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

Part Description	THERMISTORS, LEADED, NEGATIVE TEMPERATURE COEFFICIENT
Part Number and Type	JAXA 2160/B101
Applicable Specification	JAXA-QTS-2160 JAXA-QTS-2160/B101

February 2023

Prepared and Established by TATEYAMA KAGAKU DEVICE TECHNOLOGY CO., LTD.

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: 18 June 2025

Record of revisions

Rev.	Date	Description
NC	27 Sept. 2016	Original.
A	28 Feb. 2023	Reflected the change of document by TATEYAMA KAGAKU DEVICE TECHNOLOGY CO., LTD. Document No: S3SU-2302 (Rev. NC)
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Revision history

Rev.	Date	Description
NC	28 Feb. 2023	Original The in-house control number was assigned to the first edition of JAXA-ADS-2160/B101 (Common Parts/Materials, Space use, Application data sheets for a Leaded Negative Thermistor) issued by JAXA with the updated information. The details were as follows. Updated the test results in the following test items to reflect requalification test results (Feb 2023). ・ Paragraph 4.1: Zero-power resistance deviation, dielectric withstanding voltage (in atmosphere), dielectric withstanding voltage (in reduced pressure), insulation resistance, and short-time load. ・ Paragraph 4.2: Dimensions (symbols A, B, C, D and E) and mass, resistance to soldering heat, terminal strength, high frequency vibration, random vibration, shock, thermal shock [I], thermal shock [II], thermal shock [IV], moisture resistance, moisture resistance (insulation resistance), and immersion cycling. ・ Paragraph 5.1: Resistance-temperature characteristics ・ Paragraph 5.2: Heat dissipation constant ・ Paragraph 5.3: Thermal time constant ・ Paragraph 5.4: Low temperature storage ・ Paragraph 5.5: High temperature exposure [I] and high temperature exposure [III] ・ Paragraph 5.6: Load life [II] ・ Paragraph 7.1: Failure rate
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COMMON PARTS/MATERIALS, SPACE USE,
APPLICATION DATA SHEET FOR

1. GENERAL

1.1 Scope

This Application Data Sheet provides additional detailed information necessary for designing or selecting products not contained in JAXA QML. Relevant information not covered in this document shall also be considered. Users are responsible for their decisions on part selection and usage.

1.2 Applicable Documents

JAXA -QTS-2160	Thermistors, High Reliability, Space Use, General Specification For
JAXA -QTS-2160/B101	Thermistors, Leaded, Negative Temperature Coefficient, High Reliability, Space Use, Detail Specification For

1.3 Reference Documents

Not applicable.

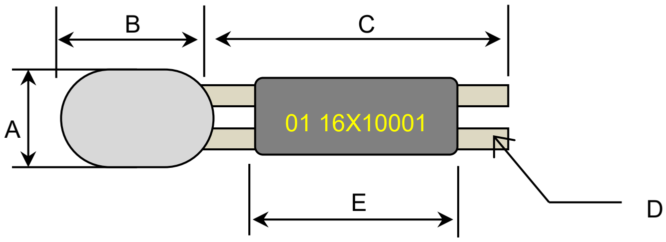
2. SUMMARY OF PRODUCT

The thermistors were developed as a leaded, negative coefficient thermistors for temperature monitor used in electric devices on satellites, and have high quality and high reliability.

2.1 Externals and Dimensions

The dimensions and mass of the products are shown in Table 1. The structure is shown in Figure 1.

Table 1. Dimensions and Mass



Unit: mm

Style	A	B	C	D	E	Mass (Ref.)
1800	MAX2.8	4.0±1.5	80+15/-0	Φ0.63 to 0.74	10±1.0	0.3 g
1501	MAX2.8	4.0±1.5	500+15/-0	Φ0.63 to 0.74	10±1.0	1.3 g
1102	MAX2.8	4.0±1.5	1000+15/-0	Φ0.63 to 0.74	10±1.0	2.7 g

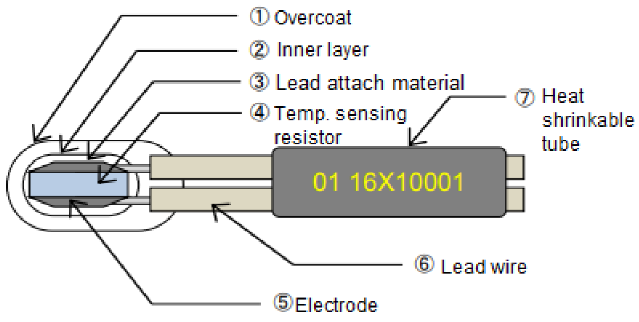


Figure 1. Structure

3. USAGE

3.1 Ratings

The ratings are shown in Table 2.

Table 2. Ratings

Test item	Applicable paragraph of JAXA-QTS-2160	Specification JAXA 2160/B101
Operating temperature range (°C)	B.3.5.a)	-55 to +150
Storage temperature range (°C)(1)	B.3.5.b)	-55 to +150
Rated ambient temperature(°C)	B.3.5.c)	+25
Nominal zero-power resistance range (Ω)	B.3.5.d)	As specified in Table 3
Zero-power resistance tolerance	B.3.5.e)	F=±1%, J=±5%
Nominal B-value range (K)	B.3.5.f)	As specified in Table 3
B-value tolerance	B.3.5.g)	F=±1%
Allowable operating power (mW)	B.3.5.h)	10
Heat dissipation constant (in air)	B.3.6.5	MIN 2.0mW/°C
Thermal time constant (in air)	B.3.6.6	MAX 20 seconds
Rated power (mW at +25°C) (2)	B.3.5.i)	310

Notes:

(1) Temperature range which allows parts to keep their performances even if they are left unloaded.

(2) The operating temperature shall be 25°C as a maximum and in the case the parts are used or tested continuously at a temperature exceeding 25°C, the rated power shall be derated in accordance with the derating curve shown in Figure 2.

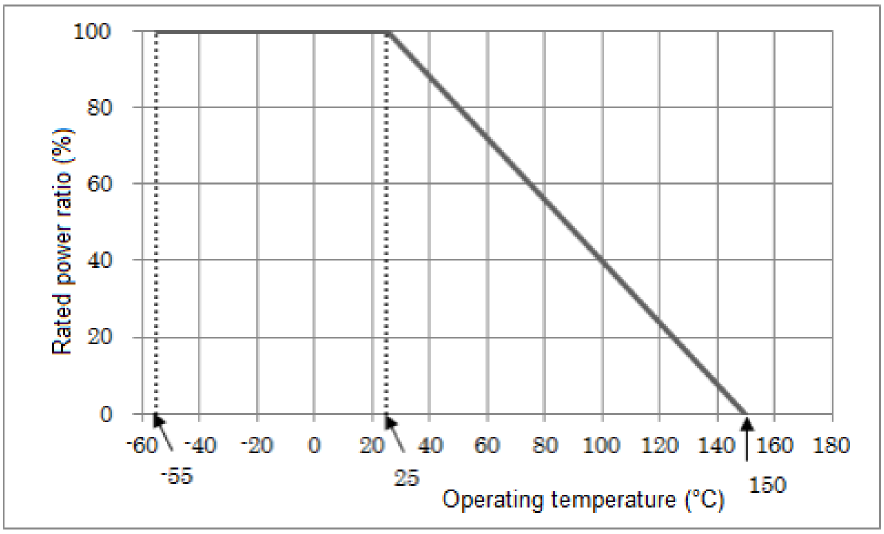


Figure 2. Power Derating Curve

3.2 Nominal B values and Nominal Zero-Power Resistance

The nominal B values (+25°C/+85°C) and the corresponding nominal zero-power resistances are shown in Table 3.

Table 3. Nominal B Value – Nominal Zero-Power Resistance

Part number	Nominal zero-power resistance (25°C)	Zero-power resistance tolerance	Nominal B value (25°C/85°C)	B value tolerance
JAXA2160/B101-1***S3750*2201*	2200Ω	±1%, ±5%	3750K	±1%
JAXA2160/B101-1***S3970*5001*	5000Ω	±1%, ±5%	3970K	±1%
JAXA2160/B101-1***S4150*1002*	10000Ω	±1%, ±5%	4150K	±1%

3.3 Recommended Operating Conditions

It is recommended to operate the thermistors at 10mW of the allowable operating power or less to ensure the accuracy of temperature correction and temperature measurement.

3.4 Rated Power and Allowable Operating Power

· JAXA-QTS-2160 defines rated power as “Rated power is a maximum power at which a thermistor can be loaded continuously at an operating temperature of 25°C or lower in the atmosphere or under atmospheric pressure”. Based on this definition, the rated power at 25°C is calculated by using heat dissipation constant and the maximum operating temperature.

Rated power = {(Maximum operating temperature) - (+25°C)}
x Heat dissipation constant

· The rated power can be applied under the environment where the operating temperature is controlled. However, the heat dissipation constant can be a problem.
· The heat dissipation constant of the thermistors varies significantly depending on the environment where the thermistors are used and installation condition. Since the rated power depends on heat dissipation constant, it is very difficult to control rated power for each circumstance.
· When the rated power cannot be controlled, the thermistors may cause thermal runaway.
When power is applied rapidly, the characteristics may deteriorate due to the temperature difference between the temperatures of the thermistor and atmosphere.
· The maximum power specified which can be applied at operating temperature range regardless of the installation conditions is allowable operating power.

3.5 Notes for Circuit Design

Not specified.

3.6 Recommended Mounting Method

It is recommended to refer JERG-0-041 for mounting method. However, soldering can be performed at +280°C to +320°C at the soldering tip within 5 seconds.

3.7 Table of Resistance-Temperature Characteristics (R-T Curve)

The table of resistance-temperature characteristics for the nominal zero-power resistance in Table 3 are shown in Tables 4 through 6. The values in tables 4 through 6 are for reference only and will not assure the characteristics of the thermistors.

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Table 4. Resistance-Temperature Characteristics JAXA2160/B101-1*S3750*2201***

Temperature	Resistance (kΩ)				
	R: -5% (J)	R: -1% (F)	Norm/ typ.	R: +1% (F)	R: +5% (J)
(°C)	B: -1% (F)	B: -1% (F)		B: +1% (F)	B: +1% (F)
-55	145.450	151.570	160.330	169.580	176.300
-50	103.710	108.080	113.880	119.990	124.740
-45	74.867	78.019	81.908	85.982	89.387
-40	54.679	56.981	59.611	62.355	64.825
-35	40.376	42.076	43.869	45.735	47.546
-30	30.126	31.394	32.626	33.904	35.246
-25	22.700	23.655	24.508	25.388	26.393
-20	17.264	17.991	18.584	19.194	19.954
-15	13.247	13.805	14.219	14.643	15.223
-10	10.250	10.682	10.972	11.269	11.715
-5	7.995	8.332	8.536	8.743	9.089
0	6.284	6.549	6.692	6.837	7.108
5	4.976	5.185	5.285	5.386	5.600
10	3.967	4.134	4.204	4.274	4.443
15	3.184	3.318	3.366	3.415	3.550
20	2.572	2.680	2.713	2.746	2.855
25	2.090	2.178	2.200	2.222	2.310
30	1.702	1.773	1.795	1.817	1.888
35	1.393	1.452	1.473	1.493	1.553
40	1.147	1.196	1.215	1.235	1.283
45	0.950	0.990	1.008	1.026	1.066
50	0.7903	0.8236	0.840	0.857	0.891
55	0.6609	0.6887	0.704	0.719	0.747
60	0.5554	0.5788	0.592	0.606	0.630
65	0.4689	0.4886	0.501	0.514	0.534
70	0.3976	0.4144	0.4255	0.437	0.454
75	0.3387	0.3530	0.3630	0.373	0.388
80	0.2897	0.3019	0.3110	0.320	0.333
85	0.2488	0.2593	0.2675	0.276	0.287
90	0.2146	0.2236	0.2310	0.2386	0.2481
95	0.1858	0.1936	0.2003	0.2072	0.2154
100	0.1614	0.1682	0.1742	0.1805	0.1876
105	0.1408	0.1467	0.1522	0.1578	0.1641
110	0.1232	0.1284	0.1334	0.1385	0.1440
115	0.1082	0.1128	0.1173	0.1219	0.1268
120	0.0954	0.0994	0.1035	0.1077	0.1120
125	0.0843	0.0879	0.0916	0.0955	0.0993
130	0.0748	0.0779	0.0813	0.0849	0.0883
135	0.0665	0.0693	0.0725	0.0757	0.0787
140	0.0594	0.0619	0.0647	0.0677	0.0704
145	0.0532	0.0554	0.0580	0.0608	0.0632
150	0.0477	0.0498	0.0522	0.0547	0.0568

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Table 5. Resistance-Temperature Characteristics JAXA2160/B101-1*S3970*5001***

