COMMON PARTS/MATERIALS, SPACE USE, APPLICATION DATA SHEET FOR

Part Description	FINE PITCH PRINTED WIRING BOARDS, GLASS BASE WOVEN EPOXY RESIN BASE MATERIAL, HIGH RELIABILITY, SPACE USE
Part Number and Type	JAXA 2140/B601GF III10
Applicable Specification	JAXA-QTS-2140 JAXA-QTS-2140/B601

August 2023

Prepared and Established by CMK CORPORATION

Issued by 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 data sheet: 24 September 2025

Record of revisions

Rev.	Date	Description
NC	24 Aug. 2023	Original Issued by CMK CORPORATION document number: CM84701

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Revision history

Rev.	Date	Description
-	2 Dec. 2022	Original
01	7 Jul. 2023	Changed the part name (consistency of application for certification content.) Paragraph 1.2 Applicable documents Changed the document name (consistency of detail specification document name change.) Changed the contents and details in accordance with appendix G of JAXA-QTS-2000. Paragraph 3.2.1 Added the paragraph titled "Conductor Width" with the contents. Paragraph 3.2.2 Added the paragraph titled "Copper Foil" with the contents. Paragraph 3.2.3 Added the paragraph titled "Conductor Spacing" with the contents. Paragraph 3.2.4 Added the paragraph titled "Interlayer Connection" with the contents. Paragraph 3.2.5 Added the paragraph titled "Land Diameter" with the contents. Paragraph 3.2.6 Added the paragraph titled "Thermal Land" with the contents. Paragraph3.2.7 Added the paragraph titled "Plating Thickness" with the contents. Paragraph 3.2.8 Added the paragraph titled "Dimensional Tolerance" with the contents. Paragraph 3.2.9 Added the paragraph titled "Design Value of Solder Resist" with the contents. Paragraph 3.2.10 Added the paragraph titled "Marking of Part Number" with the contents. Paragraph 3.2.11 Added the paragraph titled "SVH" with the contents. Paragraph 3.2.12 Added the paragraph titled "Location Layout of Mount Pads" with the contents. Paragraph 3.2.13 Added the paragraph titled "Connectors" with the contents. Paragraph 3.3 Added the paragraph titled "Recommended Mounting Method." Paragraph 4. CHARACTERISTICS UNDER NORMAL OPERATING CONDITIONS Changed the titles in the subparagraphs. Paragraph 6. ENVIRONMENTAL LIMITS Changed the test items to align with the requirements of qualification tests specified in appendix B of JAXA-QTS-2140. Paragraph 6.2 Design Specification for Samples

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Rev.	Date	Description
		Added the wording "As specified in appendix B of JAXA-QTS-2140" in the item "Materials" in Table 8. Deleted the document numbers "R-1566/R-1551" in the item "Materials" in Table 8 (Alignment to the detail specification.) Paragraph 6.3 Thermal Shock Changed the contents. Paragraph 6.4 Humidity and Insulation Resistance Changed the contents. Paragraph 6.5 Hot Oil Resistance Added the paragraph with the contents. Paragraph 6.6 Thermal stress Added the paragraph with the contents. Paragraph 6.7 Radiation Hardness Added the paragraph with the contents. Paragraph 6.8 Outgassing Added the paragraph with the contents. Paragraph 7. RELIABLITY Added the subparagraph with the contents of the possible failure modes. Paragraph 8. STORAGE CONDITIONS Changed the ambient temperature range and the relative humidity. Paragraph 9. NOTES Added the cautions for handling.

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Contents

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COMMON PARTS AND MATERIALS, SPACE USE,
APPLICATION DATA SHEET FOR

1. GENERAL

1.1 Scope

This Application Data Sheet provides detailed information necessary for part users for selection, design, and usage etc. of JAXA qualified parts to be installed in the applications. Users are responsible for their decisions on part selection and usage.

1.2 Applicable Documents

Unless otherwise specified, the documents listed below form a part of this specification to the extent specified herein.

