		
	7	Resistance to soldering heat	G.3.7.3	G.4.4.5.3		
	8	Moisture resistance	G.3.8.4	G.4.4.6.4		
	9	Terminal strength	G.3.7.1	G.4.4.5.1		
B2	1	Solderability	G.3.7.2	G.4.4.5.2	8	0
	2	Resistance to solvents	G.3.8.5	G.4.4.6.5		
B3	1	Life	G.3.9.1	G.4.4.7.1	10	0
B4	1	Stability	G.3.8.7	G.4.4.6.7	10	0

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

Inspection			Requirement paragraph	Test method paragraph	Criteria for Pass/fail	
Group	Order	Item			Sample size	No. of defectives allowed
C1	1	Shock	G.3.8.2	G.4.4.6.2	10	0
	2	High frequency vibration	G.3.8.1.1	G.4.4.6.1.1		
C2	1	Thermal shock [II]	G.3.8.3.2	G.4.4.6.3.2	10	0
C3	1	Random vibration	G.3.8.1.2	G.4.4.6.1.2	10	0
C4	1	Externals and construction (uncoated or unenclosed)	G.3.3	G.4.4.2	4	0

G.4.4 Methods for Test and Inspection

G.4.4.1 Test Conditions

a) Standard conditions
Standard conditions shall be a temperature between 15 and 35°C, relative humidity between 25 and 75% and atmospheric pressure between 86 and 106kPa. All tests and measurements shall be performed under the standard conditions unless otherwise specified. If the values measured under the standard conditions may result in a questionable pass/fail result, or if required otherwise, the test and measurement shall be performed in accordance with condition c). The conversion shall be in accordance with condition b), if necessary. Other conditions may apply, unless the pass/fail result may be questionable.

b) Reference conditions
Reference conditions shall be 25°C and an atmospheric pressure of 101.3kPa.

c) Judgment conditions
Judgment conditions shall be either condition A or B specified in Table G-11. Unless specified, condition A shall apply.

Table G-11. Judgment Conditions

Condition	A	B
Temperature (°C)	23±2	20±2
Relative humidity (%)	50±5	65±5
Atmospheric pressure (kPa)	86 to 106	86 to 106

d) Magnification of external inspection
Unless otherwise specified, magnification for external inspection shall be between 5X and 20X. In case of conflict, external inspection shall be performed with minimum 20X magnification.

G.4.4.2 Externals, Dimensions, Mass and Marking

G.4.4.2.1 Qualification Test

a) The external inspection shall be performed using magnifier with 5X to 20X magnification. In case of conflict, external inspection shall be performed with minimum 20X magnification.
b) The marking test shall be performed visually.
c) 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. The dimensions may be measured with another measuring instrument, unless the measured value is questionable. If the dimensions are measured with dimension gauge which is set in advance, it shall be proven that the dimension gauge is sufficiently functional as a measuring instrument prior to the test. The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.
d) The mass shall be measured with a precision-type trip balance with a weighing capacity of 50g and sensitivity of less than 50mg, compliant to JIS B 7601. The mass may be measured with another measuring instrument, unless the measured value is questionable. Measured values shall be judged to avoid doubt. For the mass inspection, the pass/fail results may be determined by comparing the sample to the criteria samples of maximum mass for each style, which is determined in advance.

Resistors without a protective coating or enclosure shall be tested as follows.

a) Resistance wire
A magnifier of 5x-20x shall be used.
b) Winding pitch
Spacing of the winding pitch shall be measured with a magnifier of 5x-20x.
c) Effective winding coverage
The effective winding coverage shall be measured with a magnifier of 5x-20x.
d) Terminals
The terminal connection, welded points and a resistance wire shall be examined with a magnifier of 5x-20x.

