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

Part Description	CAPACITORS, MINIATURE, HIGH-CAPACITY, SURFACE MOUNT, FINE CERAMIC DIELECTRIC
Part Number and Type	J2040/M105
Applicable Specification	JAXA-QTS-2040 JAXA-QTS-2040/M105

April 2026

Prepared and Established by Fukui Murata Manufacturing 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: 9 October 2026

Record of revisions

Rev.	Date	Description
NC	8 May. 2012	Original
A	28 Nov. 2019	Reflected the change of document by Fukui Murata Manufacturing Co., Ltd. Document No: JMCG0-0020-R (Rev. A)
B	21 Oct. 2022	Reflected the change of document by Fukui Murata Manufacturing Co., Ltd. Document No: JMCG0-0020-R (Rev. B)
C	10 Sept. 2025	Reflected the change of document by Fukui Murata Manufacturing Co., Ltd. Document No: JMCG0-0020-R (Rev. C)
D	24 Apr. 2026	Reflected the change of document by Fukui Murata Manufacturing Co., Ltd. Document No: JMCG0-0020-R (Rev. D)
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No. JMCG0-0020-R

Revision history

Rev.	Date	Description
NC	8 May 2012	Original
A	28 Nov. 2019	Affected Section: Paragraph 2.1, “Externals and Dimensions” Details: Changed the dimensions L, W, T, G and S to the proper values. Reason: To reduce the selection effort by correcting the dimensions. Affected Section: Paragraph 2.3, “Terminal Finish” Details: Changed the description of terminal finish S from “Sn60Pb37Ag3 solder coating over Ni plating” to “Replacement solder coating for terminal finish “Y””. Reason: To align with the detail specification. Affected Section: Paragraph 8, “STORAGE CONDITIONS” Details: Specified the lower limit of the storage temperature and of the humidity. Reason: To align with the detail specification. Affected Section: Paragraph 10, “OTHERS” Details: Updated the contact information for Fukui Murata Manufacturing Co., Ltd. from “AS Capacitor Product Engineering Section II” to “Products Planning Section 1, Product Engineering Department, Capacitor Division,” and changed the telephone number from “+81-778-21-8409” to “+81-778-21-8371”. Reason: To reflect organizational change.
B	21 Oct. 2022	Affected Section: Cover page Details: Revised the Part Number and Type entry from “JAXA2040/M105” to “J2040/M105”. Reason: To align with the naming convention used in JAXA-QTS-2040/M105. Affected Section: Paragraph 2.1 (a), "Externals" Details: Added a photograph of J2040/M105-1005X7SB104KR and a scale bar. Reason: The photograph was added to reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. The scale bar was added to provide a visual reference for size comparison. Affected Section: Paragraph 2.1 (b), “Dimensions and Mass” Details: Added J2040/M105-1005X7SB104KR to the table.

No. JMCG0-0020-R

Revision history

Rev.	Date	Description
		Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: Paragraph 2.3, “Terminal Finish” Details: Revised the descriptions of terminal finish “Y” and “S”. Reason: To align with JAXA-QTS-2040/M105. Affected Section: Paragraph 2.3, “Terminal Finish” Details: Added terminal finish “R” to the table. Reason: To reflect the addition of the 1005 size variant with terminal finish "R" to the qualified product lineup as part of requalification. Affected Section: Paragraph 3.1, “Ratings” Details: Added J2040/M105-1005X7SB104KR to the table. Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: Paragraph 3.1, “Ratings” Details: Replaced the "Element thickness" column with "Dielectric thickness" in the table. Reason: To align with the terminology used in Supplementary Table 1, “Parts List” of JAXA-QTS-2040/M105. Affected Section: Paragraph 3.4, “Recommended Mounting Methods” Details: Added size 1005 to the table. Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: The Sample table in Paragraph 4, “CHARACTERISTICS UNDER NORMAL CONDITIONS” Details: Revised the entries for the Part number column in the table from “JAXA2040” to “J2040”. Reason: To align with the naming convention used in the detail specification, JAXA-QTS-2040/M105.

Revision history

Rev.	Date	Description
		Affected Section: The Sample table in Paragraph 4, “CHARACTERISTICS UNDER NORMAL CONDITIONS” Details: Added item No. 5, J2040/M105-1005X7SB104KR, to the table. Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: Paragraph 4.1, “Electrical Characteristics”: Tables “Capacitance,” “Dissipation factor,” “Dielectric withstanding voltage,” “Insulation resistance (+25 °C),” “Insulation resistance (+125 °C),” “Impedance / ESR-Frequency characteristics,” and “Ripple temperature characteristics” Paragraph 4.2, “Mechanical and Thermal Characteristics”: Tables “Board bending,” “Solderability,” “Resistance to soldering heat,” “Random vibration,” “Shock,” “Thermal shock and immersion cycling,” “Moisture resistance,” and “Humidity, Steady-State, Low Voltage” Paragraph 5, “CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS”: Tables “Voltage-Temperature characteristics,” “Thermal shock (I),” “Life” Paragraph 6.1, “Shear,” Paragraph 6.2, “Direct Voltage Breakdown,” and Paragraph 7.1, “Failure Rates”. Details: Added item No. 5, J2040/M105-1005X7SB104KR. Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the capacitance measurement voltage notation from V to Vrms. Reason: To align with the terminology used in paragraph M.4.4.7.1 of Appendix M to JAXA-QTS-2040. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the significant figures for item No. 1 in the “Capacitance” table to one additional digit beyond the precision of the specification value. Reason: To appropriately reflect measurement precision. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the significant figures for items in the “Dissipation factor” table to one additional digit beyond the precision of the specification value and applied the same change to all subsequent “Dissipation factors” tables. Reason: To appropriately reflect measurement precision.

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Revision history

Rev.	Date	Description
		Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Added a table presenting the dielectric withstanding voltage test results as the number of failures/sample size. Reason: To align with the reporting format based on the number of failures/sample size. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the y-axis title of the Insulation resistance (+25 °C) graph to "Log IR [-]," and applied the same change to all subsequent Insulation resistance (+25 °C) and Insulation resistance (+125 °C) graphs. Reason: To correctly represent the logarithm of insulation resistance as a dimensionless quantity. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the logarithmic representation of insulation resistance (+25 °C) from MΩ to Ω in the graph and table and applied the same change to all subsequent insulation resistance (+25 °C) and insulation resistance (+125 °C) graphs and tables. Reason: To align with the standard convention of expressing insulation resistance logarithmically in Ω. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the significant figures for items in the “Insulation resistance (+25 °C)” table to one additional digit beyond the precision of the specification value and applied the same change to all subsequent “Insulation resistance (+25 °C)” and “Insulation resistance (+125 °C)”. Reason: To appropriately reflect measurement precision. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Revised the wording from “Ripple temperature characteristics” to “Ripple heating characteristics”. Reason: To use more appropriate terminology. Affected Section: Paragraph 4.2, “Mechanical and Thermal Characteristics” Details: Revised the significant figures for items in the “Capacitance change rate” table under “Substrate bending” to one additional digit beyond the precision of the specification value and applied the same change to all subsequent “Capacitance change rate”.

Revision history

Rev.	Date	Description
		Reason: To appropriately reflect measurement precision. Affected Section: Paragraph 5, “CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS” Details: Revised the wording from “Thermal shock (I)” to “Thermal shock in Drifting in Thermal shock (I)”. Reason: To align with the terminology used in paragraph M.3.10.3 of Appendix M to JAXA-QTS-2040. Affected Section: Paragraph 5, “CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS” Details: Revised the wording from “IR” to “Insulation resistance”. Reason: To ensure consistent terminology. Affected Section: Paragraph 6.1 a), “Mounting method” Details: Revised the solder fillet thickness description to include the 1005 size variant. Reason: To reflect the addition of the 1005 size variant to the qualified product lineup as part of requalification. Affected Section: Paragraph 6.1 b), “Test method” Details: Divided shear mode symbol D into D1 and D2 in the table. Reason: To align with the format presented in Table M-16, “Shear Mode” under paragraph M.4.4.8.1 of Appendix M to JAXA-QTS-2040. Affected Section: Paragraph 6.2, “Direct Voltage Breakdown” Details: Deleted the safety factor from the table. Reason: To avoid potential misinterpretation. Affected Section: Paragraph 9.3, “Note for Tin Whisker” Details: Revised the description to specify that tin whisker growth does not occur with terminal finishes “S” and “R”. Reason: To reflect the addition of the 1005 size variant with terminal finish “R” to the qualified product lineup as part of requalification.

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Revision history

Rev.	Date	Description
		Affected Section: Paragraph 10, “OTHERS” Details: Updated contact information to Products Planning Section 1, Product Engineering Department, Ceramic Capacitor Division. Reason: To reflect organizational change.
C	10 Sept. 2025	Affected Section: Paragraphs 4 through 6 Details: Corrected part numbers as follows: From J2040/M105-3216X7RA226KS to J2040/M105-3216X7RA226MS. From J2040/M105-3225X7RB226KS to J2040/M105-3225X7RB226MS. Reason: The parts with capacitance tolerance "M", not "K", were used as samples. Affected Section: Paragraph 3.1, “Ratings” Details: Revised the rating description format to match the format used in the ADS for the N2040/L104 model type. Accordingly, the dielectric thickness information was deleted. Reason: The dielectric thickness is not required in the ADS, and the format is to be standardized with the L104 description. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Added DC Bias Characteristics to the electrical characteristics. Reason: To indicate that in high dielectric constant type MLCCs, capacitance may vary from the nominal value when a DC voltage is applied. Affected Section: Paragraph 4.1, “Electrical Characteristics” Details: Added AC Voltage Characteristics to the electrical characteristics. Reason: To indicate that in high dielectric constant type MLCCs, capacitance may vary from the nominal value when an AC voltage is applied. Affected Section: Paragraph 6.3 b), “Sample and sample size” Details: Changed the part number from the former Murata part number to the new Murata part number as follows: From GRK42-6X7R226K6.3 to GCM31CR70J226K. Affected Section: Paragraph 8, “STORAGE CONDITIONS” Details: Revised some expressions Reason: To align with the terminology used in other paragraphs.

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Revision history

Rev.	Date	Description
		Affected Section: Item d) under Paragraph 9.2.1, “Notes” Details: Added a note requiring the use of a resin coating material with high barrier properties against sulfur-containing gases. Reason: To mitigate the risk of dendrite formation in environments containing sulfur-containing gases. Affected Section: Paragraph 9.2.2, “Relationship between Resin Coating, Life Test Conditions, and Dendrite Formation” Details: Added reference data on the relationship between resin coating, life test conditions, and dendrite formation. Reason: To provide reference data showing that dendrite formation tends to occur at higher ambient temperatures without a resin coating, whereas a resin coating suppressed dendrite formation even under high-temperature conditions. Affected Section: Paragraph 9, “Notes” Details: Added paragraph 9.4, “DC Bias Characteristics” and paragraph 9.5, “AC Voltage Characteristics”. Reason: To clarify that in high dielectric constant type MLCCs, the capacitance may vary from its nominal value depending on the applied DC bias or AC voltage.
D	24 Apr. 2026	Affected Section: Rev. A through C of Revision history Details: Added a blank line after each revision history record and applied a left indent to the revision details and reason text. Reason: To improve readability. Affected Section: Items a) and b) under paragraph 2.1, “Externals and Dimensions,” paragraph 3.4, “Recommended Mounting Methods,” paragraph 4, “CHARACTERISTICS UNDER NORMAL CONDITIONS,” paragraph 5, “CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS,” paragraph 6.1, “Shear (Destructive),” paragraph 6.2, “Direct Voltage Breakdown,” and paragraph 7.1, “Failure Rates”. Details: Added a new size variant, J2040/M105-2012X7SB106KS to the sections. Reason: To reflect the addition of the 2012 size variant to the qualified product lineup as part of requalification. Affected Section: “Voltage-Temperature characteristics” under Paragraph 5, “CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS”

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Revision history

Rev.	Date	Description
		Details: Added the capacitance measurement frequency and measurement voltage to all voltage-temperature characteristics graphs. Reason: To clarify the capacitance measurement conditions, as different measurement frequencies and voltages are specified for different J2040/M105 products. Affected Section: Paragraph 9.3, “Note for Tin Whisker” Details: Deleted the statement, “Whiskers do not grow on terminal finishes ‘S’ and ‘R’.” Reason: To avoid implying that the risk of tin whisker formation is completely eliminated by leaded solder coatings.

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

1. GENERAL

1.1 Scope

This Application Data Sheet details additional general information necessary for parts selection and/or equipment design that is not contained in JAXA-QML. Users are encouraged to look into other information sources for specific applications, and responsible for their decisions on part selection and usage.

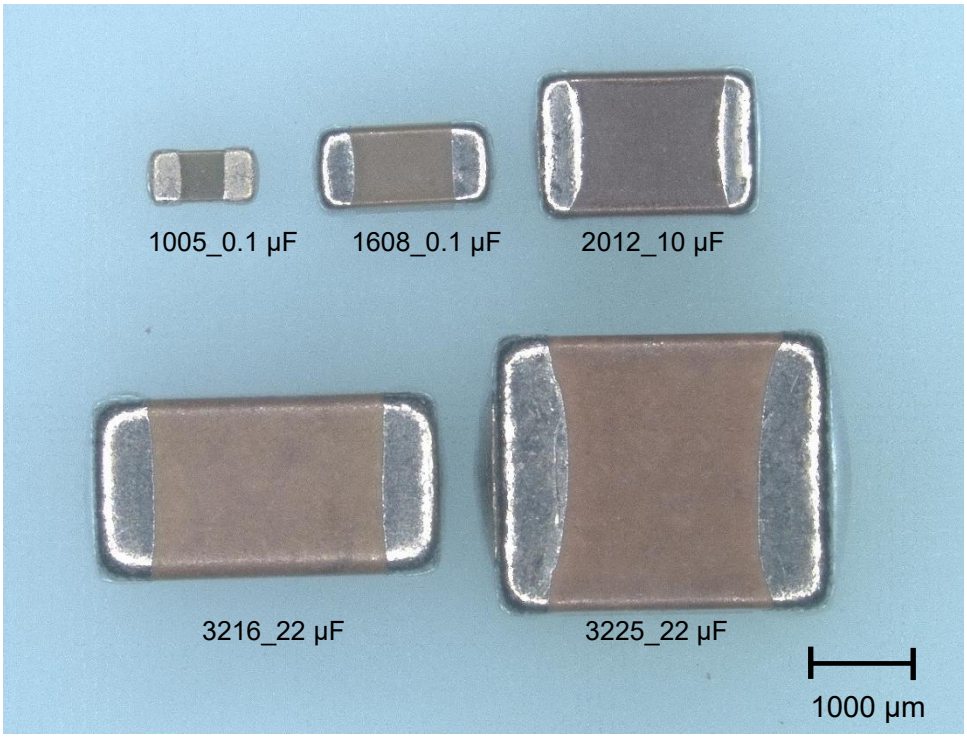
1.2 Applicable Documents

(a)	JAXA-QTS-2040	Capacitors, Fixed, High Reliability, Space Use, General Specification For
(b)	JAXA-QTS-2040/M105	Capacitors, Miniature, High-Capacity, Surface Mount, Fine Ceramic Dielectric, (J2040/M105), High Reliability, Space Use, Detail Specification For

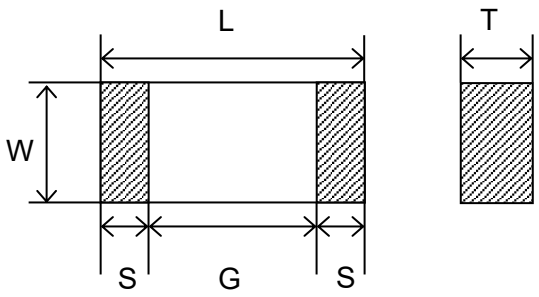
2. SUMMARY OF PRODUCTS

2.1 Externals and Dimensions

a) Externals



b) Dimensions and Mass

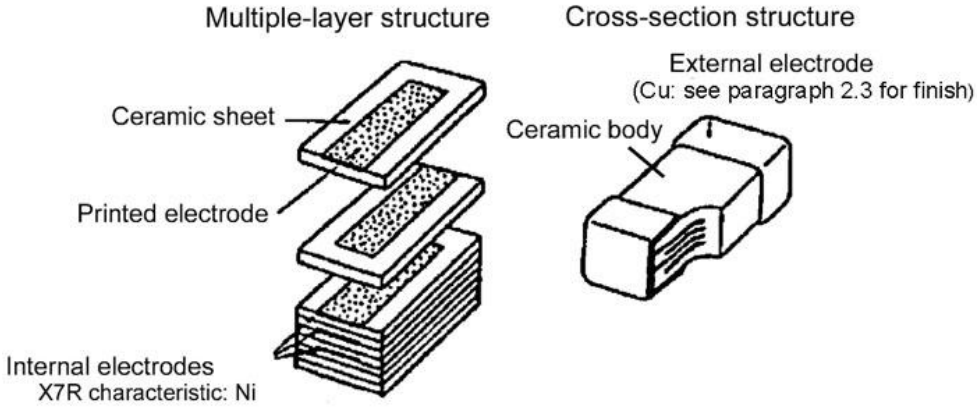


Outline of the Capacitor

Unit: mm

Symbol / Style	L		W		T		G	S	Mass (mg)
	Max	Min	Max	Min	Max	Min			
1005	1.10	0.90	0.60	0.40	0.60	0.40	0.3 min.	0.1 to 0.4	1.6
1608	1.80	1.50	1.00	0.70	1.00	0.70	0.5 min.	0.2 to 0.6	7
2012	2.35	1.85	1.60	1.10	1.60	1.10	0.7 min	0.2 to 0.8	22
3216	3.60	3.05	1.90	1.45	1.90	1.50	1.2 min.	0.3 min.	55
3225	3.60	2.90	2.80	2.30	2.80	2.30	1.0 min.	0.3 min.	130

2.2 Element Construction



2.3 Terminal Finish

Symbol	Terminal finish
Y	Ni and Sn plating over underlying metal
S	Replacement solder coating for terminal finish “Y”
R	Resin electrode, Ni plating, Sn plating, and solder (SnPb) plating over underlying metal

2.4 Failure Rate Level

The product satisfies S level (0.001 %/1000 HR). See paragraph 7.1 for details.

