



**THE DATASHEET OF  
SMK316BJ223ML-T**



## Notice for TAIYO YUDEN products

Please read this notice before using the TAIYO YUDEN products.

### ⚠ REMINDERS

#### ■ Product Information in this Catalog

Product information in this catalog is as of January 2021. All of the contents specified herein and production status of the products listed in this catalog are subject to change without notice due to technical improvement of our products, etc. Therefore, please check for the latest information carefully before practical application or use of our products.

Please note that TAIYO YUDEN shall not be in any way responsible for any damages and defects in products or equipment incorporating our products, which are caused under the conditions other than those specified in this catalog or individual product specification sheets.

#### ■ Approval of Product Specifications

Please contact TAIYO YUDEN for further details of product specifications as the individual product specification sheets are available. When using our products, please be sure to approve our product specifications or make a written agreement on the product specification with TAIYO YUDEN in advance.

#### ■ Pre-Evaluation in the Actual Equipment and Conditions

Please conduct validation and verification of our products in actual conditions of mounting and operating environment before using our products.

#### ■ Limited Application

##### 1. Equipment Intended for Use

The products listed in this catalog are intended for general-purpose and standard use in general electronic equipment (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment including, without limitation, mobile phone, and PC) and other equipment specified in this catalog or the individual product specification sheets.

TAIYO YUDEN has the line-up of the products intended for use in automotive electronic equipment, telecommunications infrastructure and industrial equipment, or medical devices classified as GHTF Classes A to C (Japan Classes I to III). Therefore, when using our products for these equipment, please check available applications specified in this catalog or the individual product specification sheets and use the corresponding products.

##### 2. Equipment Requiring Inquiry

Please be sure to contact TAIYO YUDEN for further information before using the products listed in this catalog for the following equipment (excluding intended equipment as specified in this catalog or the individual product specification sheets) which may cause loss of human life, bodily injury, serious property damage and/or serious public impact due to a failure or defect of the products and/or malfunction attributed thereto.

- (1) Transportation equipment (automotive powertrain control system, train control system, and ship control system, etc.)
- (2) Traffic signal equipment
- (3) Disaster prevention equipment, crime prevention equipment
- (4) Medical devices classified as GHTF Class C (Japan Class III)
- (5) Highly public information network equipment, data-processing equipment (telephone exchange, and base station, etc.)
- (6) Any other equipment requiring high levels of quality and/or reliability equal to the equipment listed above

##### 3. Equipment Prohibited for Use

Please do not incorporate our products into the following equipment requiring extremely high levels of safety and/or reliability.

- (1) Aerospace equipment (artificial satellite, rocket, etc.)
- (2) Aviation equipment \*<sup>1</sup>
- (3) Medical devices classified as GHTF Class D (Japan Class IV), implantable medical devices \*<sup>2</sup>

- (4) Power generation control equipment (nuclear power, hydroelectric power, thermal power plant control system, etc.)
- (5) Undersea equipment (submarine repeating equipment, underwater work equipment, etc.)
- (6) Military equipment
- (7) Any other equipment requiring extremely high levels of safety and/or reliability equal to the equipment listed above

\*Notes:

1. There is a possibility that our products can be used only for aviation equipment that does not directly affect the safe operation of aircraft (e.g., in-flight entertainment, cabin light, electric seat, cooking equipment) if such use meets requirements specified separately by TAIYO YUDEN. Please be sure to contact TAIYO YUDEN for further information before using our products for such aviation equipment.
2. Implantable medical devices contain not only internal unit which is implanted in a body, but also external unit which is connected to the internal unit.

#### 4. Limitation of Liability

Please note that unless you obtain prior written consent of TAIYO YUDEN, TAIYO YUDEN shall not be in any way responsible for any damages incurred by you or third parties arising from use of the products listed in this catalog for any equipment that is not intended for use by TAIYO YUDEN, or any equipment requiring inquiry to TAIYO YUDEN or prohibited for use by TAIYO YUDEN as described above.

#### ■ Safety Design

When using our products for high safety and/or reliability-required equipment or circuits, please fully perform safety and/or reliability evaluation. In addition, please install (i) systems equipped with a protection circuit and a protection device and/or (ii) systems equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault for a failsafe design to ensure safety.

#### ■ Intellectual Property Rights

Information contained in this catalog is intended to convey examples of typical performances and/or applications of our products and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of TAIYO YUDEN or any third parties nor grant any license under such rights.

#### ■ Limited Warranty

Please note that the scope of warranty for our products is limited to the delivered our products themselves and TAIYO YUDEN shall not be in any way responsible for any damages resulting from a failure or defect in our products. Notwithstanding the foregoing, if there is a written agreement (e.g., supply and purchase agreement, quality assurance agreement) signed by TAIYO YUDEN and your company, TAIYO YUDEN will warrant our products in accordance with such agreement.

#### ■ TAIYO YUDEN's Official Sales Channel

The contents of this catalog are applicable to our products which are purchased from our sales offices or authorized distributors (hereinafter "TAIYO YUDEN's official sales channel"). Please note that the contents of this catalog are not applicable to our products purchased from any seller other than TAIYO YUDEN's official sales channel.

#### ■ Caution for Export

Some of our products listed in this catalog may require specific procedures for export according to "U.S. Export Administration Regulations", "Foreign Exchange and Foreign Trade Control Law" of Japan, and other applicable regulations. Should you have any questions on this matter, please contact our sales staff.

▶ This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our product specification sheets. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our website (<http://www.ty-top.com/>).

# MULTILAYER CERAMIC CAPACITORS

WAVE REFLOW

PARTS NUMBER



Δ = Blank space

① Rated voltage

| Code | Rated voltage [VDC] |
|------|---------------------|
| P    | 2.5                 |
| A    | 4                   |
| J    | 6.3                 |
| L    | 10                  |
| E    | 16                  |
| T    | 25                  |
| G    | 35                  |
| U    | 50                  |
| H    | 100                 |
| Q    | 250                 |
| S    | 630                 |
| X    | 2000                |

② Series name

| Code | Series name                                     |
|------|---|
| M    | Multilayer ceramic capacitor                    |
| V    | Multilayer ceramic capacitor for high frequency |
| W    | LW reverse type multilayer capacitor            |

③ End termination

| Code | End termination                             |
|------|---|
| K    | Plated                                      |
| S    | Cu Internal Electrodes (For High Frequency) |

④ Dimension (L × W)

| Type | Dimensions (L × W) [mm] | EIA (inch) |
|------|-------------------------|------------|
| 021  | 0.25 × 0.125            | 008004     |
| 042  | 0.4 × 0.2               | 01005      |
| 063  | 0.6 × 0.3               | 0201       |
| 105  | 1.0 × 0.5               | 0402       |
|      | 0.52 × 1.0 ※            | 0204       |
| 107  | 1.6 × 0.8               | 0603       |
|      | 0.8 × 1.6 ※             | 0306       |
| 212  | 2.0 × 1.25              | 0805       |
|      | 1.25 × 2.0 ※            | 0508       |
| 316  | 3.2 × 1.6               | 1206       |
| 325  | 3.2 × 2.5               | 1210       |
| 432  | 4.5 × 3.2               | 1812       |

Note : ※LW reverse type (□WK) only

⑤ Dimension tolerance

| Code | Type | L [mm]              | W [mm]               | T [mm]               |
|------|------|---------------------|----------------------|----------------------|
| Δ    | ALL  | Standard            | Standard             | Standard             |
|      | 063  | 0.6 ± 0.05          | 0.3 ± 0.05           | 0.3 ± 0.05           |
|      | 105  | 1.0 ± 0.10          | 0.5 ± 0.10           | 0.5 ± 0.10           |
|      | 107  | 1.6 + 0.15 / - 0.05 | 0.8 + 0.15 / - 0.05  | 0.8 + 0.15 / - 0.05  |
| A    | 212  | 2.0 + 0.15 / - 0.05 | 1.25 + 0.15 / - 0.05 | 0.45 ± 0.05          |
|      |      |                     |                      | 0.85 ± 0.10          |
|      |      |                     |                      | 1.25 + 0.15 / - 0.05 |
|      | 316  | 3.2 ± 0.20          | 1.6 ± 0.20           | 0.85 ± 0.10          |
| B    | 105  | 1.0 + 0.15 / - 0.05 | 0.5 + 0.15 / - 0.05  | 1.6 ± 0.20           |
|      |      |                     |                      | 2.5 ± 0.30           |
|      |      |                     |                      | 2.5 ± 0.30           |
|      | 063  | 0.6 ± 0.09          | 0.3 ± 0.09           | 0.3 ± 0.09           |
| B    | 212  | 2.0 + 0.20 / - 0    | 1.25 + 0.20 / - 0    | 0.45 ± 0.05          |
|      |      |                     |                      | 0.85 ± 0.10          |
|      |      |                     |                      | 1.25 + 0.20 / - 0    |
|      | 107  | 1.6 + 0.20 / - 0    | 0.8 + 0.20 / - 0     | 0.8 + 0.20 / - 0     |
| C    | 105  | 1.0 + 0.20 / - 0    | 0.5 + 0.20 / - 0     | 0.45 ± 0.05          |
|      |      |                     |                      | 0.8 + 0.20 / - 0     |
| E    | 063  | 0.6 + 0.25 / - 0    | 0.3 + 0.25 / - 0     | 0.45 ± 0.05          |
|      |      |                     |                      | 0.85 ± 0.10          |
| E    | 105  | 1.0 + 0.30 / - 0    | 0.5 + 0.30 / - 0     | 1.25 + 0.20 / - 0    |
|      |      |                     |                      | 1.6 ± 0.30           |

Note: cf. STANDARD EXTERNAL DIMENSIONS

Δ = Blank space

⑥ Temperature characteristics code

■ High dielectric type (Excluding Super low distortion multilayer ceramic capacitor)

| Code  | Applicable standard | Temperature range [°C] | Ref. Temp. [°C] | Capacitance change | Capacitance tolerance | Tolerance code |
|-------|---------------------|------------------------|-----------------|--------------------|-----------------------|----------------|
| BJ    | JIS                 | B                      | -25 ~ + 85      | 20                 | ± 10%                 | ± 10%          |
|       | B                   |                        |                 |                    |                       | ± 20%          |
| B7    | EIA                 | X5R                    | -55 ~ + 85      | 25                 | ± 15%                 | ± 10%          |
|       | X7R                 |                        |                 |                    |                       | ± 20%          |
| C6    | EIA                 | X6S                    | -55 ~ + 105     | 25                 | ± 22%                 | ± 10%          |
|       |                     |                        |                 |                    |                       | X7S            |
| C7    | EIA                 | X7S                    | -55 ~ + 125     | 25                 | ± 22%                 | ± 10%          |
|       |                     |                        |                 |                    |                       | X5R            |
| LD(※) | EIA                 | X5R                    | -55 ~ + 85      | 25                 | ± 15%                 | ± 10%          |
|       |                     |                        |                 |                    |                       | X7S            |