JAXA-QTS-2140	Printed Wiring Boards, High Reliability, Space Use, General Specification for
CM84802	Fine Pitch Printed Wiring Boards, Glass Base Woven Epoxy Resin Base Material, High Reliability, Space Use, Detail Specification for △1

1.3 Reference Documents

Not applicable.

2. SUMMARY OF PRODUCTS

2.1 Externals and Dimensions

Externals and dimensions of the printed wiring board are specified in the drawing designed by the users. There are no such things as standard externals or dimensions of the printed wiring board.

2.2 Mass

Mass is dependent on the dimension andthickness of the printed wiring board, there are no such things as standard mass of the printed wiring board.

2.3 Construction of Elements

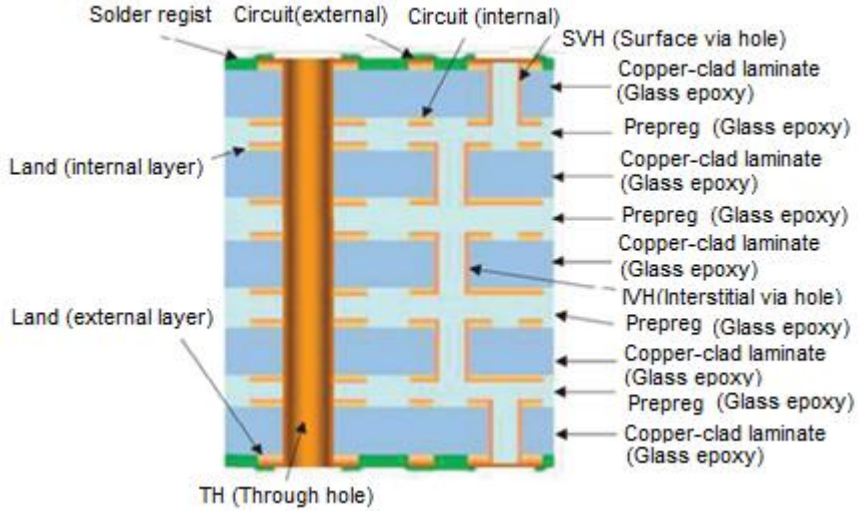


Figure 1. Printed Wiring Board with IVH (example: 10 layers)

Materials shall be a halogen free, FR-4.1 (UL/ANSI grade), R-1566 (copper-clad laminate) and R-1551 (Prepreg.) suppied by Panasonic Corporation.