3. USAGE

3.1 Ratings

Item	JAXA-QTS-2040 Applicable paragraph	Note
Voltage－Temperature Characteristics	M.1.3.2	X7R X7S
Nominal capacitance range	M.1.3.4	0.1 μF to 22 μF
Rated voltage	M.1.3.3	3.5 V, 8 V, 25 V
Operating temperature range	M.1.3.2	-55 °C to +125 °C
Capacitance tolerance	M.1.3.5	K, M

3.2 Recommended Operating Conditions

Ambient temperature: -55 to +75 °C

3.3 Notes for Circuit Design

Capacitors with X7R characteristics are suitable for use as bypass and coupling capacitors in high frequency circuits. The capacitors shall be used under the rated voltage within the operating temperature range.

3.4 Recommended Mounting Methods

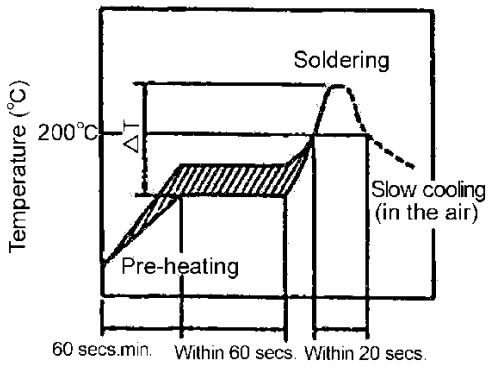
a) Fluxes shall be selected from those of rosin types with chlorine concentration of 0.2 wt% as a maximum.
b) Solders shall be selected from those of Sn-Pb types with Sn:Pb ratio of 6:4 or 5:5.
c) Preheating shall be performed prior to soldering to control the temperature differences as shown in the table below. If the temperature difference exceeds the limit, cracks could occur on the ceramic element and reduce the insulation resistance, which could lead to insulation failures and/or short-circuiting.

Chip size	Temperature difference (ΔT)
1005, 1608, 2012	Up to 190 °C
3216, 3225	Up to 130 °C

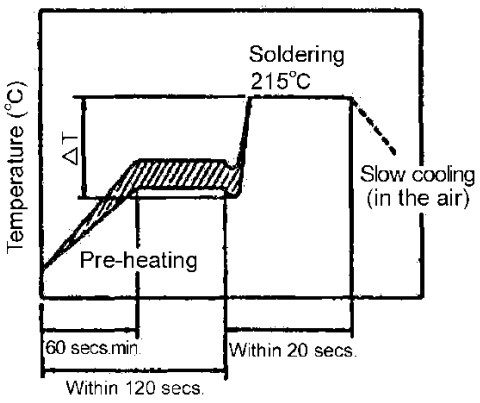
d) Recommended Soldering Conditions

Reflow soldering

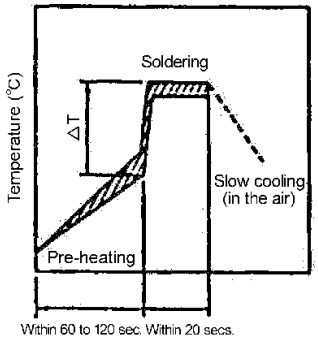
Infrared reflow soldering



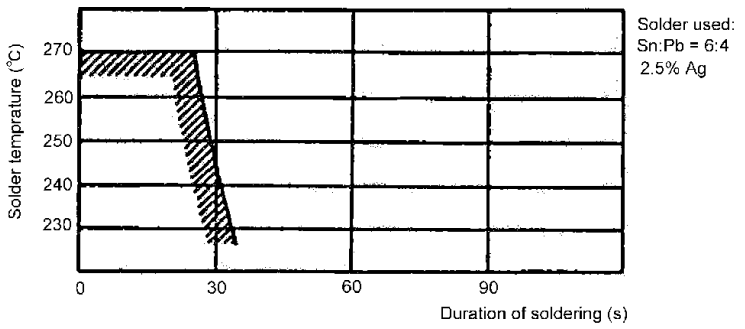
Vapor reflow soldering



·Iron soldering



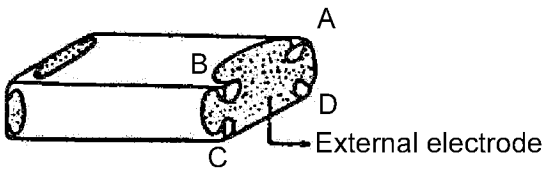
e) Allowable soldering temperatures and durations



When soldering is repeated, note that the allowable duration is a total of soldering durations. When soldering is performed with different method(s), the allowable duration is a total of normalized soldering durations which offset different soldering conditions.

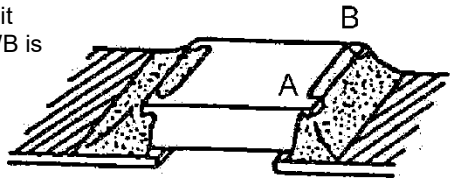
f) If soldering took a long time, verify with a magnifier that dissolution of the electrodes shall not exceed a maximum of 25 % of the perimeter of A-B-C-D face.

Single unit



Unit soldered on PWB

As the edge of unit soldered on a PWB is partially invisible, 25 % shall be measured within visible area (side A-B).



g) Limit the solder amount (fillet height) between 0.30 and 0.50T (T: thickness of the capacitor) and mount on an Alumina board or glass epoxy board (FR-4). Verify that the solder joint is firmly secured to the board. When 3225 size capacitor is mounted on an Alumina board, limit the solder amount between 0.15T and 0.25T. Minimize the solder quantity. Check the compatibility with the boards (compatibility of Coefficient of Thermal Expansion (CTE)) prior to use.
CTE (as an example)
Ceramics: 11 ppm/°C
Alumina: 7 ppm/°C
FR-4: less than Tg: 16 ppm/°C, more than Tg: 15 ppm/°C, (Tg=140 to 150 °C)

h) After soldering the capacitors shall be left in room temperature for slow cooling.

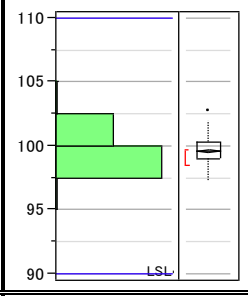
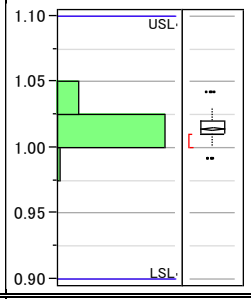
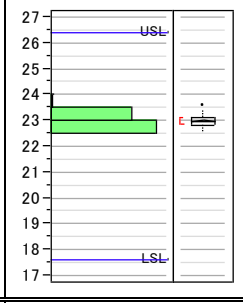
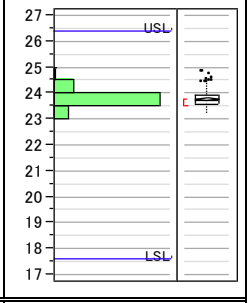
4. CHARACTERISTICS UNDER NORMAL CONDITIONS

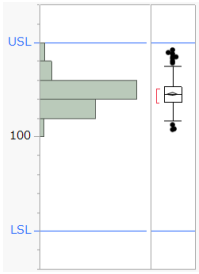
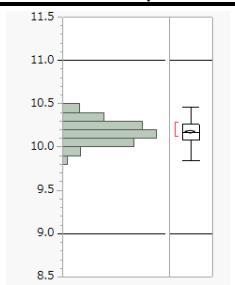
Sample

No.	Part number	Size	Characteristics	Rate voltage (V)	Capacitance (μF)
1.	J2040/M105-1608X7RC104KS	1608	X7R	25	0.1
2.	J2040/M105-1608X7RB105KS	1608	X7R	8	1
3.	J2040/M105-3216X7RA226MS	3216	X7R	3.5	22
4.	J2040/M105-3225X7RB226MS	3225	X7R	8	22
5.	J2040/M105-1005X7SB104KR	1005	X7S	8	0.1
6.	J2040/M105-2012X7SB106KS	2012	X7S	8	10

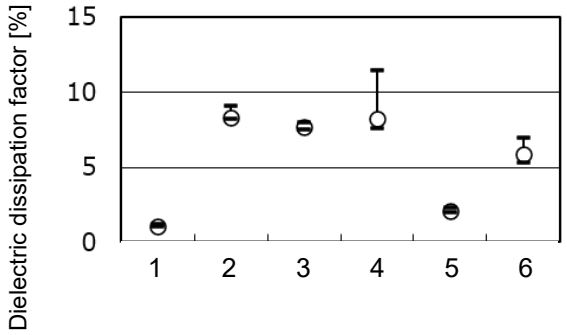
4.1 Electrical Characteristics

[Capacitance]

No.	1.	2.	3.	4.
Sample size	245	245	245	245
Measuring condition	1 kHz 1.0 V_{rms}	1 kHz 1.0 V_{rms}	120 Hz 0.5 V_{rms}	120 Hz 0.5 V_{rms}
Limit	90 to 110 nF	0.9 to1.1 μF	17.6 to 26.4 μF	17.6 to 26.4 μF
				
Ave	99.61	1.010	22.970	23.770
Max	102.6	1.04	23.52	24.80
Min	97.3	0.99	22.51	23.14

No.	5.	6.		
Sample size	241	215		
Measuring condition	1 kHz 1.0 V_{rms}	1 kHz 1.0 V_{rms}		
Limit	90 to 110 nF	9 to 11 μF		
				
Ave	104.54	10.18		
Max	109.2	10.46		
Min	100.8	9.85		

[Dissipation factor]

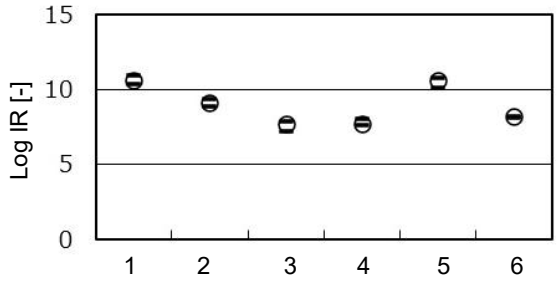


No.	1.	2.	3.	4.	5.	6.
Sample size	245	245	245	245	241	215
Limit	15 % as a maximum					
Ave	1.14	8.33	7.66	8.15	2.13	5.83
Max	1.2	9.1	8.0	11.5	2.3	7.0
Min	1.1	8.2	7.5	7.6	2.0	5.3

[Dielectric withstanding voltage] (250 %WV, 5 s±1 s as a minimum)

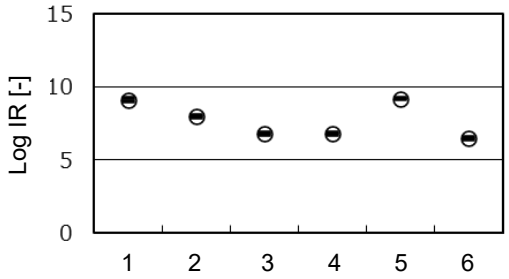
No.	1.	2.	3.	4.	5.	6.
No. of defective/ Sample size	0/245	0/245	0/245	0/245	0/241	0/215

[Insulation resistance] (+25 °C)



No.	1.	2.	3.	4.	5.	6.
Sample size	245	245	245	245	241	215
Limit	9.0≦	8.0≦	6.7≦	6.7≦	8.7≦	7.0≦
Ave	10.61	9.120	7.680	7.740	10.59	8.19
Max	11.0	9.40	7.89	8.04	10.8	8.21
Min	10.4	8.88	7.23	7.60	10.1	8.13

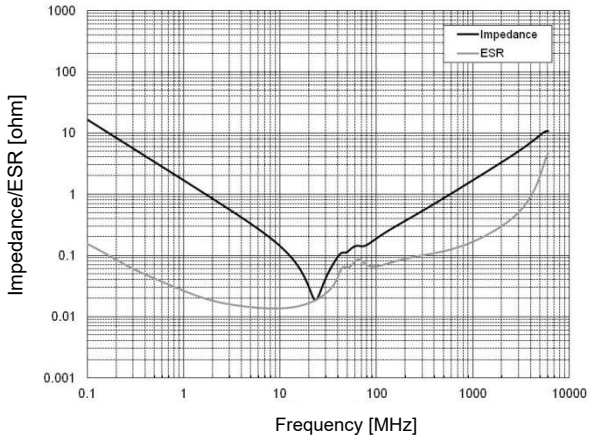
[Insulation resistance] (+125 °C)



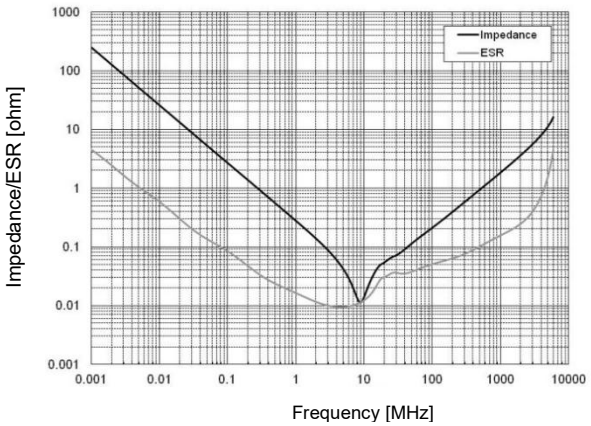
No.	1.	2.	3.	4.	5.	6.
Sample size	245	245	245	245	241	215
Limit	8.0≦	7.0≦	5.7≦	5.7≦	7.7≦	6.0≦
Ave	9.120	8.000	6.780	6.790	9.199	6.49
Max	9.29	8.09	6.85	6.89	9.26	6.60
Min	9.05	7.94	6.71	6.71	9.17	6.45

[Impedance / ESR - Frequency characteristics]

