

# DATA SHEET

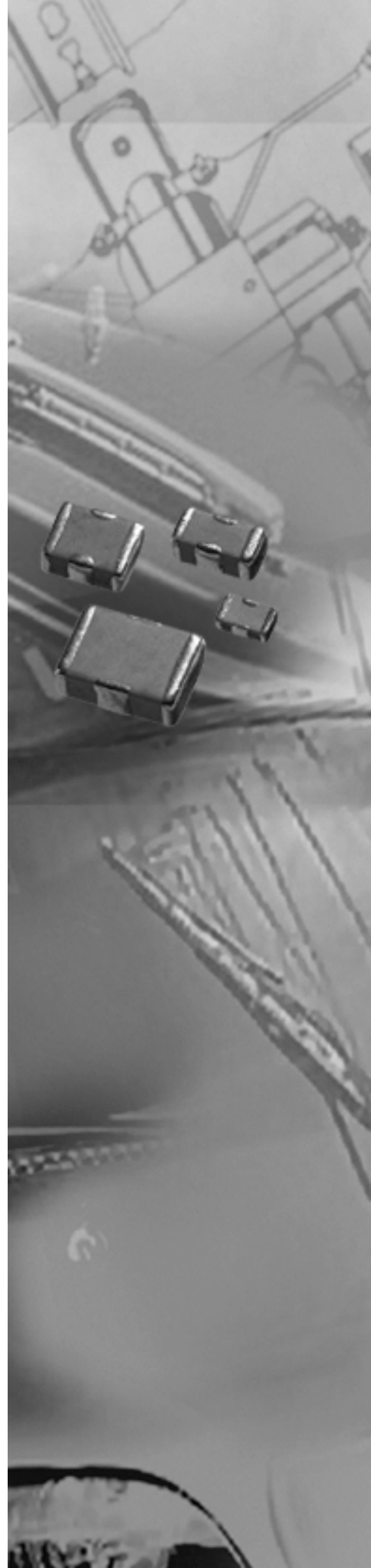
## SURFACE-MOUNT CERAMIC EMI FILTER CAPACITORS

X2Y® Series  
6.3 V TO 100 V



**Phi**comp

Product Specification – Nov. 10, 2008 V.13



## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### DESCRIPTION

X2Y® series is a breakthrough in the design of ceramic multilayer products for decoupling and filtering in an IPD (integrated passive device).

X2Y® products comprise two identical Y-capacitors and one X-capacitor, integrated into a 4 terminal device, which is available in standard MLCC sizes. Thanks to the unique multilayer construction the device provides noise cancellation within the device, reducing ESL from nanohenry to picohenry levels.

Using the unique balance between the Y-capacitors and the shielded multilayer structure the X2Y® products offer superior decoupling and filtering.

The X2Y® device performs as a broadband filter enabling better EMC compliance for electrical equipment in a wide range of applications.

### FEATURES

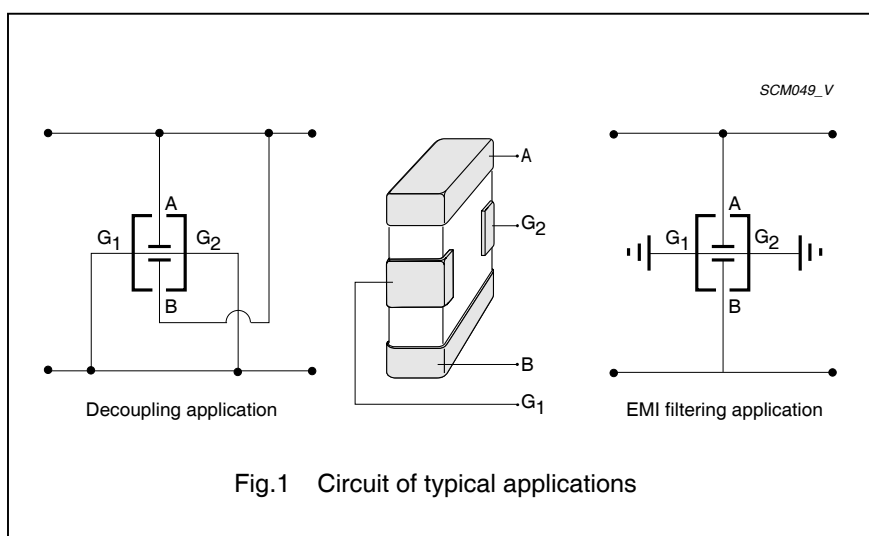
- **Broadband Filtering and Decoupling:** X2Y® is effective up to 10 GHz and frequencies beyond
- **Ultra Low ESL:** Noise cancellation within X2Y® makes ESL reducing from nanohenry to picohenry levels
- **Bypass:** Unlike feedthrough capacitors, X2Y® is in bypass, so no DC current limitations
- **Matched Y-caps:** Two tightly matched line to ground capacitors in one device
- **Superior Balance:** Temperature and voltage variations balanced of two Y-caps
- **Aging Reliability:** Aging effects are equal on two Y-caps

### BENEFITS

- **Fewer Component in Filtering:** One X2Y® can replace multiple inductors and/or capacitors
- **Superior Performance in Filtering:** One X2Y® can eliminate both differential and common mode noises
- **Fewer Component in Decoupling:** Up to 1:7 replacement of MLCC in power delivering system bypass networks
- **Superior Performance in Decoupling:** Large or small, X2Y® components exhibit ultra low ESL
- **Total Cost Savings:** Assembly cost savings through reduced component count and placement costs
- **Board Level Design Advantages:** Dramatically reduces via drills, which blocks routing

### APPLICATIONS

- EMI filtering on DC motors
- Filtered connectors (airbag connectors, RJ-45 connectors)
- High speed data-line filtering
- Decoupling of supply-lines in high speed digital circuits
- Broadband filtering.
- Amplifier decoupling and EMI suppression.
- IC Decoupling, on-package, on-PCB.
- DC power line filtering.
- Data line filtering.
- EMI suppression for DC motors.
- Sensors
- Audio



## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### QUICK REFERENCE DATA

| DESCRIPTION                     | VALUE                                                           |
|---------------------------------|-----------------------------------------------------------------|
| Materials                       | NPO / X7R / X5R                                                 |
| Rated voltage                   |                                                                 |
| NPO                             | 50 / 63 V                                                       |
| X7R                             | 10 V, 16 V, 25 V, 50 / 63 V, 100 V (IEC)                        |
| X5R                             | 6.3 V, 10V                                                      |
| Capacitance range (Y-capacitor) |                                                                 |
| NPO 0805 series                 | 22 pF, 47 pF                                                    |
| X7R 0603 series                 | 1.0 nF to 100 nF                                                |
| 0805 series                     | 4.7 nF to 180 nF                                                |
| 1206 series                     | 15 nF to 820 nF                                                 |
| 1210 series                     | 47 nF to 1 µF                                                   |
| 1410 series                     | 390 nF                                                          |
| X5R 0603 series                 | 220 nF to 470 nF                                                |
| Tolerance on capacitance        | ±20% (M)                                                        |
| Test voltage (DC) for 1 minute  | $2.5 \times U_r$                                                |
| Sectional specifications        | IEC 60384-10, second edition 1989-04; also based on CECC 32 100 |
| Detailed specification          | based on IEC 60384-10-1                                         |
| Climatic category (IEC 60068)   | X7R: 55 / 125 / 56                                              |

# Surface-mount ceramic EMI filter capacitors

## X2Y® Series

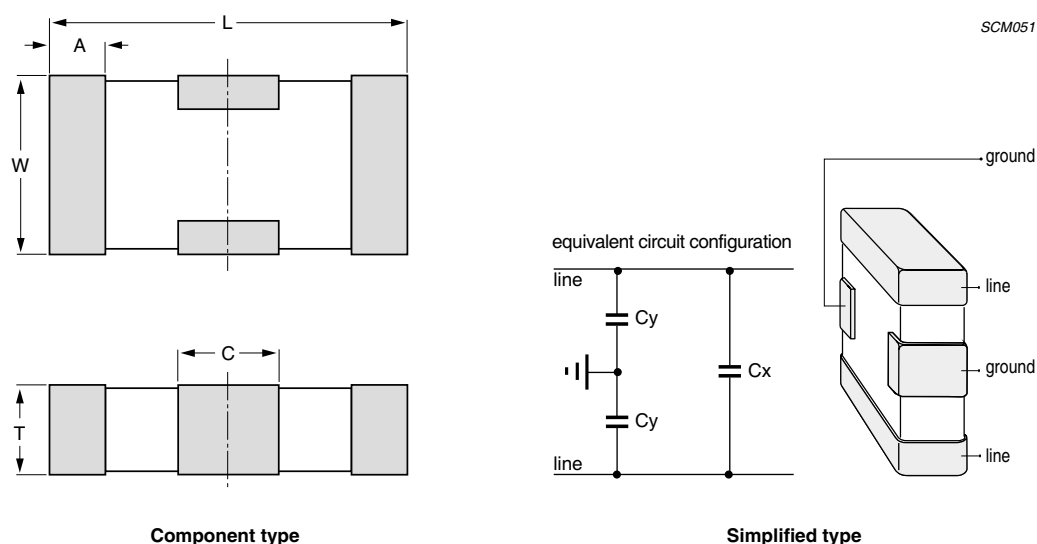
### GENERAL SELECTION CHART

| C<br>(pF) | NPO  | X7R         |             |             |             |      | X5R  |       |
|-----------|------|-------------|-------------|-------------|-------------|------|------|-------|
|           | 0805 | 0603        | 0805        | 1206        | 1210        | 1410 | 0603 |       |
| 10        |      |             |             |             |             |      |      |       |
| 22        | 50 V |             |             |             |             |      |      |       |
| 47        |      |             |             |             |             |      |      |       |
| 100       |      |             |             |             |             |      |      |       |
| 220       |      |             |             |             |             |      |      |       |
| 330       |      |             |             |             |             |      |      |       |
| 1,000     |      | 100 V       |             |             |             |      |      |       |
| 1,500     |      |             |             |             |             |      |      |       |
| 2,200     |      |             |             |             |             |      |      |       |
| 4,700     |      |             | 100 V       |             |             |      |      |       |
| 5,600     |      | 50 V / 63 V |             |             |             |      |      |       |
| 10,000    |      |             |             |             |             |      |      |       |
| 15,000    |      | 25 V        | 50 V / 63 V | 100 V       |             |      |      |       |
| 18,000    |      |             |             |             |             |      |      |       |
| 22,000    |      |             | 25 V        |             |             |      |      |       |
| 39,000    |      | 16 V        | 16 V        | 50 V / 63 V | 100 V       |      |      |       |
| 47,000    |      |             |             |             |             |      |      |       |
| 56,000    |      |             |             |             |             |      |      |       |
| 100,000   |      | 10 V        |             |             | 50 V / 63 V |      |      |       |
| 180,000   |      |             | 10 V        | 25 V        |             |      |      |       |
| 220,000   |      |             |             | 16 V        | 50 V / 63 V |      | 10 V |       |
| 270,000   |      |             |             |             |             |      |      |       |
| 330,000   |      |             |             |             |             | 25 V |      | 6.3 V |
| 390,000   |      |             |             |             |             |      | 50 V |       |
| 470,000   |      |             |             | 10 V        |             |      |      |       |
| 560,000   |      |             |             |             |             |      |      |       |
| 820,000   |      |             |             |             | 16 V        |      |      |       |
| 1 000,000 |      |             |             |             |             |      |      |       |

## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

## MECHANICAL DATA



For dimensions see Table 1.