Note : ※LD Low distortion high value multilayer ceramic capacitor

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CERAMIC CAPACITORS MULTILAYER CERAMIC CAPACITORS

■ Temperature compensating type

| Code | Applicable standard |     | Temperature range [°C] | Ref. Temp. [°C] | Capacitance change | Capacitance tolerance | Tolerance code |
|------|---------------------|-----|------------------------|-----------------|--------------------|-----------------------|----------------|
| CG   | EIA                 | C0G | -55~+125               | 25              | 0±30ppm/°C         | ±0.05pF               | A              |
|      |                     |     |                        |                 |                    | ±0.1pF                | B              |
|      |                     |     |                        |                 |                    | ±0.25pF               | C              |
|      |                     |     |                        |                 |                    | ±0.5pF                | D              |
|      |                     |     |                        |                 |                    | ±5%                   | J              |
| UJ   | JIS                 | UJ  | -55~+125               | 20              | -750±120ppm/°C     | ±0.25pF               | C              |
|      |                     | U2J |                        |                 |                    | ±0.5pF                | D              |
|      | EIA                 |     | 25                     | ±5%             |                    | J                     |                |
| UK   | JIS                 | UK  | -55~+125               | 20              | -750±250ppm/°C     | ±0.25pF               | C              |
|      | EIA                 | U2K | -55~+125               | 25              |                    |                       |                |

⑥ Series code

• Super low distortion multilayer ceramic capacitor

| Code | Series code |
|------|-------------|
| SD   | Standard    |

• Medium-High Voltage Multilayer Ceramic Capacitor

| Code | Series code |
|------|-------------|
| SD   | Standard    |

⑦ Nominal capacitance

| Code (example) | Nominal capacitance |
|----------------|---------------------|
| 0R5            | 0.5pF               |
| 010            | 1pF                 |
| 100            | 10pF                |
| 101            | 100pF               |
| 102            | 1,000pF             |
| 103            | 10,000pF            |
| 104            | 0.1 μF              |
| 105            | 1.0 μF              |
| 106            | 10 μF               |
| 107            | 100 μF              |

Note : R=Decimal point

⑧ Capacitance tolerance

| Code | Capacitance tolerance |
|------|-----------------------|
| A    | ±0.05pF               |
| B    | ±0.1pF                |
| C    | ±0.25pF               |
| D    | ±0.5pF                |
| F    | ±1pF                  |
| G    | ±2%                   |
| J    | ±5%                   |
| K    | ±10%                  |
| M    | ±20%                  |
| Z    | +80/-20%              |

⑨ Thickness

| Code | Thickness [mm]         |
|------|------------------------|
| K    | 0.125                  |
| H    | 0.13                   |
| E    | 0.18                   |
| C    | 0.2                    |
| D    |                        |
| P    | 0.3                    |
| T    |                        |
| K    | 0.45 (107type or more) |
| V    | 0.5                    |
| W    |                        |
| A    | 0.8                    |
| D    | 0.85 (212type or more) |
| F    | 1.15                   |
| G    | 1.25                   |
| L    | 1.6                    |
| N    | 1.9                    |
| Y    | 2.0 max                |
| M    | 2.5                    |

⑩ Special code

| Code | Special code |
|------|--------------|
| -    | Standard     |

⑪ Packaging

| Code | Packaging  |
|------|--|
| F    | φ 178mm Taping (2mm pitch)   |
| T    | φ 178mm Taping (4mm pitch)   |
| P    | φ 178mm Taping (4mm pitch, 1000 pcs/reel)<br>325 type (Thickness code M) |
| R    | φ 178mm Taping (2mm pitch) 105type only<br>(Thickness code E,H)          |
| W    | φ 178mm Taping (1mm pitch) 021/042type only                              |

⑫ Internal code

| Code | Internal code |
|------|---------------|
| △    | Standard      |

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## STANDARD EXTERNAL DIMENSIONS



※ LW reverse type

| Type( EIA )    | Dimension [mm] |             |              |           |                |   |
|----------------|----------------|-------------|--------------|-----------|----------------|---|
|                | L              | W           | T            | *1        | e              |   |
| □MK021(008004) | 0.25±0.013     | 0.125±0.013 | 0.125±0.013  | K         | 0.0675±0.0275  |   |
| □VS021(008004) | 0.25±0.013     | 0.125±0.013 | 0.125±0.013  | K         | 0.0675±0.0275  |   |
| □MK042(01005)  | 0.4±0.02       | 0.2±0.02    | 0.2±0.02     | C         | 0.1±0.03       |   |
| □VS042(01005)  |                |             |              | D         |                |   |
| □MK063(0201)   | 0.6±0.03       | 0.3±0.03    | 0.3±0.03     | P         | 0.15±0.05      |   |
| □MK105(0402)   |                |             |              | T         |                |   |
| □MK105(0402)   | 1.0±0.05       | 0.5±0.05    | 0.13±0.02    | H         | 0.25±0.10      |   |
|                |                |             |              | 0.18±0.02 |                | E |
|                |                |             |              | 0.2±0.02  |                | C |
|                |                |             |              | 0.3±0.03  |                | P |
|                |                |             |              | 0.5±0.05  |                | V |
| □VK105(0402)   | 1.0±0.05       | 0.5±0.05    | 0.5±0.05     | W         | 0.25±0.10      |   |
| □WK105(0204)※  | 0.52±0.05      | 1.0±0.05    | 0.3±0.05     | P         | 0.18±0.08      |   |
| □MK107(0603)   | 1.6±0.10       | 0.8±0.10    | 0.45±0.05    | K         | 0.35±0.25      |   |
|                |                |             | 0.8±0.10     | A         |                |   |
| □WK107(0306)※  | 0.8±0.10       | 1.6±0.10    | 0.5±0.05     | V         | 0.25±0.15      |   |
| □MK212(0805)   | 2.0±0.10       | 1.25±0.10   | 0.45±0.05    | K         | 0.5±0.25       |   |
|                |                |             | 0.85±0.10    | D         |                |   |
|                |                |             | 1.25±0.10    | G         |                |   |
| □WK212(0508)※  | 1.25±0.15      | 2.0±0.15    | 0.85±0.10    | D         | 0.3±0.2        |   |
| □MK316(1206)   | 3.2±0.15       | 1.6±0.15    | 0.85±0.10    | D         | 0.5+0.35/-0.25 |   |
|                |                |             | 1.15±0.10    | F         |                |   |
|                |                |             | 1.6±0.20     | L         |                |   |
| □MK325(1210)   | 3.2±0.30       | 2.5±0.20    | 0.85±0.10    | D         | 0.6±0.3        |   |
|                |                |             | 1.15±0.10    | F         |                |   |
|                |                |             | 1.9±0.20     | N         |                |   |
|                |                |             | 1.9+0.1/-0.2 | Y         |                |   |
|                |                |             | 2.5±0.20     | M         |                |   |
| □MK432(1812)   | 4.5±0.40       | 3.2±0.30    | 2.0+0/-0.30  | Y         | 0.6±0.4        |   |
|                |                |             | 2.5±0.20     | M         | 0.9±0.6        |   |

Note : ※. LW reverse type, \*1.Thickness code

## STANDARD QUANTITY

| Type   | EIA (inch) | Dimension |         | Standard quantity [pcs] |               |       |
|--------|------------|-----------|---------|-------------------------|---------------|-------|
|        |            | [mm]      | Code    | Paper tape              | Embossed tape |       |
| 021    | 008004     | 0.125     | K       | —                       | 50000         |       |
| 042    | 01005      | 0.2       | C       | —                       | 40000         |       |
|        |            |           | D       |                         |               |       |
| 063    | 0201       | 0.3       | P       | 15000                   | —             |       |
|        |            |           | T       |                         |               |       |
| 105    | 0402       | 0.13      | H       | —                       | 20000         |       |
|        |            |           | 0.18    | E                       | —             | 15000 |
|        |            |           | 0.2     | C                       | 20000         | —     |
|        |            |           | 0.3     | P                       | 15000         | —     |
|        |            |           | 0.5     | V                       | 10000         | —     |
|        |            |           |         | W                       |               |       |
| 0204 ※ | 0.30       | P         | —       | —                       |               |       |
| 107    | 0603       | 0.45      | K       | 4000                    | —             |       |
|        |            |           | A       |                         |               |       |
|        | 0306 ※     | 0.50      | V       | —                       | 4000          |       |
| 212    | 0805       | 0.45      | K       | 4000                    | —             |       |
|        |            |           | 0.85    |                         |               | D     |
|        |            |           | 1.25    |                         |               | G     |
| 0508 ※ | 0.85       | D         | 4000    | —                       |               |       |
| 316    | 1206       | 0.85      | D       | 4000                    | —             |       |
|        |            |           | 1.15    | F                       | —             | 3000  |
|        |            |           | 1.6     | L                       | —             | 2000  |
| 325    | 1210       | 0.85      | D       | —                       | 2000          |       |
|        |            |           | 1.15    |                         |               | F     |
|        |            |           | 1.9     |                         |               | N     |
|        |            |           | 2.0 max |                         |               | Y     |
|        |            |           | 2.5     |                         |               | M     |
| 432    | 1812       | 2.0 max   | Y       | —                       | 1000          |       |
|        |            |           | 2.5     | M                       | —             | 500   |

Note : ※LW Reverse type (□WK)

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PARTS NUMBER

Medium-High Voltage Multilayer Ceramic Capacitors

105TYPE

[Temperature Characteristic B7 : X7R (-55~+125°C)] 0.5mm thickness (V)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |     | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |     |                 |                           |           | Rated voltage x % |                  |                           |
| HMK105 B7221□V-F |               | 100               |                             | X7R | 220 p           | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7331□V-F |               |                   |                             | X7R | 330 p           | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7471□V-F |               |                   |                             | X7R | 470 p           | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7681□V-F |               |                   |                             | X7R | 680 p           | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7102□V-F |               |                   |                             | X7R | 1000 p          | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7152□V-F |               |                   |                             | X7R | 1500 p          | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7222□V-F |               |                   |                             | X7R | 2200 p          | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7332□V-F |               |                   |                             | X7R | 3300 p          | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
| HMK105 B7472□V-F |               |                   |                             | X7R | 4700 p          | ±10, ±20                  | 2.5       | 200               | 0.5±0.05         | R                         |
|                  |               |                   |                             |     |                 |                           |           |                   |                  |                           |