Glass epoxy resin copper clad laminate: Tg (DSC method): 148°C

3. USAGE

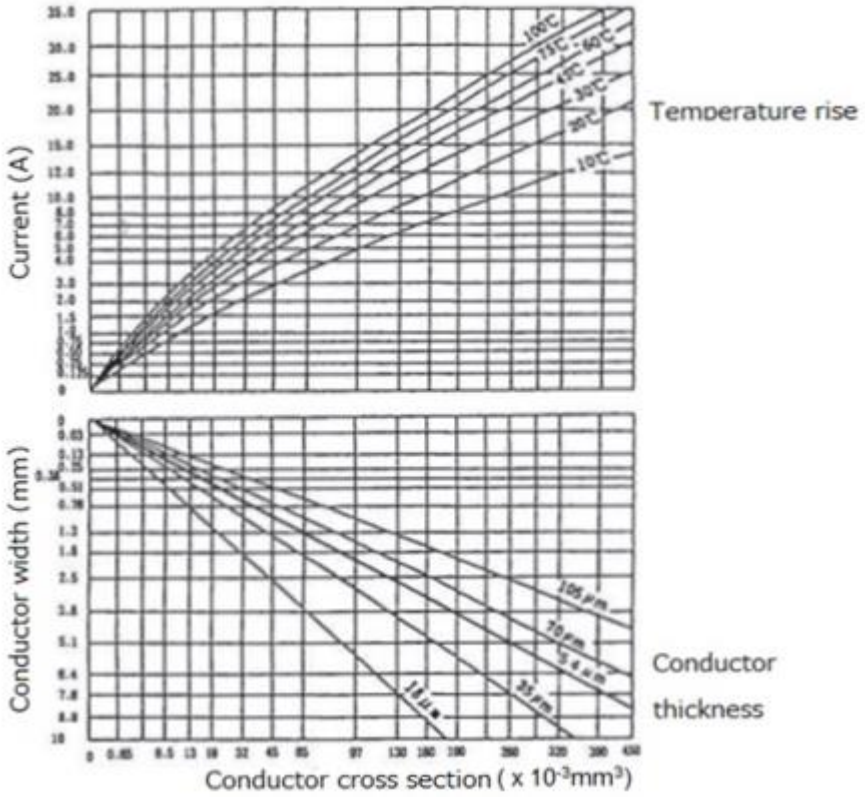
3.1 Rating

Temperature -65°C to 125°C

3.2 Caution in Circuit Design

3.2.1 Conductor Width ⚠1

The conductor width shall be 0.13 mm as a minimum on the design value.
The conductor width of the external and internal layers shall be designed with reference to Figures 2 and 3.



Remarks:

(1) This chart has been prepared as an aid in estimating relationships between the conductor sectional area and the current flowing in the conductor or the temperature rise from ambient temperature. The conductor surface area is assumed to be relatively small, compared to the adjacent insulating plate area. The allowable current value of this curve includes a nominal of 10 percent derating to allow for normal variations due to etching techniques, conductor thickness and width and cross-sectional areas.

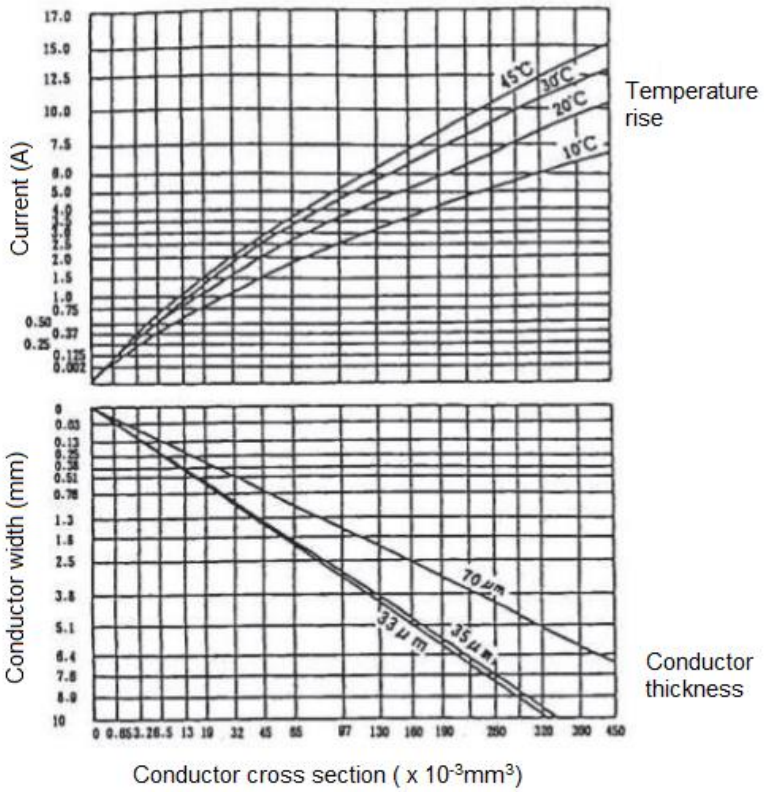
(2) Additional derating of 15% for the allowable current is suggnested under the following conditions:
a) When dilelectric layer thickness is less than 0.8mm.
b) When conductor thickness is 105μm or more.

(3) In general, the allowable temperature rise is defined as the difference between the maximum operating temperature of the printed wiring board and the maximum ambient temperature in the location where the printed wiring board will be used.

(4) For single conductor applications, the chart may be used for determing conductor widths, cross-sectional area and allowable current (current-carrying capacity)for various temperature rise.

(5) For groups of similar parallel conductors, if colsely spaced, the temperature rise may be found by using an equivalent cross-section and an equivalent current.
(6) The effect of heating due to heat generating parts in not considered.
(7) The final conductor thickness in the chart does not include plating thickness of metals other than copper.
(8) The 54μm line shall appliy to an external layer with SVH.

