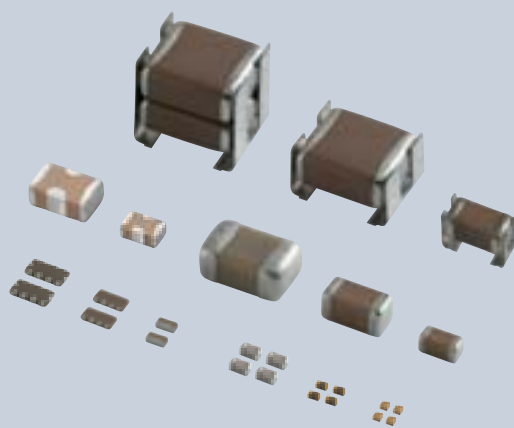


Chip Multilayer Ceramic Capacitors for General



2018

Safety Standard Certified Chip Multilayer Ceramic Capacitors for General Purpose / IEC60384-14 Class X2

GA3 Series Type GB



IEC60384-14 X2 Class Certified Product

Features

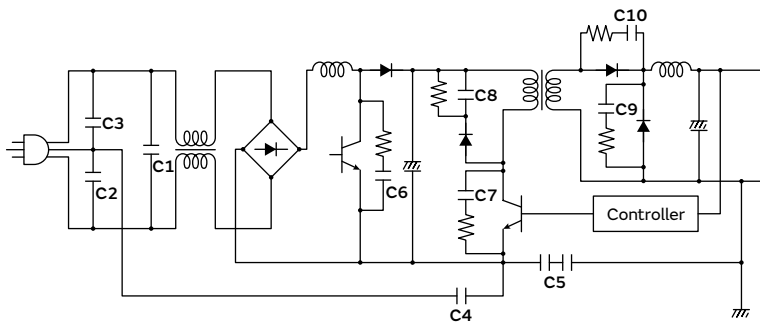
- 1 International Standard (IEC60384-14) certified product.

Please down load Safety Standard Certification (Type GB: X2) from here.



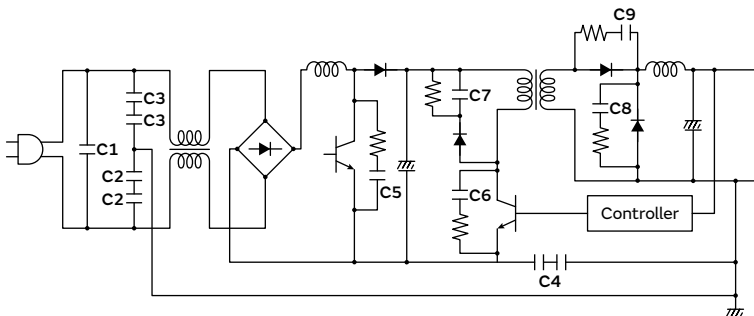
- 2 Can be used as a Class X2 capacitor.

- Switching Power Supply - Class 1 Equipment



| No. | Application | Recommend MLCC Type |
|-----|------------------------------|---------------------|
| C1 | X Cap | Type: GB |
| C2 | Y Cap | Type: GF |
| C3 | | |
| C4 | | |
| C5 | Primary - Secondary Coupling | Type: GF×2 |

- Switching Power Supply - Class 2 Equipment

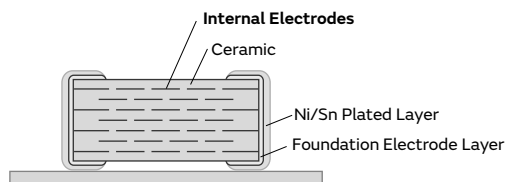


| No. | Application | Recommend MLCC Type |
|-----|------------------------------|---------------------|
| C1 | X Cap | Type: GB |
| C2 | Y Cap | Type: GF×2 |
| C3 | | |
| C4 | Primary - Secondary Coupling | |

- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KPM
- KR3
- GMA
- GMD
- △Caution / Notice

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

- 3 Realized large capacitance value and small size while maintaining high withstand voltages by the multilayer structure.

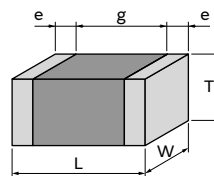


<Example of Structure>

- 4 Compared with conventional lead type capacitors, this product realized great reductions in size and height, with a volume of 1/10 or less, and height of 1/4 or less.
- 5 This product is only for reflow soldering.

Specifications

| | |
|-------------------|--------------------|
| Size (mm) | 5.7×5.0mm |
| Rated Voltage | 250Vac |
| Capacitance | 10000pF to 56000pF |
| Main Applications | AC-DC power supply |



<Dimensions>

This catalog contains only a portion of the product lineup.
 Please refer to the capacitor search tool on the Murata Web site for details.

GA3 Series Type GB High Dielectric Constant Type Part Number List

5.7×5.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|---------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 10000pF | ±10% | GA355QR7GB103KW01# | p192 |
| | | | 15000pF | ±10% | GA355QR7GB153KW01# | p192 |
| 2.0mm | 250Vac | X7R | 22000pF | ±10% | GA355DR7GB223KW01# | p192 |
| 2.5mm | 250Vac | X7R | 33000pF | ±10% | GA355ER7GB333KW01# | p192 |
| | | | 47000pF | ±10% | GA355ER7GB473KW01# | p192 |
| 2.9mm | 250Vac | X7R | 56000pF | ±10% | GA355XR7GB563KW06# | p192 |

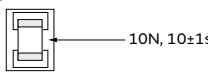
- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB**
- GA3 GD
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KRM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

*: Refers to the page of the "Specifications and Test Methods".

Part number # indicates the package specification code.

1

GA3 Series Type GB Specifications and Test Methods (1)

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | |
|------|--|--|---|------|------------------|---|--------------------|---|-------------------------|---|--------------------|---|-------------------------|---|--------------------|
| 1 | Appearance | No defects or abnormalities. | Visual inspection. | | | | | | | | | | | | |
| 2 | Dimension | Within the specified dimensions. | Using calipers and micrometers. | | | | | | | | | | | | |
| 3 | Voltage Proof | No defects or abnormalities. | Measurement Point: Between the terminations Test Voltage: DC1075V Applied Time: 60±1s Charge/discharge current: 50mA max. | | | | | | | | | | | | |
| 4 | Insulation Resistance (I.R.) | 6000MΩ or more | Measurement Point: Between the terminations Measurement Voltage: DC500±50V Charging Time: 60±5s Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 5 | Capacitance | Shown in Rated value. | Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 6 | Dissipation Factor (D.F.) | 0.025 max. | Measurement Frequency: 1.0±0.1kHz Measurement Voltage: AC1.0±0.2V (r.m.s.) | | | | | | | | | | | | |
| 7 | Temperature Characteristics of Capacitance | R7: Within ±15% (-55 to +125°C) | The capacitance change should be measured after 5 minutes at each specified temp. stage. Capacitance value as a reference is the value in step 3. <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ±3</td> </tr> <tr> <td>3</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ±3</td> </tr> <tr> <td>5</td> <td>Reference Temp. ±2</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h. at room condition*. | Step | Temperature (°C) | 1 | Reference Temp. ±2 | 2 | Min. Operating Temp. ±3 | 3 | Reference Temp. ±2 | 4 | Max. Operating Temp. ±3 | 5 | Reference Temp. ±2 |
| Step | Temperature (°C) | | | | | | | | | | | | | | |
| 1 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 2 | Min. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 3 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 4 | Max. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 5 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 8 | Vibration | Appearance | No defects or abnormalities. | | | | | | | | | | | | |
| | | Capacitance | Within the specified initial value. | | | | | | | | | | | | |
| | | D.F. | Within the specified initial value. | | | | | | | | | | | | |
| 9 | Solderability | 95% of the terminations is to be soldered evenly and continuously. | Test Method: Solder bath method Flux: Solution of rosin ethanol 25 (wt)% Preheat: 80 to 120°C for 10 to 30s Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 245±5°C Immersion time: 2±0.5s Immersing in speed: 25±2.5mm/s. | | | | | | | | | | | | |
| 10 | Resistance to Soldering Heat | Appearance | No defects or abnormalities. | | | | | | | | | | | | |
| | | Capacitance Change | Within ±10% | | | | | | | | | | | | |
| | | I.R. | 1000MΩ or more | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | |
| 11 | Adhesive Strength of Termination | No removal of the terminations or other defect should occur. | Solder the capacitor on the test substrate A shown in "Complement of Test Method".  10N, 10±1s Applied Direction: In parallel with the test substrate and vertical with the capacitor side. | | | | | | | | | | | | |
| 12 | Substrate Bending Test | No defects or abnormalities. | Solder the capacitor on the test substrate B shown in "Complement of Test Method". Then apply the force in the direction shown in "Test Method of Substrate Bending Test" of "Complement of Test Method". Flexure: 1mm Holding Time: 5±1s Soldering Method: Reflow soldering | | | | | | | | | | | | |

* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
GR3
GRJ
GR4
GR7
GJM
GQM
GA2
GA3 GB
GA3 GD
GA3 GF
LLL
LLA
LLM
LLR
NFM
KRM
KR3
GMA
GMD
⚠Caution /Notice

GA3 Series Type GB Specifications and Test Methods (1)

Continued from the preceding page. ↘

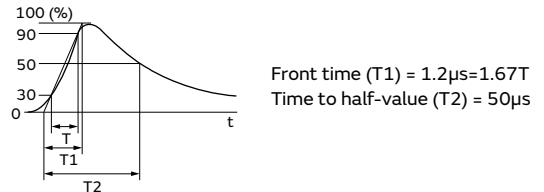
| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|---|--------------------|---|
| 13 | Temperature Sudden Change | Appearance | No defects or abnormalities. |
| | | Capacitance Change | Within±15% |
| | | D.F. | 0.05 max. |
| | | I.R. | 3000MΩ or more |
| | | Voltage Proof | No defects. |
| 14 | High Temperature High Humidity (Steady) | Appearance | No defects or abnormalities. |
| | | Capacitance Change | Within±15% |
| | | D.F. | 0.05 max. |
| | | I.R. | 3000MΩ or more |
| | | Voltage Proof | No defects. |
| 15 | Durability | Appearance | No defects or abnormalities. |
| | | Capacitance Change | Within ±20% |
| | | D.F. | 0.05 max. |
| | | I.R. | 3000MΩ or more |
| | | Voltage Proof | No defects. |

| Step | Temp. (°C) | Time (min) |
|------|----------------------------|------------|
| 1 | Min. Operating Temp. +0/-3 | 30±3 |
| 2 | Room Temp. | 2 to 3 |
| 3 | Max. Operating Temp. +3/-0 | 30±3 |
| 4 | Room Temp. | 2 to 3 |

Exposure Time: 24±2h at room condition*.
 • Pretreatment
 Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*.

Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method".
 Before this test, the test shown in the following is performed.
 • No.11 Adhesive Strength of Termination (apply force: 5N)
 • No.12 Substrate Bending Test
 Test Temperature: 40±2°C
 Test Humidity: 90 to 95%RH
 Test Time: 500+24/-0h
 Applied Voltage: Rated voltage
 Exposure Time: 24±2h at room condition*.
 • Pretreatment
 Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*.

Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method".
 Before this test, the test shown in the following is performed.
 • No.11 Adhesive Strength of Termination (apply force: 5N)
 • No.12 Substrate Bending Test
 Next, Impulse Voltage test is performed.
 Each individual capacitor shall be subjected to a 2.5kV Impulse (the voltage value means zero to peak) for 3 times.
 Then the capacitors are applied to life test.



Apply voltage as Table for 1000h at 125+2/-0°C , relative humidity 50% max.

Applied Voltage
 AC312.5V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s.

Exposure Time: 24±2h at room condition*.
 • Pretreatment
 Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*.

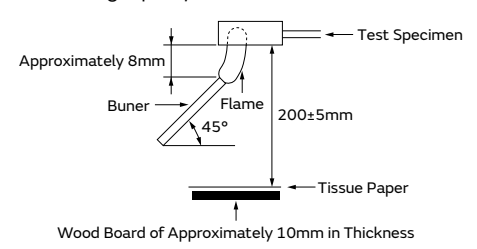
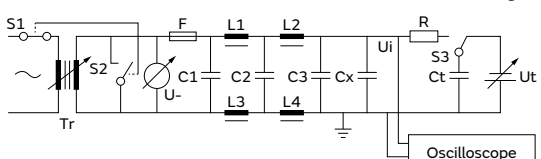
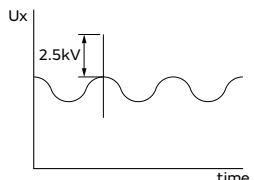
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution / Notice

GA3 Series Type GB Specifications and Test Methods (1)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|----------------------|--|---|
| 16 | Passive Flammability | The burning time shall not be exceeded the time 30s. The tissue paper shall not ignite. | <p>The capacitor under test shall be held in the flame in the position which best promotes burning. Each specimen shall only be exposed once to the flame. Time of exposure to flame: 30s Length of flame: 12 ± 1mm Gas burner: Length 35mm min. Inside dia: 0.5 ± 0.1mm Outside dia: 0.9mm max. Gas: Butane gas purity 95% min.</p>  |
| 17 | Active Flammability | The cheesecloth shall not be on fire. | <p>The specimens shall be individually wrapped in at least one but more than two complete layers of cheesecloth. The specimens shall be subjected to 20 discharges. The interval between successive discharges shall be 5s. The UAC shall be maintained for 2min after the last discharge.</p>  <p>C1,C2: Filter capacitor $1 \mu\text{F} \pm 10\%$ C3: Capacitor $0.033 \mu\text{F} \pm 5\%$ L1 to L4: Rod coa choke $1.5\text{mH} \pm 20\%$, 16A R: Resistor $100 \Omega \pm 2\%$ $C_x < 0.068 \mu\text{F}$ Ct: Tank capacitor $3 \mu\text{F} \pm 5\%$ 10kV $C_x \leq 1 \mu\text{F}$ U-: $U_R \pm 5\%$ UR: Rated voltage Cx: Capacitor under test F: Slow-blow fuse, rated 16A Ut: Voltage to which the tank capacitor Ct is charged</p>  |

GA3 Series Type GB Specifications and Test Methods (1)

Continued from the preceding page. ↘

Complement of Test Method

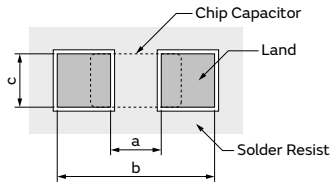
1. Test Substrate

The test substrate should be Substrate A or Substrate B as described in "Specifications and Test Methods".
 The specimen should be soldered by the conditions as described below.

Soldering Method: Reflow soldering
 Solder: Sn-3.0Ag-0.5Cu

(1) Test Substrate A

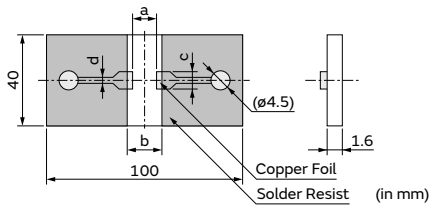
• Land Dimensions



| Part Number | Dimension (mm) | | |
|-------------|----------------|-----|-----|
| | a | b | c |
| GA355 | 4.5 | 8.0 | 5.6 |

- Material: Glass Epoxy Board
- Thickness: 1.6mm
- Thickness of Copper Foil: 0.035mm

(2) Test Substrate B

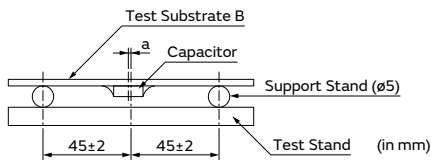


| Part Number | Dimension of Pattern (mm) | | | |
|-------------|---------------------------|-----|-----|-----|
| | a | b | c | d |
| GA355 | 4.5 | 8.0 | 5.6 | 1.0 |

- Material: Glass Epoxy Board
- Thickness of Copper Foil: 0.035mm

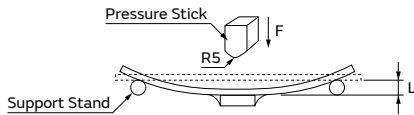
2. Test Method of Substrate Bending Test

(a) Support State

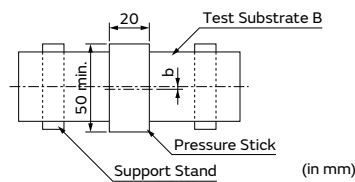


a: ±2 gap between support stand center and test stand

- Material of Test Stand and Pressure Stick
 The material should be a metal where a remarkable transformation and the distortion are not caused even if it is pressurized.
- Pressurizing Speed
 The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



(b) Test State



b: ±5 gap between support stand center and test stand center

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KPM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

Safety Standard Certified Chip Multilayer Ceramic Capacitors for General Purpose / Acquired certifications of UL60950-1

GA3 Series Type GD



UL60950-1 Certified Product

Features

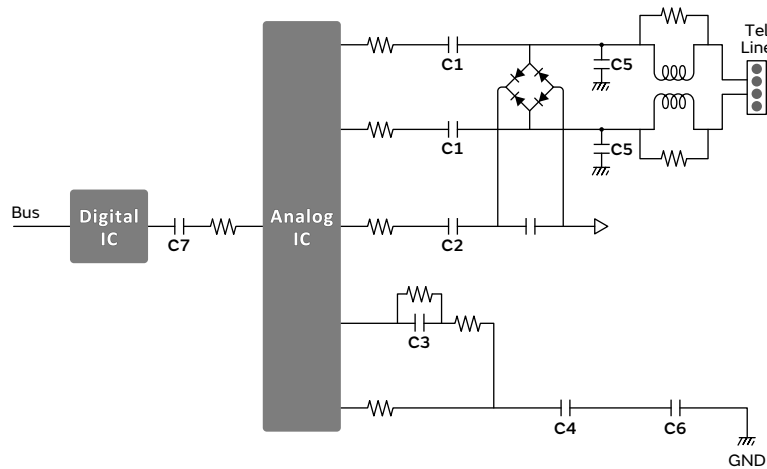
- 1 International Standard (IEC60384-14) certified product.

Please download Safety Standard Certification (Type GD) from here.



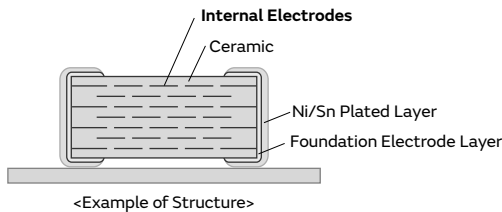
- 2 Can be used for UL60950-1 devices.

● DAA Modem - Transformer Less



| No. | Application | Recommend MLCC Type |
|-----|---------------------------|---------------------|
| C5 | Lighting Surge Absorption | Type: GD / GF |
| C6 | Noise Immunity | |
| C7 | D/A Isolation Barrier | |

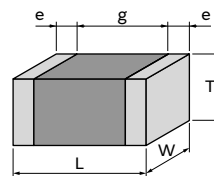
- 3 Realized large capacitance value and small size while maintaining high withstand voltages by the multilayer structure.



- 4 This product is only for reflow soldering.

Specifications

| | |
|-------------------|------------------------|
| Size (mm) | 4.5×2.0mm to 4.5×3.2mm |
| Rated Voltage | 250Vac |
| Capacitance | 10pF to 4700pF |
| Main Applications | Modem |



<Dimensions>

This catalog contains only a portion of the product lineup.
 Please refer to the capacitor search tool on the Murata Web site for details.

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

GA3 Series Type GD Temperature Compensating Type Part Number List

4.5×2.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|------|------|--------------------|------|
| 1.0mm | 250Vac | SL | 10pF | ±5% | GA342A1XGD100JW31# | p199 |
| | | | 12pF | ±5% | GA342A1XGD120JW31# | p199 |
| | | | 15pF | ±5% | GA342A1XGD150JW31# | p199 |
| | | | 18pF | ±5% | GA342A1XGD180JW31# | p199 |
| | | | 22pF | ±5% | GA342A1XGD220JW31# | p199 |
| | | | 27pF | ±5% | GA342A1XGD270JW31# | p199 |
| | | | 33pF | ±5% | GA342A1XGD330JW31# | p199 |
| | | | 39pF | ±5% | GA342A1XGD390JW31# | p199 |
| | | | 47pF | ±5% | GA342A1XGD470JW31# | p199 |
| | | | 56pF | ±5% | GA342A1XGD560JW31# | p199 |
| | | | 68pF | ±5% | GA342A1XGD680JW31# | p199 |
| | | | 82pF | ±5% | GA342A1XGD820JW31# | p199 |

- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD**
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KRM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

*: Refers to the page of the "Specifications and Test Methods".