Fig.2. Component outline & simplified outline

## Physical dimensions

**Table 1** Capacitor dimensions

| CASE SIZE                 | L            | W            | T     |       | A     |       | C            |
|---------------------------|--------------|--------------|-------|-------|-------|-------|--------------|
|                           |              |              | MIN.  | MAX.  | MIN.  | MAX.  |              |
| Dimensions in millimetres |              |              |       |       |       |       |              |
| 0603                      | 1.6 ±0.15    | 0.85 ±0.15   | 0.55  | 0.75  | 0.25  | 0.55  | 0.40 ±0.20   |
| 0805                      | 2.0 ±0.15    | 1.25 ±0.15   | 0.75  | 0.95  | 0.25  | 0.55  | 0.70 ±0.20   |
| 1206                      | 3.2 ±0.20    | 1.65 ±0.20   | 1.10  | 1.40  | 0.25  | 0.65  | 1.20 ±0.30   |
| 1210                      | 3.2 ±0.20    | 2.5 ±0.20    | 1.10  | 1.70  | 0.25  | 0.65  | 1.20 ±0.30   |
| 1410                      | 3.56 ±0.20   | 2.5 ±0.20    | 1.10  | 1.50  | 0.25  | 0.65  | 1.20 ±0.30   |
| Dimensions in inches      |              |              |       |       |       |       |              |
| 0603                      | 0.063 ±0.006 | 0.032 ±0.006 | 0.022 | 0.030 | 0.010 | 0.022 | 0.016 ±0.008 |
| 0805                      | 0.079 ±0.006 | 0.049 ±0.006 | 0.030 | 0.037 | 0.010 | 0.022 | 0.028 ±0.008 |
| 1206                      | 0.126 ±0.008 | 0.065 ±0.008 | 0.043 | 0.055 | 0.010 | 0.026 | 0.047 ±0.012 |
| 1210                      | 0.126 ±0.008 | 0.098 ±0.008 | 0.043 | 0.067 | 0.010 | 0.026 | 0.047 ±0.012 |
| 1410                      | 0.140 ±0.008 | 0.098 ±0.008 | 0.043 | 0.059 | 0.010 | 0.026 | 0.047 ±0.012 |

## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### ELECTRICAL CHARACTERISTICS FOR NPO

#### Class 1 capacitors; NPO dielectric; NiSn terminations

| DESCRIPTION                                        | VALUE                                  |
|----------------------------------------------------|----------------------------------------|
| Rated voltage $U_r$ (DC)                           | 50 V                                   |
| Capacitance range                                  | 22 pF, 47pF                            |
| Capacitance tolerance                              | $\pm 20\%$                             |
| Tan $\delta$ ; note 1                              | $\leq 10 \times 10^{-4}$               |
| Insulation resistance after 1 minute at $U_r$ (DC) | $R_{ins} > 10 \text{ G}\Omega$         |
| Temperature Coefficient                            | $(0 \pm 30) \times 10^{-6} / \text{K}$ |

#### Note

1. Measured at 20 °C, 1 V and 1 MHz, using a four-gauge method.

### ELECTRICAL CHARACTERISTICS FOR X7R / X5R

#### Class 2 capacitors; X7R / X5R dielectric; NiSn terminations

Unless otherwise stated all electrical values apply at an ambient temperature of  $20 \pm 1$  °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

| DESCRIPTION                                             | VALUE                                                                                  |
|---------------------------------------------------------|----------------------------------------------------------------------------------------|
| Rated voltage $U_r$ (DC)                                | 6.3 V, 10 V, 16 V, 25 V, 50 V/63 V and 100 V                                           |
| Capacitance range                                       | 1.0 nF to 1 $\mu$ F                                                                    |
| Tolerance on capacitance after 1,000 hours              | $\pm 20\%$                                                                             |
| Dissipation factor (D.F.); note 1                       |                                                                                        |
| 6.3 V                                                   | 7%                                                                                     |
| 10 V                                                    | 7%                                                                                     |
| 16 V                                                    | 7%                                                                                     |
| $\geq 25 \text{ V}$                                     | 5%                                                                                     |
| Insulation resistance after 1 minute at $U_r$ (DC)      | $R_{ins} \times C > 500$ seconds or $R_{ins} > 10 \text{ G}\Omega$ , whichever is less |
| Maximum capacitance change as a function of temperature | $\pm 15\%$                                                                             |
| Operating temperature range:                            |                                                                                        |
| X5R                                                     | - 55 °C to +85 °C                                                                      |
| X7R                                                     | - 55 °C to +125 °C                                                                     |
| Aging                                                   | Typical 1% per time decade                                                             |

#### Note

1. Measured at 20 °C, 1 V and 1 kHz, using a four-gauge method.

# Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### SELECTION CHART FOR X7R SIZES 0603, 0805, 1206, 1410 <sup>(1)</sup>