G.4.4.2.2 Quality Conformance Inspection

a) The external inspection shall be performed using magnifier with 5X to 20X magnification. In case of conflict, external inspection shall be performed with minimum 20x magnification.
b) The marking test shall be performed visually.
c) 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. The dimensions may be measured with another measuring instrument, unless the measured value is questionable. If the dimensions are measured with dimension gauge which is set in advance, it shall be proven that the dimension gauge is sufficiently functional as a measuring instrument prior to the test.

The sample shall pass this test when the measurements do not exceed the dimensional tolerances specified in the detail specification.

d) The mass shall be measured with a precision-type trip balance with a weighing capacity of 50g and sensitivity of less than 50mg, compliant to JIS B 7601. The mass may be measured with another measuring instrument, unless the measured value may be questionable. Measured values shall be judged to avoid doubt. For the mass inspection, the pass/fail results may be determined by comparing the sample to the criteria samples of maximum mass for each style, which is determined in advance.
Resistors without protective coating or enclosure for the Group C quality conformance inspection shall be inspected as specified in paragraph G.4.4.2.1.

G.4.4.3 Workmanship

G.4.4.3.1 DPA

The resistors shall be disassembled to ensure that processes such as terminal connection and protective coating or enclosure have been successfully achieved. DPA shall be conducted in accordance with the DPA procedures et al., which compose the Quality Assurance Program.

a) The protective coating or enclosure shall be removed from the resistors with a resinous solvent or by other means. The resistors shall be examined visually or by using a 5 to 50x magnifier for inspecting the resistance wire, effective winding coverage, nominal diameter of the resistance wire, and weld condition of the caps with terminal leads.
b) The resistors shall be embedded in a proper resin or other materials and cut at the center along the longitudinal axis of the resistors. One cut face shall be grounded and examined visually or by using a 5x magnifier for the length of effective winding coverage, uniformity of the winding pitch, foreign materials, close adhesion state and voids in the external coating and connection state of caps and lead wire (tilt of cap (shall be less than 5 degrees)).

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

G.4.4.3.2 Radiographic Inspection

The resistors shall be tested in accordance with Test Method 209 of MIL-STD-202. Test conditions shall be as follows:

a) Criteria sample for radiographic inspection shall be prepared and inspection results shall be judged in accordance with the criteria sample.
b) Radiograph shall have adequate quality to show images of penetrameter clearly and sharply.
c) Sample shall be put into position to show contour of image clearly.
d) Sample shall be radiographed from 2 directions crossing at right angles. Otherwise, X-ray radiograph system for 360 degrees real-time filming may be used.

e) Films used for radiograph shall have ability of detecting Φ0.10mm lead particles clearly.
f) Images of penetrameter shall be included in each film.
g) When electronic data on images are shown, resolution of the electronic data shall be in accordance with MIL-STD-202. Furthermore, electronic data shall demonstrate resolution of sample images using penetrameter images which were taken at filming and image processing conditions identical to those of sample.
h) Radiograph shall be inspected using equal to or more than 10x magnifier.

G.4.4.4 Electrical Performance

The electrical performance tests shall be performed as follows.

G.4.4.4.1 Voltage Aging

The voltage aging test shall be performed under the following conditions.

a) Mounting method
The resistors shall be supported by their terminal leads at a point 9.5±1.6mm from the resistor body.
b) Measurement before test
Resistance shall be measured as specified in paragraph G.4.4.4.2.
c) Test conditions: 25^{+15}_{0} °C
d) Test duration: 100^{+16}_{-4} hours
e) Test conditions
Rated dc voltage or rated ac voltage (root-mean-square value at commercial-line frequency) shall be applied intermittently, 90 minutes ON and 30 minutes OFF, for 100^{+16}_{-4} hours.
f) Measurement after test
After the load is removed from the resistors for 30 minutes or more, the resistance shall be measured in accordance with paragraph G.4.3.4.2 to calculate the change in resistance before and after the test.
g) Examination after test
The resistors shall be examined visually using 5x-20x magnifier for evidence of mechanical damages, arcing, burning or charring.