Part number # indicates the package specification code.

GA3 Series Type GD High Dielectric Constant Type Part Number List

4.5×2.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|--------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 100pF | ±10% | GA342QR7GD101KW01# | p203 |
| | | | 150pF | ±10% | GA342QR7GD151KW01# | p203 |
| | | | 220pF | ±10% | GA342QR7GD221KW01# | p203 |
| | | | 330pF | ±10% | GA342QR7GD331KW01# | p203 |
| | | | 470pF | ±10% | GA342QR7GD471KW01# | p203 |
| | | | 680pF | ±10% | GA342QR7GD681KW01# | p203 |
| | | | 1000pF | ±10% | GA342QR7GD102KW01# | p203 |
| | | | 1500pF | ±10% | GA342QR7GD152KW01# | p203 |

4.5×3.2mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|--------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 1800pF | ±10% | GA343QR7GD182KW01# | p203 |
| | | | 2200pF | ±10% | GA343QR7GD222KW01# | p203 |
| 2.0mm | 250Vac | X7R | 4700pF | ±10% | GA343DR7GD472KW01# | p203 |

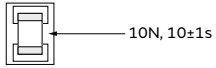
- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD**
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KRM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

*: Refers to the page of the "Specifications and Test Methods".

Part number # indicates the package specification code.

1

GA3 Series Type GD Specifications and Test Methods (1)

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | |
|------|--|--|--|------|------------------|---|--------------------|---|-------------------------|---|--------------------|---|-------------------------|---|--------------------|
| 1 | Appearance | No defects or abnormalities. | Visual inspection. | | | | | | | | | | | | |
| 2 | Dimension | Within the specified dimensions. | Using calipers and micrometers. | | | | | | | | | | | | |
| 3 | Voltage Proof | No defects or abnormalities. | Measurement Point: Between the terminations Test Voltage: AC1500V (r.m.s.) Applied Time: 60±1s Charge/discharge current: 50mA max. | | | | | | | | | | | | |
| 4 | Impulse Voltage | No self healing break downs or flash-overs have taken place in the capacitor. | 10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60s. Applied Voltage: 2.5kVo-p | | | | | | | | | | | | |
| 5 | Insulation Resistance (I.R.) | 6000MΩ or more | Measurement Point: Between the terminations Measurement Voltage: DC500±50V Charging Time: 60±5s Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 6 | Capacitance | Shown in Rated value. | Measurement Temperature: Room Temperature Measurement Frequency: 1.0±0.1MHz Measurement Voltage: AC1.0±0.2V (r.m.s.) | | | | | | | | | | | | |
| 7 | Q | C ≥ 30pF: 1000 or more C < 30pF: 400+20C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | |
| 8 | Temperature Characteristics of Capacitance | 1X: +350 to -1000 ppm/°C (Temp.Range:+20 to +85°C) | The capacitance change should be measured after 5 minutes at each specified temp. stage. Capacitance value as a reference is the value in step 3. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ±3</td> </tr> <tr> <td>3</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ±3</td> </tr> <tr> <td>5</td> <td>Reference Temp. ±2</td> </tr> </tbody> </table> However, the capacitance shall be measured at even 85°C between step 3 and step 4. | Step | Temperature (°C) | 1 | Reference Temp. ±2 | 2 | Min. Operating Temp. ±3 | 3 | Reference Temp. ±2 | 4 | Max. Operating Temp. ±3 | 5 | Reference Temp. ±2 |
| Step | Temperature (°C) | | | | | | | | | | | | | | |
| 1 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 2 | Min. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 3 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 4 | Max. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 5 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 9 | Vibration | Appearance | Solder the capacitor on the test substrate A shown in "Complement of Test Method". Kind of Vibration: A simple harmonic motion 10Hz to 55Hz to 10Hz (1min) Total amplitude: 1.5mm This motion should be applied for a period of 2h in each 3 mutually perpendicular directions (total of 6h). | | | | | | | | | | | | |
| | | Capacitance | | | | | | | | | | | | | |
| | | Q | | | | | | | | | | | | | |
| 10 | Solderability | 95% of the terminations is to be soldered evenly and continuously. | Test Method: Solder bath method Flux: Solution of rosin ethanol 25 (wt)% Preheat: 80 to 120°C for 10 to 30s Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 245±5°C Immersion time: 2±0.5s Immersing in speed: 25±2.5mm/s. | | | | | | | | | | | | |
| 11 | Resistance to Soldering Heat | Appearance | Test Method: Solder bath method Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 260±5°C Immersion time: 10±1s Immersing in speed: 25±2.5mm/s. Exposure Time: 24±2h at room condition*. Preheat: GA342 size: 100 to 120°C for 1min and 170 to 200°C for 1min | | | | | | | | | | | | |
| | | Capacitance Change | | | | | | | | | | | | | |
| | | I.R. | | | | | | | | | | | | | |
| | | Voltage Proof | | | | | | | | | | | | | |
| 12 | Adhesive Strength of Termination | No removal of the terminations or other defect should occur. | Solder the capacitor on the test substrate A shown in "Complement of Test Method".  Applied Direction: In parallel with the test substrate and vertical with the capacitor side. | | | | | | | | | | | | |
| 13 | Substrate Bending Test | No defects or abnormalities. | Solder the capacitor on the test substrate B shown in "Complement of Test Method". Then apply the force in the direction shown in "Test Method of Substrate Bending Test" of "Complement of Test Method". Flexure: 1mm Holding Time: 5±1s Soldering Method: Reflow soldering | | | | | | | | | | | | |

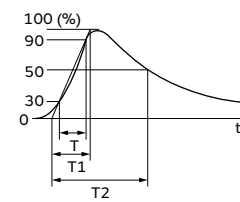
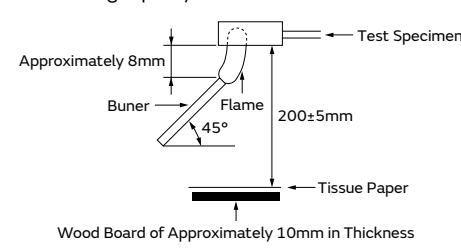
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KPM
 KR3
 GMA
 GMD
 △Caution /Notice

GA3 Series Type GD Specifications and Test Methods (1)

Continued from the preceding page. ↘

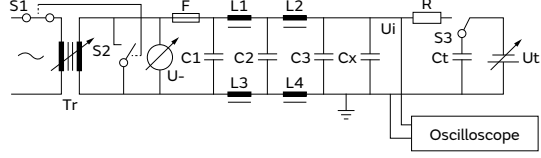
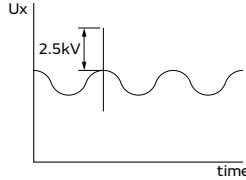
| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | | | | |
|--|---|---|---|-----------------|------------|--|---|----------------------------|------------|---|------------|--------|---|----------------------------|------------|---|------------|--------|
| 14 | Temperature Sudden Change | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | Within the specified initial value. | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate A (glass epoxy board) shown in "Complement of Test Method" Perform the 5 cycles according to the four heat treatments shown in the following table. | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. Operating Temp. +0/-3</td> <td>30\pm3</td> </tr> <tr> <td>2</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Max. Operating Temp. +3/-0</td> <td>30\pm3</td> </tr> <tr> <td>4</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> </tbody> </table> | Step | Temp. (°C) | Time (min) | 1 | Min. Operating Temp. +0/-3 | 30 \pm 3 | 2 | Room Temp. | 2 to 3 | 3 | Max. Operating Temp. +3/-0 | 30 \pm 3 | 4 | Room Temp. | 2 to 3 |
| Step | Temp. (°C) | Time (min) | | | | | | | | | | | | | | | | |
| 1 | Min. Operating Temp. +0/-3 | 30 \pm 3 | | | | | | | | | | | | | | | | |
| 2 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| 3 | Max. Operating Temp. +3/-0 | 30 \pm 3 | | | | | | | | | | | | | | | | |
| 4 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| | | | Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 15 | High Temperature High Humidity (Steady) | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 5.0\%$ or $\pm 0.5\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | C \geq 30pF: 350 or more C < 30pF: 275+5/2C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Test Temperature: 40 \pm 2°C Test Humidity: 90 to 95%RH Test Time: 500+24/-0h. Applied Voltage: Rated voltage Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 16 | Durability | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | C \geq 30pF: 350 or more C < 30pF: 275+5/2C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Next, Impulse Voltage test is performed. Each individual capacitor shall be subjected to a 2.5kV Impulse (the voltage value means zero to peak) for 3 times. Then the capacitors are applied to life test. | | | | | | | | | | | | | | | |
| | | |  <p>Front time (T1) = 1.2μs=1.67T Time to half-value (T2) = 50μs</p> | | | | | | | | | | | | | | | |
| | | | Apply voltage as Table for 1000h at 125+2/-0°C, relative humidity 50% max. | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th colspan="2">Applied voltage</th> </tr> </thead> <tbody> <tr> <td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s.</td> <td></td> </tr> </tbody> </table> | Applied voltage | | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | |
| Applied voltage | | | | | | | | | | | | | | | | | | |
| AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | | | | | | |
| | | | Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 17 | Passive Flammability | The burning time shall not be exceeded the time 30s. The tissue paper shall not ignite. | The capacitor under test shall be held in the flame in the position which best promotes burning. Each specimen shall only be exposed once to the flame. Time of exposure to flame: 30s Length of flame: 12 \pm 1mm Gas burner: Length 35mm min. Inside dia: 0.5 \pm 0.1mm Outside dia: 0.9mm max. Gas: Butane gas purity 95% min. | | | | | | | | | | | | | | | |
| | | |  | | | | | | | | | | | | | | | |

* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GA3 Series Type GD Specifications and Test Methods (1)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|---------------------|---------------------------------------|---|
| 18 | Active Flammability | The cheesecloth shall not be on fire. | <p>The specimens shall be individually wrapped in at least one but more than two complete layers of cheesecloth. The specimens shall be subjected to 20 discharges. The interval between successive discharges shall be 5s. The UAC shall be maintained for 2min after the last discharge.</p>  <p>C1, C2: Filter capacitor $1\mu\text{F}\pm 10\%$ C3: Capacitor $0.033\mu\text{F}\pm 5\%$ L1 to L4: Rod coa choke $1.5\text{mH}\pm 20\%$, 16A R: Resistor $100\Omega\pm 2\%$ $C_x < 0.068\mu\text{F}$ Ct: Tank capacitor $3\mu\text{F}\pm 5\%$ 10kV $C_x \leq 1\mu\text{F}$ U-: $UR\pm 5\%$ UR: Rated voltage Cx: Capacitor under test F: Slow-blow fuse, rated 16A Ut: Voltage to which the tank capacitor Ct is charged</p>  |

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KPM
 KR3
 GMA
 GMD
 ⚠Caution / Notice

GA3 Series Type GD Specifications and Test Methods (1)

Continued from the preceding page. ↘

Complement of Test Method

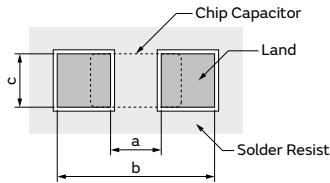
1. Test Substrate

The test substrate should be Substrate A or Substrate B as described in "Specifications and Test Methods".
 The specimen should be soldered by the conditions as described below.

Soldering Method: Reflow soldering
 Solder: Sn-3.0Ag-0.5Cu

(1) Test Substrate A

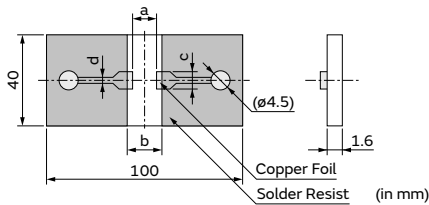
• Land Dimensions



| Part Number | Dimension (mm) | | |
|--------------|----------------|-----|-----|
| | a | b | c |
| GA342 | 3.5 | 7.0 | 2.4 |

- Material: Glass Epoxy Board
- Thickness: 1.6mm
- Thickness of Copper Foil: 0.035mm

(2) Test Substrate B

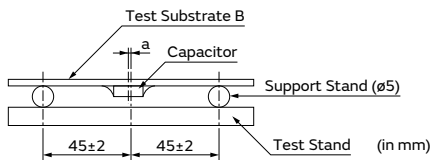


| Part Number | Dimension of Pattern (mm) | | | |
|--------------|---------------------------|-----|-----|-----|
| | a | b | c | d |
| GA342 | 3.5 | 7.0 | 2.4 | 1.0 |

- Material: Glass Epoxy Board
- Thickness of Copper Foil: 0.035mm

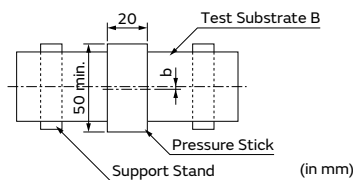
2. Test Method of Substrate Bending Test

(a) Support State



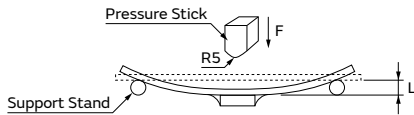
a: ±2 gap between support stand center and test stand

(b) Test State



b: ±5 gap between support stand center and test stand center

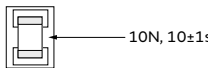
- Material of Test Stand and Pressure Stick
 The material should be a metal where a remarkable transformation and the distortion are not caused even if it is pressurized.
- Pressurizing Speed
 The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 Caution / Notice

2

GA3 Series Type GD Specifications and Test Methods (2)

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | |
|------|--|---|---|------|------------------|---|--------------------|---|-------------------------|---|--------------------|---|-------------------------|---|--------------------|
| 1 | Appearance | No defects or abnormalities. | Visual inspection. | | | | | | | | | | | | |
| 2 | Dimension | Within the specified dimensions. | Using calipers and micrometers. | | | | | | | | | | | | |
| 3 | Voltage Proof | No defects or abnormalities. | Measurement Point: Between the terminations Test Voltage: AC1500V (r.m.s.) Applied Time: 60±1s Charge/discharge current: 50mA max. | | | | | | | | | | | | |
| 4 | Impulse Voltage | No self healing break downs or flash-overs have taken place in the capacitor. | 10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60s. Applied Voltage: 2.5kVo-p | | | | | | | | | | | | |
| 5 | Insulation Resistance (I.R.) | 6000MΩ or more | Measurement Point: Between the terminations Measurement Voltage: DC500±50V Charging Time: 60±5s Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 6 | Capacitance | Shown in Rated value. | Measurement Temperature: Room Temperature Measurement Frequency: 1.0±0.1kHz | | | | | | | | | | | | |
| 7 | Dissipation Factor (D.F.) | 0.025 max. | Measurement Voltage: AC1.0±0.2V (r.m.s.) | | | | | | | | | | | | |
| 8 | Temperature Characteristics of Capacitance | R7: Within ±15% (-55 to +125°C) | The capacitance change should be measured after 5 minutes at each specified temp. stage. Capacitance value as a reference is the value in step 3. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ±3</td> </tr> <tr> <td>3</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ±3</td> </tr> <tr> <td>5</td> <td>Reference Temp. ±2</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Step | Temperature (°C) | 1 | Reference Temp. ±2 | 2 | Min. Operating Temp. ±3 | 3 | Reference Temp. ±2 | 4 | Max. Operating Temp. ±3 | 5 | Reference Temp. ±2 |
| Step | Temperature (°C) | | | | | | | | | | | | | | |
| 1 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 2 | Min. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 3 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 4 | Max. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 5 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 9 | Vibration | Appearance | Solder the capacitor on the test substrate A shown in "Complement of Test Method". Kind of Vibration: A simple harmonic motion 10Hz to 55Hz to 10Hz (1min) Total amplitude: 1.5mm This motion should be applied for a period of 2h in each 3 mutually perpendicular directions (total of 6h). | | | | | | | | | | | | |
| | | Capacitance | | | | | | | | | | | | | |
| | | D.F. | | | | | | | | | | | | | |
| 10 | Solderability | 95% of the terminations is to be soldered evenly and continuously. | Test Method: Solder bath method Flux: Solution of rosin ethanol 25 (wt)% Preheat: 80 to 120°C for 10 to 30s Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 245±5°C Immersion time: 2±0.5s Immersing in speed: 25±2.5mm/s. | | | | | | | | | | | | |
| 11 | Resistance to Soldering Heat | Appearance | Test Method: Solder bath method Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 260±5°C Immersion time: 10±1s Immersing in speed: 25±2.5mm/s. Exposure Time: 24±2h at room condition*. Preheat: GA342/43 size: 100 to 120°C for 1min and 170 to 200°C for 1min <ul style="list-style-type: none"> • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | | | | | | | | | | | | |
| | | Capacitance Change | | | | | | | | | | | | | |
| | | I.R. | | | | | | | | | | | | | |
| | | Voltage Proof | | | | | | | | | | | | | |
| 12 | Adhesive Strength of Termination | No removal of the terminations or other defect should occur. | Solder the capacitor on the test substrate A shown in "Complement of Test Method".  Applied Direction: In parallel with the test substrate and vertical with the capacitor side. | | | | | | | | | | | | |

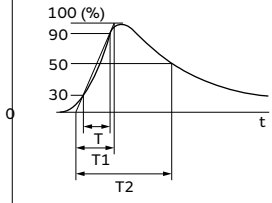
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
GR3
GRJ
GR4
GR7
GJM
GQM
GA2
GA3 GB
GA3 GD
GA3 GF
LLL
LLA
LLM
LLR
NFM
KPM
KR3
GMA
GMD
⚠Caution / Notice

GA3 Series Type GD Specifications and Test Methods (2)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | | | | |
|--|---|------------------------------|--|----------------------------|--|------------|---|----------------------------|------|---|------------|--------|---|----------------------------|------|---|------------|--------|
| 13 | Substrate Bending Test | No defects or abnormalities. | Solder the capacitor on the test substrate B shown in "Complement of Test Method". Then apply the force in the direction shown in "Test Method of Substrate Bending Test" of "Complement of Test Method" Flexure: 1mm Holding Time: 5±1s Soldering Method: Reflow soldering | | | | | | | | | | | | | | | |
| 14 | Temperature Sudden Change | Appearance | Fix the capacitor to the supporting test substrate A (glass epoxy board) shown in "Complement of Test Method". Perform the 5 cycles according to the four heat treatments shown in the following table. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. Operating Temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Max. Operating Temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> </tbody> </table> Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Step | Temp. (°C) | Time (min) | 1 | Min. Operating Temp. +0/-3 | 30±3 | 2 | Room Temp. | 2 to 3 | 3 | Max. Operating Temp. +3/-0 | 30±3 | 4 | Room Temp. | 2 to 3 |
| | | Step | | Temp. (°C) | Time (min) | | | | | | | | | | | | | |
| | | 1 | | Min. Operating Temp. +0/-3 | 30±3 | | | | | | | | | | | | | |
| | | 2 | | Room Temp. | 2 to 3 | | | | | | | | | | | | | |
| | | 3 | | Max. Operating Temp. +3/-0 | 30±3 | | | | | | | | | | | | | |
| 4 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| Capacitance Change | Within±15% | | | | | | | | | | | | | | | | | |
| D.F. | 0.05 max. | | | | | | | | | | | | | | | | | |
| I.R. | 3000MΩ or more | | | | | | | | | | | | | | | | | |
| Voltage Proof | No defects. | | | | | | | | | | | | | | | | | |
| 15 | High Temperature High Humidity (Steady) | Appearance | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Test Temperature: 40±2°C Test Humidity: 90 to 95%RH Test Time: 500+24/-0h Applied Voltage: Rated voltage Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | | | | | | | | | | | | | | | |
| | | Capacitance Change | | Within±15% | | | | | | | | | | | | | | |
| | | D.F. | | 0.05 max. | | | | | | | | | | | | | | |
| | | I.R. | | 3000MΩ or more | | | | | | | | | | | | | | |
| | | Voltage Proof | | No defects. | | | | | | | | | | | | | | |
| 16 | Durability | Appearance | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Next, Impulse Voltage test is performed. Each individual capacitor shall be subjected to a 2.5kV Impulse (the voltage value means zero to peak) for 3 times. Then the capacitors are applied to life test.  Front time (T1) = 1.2μs=1.67T Time to half-value (T2) = 50μs | | | | | | | | | | | | | | | |
| | | Capacitance Change | | Within ±20% | | | | | | | | | | | | | | |
| | | D.F. | | 0.05 max. | | | | | | | | | | | | | | |
| | | I.R. | | 3000MΩ or more | | | | | | | | | | | | | | |
| | | Voltage Proof | | No defects. | | | | | | | | | | | | | | |
| | | | Apply voltage as Table for 1000h at 125+2/-0°C, relative humidity 50% max. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Applied Voltage</th> </tr> </thead> <tbody> <tr> <td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s.</td> </tr> </tbody> </table> Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Applied Voltage | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | |
| Applied Voltage | | | | | | | | | | | | | | | | | | |
| AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | | | | | | |