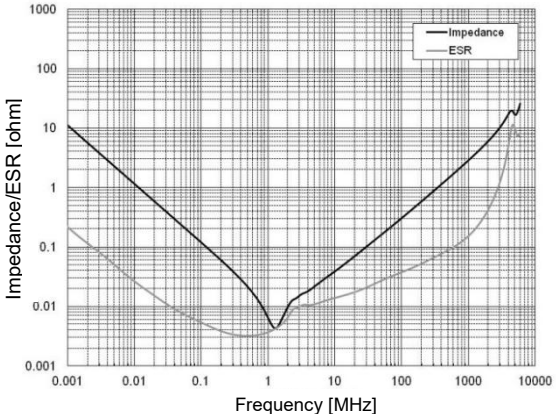
1. 1608X7RC104KS



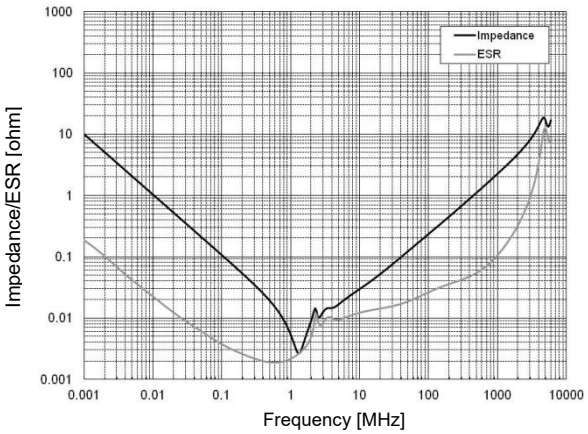
2. 1608X7RB105KS



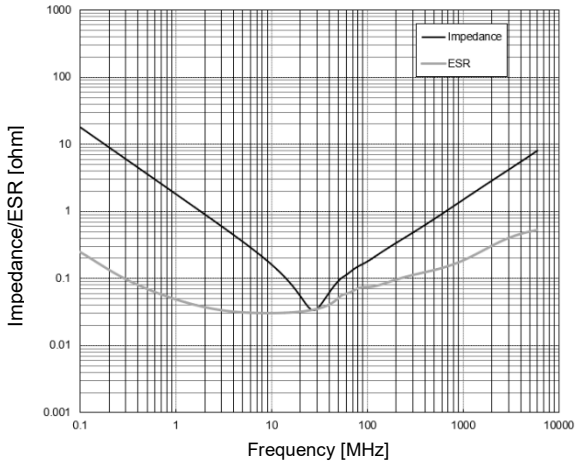
3. 3216X7RA226MS



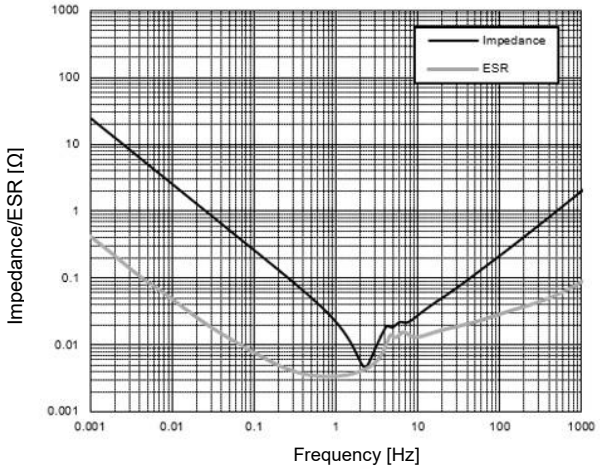
4. 3225X7RB226MS



5. 1005X7SB104KR

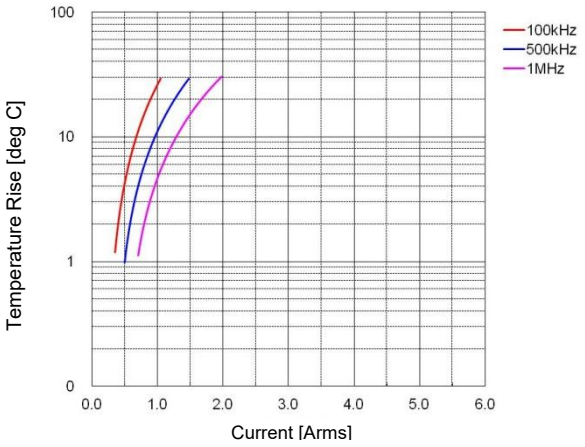


6. 2012X7SB106KS

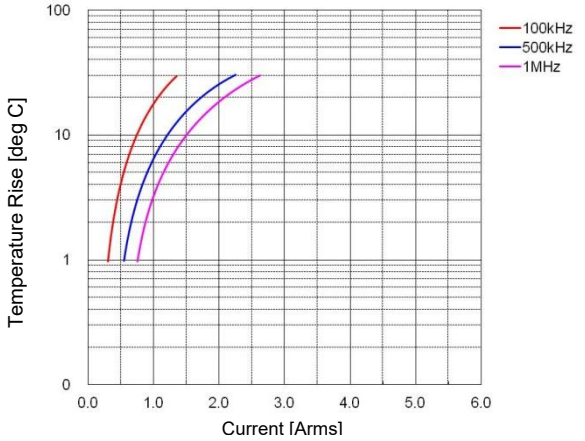


[Ripple temperature characteristics]