Temperature	Resistance (kΩ)				
	R: -5% (J)	R: -1% (F)	Norm/ typ.	R: +1% (F)	R: +5% (J)
(°C)	B: -1% (F)	B: -1% (F)		B: +1% (F)	B: +1% (F)
-55	420.050	437.740	464.290	492.400	511.900
-50	294.070	306.450	323.710	341.910	355.460
-45	208.540	217.320	228.670	240.590	250.120
-40	149.700	156.000	163.540	171.420	178.210
-35	108.700	113.270	118.320	123.580	128.480
-30	79.789	83.149	86.557	90.095	93.663
-25	59.174	61.665	63.982	66.379	69.008
-20	44.315	46.181	47.765	49.398	51.354
-15	33.496	34.907	35.994	37.112	38.582
-10	25.543	26.618	27.368	28.135	29.249
-5	19.642	20.469	20.986	21.514	22.366
0	15.226	15.867	16.224	16.587	17.244
5	11.894	12.394	12.640	12.889	13.400
10	9.359	9.753	9.921	10.091	10.491
15	7.416	7.728	7.842	7.957	8.273
20	5.916	6.165	6.242	6.318	6.569
25	4.750	4.950	5.000	5.050	5.250
30	3.821	3.982	4.031	4.080	4.242
35	3.092	3.222	3.269	3.316	3.447
40	2.517	2.623	2.667	2.711	2.818
45	2.061	2.148	2.188	2.228	2.316
50	1.6964	1.7678	1.804	1.841	1.914
55	1.4038	1.4629	1.496	1.529	1.590
60	1.1677	1.2168	1.247	1.277	1.327
65	0.9761	1.0172	1.044	1.071	1.113
70	0.8198	0.8543	0.8781	0.903	0.938
75	0.6917	0.7209	0.7422	0.764	0.794
80	0.5863	0.6110	0.6301	0.650	0.675
85	0.4991	0.5202	0.5373	0.555	0.577
90	0.4267	0.4447	0.4600	0.4758	0.4947
95	0.3663	0.3818	0.3955	0.4097	0.4259
100	0.3158	0.3290	0.3414	0.3542	0.3682
105	0.2732	0.2847	0.2958	0.3073	0.3195
110	0.2373	0.2473	0.2573	0.2677	0.2783
115	0.2069	0.2156	0.2246	0.2340	0.2432
120	0.1810	0.1887	0.1968	0.2053	0.2134
125	0.1590	0.1657	0.1730	0.1807	0.1879
130	0.1401	0.1460	0.1526	0.1596	0.1659
135	0.1238	0.1291	0.1351	0.1415	0.1471
140	0.1099	0.1145	0.1200	0.1258	0.1308
145	0.0978	0.1019	0.1069	0.1122	0.1166
150	0.0873	0.0909	0.0956	0.1004	0.1044

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Table 6. Resistance-Temperature Characteristics JAXA2160/B101-1*S4150*1002***

Temperature	Resistance (kΩ)				
	R: -5% (J)	R: -1% (F)	Norm/ typ.	R: +1% (F)	R: +5% (J)
(°C)	B: -1% (F)	B: -1% (F)		B: +1% (F)	B: +1% (F)
-55	1,017.300	1,060.100	1,126.900	1,197.800	1,245.200
-50	701.930	731.490	774.270	819.460	851.910
-45	490.820	511.490	539.200	568.350	590.860
-40	347.540	362.170	380.300	399.310	415.120
-35	249.010	259.500	271.470	283.970	295.220
-30	180.430	188.020	196.000	204.290	212.380
-25	132.130	137.690	143.040	148.580	154.460
-20	97.740	101.860	105.460	109.180	113.510
-15	72.997	76.070	78.514	81.028	84.237
-10	55.017	57.333	58.994	60.698	63.102
-5	41.827	43.589	44.720	45.876	47.693
0	32.065	33.415	34.185	34.970	36.355
5	24.777	25.820	26.343	26.874	27.938
10	19.291	20.103	20.456	20.814	21.638
15	15.129	15.766	16.003	16.241	16.884
20	11.949	12.452	12.607	12.764	13.269
25	9.500	9.900	10.000	10.100	10.500
30	7.567	7.886	7.984	8.082	8.402
35	6.066	6.321	6.414	6.508	6.765
40	4.893	5.099	5.185	5.271	5.480
45	3.969	4.137	4.215	4.295	4.465
50	3.2388	3.3752	3.446	3.518	3.658
55	2.6573	2.7692	2.833	2.898	3.013
60	2.1918	2.2841	2.341	2.399	2.494
65	1.8172	1.8938	1.945	1.997	2.076
70	1.5142	1.5780	1.6233	1.670	1.736
75	1.2678	1.3212	1.3615	1.403	1.459
80	1.0666	1.1115	1.1473	1.184	1.231
85	0.9013	0.9393	0.9712	1.004	1.044
90	0.7651	0.7973	0.8257	0.8550	0.8889
95	0.6523	0.6797	0.7050	0.7312	0.7601
100	0.5584	0.5819	0.6045	0.6279	0.6527
105	0.4801	0.5003	0.5204	0.5413	0.5628
110	0.4143	0.4318	0.4498	0.4686	0.4871
115	0.3590	0.3741	0.3903	0.4071	0.4232
120	0.3122	0.3254	0.3399	0.3551	0.3691
125	0.2726	0.2841	0.2971	0.3108	0.3231
130	0.2388	0.2489	0.2607	0.2730	0.2838
135	0.2100	0.2189	0.2295	0.2407	0.2502
140	0.1853	0.1931	0.2028	0.2129	0.2213
145	0.1641	0.1710	0.1798	0.1890	0.1964
150	0.1458	0.1519	0.1599	0.1683	0.1749

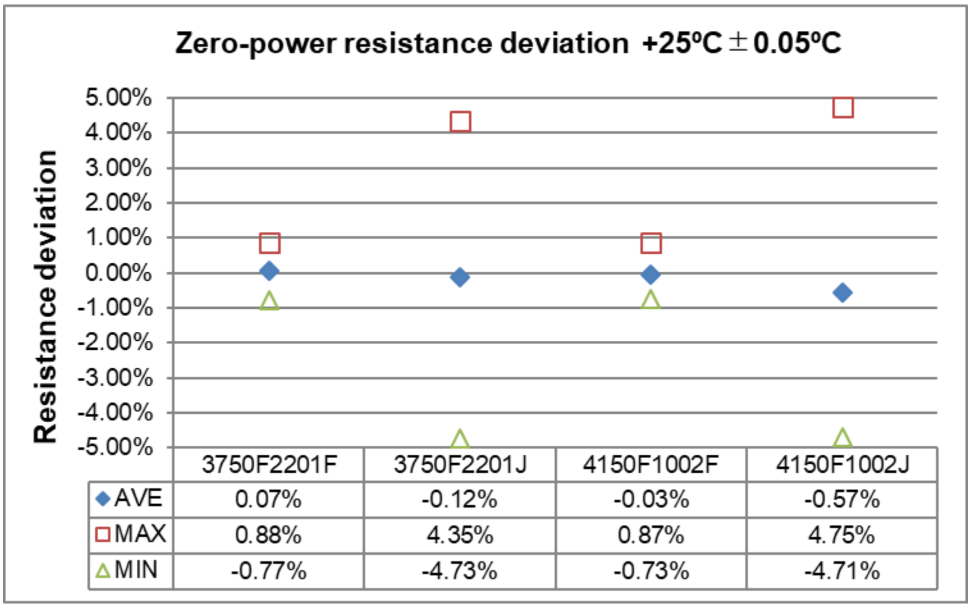
4. CHARACTERISTICS UNDER NORMAL OPERATING CONDITIONS

4.1 Electrical Characteristics

4.1.1 Zero-Power Resistance

+25°C±0.05°C The allowable resistance deviation varies depending upon the part number. n=334.

The zero-power resistance deviation is shown in Figure 3.



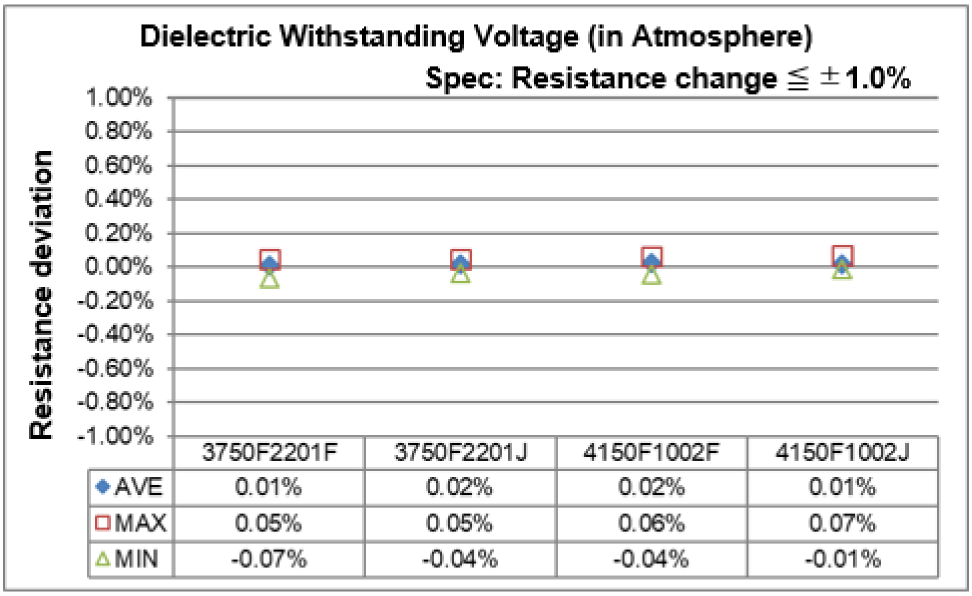
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	0.07%	-0.12%	-0.03%	-0.57%
MAX	0.88%	4.35%	0.87%	4.75%
MIN	-0.77%	-4.73%	-0.73%	-4.71%

Figure 3. Zero-Power Resistance

4.1.2 Dielectric Withstanding Voltage (in Atmosphere)

Applied 500VAC for 120 seconds: buried in the container with small metallic balls: n=20.

The result of dielectric withstanding voltage (in atmosphere) is shown in Figure 4.

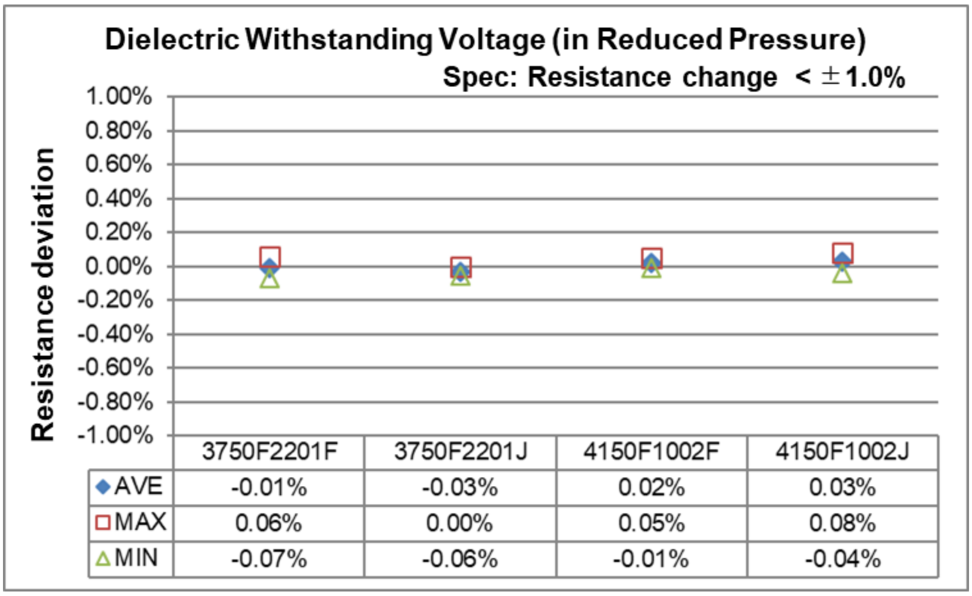


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	0.01%	0.02%	0.02%	0.01%
MAX	0.05%	0.05%	0.06%	0.07%
MIN	-0.07%	-0.04%	-0.04%	-0.01%

Figure 4. Dielectric Withstanding Voltage (In Atmosphere)

4.1.3 Dielectric Withstanding Voltage (in Reduced Pressure)

Applied 200VAC for 120 seconds: 4.39kPa, buried in the container with small metallic balls: n=20.
The result of dielectric withstanding voltage (in reduced pressure) is shown in Figure 5.

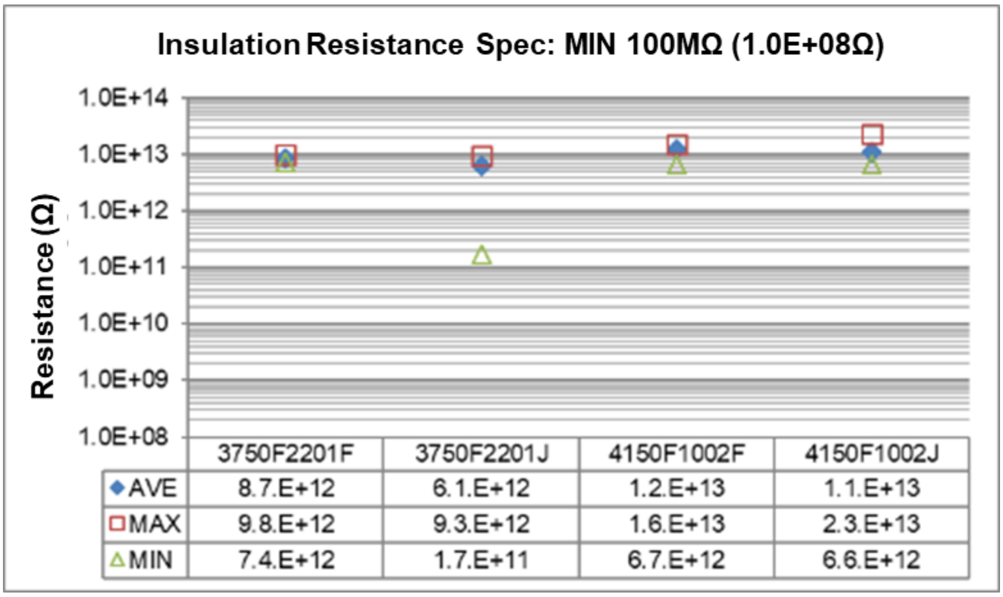


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	-0.01%	-0.03%	0.02%	0.03%
MAX	0.06%	0.00%	0.05%	0.08%
MIN	-0.07%	-0.06%	-0.01%	-0.04%

Figure 5. Dielectric Withstanding Voltage (in Reduced Pressure)

4.1.4 Insulation Resistance

Applied 100VDC for 60 seconds: buried in the container with small metallic balls: n=20.
The result of insulation resistance is shown in Figure 6.

