



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

BASED ON TYPES 0603 TO 2220

ESCC Detail Specification No. 3009/040

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1 **GENERAL**

1.1 **SCOPE**

This specification details the ratings, physical and electrical characteristics, test and inspection data for Capacitors, Fixed, Chips, Ceramic Dielectric, Type I With Flexible Terminations, based on Types 0603 to 2220. It shall be read in conjunction with ESCC Generic Specification No. 3009, the requirements of which are supplemented herein.

1.2 **COMPONENT TYPE VARIANTS AND RANGE OF COMPONENTS**

The variants and the range of components covered by this specification are given in Table 1(a).

1.3 **MAXIMUM RATINGS**

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the components specified herein, are as scheduled in Table 1(b).

1.4 **PARAMETER DERATING INFORMATION (FIGURE 1)**

Not applicable.

1.5 **PHYSICAL DIMENSIONS**

The physical dimensions of the capacitors specified herein are shown in Figure 2.

1.6 **FUNCTIONAL DIAGRAM**

The functional diagram for the capacitors specified herein is shown in Figure 3.

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, Capacitors, Fixed, Chips, Ceramic Dielectric, Types I and II

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.

TABLE 1(a) – COMPONENT TYPE VARIANTS AND RANGE OF COMPONENTS

Variant Number	Style	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 coating (Note 2)	0.1
02	0805	See Note 1	Flexible + Ni barrier	Sn/Pb coating (Note 2)	0.1
03	1206	See Note 1	Flexible + Ni barrier	Sn/Pb coating (Note 2)	0.15
04	1210	See Note 1	Flexible + Ni barrier	Sn/Pb coating (Note 2)	0.15
05	1812	See Note 1	Flexible + Ni barrier	Sn/Pb coating (Note 2)	0.2
06	2220	See Note 1	Flexible + Ni barrier	Sn/Pb coating (Note 2)	0.3
07	0603	See Note 1	Flexible + Ni barrier	Au plating	0.1
08	0805	See Note 1	Flexible + Ni barrier	Au plating	0.1
09	1206	See Note 1	Flexible + Ni barrier	Au plating	0.15
10	1210	See Note 1	Flexible + Ni barrier	Au plating	0.15
11	1812	See Note 1	Flexible + Ni barrier	Au plating	0.2
12	2220	See Note 1	Flexible + Ni barrier	Au plating	0.3

NOTES:

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

Variant Number	Style	Capacitance Range C _n (pF)		Rated Voltage U _R (V)
		Min	Max	
01, 07	0603	1	330	100
02, 08	0805	1	1200	
03, 09	1206	1	3900	
04, 10	1210	10	6800	
05, 11	1812	100	12000	
06, 12	2220	470	27000	
01, 07	0603	1	560	50
02, 08	0805	1	1800	
03, 09	1206	1	5600	
04, 10	1210	10	12000	
05, 11	1812	100	22000	
06, 12	2220	470	47000	
01, 07	0603	10	680	25
02, 08	0805	10	2200	
03, 09	1206	10	5600	
04, 10	1210	10	12000	
05, 11	1812	100	27000	
06, 12	2220	470	56000	
01, 07	0603	10	1000	16
02, 08	0805	10	2700	
03, 09	1206	10	6800	
04, 10	1210	10	15000	
05, 11	1812	100	33000	
06, 12	2220	470	68000	

Capacitance Value (pF)	Tolerance (±)	Value Series
For C _n ≤ 11.5pF	0.25pF	E 48
For C _n ≤ 9.1pF	0.5pF	E 24
For C _n ≤ 8.2pF	1pF	E 12
For C _n ≥ 27.4pF	1%	E 96
For C _n ≥ 12.7pF	2%	E 48
For C _n ≥ 10pF	5%	E 24
For C _n ≥ 10pF	10%	E 12

2. Sn/Pb coating, with typically 60% Sn 40% Pb.

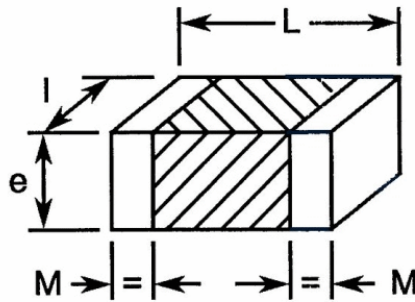
TABLE 1(b) – MAXIMUM RATINGS

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 Table 1(a).
2. Duration 10 seconds maximum.