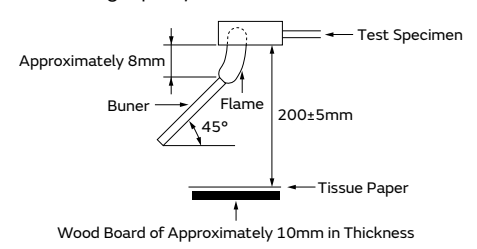
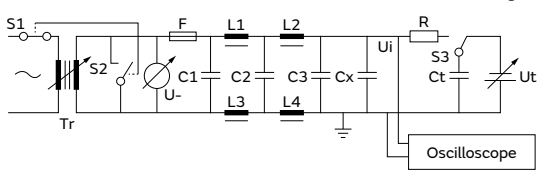
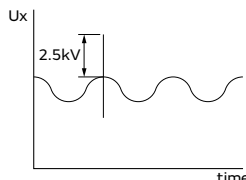
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

GA3 Series Type GD Specifications and Test Methods (2)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|----------------------|--|---|
| 17 | Passive Flammability | The burning time shall not be exceeded the time 30s. The tissue paper shall not ignite. | <p>The capacitor under test shall be held in the flame in the position which best promotes burning. Each specimen shall only be exposed once to the flame. Time of exposure to flame: 30s Length of flame: 12±1mm Gas burner: Length 35mm min. Inside dia: 0.5±0.1mm Outside dia: 0.9mm max. Gas: Butane gas purity 95% min.</p>  |
| 18 | Active Flammability | The cheesecloth shall not be on fire. | <p>The specimens shall be individually wrapped in at least one but more than two complete layers of cheesecloth. The specimens shall be subjected to 20 discharges. The interval between successive discharges shall be 5s. The UAC shall be maintained for 2min after the last discharge.</p>  <p>C1, C2: Filter capacitor 1μF±10% C3: Capacitor 0.033μF±5% L1 to L4: Rod coa choke 1.5mH±20%, 16A R: Resistor 100Ω±2% Cx < 0.068μF Ct: Tank capacitor 3μF±5% 10kV Cx ≤ 1μF U-: UR±5% UR: Rated voltage Cx: Capacitor under test F: Slow-blow fuse, rated 16A Ut: Voltage to which the tank capacitor Ct is charged</p>  |

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KPM
 KR3
 GMA
 GMD
 ⚠Caution / Notice

GA3 Series Type GD Specifications and Test Methods (2)

Continued from the preceding page. ↘

Complement of Test Method

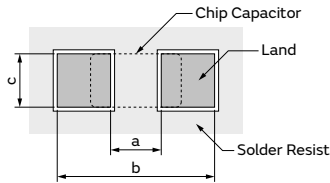
1. Test Substrate

The test substrate should be Substrate A or Substrate B as described in "Specifications and Test Methods".
 The specimen should be soldered by the conditions as described below.

Soldering Method: Reflow soldering
 Solder: Sn-3.0Ag-0.5Cu

(1) Test Substrate A

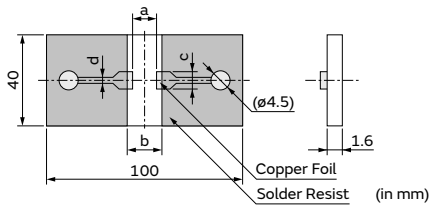
• Land Dimensions



- Material: Glass Epoxy Board
- Thickness: 1.6mm
- Thickness of Copper Foil: 0.035mm

| Part Number | Dimension (mm) | | |
|-------------|----------------|-----|-----|
| | a | b | c |
| GA342 | 3.5 | 7.0 | 2.4 |
| GA343 | 3.5 | 7.0 | 3.7 |

(2) Test Substrate B

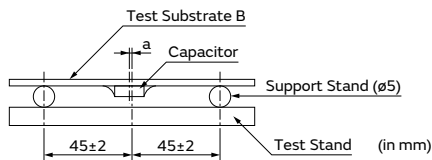


- Material: Glass Epoxy Board
- Thickness of Copper Foil: 0.035mm

| Part Number | Dimension of Pattern (mm) | | | |
|-------------|---------------------------|-----|-----|-----|
| | a | b | c | d |
| GA342 | 3.5 | 7.0 | 2.4 | 1.0 |
| GA343 | 3.5 | 7.0 | 3.7 | 1.0 |

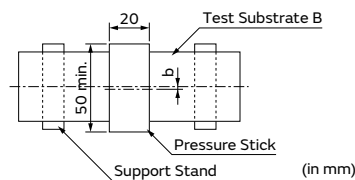
2. Test Method of Substrate Bending Test

(a) Support State



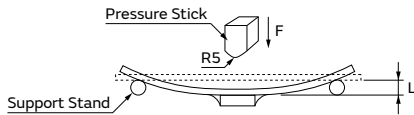
a: ± 2 gap between support stand center and test stand

(b) Test State



b: ± 5 gap between support stand center and test stand center

- Material of Test Stand and Pressure Stick
 The material should be a metal where a remarkable transformation and the distortion are not caused even if it is pressurized.
- Pressurizing Speed
 The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

Safety Standard Certified Chip Multilayer Ceramic Capacitors for General Purpose / Acquired certifications of IEC60384-14 Class X1/Y2 and UL60950-1

GA3 Series Type GF



Size 4.5x2.0mm: This product is applicable only for the instruments certified by EN/IEC60950-1
Size 5.7x2.8mm or 5.7x5.0mm: This product is applicable as X or Y capacitor

Features

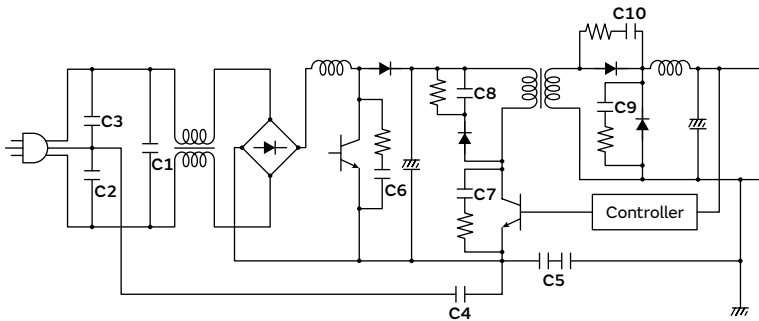
① **International Standard (IEC60384-14) certified product.**

Please down load Safety Standard Certification (Type GF: X1/Y2) from here.



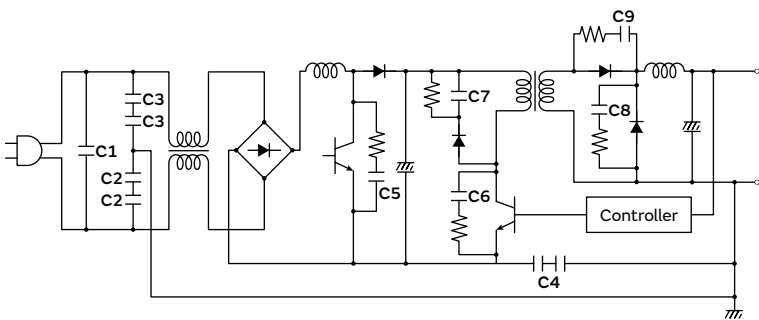
② **Can be used as a Class Y2 capacitor.**

● **Switching Power Supply - Class 1 Equipment**



| No. | Application | Recommend MLCC Type |
|-----|------------------------------|---------------------|
| C1 | X Cap | Type: GB |
| C2 | Y Cap | Type: GF |
| C3 | | |
| C4 | | |
| C5 | Primary - Secondary Coupling | Type: GF×2 |

● **Switching Power Supply - Class 2 Equipment**

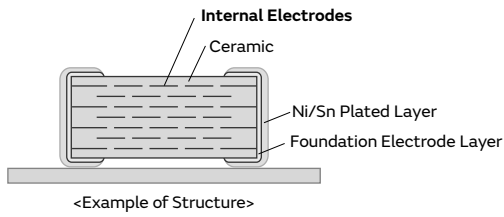


| No. | Application | Recommend MLCC Type |
|-----|------------------------------|---------------------|
| C1 | X Cap | Type: GB |
| C2 | Y Cap | Type: GF×2 |
| C3 | | |
| C4 | Primary - Secondary Coupling | |

- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KPM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

GRM
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 ⚠Caution /Notice

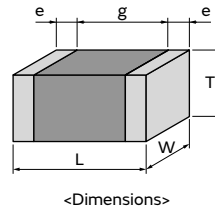
3 Realized large capacitance value and small size while maintaining high withstand voltages by the multilayer structure.



4 This product is only for reflow soldering.

Specifications

| | |
|-------------------|------------------------|
| Size (mm) | 4.5×2.0mm to 5.7×5.0mm |
| Rated Voltage | 250Vac |
| Capacitance | 10pF to 4700pF |
| Main Applications | AC-DC power supply |



This catalog contains only a portion of the product lineup.
 Please refer to the capacitor search tool on the Murata Web site for details.