| SIZE | Y-CAPACITOR  |                       | X-CAPACITOR  |                       | THICKNESS<br>(mm) | CTC ORDERING CODE<br><sup>(2)</sup> |
|------|--------------|-----------------------|--------------|-----------------------|-------------------|-------------------------------------|
|      | CAP.<br>(nF) | VOLTAGE<br>RATING (V) | CAP.<br>(nF) | VOLTAGE<br>RATING (V) |                   |                                     |
| 0603 | 1.0          | 100                   | 0.5          | 200                   | 0.60              | CX 0603 MR X7R 0BB 102              |
|      | 1.5          | 100                   | 0.75         | 200                   | 0.60              | CX 0603 MR X7R 0BB 152              |
|      | 2.2          | 100                   | 1.1          | 200                   | 0.60              | CX 0603 MR X7R 0BB 222              |
|      | 4.7          | 100                   | 2.4          | 200                   | 0.60              | CX 0603 MR X7R 0BB 472              |
|      | 5.6          | 50 / 63               | 2.8          | 100                   | 0.60              | CX 0603 MR X7R 9BB 562              |
|      | 10           | 50 / 63               | 5            | 100                   | 0.60              | CX 0603 MR X7R 9BB 103              |
|      | 22           | 25                    | 11           | 50                    | 0.60              | CX 0603 MR X7R 8BB 223              |
|      | 47           | 16                    | 24           | 25                    | 0.60              | CX 0603 MR X7R 7BB 473              |
|      | 56           | 16                    | 28           | 25                    | 0.60              | CX 0603 MR X7R 7BB 563              |
|      | 100          | 10                    | 50           | 16                    | 0.60              | CX 0603 MR X7R 6BB 104              |
| 0805 | 4.7          | 100                   | 2.4          | 200                   | 0.85              | CX 0805 MR X7R 0BB 472              |
|      | 10           | 100                   | 5            | 200                   | 0.85              | CX 0805 MR X7R 0BB 103              |
|      | 15           | 50 / 63               | 8            | 100                   | 0.85              | CX 0805 MR X7R 9BB 153              |
|      | 18           | 50 / 63               | 9            | 100                   | 0.85              | CX 0805 MR X7R 9BB 183              |
|      | 22           | 25                    | 11           | 50                    | 0.85              | CX 0805 MR X7R 8BB 223              |
|      | 39           | 25                    | 20           | 50                    | 0.85              | CX 0805 MR X7R 8BB 393              |
|      | 47           | 16                    | 24           | 25                    | 0.85              | CX 0805 MR X7R 7BB 473              |
|      | 100          | 16                    | 50           | 25                    | 0.85              | CX 0805 MR X7R 7BB 104              |
|      | 180          | 10                    | 90           | 16                    | 0.85              | CX 0805 MR X7R 6BB 184              |
| 1206 | 22           | 100                   | 11           | 200                   | 1.20              | CX 1206 MK X7R 0BB 223              |
|      | 47           | 50 / 63               | 24           | 100                   | 1.20              | CX 1206 MK X7R 9BB 473              |
|      | 100          | 50 / 63               | 50           | 100                   | 1.20              | CX 1206 MK X7R 9BB 104              |
|      | 180          | 25                    | 90           | 50                    | 1.20              | CX 1206 MK X7R 8BB 184              |
|      | 220          | 16                    | 110          | 25                    | 1.20              | CX 1206 MK X7R 7BB 224              |
|      | 390          | 16                    | 195          | 25                    | 1.20              | CX 1206 MK X7R 7BB 394              |
|      | 470          | 10                    | 235          | 20                    | 1.20              | CX 1206 MK X7R 6BB 474              |
|      | 820          | 10                    | 410          | 20                    | 1.20              | CX 1206 MK X7R 6BB 824              |
| 1210 | 47           | 100                   | 24           | 200                   | 1.20              | CX 1210 MK X7R 0BB 473              |
|      | 100          | 50/63                 | 50           | 100                   | 1.20              | CX 1210 MK X7R 9BB 104              |
|      | 220          | 50/63                 | 110          | 100                   | 1.60              | CX 1210 MK X7R 9BB 224              |
|      | 470          | 25                    | 235          | 50                    | 1.60              | CX 1210 MK X7R 8BB 474              |
|      | 560          | 25                    | 280          | 50                    | 1.60              | CX 1210 MK X7R 8BB 564              |
|      | 820          | 16                    | 410          | 25                    | 1.60              | CX 1210 MK X7R 7BB 824              |
|      | 1000         | 16                    | 500          | 25                    | 1.60              | CX 1210 MK X7R 7BB 105              |
| 1410 | 390          | 50                    | 195          | 100                   | 1.30              | CX 1410 MK X7R 9BB 394              |

## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### SELECTION CHART FOR X5R SIZES 0603 <sup>(1)</sup>

| SIZE | Y-CAPACITOR  |                          | X-CAPACITOR  |                          | THICKNESS<br>(mm) | CTC ORDERING CODE<br><sup>(2)</sup> |
|------|--------------|--------------------------|--------------|--------------------------|-------------------|-------------------------------------|
|      | CAP.<br>(nF) | VOLTAGE<br>RATING<br>(V) | CAP.<br>(nF) | VOLTAGE<br>RATING<br>(V) |                   |                                     |
| 0603 | 220          | 10                       | 110          | 20                       | 0.60              | CX 0603 MR X5R 6BB 224              |
|      | 330          | 10                       | 165          | 20                       | 0.60              | CX 0603 MR X5R 6BB 334              |
|      | 470          | 6.3                      | 235          | 12                       | 0.60              | CX 0603 MR X5R 5BB 474              |

#### Notes

- Other values are available on request.
- Ordering codes for preferred versions (20% tolerance, 180 mm reel). For other packing and tolerance see section "Ordering Code Information".

### SELECTION CHART FOR NPO SIZES 0805 <sup>(1)</sup>

| SIZE | Y-CAPACITOR  |                          | X-CAPACITOR  |                          | THICKNESS<br>(mm) | CTC ORDERING CODE<br><sup>(2)</sup> |
|------|--------------|--------------------------|--------------|--------------------------|-------------------|-------------------------------------|
|      | CAP.<br>(nF) | VOLTAGE<br>RATING<br>(V) | CAP.<br>(nF) | VOLTAGE<br>RATING<br>(V) |                   |                                     |
| 0805 | 0.022        | 50                       | 0.011        | 100                      | 0.85              | CX 0805 MR NPO 9BB 220              |
|      | 0.047        | 50                       | 0.023        | 100                      | 0.85              | CX 0805 MR NPO 9BB 470              |

#### Notes

- Other values are available on request.
- Ordering codes for preferred versions (20% tolerance, 180 mm reel). For other packing and tolerance see section "Ordering Code Information".

### THICKNESS CLASSIFICATION AND PACKING QUANTITIES FOR X7R

| THICKNESS<br>CLASSIFICATION<br>(mm) | QUANTITY PER REEL |         |
|-------------------------------------|-------------------|---------|
|                                     | 8 mm TAPE WIDTH   |         |
|                                     | Ø180 mm; 7"       |         |
|                                     | PAPER             | BLISTER |
| 0.6 ±0.1                            | 4,000             | —       |
| 0.85 ±0.1                           | 4,000             | —       |
| 1.2 ±0.15                           | —                 | 2,500   |
| 1.6 ±0.15                           | —                 | 2,500   |
| 1.9 ±0.2                            | —                 | 2,500   |