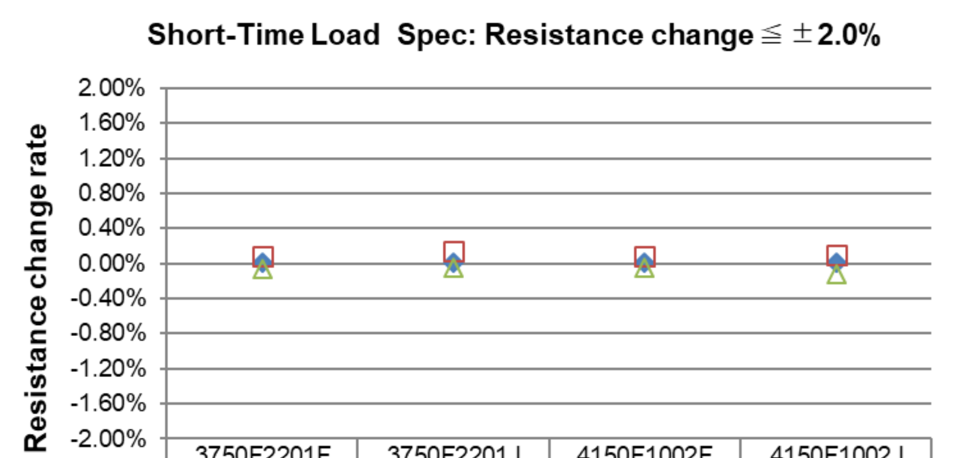


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	8.7.E+12	6.1.E+12	1.2.E+13	1.1.E+13
MAX	9.8.E+12	9.3.E+12	1.6.E+13	2.3.E+13
MIN	7.4.E+12	1.7.E+11	6.7.E+12	6.6.E+12

Figure 6. Insulation Resistance

4.1.5 Short-Time Load

Applied power: 10mW, ON for 5 minutes OFF for 10 minutes, 10 cycles, n=334.
The result of short-time load is shown in Figure 7.



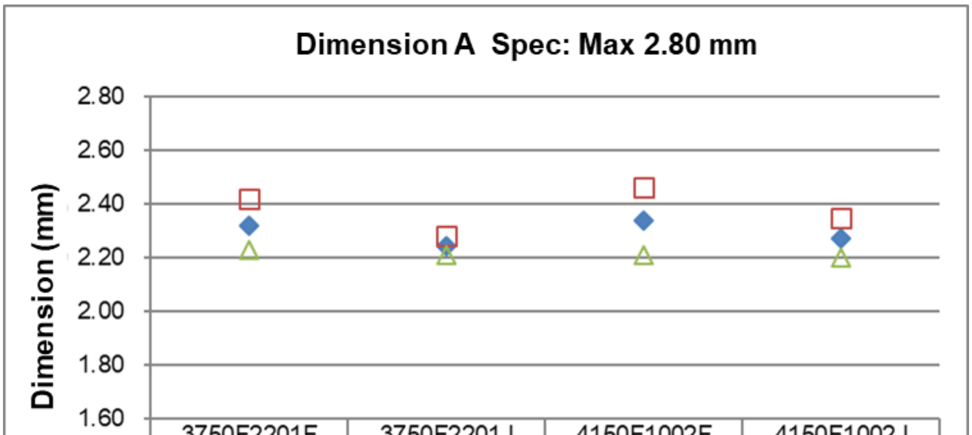
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.00%	0.02%	0.01%	0.01%
□MAX	0.09%	0.14%	0.09%	0.09%
△MIN	-0.07%	-0.05%	-0.04%	-0.12%

Figure 7. Short-Time Load

4.2 Mechanical and Thermal Characteristics

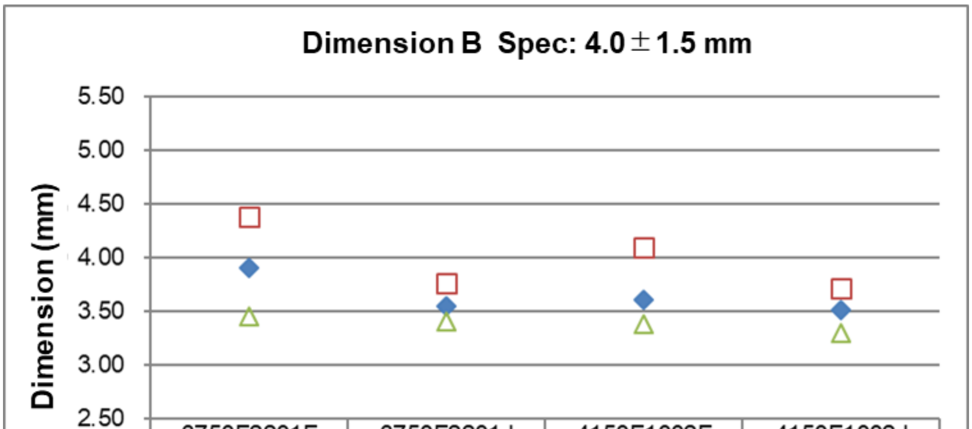
4.2.1 Dimensions and Mass

As specified in Table 1. Performed by using digital multi-meter and electric balance scale, n=13.
The result of each dimension and mass are shown in Figures 8 through 13.



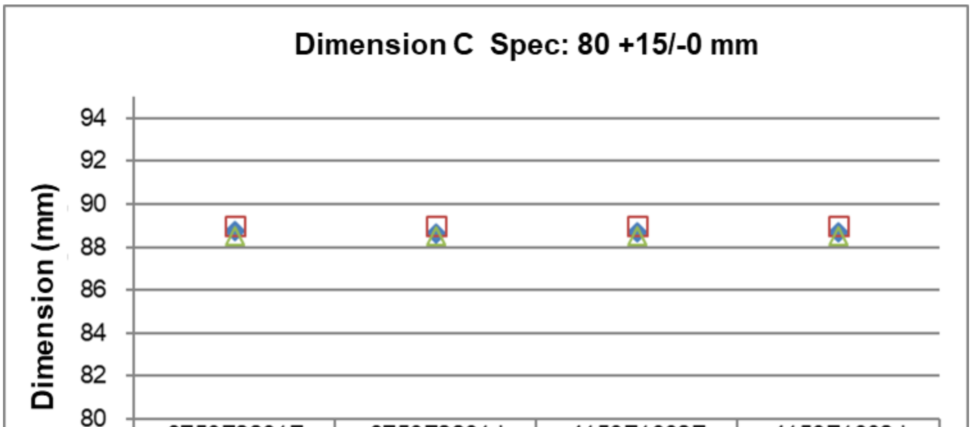
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	2.32	2.24	2.34	2.27
□MAX	2.42	2.28	2.46	2.35
△MIN	2.23	2.21	2.21	2.20

Figure 8. Dimension A



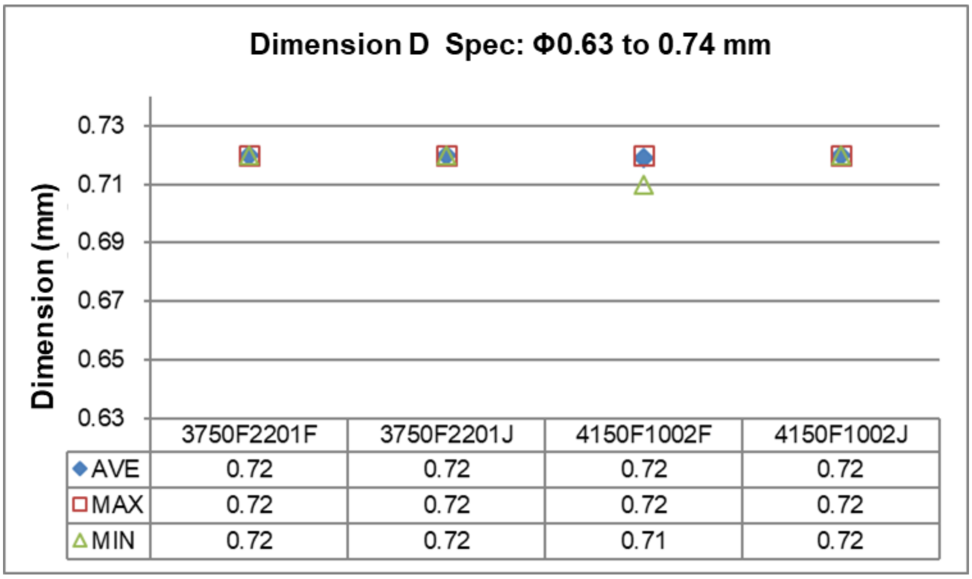
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	3.90	3.55	3.60	3.52
□MAX	4.38	3.76	4.10	3.72
△MIN	3.45	3.41	3.38	3.30

Figure 9. Dimension B



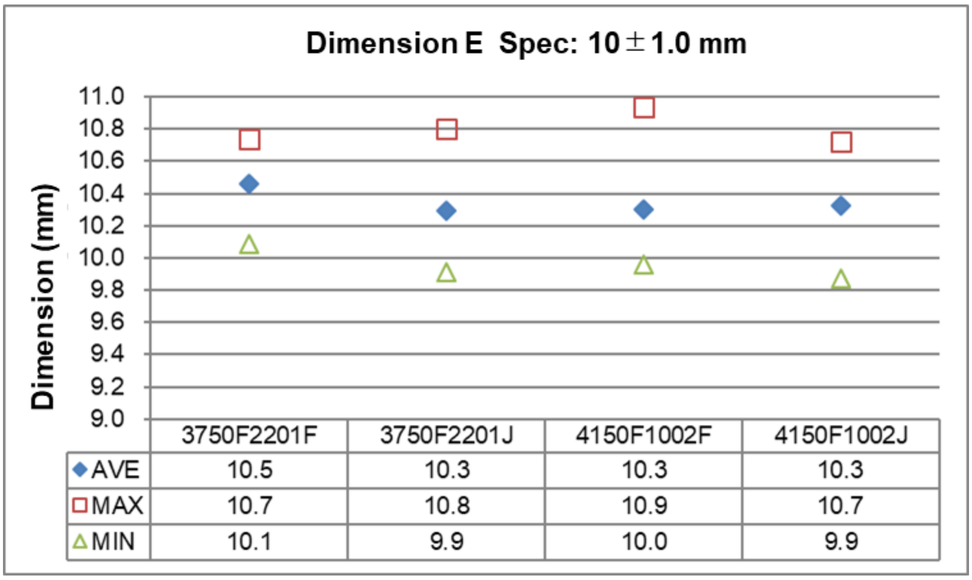
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	89	89	89	89
□MAX	89	89	89	89
△MIN	89	89	89	89

Figure 10. Dimension C
(For part number JAXA2160/B101-1800S □□□□*□□□□*)



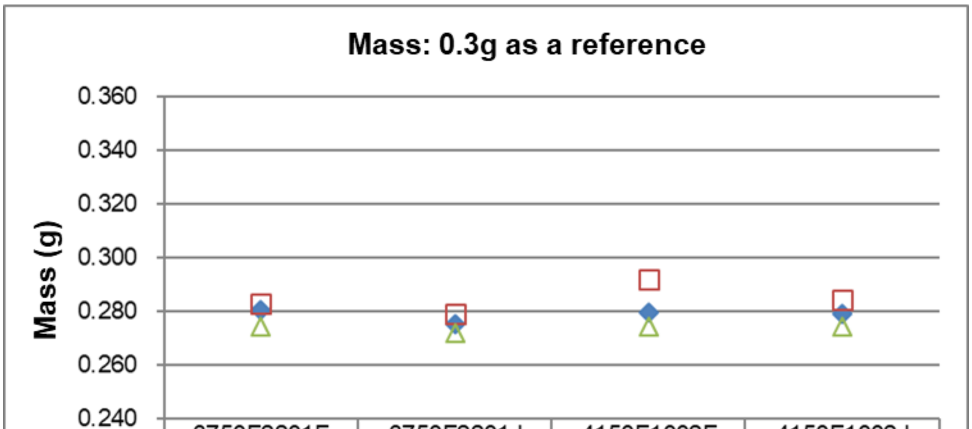
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	0.72	0.72	0.72	0.72
MAX	0.72	0.72	0.72	0.72
MIN	0.72	0.72	0.71	0.72

Figure 11. Dimension D



	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	10.5	10.3	10.3	10.3
MAX	10.7	10.8	10.9	10.7
MIN	10.1	9.9	10.0	9.9

Figure 12. Dimension E



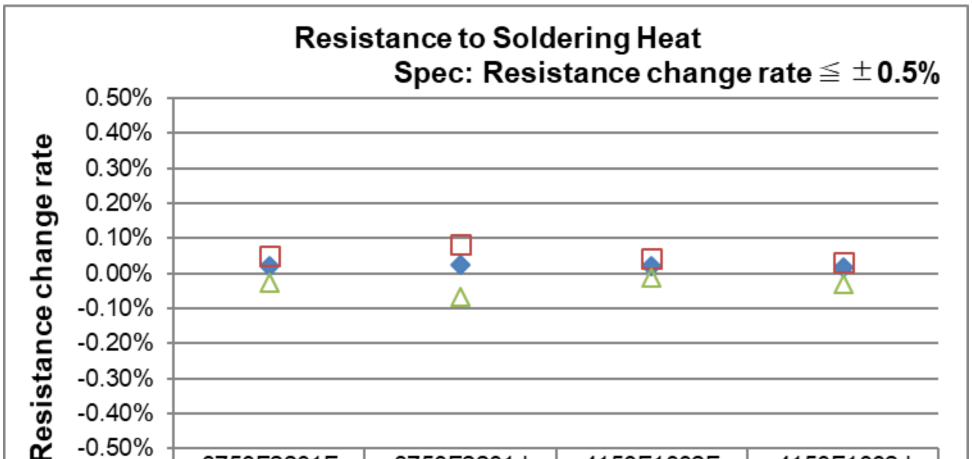
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.280	0.275	0.279	0.279
□MAX	0.283	0.279	0.292	0.284
△MIN	0.274	0.272	0.274	0.274

Figure 13. Mass (Reference)
(For part number JAXA2160/B101-1800S□□□□*□□□□*)

4.2.2 Resistance to Soldering Heat

Solder bath: +300 ± 10°C, immersion time 2±0.5 seconds, immersion speed: 25±6mm/s, immersion depth: 3.2 to 4.8mm from the sealed part of the thermistor, n=20.