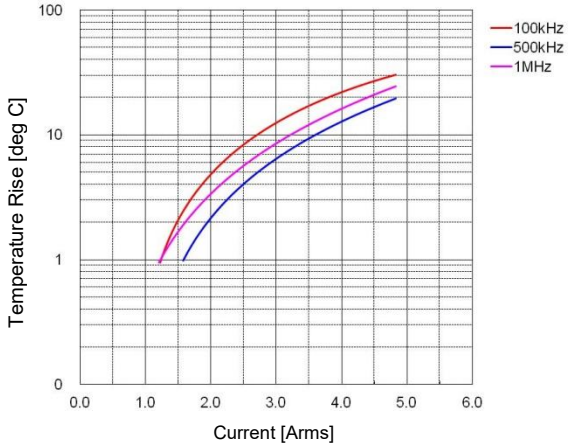
1. 1608X7RC104KS



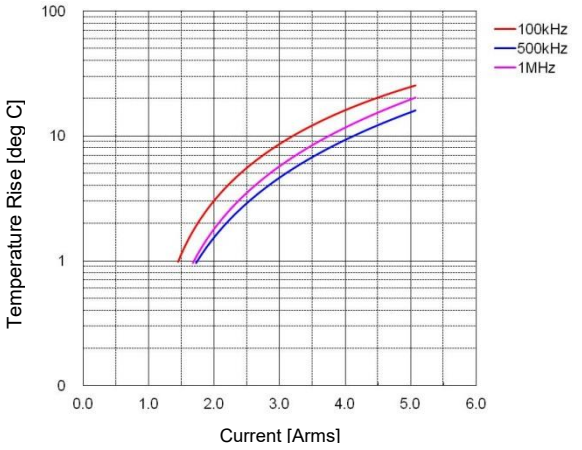
2. 1608X7RB105KS



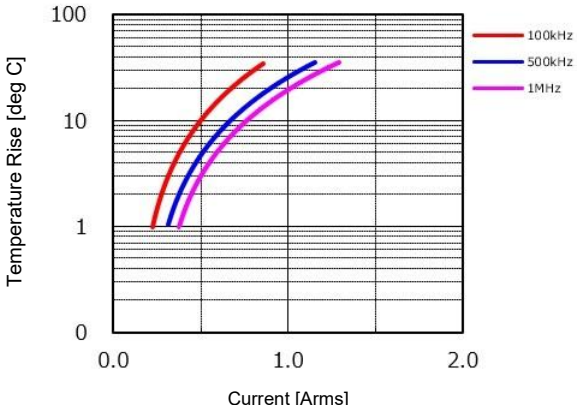
3. 3216X7RA226MS



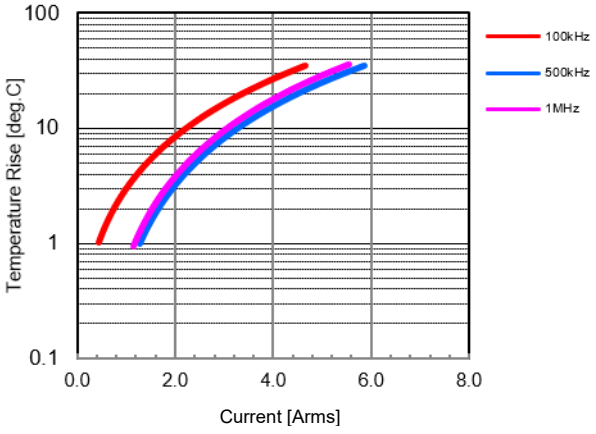
4. 3225X7RB226MS



5. 1005X7SB104KR

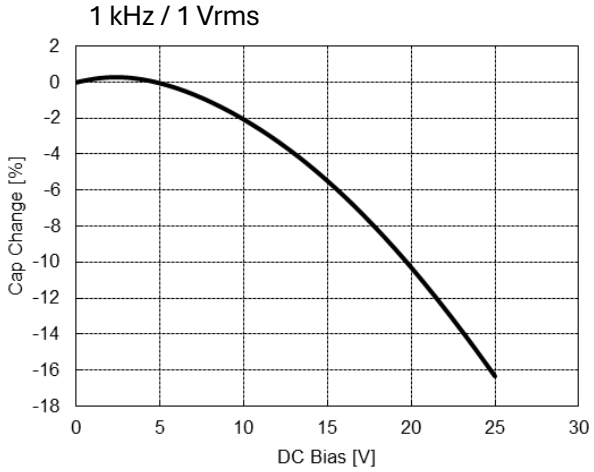


6. 2012X7SB106KS

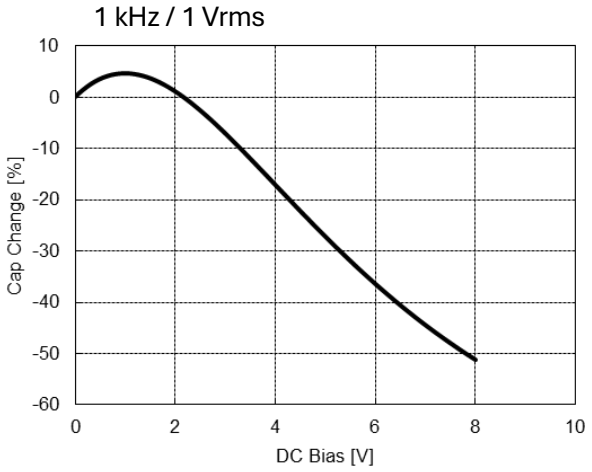


〔DC Bias Characteristics〕

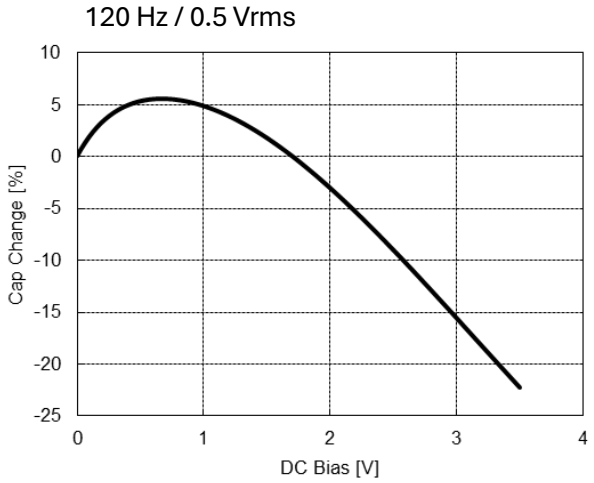
1. 1608X7RC104KS



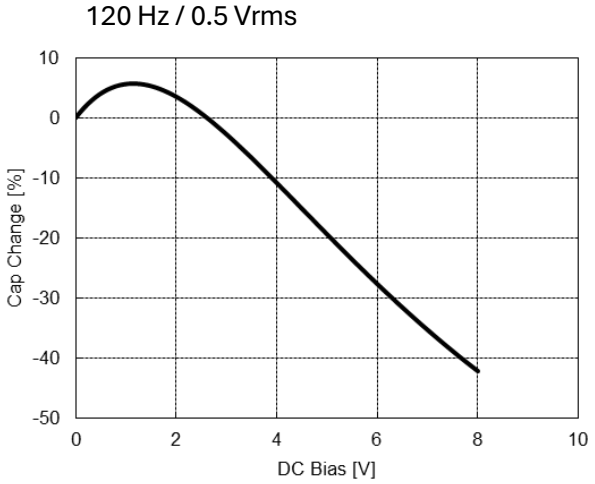
2. 1608X7RB105KS



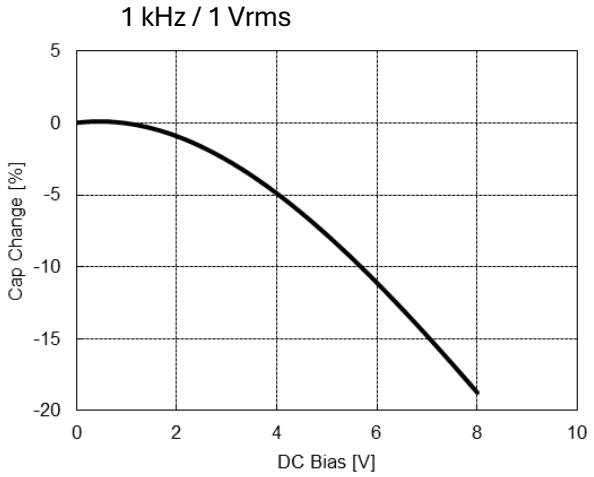
3. 3216X7RA226MS



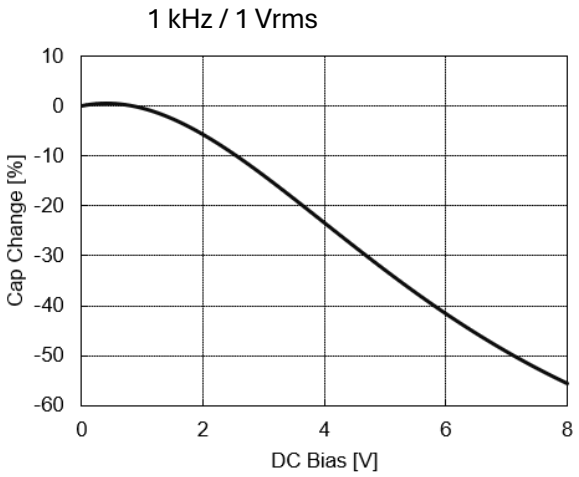
4. 3225X7RB226MS



5. 1005X7SB104KR

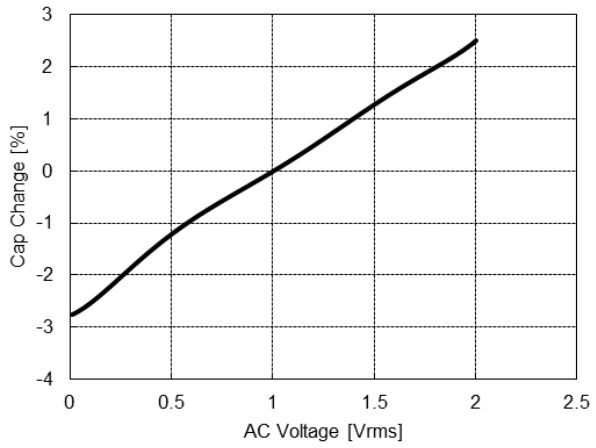


6. 2012X7SB106KS

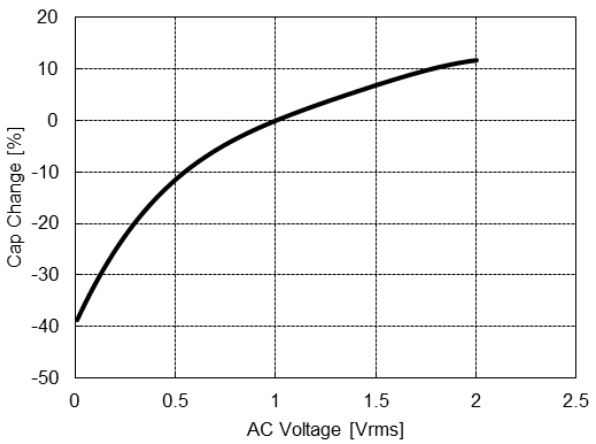


〔AC Voltage Characteristics〕

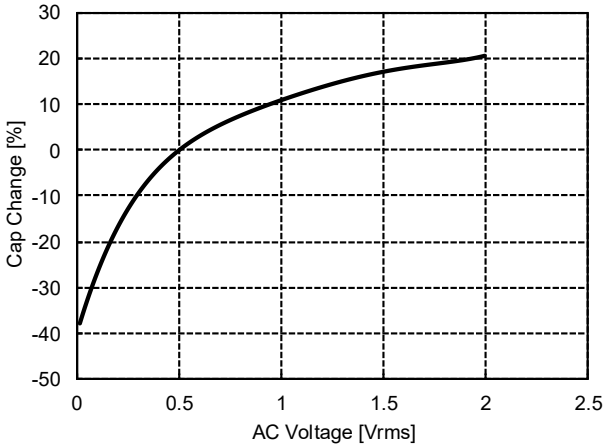
1. 1608X7RC104KS



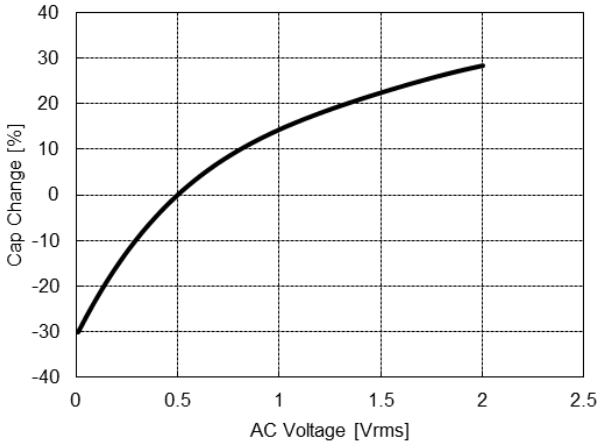
2. 1608X7RB105KS



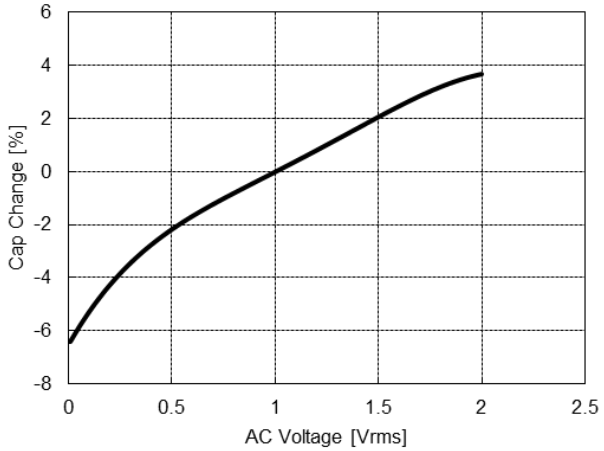
3. 3216X7RA226MS



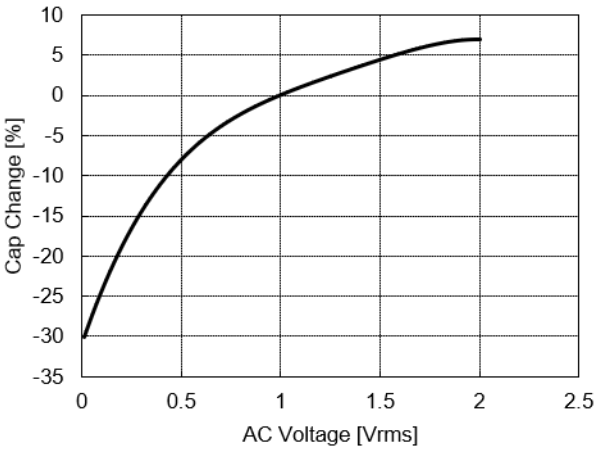
4. 3225X7RB226MS



5. 1005X7SB104KR



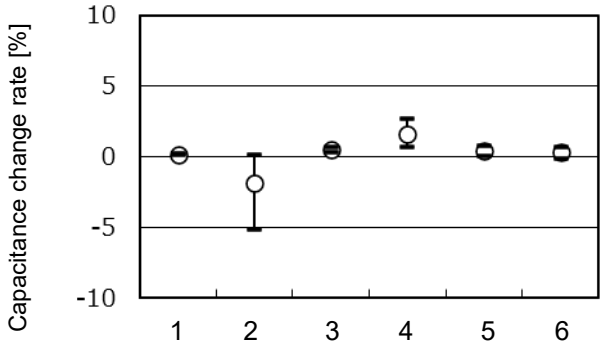
6. 2012X7SB106KS



4.2 Mechanical and Thermal Characteristics

[Substrate bending]
Flexure: 1 mm, Duration: 5±1 seconds

[Capacitance change rate]



No.	1.	2.	3.	4.	5.	6.
Sample size	3	3	3	3	3	3
Limit	Within ±10 %					
Ave	0.13	-1.87	0.54	1.63	0.40	0.28
Max	0.2	0.1	0.7	2.7	0.8	0.62
Min	0.1	-5.2	0.3	0.7	0.0	-0.15

[Solderability]
Solder temperature: 230±5 °C, Immersion duration: 5±0.5 seconds

[Externals]

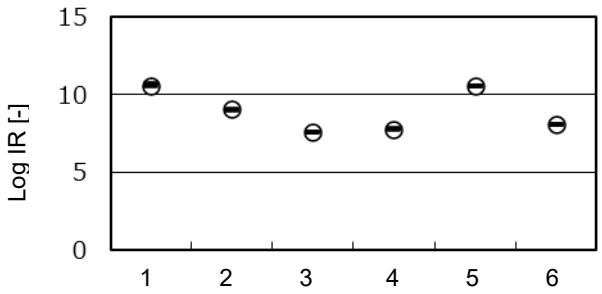
No.	1.	2.	3.	4.	5.	6.
No. of defective/ Sample size	0/4	0/4	0/4	0/4	0/4	0/4

No. JMCG0-0020-R

[Resistance to soldering heat]
Solder temperature: 260±5 °C, Immersion duration: 10±1 seconds
[Externals]

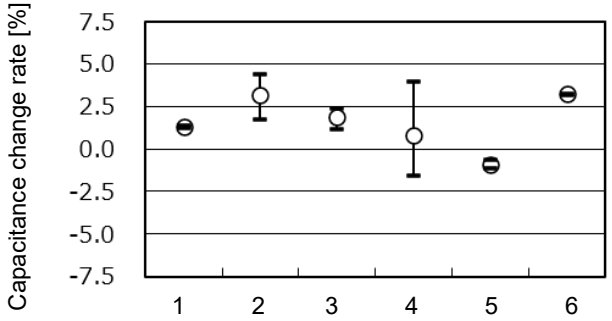
No.	1.	2.	3.	4.	5.	6.
No. of defective/ Sample size	0/4	0/4	0/4	0/4	0/4	0/4

[Insulation resistance] (+25 °C)



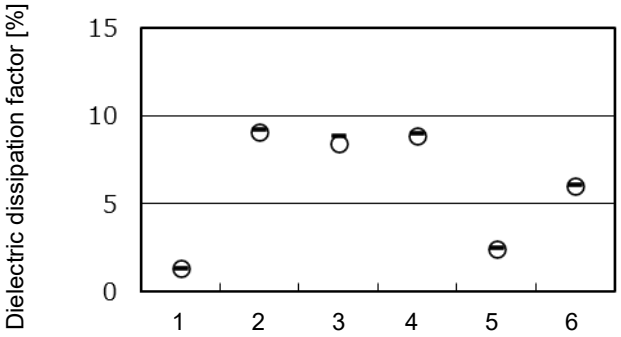
No.	1.	2.	3.	4.	5.	6.
Sample size	4	4	4	4	4	4
Limit	9.0≦	8.0≦	6.7≦	6.7≦	8.7≦	7.0≦
Ave	10.65	9.045	7.605	7.790	10.56	8.11
Max	10.7	9.06	7.61	7.80	10.6	8.12
Min	10.6	9.03	7.60	7.78	10.5	8.09

[Capacitance change rate]



No.	1.	2.	3.	4.	5.	6.
Sample size	4	4	4	4	4	4
Limit	Within ±7.5 %					
Ave	1.310	3.150	1.870	0.830	-0.887	3.21
Max	1.40	4.41	2.38	3.95	-0.64	3.26
Min	1.26	1.74	1.17	-1.58	-1.11	3.17

[Dissipation factor]



No.	1.	2.	3.	4.	5.	6.
Sample size	4	4	4	4	4	4
Limit	15 % as a maximum					
Ave	1.27	9.13	8.41	8.92	2.44	6.03
Max	1.3	9.2	8.9	9.0	2.5	6.09
Min	1.2	9.1	8.2	8.7	2.4	5.95

[Random vibration]
1 WV x 125 % Frequency range: 50 to 2000 Hz, Overall effective acceleration: 53.79 Grms
Direction and duration of vibration: 3 min. each direction (total of 9 min.) of three angles which are perpendicular to each other.

No.	1.	2.	3.	4.	5.
No. of Defective/ Sample size	0/10	0/10	0/10	0/10	0/10

*Shall not have any intermittent contact, open or short-circuitry of 0.1 ms or more.

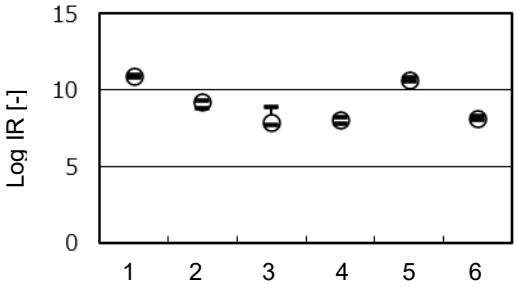
[Shock]
Maximum acceleration: 14.71 km/s^2, Normal duration: 0.5 ms, Waveform: half-wave sine wave, Rate change: 4.69 m/s, All effect acceleration: 1500 g's

No.	1.	2.	3.	4.	5.
No. of Defective/ Sample size	0/10	0/10	0/10	0/10	0/10

*Shall not have any intermittent contact, open or short-circuitry of 0.1 ms or more.

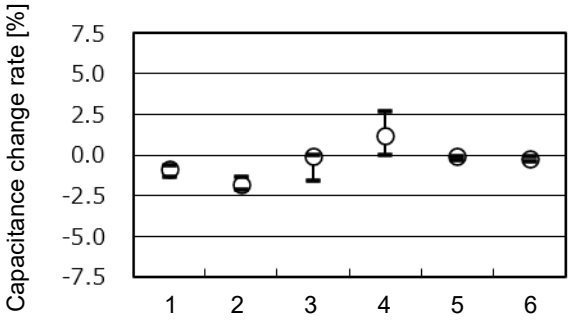
[Thermal shock and Immersion cycle]
Thermal shock: -55 to 125 °C, 250 cycles
Immersion cycle: 65 °C fresh water ◂▸ 25 °C saturated saline, 2 cycles

[Insulation resistance] (25 °C)



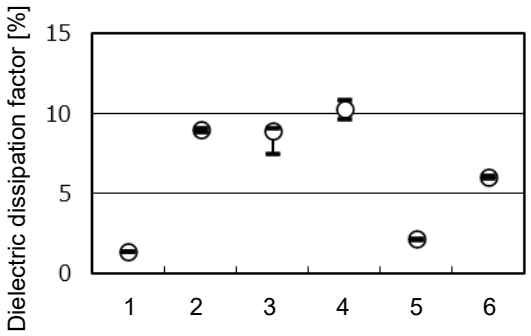
No.	1.	2.	3.	4.	5.	6.
Sample size	18	18	18	18	18	18
Limit	8.7≦	7.7≦	6.4≦	6.4≦	8.4≦	6.7≦
Ave	10.90	9.220	7.860	8.092	10.68	8.18
Max	11.0	9.32	8.92	8.24	10.8	8.30
Min	10.8	8.78	7.72	7.84	10.6	8.07

[Capacitance change rate]



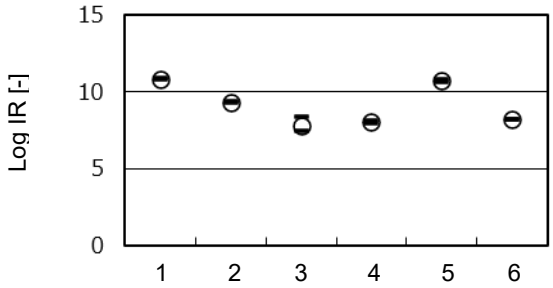
No.	1.	2.	3.	4.	5.	6.
Sample size	18	18	18	18	18	18
Limit	Within ±10 %					
Ave	-0.89	-1.78	-0.13	1.15	-0.14	-0.21
Max	-0.6	-1.3	0.0	2.7	-0.1	-0.09
Min	-1.3	-2.1	-1.6	0.0	-0.3	-0.37

[Dissipation factor]



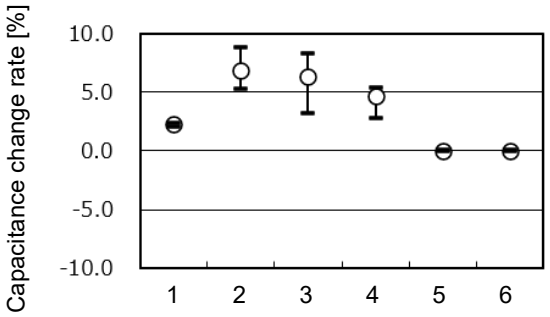
No.	1.	2.	3.	4.	5.	6.
Sample size	18	18	18	18	18	18
Limit	15 % as a maximum					
Ave	1.41	9.01	8.91	10.25	2.15	6.00
Max	1.4	9.1	9.1	10.8	2.2	6.1
Min	1.4	8.8	7.5	9.6	2.1	5.9

[Moisture resistance]
MIL-STD-202 TM106 20 times in a row
[Insulation resistance] (+25 °C)



No.	1.	2.	3.	4.	5.	6.
Sample size	12	12	12	12	12	12
Limit	8.7≦	7.7≦	6.4≦	6.4≦	8.4≦	7.0≦
Ave	10.82	9.300	7.821	8.019	10.74	8.17
Max	10.9	9.34	8.33	8.09	10.8	8.18
Min	10.8	9.25	7.44	7.96	10.6	8.16

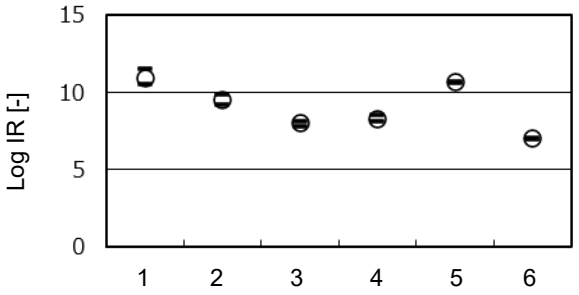
[Capacitance change rate]



No.	1.	2.	3.	4.	5.	6.
Sample size	12	12	12	12	12	12
Limit	Within ±10 %					
Ave	2.27	6.82	6.32	4.66	0.02	0.04
Max	2.4	8.8	8.3	5.4	0.1	0.12
Min	2.1	5.3	3.2	2.8	0.0	-0.05

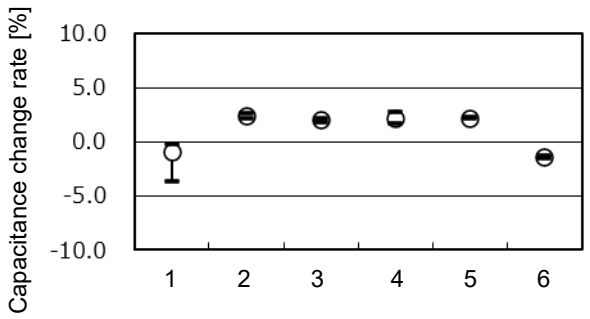
[Humidity, Steady-State, Low voltage]
85 °C, 85 %RH, DC1.3 V, 240 h

[Insulation resistance] (+25 °C)



No.	1.	2.	3.	4.	5.	6.
Sample size	12	12	12	12	12	12
Limit	9.0≦	8.0≦	6.7≦	6.7≦	8.7≦	7.0≦
Ave	10.90	9.500	8.030	8.310	10.65	7.01
Max	11.5	9.84	8.12	8.52	10.7	7.03
Min	10.5	9.20	7.82	8.16	10.6	7.01

[Capacitance change rate]