G.4.4.4.2 Resistance

The resistance test shall be performed in accordance with Test Method 303 of MIL-STD-202. The following details and exceptions shall apply.

a) Limit of error of measuring apparatus: ±(0.05%+0.002Ω)
b) Test voltage: Test voltages shall be applied in accordance with Table G-12.
c) Points of application of test voltage
For resistors 20Ω and less, the test lead attach points shall be 9.5±1.6mm from the body.

Table G-12. Test Voltages

Unit: V_{DC}

Nominal resistance range (Ω)	Maximum test voltage
Less than 1	0.1
1 or more and less than 10	0.3
10 or more and less than 100	0.3
100 or more and less than 1k	1
1k or more and less than 10k	3
10k or more and less than 100k	10

G.4.4.4.3 Resistance-Temperature Characteristic

The resistance-temperature characteristic test shall be performed in accordance with Test Method 304 of MIL-STD-202. The following details and exceptions shall apply.

a) Reference temperature: 25°C
b) Test temperature: As specified in Table G-13.
c) Unit of resistance-temperature characteristic: 10^{-6}/°C.

Table G-13. Test Temperature for Resistance-Temperature Characteristic

Unit: °C

Order	Test temperature	
	Qualification test	Quality conformance inspection
1	25±3	25±3
2	-15±3	-55±3
3	-55±3	25±3
4	25±3	275±3
5	125±3	-
6	200±3	-
7	275±3	-

G.4.4.4.4 Short-Time Overload

The resistance shall be measured as specified in paragraph G.4.4.4.2 under condition b) specified below. After the test, the resistors shall remain at room temperature with no load for 30 minutes before the resistance is measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test. At the completion of this test, the resistors shall be examined for evidence of arcing, burning or charring using 5x-20x magnifier. The marking shall also be examined for legibility. This test shall be performed under the following conditions.

a) Mounting method
   The resistors shall be mounted to the fixtures by means other than soldering or be placed in a tray of small heat inertia.
b) Test condition
   A dc potential of 10 times the rated power shall be applied to the resistors for

5 seconds. For the resistors with a rated power less than 5W, a dc potential of 5 times the rated power shall be applied to the resistors for 5 seconds.

G.4.4.4.5 Dielectric Withstanding Voltage

G.4.4.4.5.1 Atmospheric Pressure

Resistors shall be tested in accordance with Test Method 301 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2. The resistance shall not be measured before the withstanding voltage test of Group A4 of the Group A inspection.

b) Method of mounting
The resistors shall be placed on the joint of a metal V block such that the resistive-elements do not protrude from either end of the V block. A distance between the resistor lead and the V block shall not be less than the thickness of the insulator.

c) Test voltage
The applied voltage shall be alternating current voltage (root-mean-square value at commercial-line frequency) in accordance with Table G-14.

d) Duration of test:
   1) Qualification test: $60^{+0.5}_{0}$ seconds
   2) Quality conformance inspection: $5^{+0.5}_{0}$ seconds

e) Rate of application of voltage
   1) Qualification test
      The test voltage shall be increased from zero to the application value at the rate of $100V_{AC}$ per second.
   2) Quality conformance inspection
      The test voltage shall be increased from zero to the application value at the rate of $500V_{AC}$ per second.

f) Measurement during test
The leak current shall be monitored during the application of test voltage.

g) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test. The resistance shall not be measured after the withstanding voltage test of Group A4 of the Group A inspection.

h) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using 5x-20x magnifier.

Table G-14. Dielectric Withstanding Voltage (Ambient Pressure)

Unit: V_{AC}

Rated power (W)	Test voltage
1, 2	500
3, 5, 7	1,000

G.4.4.4.5.2 Reduced Pressure

Resistors shall be tested in accordance with Test Method 105 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted as specified in item b), paragraph G.4.4.4.5.1.

b) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

c) Test condition: D (1.1± 0.1kPa)

d) Test voltage
The applied voltage shall be alternating current voltage (root-mean-square value at commercial-line frequency) in accordance with Table G-15.

e) Duration of test: $60^{+0.5}_{0}$ seconds

f) Rate of application of voltage
The test voltage shall be increased from zero to the application value at the rate of $100V_{AC}$ per second.

g) Measurement during test
The leakage current shall be monitored during the application of test voltage.

h) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

i) Examination after test
The resistors shall be examined for evidence of flashover, arcing, insulation breakdown and mechanical damage using 5x-20x magnifier.