## Surface-mount ceramic EMI filter capacitors

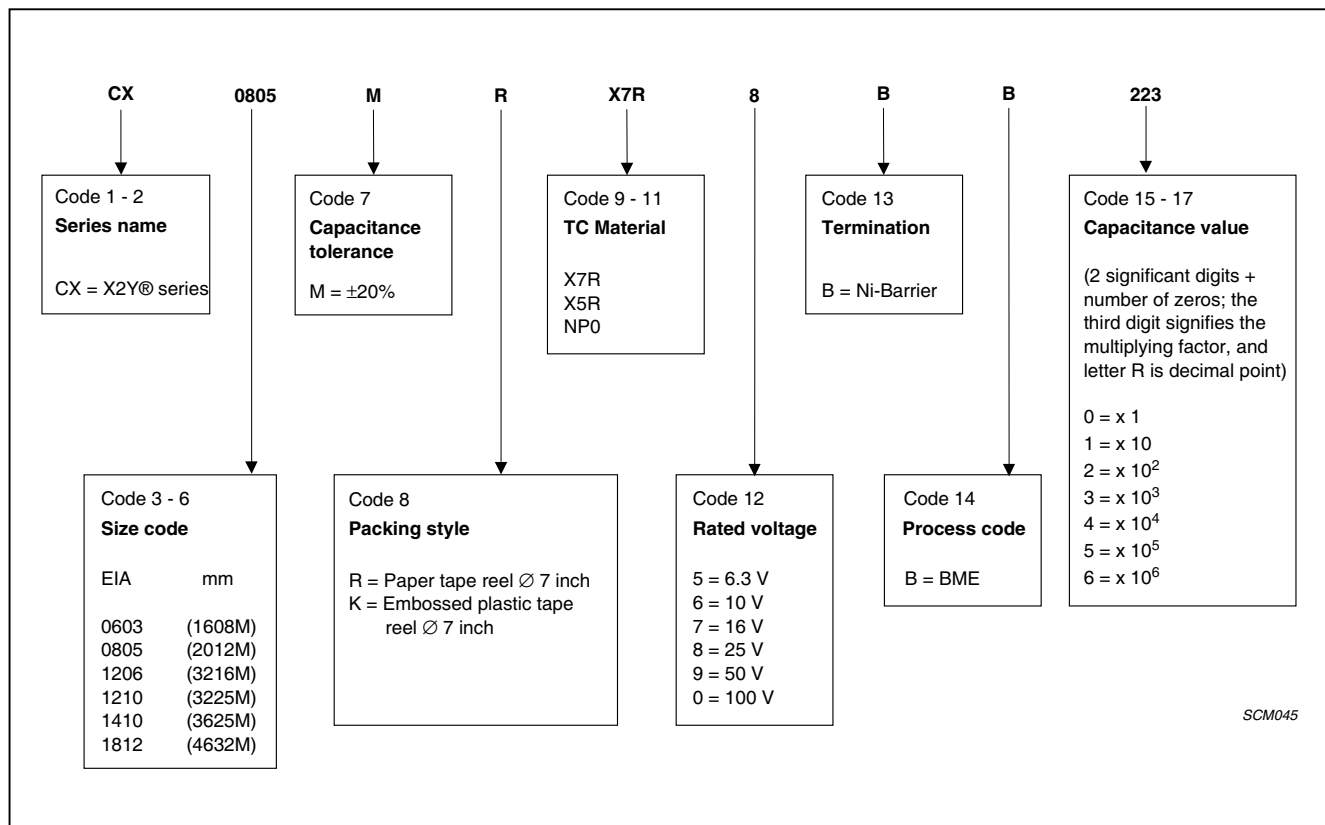
## X2Y® Series

### ORDERING INFORMATION

Components may be ordered by using either a Yageo part number or Phycomp's unique 12NC.

#### Ordering code: Yageo part number

Example: CX0805MRX7R8BB223



# Surface-mount ceramic EMI filter capacitors

## X2Y® Series

**Table 2** Conversion table for Yageo part number

| TC  | SIZE | CAP. VALUE | CAP. TOLERANCE | RATED VOLTAGE (V) | CTC ORDERING CODE      | QUANTITY PER REEL |
|-----|------|------------|----------------|-------------------|------------------------|-------------------|
|     |      | Y-CAP      | Y-CAP          | Y-CAP             |                        |                   |
| X7R | 0603 | 1.0 nF     | ±20%           | 100               | CX 0603 MR X7R 0BB 102 | 4,000             |
| X7R | 0603 | 1.5 nF     | ±20%           | 100               | CX 0603 MR X7R 0BB 152 | 4,000             |
| X7R | 0603 | 2.2 nF     | ±20%           | 100               | CX 0603 MR X7R 0BB 222 | 4,000             |
| X7R | 0603 | 4.7 nF     | ±20%           | 100               | CX 0603 MR X7R 0BB 472 | 4,000             |
| X7R | 0603 | 5.6 nF     | ±20%           | 50 / 63           | CX 0603 MR X7R 9BB 562 | 4,000             |
| X7R | 0603 | 10 nF      | ±20%           | 50 / 63           | CX 0603 MR X7R 9BB 103 | 4,000             |
| X7R | 0603 | 22 nF      | ±20%           | 25                | CX 0603 MR X7R 8BB 223 | 4,000             |
| X7R | 0603 | 47 nF      | ±20%           | 16                | CX 0603 MR X7R 7BB 473 | 4,000             |
| X7R | 0603 | 56 nF      | ±20%           | 16                | CX 0603 MR X7R 7BB 563 | 4,000             |
| X7R | 0603 | 100 nF     | ±20%           | 10                | CX 0603 MR X7R 6BB 104 | 4,000             |
| X7R | 0805 | 4.7 nF     | ±20%           | 100               | CX 0805 MR X7R 0BB 472 | 4,000             |
| X7R | 0805 | 10 nF      | ±20%           | 100               | CX 0805 MR X7R 0BB 103 | 4,000             |
| X7R | 0805 | 15 nF      | ±20%           | 50 / 63           | CX 0805 MR X7R 9BB 153 | 4,000             |
| X7R | 0805 | 18 nF      | ±20%           | 50 / 63           | CX 0805 MR X7R 9BB 183 | 4,000             |
| X7R | 0805 | 22 nF      | ±20%           | 25                | CX 0805 MR X7R 8BB 223 | 4,000             |
| X7R | 0805 | 39 nF      | ±20%           | 25                | CX 0805 MR X7R 8BB 393 | 4,000             |
| X7R | 0805 | 47 nF      | ±20%           | 16                | CX 0805 MR X7R 7BB 473 | 4,000             |
| X7R | 0805 | 100 nF     | ±20%           | 16                | CX 0805 MR X7R 7BB 104 | 4,000             |
| X7R | 0805 | 180 nF     | ±20%           | 10                | CX 0805 MR X7R 6BB 184 | 4,000             |
| X7R | 1206 | 22 nF      | ±20%           | 100               | CX 1206 MK X7R 0BB 223 | 2,500             |
| X7R | 1206 | 47 nF      | ±20%           | 50 / 63           | CX 1206 MK X7R 9BB 473 | 2,500             |
| X7R | 1206 | 100 nF     | ±20%           | 50 / 63           | CX 1206 MK X7R 9BB 104 | 2,500             |
| X7R | 1206 | 180 nF     | ±20%           | 25                | CX 1206 MK X7R 8BB 184 | 2,500             |
| X7R | 1206 | 220 nF     | ±20%           | 16                | CX 1206 MK X7R 7BB 224 | 2,500             |
| X7R | 1206 | 390 nF     | ±20%           | 16                | CX 1206 MK X7R 7BB 394 | 2,500             |
| X7R | 1206 | 470 nF     | ±20%           | 10                | CX 1206 MK X7R 6BB 474 | 2,500             |
| X7R | 1206 | 820 nF     | ±20%           | 10                | CX 1206 MK X7R 6BB 824 | 2,500             |
| X7R | 1210 | 47 nF      | ±20%           | 100               | CX 1210 MK X7R 0BB 473 | 2,500             |
| X7R | 1210 | 100 nF     | ±20%           | 50 / 63           | CX 1210 MK X7R 9BB 104 | 2,500             |
| X7R | 1210 | 220 nF     | ±20%           | 50 / 63           | CX 1210 MK X7R 9BB 224 | 2,500             |
| X7R | 1210 | 470 nF     | ±20%           | 25                | CX 1210 MK X7R 8BB 474 | 2,500             |
| X7R | 1210 | 560 nF     | ±20%           | 25                | CX 1210 MK X7R 8BB 564 | 2,500             |
| X7R | 1210 | 820 nF     | ±20%           | 16                | CX 1210 MK X7R 7BB 824 | 2,500             |
| X7R | 1210 | 1 µF       | ±20%           | 16                | CX 1210 MK X7R 7BB 105 | 2,500             |
| X7R | 1410 | 390 nF     | ±20%           | 50                | CX 0603 MR X5R 9BB 394 | 2,500             |