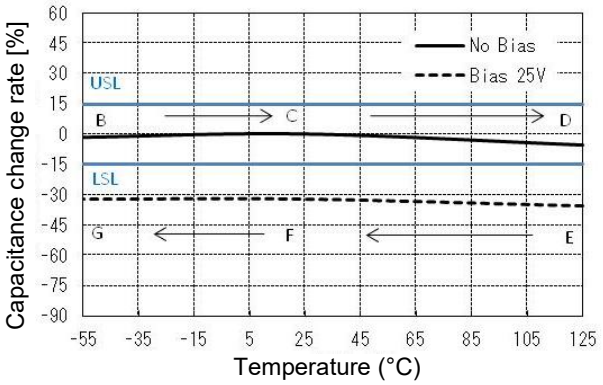
No.	1.	2.	3.	4.	5.	6.
Sample size	12	12	12	12	12	12
Limit	Within ±10 %					
Ave	-0.88	2.43	1.97	2.08	2.18	-1.37
Max	-0.2	2.6	2.2	2.7	2.3	-1.2
Min	-3.7	2.1	1.8	1.7	2.1	-1.5

5. CHARACTERISTICS UNDER VARIOUS OPERATING ENVIRONMENTAL CONDITIONS

[Voltage – Temperature characteristics] (Sample size: 4 pieces)

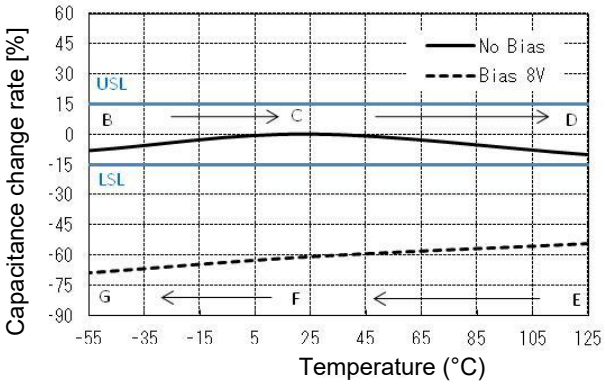
1. 1608X7RC104KS

1 kHz / 1 Vrms



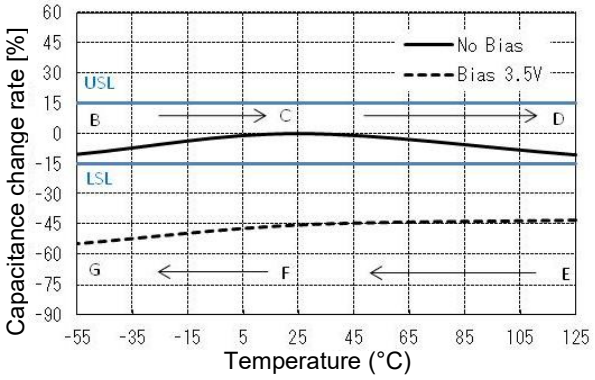
2. 1608X7RB105KS

1 kHz / 1 Vrms



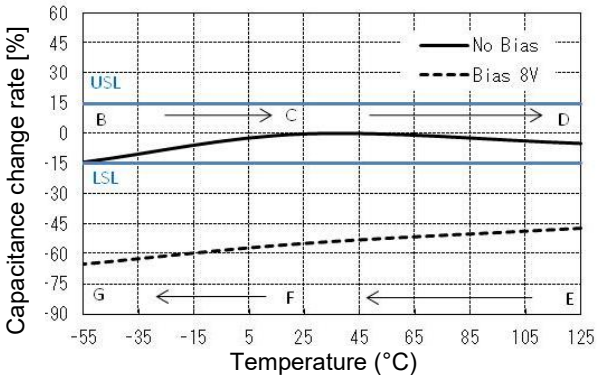
3. 3216X7RA226MS

120 Hz / 0.5 Vrms



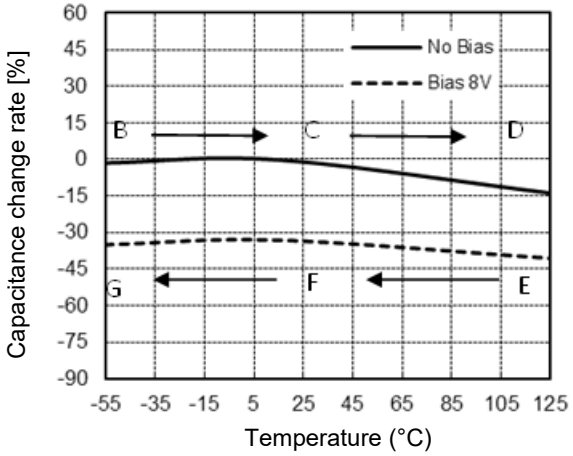
4. 3225X7RB226MS

120 Hz / 0.5 Vrms



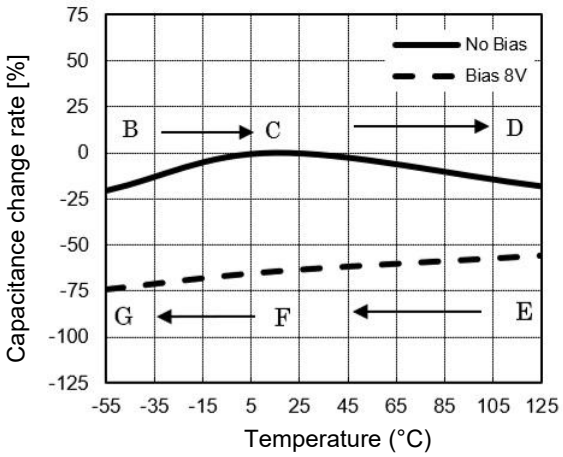
5. 1005X7SB104KR

1 kHz / 1 Vrms



6. 2012X7SB106KS

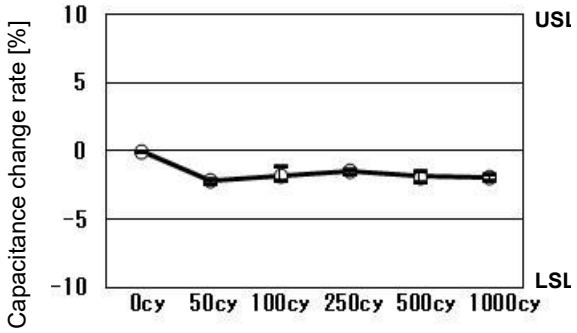
1 kHz / 0.3 Vrms



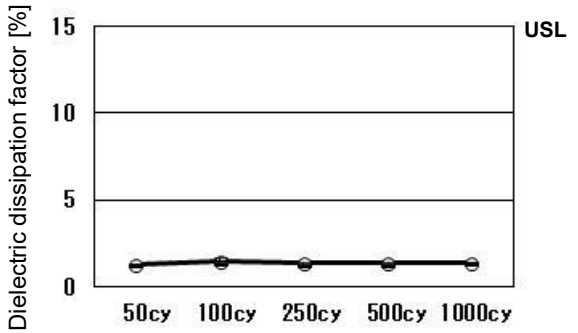
[Drifting in Thermal shock (I)] (Sample size: 18 pieces)

1. 1608X7RC104KS

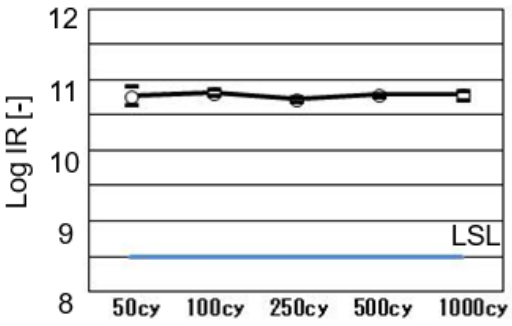
[Capacitance change rate]



[DF]

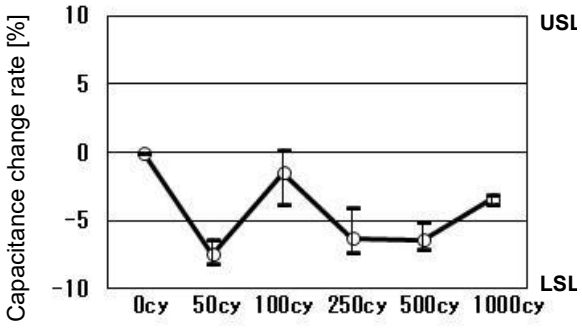


[IR] (+25 °C)

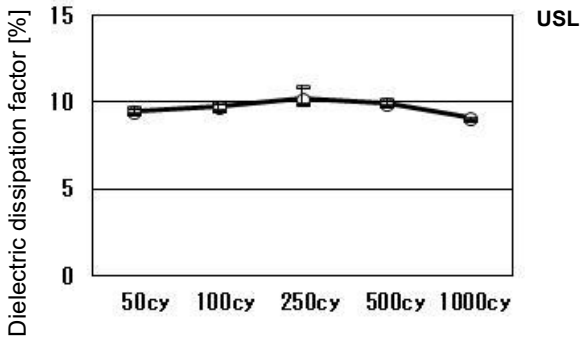


2. 1608X7RB105KS

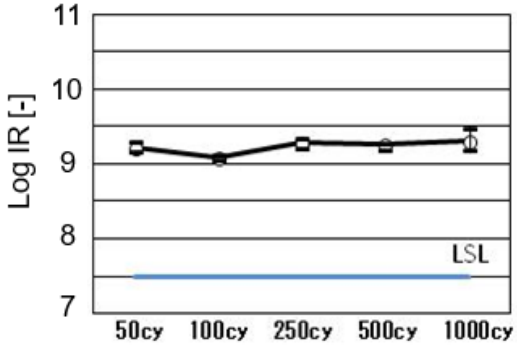
[Capacitance change rate]



[DF]

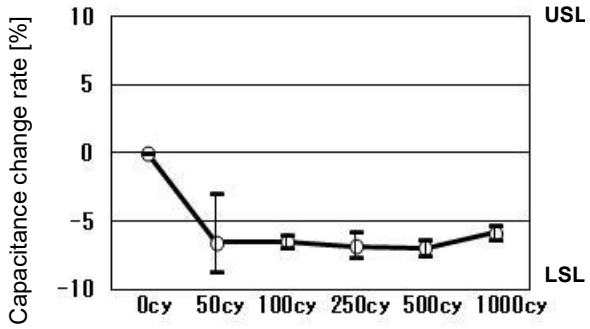


[IR] (+25 °C)

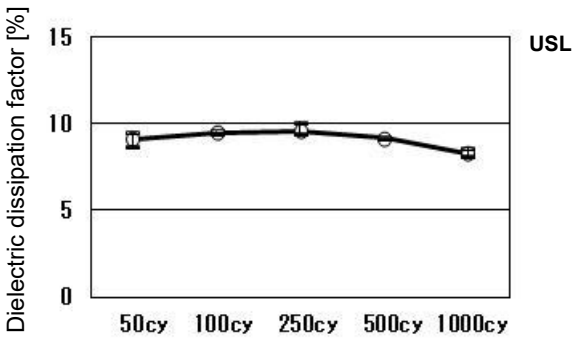


3. 3216X7RA226MS

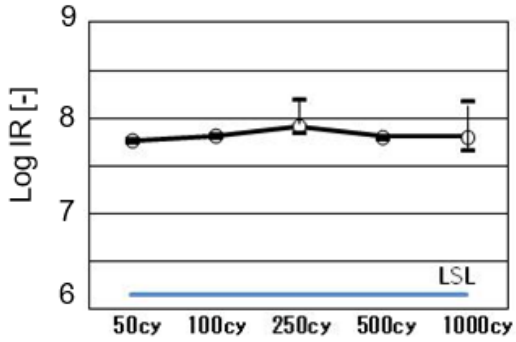
[Capacitance change rate]



[DF]

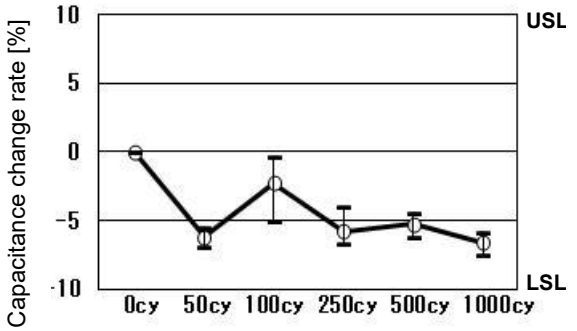


[IR] (+25 °C)

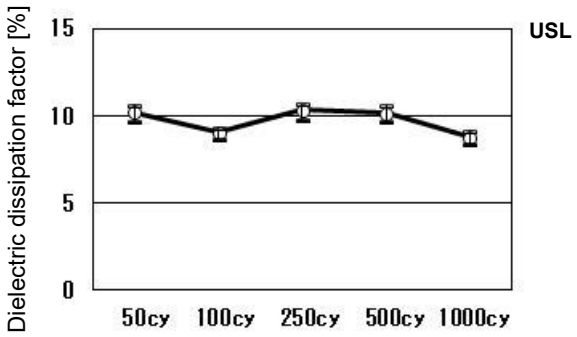


4. 3225X7RB226MS

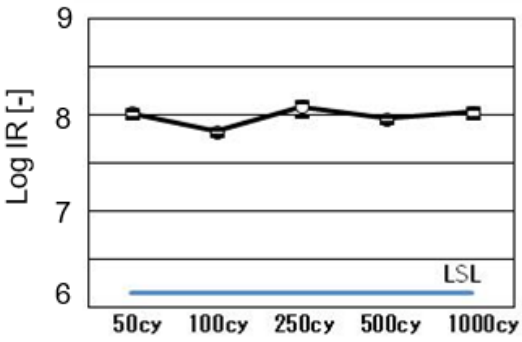
[Capacitance change rate]



[DF]



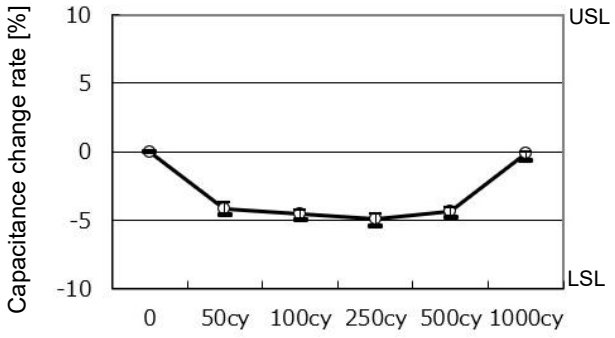
[IR] (+25 °C)



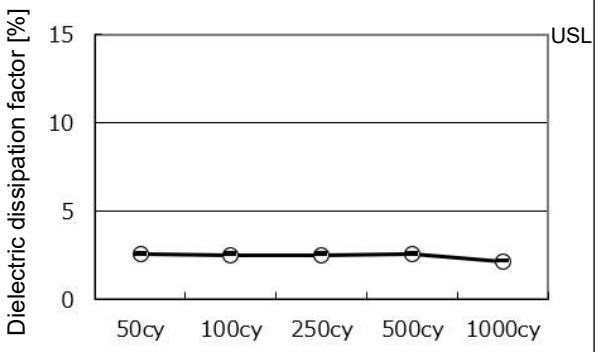
No. JMCG0-0020-R

5. 1005X7SB104KR

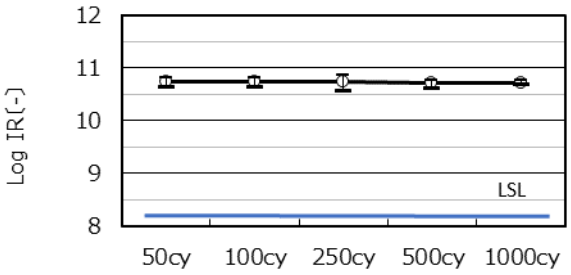
[Capacitance change rate]



[DF]

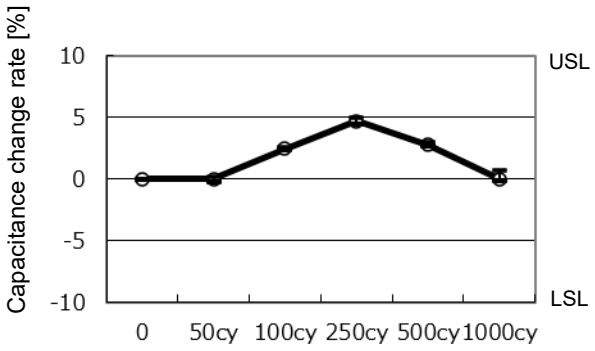


[IR] (+25 °C)