Table G-15. Dielectric Withstanding Voltage (Reduced Barometric Pressure)

Unit: V_{AC}

Rated power (W)	Test voltage
1, 2	100
3,5	200
7	300

G.4.4.4.6 Insulation Resistance

The resistors shall be measured in accordance with Test Method 302 of MIL-STD-202. The following details and exceptions shall apply.

a) Mounting method
As specified in item b), paragraph G.4.4.4.5.1.

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

G.4.4.5 Mechanical Performance

The mechanical performance tests shall be performed as follows.

G.4.4.5.1 Terminal Strength

Resistors shall be tested in accordance with Test Method 211 of MIL-STD-202. The condition A (pull test) specified in paragraph 3.1 and D (twist test) in paragraph 3.4 therein shall apply. However, the test shall be subject to the following details and exceptions.

G.4.4.5.1.1 Pull Test (Test Condition A)

a) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.
b) Load: As specified in Table G-16.
c) Duration of test: 5 to 10 seconds
d) Test method
The specified load shall be applied in the axial direction of the lead without inducing a shock. The application point of the load shall be at the closest point to the lead edge.
e) Measurement after test
Resistance shall not be measured after the pull test since the test shall be performed with the twist test specified in paragraph G.4.4.5.1.2.
f) Examination after test
The terminals shall be examined for evidence of mechanical damage using 5x-20x magnifier.

Table G-16. Load

Unit: N{kgf}

Nominal wire diameter (mm)	Load
Less than 0.8	24.5 {2.5}
0.8 or more	44.1 {4.5}

G.4.4.5.1.2 Twist Test (Test Condition D)

Following the pull test, the twist test shall be performed using the same samples.

a) Measurement before test
The resistance shall not be measured before the test.
b) Test conditions
With the center axis of the resistor's lead wire used as a rotating axis, the lead wire shall be rotated 360 degrees along a plane perpendicular to the rotating axis. This shall be defined as the first twist. The lead wire shall then be rotated 360 degrees in the opposite direction. This shall be counted as the second twist.
c) Number of twists: 5

d) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

e) Examination after test
The terminals shall be examined for evidence of breaking or loosening. Plating of the terminals shall be examined for evidence of cracks or peelings which expose base material using 5x-20x magnifier.

G.4.4.5.2 Solderability

Resistors shall be tested in accordance with Test Method 208 of MIL-STD-202. The following details and exceptions shall apply.

a) Preparations: shall be performed.
b) Number of terminals tested: all terminals
c) Solder temperature: 245±5°C
d) Solder immersion time: 5±0.5 seconds
e) Solder immersion depth
The terminals shall be immersed within 1.6mm from the base of the terminals.
f) Examination after test
Resistors shall be examined for solder wettability using 5x-20x magnifier.

G.4.4.5.3 Resistance to Soldering Heat

Resistors shall be tested in accordance with Test Method 210 of MIL-STD-202. The following details and exceptions shall apply.

a) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2
b) Test condition: B (Solder dip method)
c) Solder temperature: 350±10°C
d) Solder immersion time: 3+0.5/-0 seconds
e) Solder immersion depth
The terminals shall be immersed within 1.3mm from the base of the terminals.
f) Measurement after test
The resistors shall be at room temperature for specified period before the resistance is measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.
g) Examination after test
Mechanical damages of the resistors shall be examined using 5x-20x magnifier.

G.4.4.6 Environmental Performance

The environmental performance tests shall be performed as follows.