The result of resistance to soldering heat is shown in Figure 14.

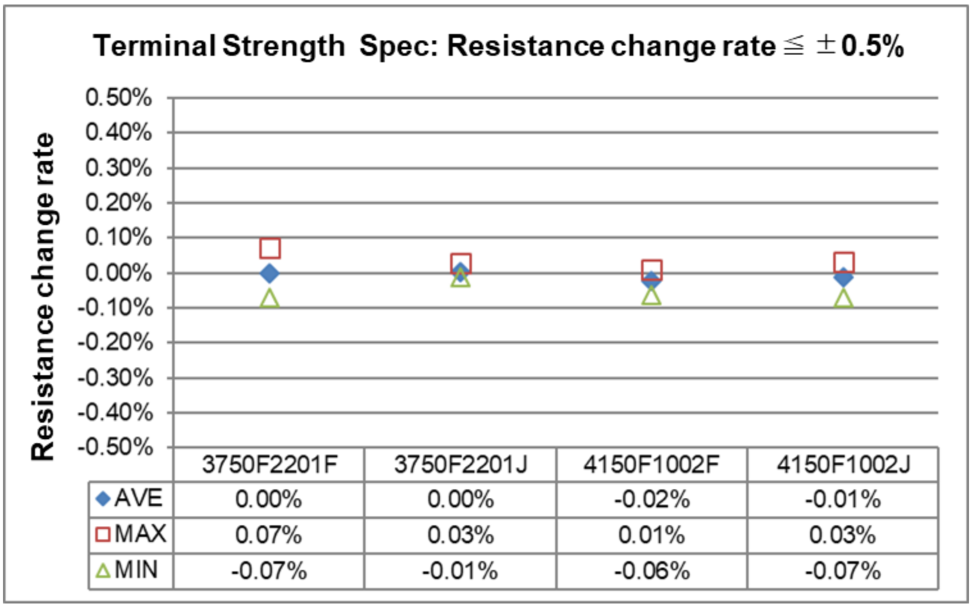


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.02%	0.02%	0.02%	0.02%
□MAX	0.05%	0.08%	0.04%	0.03%
△MIN	-0.03%	-0.07%	-0.01%	-0.03%

Figure 14. Resistance to Soldering Heat

4.2.3 Terminal Strength

2.2N (224gf) for 5 to 10 seconds, n=20.
The result of terminal strength is shown in Figure 15.

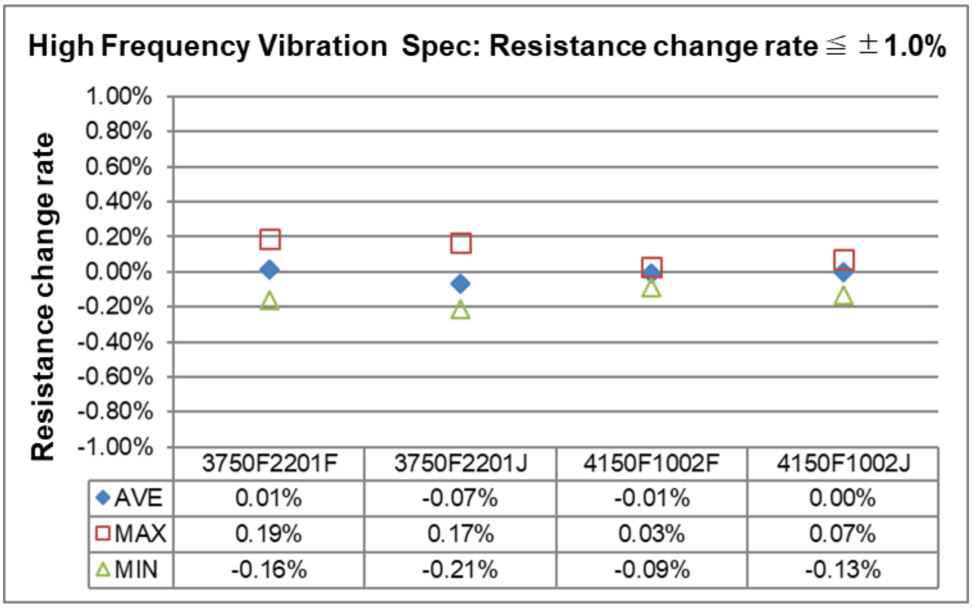


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.00%	0.00%	-0.02%	-0.01%
□MAX	0.07%	0.03%	0.01%	0.03%
△MIN	-0.07%	-0.01%	-0.06%	-0.07%

Figure 15. Terminal Strength

4.2.4 High Frequency Vibration

196 m/s2 (20 G) or total amplitude of 1.5mm whichever is smaller, 10 to 2,000Hz for 20 minutes, 12 times x 3 directions, n=20.
The result of high frequency vibration is shown in Figure 16.

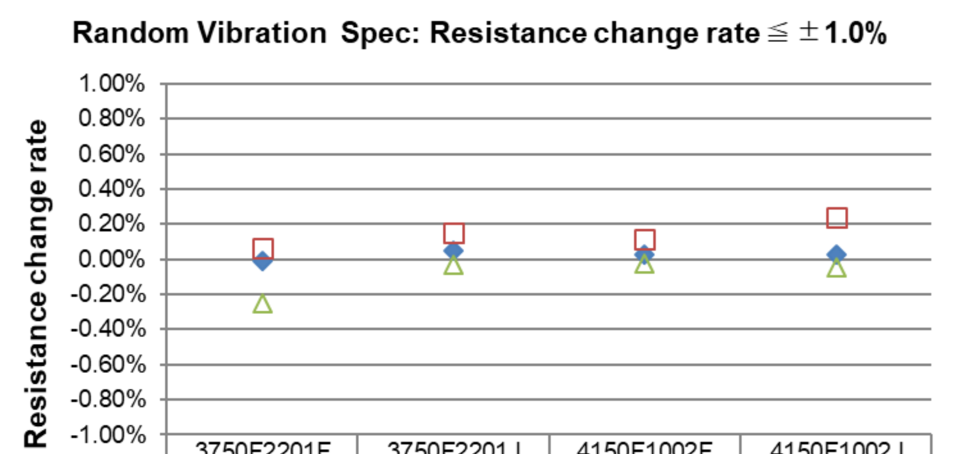


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.01%	-0.07%	-0.01%	0.00%
□MAX	0.19%	0.17%	0.03%	0.07%
△MIN	-0.16%	-0.21%	-0.09%	-0.13%

Figure 16. High Frequency Vibration

4.2.5 Random Vibration

50 to 2,000Hz, 334m/s² (34.02G) for 2 minutes, 5 times x 3 directions, n=20.
The result of random vibration is shown in Figure 17.

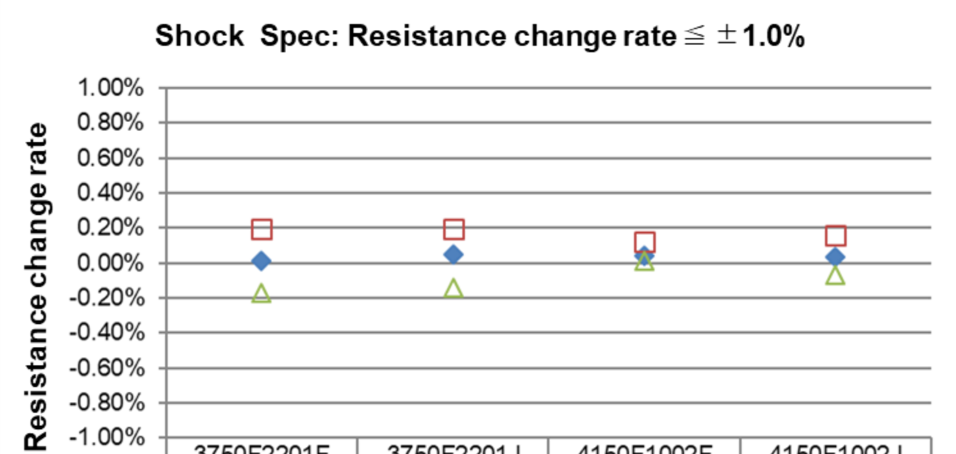


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	-0.01%	0.05%	0.03%	0.03%
□MAX	0.06%	0.15%	0.11%	0.24%
△MIN	-0.25%	-0.03%	-0.03%	-0.04%

Figure 17. Random Vibration

4.2.6 Shock

Amplitude of 980m/s² (100g's), for 6 milliseconds, half sinusoidal wave, speed change 3.75m/s, 10 times x 3 directions, n=20.
The result of shock is shown in Figure 18.



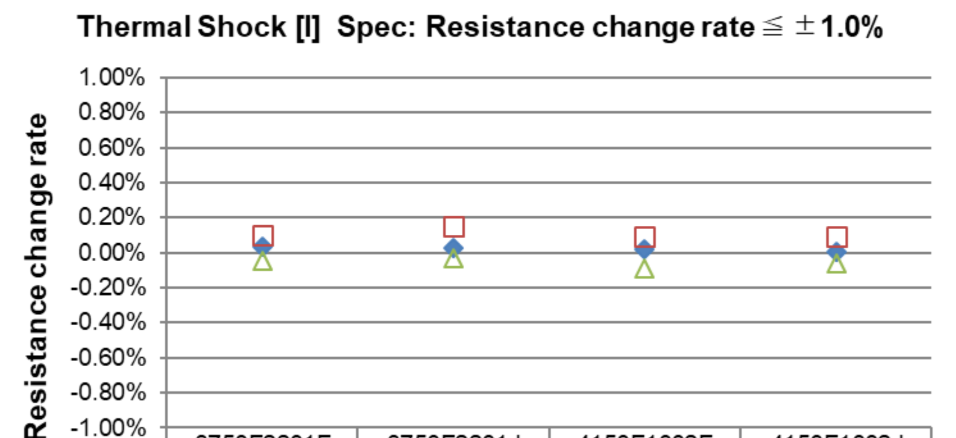
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.01%	0.05%	0.04%	0.04%
□MAX	0.19%	0.20%	0.12%	0.16%
△MIN	-0.17%	-0.14%	0.01%	-0.07%

Figure 18. Shock

4.2.7 Thermal Shock

4.2.7.1 Thermal Shock [I]

-55°C and +150°C, exposure for 15 minutes each, 10 cycles, n=334.
The result of thermal shock [I] is shown in Figure 19.

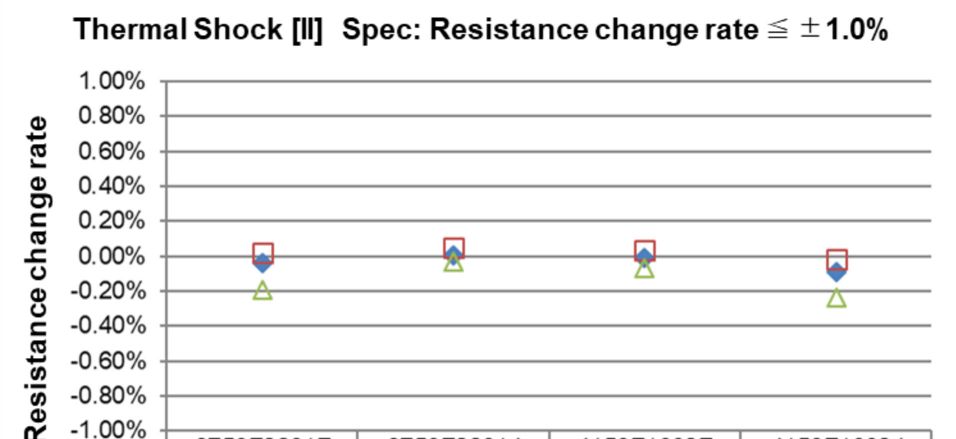


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.03%	0.02%	0.02%	0.01%
□MAX	0.10%	0.15%	0.10%	0.09%
△MIN	-0.05%	-0.03%	-0.09%	-0.06%

Figure 19. Thermal Shock [I]

4.2.7.2 Thermal Shock [II]

-55°C and +150°C, exposure for 15 minutes each, 25 cycles, n=20.
The result of thermal shock [II] is shown in Figure 20.

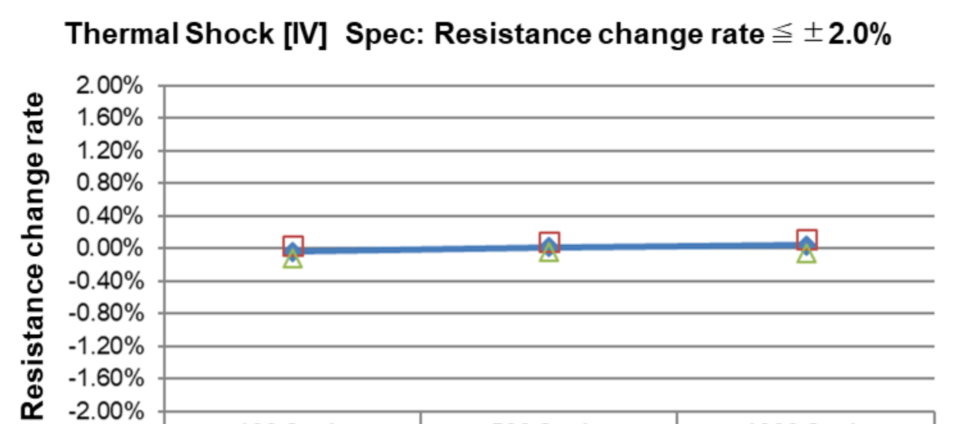


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	-0.04%	0.00%	-0.01%	-0.09%
□MAX	0.02%	0.05%	0.04%	-0.01%
△MIN	-0.20%	-0.03%	-0.07%	-0.23%

Figure 20. Thermal Shock [II]

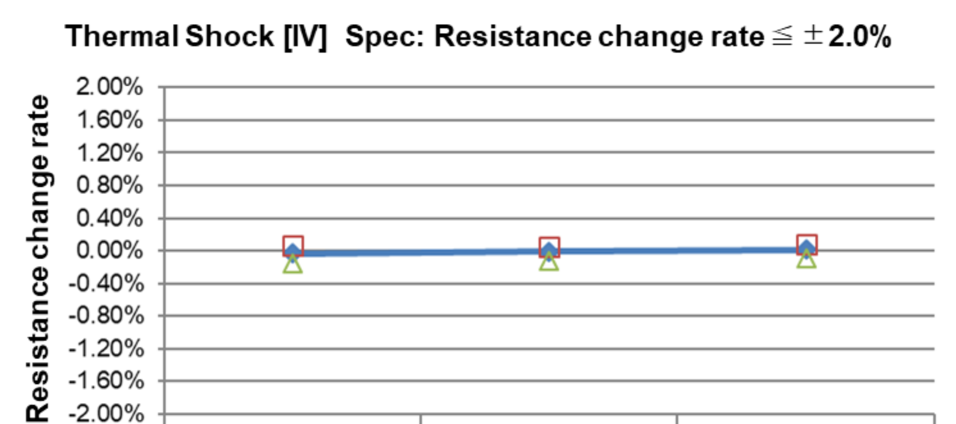
4.2.7.3 Thermal Shock [IV]

-55°C and +150°C, exposure for 15 minutes each, 1,000 cycles (intermediate measurement points at 100 and 500 cycles), n=20.
The results of thermal shock [IV] are shown in Figures 21 through 24.