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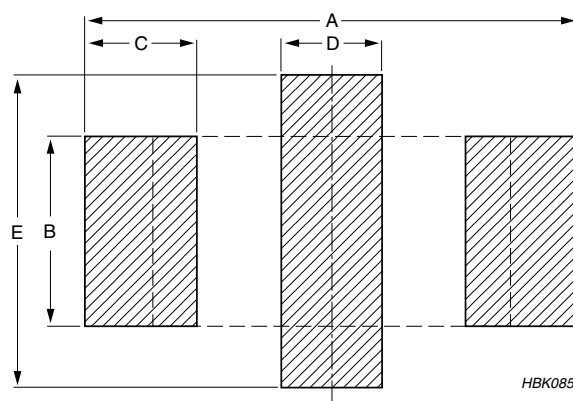
**Table 2** Conversion table for Yageo part number

| TC  | SIZE | CAP. VALUE | CAP. TOLERANCE | RATED VOLTAGE (V) | CTC ORDERING CODE      | QUANTITY PER REEL |
|-----|------|------------|----------------|-------------------|------------------------|-------------------|
|     |      | Y-CAP      | Y-CAP          | Y-CAP             |                        |                   |
| X5R | 0603 | 220 nF     | ±20%           | 10                | CX 0603 MR X5R 6BB 224 | 4,000             |
| X5R | 0603 | 330 nF     | ±20%           | 10                | CX 0603 MR X5R 6BB 334 | 4,000             |
| X5R | 0603 | 470 nF     | ±20%           | 6.3               | CX 0603 MR X5R 5BB 474 | 4,000             |
| NPO | 0805 | 22 pF      | ±20%           | 50                | CX 0805 MR NPO 9BB 220 | 4,000             |
| NPO | 0805 | 47 pF      | ±20%           | 50                | CX 0805 MR NPO 9BB 470 | 4,000             |

### RECOMMENDED DIMENSIONS OF SOLDER LANDS

**Table 3** Reflow soldering

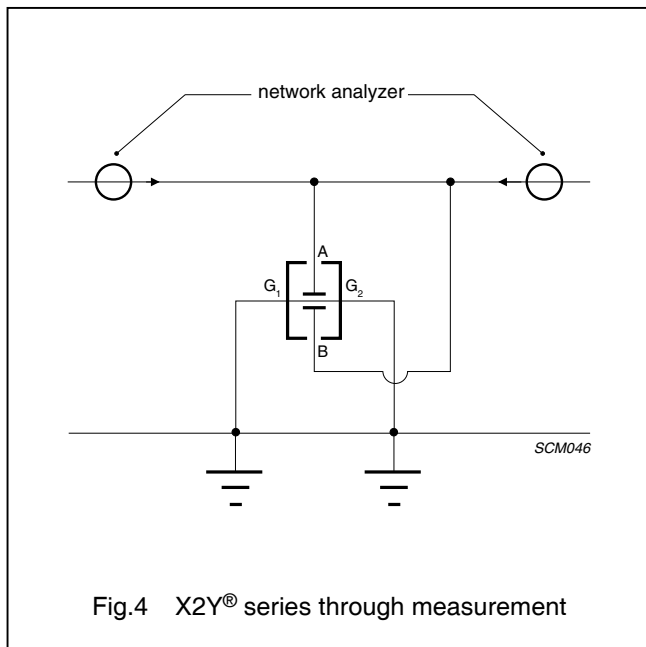
| CASE SIZE (EIA) | Footprint dimensions (mm) |      |      |      |      | Placement Accuracy (mm) |
|-----------------|---------------------------|------|------|------|------|-------------------------|
|                 | A                         | B    | C    | D    | E    |                         |
| 0603            | 2.30                      | 0.76 | 0.64 | 0.51 | 1.52 | ±0.20                   |
| 0805            | 3.05                      | 1.27 | 0.89 | 0.56 | 2.03 | ±0.20                   |
| 1206            | 4.06                      | 1.65 | 1.00 | 1.02 | 3.05 | ±0.25                   |
| 1210            | 4.57                      | 2.55 | 1.00 | 1.14 | 4.06 | ±0.25                   |
| 1410            | 4.57                      | 2.55 | 1.00 | 1.14 | 4.06 | ±0.25                   |