G.4.4.6.1 Vibration

G.4.4.6.1.1 High Frequency Vibration

Resistors shall be tested in accordance with Test Method 204 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph G.4.4.6.2. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting fixture.

b) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

c) Test condition
Test condition D (196m/s^2 p-p or 1.5mm in double amplitude, whichever is smaller).

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Duration of vibration
Six hours in each direction for a total of 12 hours.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

G.4.4.6.1.2 Random Vibration

Resistors shall be tested in accordance with Test Method 214 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted in accordance with item a), paragraph G.4.4.6.2.

b) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

c) Test condition:
Test condition II-H Frequency range: 20 to 2,000Hz
Rms value of acceleration: 334m/s^{2}rms

d) Direction of motion
In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of application and duration of vibration
Vibration shall be applied for 3 minutes, in each direction, for a total test time of 6 minutes.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the vibration for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

G.4.4.6.2 Shock

Resistors shall be tested in accordance with Test Method 213 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
Resistors shall be rigidly mounted on appropriate fixtures or mounted with the bodies cemented to a flat surface. The resistors shall be fixed with their leads supported approximately 9.5±1.6mm from the resistor body. The fixtures shall be constructed to insure that the points of the resistor mounting supports will have the same motion as the shock table. The mounting fixtures shall be constructed to preclude any resonance in the fixtures when subjected to the shock test, and the fixtures shall be monitored if necessary. Test lead used during this test shall be stranded wire no larger than 0.6mm in diameter so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no greater than necessary.

b) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

c) Test condition: I (980m/s^2, 6ms sawtooth)

d) Direction of applied shocks : In each of two mutually perpendicular directions, one perpendicular and the other parallel to the longitudinal axis of the resistors.

e) Number of applied shocks : The resistors shall be subjected to 10 shocks in each direction, for a total of 20 shocks.

f) Measurement during test
Each resistor shall be monitored with specified equipment during the shock for electrical discontinuity of 0.1ms or greater.

g) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

h) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

G.4.4.6.3 Thermal Shock

G.4.4.6.3.1 Thermal Shock [I]

Resistors shall be tested in accordance with Test Method 107 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

c) Test conditions
1) Temperature: As specified in Table G-17.
2) Load
The dc voltage corresponding to 50% of the rated power shall be applied to the resistors at the temperature as specified in step 2 of Table G-17 below.

d) Number of test cycles: 25 cycles

e) Cycle conditions
The first five cycles shall run continuously. After five cycles, the test may be interrupted following completion of any full cycle.

f) Measurement after test
The resistors shall be at room temperature for 30 minutes or more before the resistance is measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

Table G-17. Test Conditions of Thermal Shock [I]

Step	Temperature (°C)	Time (min.)
1	$-65\,^{0}_{-5}$	15
2	$150\,^{+3}_{0}$	15

G.4.4.6.3.2 Thermal Shock [II]

After measuring resistance in accordance with paragraph G.4.4.4.2, the resistors shall be subjected to the specified thermal shock cycle test under the conditions shown in Table G-18 and Figure G-2. The following conditions shall apply.

a) Method of mounting
The resistors shall be mounted by means other than soldering or be placed in trays of small heat inertia.

b) Load
The dc voltage corresponding to 50% of the rated power shall be applied at the temperature as specified in step 2 of Table G-18 below.

c) Number of test cycles: 1,000 cycles

d) Cycle conditions
The first 25 cycles shall run continuously. After 25 cycles, the test may be interrupted following completion of any full cycle.

e) Measurements during test and external inspection
The resistance shall be measured after the resistors are at room temperature for 30 minutes or more for each 25^{+5}_{0} cycles, 50^{+5}_{0} cycles, 100^{+10}_{0} cycles, 250^{+10}_{0} cycles and 500^{+10}_{0} cycles. The externals of all resistors shall be inspected visually for surface cracks.

f) Measurement after test
The resistance shall be measured in accordance with paragraph G.4.4.4.2 after the resistors are at room temperature for 30 minutes or more to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

