



Page 1 of 14

**CAPACITORS, FIXED, CHIPS, CERAMIC DIELECTRIC,
TYPE II, WITH FLEXIBLE TERMINATIONS**

BASED ON TYPES 0402 TO 2220

ESCC Detail Specification No. 3009/039

| | |
|---------|------------|
| Issue 3 | March 2017 |
|---------|------------|



Document Custodian: European Space Agency – see <https://escies.org>

LEGAL DISCLAIMER AND COPYRIGHT

European Space Agency, Copyright © 2017. All rights reserved.

The European Space Agency disclaims any liability or responsibility, to any person or entity, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without the prior permission of the European Space Agency and provided that it is not used for a commercial purpose, may be:

- copied in whole, in any medium, without alteration or modification.
- copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.

DOCUMENTATION CHANGE NOTICE

(Refer to <https://escies.org> for ESCC DCR content)

| DCR No. | CHANGE DESCRIPTION |
|----------------------|---|
| 1053 | Specification updated to incorporate changes per DCR. |

TABLE OF CONTENTS

| | | |
|-------|--|----|
| 1 | GENERAL | 5 |
| 1.1 | SCOPE | 5 |
| 1.2 | APPLICABLE DOCUMENTS | 5 |
| 1.3 | TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS | 5 |
| 1.4 | THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS | 5 |
| 1.4.1 | The ESCC Component Number | 5 |
| 1.4.2 | Component Type Variants and Range of Components | 7 |
| 1.5 | MAXIMUM RATINGS | 10 |
| 1.6 | PHYSICAL DIMENSIONS | 10 |
| 1.7 | FUNCTIONAL DIAGRAM | 11 |
| 2 | REQUIREMENTS | 11 |
| 2.1 | GENERAL | 11 |
| 2.1.1 | Deviations from the Generic Specification | 11 |
| 2.2 | MARKING | 11 |
| 2.3 | ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES | 12 |
| 2.3.1 | Room Temperature Electrical Measurements | 12 |
| 2.3.2 | High and Low Temperatures Electrical Measurements | 12 |
| 2.4 | INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS | 13 |
| 2.5 | BURN-IN | 14 |

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: 300903901101KC

- Detail Specification Reference: 3009039
- Component Type Variant Number: 01 (as required)
- Characteristic code: Capacitance Value (100pF): 101 (as required)
- Characteristic code: Capacitance Tolerance ($\pm 10\%$): 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 | XX0 |
| XX 10^1 | XX1 |
| XX 10^2 | XX2 |
| XX 10^3 | XX3 |
| XX 10^4 | XX4 |
| XX 10^5 | XX5 |

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

| Tolerance (\pm %) | 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 |
|----------------------------|----------------|
| 10 | Y |
| 16 | X |
| 25 | A |
| 50 | C |
| 100 | E |
| 200 | G |

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 5) | Capacitance Range, Tolerance, Rated Voltage | Terminal Material and Finish | | Weight Max (g) |
|----------------|----------------|---|------------------------------|------------------------|----------------|
| | | | End Terminations | Termination Finish | |
| 01 | 0603 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.1 |
| 02 | 0805 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.1 |
| 03 | 1206 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.15 |
| 04 | 1210 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.15 |
| 05 | 1812 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.2 |
| 06 | 2220 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.3 |
| 07 | 0603 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.1 |
| 08 | 0805 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.1 |
| 09 | 1206 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.15 |
| 10 | 1210 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.15 |
| 11 | 1812 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.2 |
| 12 | 2220 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.3 |
| 13 (Note 4) | 0603 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.1 |
| 14 (Note 4) | 0805 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.1 |
| 15 (Note 4) | 1206 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.15 |
| 16 (Note 4) | 1210 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.15 |
| 17 (Note 4) | 1812 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.2 |
| 18 (Note 4) | 2220 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.3 |
| 19 (Note 4) | 0603 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.1 |
| 20 (Note 4) | 0805 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.1 |
| 21 (Note 4) | 1206 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.15 |
| 22 (Note 4) | 1210 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.15 |
| 23 (Note 4) | 1812 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.2 |
| 24 (Note 4) | 2220 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.3 |
| 25 (Note 4) | 0402 | See Note 1 | Flexible + Ni barrier | Sn/Pb plating (Note 3) | 0.1 |
| 26 (Note 4) | 0402 | See Note 1 | Flexible + Ni barrier | Au plating (Note 2) | 0.1 |