[Temperature Characteristic CG : CG/C0G (-55~+125°C)] 0.5mm thickness (V)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |     | Capacitance [F] | Capacitance tolerance [%] | Q (at 1MHz) min | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |  |
|------------------|---------------|-------------------|-----------------------------|-----|-----------------|---------------------------|-----------------|-------------------|------------------|---------------------------|--|
|                  |               |                   |                             |     |                 |                           |                 | Rated voltage x % |                  |                           |  |
| HMK105 CG080DV-F |               | 100               | CG                          | C0G | 8 p             | ±0.5pF                    | 560             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG090DV-F |               |                   | CG                          | C0G | 9 p             | ±0.5pF                    | 580             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG100DV-F |               |                   | CG                          | C0G | 10 p            | ±0.5pF                    | 600             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG120JV-F |               |                   | CG                          | C0G | 12 p            | ±5%                       | 640             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG150JV-F |               |                   | CG                          | C0G | 15 p            | ±5%                       | 700             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG180JV-F |               |                   | CG                          | C0G | 18 p            | ±5%                       | 760             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG220JV-F |               |                   | CG                          | C0G | 22 p            | ±5%                       | 840             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG240JV-F |               |                   | CG                          | C0G | 24 p            | ±5%                       | 880             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG270JV-F |               |                   | CG                          | C0G | 27 p            | ±5%                       | 940             | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG330JV-F |               |                   | CG                          | C0G | 33 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG390JV-F |               |                   | CG                          | C0G | 39 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG470JV-F |               |                   | CG                          | C0G | 47 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG560JV-F |               |                   | CG                          | C0G | 56 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG680JV-F |               |                   | CG                          | C0G | 68 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG820JV-F |               |                   | CG                          | C0G | 82 p            | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
| HMK105 CG101JV-F |               |                   | CG                          | C0G | 100 p           | ±5%                       | 1000            | 200               | 0.5±0.05         | R                         |  |
|                  |               |                   |                             |     |                 |                           |                 |                   |                  |                           |  |

107TYPE

[Temperature Characteristic BJ : B (-25~+85°C)/X5R (-55~+85°C)] 0.8mm thickness (A)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |                  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |  |
|-------------------|---------------|-------------------|-----------------------------|------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|--|
|                   |               |                   |                             |                  |                 |                           |           | Rated voltage x % |                  |                           |  |
| HMK107 BJ102□A-T  |               | 100               | B                           | X5R <sup>+</sup> | 1000 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ152□A-T  |               |                   | B                           | X5R <sup>+</sup> | 1500 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ222□A-T  |               |                   | B                           | X5R <sup>+</sup> | 2200 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ332□A-T  |               |                   | B                           | X5R <sup>+</sup> | 3300 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ472□A-T  |               |                   | B                           | X5R <sup>+</sup> | 4700 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ682□A-T  |               |                   | B                           | X5R <sup>+</sup> | 6800 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ103□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.01 μ          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ153□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.015 μ         | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ223□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.022 μ         | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ333□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.033 μ         | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ473□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.047 μ         | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ104□A-T  |               |                   | B                           | X5R <sup>+</sup> | 0.1 μ           | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |  |
| HMK107 BJ224□A-TE |               |                   | B                           | X5R <sup>+</sup> | 0.22 μ          | ±10, ±20                  | 3.5       | 150               | 0.8±0.10         | R                         |  |
|                   |               |                   |                             |                  |                 |                           |           |                   |                  |                           |  |

[Temperature Characteristic C7 : X7S (-55~+125°C)] 0.8mm thickness (A)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |     | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|-----|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |     |                 |                           |           | Rated voltage x % |                  |                           |
| HMK107 C7224□A-TE |               | 100               |                             | X7S | 0.22 μ          | ±10, ±20                  | 3.5       | 150               | 0.8±0.10         | R                         |
|                   |               |                   |                             |     |                 |                           |           |                   |                  |                           |

[Temperature Characteristic B7 : X7R (-55~+125°C)] 0.8mm thickness (A)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |     | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |   |
|------------------|---------------|-------------------|-----------------------------|-----|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|---|
|                  |               |                   |                             |     |                 |                           |           | Rated voltage x % |                  |                           |   |
| HMK107 B7102□A-T |               | 100               |                             | X7R | 1000 p          | ±10, ±20                  | 3.5       | 200               | 0.8±0.10         | R                         |   |
| HMK107 B7152□A-T |               |                   |                             |     | X7R             | 1500 p                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7222□A-T |               |                   |                             |     | X7R             | 2200 p                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7332□A-T |               |                   |                             |     | X7R             | 3300 p                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7472□A-T |               |                   |                             |     | X7R             | 4700 p                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7682□A-T |               |                   |                             |     | X7R             | 6800 p                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7103□A-T |               |                   |                             |     | X7R             | 0.01 μ                    | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7153□A-T |               |                   |                             |     | X7R             | 0.015 μ                   | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7223□A-T |               |                   |                             |     | X7R             | 0.022 μ                   | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7333□A-T |               |                   |                             |     | X7R             | 0.033 μ                   | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7473□A-T |               |                   |                             |     | X7R             | 0.047 μ                   | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
| HMK107 B7104□A-T |               |                   |                             |     | X7R             | 0.1 μ                     | ±10, ±20  | 3.5               | 200              | 0.8±0.10                  | R |
|                  |               |                   |                             |     |                 |                           |           |                   |                  |                           |   |

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PARTS NUMBER

【Temperature Characteristic SD : Standard (−55~+125°C)】 0.8mm thickness (A)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK107 SD101KA-T |               | 100               | Standard Type               | 100 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD121KA-T |               |                   |                             | 120 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD151KA-T |               |                   |                             | 150 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD181KA-T |               |                   |                             | 180 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD221KA-T |               |                   |                             | 220 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD271KA-T |               |                   |                             | 270 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD331KA-T |               |                   |                             | 330 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD391KA-T |               |                   |                             | 390 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD471KA-T |               |                   |                             | 470 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD561KA-T |               |                   |                             | 560 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD681KA-T |               |                   |                             | 680 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD821KA-T |               |                   |                             | 820 p           | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |
| HMK107 SD102KA-T |               |                   |                             | 1000 p          | ±10                       | 0.1       | 200               | 0.8±0.10         | R                         |

● 212TYPE

【Temperature Characteristic BJ : B (−25~+85°C)/X5R (−55~+85°C)】 1.25mm thickness (G)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |           |   |
|-------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|-----------|---|
|                   |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |           |   |
| HMK212 BJ103□G-T  |               | 100               | B X5R <sup>+</sup>          | 0.01 μ          | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ153□G-T  |               |                   |                             | 0.015 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ223□G-T  |               |                   |                             | 0.022 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ333□G-T  |               |                   |                             | 0.033 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ473□G-T  |               |                   |                             | 0.047 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ683□G-T  |               |                   |                             | 0.068 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ104□G-T  |               |                   |                             | 0.1 μ           | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ224□G-T  |               |                   |                             | 0.22 μ          | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 BJ474□G-TE |               |                   |                             | 0.47 μ          | ±10, ±20                  | 3.5       | 150               | 1.25±0.10        | R                         |           |   |
| HMK212BBJ105□G-TE |               |                   |                             | 1 μ             | ±10, ±20                  | 3.5       | 150               | 1.25+0.20/-0     | R                         |           |   |
| QMK212 BJ472□G-T  |               |                   |                             | 250             | B X5R <sup>+</sup>        | 4700 p    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 BJ682□G-T  |               |                   |                             |                 |                           | 6800 p    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 BJ103□G-T  |               |                   |                             |                 |                           | 0.01 μ    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 BJ153□G-T  |               |                   |                             |                 |                           | 0.015 μ   | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 BJ223□G-T  |               | 0.022 μ           | ±10, ±20                    |                 |                           | 2.5       | 150               | 1.25±0.10        | R                         |           |   |

【Temperature Characteristic BJ : B (−25~+85°C)/X5R (−55~+85°C)】 0.85mm thickness (D)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| QMK212 BJ102□D-T |               | 250               | B X5R <sup>+</sup>          | 1000 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 BJ152□D-T |               |                   |                             | 1500 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 BJ222□D-T |               |                   |                             | 2200 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 BJ332□D-T |               |                   |                             | 3300 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |

【Temperature Characteristic C7 : X7S (−55~+125°C)】 1.25mm thickness (G)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK212 C7474□G-TE |               | 100               | X7S                         | 0.47 μ          | ±10, ±20                  | 3.5       | 150               | 1.25±0.10        | R                         |
| HMK212BC7105□G-TE |               | 100               | X7S                         | 1 μ             | ±10, ±20                  | 3.5       | 150               | 1.25+0.20/-0     | R                         |

【Temperature Characteristic B7 : X7R (−55~+125°C)】 1.25mm thickness (G)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |           |   |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|-----------|---|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |           |   |
| HMK212 B7103□G-T |               | 100               | X7R                         | 0.01 μ          | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7153□G-T |               |                   |                             | 0.015 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7223□G-T |               |                   |                             | 0.022 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7333□G-T |               |                   |                             | 0.033 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7473□G-T |               |                   |                             | 0.047 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7683□G-T |               |                   |                             | 0.068 μ         | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7104□G-T |               |                   |                             | 0.1 μ           | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| HMK212 B7224□G-T |               |                   |                             | 0.22 μ          | ±10, ±20                  | 3.5       | 200               | 1.25±0.10        | R                         |           |   |
| QMK212 B7472□G-T |               |                   |                             | 250             | X7R                       | 4700 p    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 B7682□G-T |               |                   |                             |                 |                           | 6800 p    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 B7103□G-T |               |                   |                             |                 |                           | 0.01 μ    | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 B7153□G-T |               |                   |                             |                 |                           | 0.015 μ   | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |
| QMK212 B7223□G-T |               |                   |                             |                 |                           | 0.022 μ   | ±10, ±20          | 2.5              | 150                       | 1.25±0.10 | R |

【Temperature Characteristic B7 : X7R (−55~+125°C)】 0.85mm thickness (D)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| QMK212 B7102□D-T |               | 250               | X7R                         | 1000 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 B7152□D-T |               |                   |                             | 1500 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 B7222□D-T |               |                   |                             | 2200 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |
| QMK212 B7332□D-T |               |                   |                             | 3300 p          | ±10, ±20                  | 2.5       | 150               | 0.85±0.10        | R                         |

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CERAMIC CAPACITORS MULTILAYER CERAMIC CAPACITORS

PARTS NUMBER

[Temperature Characteristic SD : Standard (-55~+125°C)] 0.85mm thickness (D)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK212 SD222KD-T |               | 100               | Standard Type               | 2200 p          | ±10                       | 0.1       | 200               | 0.85±0.10        | R                         |
| HMK212 SD472KD-T |               |                   |                             | 4700 p          | ±10                       | 0.1       | 200               | 0.85±0.10        | R                         |
| QMK212 SD101KD-T |               |                   |                             | 100 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD121KD-T |               |                   |                             | 120 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD151KD-T |               |                   |                             | 150 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD181KD-T |               |                   |                             | 180 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD221KD-T |               |                   |                             | 220 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD331KD-T |               |                   |                             | 330 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD391KD-T |               |                   |                             | 390 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD471KD-T |               |                   |                             | 470 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD561KD-T |               |                   |                             | 560 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD681KD-T |               |                   |                             | 680 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD821KD-T |               |                   |                             | 820 p           | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |
| QMK212 SD102KD-T |               |                   |                             | 1000 p          | ±10                       | 0.1       | 150               | 0.85±0.10        | R                         |

[Temperature Characteristic SD : Standard (-55~+125°C)] 1.25mm thickness (G)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK212 SD392KG-T |               | 100               | Standard Type               | 3900 p          | ±10                       | 0.1       | 200               | 1.25±0.10        | R                         |

