



## X5R, X7R Dielectrics

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### ■ Features

- A monolithic structure ensures high reliability and mechanical strength.
- High capacitance density.
- A wide range of capacitance values in standard case size.
- Suitable for high speed SMT placement on PCBs.
- Ni barrier termination highly resistance to migration.
- Lead-free termination is in compliance with the requirement of green plan and ROHS.

### ■ Applications

- General electronic equipment.
- Communication equipment.
- Custom Application

### ■ X5R, X7R Dielectric Characteristics

|   |   |
|---|---|
| Capacitance Range   | 100pF to 100uF                                      |
| Size (mm)   | 0603    1005    1608    2012    3216    3225        |
| (EIA inch)  | (0201)   (0402)   (0603)   (0805)   (1206)   (1210) |
| Test Voltage  | 1.0 ± 0.2Vrms                                       |
| Test Frequency  | 1.0 ± 0.2KHz  |
| Capacitance Tolerance                                       | ± 10%, ± 20% (± 5% available on request)            |
| Operating Temperature Range                                 | -55°C to +85°C for X5R<br>-55°C to +125°C for X7R   |
| Maximum Capacitance Change                                  | ± 15 %  |
| Rated Voltage   | 6.3, 10, 16, 25, 50, 100 VDC                        |
| Dissipation Factor  | Pls refer to DF table on page No. 7                 |
| Insulation Resistance (+25°C, RVDC)                         | 10,000 MΩ min. or 500Ω-F min., whichever is smaller |
| Insulation Resistance (Maximum operating temperature, RVDC) | 1,000 MΩ min. or 50Ω-F min., whichever is smaller   |