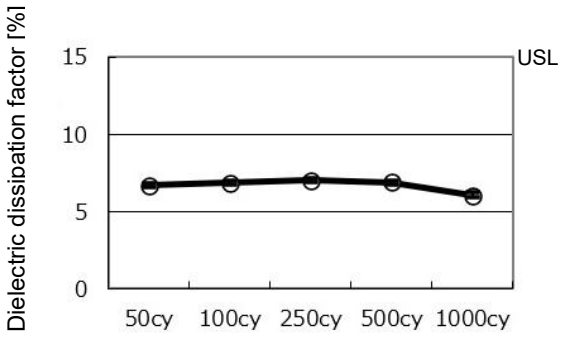


6. 2012X7SB106KS

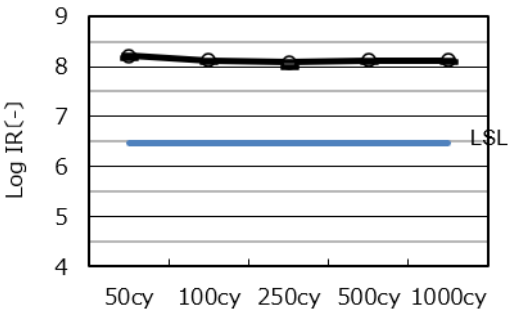
[Capacitance change rate]



[DF]



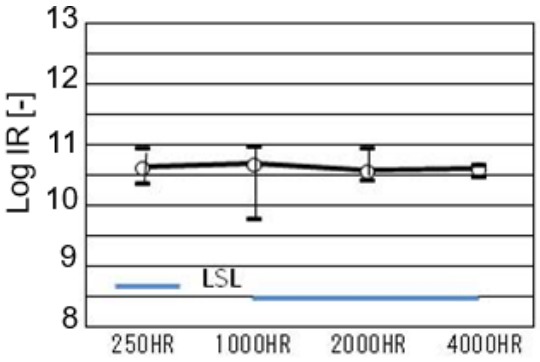
[IR] (+25 °C)



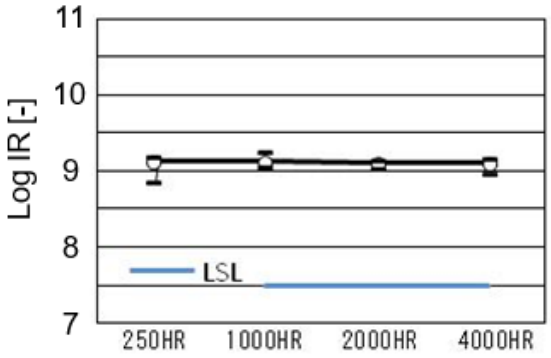
[Drifting in Life test] (Sample size: 123 pieces)

1. 1608X7RC104KS

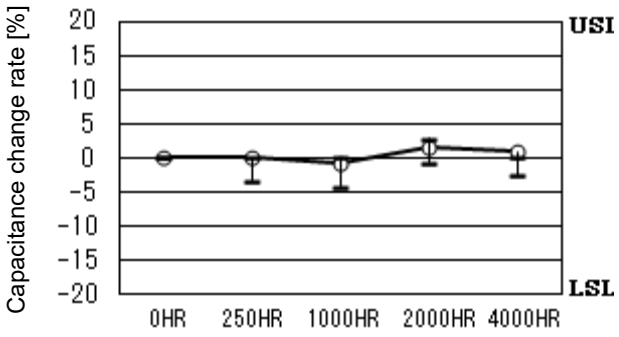
[IR] (+25 °C)



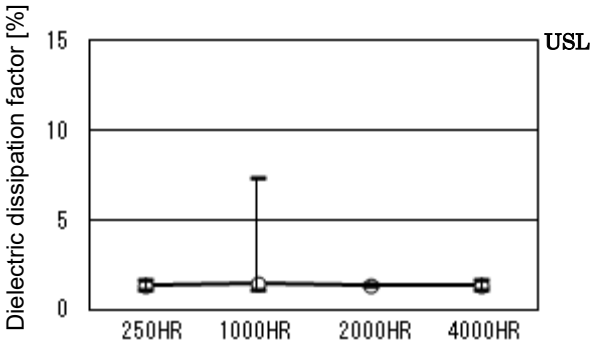
[IR] (+125 °C)



[Capacitance change rate]

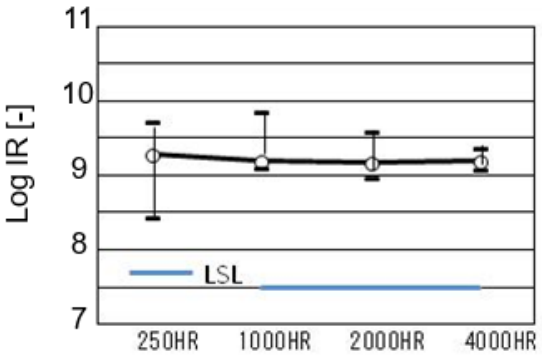


[DF]

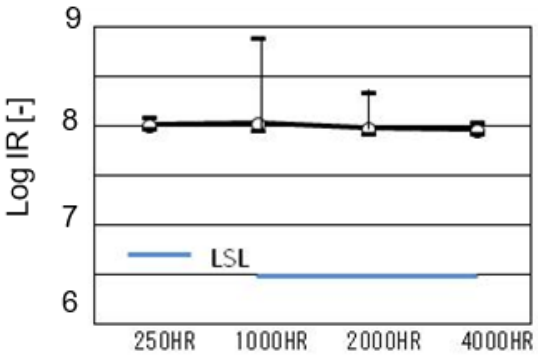


2. 1608X7RB105KS

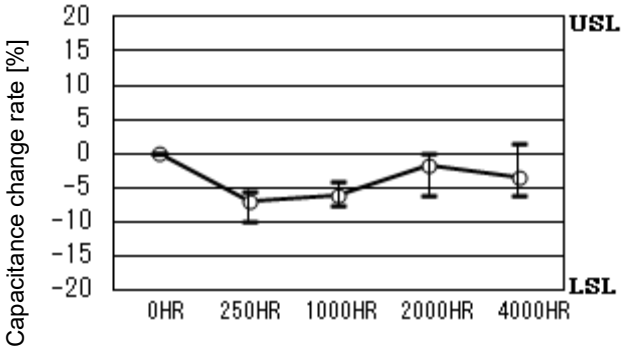
[IR] (+25 °C)



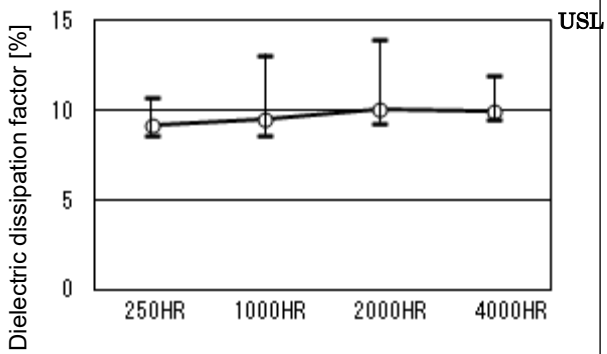
[IR] (+125 °C)



[Capacitance change rate]

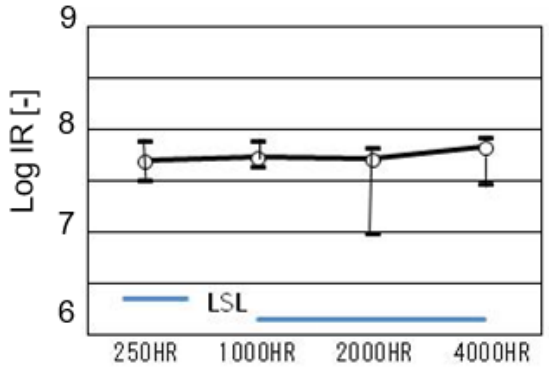


[DF]

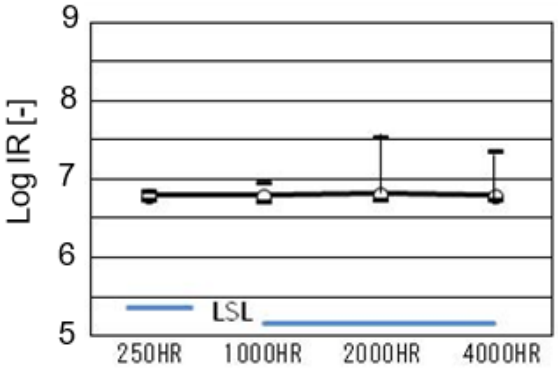


3. 3216X7RA226MS

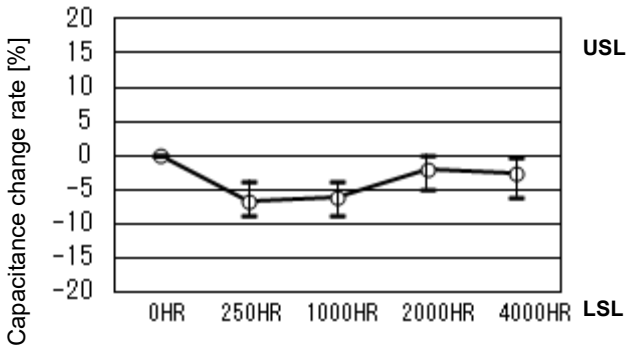
[IR] (+25 °C)



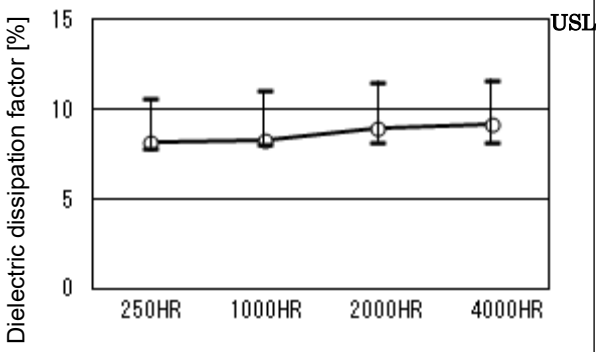
[IR] (+125 °C)



[Capacitance change rate]

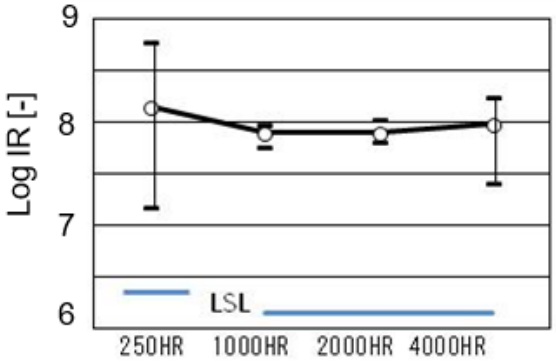


[DF]

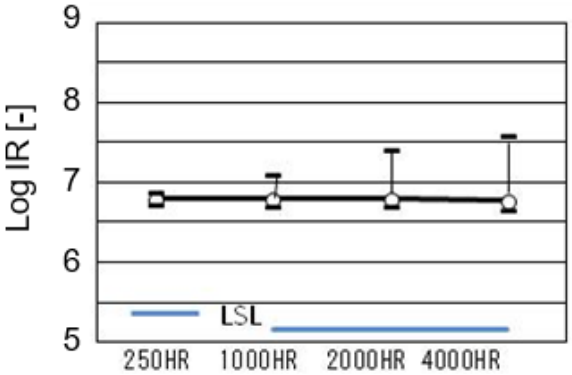


4. 3225X7RB226MS

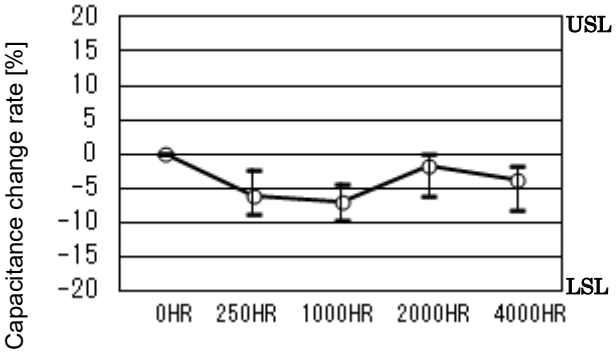
[IR] (+25 °C)



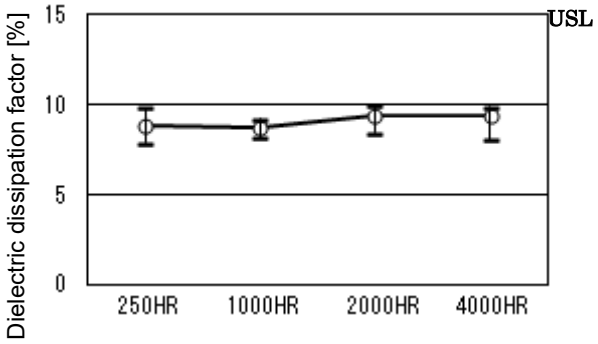
[IR] (+125 °C)



[Capacitance change rate]

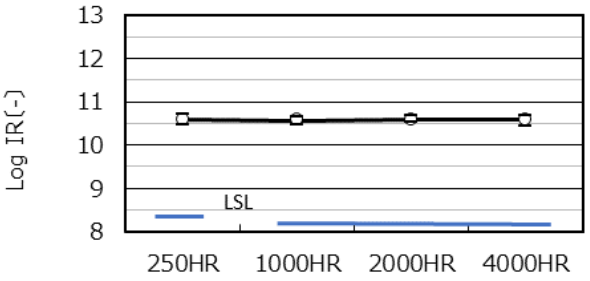


[DF]

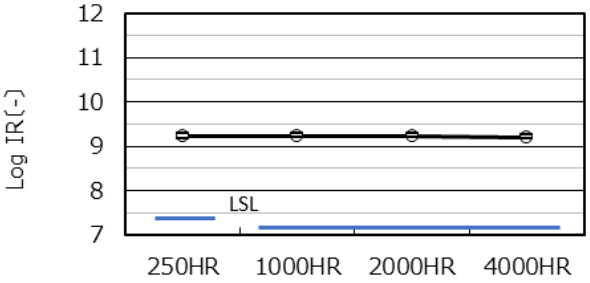


5. 1005X7SB104KR

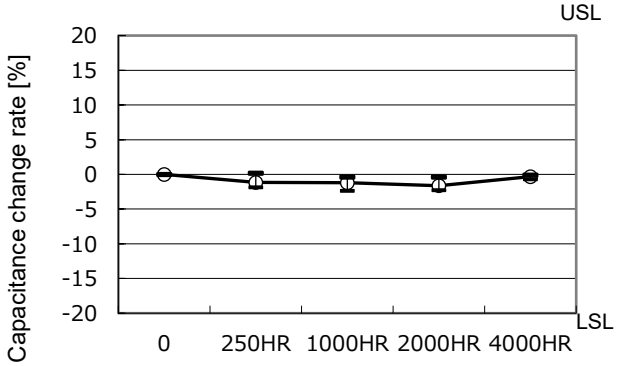
[IR] (+25 °C)



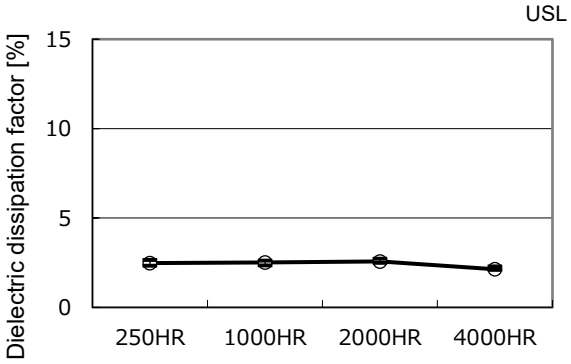
[IR] (+125 °C)



[Capacitance change rate]

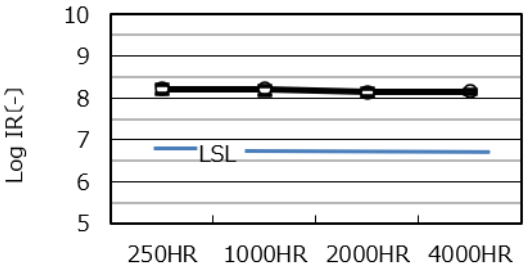


[DF]