NOTES:

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

| Variant Number | Style (Note 5) | Capacitance Range C _n (pF) | | Rated Voltage U _R (V) |
|----------------|----------------|---------------------------------------|---------|----------------------------------|
| | | Min | Max | |
| 01, 07 | 0603 | 10 | 1000 | 200 |
| 02, 08 | 0805 | 330 | 3900 | |
| 03, 09 | 1206 | 470 | 12000 | |
| 04, 10 | 1210 | 2200 | 27000 | |
| 05, 11 | 1812 | 4700 | 47000 | |
| 06, 12 | 2220 | 10000 | 120000 | |
| 13, 19 | 0603 | 10 | 3900 | |
| 14, 20 | 0805 | 330 | 15000 | |
| 15, 21 | 1206 | 470 | 47000 | |
| 16, 22 | 1210 | 2200 | 100000 | |
| 17, 23 | 1812 | 4700 | 180000 | |
| 18, 24 | 2220 | 10000 | 470000 | |
| 01, 07 | 0603 | 10 | 2700 | 100 |
| 02, 08 | 0805 | 68 | 10000 | |
| 03, 09 | 1206 | 470 | 27000 | |
| 04, 10 | 1210 | 2200 | 56000 | |
| 05, 11 | 1812 | 3900 | 120000 | |
| 06, 12 | 2220 | 22000 | 270000 | |
| 13, 19 | 0603 | 10 | 12000 | |
| 14, 20 | 0805 | 68 | 47000 | |
| 15, 21 | 1206 | 470 | 120000 | |
| 16, 22 | 1210 | 2200 | 220000 | |
| 17, 23 | 1812 | 3900 | 470000 | |
| 18, 24 | 2220 | 22000 | 1000000 | |
| 25, 26 | 0402 | 68 | 3300 | 50 |
| 01, 07 | 0603 | 10 | 10000 | |
| 02, 08 | 0805 | 100 | 56000 | |
| 03, 09 | 1206 | 470 | 82000 | |
| 04, 10 | 1210 | 2200 | 220000 | |
| 05, 11 | 1812 | 3900 | 470000 | |
| 06, 12 | 2220 | 22000 | 1200000 | |
| 13, 19 | 0603 | 10 | 22000 | |
| 14, 20 | 0805 | 100 | 100000 | |
| 15, 21 | 1206 | 470 | 180000 | |
| 16, 22 | 1210 | 2200 | 390000 | |
| 17, 23 | 1812 | 3900 | 820000 | |
| 18, 24 | 2220 | 22000 | 1800000 | |

| Variant Number | Style (Note 5) | Capacitance Range C _n (pF) | | Rated Voltage U _R (V) |
|----------------|----------------|---------------------------------------|---------|----------------------------------|
| | | Min | Max | |
| 25, 26 | 0402 | 68 | 5600 | 25 |
| 01, 07 | 0603 | 390 | 33000 | |
| 02, 08 | 0805 | 6800 | 150000 | |
| 03, 09 | 1206 | 10000 | 270000 | |
| 04, 10 | 1210 | 33000 | 560000 | |
| 05, 11 | 1812 | 100000 | 1200000 | |
| 06, 12 | 2220 | 150000 | 2200000 | |
| 13, 19 | 0603 | 390 | 33000 | |
| 14, 20 | 0805 | 6800 | 150000 | |
| 15, 21 | 1206 | 10000 | 270000 | |
| 16, 22 | 1210 | 33000 | 560000 | |
| 17, 23 | 1812 | 100000 | 1200000 | |
| 18, 24 | 2220 | 150000 | 2200000 | |
| 25, 26 | 0402 | 68 | 8200 | 16 |
| 01, 07 | 0603 | 390 | 100000 | |
| 02, 08 | 0805 | 6800 | 390000 | |
| 03, 09 | 1206 | 10000 | 1000000 | |
| 04, 10 | 1210 | 33000 | 820000 | |
| 05, 11 | 1812 | 100000 | 1200000 | |
| 06, 12 | 2220 | 150000 | 2700000 | |
| 13, 19 | 0603 | 390 | 100000 | |
| 14, 20 | 0805 | 6800 | 390000 | |
| 15, 21 | 1206 | 10000 | 1000000 | |
| 16, 22 | 1210 | 33000 | 820000 | |
| 17, 23 | 1812 | 100000 | 1800000 | |
| 18, 24 | 2220 | 150000 | 3900000 | |
| 25, 26 | 0402 | 10 | 12000 | 10 |
| 01, 07 | 0603 | 10 | 120000 | |
| 02, 08 | 0805 | 68 | 470000 | |
| 03, 09 | 1206 | 470 | 1500000 | |
| 04, 10 | 1210 | 2200 | 2200000 | |