Figure 2. Conductor Width (External layer)



Remarks
(1) The remarks in Figure 2 apply to this figure. Remark (8) is excluded.
(2) For the internal layer comprising SVH and the internal layer comprising IVH, a line of 33μm shall be applied.
* If 12μm copper foil is to be applied to the internal layer of SVH, consult with the manufacturer in advance. △1

Figure 3. Conductor Width (Internal layer)

3.2.2 Copper Foil △1

Table 1. Copper Foil Thickness

	With SVH	With IVH	Without SVH/IVH
External layer	9μm as a mimimum	-	18μm as a mimimum
Internal layer	12μm as a mimimum	18μm as a minimum	35μm as a minimum

3.2.3 Conductor Spacing ⚠1

Table 2. Conductor Spacing

Voltage applied between conductors, DC or AC p-p (V)	Minimum conductor spacing (mm)	
	External layer	Internal layer
0 to 100	0.18	0.18
101 to 300	0.48	0.30
301 to 500	0.86	0.35
501 or higher	(0.003 x V) + 0.1	(0.003 x V) + 0.1

3.2.4 Interlayer Connection ⚠1

All interlayer connection shall be implemented using plating through holes including small via hole (drill hole ø0.35mm minimum), IVH (drill hole ø0.2mm minimum SVH (drill hole ø0.2 minimum.)

3.2.5 Land Diameter ⚠1

Table 3. Land Diameter

Hole	Minimum land diameter (mm)
IVH, SVH and small via holes	Ø (Drill Diameter+0.4) ※Minimum land diameter of small via hole is ø0.76
Plated-through holes except the above	Ø (Finished Through Hole Diameter +0.5)
Non-plated-through holes	Ø (Drill diameter +1.1)

To ensure the robustness of conductor connections, teardrops shall be provided on both the inner and external layers.

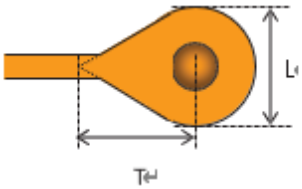
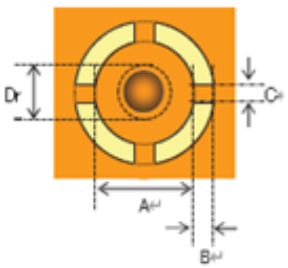


Figure 4. Tear Drop

Table 4. Tear Drop

Teardrop: T	T ≧ L

3.2.6 Thermal Land ⚠1



Figire 5. Thermal Land

Table 5. Thermal Land

A	B	C
A ≧Dr+0.40	B ≧ 0.15	C ≧ 0.10

3.2.7 Plating Thickness ⚠1

Table 6. Plating Thickness

Plating material	Thickness at the surface and through hole	
Electrolytic copper plating	Parts hole	25μm as a minimum
	Small via hole	30μm as a minimum
	IVH and SVH	15μm as a minimum
Solder coating	Thickness is not specified. However, the coating shall meet the requirements for solderability.	

3.2.8 Dimensional Toleralnce ⚠1

Table 7. Dimensional Tolerance

Item	Tolerance (mm)
External dimensions	±0.3 for the dimension of 100 or smaller, and additional 0.05 for every 50 in excess of 100.
Finished hole diameter	The tolerance of all hole diameters shall be +0.10 -0.15. However, the tolerance of finished diameters of IVH, SVH and small via holes is not specified.
Conductor width	0.13 or more and less than 0.20: ±0.05 0.20 or more and less than 0.50: ±0.10 0.50 or more: ±20% of conductor width
Conductor spacing	The conductor spacing in the case of 3 patterns between basic grids shall be set as -0.08, and the positive side is not specified. In addition, if there are two or less patterns between basic grids, the conductor spacing shall be set as -0.10, and the positive side is not specified. The conductor spacing in the external layer shall be 0.13 as a minimum.
Board thickness	The board thickness shall be between solder resist and solder resist.
Bow and twist	0.8% maximum (No treatment)

Nominal Board Thickness(T)	Tolerance
T≦0.6	±0.10
0.6<T≦1.0	±0.15
1.0<T≦1.2	±0.17
1.2<T≦1.6	±0.19

3.2.9 Design Value of Solder Resist ⚠1

The design value of solder resist diameter (diameter of solder resist recess) shall be designed as follows.