GA3 Series Type GF Temperature Compensating Type Part Number List

4.5×2.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|------|------|--------------------|------|
| 1.0mm | 250Vac | SL | 10pF | ±5% | GA342A1XGF100JW31# | p211 |
| | | | 12pF | ±5% | GA342A1XGF120JW31# | p211 |
| | | | 15pF | ±5% | GA342A1XGF150JW31# | p211 |
| | | | 18pF | ±5% | GA342A1XGF180JW31# | p211 |
| | | | 22pF | ±5% | GA342A1XGF220JW31# | p211 |
| | | | 27pF | ±5% | GA342A1XGF270JW31# | p211 |
| | | | 33pF | ±5% | GA342A1XGF330JW31# | p211 |
| | | | 39pF | ±5% | GA342A1XGF390JW31# | p211 |
| | | | 47pF | ±5% | GA342A1XGF470JW31# | p211 |
| | | | 56pF | ±5% | GA342A1XGF560JW31# | p211 |
| | | | 68pF | ±5% | GA342A1XGF680JW31# | p211 |
| | | | 82pF | ±5% | GA342A1XGF820JW31# | p211 |

- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD
- GA3 GF**
- LLL
- LLA
- LLM
- LLR
- NFM
- KRM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

*: Refers to the page of the "Specifications and Test Methods".

Part number # indicates the package specification code.

GA3 Series Type GF High Dielectric Constant Type Part Number List

4.5×2.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|--------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 100pF | ±10% | GA342QR7GF101KW01# | p215 |
| | | | 150pF | ±10% | GA342QR7GF151KW01# | p215 |
| | | | 470pF | ±10% | GA342QR7GF471KW01# | p215 |
| | | | 680pF | ±10% | GA342QR7GF681KW01# | p215 |
| 2.2mm | 250Vac | X7R | 220pF | ±10% | GA342DR7GF221KW02# | p215 |
| | | | 330pF | ±10% | GA342DR7GF331KW02# | p215 |
| | | | 1000pF | ±10% | GA342DR7GF102KW02# | p215 |

5.7×2.8mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|--------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 100pF | ±10% | GA352QR7GF101KW31# | p215 |
| | | | 150pF | ±10% | GA352QR7GF151KW31# | p215 |
| | | | 220pF | ±10% | GA352QR7GF221KW31# | p215 |
| | | | 330pF | ±10% | GA352QR7GF331KW31# | p215 |
| | | | 470pF | ±10% | GA352QR7GF471KW01# | p215 |
| | | | 680pF | ±10% | GA352QR7GF681KW01# | p215 |
| | | | 1000pF | ±10% | GA352QR7GF102KW01# | p215 |
| | | | 1500pF | ±10% | GA352QR7GF152KW01# | p215 |

5.7×5.0mm

| T max. | Rated Voltage | TC Code | Cap. | Tol. | Part Number | p* |
|--------|---------------|---------|--------|------|---------------------------|------|
| 1.5mm | 250Vac | X7R | 1800pF | ±10% | GA355QR7GF182KW01# | p215 |
| | | | 2200pF | ±10% | GA355QR7GF222KW01# | p215 |
| | | | 3300pF | ±10% | GA355QR7GF332KW01# | p215 |
| 2.0mm | 250Vac | X7R | 4700pF | ±10% | GA355DR7GF472KW01# | p215 |

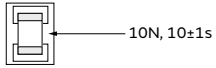
GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

*: Refers to the page of the "Specifications and Test Methods".

Part number # indicates the package specification code.

1

GA3 Series Type GF Specifications and Test Methods (1)

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | |
|------|--|--|--|------|------------------|---|--------------------|---|-------------------------|---|--------------------|---|-------------------------|---|--------------------|
| 1 | Appearance | No defects or abnormalities. | Visual inspection. | | | | | | | | | | | | |
| 2 | Dimension | Within the specified dimensions. | Using calipers and micrometers. | | | | | | | | | | | | |
| 3 | Voltage Proof | No defects or abnormalities. | Measurement Point: Between the terminations Test Voltage: AC2000V (r.m.s.) Applied Time: 60±1s Charge/discharge current: 50mA max. | | | | | | | | | | | | |
| 4 | Impulse Voltage | No self healing break downs or flash-overs have taken place in the capacitor. | 10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60s. Applied Voltage: 2.5kVo-p | | | | | | | | | | | | |
| 5 | Insulation Resistance (I.R.) | 6000MΩ or more | Measurement Point: Between the terminations Measurement Voltage: DC500±50V Charging Time: 60±5s Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 6 | Capacitance | Shown in Rated value. | Measurement Temperature: Room Temperature Measurement Frequency: 1.0±0.1MHz Measurement Voltage: AC1.0±0.2V (r.m.s.) | | | | | | | | | | | | |
| 7 | Q | C ≥ 30pF: 1000 or more C < 30pF: 400+20C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | |
| 8 | Temperature Characteristics of Capacitance | 1X: +350 to -1000 ppm/°C (Temp.Range:+20 to +85°C) | The capacitance change should be measured after 5 minutes at each specified temp. stage. Capacitance value as a reference is the value in step 3. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ±3</td> </tr> <tr> <td>3</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ±3</td> </tr> <tr> <td>5</td> <td>Reference Temp. ±2</td> </tr> </tbody> </table> However, the capacitance shall be measured at even 85°C between step 3 and step 4. | Step | Temperature (°C) | 1 | Reference Temp. ±2 | 2 | Min. Operating Temp. ±3 | 3 | Reference Temp. ±2 | 4 | Max. Operating Temp. ±3 | 5 | Reference Temp. ±2 |
| Step | Temperature (°C) | | | | | | | | | | | | | | |
| 1 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 2 | Min. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 3 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 4 | Max. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 5 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 9 | Vibration | Appearance | Solder the capacitor on the test substrate A shown in "Complement of Test Method". Kind of Vibration: A simple harmonic motion 10Hz to 55Hz to 10Hz (1min) Total amplitude: 1.5mm This motion should be applied for a period of 2h in each 3 mutually perpendicular directions (total of 6h). | | | | | | | | | | | | |
| | | Capacitance | | | | | | | | | | | | | |
| | | Q | | | | | | | | | | | | | |
| 10 | Solderability | 95% of the terminations is to be soldered evenly and continuously. | Test Method: Solder bath method Flux: Solution of rosin ethanol 25 (wt)% Preheat: 80 to 120°C for 10 to 30s Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 245±5°C Immersion time: 2±0.5s Immersing in speed: 25±2.5mm/s. | | | | | | | | | | | | |
| 11 | Resistance to Soldering Heat | Appearance | Test Method: Solder bath method Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 260±5°C Immersion time: 10±1s Immersing in speed: 25±2.5mm/s. Exposure Time: 24±2h at room condition*. Preheat: GA342 size: 100 to 120°C for 1min and 170 to 200°C for 1min | | | | | | | | | | | | |
| | | Capacitance Change | | | | | | | | | | | | | |
| | | I.R. | | | | | | | | | | | | | |
| | | Voltage Proof | | | | | | | | | | | | | |
| 12 | Adhesive Strength of Termination | No removal of the terminations or other defect should occur. | Solder the capacitor on the test substrate A shown in "Complement of Test Method".  Applied Direction: In parallel with the test substrate and vertical with the capacitor side. | | | | | | | | | | | | |
| 13 | Substrate Bending Test | No defects or abnormalities. | Solder the capacitor on the test substrate B shown in "Complement of Test Method". Then apply the force in the direction shown in "Test Method of Substrate Bending Test" of "Complement of Test Method". Flexure: 1mm Holding Time: 5±1s Soldering Method: Reflow soldering | | | | | | | | | | | | |

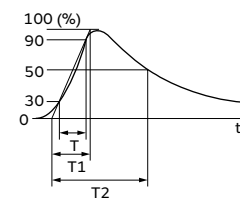
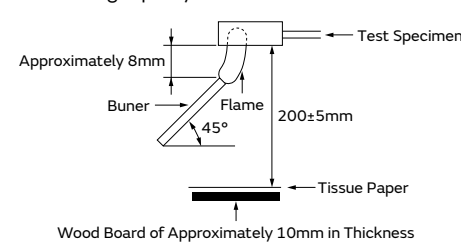
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GRM
 GR3
 GRJ
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 GR7
 GJM
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 GA2
 GA3 GB
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 LLL
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 ⚠Caution /Notice

GA3 Series Type GF Specifications and Test Methods (1)