| Capacitance Value C _n (pF) | Tolerance (± %) | Value Series |
|---------------------------------------|-----------------|--------------|
| 10 to 3900000 | 5 | E24 |
| | 10 | E12 |
| 10 to 3300000 | 20 | E6 |

Any capacitance value in the capacitance range may be available on request.

2. Variants 07 to 12 and 19 to 24 and 26 are not suitable for solder assembly methods. They shall be assembled using glue or wire bond techniques.
3. Sn/Pb plating with typically 60% Sn, 40% Pb.

4. Variants 13 to 24 have X7R dielectric; see High and Low Temperatures Electrical Measurements.
5. See Physical Dimensions.

1.5 MAXIMUM RATINGS

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

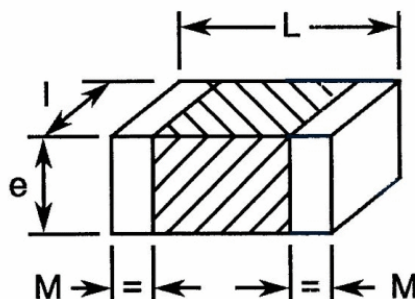
Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

| Characteristics | Symbols | Maximum Ratings | Units | Remarks |
|-----------------------------|-----------|--------------------------|-------|--------------------------------|
| Rated Voltage | U_R | 10, 16, 25, 50, 100, 200 | 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 Component Type Variants and Range of Components.
2. Duration 10 seconds maximum.

1.6 PHYSICAL DIMENSIONS



| Symbols | Dimensions (mm) | | | | | | | | | | | | | |
|---------|----------------------------------|-----|--|-----|--|------|--|------|--|-----|--|-----|--|-----|
| | Style 0402 Variants 25, 26 | | Style 0603 Variants 01, 07, 13, 19 | | Style 0805 Variants 02, 08, 14, 20 | | Style 1206 Variants 03, 09, 15, 21 | | Style 1210 Variants 04, 10, 16, 22 | | Style 1812 Variants 05, 11, 17, 23 | | Style 2220 Variants 06, 12, 18, 24 | |
| | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| L | 0.9 | 1.1 | 1.4 | 1.8 | 1.7 | 2.3 | 2.95 | 3.45 | 2.8 | 3.6 | 4 | 5 | 5.2 | 6.2 |
| I | 0.4 | 0.6 | 0.6 | 1 | 1.05 | 1.45 | 1.45 | 1.75 | 2.2 | 2.8 | 2.8 | 3.6 | 4.5 | 5.5 |
| e | - | 0.6 | - | 1 | - | 1.8 | - | 2.3 | - | 2.3 | - | 2.8 | - | 2.8 |
| M | 0.1 | 0.3 | 0.1 | 0.5 | 0.1 | 0.75 | 0.2 | 0.75 | 0.2 | 1 | 0.2 | 1 | 0.2 | 1 |

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

2.1.1.1 *Deviations from Qualification and Periodic Tests (Chart F4)*

- (a) Solderability: not applicable to Variants 07 to 12 and 19 to 24 and 26.