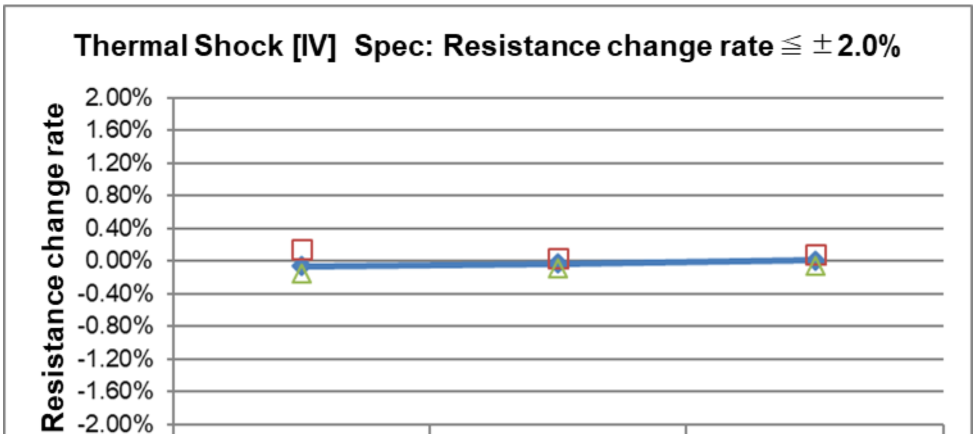
	100 Cycle	500 Cycle	1000 Cycle
AVE	-0.04%	0.01%	0.04%
MAX	0.03%	0.08%	0.12%
MIN	-0.12%	-0.04%	-0.05%

Figure 21. Thermal Shock [IV] 3750F2201F



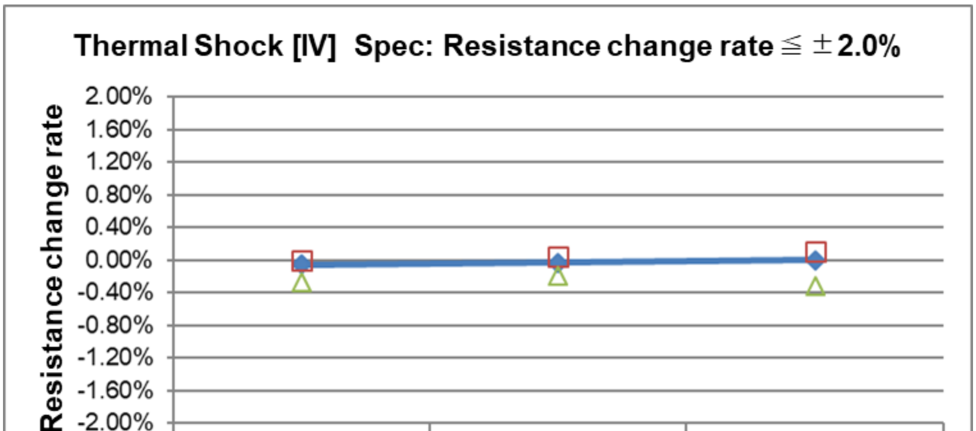
	100 Cycle	500 Cycle	1000 Cycle
AVE	-0.03%	-0.01%	0.01%
MAX	0.07%	0.05%	0.08%
MIN	-0.16%	-0.13%	-0.10%

Figure 22. Thermal Shock [IV] 3750F2201J



	100 Cycle	500 Cycle	1000 Cycle
AVE	-0.06%	-0.03%	0.01%
MAX	0.15%	0.03%	0.09%
MIN	-0.14%	-0.09%	-0.06%

Figure 23. Thermal Shock [IV] 4150F1002F



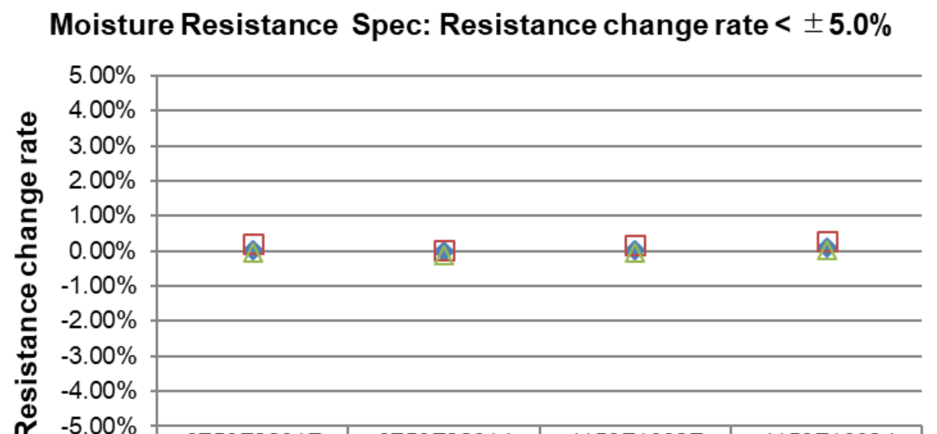
	100 Cycle	500 Cycle	1000 Cycle
AVE	-0.05%	-0.03%	0.00%
MAX	-0.01%	0.05%	0.10%
MIN	-0.26%	-0.19%	-0.31%

Figure 24. Thermal Shock [IV] 4150F1002J

4.2.8 Moisture Resistance

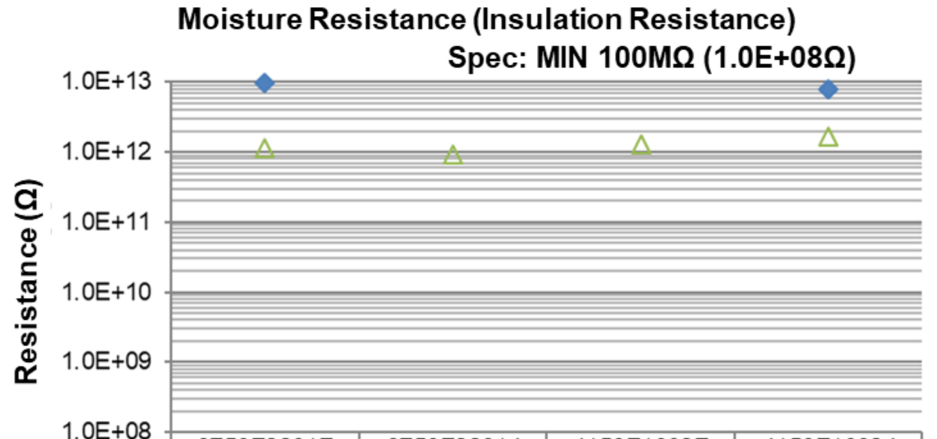
+25°C for 3 hours and +65°C for 3 hours, 90 to 100%RH, 10 cycles, applied voltage for the first 2 hours of steps 2 and 5 (as shown in MIL-STD-202-106) to the half of the total samples, n=20.

The result of moisture resistance is shown in Figures 25 and 26.



	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.02%	-0.02%	0.02%	0.09%
□MAX	0.22%	0.01%	0.16%	0.27%
△MIN	-0.06%	-0.11%	-0.04%	0.03%

Figure 25. Moisture Resistance (Resistance Change Rate)

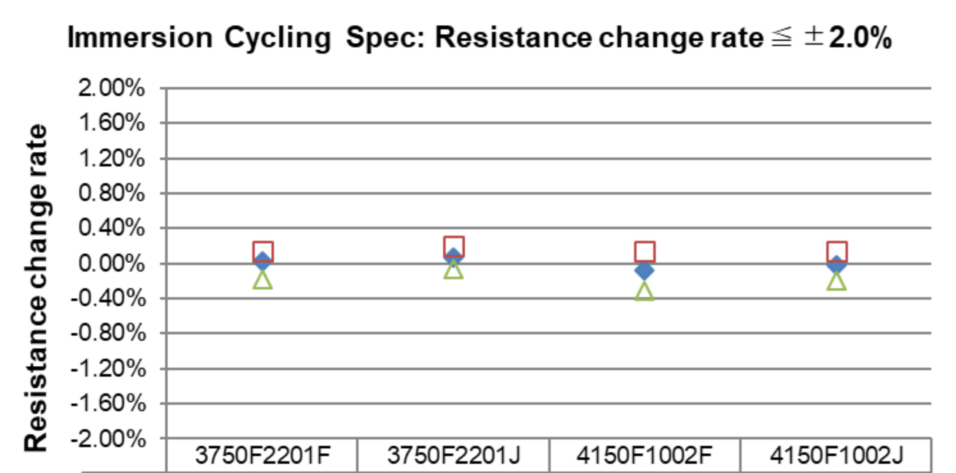


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	9.7.E+12	1.7.E+13	1.5.E+13	8.0.E+12
□MAX	6.5.E+13	9.7.E+13	6.5.E+13	3.4.E+13
△MIN	1.2.E+12	9.3.E+11	1.3.E+12	1.7.E+12

Figure 26. Moisture Resistance (Insulation Resistance)

4.2.9 Immersion Cycling

Soaked in water at +65°C and Saturated Sodium Chloride solution at +25°C, 2 cycles, n=20. The result of Immersion cycling is shown in Figure 27.



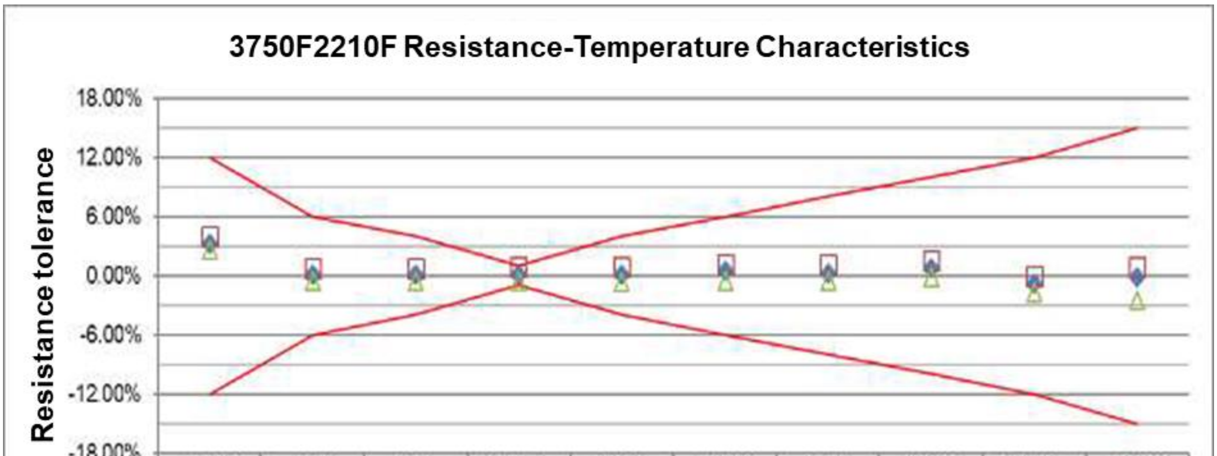
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
◆AVE	0.02%	0.07%	-0.07%	-0.01%
□MAX	0.15%	0.19%	0.15%	0.14%
△MIN	-0.18%	-0.06%	-0.31%	-0.20%

Figure 27. Immersion Cycling

5. Characteristics under Various Operating Conditions

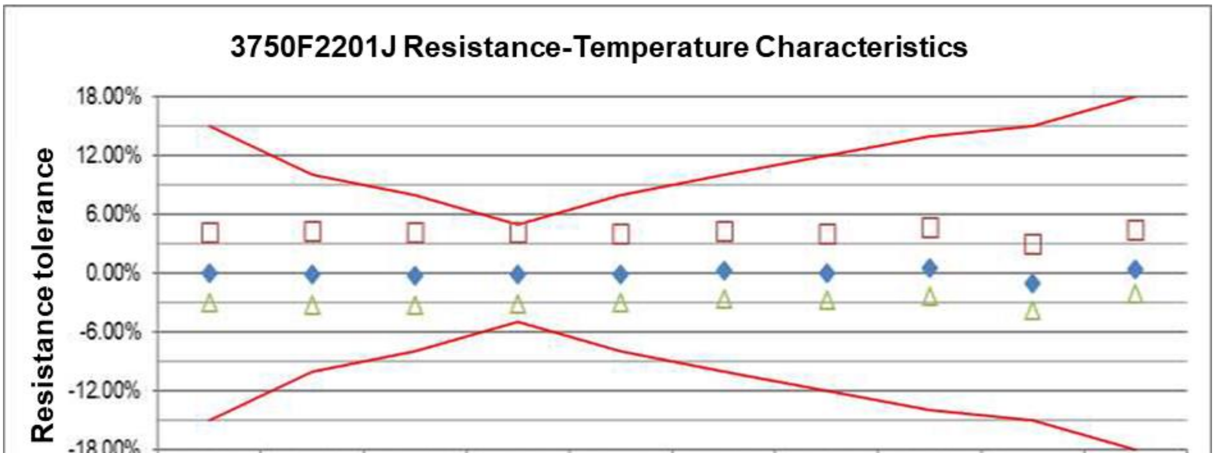
5.1 Resistance-Temperature Characteristics

Conditions: -55°C, -15°C, 0°C, +25°C, +50°C, +75°C, +85°C, +100°C, +125°C, +150°C, Temperature stability at each temperature ±0.05°C. n=20.
The results of each resistance-temperature characteristic are shown in Figures 28 through 31.