Continued from the preceding page. ↘

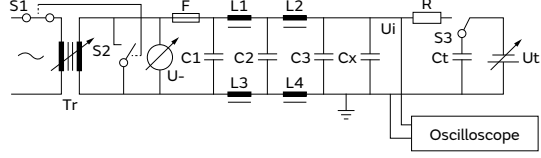
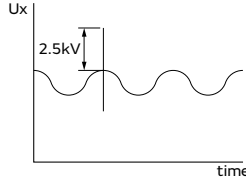
| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | | | | |
|--|---|--|---|-----------------|------------|--|---|----------------------------|------------|---|------------|--------|---|----------------------------|------------|---|------------|--------|
| 14 | Temperature Sudden Change | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | Within the specified initial value. | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate A (glass epoxy board) shown in "Complement of Test Method". Perform the 5 cycles according to the four heat treatments shown in the following table. | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. Operating Temp. +0/-3</td> <td>30\pm3</td> </tr> <tr> <td>2</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Max. Operating Temp. +3/-0</td> <td>30\pm3</td> </tr> <tr> <td>4</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> </tbody> </table> | Step | Temp. (°C) | Time (min) | 1 | Min. Operating Temp. +0/-3 | 30 \pm 3 | 2 | Room Temp. | 2 to 3 | 3 | Max. Operating Temp. +3/-0 | 30 \pm 3 | 4 | Room Temp. | 2 to 3 |
| Step | Temp. (°C) | Time (min) | | | | | | | | | | | | | | | | |
| 1 | Min. Operating Temp. +0/-3 | 30 \pm 3 | | | | | | | | | | | | | | | | |
| 2 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| 3 | Max. Operating Temp. +3/-0 | 30 \pm 3 | | | | | | | | | | | | | | | | |
| 4 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| | | | Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 15 | High Temperature High Humidity (Steady) | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 5.0\%$ or $\pm 0.5\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | C \geq 30pF: 350 or more C < 30pF: 275+5/2C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending test Test Temperature: 40 \pm 2°C Test Humidity: 90 to 95%RH Test Time: 500+24/-0h Applied Voltage: Rated voltage Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 16 | Durability | Appearance | No defects or abnormalities. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ (Whichever is larger) | | | | | | | | | | | | | | | |
| | | Q | C \geq 30pF: 350 or more C < 30pF: 275+5/2C or more C: Nominal Capacitance (pF) | | | | | | | | | | | | | | | |
| | | I.R. | 3000M Ω or more | | | | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | | | | |
| | | | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending test Next, Impulse Voltage test is performed. Each individual capacitor shall be subjected to a 5kV Impulse (the voltage value means zero to peak) for 3 times. Then the capacitors are applied to life test. | | | | | | | | | | | | | | | |
| | | |  <p>Front time (T1) = 1.2μs=1.67T Time to half-value (T2) = 50μs</p> | | | | | | | | | | | | | | | |
| | | | Apply voltage as Table for 1000h at 125+2/-0°C, relative humidity 50% max. | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th colspan="2">Applied voltage</th> </tr> </thead> <tbody> <tr> <td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s.</td> <td></td> </tr> </tbody> </table> | Applied voltage | | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | |
| Applied voltage | | | | | | | | | | | | | | | | | | |
| AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | | | | | | |
| | | | Exposure Time: 24 \pm 2h at room condition*. | | | | | | | | | | | | | | | |
| 17 | Passive Flammability | The burning time shall not be exceeded the time 30s. The tissue paper shall not ignite. | The capacitor under test shall be held in the flame in the position which best promotes burning. Each specimen shall only be exposed once to the flame. Time of exposure to flame: 30s Length of flame: 12 \pm 1mm Gas burner: Length 35mm min. Inside dia: 0.5 \pm 0.1mm Outside dia: 0.9mm max. Gas: Butane gas purity 95% min. | | | | | | | | | | | | | | | |
| | |  | | | | | | | | | | | | | | | | |

* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

Continued on the following page. ↗

GA3 Series Type GF Specifications and Test Methods (1)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|---------------------|---------------------------------------|---|
| 18 | Active Flammability | The cheesecloth shall not be on fire. | <p>The specimens shall be individually wrapped in at least one but more than two complete layers of cheesecloth. The specimens shall be subjected to 20 discharges. The interval between successive discharges shall be 5s. The UAC shall be maintained for 2min after the last discharge.</p>  <p>C1, C2: Filter capacitor $1\mu\text{F}\pm 10\%$ C3: Capacitor $0.033\mu\text{F}\pm 5\%$ L1 to L4: Rod coa choke $1.5\text{mH}\pm 20\%$, 16A R: Resistor $100\Omega\pm 2\%$ $C_x < 0.068\mu\text{F}$ Ct: Tank capacitor $3\mu\text{F}\pm 5\%$ 10kV $C_x \leq 1\mu\text{F}$ U-: $UR\pm 5\%$ UR: Rated voltage Cx: Capacitor under test F: Slow-blow fuse, rated 16A Ut: Voltage to which the tank capacitor Ct is charged</p>  |

- GRM
- GR3
- GRJ
- GR4
- GR7
- GJM
- GQM
- GA2
- GA3 GB
- GA3 GD
- GA3 GF
- LLL
- LLA
- LLM
- LLR
- NFM
- KPM
- KR3
- GMA
- GMD
- ⚠Caution /Notice

GA3 Series Type GF Specifications and Test Methods (1)

Continued from the preceding page. ↘

Complement of Test Method

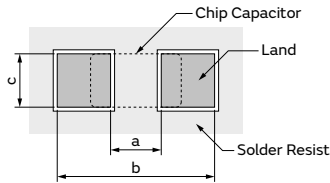
1. Test Substrate

The test substrate should be Substrate A or Substrate B as described in "Specifications and Test Methods".
 The specimen should be soldered by the conditions as described below.

Soldering Method: Reflow soldering
 Solder: Sn-3.0Ag-0.5Cu

(1) Test Substrate A

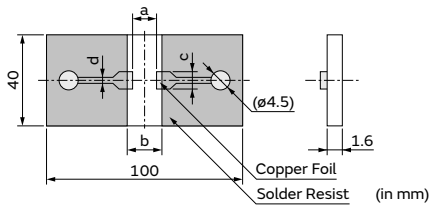
• Land Dimensions



| Part Number | Dimension (mm) | | |
|--------------|----------------|-----|-----|
| | a | b | c |
| GA342 | 3.5 | 7.0 | 2.4 |

- Material: Glass Epoxy Board
- Thickness: 1.6mm
- Thickness of Copper Foil: 0.035mm

(2) Test Substrate B

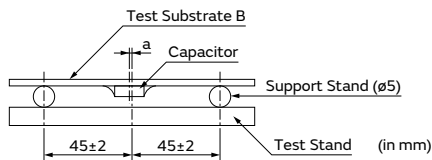


| Part Number | Dimension of Pattern (mm) | | | |
|--------------|---------------------------|-----|-----|-----|
| | a | b | c | d |
| GA342 | 3.5 | 7.0 | 2.4 | 1.0 |

- Material: Glass Epoxy Board
- Thickness of Copper Foil: 0.035mm

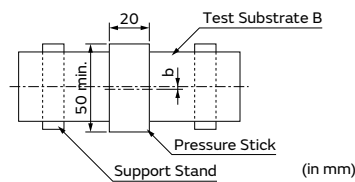
2. Test Method of Substrate Bending Test

(a) Support State



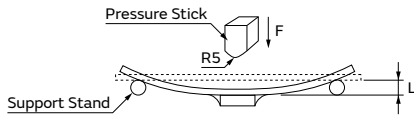
a: ±2 gap between support stand center and test stand

(b) Test State



b: ±5 gap between support stand center and test stand center

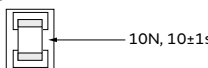
- Material of Test Stand and Pressure Stick
 The material should be a metal where a remarkable transformation and the distortion are not caused even if it is pressurized.
- Pressurizing Speed
 The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 Caution / Notice

2

GA3 Series Type GF Specifications and Test Methods (2)

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | |
|------|--|---|--|------|------------------|---|--------------------|---|-------------------------|---|--------------------|---|-------------------------|---|--------------------|
| 1 | Appearance | No defects or abnormalities. | Visual inspection. | | | | | | | | | | | | |
| 2 | Dimension | Within the specified dimensions. | Using calipers and micrometers. | | | | | | | | | | | | |
| 3 | Voltage Proof | No defects or abnormalities. | Measurement Point: Between the terminations Test Voltage: AC2000V (r.m.s.) Applied Time: 60±1s Charge/discharge current: 50mA max. | | | | | | | | | | | | |
| 4 | Impulse Voltage | No self healing break downs or flash-overs have taken place in the capacitor. | 10 impulse of alternating polarity is subjected. (5 impulse for each polarity) The interval between impulse is 60s. Applied Voltage: 2.5kVo-p | | | | | | | | | | | | |
| 5 | Insulation Resistance (I.R.) | 6000MΩ or more | Measurement Point: Between the terminations Measurement Voltage: DC500±50V Charging Time: 60±5s Charge/discharge current: 50mA max. Measurement Temperature: Room Temperature | | | | | | | | | | | | |
| 6 | Capacitance | Shown in Rated value. | Measurement Temperature: Room Temperature Measurement Frequency: 1.0±0.1kHz Measurement Voltage: AC1.0±0.2V (r.m.s.) | | | | | | | | | | | | |
| 7 | Dissipation Factor (D.F.) | 0.025 max. | | | | | | | | | | | | | |
| 8 | Temperature Characteristics of Capacitance | R7: Within ±15% (-55 to +125°C) | The capacitance change should be measured after 5 minutes at each specified temp. stage. Capacitance value as a reference is the value in step 3. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>2</td> <td>Min. Operating Temp. ±3</td> </tr> <tr> <td>3</td> <td>Reference Temp. ±2</td> </tr> <tr> <td>4</td> <td>Max. Operating Temp. ±3</td> </tr> <tr> <td>5</td> <td>Reference Temp. ±2</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Step | Temperature (°C) | 1 | Reference Temp. ±2 | 2 | Min. Operating Temp. ±3 | 3 | Reference Temp. ±2 | 4 | Max. Operating Temp. ±3 | 5 | Reference Temp. ±2 |
| Step | Temperature (°C) | | | | | | | | | | | | | | |
| 1 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 2 | Min. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 3 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 4 | Max. Operating Temp. ±3 | | | | | | | | | | | | | | |
| 5 | Reference Temp. ±2 | | | | | | | | | | | | | | |
| 9 | Vibration | Appearance | No defects or abnormalities. | | | | | | | | | | | | |
| | | Capacitance | Within the specified initial value. | | | | | | | | | | | | |
| | | D.F. | Within the specified initial value. | | | | | | | | | | | | |
| 10 | Solderability | 95% of the terminations is to be soldered evenly and continuously. | Test Method: Solder bath method Flux: Solution of rosin ethanol 25 (wt)% Preheat: 80 to 120°C for 10 to 30s Solder: Sn-3.0Ag-0.5Cu (Lead Free Solder) Solder Temp.: 245±5°C Immersion time: 2±0.5s Immersing in speed: 25±2.5mm/s. | | | | | | | | | | | | |
| 11 | Resistance to Soldering Heat | Appearance | No defects or abnormalities. | | | | | | | | | | | | |
| | | Capacitance Change | Within ±10% | | | | | | | | | | | | |
| | | I.R. | 1000MΩ or more | | | | | | | | | | | | |
| | | Voltage Proof | No defects. | | | | | | | | | | | | |
| 12 | Adhesive Strength of Termination | No removal of the terminations or other defect should occur. | Solder the capacitor on the test substrate A shown in "Complement of Test Method".  Applied Direction: In parallel with the test substrate and vertical with the capacitor side. | | | | | | | | | | | | |