## Multi-Layer Ceramic Capacitor

C-S2-5-01

### Product Range and Thickness

| CLASS | Class II |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
|-------|----------|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|------|-----|-----|-----|------|------|-----|-----|-----|------|------|-----|-----|-----|
| TYPE  | Standard |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| T.C.  | X7R      |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| SIZE  | 0603     |     |     |      | 1005 |     |     |      | 1608 |     |     |      |      | 2012 |     |     |     |      | 3216 |     |     |     |      | 3225 |     |     |     |
| (EIA) | 0201     |     |     | 0402 |      |     |     | 0603 |      |     |     |      | 0802 |      |     |     |     | 1206 |      |     |     |     | 1210 |      |     |     |     |
| RV    | 10V      | 16V | 25V | 10V  | 16V  | 25V | 50V | 10V  | 16V  | 25V | 50V | 100V | 6.3V | 10V  | 16V | 25V | 50V | 100V | 10V  | 16V | 25V | 50V | 100V | 10V  | 16V | 25V | 50V |
| 100 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 120 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 150 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 180 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      |     |     |     |      |      |     |     |     |
| 220 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 270 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 330 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 390 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 470 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 560 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 680 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 820 p | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 1.0 n | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 1.2 n | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 1.5 n | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 1.8 n | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 2.2 n | A        | A   | A   | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 2.7 n |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 3.3 n | A        |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 3.9 n |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 4.7 n | A        |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 5.6 n |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E G  |      | E   | E   | E   | E    |      |     |     |     |
| 6.8 n |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E G  |      | E   | E   | E   | E    |      |     |     |     |
| 8.2 n |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D    |      | C    | C   | C   | C   | E G  |      | E   | E   | E   | E    |      |     |     |     |
| 10 n  |          |     |     | B    | B    | B   | B   | D    | D    | D   | D   | D*   |      | C    | C   | C   | C   | E G  |      | E   | E   | E   | E    |      |     |     |     |
| 12 n  |          |     |     | B    | B    | B   |     | D    | D    | D   | D   |      |      | C    | C   | C   | C   | E G  |      | E   | E   | E   | E    |      |     |     |     |
| 15 n  |          |     |     | B    | B    | B   |     | D    | D    | D   | D   | D*   |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    |      |     |     |     |
| 18 n  |          |     |     | B    | B    | B   |     | D    | D    | D   | D   |      |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    | F    |     |     |     |
| 22 n  |          |     |     | B    | B    | B   |     | D    | D    | D   | D   |      |      | C    | C   | C   | C   | E    |      | E   | E   | E   | E    | F    |     |     |     |
| 27 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | C    | C   | C   | C   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 33 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | C    | C   | C   | C   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 39 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | C    | C   | C   | C   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 47 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | E    | E   | E   | E   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 56 n  |          |     |     |      |      |     |     | D    | D    | D   | D*  |      |      | E    | E   | E   | E   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 68 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | E    | E   | E   | E   |      |      | E   | E   | E   | E    | F    |     |     |     |
| 82 n  |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | E    | E   | E   | E   |      |      | E   | E   | E   | F    | G    |     |     |     |
| 100 n |          |     |     | B    | B    |     |     | D    | D    | D   | D*  |      |      | E    | E   | E   | E   |      |      | E   | E   | E   | F    | G    |     |     |     |
| 120 n |          |     |     |      |      |     |     | D    |      |     |     |      |      | E G  | E G | E G | E G | G    |      | E   | E   | E   |      |      |     |     |     |
| 150 n |          |     |     |      |      |     |     | D    | D    |     |     |      |      | E G  | E G | E G | E G | E G  |      | E I | E I | E I | E I  |      |     |     |     |
| 180 n |          |     |     |      |      |     |     | D    |      |     |     |      |      | E G  | E G | E G | E G |      |      | E I | E I | E I | E I  |      |     |     |     |
| 220 n |          |     |     |      |      |     |     | D    | D    | D   |     |      |      | E G  | E G | E G | E G | E G  |      | E I | E I | E I | E I  |      |     |     |     |
| 270 n |          |     |     |      |      |     |     |      |      |     |     |      |      | G    | G   |     |     |      |      | E I | E I | E I |      |      |     |     |     |
| 330 n |          |     |     |      |      |     |     | D*   | D*   |     |     |      |      | G    | G   | G   | G   |      |      | E I | E I | E I | G    |      |     |     |     |
| 390 n |          |     |     |      |      |     |     |      |      |     |     |      |      | G    | G   |     |     |      |      | F   | F   |     |      |      |     |     |     |
| 470 n |          |     |     |      |      |     |     | D*   | D*   |     |     |      |      | G    | G   | G   |     |      |      | F   | F   | L   |      |      |     |     |     |
| 560 n |          |     |     |      |      |     |     |      |      |     |     |      |      | G    | G   |     |     |      |      | F   |     |     |      |      |     |     |     |
| 680 n |          |     |     |      |      |     |     | D*   | D*   |     |     |      |      | G    | G   |     |     |      |      | F G |     |     |      |      |     |     |     |
| 820 n |          |     |     |      |      |     |     |      |      |     |     |      |      | G    | G   |     |     |      |      | F   |     |     |      |      |     |     |     |
| 1.0 u |          |     |     |      |      |     |     | D    | D    |     |     |      |      | G    | G   | G   |     |      |      | G   | G   | G   | L    | G    | L   |     |     |
| 1.2 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 1.5 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 1.8 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 2.2 u |          |     |     |      |      |     |     |      |      |     |     |      |      | G    | G   | G   |     |      |      | L   | L   | L   |      |      |     |     |     |
| 2.7 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 3.3 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 3.9 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |
| 4.7 u |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      | L   | L   | L   |      |      |     | N   |     |
| 10 u  |          |     |     |      |      |     |     |      |      |     |     |      |      |      |     |     |     |      |      | L   | L   |     |      |      |     | N   |     |

- Non-standard capacitance or thickness is available on request
- The thickness might be changed due to technology improvement.