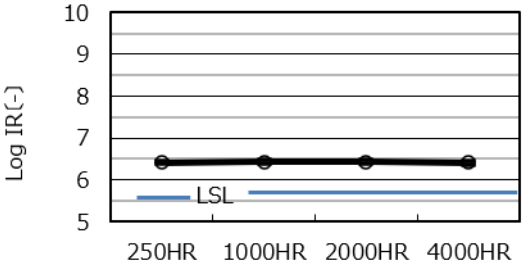


6. 2012X7SB106KS

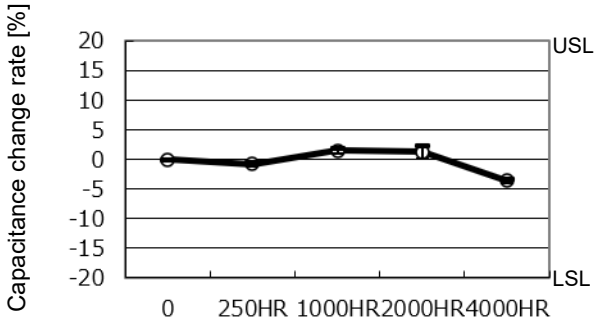
[IR] (+25 °C)



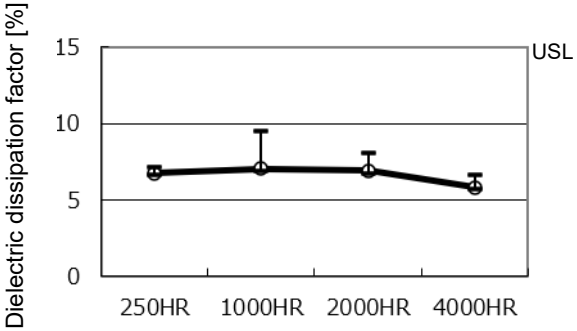
[IR] (+125 °C)



[Capacitance change rate]



[DF]



6. ENVIRONMENTAL LIMITS

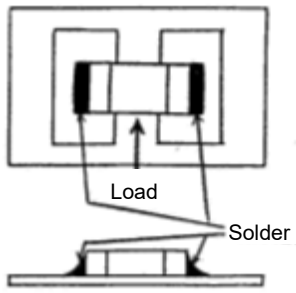
6.1 Shear (Destructive)

a) Mounting method

The capacitor was mounted on the test jig shown in the figure below (thickness of 0.635 mm±0.05 mm or thicker, with a minimum of 95 % of Alumina substrate) by the reflow soldering method with Sn60/Pb40 solder. The thickness was adjusted to be between 0.30 and 0.50 T (where T = Thickness of the capacitor) for the capacitor with the solder fillet thickness of 1005 through 3216, and to be between 0.15 and 0.25 T for the capacitor with the fillet thickness of 3225 size.

b) Test method

The load was applied to the direction of the arrow in the figure below with the velocity of 30 mm/min ± 6 mm/min.



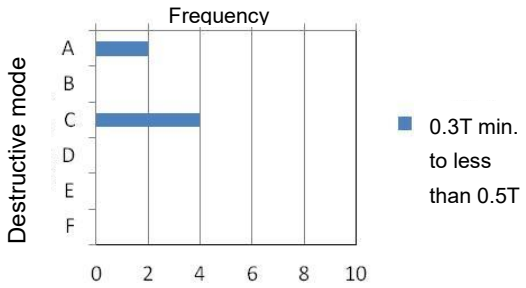
Test jig

Symbol	Shear mode
A	Sheared ceramic
B	Separation between ceramic and terminal electrodes
C	Sheared solder
D1	Detachment of solder joint (from part surface)
D2	Detachment of solder joint (from board surface)
E	Peeling of the land on test board
F	Others

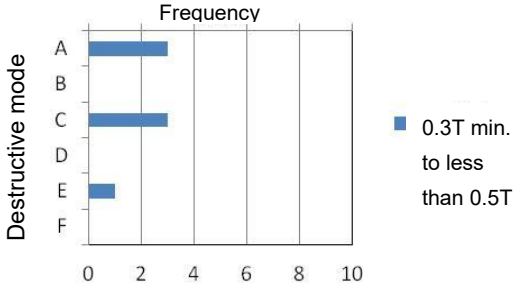
c) Results

[Destructive Mode]

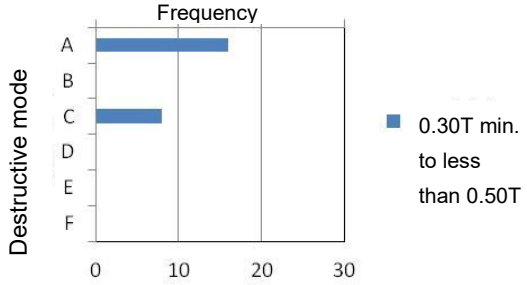
1.1608X7RC104KS



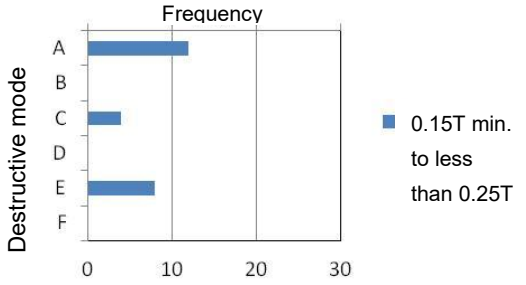
2.1608X7RB105KS



3.3216X7RA226MS



4.3225X7RB226MS



〔piece〕

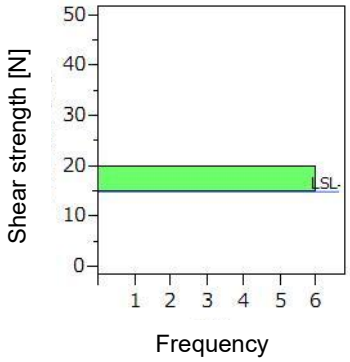
	Shear mode symbol						
Sample	A	B	C	D1	D2	E	F
5. 1005X7SB104KS	6	0	0	0	0	0	0
6. 2012X7SB106KS	5	0	0	0	0	1	0

No. JMCG0-0020-R

[Breakdown strength]

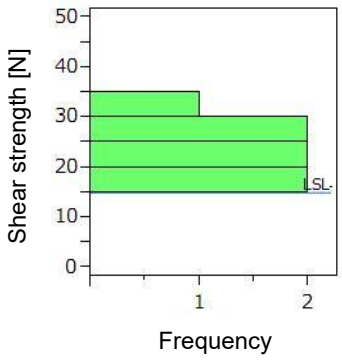
1.1608X7RC104KS (Min. Shear strength: 15 N)

0.3 T min. to less than 0.5 T



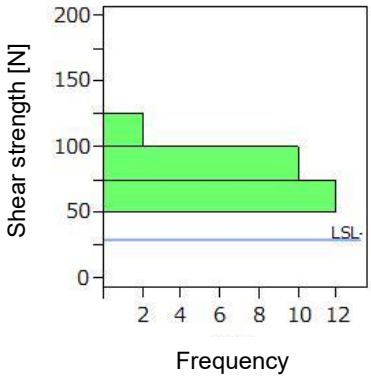
2.1608X7RB105KS (Min. Shear strength: 15 N)

0.3 T min. to less than 0.5 T



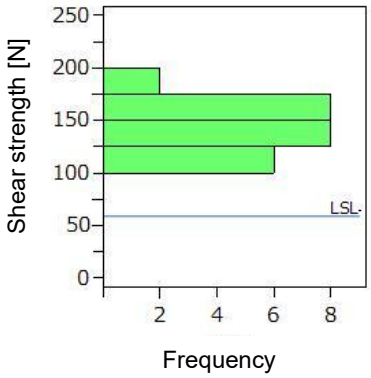
3.3216X7RA226MS (Min. Shear strength: 30 N)

0.3 T min. to less than 0.5 T



4.3225X7RB226MS (Min. Shear strength: 60 N)

0.15 T min. to less than 0.25 T



〔N〕

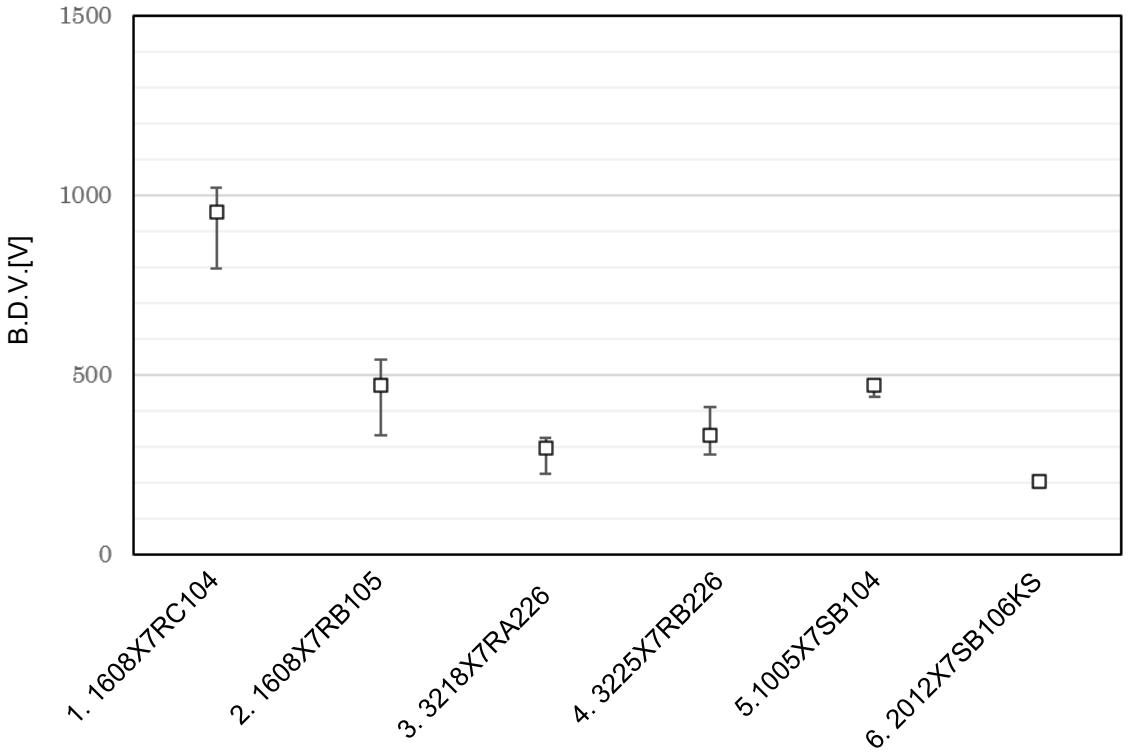
Sample	Std.	Ave.	Max.	Min.
5. 1005X7SB104KS	5	16.42	18.9	14.1
6. 2012X7SB106KS	30	68.97	73.7	58.6

6.2 Direct Voltage Breakdown

a) Test method:
Applied voltage was raised by the rate of 12.5 V/sec.

b) Sample size: 10 pieces each

c) Results:



〔V〕

No.	1.	2.	3.	4.	5.	6.
Sample size	10	10	10	10	10	10
Ave	953	470	298	334	470	204
Max	1020	540	330	410	480	236
Min	800	330	230	280	440	178

6.3 Thermal Shock + PCBT (Pressure cooker Bias Test) (Reference)

The Limit evaluation test by 2000 cycles of thermal shock + PCBT was performed on the chip capacitor for automotive mounted on FR-4.

a) Mount method

The capacitor was mounted on the copper-clad laminate board for glass woven base epoxy resin printed wiring board (thickness: 1.6±0.2 mm) by solder reflow method with SAC305 solder.

Solder fillet thickness shall be shown in Table 1.

b) Sample and sample size

GCM31CR70J226K (size: 3216, rated value: 22 µF, 6.3 V)

Unit: piece

Test item	Sample size	
	Lot A	Lot B
Thermal shock + DPA	9	9
Thermal shock + PCBT	23	23

c) Test condition

1) Thermal shock (air)

Test temperature: -55 to +125 °C

Soak time: 30 minutes each

Test cycle: 2000 cycles

Limit temperature transition time: within 5 minutes

2) PCBT

Test temperature: +125 °C

Relative humidity: 95 %RH

Test atmosphere: 2 atmosphere

Applied voltage: Rated voltage

Test duration: 144 hours

d) Results

After the completion of thermal shock test, small crack was found in the external ceramic part of the capacitor. However, the depth of the crack was less than 30 μm and it did not reach the internal electrode. (See images 2 and 3)

During PCBT, the insulation resistance was stabilized at 1 MΩ or more and it is confirmed that the reliability of the capacitor was not affected by the small crack.

Table 1. Filet Thickness ([1])

No.	Lot A			Lot B		
	Solder fillet thickness (mm)	T dimension ratio ([2])	Note	Solder fillet thickness (mm)	T dimension ratio ([2])	Note
1	1.195	0.650	See image 2	1.314	0.714	
2	1.123	0.610		1.275	0.693	
3	1.203	0.654		1.231	0.669	
4	1.336	0.726		1.219	0.662	See image 3
5	1.063	0.578		1.069	0.581	
6	1.207	0.656		1.051	0.571	
7	1.098	0.597		1.175	0.639	
8	1.189	0.646	See image 1	1.211	0.658	
9	1.165	0.633		1.255	0.682	
10	1.266	0.688		1.192	0.648	
11	1.251	0.680		1.131	0.615	
12	1.218	0.662		1.228	0.668	
13	1.252	0.680		1.255	0.682	
14	1.049	0.570		1.264	0.687	
15	1.077	0.585		1.271	0.691	
16	1.279	0.695		1.195	0.649	
17	1.257	0.683		1.281	0.696	
18	1.252	0.680		1.313	0.713	
Ave	1.193	0.649		1.218	0.662	
Max	1.336	0.726		1.314	0.714	
Min	1.049	0.570		1.051	0.571	

Notes: ([1]) The fillet thicknesses on 18 samples of PCBT were measured.
([2]) The ratio of the solder fillet thickness to the thickness of the capacitor (T dimension)

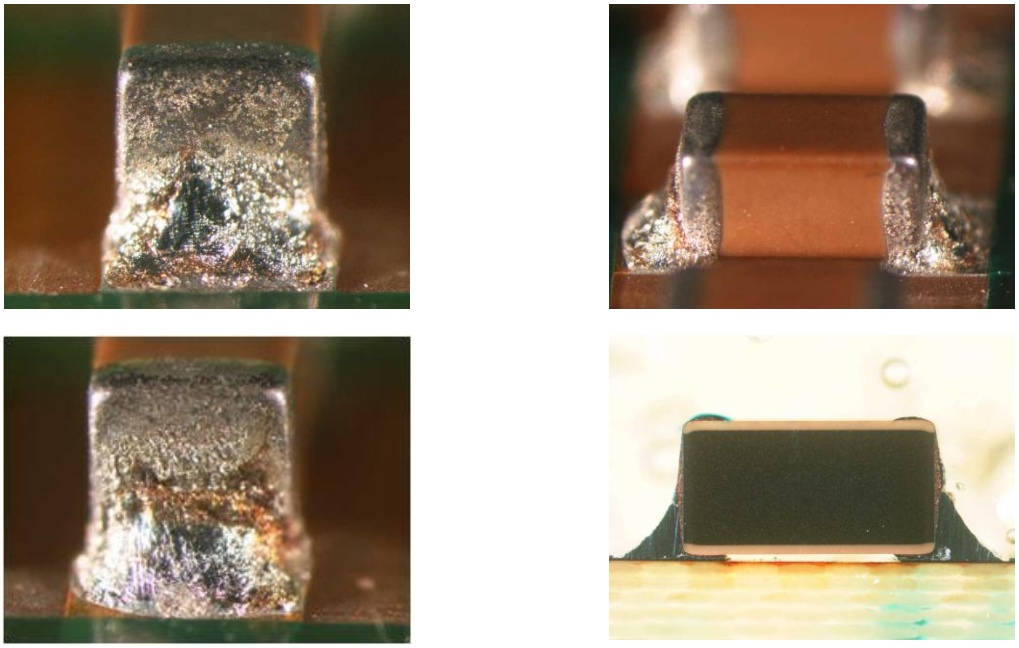


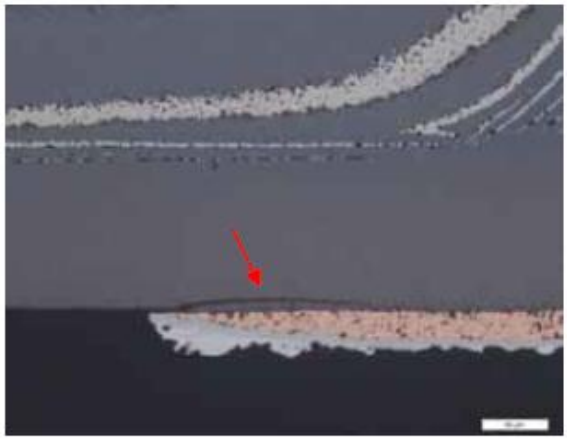
Image 1. The Mount State of the Capacitor (No. 8 in Lot A)