- Hole for attaching parts: land diameter + 0.2mm
- Small via hole: drill diameter + 0.1mm
- SVH: land shall be coated with solder resist.

▪ Pad for surface mounting: Normal: pad circumference + 0.1mm recess.
Minimum: pad circumference + 0.075mm recess

＊ If the minimum value other than specified above is to be used, consult with the manufacturer in advance.
If the solder resist recess diameter should be increased, take caution on the solder resist dam width.

3.2.10 Marking of Part Number △1

In principle, part number shall be marked on printed wiring board as specified in the applicable specification.

Part number example: JAXA 2140/B 601 GF III 10

JAXA 2140/B	: Applicable specification
601	: Individual identification
GF	: Glass base woven epoxy resin
III	: Multilayer
10	: Number of layers

3.2.11 SVH △1

SVH shall not be used as a part mounting pad.

3.2.12 Location Layout of Mount Pads △1

It is recommended to place solder resist between the mounting pads.
The conductor spacing, which conductor is on the external layer with the solder coat, shall be 0.25mm minimum where the solder resist is not coated between the mounting pads and/or the mounting pads are placed in a mixture in vertical, horizontal, and/or diagonal directions.

3.2.13 Connectors △1

Direct type printed circuit board connectors shall not be used.

3.3 Recommended Mounting Method △1

3.3.1 Soldering

The conditions of the flow soldering are recommended to a soldering temperature of 240 (+0, -5)°C and a soldering time of 3±0.5 seconds.
Storage during the mounting process shall be avoided and the next process shall be started immediately.

3.3.2 Repair

The conditions such as the temperature of soldeing iron, diameter of pad, material, operating environments shall be verified before repair.
Recommended conditions: Soldering tip temperature 350 ±10°C for 5 seconds, maximum 2 times.

4. CHARACTERISTICS UNDER NORMAL OPERATING CONDITIONS △1

4.1 Electric Characteristics

Conductor resistance of conductive pattern doesn't exceed Ri which is calculated by the following formula.

$$Ri = 2\rho\frac{\ell}{W \cdot t} \ (m\Omega \cdot mm)$$

ρ = 1.72 x 10^{-2} (mΩ • mm) (volume resistivity of copper at 20°C)
ℓ = Distance between lands (mm)
W = Conductor width (mm)
t = Conductor thickness (mm)

4.2 Mechanical Characteristics

Terminal pull strength is as follows.
The terminal pull strength shall be greater or equal to 89.2N or 1380N/cm^2, whichever is smaller. The pull strength is calculated by the following formula.

$$L \geqq 1380 \frac{\pi\left\{(d2)^2 - (d1)^2\right\}}{4}$$

L = Terminal pull strength (N)
d_1 = Hole diameter (cm)
d_2 = Land diameter (cm)

4.3 Thermal Characteristics

Conductor resistance change of conductive pattern due to temperature is given by Rx (mΩ) in the following formula.

Rx = Rc { 1 + 0.00377 (Tx - 20) }

Rc = Conductor resistance (mΩ) at 20°C
Tx = Temperature (°C)

4.4 Dielectric Withstanding Voltage

Dielectric withstanding voltage at 1000VAC/DC shall be applied for 30 seconds and meet the requirements without any insulation breakdown such as flashover and sparkover.

4.5 Solderability

a) Hole solderability
The through hole inside wall and land surface shall exhibit proper wetting of solder.

b) Surface solderability
A minimum of 95 percent of the surface conductor area shall be covered uniformly with new solder. The scattered existence of pinholes, dewetting or small roughened points shall be acceptable, provided that they are not concentrated in one area.

5. CHARACTERISTICS UNDER VARIOUS OPERATING CONDITIONS

No data.