FIGURE 2 – PHYSICAL DIMENSIONS



Symbols	Dimensions (mm)											
	Style 0603 Variants 01, 07		Style 0805 Variants 02, 08		Style 1206 Variants 03, 09		Style 1210 Variants 04, 10		Style 1812 Variants 05, 11		Style 2220 Variants 06, 12	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
L	1.45	1.75	1.7	2.3	2.95	3.45	2.8	3.6	4	5	5.2	6.2
l	0.65	0.95	1.05	1.45	1.45	1.75	2.2	2.8	2.8	3.6	4.5	5.5
e	-	1	-	1.3	-	1.6	-	1.8	-	1.8	-	1.8
M	0.1	0.5	0.1	0.75	0.2	0.75	0.2	1	0.2	1	0.2	1

FIGURE 3 – FUNCTIONAL DIAGRAM



4 REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the components specified herein shall be as stated in this specification and ESCC Generic Specification No. 3009. Deviations from the Generic Specification, applicable to this specification only, are listed in Para 4.2.

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 requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviations from Special In-Process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the components specified herein shall be verified in accordance with the requirements set out in Para. 9.3 of ESCC Generic Specification No. 3009 and shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the components specified herein shall be as given in Table 1(a).

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the capacitors specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Terminal Material and Finish

The terminal material and finish shall be as specified in Table 1(a).

4.5 MARKING

4.5.1 General

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 shall be:

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

4.5.2 ESCC Component Number

The ESCC Component Number shall be constituted and marked as follows:

Example: 3009xxx01B1000KC

- Detail Specification Reference: 3009xxx
- Component Type Variant Number: 01 (as required)
- Testing Level (B or C, as applicable): B
- Characteristic code: Capacitance Value (100pF): 1000 (as required)
- Characteristic code: Capacitance Tolerance ($\pm 5\%$): K (as required)
- Rating code: Rated Voltage (50V): C (as required)

4.5.2.1 Capacitance Value

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
X.XX	XCXX
XX.X	XXCX
XXX	XXX0
XXX 10^1	XXX1
XXX 10^2	XXX2

4.5.2.2 Tolerance

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

Tolerance (\pm)	Code Letter	Remark
0.25pF	C	
0.5pF	D	
1pF	F	For $C_n \leq 8.2\text{pF}$
1%	F	For $C_n \geq 27.4\text{pF}$
2%	G	
5%	J	
10%	K	

4.5.2.3 *Rated Voltage*

Rated Voltage expressed by the following codes:

Rated Voltage (V)	Code Letter
16	X
25	A
50	C
100	E

4.5.3 Traceability Information

Traceability information shall be marked in accordance with the requirements of ESCC Basic Specification No. 21700.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. Unless otherwise specified the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Table 3. The measurements shall be performed at the respective temperatures defined in Table 3.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

4.7 BURN-IN TESTS

4.7.1 Parameter Drift Values

The parameter drift values applicable to Burn-in are as specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

The parameter drift values (Δ) applicable to the parameters scheduled shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit values specified in Table 2 shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for Burn-in are specified in Section 7 of ESCC Generic Specification No. 3009. The conditions for Burn-in shall be as specified in Table 5 of this specification.

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.

4.7.3 Electrical Circuit for Burn-in (Figure 5)

Not applicable.

TABLE 2 – ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

Characteristics	Symbols	Test Method and Conditions	Tolerance (±)	Limits		Units
				Min	Max	
Capacitance	C _A	ESCC No. 3009 Para. 9.4.1.1	0.25pF 0.5pF 1pF 1% 2% 5% 10%	C _n -0.25 C _n -0.5 C _n -1 0.99C _n 0.98C _n 0.95C _n 0.9C _n	C _n +0.25 C _n +0.5 C _n +1 1.01C _n 1.02C _n 1.05C _n 1.1C _n	pF
Tangent of Loss Angle	tgδ	ESCC No. 3009 Para. 9.4.1.2 For C _n < 50pF For C _n > 50pF	All	-	Note 1 15 x 10 ⁻⁴	-
Insulation Resistance	R _I	ESCC No. 3009 Para. 9.4.1.3 For C _n ≤ 10000pF For C _n > 10000pF	All	100 1000	- -	GΩ MΩ.µF
Voltage Proof	VP	ESCC No. 3009 Para. 9.4.1.4	All	2.5U _R	-	V

NOTES:

- For C_n < 50pF, tgδ < 1.5 x (150/C_n + 7) x 10⁻⁴, where the unit quantity for C_n is in pF.