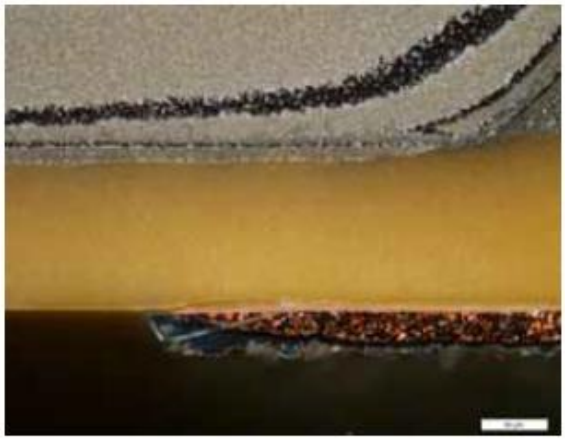
→ Center of sample No. 1



Bright field image

Dark field image

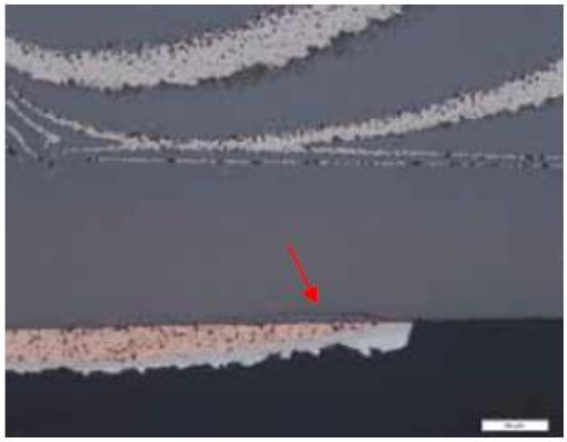






Bright field image

Dark field image



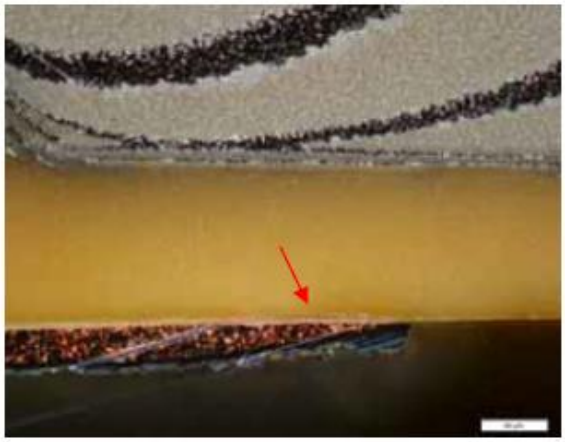


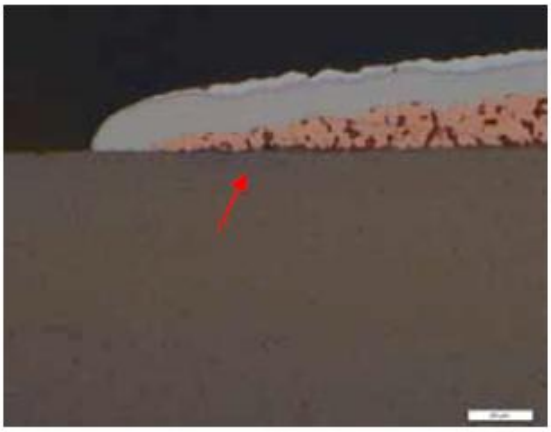
Image 2. Occurrence of Small Crack (No. 1 of Lot A)

Lot B: An example of small crack images

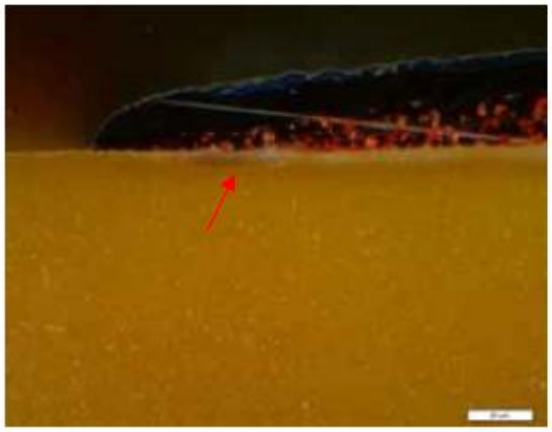
→ Center of sample No. 4

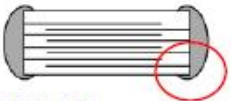


Bright field image

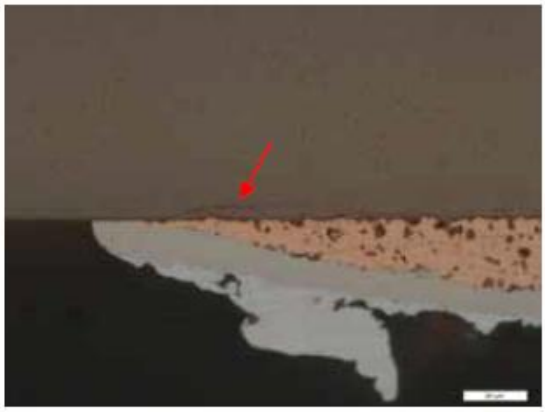


Dark field image





Bright field image



Dark field image

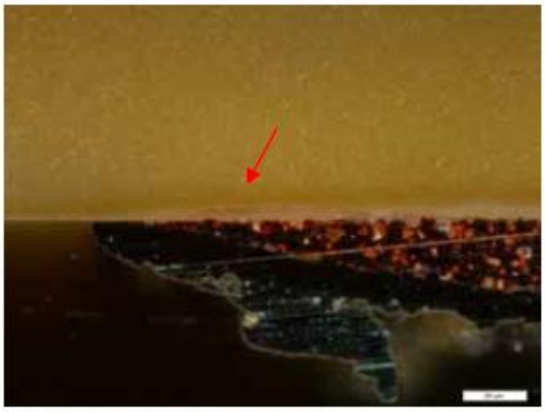


Image 3. Occurrence of Small Crack (No. 4 of Lot B)

7. RELIABILITY

7.1 Failure Rates

a) Life test condition and results

Sample name	Rating condition (125 °C, 1.5 WV)		
	Sample size	Test duration	No. of defectives
1. 1608X7RC104KS	123	4000	0
2. 1608X7RB105KS	123	4000	0
3. 3216X7RA226MS	123	4000	0
4. 3225X7RB226MS	123	4000	0
5. 1005X7SB104KR	123	4000	0
6. 2012X7SB106KS	123	4000	0

b) Calculation of failure rate

Sample name	Component hour (25 °C, WV conversion)	Failure rate (Fit)
1. 1608X7RC104KS	3,123,746,087	0.294
2. 1608X7RB105KS	3,123,746,087	0.294
3. 3216X7RA226MS	3,123,746,087	0.294
4. 3225X7RB226MS	3,123,746,087	0.294
5. 1005X7SB104KR	3,123,746,087	0.294
6. 2012X7SB106KS	3,123,746,087	0.294

[Remarks]

1. Failure criteria
   Insulation resistance, externals, capacitance change, dielectric dissipation factor
   (Specifications: As specified in JAXA-QTS-2040)
2. Voltage is accelerated by 4.5 power rule, and temperature is accelerated by 10 °C rule for converting to the application of rated voltage at 25 °C.
3. In the case of no defects, the failure rate shall be as follows. (reliability level: 60 %)
   $\lambda = 0.917 / T$ where λ: Failure rate
   T: Component hour
   As a result of the calculation, the values in the table above satisfy S level (0.001 % / 1000 HR = Less than 10 Fit)

7.2 Possible Failure Modes

Insulation resistance degradation
High capacitance change rate
High dielectric dissipation factor

Decreased solder joint strength
Occurrence of cracks

8. STORAGE CONDITIONS

Observe the following when the products are stored. Special cautions should be used about discoloration of terminal electrodes due to moisture and/or noxious fumes, which deteriorates solderability.

a) Do not open the most internal package (heat sealed plastic bag). If opened, re-heat seal the package immediately or place the product in a desiccator with a drying agent.
b) Keep the storage environments at ambient temperatures of between 5 and 40 °C and humidity of between 20 and 70 %RH.
c) Keep the storage atmosphere free of noxious gases including sulfur and chlorine.
d) Use high dielectric constant type capacitor as soon as possible as their capacitance gradually decreases due to aging.

9. NOTES

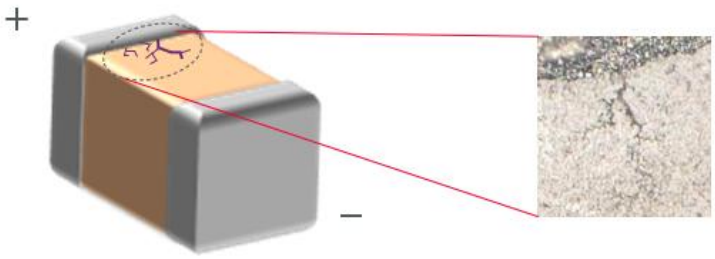
9.1 Note for Cleaning

Ultrasonic cleaning shall be conducted with chamber output of 20W/l as a maximum for 5 minutes as a maximum.

9.2 Notes for Resin Coating

9.2.1 Notes

a) Perform resin coating with a moisture-proof material for external insulation after the capacitor is mounted. Use a coating material of the minimum coefficient of thermal expansion.
b) If an improper resin is used, capacitance reduction, degradation of insulation resistance or short-circuiting may be caused due to cracks in the ceramic element and/or detachment of terminal electrodes.
c) If any problem is expected as a result of resin coating, change the coating material or perform buffer coating between the capacitor and the resin with a silicone resin.
d) In environments containing sulfur-based gases, sulfur may react with the silver (Ag) component in the resin electrode, which can lead to dendrite formation between the terminal electrodes. Please use a resin coating material with high sulfur gas barrier properties.



Locations of Dendrite Formation and Representative Photograph

9.2.2 Relationship between Resin Coating, Life Test Conditions, and Dendrite Formation (Reference)

9.2.2.1 Relationship between Life Test Conditions and Dendrite Formation (Without Resin Coating)

a) Samples and Quantity
1005X7SB104KR (with solder plating, series name: GSX): 18 pieces for each condition
1005X7SB104KJ (without solder plating, series name: GSJ): 18 pieces for each condition

b) Test Conditions
Test temperature: Three levels (85 / 105 / 125 °C)
Applied voltage: Three levels (4 / 8 / 12 V)
Test duration: 8,000 hours

c) Results
In tests conducted at 105 °C or below and under 4 V, no dendrite formation was observed up to 8,000 hours, regardless of the presence or absence of the solder plating layer.
At 125 °C, dendrites were observed even at 4 V. At 12 V, connection between terminal electrodes occurred at 6,360 hours. The test was continued until 8,000 hours, and the electrical characteristics (capacitance, dissipation factor, and insulation resistance) remained within the specification range, with no degradation caused by the dendrites.

Solder plated		Yes	No
Temperature (°C)	Voltage (V)	GSX	GSJ
85	4	Not occurred	Not occurred
105	4	Not occurred	—
125	4	Occurred	Occurred
	8	Occurred	—
	12	Occurred	Occurred

9.2.2.2 Transition of Electrical Characteristics During Life Test (Without Resin Coating)

a) Samples and Quantity
1005X7SB104KR (with solder plating, series name: GSX): 18 pieces

b) Test Conditions
Test temperature: 125 °C
Applied voltage: 12 V
Test duration: 8,000 hours

c) Results
Shown below.

Insulation Resistance Transition

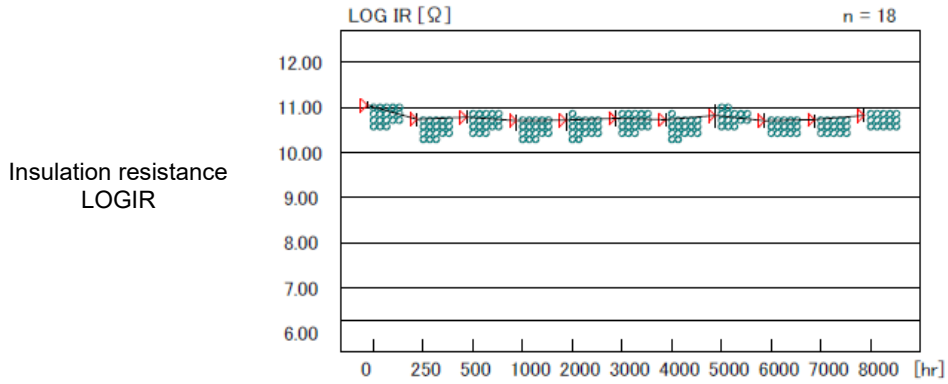


Table. Change in LOGIR of the Chip with Dendrite Bridging Between Terminal Electrodes at 6,360 Hours

Duration hr	1000	4000	5000	6000	7000	8000
LOGIR	10.65	10.67	10.85	10.56	10.56	10.74

Even after 7,000 and 8,000 hours following dendrite-induced bridging between the terminal electrodes, the insulation resistance met the specification, and no degradation trend was observed.

9.2.2.3 Relationship Between Life Test Conditions and Dendrite Formation (With Resin Coating)

a) Samples and Quantity
1005X7SB104KR (with solder plating, GSX series): 18 pieces for each condition

b) Test Conditions
Test temperature: Two levels (105 / 125 °C)
Applied voltage: Two levels (4 / 12 V)

c) Results
Even under test conditions of 125 °C and 12 V, no dendrite formation was observed up to 4,000 hours.
After the test, the coating layer was removed, and the surface of the element was inspected; no dendrites were detected.

Table Result of Dendrite Observation After Life Test

		Parylene			Uralene
Temperature (°C)	Voltage (V)	15 um	25 um	35 um	
105	4	Not occurred	Not occurred	Not occurred	Not occurred
125	12	Not occurred	Not occurred	Not occurred	Not occurred

9.3 Note for Tin Whisker

The tin whisker will occur on the products with the terminal finish "Y" in this application data sheet due to the tin plated finish on the external electrodes. Nodule whiskers around 30 μm were observed as a result of the thermal shock test (at -30 to +100 °C for 1,000 cycles) in the development test. Use caution about tin whisker growth in using terminal finish “Y” products.

9.4 DC Bias Characteristics

High-dielectric-constant type capacitors exhibit capacitance variation when a DC voltage is applied.
Before use, select capacitors after considering this DC voltage characteristic.
Since the capacitors use dielectric ceramics that have voltage dependency, the capacitance may greatly vary when the applied DC voltage is high.
In order to ensure the required capacitance, please confirm the following points:

(1) Check that the capacitance variation due to the applied voltage is within the allowable range, or that the application is not affected by such variation.
(2) The DC voltage characteristic shows that, even when the applied voltage is below the rated voltage, the capacitance change rate increases (decreases in value) as the applied voltage increases.
When using high-dielectric-constant capacitors in circuits such as time constant circuits, which require precise capacitance with a narrow tolerance, fully take into account the voltage characteristics, and carefully verify all characteristics under actual operating conditions and in the actual equipment.

9.5 AC Voltage Characteristics

High-dielectric-constant capacitors exhibit capacitance variation due to the applied AC voltage.
Before use, select capacitors after considering this AC voltage characteristic.

9.6 Others

To cut a PWB populated with capacitors, use a dedicated jig instead of manual cut to prevent breakage due to mechanical shocks.

10. OTHERS

For any questions with this data sheet, please contact:
Product Planning Section 1, Product Engineering Department, Sales Promotion Department, Ceramic Capacitor Division,
Fukui Murata Manufacturing Co., Ltd.
Address: 13-1, Okamoto-cho, Echizen-shi, Fukui 915-8601 Japan
Telephone: +81-778-21-8371