D\* Thickness Spec: 0.8+0.15/-0.1mm  
Length Spec : 1.6+0.15/-0.1mm



**Product Range and Thickness**

| CLAS  | Class II |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
|-------|----------|-----|------|-----|-----|------|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|---|---|---|---|---|
| TYPE  | Standard |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| T.C.  | X5R      |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| SIZE  | 0603     |     | 1005 |     |     | 1608 |      |     |     |     | 2012 |     |     |     | 3216 |     |     |     | 3225 |     |     |     |   |   |   |   |   |
| (EIA) | 0201     |     | 0402 |     |     | 0603 |      |     |     |     | 0805 |     |     |     | 1206 |     |     |     | 1210 |     |     |     |   |   |   |   |   |
| RV    | 6.3V     | 10V | 6.3V | 10V | 16V | 4V   | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V |   |   |   |   |   |
| 2.2 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 3.3 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 4.7 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 5.6 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 6.8 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 8.2 n | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 10 n  | A        | A   |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 15 n  |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 22 n  | A        |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 33 n  |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 47 n  | A        |     | B    | B   | B   |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 56 n  |          |     | B    | B   | B   |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 68 n  |          |     | B    | B   | B   |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 82 n  |          |     | B    | B   | B   |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 100 n | A        |     | B    | B   | B   |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 120 n |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 150 n |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 180 n |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 220 n |          |     | B    | B   | B   |      | D    | D   | D   | D*  |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 270 n |          |     |      |     |     |      | D*   | D*  |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 330 n |          |     |      |     |     |      | D*   | D*  | D*  |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 390 n |          |     |      |     |     |      | D*   | D*  |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 470 n |          |     | B    |     |     |      | D*   | D*  | D*  |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 560 n |          |     |      |     |     |      | D*   | D*  |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 680 n |          |     |      |     |     |      | D*   | D*  | D*  |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 820 n |          |     |      |     |     |      | D*   | D*  |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 1.0 u |          |     | B    | B   |     |      | D*   | D*  | D*  | D*  | E    | E   | E   | G   |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 1.5 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 1.8 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 2.2 u |          |     |      |     |     |      | D*   | D*  | D*  |     | E    | E   | G   |     | L    | L   | L   | L   |      |     |     |     |   |   |   |   |   |
| 2.7 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 3.3 u |          |     |      |     |     |      |      |     |     |     | G    | G   |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 3.9 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 4.7 u |          |     |      |     |     |      | D*   | D*  |     |     | G    | G   | G   | G   | G    | L   | G   | L   | G    | L   | L   | E   | E | E | N |   |   |
| 6.8 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |
| 10 u  |          |     |      |     |     |      | D*   | D*  |     |     | E    | G   | G   | G   |      | L   | L   | L   | L    | L   | L   | N   | N | L | N | N | P |
| 22 u  |          |     |      |     |     |      |      |     |     |     | G    |     |     |     |      | L   |     |     |      |     |     | N   | P | N | P | N | P |
| 47 u  |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      | L   |     |     |      |     |     |     |   |   |   |   |   |
| 100 u |          |     |      |     |     |      |      |     |     |     |      |     |     |     |      |     |     |     |      |     |     |     |   |   |   |   |   |

S 2

- Non-standard capacitance or thickness is available on request
- The thickness might be changed due to technology improvement.

**Typical Tolerance**

| Thickness (mm) |             | Thickness (mm) |             | Thickness (mm) |             | Thickness (mm) |             | Thickness (mm) |             |
|----------------|-------------|----------------|-------------|----------------|-------------|----------------|-------------|----------------|-------------|
| Code           | Class       | Code           | Class       | Code           | Class       | Code           | Class       | Code           | Class       |
| A              | 0.30+/-0.03 | M              | 0.70+/-0.15 | I              | 0.95+/-0.15 | H              | 1.50+/-0.20 | N              | 2.00+/-0.20 |
| B              | 0.50+/-0.05 | D              | 0.80+/-0.10 | F              | 1.15+/-0.20 | P              | 2.50+/-0.20 | R              | 3.20+/-0.20 |
| C              | 0.60+/-0.15 | E              | 0.85+/-0.15 | G              | 1.25+/-0.20 | L              | 1.60+/-0.20 |                |             |

**Special Tolerance**

| Thickness (mm) |                  | Thickness (mm) |                  | Thickness (mm) |             | Thickness (mm) |             | Thickness (mm) |             |
|----------------|------------------|----------------|------------------|----------------|-------------|----------------|-------------|----------------|-------------|
| Code           | Class            | Code           | Class            | Code           | Class       | Code           | Class       | Code           | Class       |
| G              | 1.25 -0.20/+0.30 | L              | 1.60 -0.20/+0.30 | N              | 2.00+/-0.30 | P              | 2.50+/-0.30 | R              | 3.20+/-0.30 |

For Cap≥1μF, Tolerance of dimensions will be enlarged.