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.
- (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 $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

| Characteristics | Symbols | Test Method and Conditions | Tolerance (\pm %) | Limits | | Units |
|-----------------------|-------------------|--|----------------------|-----------------------------------|-----------------------------------|-------------|
| | | | | Min | Max | |
| Capacitance (Note 1) | C_A | ESCC No. 3009 | 5 10 20 | $0.95C_n$ $0.9C_n$ $0.8C_n$ | $1.05C_n$ $1.1C_n$ $1.2C_n$ | pF |
| Tangent of Loss Angle | $\text{tg}\delta$ | ESCC No. 3009 | All | - | 250×10^{-4} | - |
| Insulation Resistance | R_i | ESCC No. 3009 For $C_n \leq 10000\text{pF}$ For $C_n > 10000\text{pF}$ | All | 100 1000 | - - | GΩ GΩ.nF |
| Voltage Proof | VP | ESCC No. 3009 | All | $2.5U_R$ | - | V |

NOTES:

- 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 | |
| Temperature Characteristic | TC | ESCC No. 3009 $T_{amb} = -55 \pm 2^{\circ}\text{C}, +20 \pm 2^{\circ}\text{C}, +125 \pm 2^{\circ}\text{C}$ Note 2 For $V_T = \text{no voltage applied}$: All Variants: For $V_T = U_R$: Variants 01 to 12, 25 and 26: Variants 13 to 24: | -20 -30 Note 3 | +20 +20 | % |

NOTES:

- 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.
- In the case of a 100% inspection, a 1% total percent defective is allowed.
- 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 $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

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

| Test Reference per ESCC No. 3009 | Characteristics | Symbols | Limits | | Units |
|---|---|--|---|--|-----------------------|
| | | | Min | Max | |
| Mounting Final Measurements | Capacitance Tangent of Loss Angle Insulation Resistance | C_A $\text{tg}\delta$ R_I | Record Values - 250×10^{-4} Note 1 | | - |
| Rapid Change of Temperature Initial Measurements | Capacitance | C_A | Notes 1, 2 | | |
| Final Measurements | Capacitance Change in Capacitance Tangent of Loss Angle | C_A $\Delta C_A/C_A$ $\text{tg}\delta$ | -10 - | +10 500×10^{-4} | % |
| Steady State Humidity (85/85) Initial Measurements | Capacitance | C_A | Note 1 | | |
| Final Measurements (1000 hours) | Capacitance Change in Capacitance Tangent of Loss Angle Insulation Resistance (Note 3): For $C_n \leq 10000\text{pF}$ For $C_n > 10000\text{pF}$ | C_A $\Delta C_A/C_A$ $\text{tg}\delta$ R_I R_I | -10 - | +10 500×10^{-4} - - | % GΩ GΩ.nF |
| Operating Life Initial Measurements | Capacitance | C_A | Notes 1, 2 | | |
| Intermediate Measurements (1000 hours) (Note 4) | Capacitance Change in Capacitance Insulation Resistance: For $C_n \leq 10000\text{pF}$ For $C_n > 10000\text{pF}$ | C_A $\Delta C_A/C_A$ R_I R_I | -15 10 100 | +15 - - | % GΩ GΩ.nF |
| Final Measurements (1000 or 2000 hours) (Note 5) | Capacitance Change in Capacitance Tangent of Loss Angle Insulation Resistance: For $C_n \leq 10000\text{pF}$ For $C_n > 10000\text{pF}$ Voltage Proof | C_A $\Delta C_A/C_A$ $\text{tg}\delta$ R_I R_I VP | -15 - | +15 500×10^{-4} - - - | % GΩ GΩ.nF V |

| Test Reference per ESCC No. 3009 | Characteristics | Symbols | Limits | | Units |
|--|----------------------------|----------------|--------|-----|-------|
| | | | Min | Max | |
| Capacitance-Temperature Characteristics | Temperature Characteristic | TC | Note 6 | | |
| Robustness of Terminations Final Measurements | Capacitance | C _A | Note 1 | | |

NOTES:

1. As specified in Room Temperature Electrical Measurements.
2. Capacitance values recorded during Mounting may be used as initial measurements.
3. Test conditions for Insulation Resistance shall be as specified in Steady State Humidity in the ESCC Generic Specification.
4. Intermediate measurements are optional at the Manufacturer's discretion.
5. 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.
6. As specified in 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.