**Fig.3** Recommended dimensions of solder lands

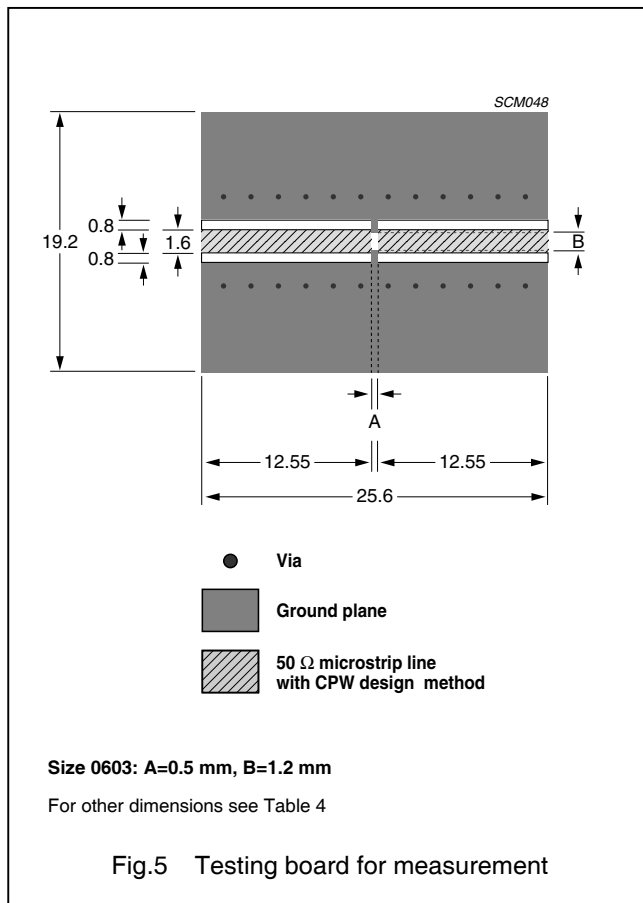
## Surface-mount ceramic EMI filter capacitors

## X2Y® Series

### MEASUREMENT SETUP



- X2Y® are soldered on a printed circuit board
- PCB: FR-4 substrate, with 50  $\Omega$  microstrip line
- Network Analyzer: Agilent E5071b
- Calibration: full 2-port calibration with 85033E kit



**Table 4** Recommended dimensions of measurement

| CASE SIZE | A (mm)         | B (mm)         |
|-----------|----------------|----------------|
| 0603      | 0.5 $\pm$ 0.10 | 1.2 $\pm$ 0.10 |
| 0805      | 0.8 $\pm$ 0.10 | 1.6 $\pm$ 0.10 |
| 1206      | 1.2 $\pm$ 0.10 | 2.8 $\pm$ 0.15 |
| 1210      | 2.1 $\pm$ 0.15 | 2.8 $\pm$ 0.15 |
| 1410      | 2.1 $\pm$ 0.15 | 3.1 $\pm$ 0.15 |

## Surface-mount ceramic EMI filter capacitors

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### TESTS AND REQUIREMENTS

**Table 5** Test procedures and requirements

| TEST METHOD    | TEST                                  | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                                 | REQUIREMENTS                      |
|----------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| IEC60384-21/22 |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |
| 4.3            | mounting                              | The capacitors may be mounted on printed-circuit boards or ceramic substrates                                                                                                                                                                                                                                                                                                                                                             | no visible damage                 |
| 4.4            | visual inspection and dimension check | any applicable method using $\times 10$ magnification                                                                                                                                                                                                                                                                                                                                                                                     | in accordance with specification  |
| 4.5.1          | capacitance                           | NP0:<br>$f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$ ;<br>$f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$<br>X5R/X7R/Y5V:<br>$f = 1 \text{ KHz}$ for $C \leq 10 \mu\text{F}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$                                                                  | within specified tolerance        |
| 4.5.2          | Dissipation factor (D.F.)             | NP0:<br>$f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$ ;<br>$f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$<br>X5R/X7R/Y5V:<br>$f = 1 \text{ KHz}$ for $C \leq 10 \mu\text{F}$ , measuring at voltage $1 V_{\text{rms}}$ at $20^\circ\text{C}$                                                                  | in accordance with specifications |
| 4.5.3          | insulation resistance                 | at $U_r$ (DC) for 1 minute                                                                                                                                                                                                                                                                                                                                                                                                                | in accordance with specification  |
| 4.5.4.2        | voltage proof                         | Test voltage (DC) applied for 1 minute<br>$U_r \leq 100 \text{ V}$ : $2.5 \times U_r$ applied to NP0/X5R/X7R/Y5V series<br>$100 \text{ V} < U_r \leq 200 \text{ V}$ : $1.5 \times U_r + 100 \text{ V}$ applied to NP0/X7R series<br>$200 \text{ V} < U_r \leq 500 \text{ V}$ : $1.3 \times U_r + 100 \text{ V}$ applied to NP0/X7R series<br>$U_r > 500 \text{ V}$ : $1.3 \times U_r$ applied to NP0/X7R series<br>$I$ : $7.5 \text{ mA}$ | no breakdown or flashover         |