Table G-18. Test Conditions of Thermal Shock [II]

Step	Temperature (°C)	Time (min.)
1	-30^{0}_{-5}	15
2	100^{+3}_{0}	15

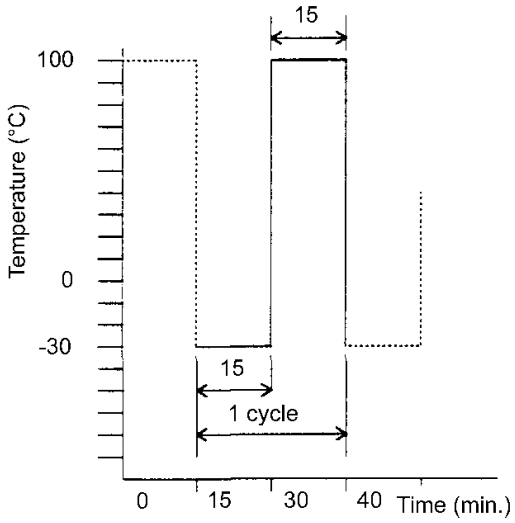


Figure G-2. Test Conditions of Thermal Shock [II]

G.4.4.6.4 Moisture Resistance

Resistors shall be tested in accordance with Test Method 106 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting

1) Where polarization is not applied
Solder both leads to rigid mounts or terminal lugs. The spacing of the mounts or terminal lugs shall be such that the length of each resistor

lead is approximately 10mm when measured from the edge of the supporting terminal to the resistor body.

2) Where polarization is applied

One half of the resistors mounted as specified in 1) above shall be covered with a V-shape metal strap whose width is equal to that of the resistor body as indicated in Figure G-3. The strap shall be made from corrosion-resistant metal and shall remain in contact with the resistor body by supporting the body as indicated in Figure G-3, with a nonconducting, noncorrosive support whose width is less than that of the resistor body. In addition, the support shall not allow condensation of moisture which may have an adverse influence on the test. An individual metal strap may be used for each resistor or one continuous metal strap for all resistors.

b) Measurement before test

After preparations are finished, the resistors shall be at room temperature for a minimum of 2 hours before the resistance is measured in accordance with paragraph G.4.4.4.2.

c) Polarization and loading voltage

1) Polarization voltage

A polarization voltage shall be applied to the resistors covered with a polarizing strap. During steps 1 through 6, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the polarizing straps.

2) Loading voltage

A loading voltage shall be applied to the resistors which are not covered with the metal strap. During the first 2 hours of steps 1 and 4, a dc test potential equivalent to 100% rated wattage shall be applied.

d) Final measurements

Upon completion of step 6 of the final cycle, the resistors shall be held at a relative humidity between 90 and 95% and 25±2°C for a period between 90 minutes and 210 minutes. Within 30 minutes of being removed from the chamber the dielectric withstanding voltage (atmospheric pressure) and insulation resistance of the resistors shall be measured, as specified in paragraphs G.4.4.4.5.1 and G.4.4.4.6 respectively. The change in resistance before and after the test shall also be calculated. After the test the resistors shall be examined for significant abnormality.

Resistors shall not be wiped nor shall forced air conditioning shall be used.

e) Subcycle

Step 7b shall not be applicable.