316TYPE

[Temperature Characteristic BJ : B (-25~+85°C)/X5R (-55~+85°C)] 1.6mm thickness (L)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F]            | Capacitance tolerance [%] | tan δ [%]                  | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |          |   |
|-------------------|---------------|-------------------|-----------------------------|----------------------------|---------------------------|----------------------------|-------------------|------------------|---------------------------|----------|---|
|                   |               |                   |                             |                            |                           |                            | Rated voltage x % |                  |                           |          |   |
| HMK316 BJ473□L-T  |               | 100               | Standard Type               | B X5R <sup>+</sup> 0.047 μ | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ683□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.068 μ | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ104□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.1 μ   | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ154□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.15 μ  | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ224□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.22 μ  | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ334□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.33 μ  | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ474□L-T  |               |                   |                             | B X5R <sup>+</sup> 0.47 μ  | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 BJ105□L-T  |               |                   |                             | B X5R <sup>+</sup> 1 μ     | ±10, ±20                  | 3.5                        | 200               | 1.6±0.20         | R                         |          |   |
| HMK316ABJ225□L-TE |               |                   |                             | B X5R <sup>+</sup> 2.2 μ   | ±10, ±20                  | 3.5                        | 150               | 1.6±0.20         | R                         |          |   |
| QMK316 BJ333□L-T  |               |                   |                             | 250                        | Standard Type             | B X5R <sup>+</sup> 0.033 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 BJ473□L-T  |               |                   |                             |                            |                           | B X5R <sup>+</sup> 0.047 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 BJ683□L-T  |               |                   |                             |                            |                           | B X5R <sup>+</sup> 0.068 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 BJ104□L-T  |               |                   |                             |                            |                           | B X5R <sup>+</sup> 0.1 μ   | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| SMK316 BJ153□L-T  |               |                   |                             |                            |                           | B X5R <sup>+</sup> 0.015 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |
| SMK316 BJ223□L-T  |               |                   |                             |                            |                           | B X5R <sup>+</sup> 0.022 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |

[Temperature Characteristic BJ : B (-25~+85°C)/X5R (-55~+85°C)] 1.15mm thickness (F)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F]           | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|---------------------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                           |                           |           | Rated voltage x % |                  |                           |
| SMK316 BJ102□F-T |               | 630               | Standard Type               | B X5R <sup>+</sup> 1000 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ152□F-T |               |                   |                             | B X5R <sup>+</sup> 1500 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ222□F-T |               |                   |                             | B X5R <sup>+</sup> 2200 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ332□F-T |               |                   |                             | B X5R <sup>+</sup> 3300 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ472□F-T |               |                   |                             | B X5R <sup>+</sup> 4700 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ682□F-T |               |                   |                             | B X5R <sup>+</sup> 6800 p | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 BJ103□F-T |               |                   |                             | B X5R <sup>+</sup> 0.01 μ | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |

[Temperature Characteristic C7 : X7S (-55~+125°C)] 1.6mm thickness (L)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK316AC7225□L-TE |               | 100               | X7S                         | 2.2 μ           | ±10, ±20                  | 3.5       | 150               | 1.6±0.20         | R                         |

[Temperature Characteristic B7 : X7R (-55~+125°C)] 1.6mm thickness (L)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%]   | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |          |   |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-------------|-------------------|------------------|---------------------------|----------|---|
|                  |               |                   |                             |                 |                           |             | Rated voltage x % |                  |                           |          |   |
| HMK316 B7473□L-T |               | 100               | Standard Type               | X7R 0.047 μ     | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7683□L-T |               |                   |                             | X7R 0.068 μ     | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7104□L-T |               |                   |                             | X7R 0.1 μ       | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7154□L-T |               |                   |                             | X7R 0.15 μ      | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7224□L-T |               |                   |                             | X7R 0.22 μ      | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7334□L-T |               |                   |                             | X7R 0.33 μ      | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7474□L-T |               |                   |                             | X7R 0.47 μ      | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| HMK316 B7105□L-T |               |                   |                             | X7R 1 μ         | ±10, ±20                  | 3.5         | 200               | 1.6±0.20         | R                         |          |   |
| QMK316 B7333□L-T |               |                   |                             | 250             | Standard Type             | X7R 0.033 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 B7473□L-T |               |                   |                             |                 |                           | X7R 0.047 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 B7683□L-T |               |                   |                             |                 |                           | X7R 0.068 μ | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| QMK316 B7104□L-T |               |                   |                             |                 |                           | X7R 0.1 μ   | ±10, ±20          | 2.5              | 150                       | 1.6±0.20 | R |
| SMK316 B7153□L-T |               |                   |                             |                 |                           | X7R 0.015 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |
| SMK316 B7223□L-T |               |                   |                             |                 |                           | X7R 0.022 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |
| SMK316AB7333□L-T |               |                   |                             |                 |                           | X7R 0.033 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |
| SMK316AB7473□L-T |               |                   |                             |                 |                           | X7R 0.047 μ | ±10, ±20          | 2.5              | 120                       | 1.6±0.20 | R |

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PARTS NUMBER

**[Temperature Characteristic B7 : X7R(-55~+125°C)] 1.15mm thickness (F)**

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| SMK316 B7102□F-T |               | 630               | X7R                         |  | 1000 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7152□F-T |               |                   | X7R                         |  | 1500 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7222□F-T |               |                   | X7R                         |  | 2200 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7332□F-T |               |                   | X7R                         |  | 3300 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7472□F-T |               |                   | X7R                         |  | 4700 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7682□F-T |               |                   | X7R                         |  | 6800 p          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |
| SMK316 B7103□F-T |               |                   | X7R                         |  | 0.01 μ          | ±10, ±20                  | 2.5       | 120               | 1.15±0.10        | R                         |

**[Temperature Characteristic SD : Standard(-55~+125°C)] 1.6mm thickness (L)**

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK316 SD223KL-T |               | 100               | Standard Type               |  | 0.022 μ         | ±10                       | 0.1       | 200               | 1.6±0.20         | R                         |
| QMK316 SD103KL-T |               | 250               |                             |  | 0.01 μ          | ±10                       | 0.1       | 150               | 1.6±0.20         | R                         |

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**[Temperature Characteristic BJ : B(-25~+85°C)/X5R(-55~+85°C)] 2.5mm thickness (M)**

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |                  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |                  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 BJ225□M-P  |               | 100               | B                           | X5R <sup>+</sup> | 2.2 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK325 BJ475□M-PE |               | 100               | B                           | X5R <sup>+</sup> | 4.7 μ           | ±10, ±20                  | 3.5       | 150               | 2.5±0.20         | R                         |

**[Temperature Characteristic BJ : B(-25~+85°C)/X5R(-55~+85°C)] 1.9mm thickness (N)**

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |                  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |                  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 BJ154□N-T  |               | 100               | B                           | X5R <sup>+</sup> | 0.15 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ224□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.22 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ334□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.33 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ474□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.47 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ684□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.68 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ105□N-T  |               |                   | B                           | X5R <sup>+</sup> | 1 μ             | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 BJ475□N-TE |               |                   | B                           | X5R <sup>+</sup> | 4.7 μ           | ±10, ±20                  | 3.5       | 150               | 1.9±0.20         | R                         |
| QMK325 BJ473□N-T  |               | 250               | B                           | X5R <sup>+</sup> | 0.047 μ         | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 BJ104□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.1 μ           | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 BJ154□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.15 μ          | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 BJ224□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.22 μ          | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| SMK325 BJ223□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.022 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |
| SMK325 BJ333□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.033 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |
| SMK325 BJ473□N-T  |               |                   | B                           | X5R <sup>+</sup> | 0.047 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |

**[Temperature Characteristic BJ : B(-25~+85°C)/X5R(-55~+85°C)] 1.15mm thickness (F)**

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |                  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 BJ104□F-T |               | 100               | B                           | X5R <sup>+</sup> | 0.1 μ           | ±10, ±20                  | 3.5       | 200               | 1.15±0.10        | R                         |

**[Temperature Characteristic B7 : X7R(-55~+125°C)] 2.5mm thickness (M)**

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 B7225□M-P |               | 100               | X7R                         |  | 2.2 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |

**[Temperature Characteristic B7 : X7R(-55~+125°C)] 1.9mm thickness (N)**

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 B7154□N-T |               | 100               | X7R                         |  | 0.15 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 B7224□N-T |               |                   | X7R                         |  | 0.22 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 B7334□N-T |               |                   | X7R                         |  | 0.33 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 B7474□N-T |               |                   | X7R                         |  | 0.47 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 B7684□N-T |               |                   | X7R                         |  | 0.68 μ          | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| HMK325 B7105□N-T |               |                   | X7R                         |  | 1 μ             | ±10, ±20                  | 3.5       | 200               | 1.9±0.20         | R                         |
| QMK325 B7473□N-T |               |                   | X7R                         |  | 0.047 μ         | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 B7104□N-T |               | 250               | X7R                         |  | 0.1 μ           | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 B7154□N-T |               |                   | X7R                         |  | 0.15 μ          | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| QMK325 B7224□N-T |               |                   | X7R                         |  | 0.22 μ          | ±10, ±20                  | 2.5       | 150               | 1.9±0.20         | R                         |
| SMK325 B7223□N-T |               |                   | X7R                         |  | 0.022 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |
| SMK325 B7333□N-T |               |                   | X7R                         |  | 0.033 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |
| SMK325 B7473□N-T |               |                   | X7R                         |  | 0.047 μ         | ±10, ±20                  | 2.5       | 120               | 1.9±0.20         | R                         |

**[Temperature Characteristic C7 : X7S(-55~+125°C)] 2.5mm thickness (M)**

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 C7475□M-PE |               | 100               | X7S                         |  | 4.7 μ           | ±10, ±20                  | 3.5       | 150               | 2.5±0.20         | R                         |

**[Temperature Characteristic C7 : X7S(-55~+125°C)] 1.9mm thickness (N)**

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics |  | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|--|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |  |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 C7475□N-TE |               | 100               | X7S                         |  | 4.7 μ           | ±10, ±20                  | 3.5       | 150               | 1.9±0.20         | R                         |

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CERAMIC CAPACITORS  
MULTILAYER CERAMIC CAPACITORS

PARTS NUMBER

【Temperature Characteristic B7 : X7R(-55~+125°C)】 1.15mm thickness(F)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK325 B7104□F-T |               | 100               | X7R                         | 0.1 μ           | ±10, ±20                  | 3.5       | 200               | 1.15±0.10        | R                         |

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【Temperature Characteristic BJ : B(-25~+85°C)/X5R(-55~+85°C)】 2.5mm thickness(M)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK432 BJ474□M-T |               | 100               | B X5R <sup>+1</sup>         | 0.47 μ          | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 BJ105□M-T |               |                   | B X5R <sup>+1</sup>         | 1 μ             | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 BJ155□M-T |               |                   | B X5R <sup>+1</sup>         | 1.5 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 BJ225□M-T |               |                   | B X5R <sup>+1</sup>         | 2.2 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| QMK432 BJ104□M-T |               | 250               | B X5R <sup>+1</sup>         | 0.1 μ           | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 BJ224□M-T |               |                   | B X5R <sup>+1</sup>         | 0.22 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 BJ334□M-T |               |                   | B X5R <sup>+1</sup>         | 0.33 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 BJ474□M-T |               |                   | B X5R <sup>+1</sup>         | 0.47 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| SMK432 BJ473□M-T |               | 630               | B X5R <sup>+1</sup>         | 0.047 μ         | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |
| SMK432 BJ683□M-T |               |                   | B X5R <sup>+1</sup>         | 0.068 μ         | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |
| SMK432 BJ104□M-T |               |                   | B X5R <sup>+1</sup>         | 0.1 μ           | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |

【Temperature Characteristic B7 : X7R(-55~+125°C)】 2.5mm thickness(M)

| Part number 1    | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                  |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| HMK432 B7474□M-T |               | 100               | X7R                         | 0.47 μ          | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 B7105□M-T |               |                   | X7R                         | 1 μ             | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 B7155□M-T |               |                   | X7R                         | 1.5 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| HMK432 B7225□M-T |               |                   | X7R                         | 2.2 μ           | ±10, ±20                  | 3.5       | 200               | 2.5±0.20         | R                         |
| QMK432 B7104□M-T |               | 250               | X7R                         | 0.1 μ           | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 B7224□M-T |               |                   | X7R                         | 0.22 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 B7334□M-T |               |                   | X7R                         | 0.33 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| QMK432 B7474□M-T |               |                   | X7R                         | 0.47 μ          | ±10, ±20                  | 2.5       | 150               | 2.5±0.20         | R                         |
| SMK432 B7473□M-T |               | 630               | X7R                         | 0.047 μ         | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |
| SMK432 B7683□M-T |               |                   | X7R                         | 0.068 μ         | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |
| SMK432 B7104□M-T |               |                   | X7R                         | 0.1 μ           | ±10, ±20                  | 2.5       | 120               | 2.5±0.20         | R                         |

【Temperature Characteristic B7 : X7R(-55~+125°C)】 2.0mm thickness(Y)

| Part number 1     | Part number 2 | Rated voltage [V] | Temperature characteristics | Capacitance [F] | Capacitance tolerance [%] | tan δ [%] | HTLT              | Thickness*3 [mm] | Soldering R:Reflow W:Wave |
|-------------------|---------------|-------------------|-----------------------------|-----------------|---------------------------|-----------|-------------------|------------------|---------------------------|
|                   |               |                   |                             |                 |                           |           | Rated voltage x % |                  |                           |
| XMK432 B7222KY-TE |               | 2000              | X7R                         | 2200 p          | ±10                       | 2.5       | 110               | 2.0+0/-0.30      | R                         |
| XMK432 B7472KY-TE |               | 2000              | X7R                         | 4700 p          | ±10                       | 2.5       | 110               | 2.0+0/-0.30      | R                         |

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# Multilayer Ceramic Capacitors

## PACKAGING

### ① Minimum Quantity

#### ● Taped package

| Type(EIA)  | Thickness |      | Standard quantity [pcs] |                 |
|--|-----------|------|-------------------------|-----------------|
|  | mm        | code | Paper tape              | Embossed tape   |
| <input type="checkbox"/> MK021(008004)                                       | 0.125     | K    | —                       | 50000           |
| <input type="checkbox"/> VS021(008004)                                       |           |      |                         |                 |
| <input type="checkbox"/> MK042(01005)  | 0.2       | C, D | —                       | 40000           |
| <input type="checkbox"/> VS042(01005)  |           |      |                         |                 |
| <input type="checkbox"/> MK063(0201)   | 0.3       | P, T | 15000                   | —               |
| <input type="checkbox"/> WK105(0204) ※                                       | 0.3       | P    | 10000                   | —               |
| <input type="checkbox"/> MK105(0402)<br><input type="checkbox"/> MF105(0402) | 0.13      | H    | —                       | 20000           |
|  | 0.18      | E    | —                       | 15000           |
|  | 0.2       | C    | 20000                   | —               |
|  | 0.3       | P    | 15000                   | —               |
|  | 0.5       | V    | 10000                   | —               |
| <input type="checkbox"/> VK105(0402)   | 0.5       | W    | 10000                   | —               |
| <input type="checkbox"/> MK107(0603)   | 0.45      | K    | 4000                    | —               |
| <input type="checkbox"/> WK107(0306) ※                                       | 0.5       | V    | —                       | 4000            |
| <input type="checkbox"/> MF107(0603)   | 0.8       | A    | 4000                    | —               |
| <input type="checkbox"/> VS107(0603)   | 0.7       | C    | 4000                    | —               |
| <input type="checkbox"/> MJ107(0603)   | 0.8       | A    | 3000                    | 3000            |
| <input type="checkbox"/> MK212(0805)   | 0.45      | K    | 4000                    | —               |
| <input type="checkbox"/> WK212(0508) ※                                       | 0.85      | D    |                         |                 |
| <input type="checkbox"/> MF212(0805)   | 1.25      | G    | —                       | 3000            |
| <input type="checkbox"/> VS212(0805)   | 0.85      | D    | 4000                    | —               |
| <input type="checkbox"/> MJ212(0805)   | 0.85      | D    | 4000                    | —               |
|  | 1.25      | G    | —                       | 2000            |
| <input type="checkbox"/> MK316(1206)<br><input type="checkbox"/> MF316(1206) | 0.85      | D    | 4000                    | —               |
|  | 1.15      | F    | —                       | 3000            |
|  | 1.6       | L    | —                       | 2000            |
| <input type="checkbox"/> MJ316(1206)   | 1.15      | F    | —                       | 3000            |
|  | 1.6       | L    | —                       | 2000            |
| <input type="checkbox"/> MK325(1210)<br><input type="checkbox"/> MF325(1210) | 0.85      | D    | —                       | 2000            |
|  | 1.15      | F    |                         |                 |
|  | 1.9       | N    |                         |                 |
|  | 2.0max.   | Y    |                         |                 |
| <input type="checkbox"/> MJ325(1210)   | 2.5       | M    | —                       | 1000            |
|  | 1.9       | N    | —                       | 2000            |
|  | 2.5       | M    | —                       | 500(T), 1000(P) |
| <input type="checkbox"/> MK432(1812)   | 2.5       | M    | —                       | 500             |

Note : ※ LW Reverse type.

### ② Taping material

※No bottom tape for pressed carrier tape

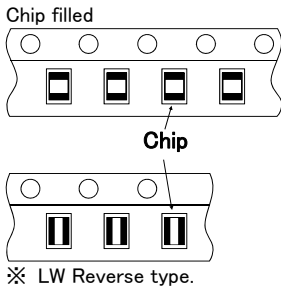
#### ● Card board carrier tape



#### ● Embossed tape



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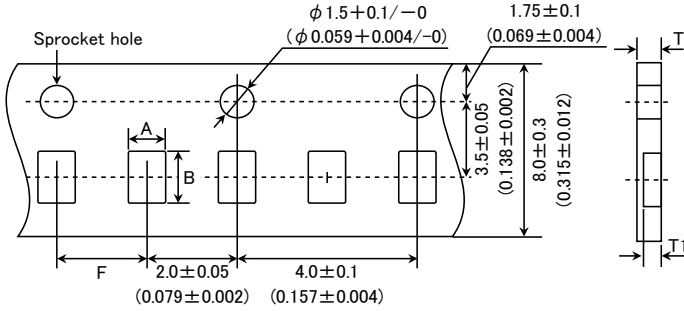


### ③ Representative taping dimensions

● Paper Tape (8mm wide)

● Pressed carrier tape ( 2mm pitch)

Unit: mm (inch)



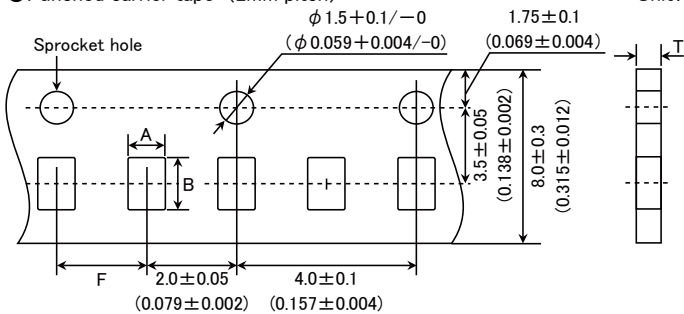
| Type(EIA)           | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |          |
|---------------------|-------------|------|----------------------|----------------|----------|
|                     | A           | B    |                      | T              | T1       |
| □MK063(0201)        | 0.37        | 0.67 | 2.0±0.05             | 0.45max.       | 0.42max. |
| □WK105(0204) ※      | 0.65        | 1.15 |                      | 0.4max.        | 0.3max.  |
| □MK105(0402) (*1 C) |             |      |                      | 0.45max.       | 0.42max. |
| □MK105(0402) (*1 P) |             |      |                      |                |          |

Note \*1 Thickness, C: 0.2mm ,P: 0.3mm. ※ LW Reverse type.

Unit: mm

● Punched carrier tape (2mm pitch)

Unit: mm (inch)

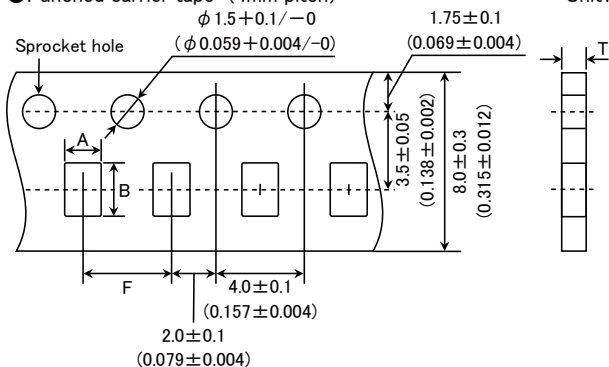


| Type(EIA)     | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |
|---------------|-------------|------|----------------------|----------------|
|               | A           | B    |                      | T              |
| □MK105 (0402) | 0.65        | 1.15 | 2.0±0.05             | 0.8max.        |
| □MF105 (0402) |             |      |                      |                |
| □VK105 (0402) |             |      |                      |                |

Unit: mm

● Punched carrier tape (4mm pitch)

Unit: mm (inch)



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| Type(EIA)                                      | Chip Cavity |     | Insertion Pitch | Tape Thickness |
|--|-------------|-----|-----------------|----------------|
|  | A           | B   | F               | T              |
| □MK107(0603)<br>□WK107(0306) ※<br>□MF107(0603) | 1.0         | 1.8 | 4.0±0.1         | 1.1max.        |
| □MK212(0805)<br>□WK212(0508) ※<br>□MK316(1206) | 1.65        | 2.4 |                 | 1.1max.        |
|  | 2.0         | 3.6 |                 |                |

Note: Taping size might be different depending on the size of the product. ※ LW Reverse type.

Unit: mm



| Type(EIA)                        | Chip Cavity |      | Insertion Pitch | Tape Thickness |          |
|----------------------------------|-------------|------|-----------------|----------------|----------|
|                                  | A           | B    |                 | K              | T        |
| □MK021(008004)<br>□VS021(008004) | 0.135       | 0.27 | 1.0±0.02        | 0.5max.        | 0.25max. |
| □MK042(01005)<br>□VS042(01005)   |             |      |                 |                |          |

Unit: mm



| Type(EIA)                                      | Chip Cavity |     | Insertion Pitch | Tape Thickness |          |
|--|-------------|-----|-----------------|----------------|----------|
|  | A           | B   |                 | K              | T        |
| □MK105(0402)                                   | 0.6         | 1.1 | 2.0±0.1         | 0.6max.        | 0.2±0.1  |
| □WK107(0306) ※<br>□MK212(0805)<br>□MF212(0805) | 1.0         | 1.8 | 4.0±0.1         | 1.3max.        | 0.25±0.1 |
| □MK316(1206)<br>□MF316(1206)                   | 2.0         | 3.6 |                 | 3.4max.        | 0.6max.  |
| □MK325(1210)<br>□MF325(1210)                   | 2.8         | 3.6 |                 |                |          |

Note: ※ LW Reverse type.