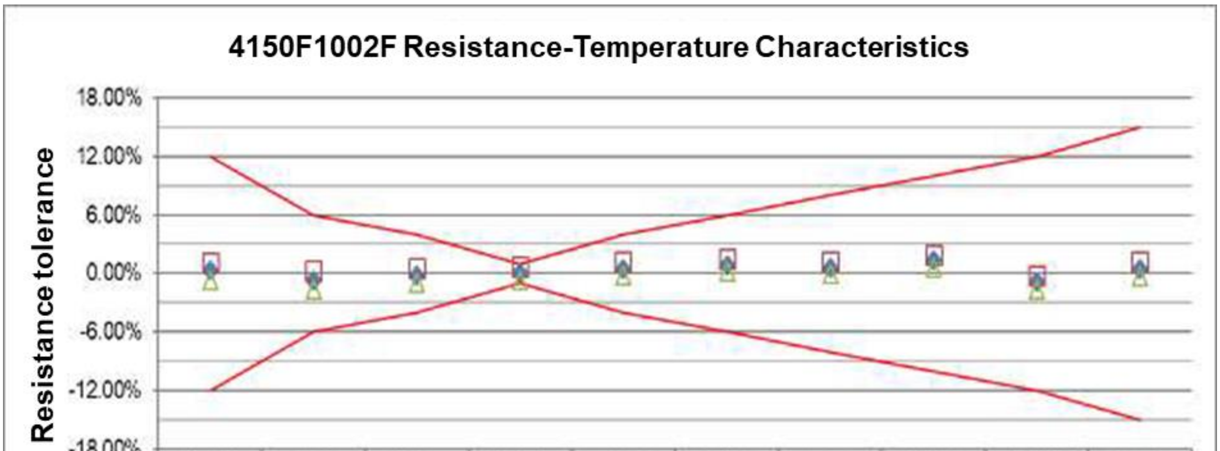
	-55℃	-15℃	0℃	25℃	50℃	75℃	85℃	100℃	125℃	150℃
◆ AVE	3.26%	0.10%	0.08%	0.13%	0.13%	0.44%	0.25%	0.77%	-0.78%	-0.14%
□ MAX	4.06%	0.70%	0.73%	0.82%	0.83%	1.16%	1.18%	1.54%	-0.01%	0.94%
△ MIN	2.60%	-0.50%	-0.50%	-0.58%	-0.68%	-0.59%	-0.59%	-0.22%	-1.77%	-2.52%
Tolerance	12.00%	6.00%	4.00%	1.00%	4.00%	6.00%	8.00%	10.00%	12.00%	15.00%
Tolerance	-12.00%	-6.00%	-4.00%	-1.00%	-4.00%	-6.00%	-8.00%	-10.00%	-12.00%	-15.00%

Figure 28. Resistance-Temperature Characteristics 3750F2201F



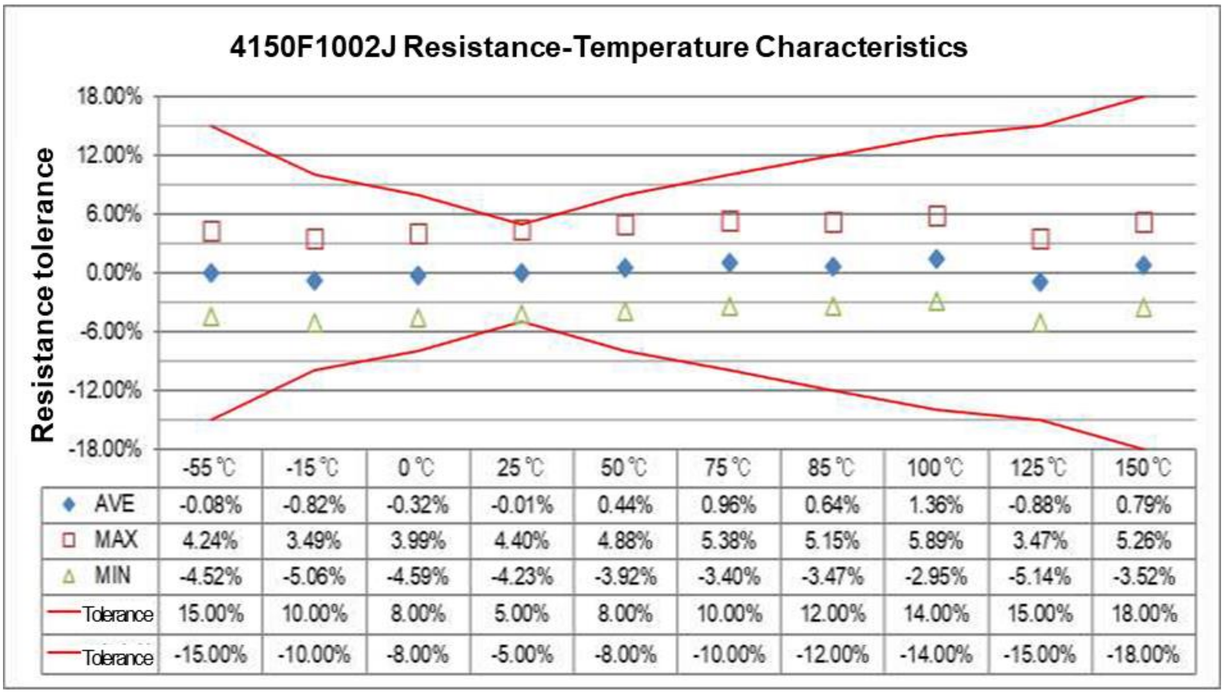
	-55 ℃	-15 ℃	0 ℃	25 ℃	50 ℃	75 ℃	85 ℃	100 ℃	125 ℃	150 ℃
◆ AVE	0.02%	-0.11%	-0.20%	-0.13%	-0.05%	0.24%	0.02%	0.53%	-1.03%	0.42%
□ MAX	4.25%	4.27%	4.14%	4.13%	4.10%	4.37%	4.01%	4.68%	3.04%	4.51%
△ MIN	-2.99%	-3.29%	-3.32%	-3.13%	-3.01%	-2.55%	-2.70%	-2.27%	-3.75%	-2.04%
Tolerance	15.00%	10.00%	8.00%	5.00%	8.00%	10.00%	12.00%	14.00%	15.00%	18.00%
Tolerance	-15.00%	-10.00%	-8.00%	-5.00%	-8.00%	-10.00%	-12.00%	-14.00%	-15.00%	-18.00%

Figure 29. Resistance-Temperature Characteristics 3750F2201J



	-55 ℃	-15 ℃	0 ℃	25 ℃	50 ℃	75 ℃	85 ℃	100 ℃	125 ℃	150 ℃
◆ AVE	0.30%	-0.74%	-0.26%	0.02%	0.50%	0.86%	0.65%	1.33%	-0.92%	0.48%
□ MAX	1.09%	0.30%	0.54%	0.74%	1.18%	1.49%	1.28%	1.95%	-0.26%	1.29%
△ MIN	-0.70%	-1.58%	-0.98%	-0.66%	-0.19%	0.23%	-0.11%	0.59%	-1.62%	-0.35%
Tolerance	12.00%	6.00%	4.00%	1.00%	4.00%	6.00%	8.00%	10.00%	12.00%	15.00%
Tolerance	-12.00%	-6.00%	-4.00%	-1.00%	-4.00%	-6.00%	-8.00%	-10.00%	-12.00%	-15.00%

Figure 30. Resistance Temperature Characteristics 4150F1002F



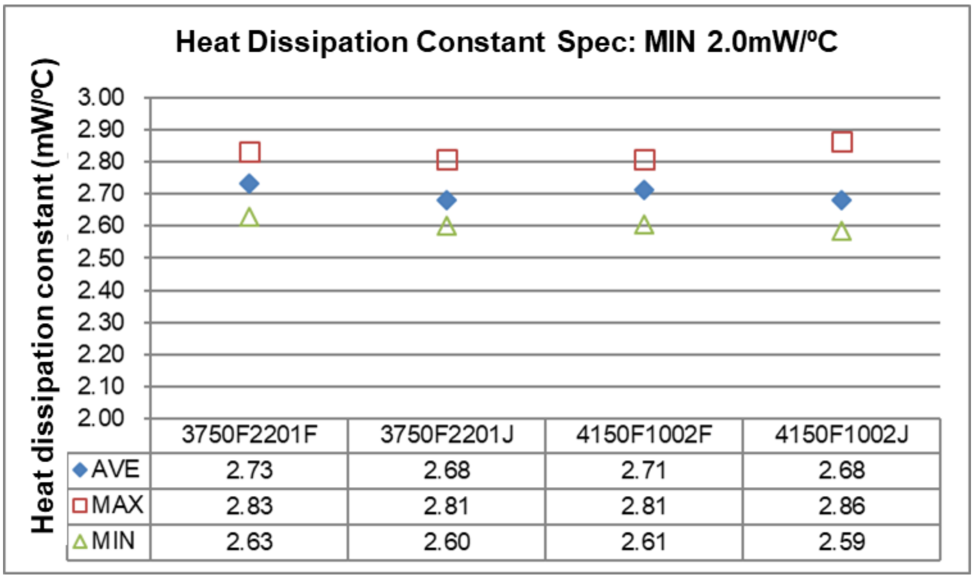
	-55 ℃	-15 ℃	0 ℃	25 ℃	50 ℃	75 ℃	85 ℃	100 ℃	125 ℃	150 ℃
AVE	-0.08%	-0.82%	-0.32%	-0.01%	0.44%	0.96%	0.64%	1.36%	-0.88%	0.79%
MAX	4.24%	3.49%	3.99%	4.40%	4.88%	5.38%	5.15%	5.89%	3.47%	5.26%
MIN	-4.52%	-5.06%	-4.59%	-4.23%	-3.92%	-3.40%	-3.47%	-2.95%	-5.14%	-3.52%
Tolerance	15.00%	10.00%	8.00%	5.00%	8.00%	10.00%	12.00%	14.00%	15.00%	18.00%
Tolerance	-15.00%	-10.00%	-8.00%	-5.00%	-8.00%	-10.00%	-12.00%	-14.00%	-15.00%	-18.00%

Figure 31. Resistance-Temperature Characteristics 4150F1002J

5.2 Heat Dissipation Constant

+25°C/+75°C, +25°C± 1°C (for 15 minutes maximum in the test chamber (still air chamber)), in static air, n=20.

The result of heat dissipation constant is shown in Figure 32.

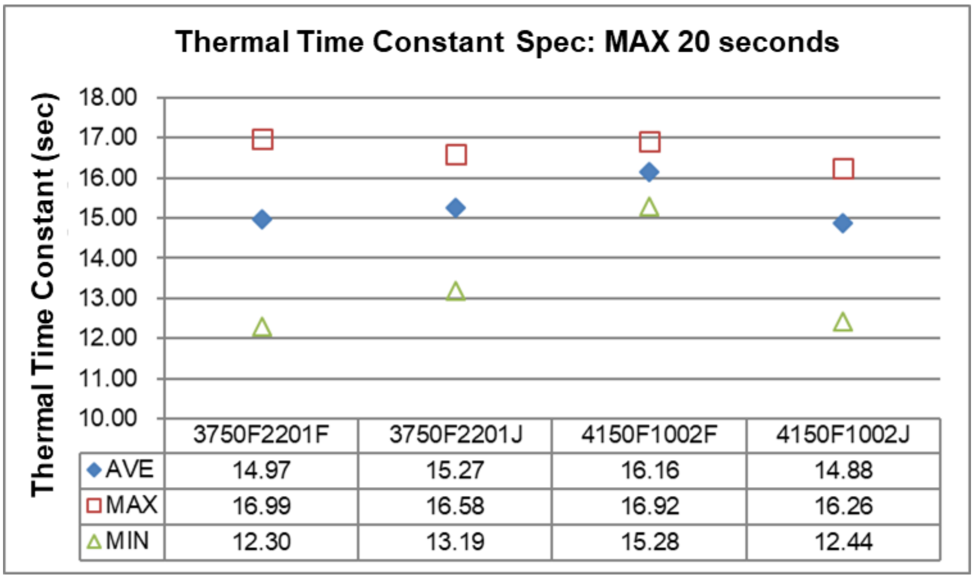


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	2.73	2.68	2.71	2.68
MAX	2.83	2.81	2.81	2.86
MIN	2.63	2.60	2.61	2.59

Figure 32. Heat Dissipation Constant

5.3 Thermal Time Constant

+75°C to +25°C, time to reach 43.4°C, in static air, n=20.
The result of thermal time constant is shown in Figure 33.