### Taping Amount

| Thickness |                  |             | Amount per reel |           |              |          |              |          |
|-----------|------------------|-------------|-----------------|-----------|--------------|----------|--------------|----------|
|           |                  |             | 180 mm (7")     |           | 250 mm (10") |          | 330 mm (13") |          |
| Code      | Spec             | Size(EIA)   | Paper           | Embossed  | Paper        | Embossed | Paper        | Embossed |
| A         | 0.30+/-0.03      | 0603 (0201) | 15K             |           |              |          |              |          |
| B         | 0.50+/-0.05      | 1005 (0402) | 10K             |           |              |          | 50K          |          |
| C         | 0.60+/-0.15      | 2012 (0805) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3216 (1206) | 4K              |           | 10K          |          | 15K          |          |
| D         | 0.80+/-0.10      | 1608 (0603) | 4K              |           | 10K          |          | 15K          |          |
| D*        | 0.80+0.15/ -0.10 | 1608 (0603) | 4K              |           | 10K          |          | 15K          |          |
| E         | 0.85+/-0.15      | 2012 (0805) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3216 (1206) | 4K              |           | 10K          |          | 15K          |          |
|           |                  | 3225 (1210) |                 | 3K        |              |          |              | 10K      |
| I         | 0.95+/-0.15      | 4532 (1812) |                 | 1K        |              |          |              |          |
|           |                  | 2012 (0805) |                 | 3K        |              |          |              |          |
| F         | 1.15+/-0.20      | 3216 (1206) |                 | 3K        |              |          |              | 10K      |
|           |                  | 4520 (1808) |                 | 3K        |              |          |              |          |
| G         | 1.25 +/-0.20     | 2012 (0805) |                 | 2K/3K     |              |          |              | 10K      |
|           |                  | 3216 (1206) |                 | 3K        |              |          |              | 10K      |
|           |                  | 3225 (1210) |                 | 3K        |              |          |              |          |
|           |                  | 4520 (1808) |                 | 3K        |              |          |              |          |
| G         | 1.25+0.3/-0.2    | 4532 (1812) |                 | 1K        |              |          |              |          |
|           |                  | 2012 (0805) |                 | 2K/3K     |              |          |              | 10K      |
|           |                  | 3216 (1206) |                 | 3K        |              |          |              | 10K      |
| H         | 1.50+/-0.20      | 3225 (1210) |                 | 2K        |              |          |              |          |
|           |                  | 4520 (1808) |                 | 2K        |              |          |              |          |
|           |                  | 4532 (1812) |                 | 1K        |              |          |              |          |
| L         | 1.60+/-0.20      | 3216 (1206) |                 | 2K        |              |          |              |          |
|           |                  | 3225 (1210) |                 | 2K        |              |          |              |          |
|           |                  | 4520 (1808) |                 | 2K        |              |          |              |          |
| L         | 1.60+0.30/-0.20  | 4532 (1812) |                 | 1K        |              |          |              |          |
|           |                  | 3216 (1206) |                 | 2K        |              |          |              |          |
|           |                  | 3225 (1210) |                 | 2K        |              |          |              |          |
| N         | 2.00+/-0.20      | 4520 (1808) |                 | 2K        |              |          |              |          |
|           |                  | 4532 (1812) |                 | 1K        |              |          |              |          |
|           |                  | 3216 (1206) |                 | 2K/3K     |              |          |              |          |
|           |                  | 3225 (1210) |                 | 2K        |              |          |              |          |
| N         | 2.00+/-0.30      | 4520 (1808) |                 | 1K        |              |          |              |          |
| N         | 2.00+/-0.30      | 4532 (1812) |                 | 1K        |              |          |              |          |
| N         | 2.00+/-0.30      | 3225 (1210) |                 | 2K        |              |          |              |          |
| P         | 2.50+/-0.20      | 3225 (1210) |                 | 500pcs/1K |              |          |              |          |
| P         | 2.50+/-0.30      | 3225 (1210) |                 | 500pcs/1K |              |          |              |          |
| R         | 3.20+/-0.20      |             |                 | 500pcs    |              |          |              |          |
| R         | 3.20+/-0.30      |             |                 | 500pcs    |              |          |              |          |