Unit: mm



## Medium-High Voltage Multilayer Ceramic Capacitor

### RELIABILITY DATA

| 1. Operating Temperature Range             |  |  |
|--|--|--|
| Specified Value                            | Temperature Compensating(Class1)   | CG : -55 to +125°C   |
|  | High Permittivity (Class2)   | X7R, X7S : -55 to +125°C<br>X5R : -55 to +85°C<br>B : -25 to +85°C<br>SD : -55 to +125°C       |
| 2. Storage Temperature Range               |  |  |
| Specified Value                            | Temperature Compensating(Class1)   | CG : -55 to +125°C   |
|  | High Permittivity (Class2)   | X7R, X7S : -55 to +125°C<br>X5R : -55 to +85°C<br>B : -25 to +85°C<br>SD : -55 to +125°C       |
| 3. Rated Voltage                           |  |  |
| Specified Value                            | Temperature Compensating(Class1)   | 100VDC(HMK)  |
|  | High Permittivity (Class2)   | 100VDC(HMK), 250VDC(QMK), 630VDC(SMK), 2000VDC(XMK)  |
| 4. Withstanding Voltage(Between terminals) |  |  |
| Specified Value                            | No breakdown or damage   |  |
| Test Methods and Remarks                   | Applied voltage : Rated voltage × 2.5(HMK), Rated voltage × 2(QMK), Rated voltage × 1.2(SMK)(XMK)<br>Duration : 1 to 5sec.<br>Charge/discharge current : 50mA max. |  |
| 5. Insulation Resistance                   |  |  |
| Specified Value                            | Temperature Compensating(Class1)   | 10000 MΩ min.  |
|  | High Permittivity (Class2)   | 100MΩ · μF or 10GΩ, whichever is smaller.  |
| Test Methods and Remarks                   | Applied voltage : Rated voltage(HMK, QMK), 500V(SMK,XMK)<br>Duration : 60±5sec.<br>Charge/discharge current : 50mA max.  |  |
| 6. Capacitance (Tolerance)                 |  |  |
| Specified Value                            | Temperature Compensating(Class1)   | 0.2pF ≤ C ≤ 5pF : ±0.25pF<br>0.2pF ≤ C ≤ 10pF : ±0.5pF<br>C > 10pF : ±5% or ±10%               |
|  | High Permittivity (Class2)   | ±10%, ±20%   |
| Test Methods and Remarks                   | Temperature Compensating(Class1)   | Measuring frequency : 1MHz ± 10%<br>Measuring voltage : 0.5~5Vrms<br>Bias application : None   |
|  | High Permittivity (Class2)   | Measuring frequency : 1kHz ± 10%<br>Measuring voltage : 1 ± 0.2Vrms<br>Bias application : None |
| 7. Q or Dissipation Factor                 |  |  |
| Specified Value                            | Temperature Compensating(Class1)   | C < 30pF : Q ≥ 400 + 20C<br>C ≥ 30pF : Q ≥ 1000 (C: Nominal capacitance)                       |
|  | High Permittivity (Class2)   | 3.5%max(HMK), 2.5%max(QMK, SMK)  |
| Test Methods and Remarks                   | Temperature Compensating(Class1)   | Measuring frequency : 1MHz ± 10%<br>Measuring voltage : 0.5~5Vrms<br>Bias application : None   |
|  | High Permittivity (Class2)   | Measuring frequency : 1kHz ± 10%<br>Measuring voltage : 1 ± 0.2Vrms<br>Bias application : None |

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| 8. Temperature Characteristic of Capacitance |  |   |      |   |                    |   |                               |  |   |                    |                    |   |                               |
|--|--|---|------|---|--------------------|---|-------------------------------|--|---|--------------------|--------------------|---|-------------------------------|
| Specified Value                              | Temperature Compensating(Class1)   | CG : $0 \pm 30 \text{ ppm}/^\circ\text{C} (-55 \text{ to } +125^\circ\text{C})$   |      |   |                    |   |                               |  |   |                    |                    |   |                               |
|  | High Permittivity (Class2)   | B : $\pm 10\% (-25 \text{ to } +85^\circ\text{C})$<br>X5R : $\pm 15\% (-55 \text{ to } +85^\circ\text{C})$<br>X7R : $\pm 15\% (-55 \text{ to } +125^\circ\text{C})$<br>X7S : $\pm 22\% (-55 \text{ to } +125^\circ\text{C})$<br>SD : - ( $-55 \text{ to } +125^\circ\text{C}$ ) |      |   |                    |   |                               |  |   |                    |                    |   |                               |
| Test Methods and Remarks                     | Class 1<br>Capacitance at $20^\circ\text{C}$ and $85^\circ\text{C}$ shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.<br>$\frac{(C_{85} - C_{20})}{C_{20} \times \Delta T} \times 10^6 (\text{ppm}/^\circ\text{C}) \quad \Delta T = 65$  |   |      |   |                    |   |                               |  |   |                    |                    |   |                               |
|  | Class 2<br>Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Step</th> <th>B</th> <th>X5R, X7R, X6S, X7S</th> </tr> </thead> <tbody> <tr> <td>1</td> <td colspan="2">Minimum operating temperature</td> </tr> <tr> <td>2</td> <td><math>20^\circ\text{C}</math></td> <td><math>25^\circ\text{C}</math></td> </tr> <tr> <td>3</td> <td colspan="2">Maximum operating temperature</td> </tr> </tbody> </table> $\frac{(C - C_2)}{C_2} \times 100 (\%)$ <p>C : Capacitance value in Step 1 or Step 3<br/>C2 : Capacitance value in Step 2</p> |   | Step | B | X5R, X7R, X6S, X7S | 1 | Minimum operating temperature |  | 2 | $20^\circ\text{C}$ | $25^\circ\text{C}$ | 3 | Maximum operating temperature |
| Step   | B  | X5R, X7R, X6S, X7S  |      |   |                    |   |                               |  |   |                    |                    |   |                               |
| 1  | Minimum operating temperature  |   |      |   |                    |   |                               |  |   |                    |                    |   |                               |
| 2  | $20^\circ\text{C}$   | $25^\circ\text{C}$  |      |   |                    |   |                               |  |   |                    |                    |   |                               |
| 3  | Maximum operating temperature  |   |      |   |                    |   |                               |  |   |                    |                    |   |                               |

| 9. Deflection            |  |   |
|--------------------------|--|---|
| Specified Value          | Temperature Compensating(Class1)   | Appearance : No abnormality<br>Capacitance change : Within $\pm 5\%$ or $\pm 0.5 \text{ pF}$ , whichever is larger. |
|                          | High Permittivity (Class2)   | Appearance : No abnormality<br>Capacitance change : Within $\pm 10\%$   |
| Test Methods and Remarks | Warp : 1mm<br>Duration : 10sec.<br>Test board : Glass epoxy-resin substrate<br>Thickness : 1.6mm |                                 |
|                          | Capacitance measurement shall be conducted with the board bent.                                  |   |

| 10. Adhesive Strength of Terminal Electrodes |  |   |
|--|--|---|
| Specified Value                              | Temperature Compensating(Class1)                         | No terminal separation or its indication. |
|  | High Permittivity (Class2)                               |   |
| Test Methods and Remarks                     | Applied force : 5N<br>Duration : $30 \pm 5 \text{ sec.}$ |   |

| 11. Solderability        |                                  |   |                           |
|--------------------------|----------------------------------|---|---------------------------|
| Specified Value          | Temperature Compensating(Class1) | At least 95% of terminal electrode is covered by new solder |                           |
|                          | High Permittivity (Class2)       |   |                           |
| Test Methods and Remarks |                                  | Eutectic solder   | Lead-free solder          |
|                          | Solder type                      | H60A or H63A  | Sn-3.0Ag-0.5Cu            |
|                          | Solder temperature               | $230 \pm 5^\circ\text{C}$                                   | $245 \pm 3^\circ\text{C}$ |
|                          | Duration                         | $4 \pm 1 \text{ sec.}$                                      |                           |

| 12. Resistance to Soldering |                                  |  |
|-----------------------------|----------------------------------|--|
| Specified Value             | Temperature Compensating(Class1) | Appearance : No abnormality<br>Capacitance change : Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is larger.(HMK)<br>Q : Initial value<br>Insulation resistance : Initial value<br>Withstanding voltage (between terminals) : No abnormality |
|                             | High Permittivity (Class2)       | Appearance : No abnormality<br>Capacitance change : Within $\pm 15\%$ (HMK), $\pm 10\%$ (QMK, SMK, XMK)<br>Dissipation facto : Initial value<br>Insulation resistance : Initial value<br>Withstanding voltage (between terminals) : No abnormality   |
| Test Methods and Remarks    | Temperature Compensating(Class1) |  |
|                             | Preconditioning                  | None   |
|                             | Solder temperature               | $270 \pm 5^\circ\text{C}$  |
|                             | Duration                         | $3 \pm 0.5\text{sec.}$   |
|                             | Preheating conditions            | 80 to $100^\circ\text{C}$ , 2 to 5 min.<br>150 to $200^\circ\text{C}$ , 2 to 5min.   |
|                             | Recovery                         | $24 \pm 2\text{hrs}$ under the standard condition Note3  |
|                             | High Permittivity (Class2)       |  |
|                             | Preconditioning                  | Thermal treatment(at $150^\circ\text{C}$ for 1hr) Note1  |
|                             | Solder temperature               | $270 \pm 5^\circ\text{C}$  |
|                             | Duration                         | $3 \pm 0.5\text{sec.}$   |
|                             | Preheating conditions            | 80 to $100^\circ\text{C}$ , 2 to 5 min.<br>150 to $200^\circ\text{C}$ , 2 to 5min.   |
|                             | Recovery                         | $24 \pm 2\text{hrs}$ under the standard condition Note3  |

| 13. Temperature Cycle (Thermal Shock) |   |  |                                  |
|---------------------------------------|---|--|----------------------------------|
| Specified Value                       | Temperature Compensating(Class1)        | Appearance : No abnormality<br>Capacitance change : Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is larger.(HMK)<br>Q : Initial value<br>Insulation resistance : Initial value<br>Withstanding voltage (between terminals) : No abnormality |                                  |
|                                       | High Permittivity (Class2)              | Appearance : No abnormality<br>Capacitance change : Within $\pm 15\%$ (HMK), $\pm 10\%$ (QMK, SMK, XMK)<br>Dissipation facto : Initial value<br>Insulation resistance : Initial value<br>Withstanding voltage (between terminals) : No abnormality   |                                  |
| Test Methods and Remarks              | Class 1                                 |  |                                  |
|                                       | Preconditioning                         | None   |                                  |
|                                       | 1 cycle                                 | Step   | Temperature ( $^\circ\text{C}$ ) |
|                                       |   | 1  | Minimum operating temperature    |
|                                       |   | 2  | Normal temperature               |
|                                       |   | 3  | Maximum operating temperature    |
|                                       | 4                                       | Normal temperature   |                                  |
| Number of cycles                      | 5 times                                 |  |                                  |
| Recovery                              | 6 to 24 hrs (Standard condition) Note 3 | $24 \pm 2$ hrs (Standard condition) Note 3   |                                  |

