# CAPACITORS, FIXED, CHIPS, BASE METAL ELECTRODE, CERAMIC DIELECTRIC, TYPE II

# BASED ON TYPES 0402 TO 2220

# ESCC Detail Specification No. 3009/041


| | |
|---|---|
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## DOCUMENTATION CHANGE NOTICE

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| DCR No. | CHANGE DESCRIPTION |
|---|---|
| 1460, 1467 | Specification updated to incorporate changes per DCR. |

**TABLE OF CONTENTS**

# 1 GENERAL

## 1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

## 1.2 APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

(a) ESCC Generic Specification No. 3009.

## 1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

## 1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

### 1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example: 300904101472KC

- Detail Specification Reference: 3009041
- Component Type Variant Number: 01 (as required)
- Characteristic code: Capacitance Value (4700pF): 472 (as required)
- Characteristic code: Capacitance Tolerance (±10%): K (as required)
- Rating code: Rated Voltage (50V): C (as required)

#### *1.4.1.1 Characteristics and Ratings Codes*

Characteristics and ratings to be codified as part of the ESCC Component Number shall be as follows:

(a) Rated Capacitance Value, $C_n$, expressed by means of the following codes in accordance with ESCC Basic Specification No. 21700. The unit quantity shall be picofarad (pF).

| Capacitance Value $C_n$ (pF) | Code |
|---|---|
| XX $10^2$ | XX2 |
| XX $10^3$ | XX3 |
| XX $10^4$ | XX4 |
| XX $10^5$ | XX5 |
| XX $10^6$ | XX6 |

(b) Capacitance Tolerance expressed by the following codes in accordance with ESCC Basic Specification No. 21700:

| Tolerance (± %) | Code Letter |
|---|---|
| 5 | J |
| 10 | K |
| 20 | M |

(c) Rated Voltage, $U_R$, expressed by the following codes:

| Rated Voltage $U_R$ (V) | Code Letter |
|---|---|
| 16 | X |
| 25 | A |
| 50 | C |
| 100 | E |

1.4.2 Component Type Variants and Range of Components

The component type variants and range of components applicable to this specification are as follows:

| Variant Number | Style (Note 3) | Capacitance Range, Tolerance, Rated Voltage | Terminal Material and Finish | | Weight Max (g) |
|---|---|---|---|---|---|
| | | | End Terminations | Termination Finish | |
| 01 | 0402 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.01 |
| 02 | 0603 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.02 |
| 03 | 0805 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.04 |
| 04 | 1206 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.08 |
| 05 | 1210 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.15 |
| 06 | 1812 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.3 |
| 07 | 2220 | See Note 1 | Copper and Silver loaded epoxy + Ni barrier | Sn/Pb plating (Note 2) | 0.45 |

**NOTES:**

1. Available rated voltages, capacitance values and tolerances are as follows:

| Variant Number | Style (Note 3) | Capacitance Range $C_n$ (pF) | | Tolerance (± %) | Value Series | Rated Voltage $U_R$ (V) |
|---|---|---|---|---|---|---|
| | | Min | Max | | | |
| 01 | 0402 | 2200 | 10000 | 5, 10, 20 | E12 | 100 |
| 02 | 0603 | 2200 | 18000 | | | |
| 03 | 0805 | 4700 | 100000 | | | |
| 04 | 1206 | 18000 | 390000 | | | |
| 05 | 1210 | 47000 | 820000 | | | |
| 06 | 1812 | 150000 | 2200000 | | | |
| 07 | 2220 | 560000 | 4700000 | | | |
| 01 | 0402 | 2200 | 27000 | 5, 10, 20 | E12 | 50 |
| 02 | 0603 | 2200 | 150000 | | | |
| 03 | 0805 | 4700 | 470000 | | | |
| 04 | 1206 | 18000 | 1000000 | | | |
| 05 | 1210 | 47000 | 1000000 | | | |
| 06 | 1812 | 150000 | 4700000 | | | |
| 07 | 2220 | 560000 | 10000000 | | | |
| 01 | 0402 | 2200 | 33000 | 5, 10, 20 | E12 | 25 |
| 02 | 0603 | 2200 | 180000 | | | |
| 03 | 0805 | 4700 | 1000000 | | | |
| 04 | 1206 | 18000 | 2200000 | | | |
| 05 | 1210 | 47000 | 1000000 | | | |
| 06 | 1812 | 150000 | 8200000 | | | |
| 07 | 2220 | 560000 | 22000000 | | | |
| 01 | 0402 | 2200 | 33000 | 5, 10, 20 | E12 | 16 |
| 02 | 0603 | 2200 | 180000 | | | |
| 03 | 0805 | 4700 | 1000000 | | | |
| 04 | 1206 | 18000 | 2200000 | | | |
| 05 | 1210 | 47000 | 1000000 | | | |
| 06 | 1812 | 150000 | 8200000 | | | |
| 07 | 2220 | 560000 | 22000000 | | | |