\*: For some products, the thickness spec can be 0.8+0.15/-0.1mm.

■ X5R, X7R Specifications

| No.   | Item                                    | Specification   | Test Method   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|-------|---|---|---|-------------|-------------|-----|----------------|-------|-----|---------------|-------|---|-----|-----|------|-----|-----|------|------|-----|-----|-----|----------------|
| 1     | Operating Temperature Range             | -55°C to 125°C for X7R<br>-55°C to 85°C for X5R   | -   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 2     | Rated Voltage                           | 6.3VDC, 10VDC, 16VDC, 25VDC, 50VDC, 100VDC  | The rated voltage is defined as the maximum voltage, which may be applied continuously to the capacitor.  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 3     | Appearance                              | No defects or abnormalities.  | Visual inspection   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 4     | Dimensions                              | Within the specified dimension.   | Using calipers  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 5     | Dielectric Strength (Flash)             | No defects or abnormalities.  | No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 to 5 seconds, the charge and discharge current is less than 50mA.   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 6     | Insulation Resistance ( I.R.)           | Rated Voltage: <500V<br>To apply rated voltage.<br>I.R. ≥10G or R <sub>C</sub> ≥500Ω·F<br>Rated Voltage: ≥500V<br>To apply 500V.<br>(whichever is smaller)  | The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at 25°C and 75%RH max, and within 1 minute of charging.   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 7     | Capacitance                             | Within the specified tolerance at 1,000 hours   | The capacitance/D.F. shall be measured at 25°C at frequency 1.0±0.2KHz and voltage 1.0±0.2Vrms.   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 8     | Dissipation Factor ( D.F.)              | See X5R/X7R DF (tan δ) table 2  |   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 9     | Capacitance Temperature Characteristics | Capacitance change within the specified tolerance as following table.<br>Reference temperature 25°C.<br><table border="1"> <thead> <tr> <th>Char.</th> <th>Temp. Range</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>-55°C to 125°C</td> <td>± 15%</td> </tr> <tr> <td>X5R</td> <td>-55°C to 85°C</td> <td>± 15%</td> </tr> </tbody> </table>  | Char.   | Temp. Range | Cap. Change | X7R | -55°C to 125°C | ± 15% | X5R | -55°C to 85°C | ± 15% | The ranges of capacitance change compared with 25°C value over the temperature ranges shown in the table should be within the specified ranges. |     |     |      |     |     |      |      |     |     |     |                |
| Char. | Temp. Range                             | Cap. Change   |   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| X7R   | -55°C to 125°C                          | ± 15%   |   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| X5R   | -55°C to 85°C                           | ± 15%   |   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 10    | Termination Strength                    | No removal of the terminations or marking defect.   | Apply a parallel force of 5N to a PCB mounted sample for 10±1sec. *2N for 0603 (EIA 0201).  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 11    | Deflection (Bending Strength)           | Appearance: No cracking or marking defects.<br>Capacitance change within ±12.5%.  | Solder the capacitor to the test jig (glass epoxy boards) shown in Fig. a. using a eutectic solder then let sit for 48±4 hours. Then apply a force in the direction shown in Fig. b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|       |   | <p>(Unit in mm)</p> <table border="1"> <thead> <tr> <th>Size</th> <th>a</th> <th>b</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>1005</td> <td>0.4</td> <td>1.5</td> <td>0.5</td> </tr> <tr> <td>1608</td> <td>1.0</td> <td>3.0</td> <td>1.2</td> </tr> <tr> <td>2012</td> <td>1.2</td> <td>4.0</td> <td>1.65</td> </tr> <tr> <td>3216</td> <td>2.2</td> <td>5.0</td> <td>2.0</td> </tr> </tbody> </table> <p>Fig. a.</p> | Size  | a           | b           | C   | 1005           | 0.4   | 1.5 | 0.5           | 1608  | 1.0   | 3.0 | 1.2 | 2012 | 1.2 | 4.0 | 1.65 | 3216 | 2.2 | 5.0 | 2.0 | <p>Fig. b.</p> |
| Size  | a                                       | b   | C   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 1005  | 0.4                                     | 1.5   | 0.5   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 1608  | 1.0                                     | 3.0   | 1.2   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 2012  | 1.2                                     | 4.0   | 1.65  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 3216  | 2.2                                     | 5.0   | 2.0   |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 12    | Solderability of Termination            | 90% of the terminations is to be soldered evenly and continuously.  | Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180°C for 2 to 3 minutes and immerse it into molten solder of 230 ± 5°C for 5±1seconds.  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
| 13    | Resistance to Soldering Heat            | Appearance  | No marking defects  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|       |   | Cap. Change   | Within ±7.5%  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|       |   | D.F.  | To satisfy the specified initial value  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|       |   | I.R.  | I.R. ≥ 10,000MΩ or R <sub>C</sub> ≥ 500Ω·F.<br>( whichever is smaller)  |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |
|       |   |   | Preheat the capacitor at 120 to 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution at 270±5°C for 10±1 seconds. Let sit at room temperature for 48±4 hours, then measure.<br>* Preheat 150 to 200°C for size ≥3216.<br><br>Initial measurement : perform a heat treatment at 150+0/-10°C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement. |             |             |     |                |       |     |               |       |   |     |     |      |     |     |      |      |     |     |     |                |