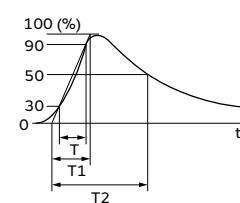
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

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GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KFM
 KR3
 GMA
 GMD
 ⚠Caution / Notice

GA3 Series Type GF Specifications and Test Methods (2)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) | | | | | | | | | | | | | | | |
|--------------------|---|--|--|----------------------------|--|------------|---|----------------------------|------|---|------------|--------|---|----------------------------|------|---|------------|--------|
| 13 | Substrate Bending Test | No defects or abnormalities. | Solder the capacitor on the test substrate B shown in "Complement of Test Method". Then apply the force in the direction shown in "Test Method of Substrate Bending Test" of "Complement of Test Method". Flexure: 1mm Holding Time: 5±1s Soldering Method: Reflow soldering | | | | | | | | | | | | | | | |
| 14 | Temperature Sudden Change | Appearance | Fix the capacitor to the supporting test substrate A (glass epoxy board) shown in "Complement of Test Method". Perform the 5 cycles according to the four heat treatments shown in the following table. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. Operating Temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Max. Operating Temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room Temp.</td> <td>2 to 3</td> </tr> </tbody> </table> Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Step | Temp. (°C) | Time (min) | 1 | Min. Operating Temp. +0/-3 | 30±3 | 2 | Room Temp. | 2 to 3 | 3 | Max. Operating Temp. +3/-0 | 30±3 | 4 | Room Temp. | 2 to 3 |
| | | Step | | Temp. (°C) | Time (min) | | | | | | | | | | | | | |
| | | 1 | | Min. Operating Temp. +0/-3 | 30±3 | | | | | | | | | | | | | |
| | | 2 | | Room Temp. | 2 to 3 | | | | | | | | | | | | | |
| | | 3 | | Max. Operating Temp. +3/-0 | 30±3 | | | | | | | | | | | | | |
| 4 | Room Temp. | 2 to 3 | | | | | | | | | | | | | | | | |
| Capacitance Change | Within±15% | | | | | | | | | | | | | | | | | |
| D.F. | 0.05 max. | | | | | | | | | | | | | | | | | |
| I.R. | 3000MΩ or more | | | | | | | | | | | | | | | | | |
| Voltage Proof | No defects. | | | | | | | | | | | | | | | | | |
| 15 | High Temperature High Humidity (Steady) | Appearance | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Test Temperature: 40±2°C Test Humidity: 90 to 95%RH Test Time: 500+24/-0h Applied Voltage: Rated voltage Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | | | | | | | | | | | | | | | |
| | | Capacitance Change | | Within±15% | | | | | | | | | | | | | | |
| | | D.F. | | 0.05 max. | | | | | | | | | | | | | | |
| | | I.R. | | 3000MΩ or more | | | | | | | | | | | | | | |
| | | Voltage Proof | | No defects. | | | | | | | | | | | | | | |
| 16 | Durability | Appearance | Fix the capacitor to the supporting test substrate B (glass epoxy board) shown in "Complement of Test Method". Before this test, the test shown in the following is performed. • No.12 Adhesive Strength of Termination (apply force: 5N) • No.13 Substrate Bending Test Next, Impulse Voltage test is performed. Each individual capacitor shall be subjected to a 5kV Impulse (the voltage value means zero to peak) for 3 times. Then the capacitors are applied to life test.  Front time (T1) = 1.2μs=1.67T Time to half-value (T2) = 50μs Apply voltage as Table for 1000h at 125+2/-0°C, relative humidity 50% max. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Applied Voltage</th> </tr> </thead> <tbody> <tr> <td>AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s.</td> </tr> </tbody> </table> Exposure Time: 24±2h at room condition*. • Pretreatment Perform a heat treatment at 150+0/-10°C for 1h±5min and then let sit for 24±2h at room condition*. | Applied Voltage | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | |
| | | Applied Voltage | | | | | | | | | | | | | | | | |
| | | AC425V (r.m.s.), except that once each hour the voltage is increased to AC1000V (r.m.s.) for 0.1s. | | | | | | | | | | | | | | | | |
| | | Capacitance Change | | Within ±20% | | | | | | | | | | | | | | |
| | | D.F. | | 0.05 max. | | | | | | | | | | | | | | |
| I.R. | 3000MΩ or more | | | | | | | | | | | | | | | | | |
| Voltage Proof | No defects. | | | | | | | | | | | | | | | | | |

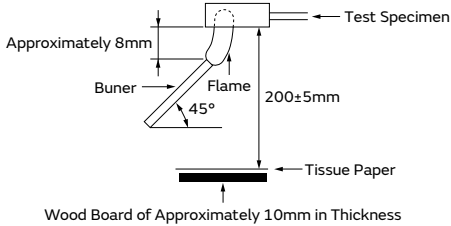
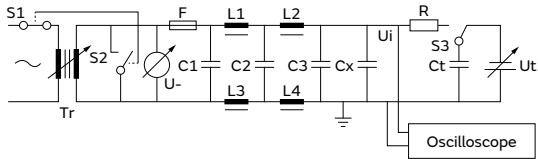
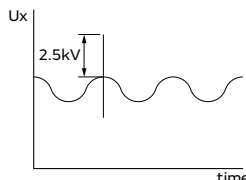
* Room Condition: Temperature: 15 to 35°C, Relative humidity: 45 to 75%, Atmosphere pressure: 86 to 106kPa

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 GRJ
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 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
 ⚠Caution /Notice

GA3 Series Type GF Specifications and Test Methods (2)

Continued from the preceding page. ↘

| No | Item | Specification | Test Method (Ref. Standard: JIS C 5101, IEC60384) |
|----|----------------------|--|---|
| 17 | Passive Flammability | The burning time shall not be exceeded the time 30s. The tissue paper shall not ignite. | <p>The capacitor under test shall be held in the flame in the position which best promotes burning. Each specimen shall only be exposed once to the flame. Time of exposure to flame: 30s Length of flame: 12±1mm Gas burner: Length 35mm min. Inside dia: 0.5±0.1mm Outside dia: 0.9mm max. Gas: Butane gas purity 95% min.</p>  |
| 18 | Active Flammability | The cheesecloth shall not be on fire. | <p>The specimens shall be individually wrapped in at least one but more than two complete layers of cheesecloth. The specimens shall be subjected to 20 discharges. The interval between successive discharges shall be 5s. The UAC shall be maintained for 2min after the last discharge.</p>  <p>C1, C2: Filter capacitor 1μF±10% C3: Capacitor 0.033μF±5% L1 to L4: Rod coa choke 1.5mH±20%, 16A R: Resistor 100Ω±2% Cx < 0.068μF Ct: Tank capacitor 3μF±5% 10kV Cx ≤ 1μF U-: UR±5% UR: Rated voltage Cx: Capacitor under test F: Slow-blow fuse, rated 16A Ut: Voltage to which the tank capacitor Ct is charged</p>  |

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
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 GA2
 GA3 GB
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 NFM
 KPM
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 ⚠Caution / Notice

GA3 Series Type GF Specifications and Test Methods (2)

Continued from the preceding page. ↘

Complement of Test Method

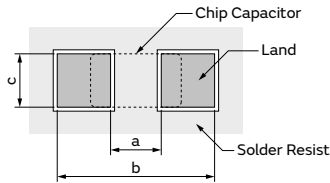
1. Test Substrate

The test substrate should be Substrate A or Substrate B as described in "Specifications and Test Methods".
 The specimen should be soldered by the conditions as described below.

Soldering Method: Reflow soldering
 Solder: Sn-3.0Ag-0.5Cu

(1) Test Substrate A

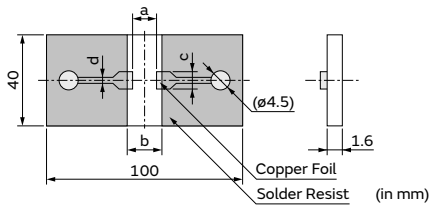
- Land Dimensions



- Material: Glass Epoxy Board
- Thickness: 1.6mm
- Thickness of Copper Foil: 0.035mm

| Part Number | Dimension (mm) | | |
|-------------|----------------|-----|-----|
| | a | b | c |
| GA342 | 3.5 | 7.0 | 2.4 |
| GA352 | 4.5 | 8.0 | 3.2 |
| GA355 | 4.5 | 8.0 | 5.6 |

(2) Test Substrate B

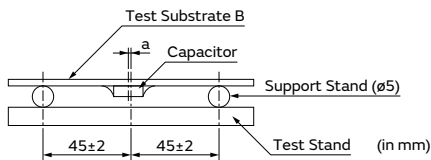


- Material: Glass Epoxy Board
- Thickness of Copper Foil: 0.035mm

| Part Number | Dimension of Pattern (mm) | | | |
|-------------|---------------------------|-----|-----|-----|
| | a | b | c | d |
| GA342 | 3.5 | 7.0 | 2.4 | 1.0 |
| GA352 | 4.5 | 8.0 | 3.2 | 1.0 |
| GA355 | 4.5 | 8.0 | 5.6 | 1.0 |

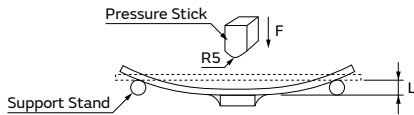
2. Test Method of Substrate Bending Test

(a) Support State

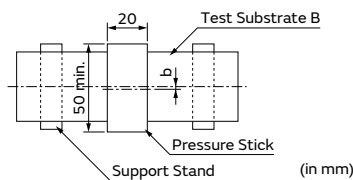


a: ±2 gap between support stand center and test stand

- Material of Test Stand and Pressure Stick
 The material should be a metal where a remarkable transformation and the distortion are not caused even if it is pressurized.
- Pressurizing Speed
 The pressurizing speed is pressurized at the speed of about 1mm/s until the flexure reaches a regulated value.



(b) Test State



b: ±5 gap between support stand center and test stand center

GRM
 GR3
 GRJ
 GR4
 GR7
 GJM
 GQM
 GA2
 GA3 GB
 GA3 GD
 GA3 GF
 LLL
 LLA
 LLM
 LLR
 NFM
 KRM
 KR3
 GMA
 GMD
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