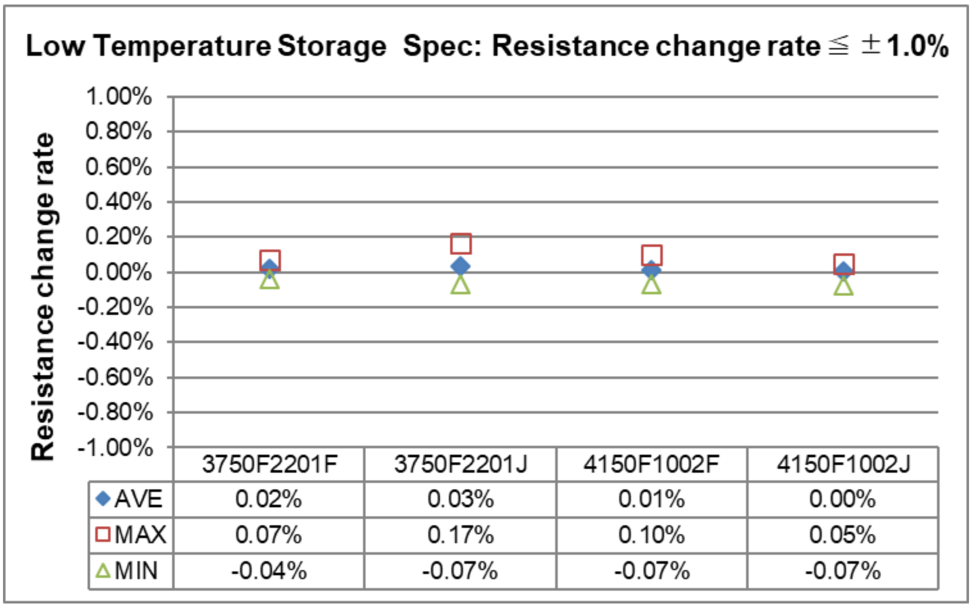


	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	14.97	15.27	16.16	14.88
MAX	16.99	16.58	16.92	16.26
MIN	12.30	13.19	15.28	12.44

Figure 33. Thermal Time Constant

5.4 Low temperature storage

-55°C +0 / -5°C, 3+1/-0 hours, n=230.
The result of low temperature storage is shown in Figure 34.



	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	0.02%	0.03%	0.01%	0.00%
MAX	0.07%	0.17%	0.10%	0.05%
MIN	-0.04%	-0.07%	-0.07%	-0.07%

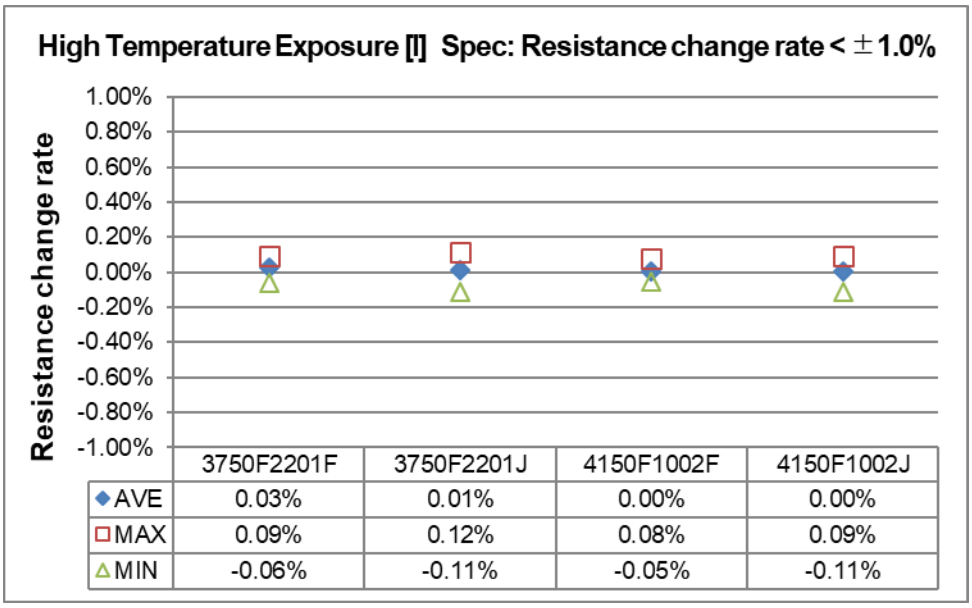
Figure 34. Low Temperature Storage

5.5 High Temperature Exposure

5.5.1 High Temperature Exposure [I]

+150±5°C, 100 +4/-0 hours, n=334.

The result of high temperature exposure [I] is shown in Figure 35.



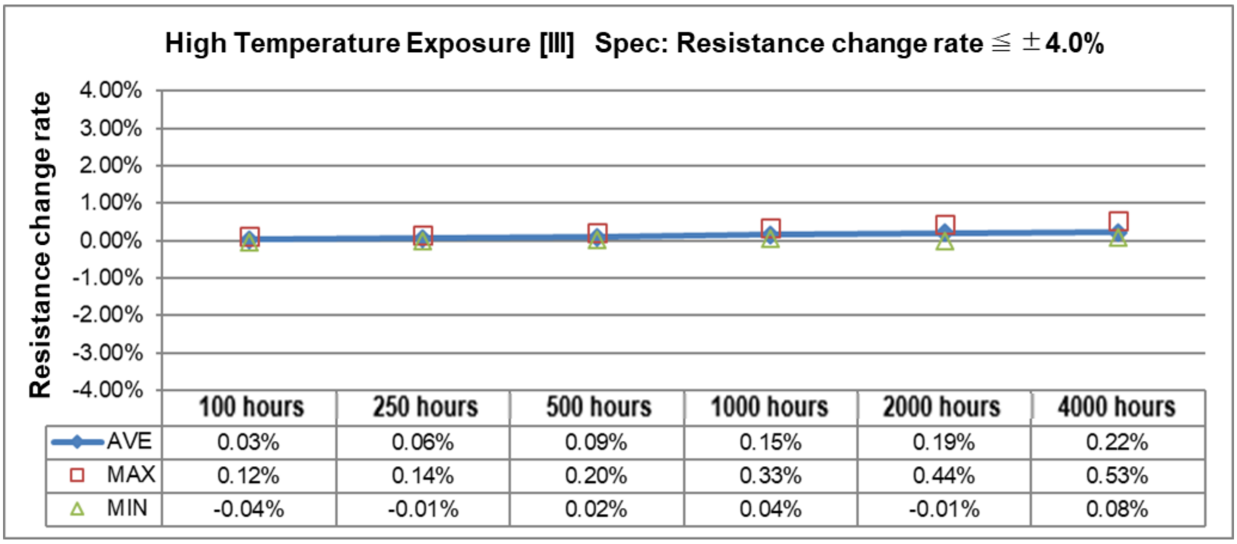
	3750F2201F	3750F2201J	4150F1002F	4150F1002J
AVE	0.03%	0.01%	0.00%	0.00%
MAX	0.09%	0.12%	0.08%	0.09%
MIN	-0.06%	-0.11%	-0.05%	-0.11%

Figure 35. High Temperature Exposure [I]

5.5.2 High Temperature Exposure [III]

+150±5°C, 4,000 +48/-0 hours (intermediate measurement points; 100, 250, 500, 1,000, and 2,000 hours), n=230.

The results of high temperature exposure [III] are shown in Figures 36 through 39.

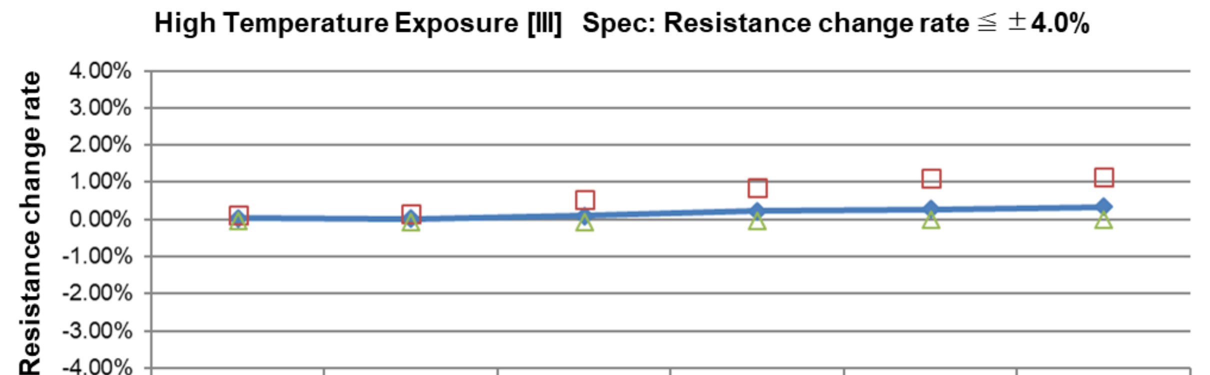


	100 hours	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.03%	0.06%	0.09%	0.15%	0.19%	0.22%
MAX	0.12%	0.14%	0.20%	0.33%	0.44%	0.53%
MIN	-0.04%	-0.01%	0.02%	0.04%	-0.01%	0.08%

Figure 36. High Temperature Exposures [III] 3750F2201F

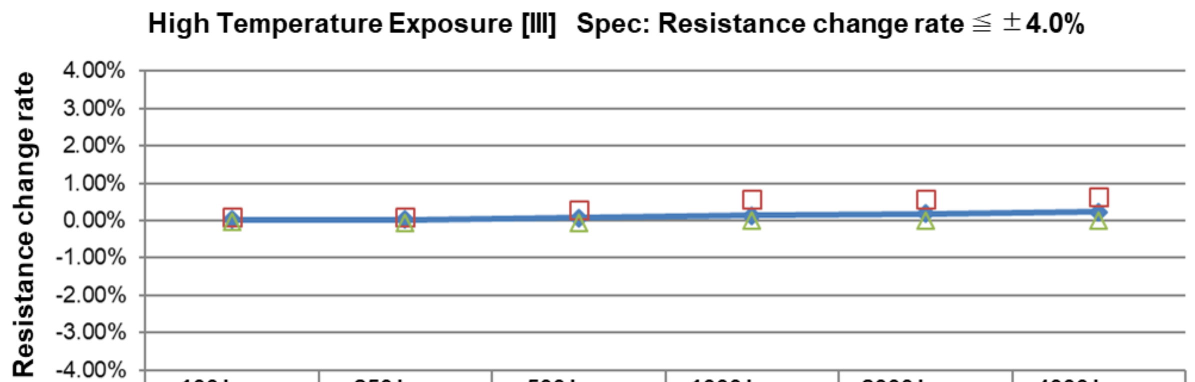
	100 hours	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.02%	0.04%	0.08%	0.10%	0.17%	0.24%
MAX	0.17%	0.18%	0.17%	0.24%	0.36%	0.50%
MIN	-0.07%	-0.11%	-0.04%	0.00%	0.05%	0.04%

Figure 37.   High Temperature Exposure [III] 3750F2201J



	100 hours	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.03%	0.02%	0.09%	0.22%	0.27%	0.33%
MAX	0.10%	0.14%	0.53%	0.86%	1.10%	1.15%
MIN	-0.04%	-0.08%	-0.08%	-0.05%	-0.01%	-0.01%

Figure 38.   High Temperature Exposure [III] 4150F1002F

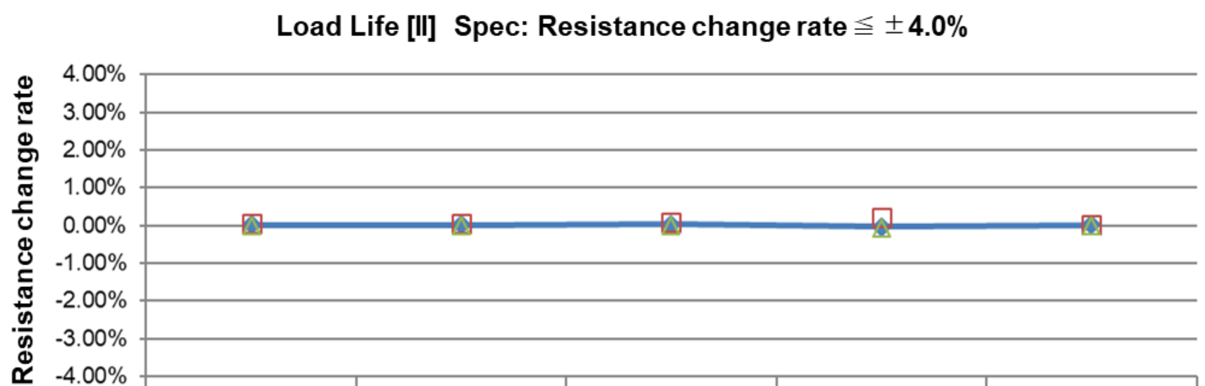


	100 hours	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.03%	0.02%	0.08%	0.14%	0.18%	0.23%
MAX	0.08%	0.09%	0.29%	0.57%	0.58%	0.64%
MIN	-0.03%	-0.07%	-0.05%	0.00%	-0.01%	0.00%

Figure 39.   High Temperature Exposure   4150F1002J

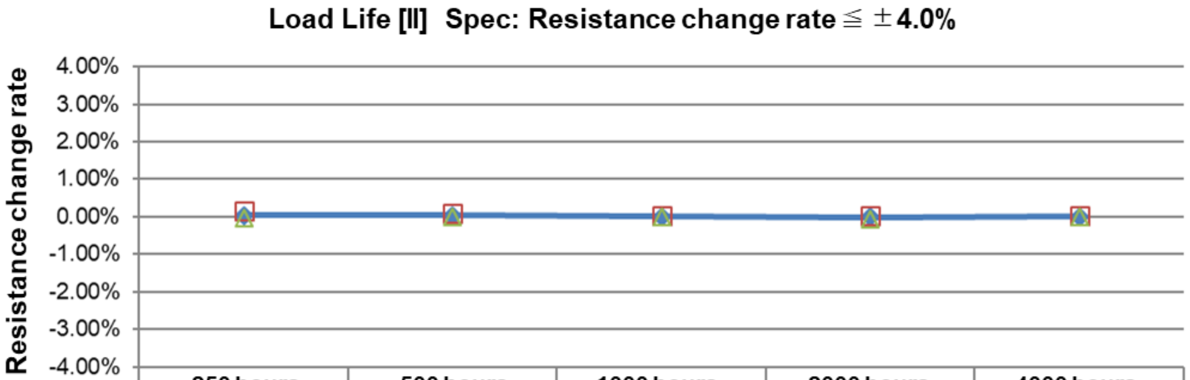
5.6 Load Life [II]

Applied power; 10mW, ON for 90 minutes, OFF for 30 minutes, 4,000hours (intermediate measurements: 250, 500, 1,000, 2000 hours), n=30.
The results of load life [II] are shown in Figures 40 through 43.