6. ENVIRONMENTAL LIMITS ⚠1

6.1 Test Items of Environmental Limits

- Thermal shock
- Moisture and insulation resistance
- Hot oil resistance
- Thermal Stress
- Radiation hardness
- Outgassing

6.2 Design Specification for Samples

Table 8. Design Specification for Samples

No.	Items	Specification
1	Materials	As specified in appendix B of JAXA-QTS-2140 ⚠1 Glass base woven epoxy resin
2	Board thickness	1.6mm
3	Number of layers	10 layers
4	Through hole	IVH, SVH: drill diameter: ø0.2mm, plating thickness: 15μm Small via hole: drill diameter ø0.35mm, plating thickness: 30μm Component hole: drill diameter: ø0.8mm plating thickness 30μm
5	Conductor	Width: 0.13mm, Spacing: 0.18mm
6	Pattern	Test coupons as specified in appendix B of JAXA-QTS-2140

6.3 Thermal Shock ⚠1

6.3.1 Test Method

(1) Thermal shock test shall be in accordance with Method 107 of MIL-STD-202.

(2) The connection resistance between circuits of the sample shall be measured before the test.

(3) Samples shall be tested under the following conditions.

Table 9. Thermal Shock Temperature

Step	Temperature (°C)	Time (minute)
1	–30°C	30
2	25°C	Within 2
3	125°C	30
4	25°C	Within 2

(4) The steps 1 through 4 as one cycle shall be performed for 200 cycles.

(5) For the samples which have been completed 200 cycles, externals shall be inspected, and the resistance between circuits of the sample shall be measured after the test. The resistance change rate shall be calculated.

(6) The samples shall be run through the procedures above (3), (4) and (5) repeatedly up to 1200 cycles.

6.3.2 Acceptance Criteria

- At the completion of the test, no open circuit, blistering, measling, crazing or delamination shall be observed.
- At the completion of the test, no open circuit or circuit shorts between circuit patterns shall be observed.
- Tthe change rate of the resistance between the end–points (pads) of conductorpatterns shall be within 10%.

6.3.3 Test Results

1) Externals
   At the completion of the test, no open circuit, blistering, measling, crazing or delamination were observed.
2) Open circuit and/or Circuit shorts
   At the completion of the test, no open circuit or circuit shorts between circuit patterns were observed.
   The insulation resistance between the circuit patterns is shown in Table 10 and is met the requirement specified in JAXA-QTS-2140/B601.

Table 10. Insulation Resistance Measurements after Thermal Shock Test

Layer	Insulation Resistance Value (MΩ)
L1	3.93E+5
L2	1.65E+6
L3	5.38E+4
L4	3.52E+5
L5	7.71E+5
L6	8.30E+4
L7	1.65E+6
L8	4.76E+4
L9	2.22E+5
L10	1.82E+5

3) Change Rate of Resistance
   The change rate of resistance between the end–points (pads) of conductor patterns is shown in Figure 6, and is met the requirements specified in JAXA-QTS-2140/B601. (The data at 1200 cycles is for a reference only.)

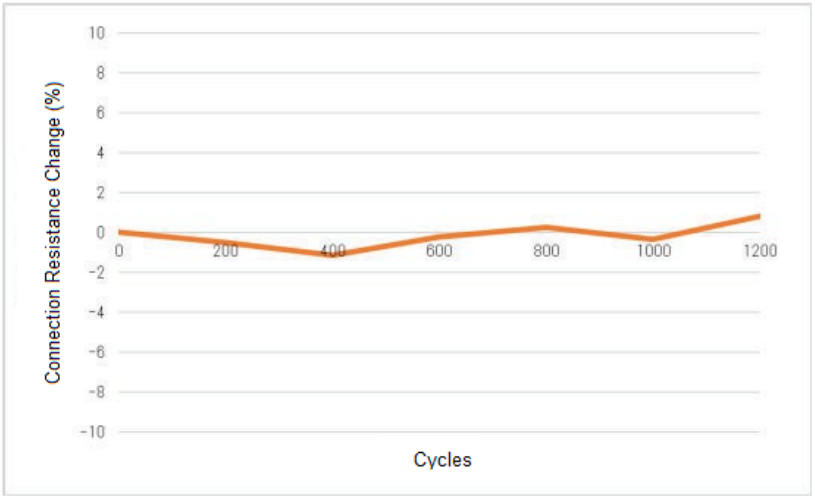


Figure 6. Change of Connection Resistance

＊ Figure 6 shows the test results of the test coupon placed the layouts of the test patterns including component hole, small via hole, SVH, IVH.