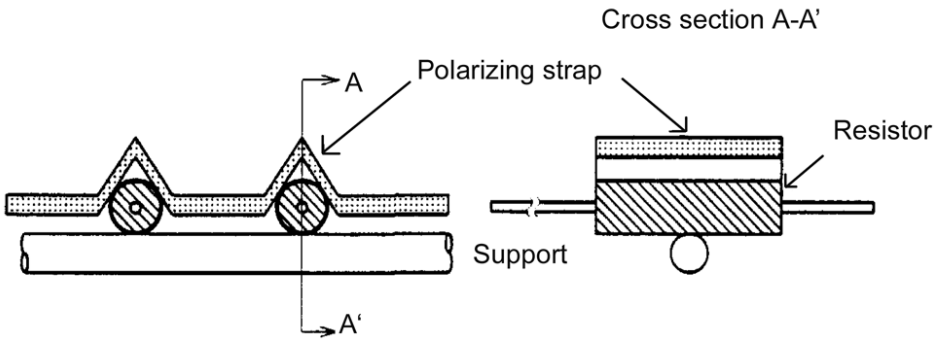


Figure G-3. Mounting Straps

G.4.4.6.5 Resistance to Solvents

Resistors shall be tested in accordance with Test Method 215 of MIL-STD-202. When type of solvents are limited, the solvents shall be specified in detail specification.

a) Application area: Marked portion
b) Solvents to be used
In accordance with Test Method 215 of MIL-STD-202.

G.4.4.6.6 Low Temperature Storage

The resistance shall be measured as specified in paragraph G.4.4.4.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at -65^{0}_{-5} °C for 24±4 hours. The temperature in the chamber shall then be gradually returned to room temperature before the resistors are removed from the chamber. Any water droplets on the surface shall be removed. The resistors shall remain at room temperature for at least 2 hours but less than 8 hours. The resistance shall then be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test. After the test the resistors shall be examined for significant abnormality using 5x-20x magnifier. The marking shall be examined for legibility.

G.4.4.6.7 Stability

After the resistance is measured in accordance with paragraph G.4.4.4.2, the resistors shall be put in a test chamber maintained at room temperature. The temperature in the chamber shall then be gradually increased to a test temperature of 275±7°C. After stabilizing at the test temperature, the resistors shall remain at no load for $2{,}000^{+48}_{0}$ hours. When the specified test time has passed, the temperature shall gradually be returned to room temperature. Upon removal from the test chamber, the resistors shall then remain at 25 ±5°C for 6±1 hours. The oxidized surface of the lead wire to be measured shall then be ground with an appropriate jig, and the resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

The resistors shall then be examined for significant abnormality using 5x-20x magnifier.

G.4.4.7 Durability

The durability test shall be performed as follows.

G.4.4.7.1 Life

Resistors shall be tested in accordance with Test Method 108 of MIL-STD-202. The following details and exceptions shall apply.

a) Method of mounting
The resistors shall be mounted to lightweight terminals. The effective length of each terminal shall be 9.5±1.6mm. The resistors shall be soldered to the terminals.

b) Test temperature: 25±5°C

c) Measurement before test
The resistance shall be measured in accordance with paragraph G.4.4.4.2.

d) Test conditions
The rated voltage specified in paragraph G.3.5.5 shall be applied intermittently, 90 minutes ON and 30 minutes OFF. The test voltage shall be regulated and controlled to maintain ±5% of the rated dc voltage. The test duration shall be $4{,}000\,^{+72}_{0}$ hours for the qualification test and $2{,}000\,^{+72}_{0}$ hours for the quality conformance inspection.

e) Measurements during test
1) Qualification test: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours, $1{,}000\,^{+48}_{0}$ hours and $2{,}000\,^{+72}_{0}$ hours.
2) Quality conformance inspection: $250\,^{+48}_{0}$ hours, $500\,^{+48}_{0}$ hours and $1{,}000\,^{+48}_{0}$ hours.

f) Measurements after test
After the resistors are at room temperature for a minimum of 45 minutes, the resistance shall be measured in accordance with paragraph G.4.4.4.2 to calculate the change in resistance before and after the test.

g) Examination after test
The resistors shall be examined for evidence of mechanical damage using 5x-20x magnifier.

G.4.5 Long-Term Storage

Long-term storage shall be in accordance with paragraph 4.7 of JAXA-QTS-2050.

G.4.6 Change of Tests and Inspections

Change of tests and inspections shall be in accordance with paragraph 4.8 of JAXA-QTS-2050.

G.5. PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with paragraph 5 of JAXA-QTS-2050.

G.6. NOTES

Refer to the paragraph 6 of JAXA-QTS-2050.