2. Sn/Pb coating with tin content of 50% minimum and 97% maximum, remainder lead.
3. See Para. 1.6.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

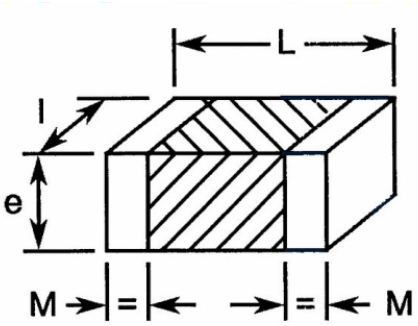
Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

| Characteristics | Symbols | Maximum Ratings | Units | Remarks |
|---|---|---|---|---|
| Rated Voltage | $U_R$ | 16, 25, 50, 100 | V | Note 1 |
| Operating Temperature Range | $T_{op}$ | -55 to +125 | °C | Without derating. $T_{amb}$ |
| Storage Temperature Range | $T_{stg}$ | -55 to +125 | °C | |
| Soldering Temperature | $T_{sol}$ | +260 | °C | Note 2 |

**NOTES:**

1. As required; See Para. 1.4.2.
2. Duration 10 seconds maximum.

1.6 PHYSICAL DIMENSIONS




| Symbols | Dimensions (mm) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Style 0402 Variant 01 | | Style 0603 Variant 02 | | Style 0805 Variant 03 | | Style 1206 Variant 04 | | Style 1210 Variant 05 | | Style 1812 Variant 06 | | Style 2220 Variant 07 | |
| | Min | Max | Min | Max | Min | Max | Min | Min | Min | Max | Min | Max | Min | Max |
| L | 0.9 | 1.15 | 1.45 | 1.75 | 1.8 | 2.2 | 3 | 3.4 | 3 | 3.4 | 4.2 | 4.8 | 5.3 | 6.1 |
| l | 0.4 | 0.6 | 0.65 | 0.95 | 1.05 | 1.45 | 1.4 | 1.8 | 2.3 | 2.7 | 3 | 3.4 | 4.6 | 5.4 |
| e | - | 0.6 | - | 1 | - | 1.52 | - | 1.8 | - | 2.8 | - | 2.8 | - | 2.8 |
| M | 0.1 | 0.4 | 0.2 | 0.5 | 0.25 | 0.75 | 0.25 | 0.75 | 0.25 | 0.75 | 0.25 | 0.95 | 0.25 | 1.03 |

1.7 FUNCTIONAL DIAGRAM

## 2 REQUIREMENTS

### 2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

#### 2.1.1 Deviations from the Generic Specification

None.

### 2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and as follows.

The information to be marked on the component or its primary package shall be:

(a) The ESCC qualified components symbol (for ESCC qualified components only).
(b) The ESCC Component Number (see Para. 1.4.1).
(c) Traceability information.

### 2.3 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

Electrical measurements shall be performed at room, high and low temperatures.