6.4 Moisture and Insuration Resistance ⚠1

6.4.1 Test Method

1) Perform the first 6 stages of MIL-STD-202 Test Method 106 for 10 cycles.
2) Apply all layers with a voltage of 100V±10VDC during the test.
3) After 10 cycles, remove from the chamber and dry in the air at 25°C ±5°C
4) Measure insulation resistance in accordance with MIL-STD-202 Test Method 302.

6.4.2 Acceptance Criteria

- At the completion of the test, no blistering, measling, or delamination shall be observed.
- At the completion of the test, insulation resistance between conductors shall be no less than 500MΩ.

6.4.3 Test Results

1) External
   In the appearance after completion of the test, defects such as open circuit, blistering, measling, crazing, and delamination were not observed.
2) Insulation Resistance
   The insulation resistance values before and after the test are as shown in Table 11, 12 and meet the requirements.

Table 11. Insulation Resistance Between Conductors on the same Layer After Moisture Resistance

Layer	Insulation resistance measurement value (MΩ)
L1	1.51E+6
L2	1.52E+6
L3	5.89E+6
L4	1.00E+7
L5	1.00E+7
L6	1.00E+7
L7	1.00E+7
L8	1.00E+7
L9	1.00E+7
L10	5.10E+7

Table 12. Insulation Resistance Between Adjacent Layers After Moisture Resistance

Layers	Insulation resistance measurement value (MΩ)
L1-L2	9.90E+5
L2-L3	3.50E+6
L3-L4	1.86E+6
L4-L5	7.04E+4
L5-L6	1.14E+6
L6-L7	1.56E+6
L7-L8	1.03E+6
L8-L9	1.00E+7
L9-L10	1.00E+7

6.5 Hot Oil Resistance △1

6.5.1 Test Method

1) The sample shall be dried at 120±5°C for 2 hours and cooled down to the room temperature.
2) The sample shall be soaked in oil or wax at 260±5°C for 5 seconds and cooled to the room temperature as one cycle, and perform 10 cycles.
3) After 10 cycles of the test, connection resistance shall be measured.

6.5.2 Criteria

▪ The rate of change in connection resistance between circuits before and after the test shall be less than 10%.

6.5.3 Test Results

The change rate of resistance after 10 cycle tests was 0.20% maximam, and met the requirements.

6.6 Thermal Stress △1

6.6.1 Test Method

1) Hold the sample at 121°C to 149°C for 2 hours to remove moisture.
2) Place on a ceramic board in a desiccator to cool.
3) Apply flux and float in a solder bath [Sn: 63%±5%, temperature: 288°C±5°C] for 10 seconds.
4) Place the sample on an insulating board and cool it.
5) Check for any abnormalities in appearance.
6) Cut vertically near the center of the hole, embed in resin and polish so that the center of the hole is exposed on the surface of the cross section.
7) Perform cross-sectional observation.

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6.6.2 Acceptance Criteria

- At the completeion of the test, defects such as measling, cracks, separation of plating and conductors, crazing and delamination shall not be observed.
- No cracks in the internal layer copper foil shall be observed when observing the cross section.
- When cross-sectional observation shows that the laminate void meets the minimum conductor spacing specified in the manufacturing drawings within the same layer or between layers, the maximum length shall be 76 μm or less.

6.6.3 Test Results

1) Externals
   In the appearance after the test, defects such as measling, cracks, peeling of plating and conductor, crazing, and delamination were not observed.
2) Cross-sectional observation
   No cracks or lamination voids in the internal layer copper foil were observed.

6.7 Radiation Hardness ⚠1

6.7.1 Test Method

1) Irradiate the sample with R-rays (cobalt-60) in the atmosphere at a rate of $0.5x10^4$Gy to $1x10^4$Gy per hour so that the total radiation dose is $1x10^4$Gy.
2) Visually inspect each part of the sample for deterioration.
3) Measure the withstand voltage and insulation resistance.