Continued from previous page.

|    |                                   |                     |  |   |
|----|-----------------------------------|---------------------|--|---|
| 14 | Temperature Cycle (Thermal Shock) | Appearance          | No marking defects   | Solder the capacitor to supporting jig (glass epoxy board) and perform the five cycles according to the four heat treatments listed in the following table. Let sit for 48±4hrs at room temperature, then measure.<br><br>Step 1: Minimum operating temperature 30±3min<br>Step 2: Room temperature 2~3 min<br>Step 3: Maximum operating temperature 30±3min<br>Step 4: Room temperature 2~3min<br><br>Initial measurement : perform a heat treatment at 150+0/-10°C for one hour and then let sit for 48±4 hours at room temperature. Perform the initial measurement. |
|    |                                   | Cap. Change         | Within ±7.5%   |   |
|    |                                   | D.F.                | To satisfy the specified initial value                                     |   |
|    |                                   | I.R.                | More than 10,000MΩ or $R_1C_R > 500\Omega\cdot F$ ( whichever is smaller ) |   |
| 15 | Humidity Load                     | Appearance          | No marking defects   | Apply the rated voltage at 40±2°C and 90 to 95% humidity for 500±12 hours. Remove and let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA.<br><br>Pre-treatment: Apply the rated DC voltage for 1 hr at 40±2°C and 90 to 95% humidity. Remove and let sit for 48±4 hours, then perform the initial measurement.  |
|    |                                   | Cap. Change         | Within ±12.5%  |   |
|    |                                   | D.F.                | Max. 200% of initial spec.   |   |
|    |                                   | I.R.                | More than 500MΩ or $R_1C_R \geq 25\Omega\cdot F$ (whichever is smaller)    |   |
|    |                                   | Dielectric Strength | No failure   |   |
| 16 | High Temperature Load (Life Test) | Appearance          | No marking defects   | Apply *200% of the rated voltage for 500±12 hours at the maximum operating temperature ± 3°C. Let sit for 48±4 hours at room temperature, then measure. The charge/discharge current is less than 50mA. (*Please refer to table 1 for details)<br><br>Pre-treatment: Apply 200%* of the rated voltage for 1 hr at maximum operating temperature ±3°C. Remove and let sit for 48±4 hours, then perform the initial measurement.<br>*some of the parts are applicable in rated voltage 1.5. please refer to table 1   |
|    |                                   | Cap. Change         | Within ±12.5%  |   |
|    |                                   | D.F.                | Max. 200% of initial spec.   |   |
|    |                                   | I.R.                | More than 1 GΩ or $R_1C_R \geq 50\Omega\cdot F$ (whichever is smaller)     |   |