# Surface-mount ceramic EMI filter capacitors

## X2Y® Series

**Table 5** Test procedures and requirements (continued)

| TEST METHOD     | TEST                                 | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                                     | REQUIREMENTS                                                                                                                                                                                                                                                                |
|-----------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IEC 60384-21/22 |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                             |
| 4.6             | temperature characteristic           | Between minimum and maximum temperature                                                                                                                                                                                                                                                                                                                                                                                                       | NP0: $\Delta C/C: \pm 30 \text{ ppm/}^\circ\text{C}$<br>X5R/X7R: $\Delta C/C: \pm 15\%$<br>Y5V: $\Delta C/C: +22\% \sim -82\%$                                                                                                                                              |
| 4.15            | adhesion                             | A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate<br>for size $\geq 0603$ : a force of 5 N applied<br>for size 0402: a force of 2.5 N applied<br>for size 0201: a force of 1 N applied                                                                                                                                                                                             | no visible damage                                                                                                                                                                                                                                                           |
| 4.8             | bond strength of plating on end face | Mounting in accordance with IEC 60384-22 paragraph 4.3                                                                                                                                                                                                                                                                                                                                                                                        | no visible damage                                                                                                                                                                                                                                                           |
|                 |                                      | Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm                                                                                                                                                                                                                                                                                                                                                                               | NP0: $ \Delta C/C : \leq 1\%$ or 0.5 pF whichever is greater<br>X5R/X7R/Y5V: $ \Delta C/C : \leq 10\%$                                                                                                                                                                      |
| 4.9             | Resistance to soldering heat         | Precondition: $150 \pm 0/-10^\circ\text{C}$ for 1 hour, then keep for $24 \pm 1$ hours at room temperature<br>Preheating: for size $\leq 1206$ : 120 to $150^\circ\text{C}$ for 1 minute<br>Preheating: for size $>1206$ : 100 to $120^\circ\text{C}$ for 1 minute and 170 to $200^\circ\text{C}$ for 1 minute<br>Solder bath temperature: $260 \pm 5^\circ\text{C}$<br>Dipping time: $10 \pm 0.5$ seconds<br>Recovery time: $24 \pm 2$ hours | The termination shall be well tinned<br>NP0: $ \Delta C/C : \leq 0.5\%$ or 0.5 pF whichever is greater<br>X5R/X7R: $ \Delta C/C : \leq 10\%$<br>Y5V: $ \Delta C/C : \leq 20\%$<br>D.F.: within initial specified value<br>$R_{\text{ins}}$ : within initial specified value |
| 4.10            | Solderability                        | Unmounted chips completely immersed in a solder bath at $235 \pm 5^\circ\text{C}$<br>Dipping time: $2 \pm 0.5$ seconds<br>Depth of immersion: 10 mm                                                                                                                                                                                                                                                                                           | The termination shall be well tinned                                                                                                                                                                                                                                        |

# Surface-mount ceramic EMI filter capacitors

## X2Y® Series

**Table 5** Test procedures and requirements (continued)

| TEST METHOD     | TEST                        | PROCEDURE                                                                                                                                                                                                                                                                                                                                                                                                                       | REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IEC 60384-21/22 |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.11            | Rapid change of temperature | Preconditioning;<br>150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature                                                                                                                                                                                                                                                                                                                                     | No visual damage<br>NP0: $\Delta C/C_i \leq 1\%$ or 1 pF whichever is greater<br>X5R/X7R: $\Delta C/C_i \leq 15\%$<br>Y5V: $\Delta C/C_i \leq 20\%$<br>D.F.: within initial specified value<br>$R_{ins}$ : within initial specified value                                                                                                                                                                        |
|                 |                             | 5 cycles with following detail:<br>30 minutes at lower category temperature;<br>30 minutes at upper category temperature                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                 |                             | Recovery time 24 ±2 hours                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4.13            | Damp heat, with $U_r$ load  | Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature<br><br>Duration and conditions: 500 ±12 hours at 40 ±2 °C; 90 to 95% RH; $U_r$ applied<br><br>Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour, final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load                                                  | NP0: $\Delta C/C_i \leq 2\%$ or 1 pF whichever is greater<br>X5R/X7R: $\Delta C/C_i \leq 20\%$<br>Y5V: $\Delta C/C_i \leq 30\%$<br><br>NP0/X5R/X7R/Y5V: D.F.: 2 × initial value max.<br><br>NP0: $R_{ins} \geq 2,500 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 25$ seconds, whichever is less<br>X5R/X7R/Y5V: $R_{ins} \geq 500 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 25$ seconds, whichever is less   |
| 4.14            | Endurance                   | Preconditioning;<br>Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature<br><br>Duration and conditions: 1,000 ±12 hours at upper category temperature with $1.5 \times U_r$ voltage applied<br><br>Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour, final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load | NP0: $\Delta C/C_i \leq 2\%$ or 1 pF whichever is greater<br>X5R/X7R: $\Delta C/C_i \leq 20\%$<br>Y5V: $\Delta C/C_i \leq 30\%$<br><br>NP0/X5R/X7R/Y5V: D.F.: 2 × initial value max.<br><br>NP0: $R_{ins} \geq 4,000 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 40$ seconds, whichever is less<br>X5R/X7R/Y5V: $R_{ins} \geq 1,000 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 50$ seconds, whichever is less |

**Surface-mount ceramic  
EMI filter capacitors****X2Y® Series****REVISION HISTORY**

| Revision | Date        | Change Notification | Description                                                                                                                                   |
|----------|-------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Rev.5    | 2001 Sep 25 | -                   | - Published on web                                                                                                                            |
| Rev.6    | 2002 Jul 10 | -                   | - Product range extended in all materials and sizes;<br>- Insertion loss measurements added.                                                  |
| Rev.7    | 2003 Apr 02 | -                   | - Updated company logo                                                                                                                        |
| Rev.8    | 2003 Jul 23 | -                   | - Cover page revised                                                                                                                          |
| Rev.9    | 2003 Sep 09 | -                   | - Cover page corrected                                                                                                                        |
| Rev.10   | 2004 Apr 21 | -                   | - Product range updated<br>- NP0, Y5V and size 1812 removed.                                                                                  |
| Rev.11   | 2006 Nov 21 | -                   | - Size 1410 extended<br>- Product applications, features and benefits update<br>- Measurement setup added<br>- Updated tests and requirements |
| Rev.12   | 2006 Dec 22 | -                   | - 12 NC revised                                                                                                                               |
| Rev.13   | 2008 Nov 10 | -                   | - Product range extended in materials of NP0 and X5R                                                                                          |