| 14. Humidity (Steady state) |  |   |
|-----------------------------|--|---|
| Specified Value             | Temperature Compensating(Class1)                           | Appearance : No abnormality<br>Capacitance change : Within $\pm 5\%$ or $\pm 0.5\text{pF}$ , whichever is larger.(HMK)<br>Q : $C < 10\text{pF}$ : $Q \geq 200 + 10C$<br>$10 \leq C < 30\text{pF}$ : $Q \geq 275 + 2.5C$<br>$C \geq 30\text{pF}$ : $Q \geq 350(C : \text{Nominal capacitance})$<br>Insulation resistance : $1000\text{M}\Omega$ min. |
|                             | High Permittivity (Class2)                                 | Appearance : No abnormality<br>Capacitance change : Within $\pm 15\%$<br>Dissipation factor : $7\%\text{max}$ (HMK), $5\%\text{max}$ (QMK, SMK, XMK).<br>Insulation resistance : $25\text{M}\Omega$ $\mu\text{F}$ or $1000\text{M}\Omega$ , whichever is smaller.   |
| Test Methods and Remarks    | Class 1  |   |
|                             | Preconditioning  | None  |
|                             | Temperature  | $40 \pm 2^\circ\text{C}$  |
|                             | Humidity   | 90 to 95%RH   |
|                             | Duration   | $500 + 24 / - 0$ hrs  |
|                             | Recovery   | 6 to 24 hrs (Standard condition) Note 3   |
| Class 2                     |  |   |
| Preconditioning             | Thermal treatment( at $150^\circ\text{C}$ for 1 hr) Note 1 |   |
| Temperature                 | $40 \pm 2^\circ\text{C}$                                   |   |
| Humidity                    | 90 to 95%RH  |   |
| Duration                    | $500 + 24 / - 0$ hrs                                       |   |
| Recovery                    | $24 \pm 2$ hrs (Standard condition) Note 3                 |   |

► This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification.  
For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>).

| 15. Humidity Loading     |                                  |   |  |
|--------------------------|----------------------------------|---|--|
| Specified Value          | Temperature Compensating(Class1) | Appearance                              | : No abnormality   |
|                          |                                  | Capacitance change                      | : Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$ , whichever is larger (HMK).                               |
|                          |                                  | Q                                       | : $C < 30\text{pF} : Q \geq 100 + 10C/3$<br>$C \geq 30\text{pF} : Q \geq 200$ (C: Nominal capacitance) |
|                          |                                  | Insulation resistance                   | : $500 \text{ M}\Omega$ min.   |
|                          | High Permittivity (Class2)       | Appearance                              | : No abnormality   |
|                          |                                  | Capacitance change                      | : Within $\pm 15\%$  |
|                          |                                  | Dissipation factor                      | : $7\% \text{max}$ (HMK), $5\% \text{max}$ (QMK, SMK, XMK).  |
|                          |                                  | Insulation resistance                   | : $10 \text{ M}\Omega \mu\text{F}$ or $500 \text{ M}\Omega$ , whichever is smaller.                    |
| Test Methods and Remarks | According to JIS 5101-1.         |   |  |
|                          |                                  | Class 1                                 | Class 2  |
|                          | Preconditioning                  | None                                    | Voltage treatment<br>(Rated voltage are applied for 1 hour at $40^\circ\text{C}$ ) Note 2              |
|                          | Temperature                      | $40 \pm 2^\circ\text{C}$                | $40 \pm 2^\circ\text{C}$   |
|                          | Humidity                         | 90 to 95%RH                             | 90 to 95%RH  |
|                          | Duration                         | $500 + 24 / - 0$ hrs                    | $500 + 24 / - 0$ hrs   |
|                          | Applied voltage                  | Rated voltage                           | Rated voltage  |
|                          | Charge/discharge current         | 50mA max.                               | 50mA max.  |
|                          | Recovery                         | 6 to 24 hrs (Standard condition) Note 3 | $24 \pm 2$ hrs (Standard condition) Note 3   |

| 16. High Temperature Loading |                                  |                                       |   |
|------------------------------|----------------------------------|---------------------------------------|---|
| Specified Value              | Temperature Compensating(Class1) | Appearance                            | : No abnormality  |
|                              |                                  | Capacitance change                    | : Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$ , whichever is larger.(HMK)                                   |
|                              |                                  | Q                                     | : $C < 30\text{pF} : Q \geq 100 + 10C/3$<br>$C \geq 30\text{pF} : Q \geq 200$ (C: Nominal capacitance)    |
|                              |                                  | Insulation resistance                 | : $500 \text{ M}\Omega$ min.  |
|                              | High Permittivity (Class2)       | Appearance                            | : No abnormality  |
|                              |                                  | Capacitance change                    | : Within $\pm 15\%$   |
|                              |                                  | Dissipation factor                    | : $7\% \text{max}$ (HMK), $5\% \text{max}$ (QMK, SMK, XMK).   |
|                              |                                  | Insulation resistance                 | : $50 \text{ M}\Omega \mu\text{F}$ or $1000 \text{ M}\Omega$ , whichever is smaller.                      |
| Test Methods and Remarks     | According to JIS 5101-1.         |                                       |   |
|                              |                                  | Class 1                               | Class 2   |
|                              | Preconditioning                  | None                                  | Voltage treatment Note 2  |
|                              | Temperature                      | Maximum operating temperature         | Maximum operating temperature   |
|                              | Duration                         | $1000 + 48 / - 0$ hrs                 | $1000 + 48 / - 0$ hrs   |
|                              | Applied voltage                  | Rated voltage $\times 2$ (HMK)        | Rated voltage $\times 2$ (HMK), Rated voltage $\times 1.5$ (QMK),<br>Rated voltage $\times 1.2$ (SMK,XMK) |
|                              | Charge/discharge current         | 50mA max.                             | 50mA max.   |
|                              | Recovery                         | 6 to 24hr (Standard condition) Note 3 | $24 \pm 2$ hrs (Standard condition) Note 3  |

Note1 Thermal treatment : Initial value shall be measured after test sample is heat-treated at  $150 \pm 0 / - 10^\circ\text{C}$  for an hour and kept at room temperature for  $24 \pm 2$  hours.

Note2 Voltage treatment : Initial value shall be measured after test sample is voltage-treated for an hour at both the temperature and voltage specified in the test conditions, and kept at room temperature for  $24 \pm 2$  hours.

Note3 Standard condition : Temperature: 5 to  $35^\circ\text{C}$ , Relative humidity: 45 to 85 % RH, Air pressure: 86 to 106kPa

When there are questions concerning measurement results, in order to provide correlation data, the test shall be conducted under the following condition.

Temperature:  $20 \pm 2^\circ\text{C}$ , Relative humidity: 60 to 70 % RH, Air pressure: 86 to 106kPa

Unless otherwise specified, all the tests are conducted under the "standard condition".

# Precautions on the use of Multilayer Ceramic Capacitors

## PRECAUTIONS

### 1. Circuit Design

- Precautions**
- ◆ Verification of operating environment, electrical rating and performance
    1. A malfunction of equipment in fields such as medical, aerospace, nuclear control, etc. may cause serious harm to human life or have severe social ramifications. Therefore, any capacitors to be used in such equipment may require higher safety and reliability, and shall be clearly differentiated from them used in general purpose applications.
  - ◆ Operating Voltage (Verification of Rated voltage)
    1. The operating voltage for capacitors must always be their rated voltage or less. If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages shall be the rated voltage or less. For a circuit where an AC or a pulse voltage may be used, the sum of their peak voltages shall also be the rated voltage or less.
    2. Even if an applied voltage is the rated voltage or less reliability of capacitors may be deteriorated in case that either a high frequency AC voltage or a pulse voltage having rapid rise time is used in a circuit.

### 2. PCB Design

- Precautions**
- ◆ Pattern configurations (Design of Land-patterns)
    1. When capacitors are mounted on PCBs, the amount of solder used (size of fillet) can directly affect the capacitor performance. Therefore, the following items must be carefully considered in the design of land patterns:
      - (1) Excessive solder applied can cause mechanical stresses which lead to chip breaking or cracking. Therefore, please consider appropriate land-patterns for proper amount of solder.
      - (2) When more than one component are jointly soldered onto the same land, each component's soldering point shall be separated by solder-resist.
  - ◆ Pattern configurations (Capacitor layout on PCBs)
 After capacitors are mounted on boards, they can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering of the boards, etc.). For this reason, land pattern configurations and positions of capacitors shall be carefully considered to minimize stresses.

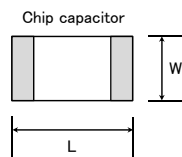
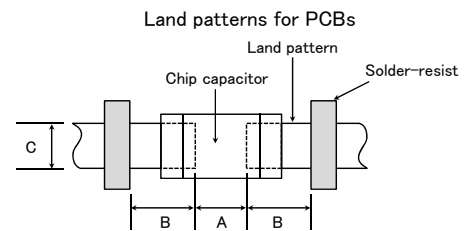
◆ Pattern configurations (Design of Land-patterns)  
The following diagrams and tables show some examples of recommended land patterns to prevent excessive solder amounts.

(1) Recommended land dimensions for typical chip capacitors

● Multilayer Ceramic Capacitors : Recommended land dimensions (unit: mm)

Wave-soldering

| Type | 107        | 212        | 316        | 325        |     |
|------|------------|------------|------------|------------|-----|
| Size | L          | 1.6        | 2.0        | 3.2        | 3.2 |
|      | W          | 0.8        | 1.25       | 1.6        | 2.5 |
| A    | 0.8 to 1.0 | 1.0 to 1.4 | 1.8 to 2.5 | 1.8 to 2.5 |     |
| B    | 0.5 to 0.8 | 0.8 to 1.5 | 0.8 to 1.7 | 0.8 to 1.7 |     |
| C    | 0.6 to 0.8 | 0.9 to 1.2 | 1.2 to 1.6 | 1.8 to 2.5 |     |



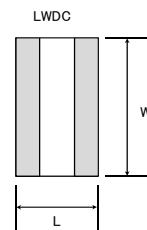
Reflow-soldering

| Type | 021         | 042       | 063       | 105       | 107     | 212     | 316     | 325     | 432     |     |
|------|-------------|-----------|-----------|-----------|---------|---------|---------|---------|---------|-----|
| Size | L           | 0.25      | 0.4       | 0.6       | 1.0     | 1.6     | 2.0     | 3.2     | 3.2     | 4.5 |
|      | W           | 0.125     | 0.2       | 0.3       | 0.5     | 0.8     | 1.25    | 1.6     | 2.5     | 3.2 |
| A    | 0.095~0.135 | 0.15~0.25 | 0.20~0.30 | 0.45~0.55 | 0.6~0.8 | 0.8~1.2 | 1.8~2.5 | 1.8~2.5 | 2.5~3.5 |     |
| B    | 0.085~0.125 | 0.10~0.20 | 0.20~0.30 | 0.40~0.50 | 0.6~0.8 | 0.8~1.2 | 1.0~1.5 | 1.0~1.5 | 1.5~1.8 |     |
| C    | 0.110~0.150 | 0.15~0.30 | 0.25~0.40 | 0.45~0.55 | 0.6~0.8 | 0.9~1.6 | 1.2~2.0 | 1.8~3.2 | 2.3~3.5 |     |

Note: Recommended land size might be different according to the allowance of the size of the product.

● LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

| Type | 105       | 107      | 212     |      |
|------|-----------|----------|---------|------|
| Size | L         | 0.52     | 0.8     | 1.25 |
|      | W         | 1.0      | 1.6     | 2.0  |
| A    | 0.18~0.22 | 0.25~0.3 | 0.5~0.7 |      |
| B    | 0.2~0.25  | 0.3~0.4  | 0.4~0.5 |      |
| C    | 0.9~1.1   | 1.5~1.7  | 1.9~2.1 |      |



Technical considerations

(2) Examples of good and bad solder application

| Item  | Not recommended   | Recommended   |
|---|---|---|
| Mixed mounting of SMD and leaded components                 |  |  |
| Component placement close to the chassis                    |  |  |
| Hand-soldering of leaded components near mounted components |  |  |
| Horizontal component placement                              |  |  |

◆ Pattern configurations (Capacitor layout on PCBs)

1-1. The following is examples of good and bad capacitor layouts ; capacitors shall be located to minimize any possible mechanical stresses from board warp or deflection.

| Items               | Not recommended  | Recommended   |
|---------------------|--|---|
| Deflection of board |  |  Place the product at a right angle to the direction of the anticipated mechanical stress. |

1-2. The amount of mechanical stresses given will vary depending on capacitor layout. Please refer to diagram below.



1-3. When PCB is split, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, please consider the PCB, split methods as well as chip location.

3. Mounting

Precautions

◆ Adjustment of mounting machine

- When capacitors are mounted on PCB, excessive impact load shall not be imposed on them.
- Maintenance and inspection of mounting machines shall be conducted periodically.

◆ Selection of Adhesives

- When chips are attached on PCBs with adhesives prior to soldering, it may cause capacitor characteristics degradation unless the following factors are appropriately checked : size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, please contact us for further information.

◆Adjustment of mounting machine

1. When the bottom dead center of a pick-up nozzle is too low, excessive force is imposed on capacitors and causes damages. To avoid this, the following points shall be considerable.
  - (1) The bottom dead center of the pick-up nozzle shall be adjusted to the surface level of PCB without the board deflection.
  - (2) The pressure of nozzle shall be adjusted between 1 and 3 N static loads.
  - (3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins shall be used on the other side of the PCB. The following diagrams show some typical examples of good and bad pick-up nozzle placement:

| Item                  | Improper method   | Proper method   |
|-----------------------|---|---|
| Single-sided mounting |  |  |
| Double-sided mounting |  |  |

Technical considerations

2. As the alignment pin is worn out, adjustment of the nozzle height can cause chipping or cracking of capacitors because of mechanical impact on the capacitors. To avoid this, the monitoring of the width between the alignment pins in the stopped position, maintenance, check and replacement of the pin shall be conducted periodically.

◆Selection of Adhesives

Some adhesives may cause IR deterioration. The different shrinkage percentage of between the adhesive and the capacitors may result in stresses on the capacitors and lead to cracking. Moreover, too little or too much adhesive applied to the board may adversely affect components. Therefore, the following precautions shall be noted in the application of adhesives.

- (1) Required adhesive characteristics
  - a. The adhesive shall be strong enough to hold parts on the board during the mounting & solder process.
  - b. The adhesive shall have sufficient strength at high temperatures.
  - c. The adhesive shall have good coating and thickness consistency.
  - d. The adhesive shall be used during its prescribed shelf life.
  - e. The adhesive shall harden rapidly.
  - f. The adhesive shall have corrosion resistance.
  - g. The adhesive shall have excellent insulation characteristics.
  - h. The adhesive shall have no emission of toxic gasses and no effect on the human body.
- (2) The recommended amount of adhesives is as follows;

[Recommended condition]

| Figure | 212/316 case sizes as examples   |
|--------|----------------------------------|
| a      | 0.3mm min                        |
| b      | 100 to 120 μm                    |
| c      | Adhesives shall not contact land |



4. Soldering

◆Selection of Flux

- Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use;
- (1) Flux used shall be less than or equal to 0.1 wt% ( in Cl equivalent) of halogenated content. Flux having a strong acidity content shall not be applied.
  - (2) When shall capacitors are soldered on boards, the amount of flux applied shall be controlled at the optimum level.
  - (3) When water-soluble flux is used, special care shall be taken to properly clean the boards.

Precautions

◆Soldering

Temperature, time, amount of solder, etc. shall be set in accordance with their recommended conditions.  
Sn-Zn solder paste can adversely affect MLOC reliability.  
Please contact us prior to usage of Sn-Zn solder.

Technical considerations

◆Selection of Flux

- 1-1. When too much halogenated substance (Chlorine, etc.) content is used to activate flux, or highly acidic flux is used, it may lead to corrosion of terminal electrodes or degradation of insulation resistance on the surfaces of the capacitors.
- 1-2. Flux is used to increase solderability in wave soldering. However if too much flux is applied, a large amount of flux gas may be emitted and may adversely affect the solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system.
- 1-3. Since the residue of water-soluble flux is easily dissolved in moisture in the air, the residues on the surfaces of capacitors in high humidity conditions may cause a degradation of insulation resistance and reliability of the capacitors. Therefore, the cleaning methods and the capability of the machines used shall also be considered carefully when water-soluble flux is used.

▶ This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>).

◆ Soldering

- Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling.
- Therefore, the soldering must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.
- Preheating : Capacitors shall be preheated sufficiently, and the temperature difference between the capacitors and solder shall be within 130°C.
- Cooling : The temperature difference between the capacitors and cleaning process shall not be greater than 100°C.

[Reflow soldering]

【Recommended conditions for eutectic soldering】



【Recommended condition for Pb-free soldering】



Caution

- ① The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of a capacitor.
- ② Because excessive dwell times can adversely affect solderability, soldering duration shall be kept as close to recommended times as possible. soldering for 2 times.



[Wave soldering]

【Recommended conditions for eutectic soldering】



【Recommended condition for Pb-free soldering】



Caution

- ① Wave soldering must not be applied to capacitors designated as for reflow soldering only. soldering for 1 times.

[Hand soldering]

【Recommended conditions for eutectic soldering】



【Recommended condition for Pb-free soldering】



|                 |                                     |
|-----------------|-------------------------------------|
| 316type or less | $\Delta T \leq 150^{\circ}\text{C}$ |
|-----------------|-------------------------------------|



|                 |                                     |
|-----------------|-------------------------------------|
| 325type or more | $\Delta T \leq 130^{\circ}\text{C}$ |
|-----------------|-------------------------------------|

Caution

- ① Use a 50W soldering iron with a maximum tip diameter of 1.0 mm.
- ② The soldering iron shall not directly touch capacitors. soldering for 1 times.

| 5. Cleaning              |   |
|--------------------------|---|
| Precautions              | <p>◆Cleaning conditions</p> <ol style="list-style-type: none"> <li>When PCBs are cleaned after capacitors mounting, please select the appropriate cleaning solution in accordance with the intended use of the cleaning. (e.g. to remove soldering flux or other materials from the production process.)</li> <li>Cleaning condition shall be determined after it is verified by using actual cleaning machine that the cleaning process does not affect capacitor's characteristics.</li> </ol>  |
| Technical considerations | <ol style="list-style-type: none"> <li>The use of inappropriate cleaning solutions can cause foreign substances such as flux residue to adhere to capacitors or deteriorate their outer coating, resulting in a degradation of the capacitor's electrical properties (especially insulation resistance).</li> <li>Inappropriate cleaning conditions (insufficient or excessive cleaning) may adversely affect the performance of the capacitors. In the case of ultrasonic cleaning, too much power output can cause excessive vibration of PCBs which may lead to the cracking of capacitors or the soldered portion, or decrease the terminal electrodes' strength. Therefore, the following conditions shall be carefully checked;<br/>           Ultrasonic output : 20 W/l or less                      Ultrasonic frequency : 40 kHz or less<br/>           Ultrasonic washing period : 5 min. or less</li> </ol> |

| 6. Resin coating and mold |  |
|---------------------------|--|
| Precautions               | <ol style="list-style-type: none"> <li>With some type of resins, decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the capacitor's performance.</li> <li>When a resin's hardening temperature is higher than capacitor's operating temperature, the stresses generated by the excessive heat may lead to damage or destruction of capacitors.<br/>The use of such resins, molding materials etc. is not recommended.</li> </ol> |

| 7. Handling |  |
|-------------|--|
| Precautions | <p>◆Splitting of PCB</p> <ol style="list-style-type: none"> <li>When PCBs are split after components mounting, care shall be taken so as not to give any stresses of deflection or twisting to the board.</li> <li>Board separation shall not be done manually, but by using the appropriate devices.</li> </ol> <p>◆Mechanical considerations</p> <p>Be careful not to subject capacitors to excessive mechanical shocks.</p> <p>(1) If ceramic capacitors are dropped onto a floor or a hard surface, they shall not be used.</p> <p>(2) Please be careful that the mounted components do not come in contact with or bump against other boards or components.</p> |

| 8. Storage conditions    |   |
|--------------------------|---|
| Precautions              | <p>◆Storage</p> <ol style="list-style-type: none"> <li>To maintain the solderability of terminal electrodes and to keep packaging materials in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible.           <ul style="list-style-type: none"> <li>Recommended conditions<br/>               Ambient temperature : Below 30°C                      Humidity : Below 70% RH</li> <li>The ambient temperature must be kept below 40°C. Even under ideal storage conditions, solderability of capacitor is deteriorated as time passes, so capacitors shall be used within 6 months from the time of delivery.</li> <li>Ceramic chip capacitors shall be kept where no chlorine or sulfur exists in the air.</li> </ul> </li> <li>The capacitance values of high dielectric constant capacitors will gradually decrease with the passage of time, so care shall be taken to design circuits. Even if capacitance value decreases as time passes, it will get back to the initial value by a heat treatment at 150°C for 1 hour.</li> </ol> |
| Technical considerations | <p>If capacitors are stored in a high temperature and humidity environment, it might rapidly cause poor solderability due to terminal oxidation and quality loss of taping/packaging materials. For this reason, capacitors shall be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the capacitors.</p>   |

※RCR-2335B (Safety Application Guide for fixed ceramic capacitors for use in electronic equipment) is published by JEITA.

Please check the guide regarding precautions for deflection test, soldering by spot heat, and so on.

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