#### 2.3.1 Room Temperature Electrical Measurements

The measurements shall be performed at $T_{amb}$ = +22 ±3°C.

| Characteristics | Symbols | Test Method and Conditions | Tolerance (± %) | Limits | | Units |
|---|---|---|---|---|---|---|
| | | | | Min | Max | |
| Capacitance (Note 1) | $C_A$ | ESCC No. 3009 | | | | pF |
| | | | 5 | $0.95C_n$ | $1.05C_n$ | |
| | | | 10 | $0.9C_n$ | $1.1C_n$ | |
| | | | 20 | $0.8C_n$ | $1.2C_n$ | |
| Tangent of Loss Angle | tgδ | ESCC No. 3009 | All | | | |
| | | For $U_R$ = 50V, 100V | | - | $250 \times 10^{-4}$ | - |
| | | For $U_R$ = 16V, 25V | | - | $300 \times 10^{-4}$ | - |
| Insulation Resistance | $R_I$ | ESCC No. 3009 | All | | | |
| | | For $C_n \leq$ 10000pF | | 100 | - | GΩ |
| | | For $C_n >$ 10000pF | | 1000 | - | GΩ.nF |
| Voltage Proof | VP | ESCC No. 3009 | All | $2.5U_R$ | - | V |

**NOTES:**

1. Capacitance limits may be adjusted to take into account capacitance ageing, as specified in the Generic Specification.

2.3.2 High and Low Temperatures Electrical Measurements

| Characteristics | Symbols | Test Method and Conditions (Note 1) | Limits | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Insulation Resistance | $R_I$ | ESCC No. 3009<br>$T_{amb}$ = +125 ±2°C<br>Note 2 | | | |
| | | For $C_n \leq$ 10000pF | 10 | - | GΩ |
| | | For $C_n >$ 10000pF | 100 | - | GΩ.nF |
| Temperature Characteristic | TC | ESCC No. 3009<br>$T_{amb}$ = -55 ±2°C, +20 ±2°C, +125 ±2°C<br>Note 3 | | | % |
| | | For $V_T$ = no voltage applied | -15 | +15 | |
| | | For $V_T = U_R$ | Note 4 | | |

**NOTES:**

1. The measurements shall be performed on a sample of 5 components from each manufacturing lot with 0 failures allowed. In the event of any failure a 100% inspection may be performed.
2. Guaranteed but not tested during Chart F3 of the Generic Specification; only tested in Temperature Characterisation during Chart F4 of the Generic Specification.
3. In the case of a 100% inspection, a 1% total percent defective is allowed.
4. X7R dielectric. Temperature Characteristic for $V_T = U_R$ is typically -60%. Temperature Characteristic measurements with rated voltage applied are not required.

2.4 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb}$ = +22 ±3°C.

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Room Temperature Electrical Measurements.

| Test Reference per ESCC No. 3009 | Characteristics | Symbols | Limits | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Mounting | | | | | |
| Final Measurements | Capacitance | $C_A$ | Record Values | | |
| | Tangent of Loss Angle | tgδ | Note 1 | | |
| | Insulation Resistance | $R_I$ | Note 1 | | |
| Rapid Change of Temperature | | | | | |
| Initial Measurements | Capacitance | $C_A$ | Notes 1, 2 | | |
| Final Measurements | Capacitance | $C_A$ | Note 1 | | |
| | Change in Capacitance | $\Delta C_A/C_A$ | -10 | +10 | % |
| | Tangent of Loss Angle | tgδ | Note 3 | | |
| Steady State Humidity (85/85) | | | | | |
| Initial Measurements | Capacitance | $C_A$ | Note 1 | | |
| Final Measurements (1000 hours) | Capacitance | $C_A$ | Note 1 | | |
| | Change in Capacitance | $\Delta C_A/C_A$ | -10 | +10 | % |
| | Tangent of Loss Angle | tgδ | Note 3 | | |
| | Insulation Resistance (Note 4): | | | | |
| | For $C_n \leq 10000$pF | $R_I$ | 10 | - | GΩ |
| | For $C_n > 10000$pF | $R_I$ | 100 | - | GΩ.nF |