6.7.2 Acceptance Criteria

- The appearance at the completion of the test shall be free of defects such as measling, delamination and weave texture.
- At the completion of the test, the insulation resistance between conductors shall be 500MΩ or more.
- At the completion of the test, the sample shall be tested in accordance with MIL-STD-202 test method 301 with the appling voltage of 1000VAC peak or 1000VDC for 30 seconds and the sample shall not exhibit insulation breakdown, flashover or sparkover.

6.7.3 Test Results

1) Externals
   In the appearance after the test, no defects such as measling, delamination, and weave texture were observed.
2) Dielectric Withstanding Voltage Test
   The insulation resistance values between patterns and layers after the withstand voltage test are shown in Tables 13 and 14 below, and no dielectric breakdown such as flashover and sparkover were obserbed, which met the requirements.

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Table 13. Insulation Resistance Between Conductors on the same Layer

Layer	Insulation resistance measurement value (MΩ)
L1	8.65E+5
L2	8.44E+5
L3	2.33E+6
L4	4.79E+6
L5	2.89E+7
L6	4.78E+5
L7	2.57E+7
L8	1.98E+6
L9	8.19E+7
L10	2.07E+7

Table 14. Insulation Resistance Between adjacent Layers

Layers	Insulation resistance measurement value (MΩ)
L1-L2	1.00E+7
L2-L3	1.00E+7
L3-L4	2.71E+6
L4-L5	3.98E+5
L5-L6	6.96E+5
L6-L7	1.00E+7
L7-L8	3.50E+6
L8-L9	9.10E+5
L9-L10	1.00E+7

6.8 Outgassing △1

6.8.1 Test Method

Perform outgas measurements according to ASTM E595.

∗The outgassing measurement sample was prepared based on the amount of outgas emitted from the actual product, and was tested at the product level (including solder resist, marking ink, etc.) rather than the individual material.

6.8.2 Criteria

a) When selecting materials for space use, make decisions based not solely on the criteria of “TML: 1.0% or less, CVCM: 1.0% or less.” Which have been used for rescreening. Instead, consider the operating environment, usage amount, location of contamination sources and contaminated surfaces, and other factors to evaluate the impact of outgassing on the entire system before making a decision.TML: Total Mass Loss

b) CVCM: Collected Volatile Condensable Materials

c) WVR: Water Vapor Regain

6.8.3 Test Results

Outgassing data is shown in Table 15. It met the criteria.

Table 15. Outgassing Data

TML (%)	CVCM (%)	WVR (%)
0.323±0.002	0.000±0.000	0.103±0.001

7. RELIABILITY

7.1 Possible Failure Modes △1

The possible failure modes are as follows.

1) Open Circuits

- External layer open circuits
- Internal layer open circuits
- Through hole (incl. IVH and SVH) open circuits
- Open circuit of conductive interface

2) Circuit short
   - Circuit short
   - Insulation failure

3) Land breakdown
4) Separation of conductor and base material
5) Separation of plating and conductor
6) Bow and twist
7) Delamination
8) Insufficient solderability

8. STORAGE CONDITIONS

1) Ambient temperature: 0°C to 30°C ⚠1
2) Relative humidity: 70% RH maximum
3) Others:
   To maintain the quality of the printed wiring boards, the following storage practices shall be avoided.
   - Storage in places affected by acids and alkalis.
   - Storage in a place exposed to direct sunlight.
   - Storage for more than one week after opening the package.
   - Storage during the mounting process.
   - Storage in locations and conditions where it may be adversely affected by condensation, etc.

9. NOTES

1) If the temperature is too high during soldering, the base material and copper foil are likely to have blistering, so be sure to control the temperature and time carefully. In addition, in the case of a special mounting process, verify mounting process and finish of soldering on a prototype board in advance.
2) Printed wiring boards may absorb moisture and cause measling or blistering due to high temperature processing during part mounting, therefore paragraph 8 of this application data sheet shall be complied.
3) The surface of the printed wiring board shall not be touched directly once opened to keep the solderability and wetting of solder. ⚠1

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10. OTHERS

Contact information is as follows.

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