**Table 1**

| TC  | Product Range               |
|-----|-----------------------------|
| X5R | 0603 (EIA 0201): C > 10 nF  |
|     | 1005 (EIA 0402): C > 0.1 uF |
|     | 1608 (EIA 0603): C ≥ 1.0 uF |
|     | 2012 (EIA 0805): C ≥ 2.2 uF |
|     | 3216 (EIA 1206): C ≥ 10 uF  |
|     | 3225 (EIA 1210): C ≥ 22 uF  |



### ■ X5R/X7R DF (tan δ) Table 2

| Rated Voltage    | Size           | Capacitance        | D.F Max. |      |
|------------------|----------------|--------------------|----------|------|
|                  |                |                    | X5R      | X7R  |
| 4V               | All            | All                | 15%      |      |
| 6.3V             | All            | cap ≤ 1.0u         | 10%      | 7.5% |
|                  | All            | 1uF < cap < 4.7u   | 10%      | 10%  |
|                  | All            | 4.7uF ≤ cap ≤ 100u | 15%      | 15%  |
| 10V              | 0603/3216/3225 | All                | 7.5%     | 5%   |
|                  |                | cap ≤ 100n         | 7.5%     | 5%   |
|                  | 1005           | 100nF < cap < 330n | 7.5%     |      |
|                  |                | 330nF ≤ cap ≤ 1u   | 10%      |      |
|                  |                | cap ≤ 1.0u         | 7.5%     | 5%   |
|                  | 1608           | 1.0uF < cap < 2.2u | 7.5%     |      |
|                  |                | 2.2uF ≤ cap ≤ 4.7u | 10%      |      |
|                  |                | cap ≤ 2.2u         | 7.5%     | 5%   |
|                  | 2012           | 2.2uF < cap < 6.8u | 7.5%     |      |
|                  |                | 6.8uF ≤ cap ≤ 10u  | 10%      |      |
| 10uF < cap ≤ 22u |                | 10%                |          |      |
| 3225             |                |                    |          |      |
| 16V              | 0603/3216/3225 | All                | 5%       | 5%   |
|                  |                | cap ≤ 100n         | 5%       | 5%   |
|                  | 1005           | 100nF < cap ≤ 220n | 7.5%     |      |
|                  |                | cap ≤ 470n         | 5%       | 5%   |
|                  |                | 470nF < cap ≤ 1.0u | 7.5%     | 5%   |
|                  | 1608           | 1.0uF < cap ≤ 2.2u | 7.5%     |      |
|                  |                | cap ≤ 2.2u         | 5%       | 5%   |
|                  |                | 2.2uF < cap ≤ 4.7u | 7.5%     |      |
|                  | 2012           | 4.7uF < cap ≤ 10u  | 10%      |      |
|                  |                | 10uF < cap ≤ 22u   | 15%      |      |
| 3225             |                |                    |          |      |
| 25V              | All            | All                | 5%       | 3.5% |
|                  | 3216           | 1uF ≤ cap ≤ 4.7u   | 5%       | 5%   |
|                  | 3225           | 4.7uF < cap ≤ 10u  | 10%      |      |
| ≥ 50V            | All            | All but below      | 2.5%     | 2.5% |
|                  | 3216/3225      | cap ≤ 1u           | 3.5%     | 3.5% |