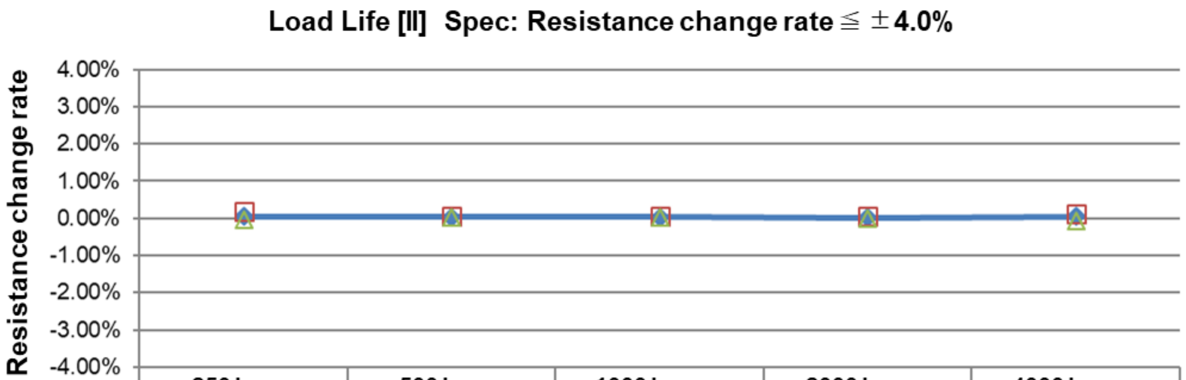
	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.02%	0.01%	0.02%	-0.04%	0.01%
MAX	0.07%	0.04%	0.07%	0.19%	0.03%
MIN	-0.03%	-0.01%	-0.02%	-0.07%	0.00%

Figure 40.   Load Life [II] 3750F2201F



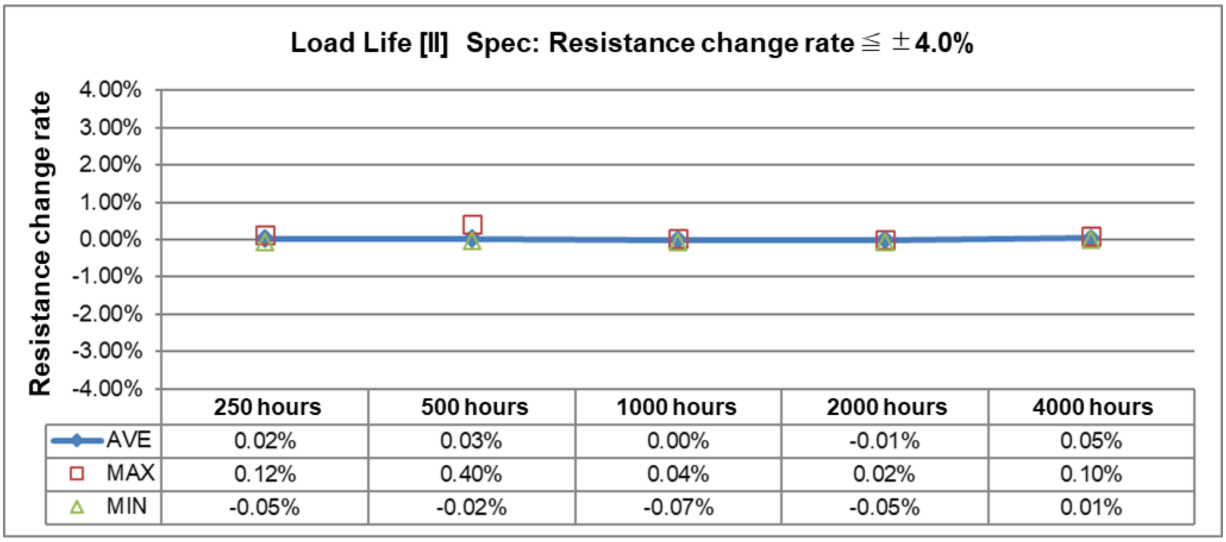
	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.04%	0.03%	0.00%	-0.02%	0.01%
MAX	0.14%	0.10%	0.01%	0.02%	0.02%
MIN	-0.04%	-0.01%	-0.01%	-0.06%	-0.02%

Figure 41. Load Life [II] 3750F2201J



	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.05%	0.04%	0.04%	0.02%	0.05%
MAX	0.20%	0.06%	0.07%	0.06%	0.11%
MIN	-0.04%	0.01%	0.02%	-0.02%	-0.06%

Figure 42. Load Life [II] 4150F1002F



	250 hours	500 hours	1000 hours	2000 hours	4000 hours
AVE	0.02%	0.03%	0.00%	-0.01%	0.05%
MAX	0.12%	0.40%	0.04%	0.02%	0.10%
MIN	-0.05%	-0.02%	-0.07%	-0.05%	0.01%

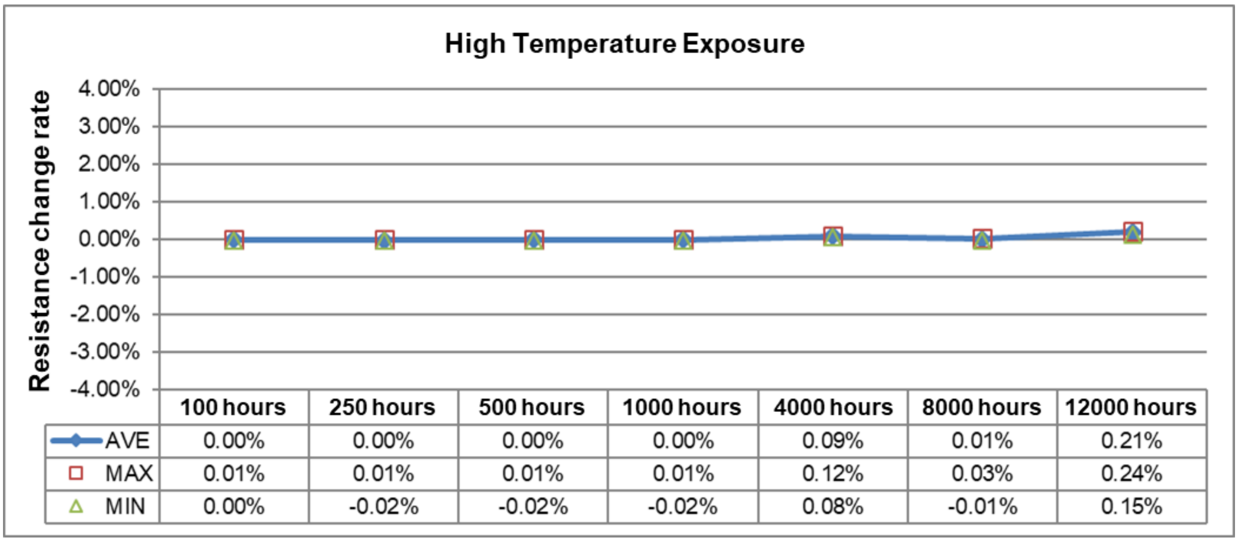
Figure 43. Load Life [II] 4150F1002J

6. ENVIRONMENTAL LIMITS

6.1 High Temperature Exposure

Test sample: JAXA2160/B101-1800S4150F1002J
+150±5°C, n=10.

The results of high temperature exposure are shown in Figure 44.



	100 hours	250 hours	500 hours	1000 hours	4000 hours	8000 hours	12000 hours
AVE	0.00%	0.00%	0.00%	0.00%	0.09%	0.01%	0.21%
MAX	0.01%	0.01%	0.01%	0.01%	0.12%	0.03%	0.24%
MIN	0.00%	-0.02%	-0.02%	-0.02%	0.08%	-0.01%	0.15%

Figure 44. High Temperature Exposure 4150F1002J

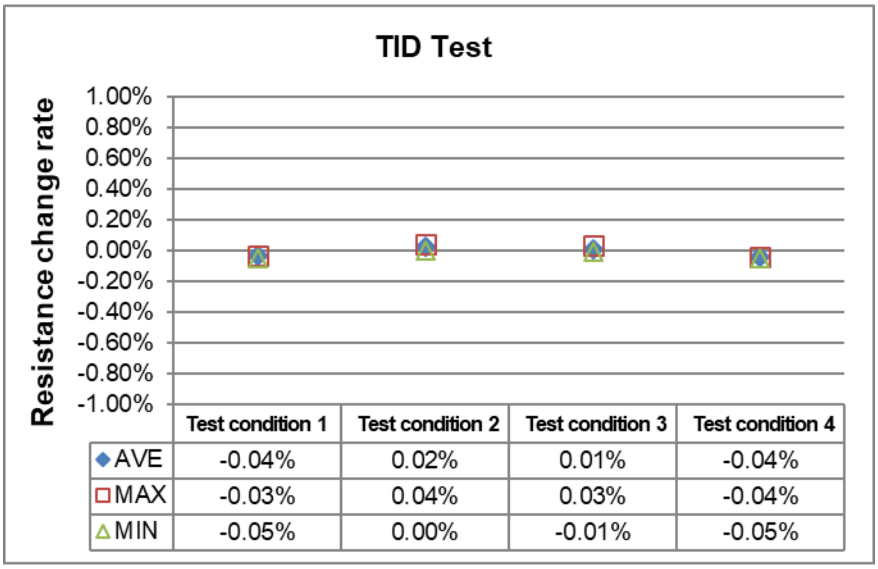
6.2 TID Test (Total Dose Test)

Test sample: JAXA2160/B101-1800S3750F2201J
Test facility: Japan Atomic Energy Agency, Takasaki Advanced Radiation Research Institute
Test conditions: As specified in Table 7, n=10.

The results of TID test are shown in Figure 45 and Table 8.

Table 7. TID Test Conditions

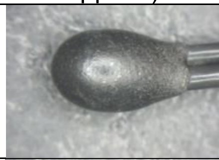
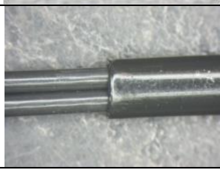
	Test condition 1	Test condition 2	Test condition 3	Test condition 4
Total dose level	8.65×10^5 rad(Si)	8.65×10^5 rad(Si)	1.12×10^7 rad(Si)	1.12×10^7 rad(Si)
Dose rate	4.68×10^4 rad(Si)/h	4.68×10^4 rad(Si)/h	5.62×10^5 rad(Si)/h	5.62×10^5 rad(Si)/h
Irradiation time	20 hours	20 hours	20 hours	20 hours
Radiation source	Gamma-ray Co-60	Gamma-ray Co-60	Gamma-ray Co-60	Gamma-ray Co-60
Power applied during test	Yes, 10mW / element	No	Yes 10mW / element	No
Sample size	10	10	10	10



	Test condition 1	Test condition 2	Test condition 3	Test condition 4
◆AVE	-0.04%	0.02%	0.01%	-0.04%
□MAX	-0.03%	0.04%	0.03%	-0.04%
△MIN	-0.05%	0.00%	-0.01%	-0.05%

Figure 45. TID Test (Resistance Change Rate)

Table 8. TID Test (Externals, Mechanical Strength)

Test condition	Condition 1 (Power applied)	Condition 2 (No power applied)	Condition 3 (Power applied)	Condition 4 (No power applied)
External image of overcoat area				
External image of lead area				
Bending test after radiation	Lead coat and heat shrinkable tube did not break 		Lead coat did not break but heat shrinkable tube broke. 	

In the dose level of 8.65x10^6 rad (Si) or less, the conditions of the resin, conditions and bending performance of lead coat, and heat shrinkable tube have showed no problem. However, in the dose level of 1.12x10^7 rad (Si) or more, the bending performance (mechanical strength) of heat shrinkable tube deteriorates even though the resin and condition and bending performance of lead coat shows no problem. Therefore, the countermeasures such as using the thermistors without the heat shrinkable tube shall be taken if there is radiation of 8.65x10^6 rad (Si) or more to be expected in the environment.

7. RELIABILITY

7.1 Failure Rate

The failure rate of the thermistor calculated using the qualification test data (100 hours, 4,000 hours) and limit test (8,000 hours) is as follows.
The test was performed at the ambient temperature of +150°C.

Product	Component hour (h)	Number of failures	Failure rate (fit)
JAXA2160/B101	8,297,900	0	111

Failure rate calculation:
The failure rate for number of failures 0 is calculated as follows:
$\lambda = 0.917 / T$ where λ = Failure rate, T = Component hour
Reliability level: 60%

7.2 Possible Failure Modes

Open-circuit and resistance increase
Short-circuit and resistance decrease

8. STORAGE

The products shall be stored in the package provided by the manufacturer at room temperature (15 to 35°C), the normal humidity (25 to 85%RH) and shall be placed in an environment free of harmful gases such as hydrochloric gas, hydrogen sulfide and sulfurous acid gas.

9. NOTES

a) Do not apply power exceeding the rated power since it may cause thermal runaway resulting in deterioration of characteristics or breakdown.
b) The thermistor can be used without heat shrinkable tube. In that case, do not outspread the leads to the outer direction.
c) The leads shall not be unnecessarily twisted or bent.
d) The sealed section of the thermistor shall not be handled by using pliers or nippers.
e) When the thermistor needs to be used with the leads bent, the lead on the side closer to the sealed section of the thermistor shall be anchored using a tool and the rest of the lead from the secured point may be bent.

10. OTHER

The contact information on this data sheet is as follows:

Supplier:	TATEYAMA KAGAKU DEVICE TECHNOLOGY CO., LTD.
Address:	3-6 Tsukioka-machi, Toyama-shi, Toyama 939-8132, Japan
Telephone:	+81-50-5535-5725
Fax:	+81-76-429-6630