| Test Reference per ESCC No. 3009 | Characteristics | Symbols | Limits | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Operating Life | | | | | |
| Initial Measurements | Capacitance | $C_A$ | Notes 1, 2 | | |
| Intermediate Measurements (1000 hours) (Note 5) | Capacitance | $C_A$ | Note 1 | | |
| | Change in Capacitance | $\Delta C_A/C_A$ | -10 | +10 | % |
| | Insulation Resistance: | | | | |
| | For $C_n \leq 10000pF$ | $R_I$ | 10 | - | GΩ |
| | For $C_n > 10000pF$ | $R_I$ | 100 | - | GΩ.nF |
| Final Measurements (1000 or 2000 hours) (Note 6) | Capacitance | $C_A$ | Note 1 | | |
| | Change in Capacitance | $\Delta C_A/C_A$ | -10 | +10 | % |
| | Tangent of Loss Angle | tgδ | Note 3 | | |
| | Insulation Resistance: | | | | |
| | For $C_n \leq 10000pF$ | $R_I$ | 10 | - | GΩ |
| | For $C_n > 10000pF$ | $R_I$ | 100 | - | GΩ.nF |
| | Voltage Proof | VP | $2.5U_R$ | - | V |
| Temperature Characterisation | Insulation Resistance at $T_{amb}$ = +125 ±2°C | $R_I$ | Note 7 | | |
| | Temperature Characteristic | TC | Note 7 | | |
| Robustness of Terminations | | | | | |
| Final Measurements | Capacitance | $C_A$ | Note 1 | | |

**NOTES:**

1. As specified in Para. 2.3.1 Room Temperature Electrical Measurements.
2. Capacitance values recorded during the final measurements of the previous test may be used as initial measurements.
3. Twice the limit specified in Para. 2.3.1 Room Temperature Electrical Measurements.
4. Test conditions for Insulation Resistance shall be as specified in Steady State Humidity in the ESCC Generic Specification.
5. Intermediate measurements are optional at the Manufacturer's discretion.
6. 1000 hours is applicable to Periodic Testing for extension of qualification. 2000 hours is applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
7. As specified in Para. 2.3.2 High and Low Temperatures Electrical Measurements.

2.5 BURN-IN

The requirements for Burn-in are specified in the ESCC Generic Specification. The following conditions shall also apply:

- After Burn-in, the components shall be removed from the chamber and allowed to cool under normal atmospheric conditions for recovery for 24 hours minimum.

## APPENDIX A

AGREED DEVIATIONS FOR KYOCERA AVX COMPONENTS LTD. (NI)

| Items Affected | Description of Deviations |
|---|---|
| Para. 2.1.1 Deviations from the Generic Specification: Screening Tests - Chart F3 | Voltage Proof: For Kyocera AVX components specified with rated voltage $U_R$ = 16V, code letter X, the Voltage Proof test voltage during electrical measurements shall be V = 62.5V |
| | Burn-in: For Kyocera AVX components specified with rated voltage $U_R$ = 16V, code letter X, the applied voltage during Burn-in shall be V = 50V |
| Para. 2.1.1 Deviations from the Generic Specification: Qualification and Periodic Tests - Chart F4 | Voltage Proof: For Kyocera AVX components specified with rated voltage $U_R$ = 16V, code letter X, the Voltage Proof test voltage during electrical measurements shall be V = 62.5V |
| | Operating Life: For Kyocera AVX components specified with rated voltage $U_R$ = 16V, code letter X, the applied voltage during Operating Life shall be V = 50V |
| Para. 2.3.1 Room Temperature Electrical Measurements | Voltage Proof: For Kyocera AVX components specified with rated voltage $U_R$ = 16V, code letter X, the Voltage Proof limit VP = 62.5V minimum, shall apply. |