TABLE 3 – ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

Characteristics	Symbols	Test Method and Conditions	Limits		Units	Remarks
			Min	Max		
Insulation Resistance	R _I	ESCC No. 3009 Para. 9.4.1.3 T _{amb} = +125 ±3°C For C _n ≤ 10000pF For C _n > 10000pF	10 100	- -	GΩ MΩ.µF	Notes 1 and 2
Temperature Coefficient	TC	ESCC No. 3009 Para. 9.11 T _{amb} between: -55°C and +20 ±2°C +20 ±2°C and +125°C	-30 -30	+30 +30	10 ⁻⁶ /°C	5 parts for each capacitance value Notes 2, 4 and 5
Temperature Coefficient	TC	ESCC No. 3009 Para. 9.11 T _{amb} between: +20 ±2°C and +125°C	-30	+30	10 ⁻⁶ /°C	5 parts for each dielectric lot Notes 3, 4 and 5

NOTES:

- Single sample; Inspection Level S3; AQL = 2.5%
- Applicable to Testing Level B only.
- Applicable to Testing Level C only.
- Temperature Coefficient is not specified for C_n ≤ 20pF due to test equipment limitations.
- 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.

TABLE 4 – PARAMETER DRIFT VALUES

Characteristics	Symbols	Test Method and Conditions	Change Limits (Δ)	Unit
Capacitance Change	$\Delta C_A/C_A$	ESCC No. 3009 Paras. 9.4.1.1 & 9.4.2	± 0.5 or (Note 1) ± 1	pF %

NOTES:

1. Whichever is greater.

TABLE 5 – CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS

Characteristics	Symbols	Conditions	Units
Ambient Temperature	T_{amb}	+125 (+0 -5)	°C
Test Voltage	V_T	$2U_R$	V

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION No. 3009)

4.8.1 Measurements and Inspections on Completion of Environmental Tests

The parameters to be measured and inspections to be performed on completion of environmental tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3^\circ\text{C}$.

4.8.2 Measurements and Inspections at Intermediate Points During Endurance Tests

The parameters to be measured and inspections to be performed at intermediate points during endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3^\circ\text{C}$.

4.8.3 Measurements and Inspections on Completion of Endurance Tests

The parameters to be measured and inspections to be performed on completion of endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3^\circ\text{C}$.

4.8.4 Conditions for Operating Life (Part of Endurance Testing)

The requirements for Operating Life testing are specified in Section 9 of ESCC Generic Specification No. 3009. The conditions for Operating Life testing shall be as specified in Table 5 of this specification.

4.8.5 Electrical Circuit for Operating Life Tests (Figure 5)

Not applicable.

TABLE 6 – MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

ESCC Generic Spec. No. 3009		Measurements and Inspections		Symbol	Limits		Unit	
Environmental and Endurance Tests (Note 1)	Test Method and Conditions	Identification	Conditions		Min	Max		
Mounting	Para 9.15	Final Examination Terminals	Good Tinning	-	-	-	Record Values Note 2 Note 2	
		Final Measurements Capacitance	Table 2	C _A				
		Tangent of Loss Angle	Table 2	tgδ				
		Insulation Resistance	Table 2	R _I				
Adhesion	Para. 9.5	Final Examination Visual Examination	Damage or loosening	-	-	-	Note 2	
		Capacitance	Table 2	C _A				
Solderability	Para. 9.6	Final Examination Visual Examination	Para. 9.6.2	-	-	-		
Rapid Change of Temperature	Para. 9.7.2	Initial Measurements Capacitance	Table 2	C _A	Note 3		pF or % (Note 4)	
		Final Measurements Recovery period 24 ±2 hours	No damage	-	-	-		
		Visual Examination	Table 2	ΔC _A /C _A	-1	+1		
		Capacitance Change	Table 2	ΔC _A /C _A	-1	+1		
		Tangent of Loss Angle	Table 2	tgδ	-	Note 5		
Climatic Test Sequence	Para. 9.8	Initial Measurements Capacitance	Table 2	C _A	Note 3		pF or % (Note 4)	
		Final Measurements Recovery period 1 to 24 hours	Para. 9.8.6	-	-	-		
		Visual Examination	Table 2	ΔC _A /C _A	-1	+1		
		Capacitance Change	Table 2	ΔC _A /C _A	-2	+2		
		Tangent of Loss Angle	Table 2	tgδ	-	Note 5		
		Insulation Resistance	Table 2 For C _n ≤ 10000pF For C _n > 10000pF	R _I R _I	10 100	- -	GΩ MΩ.μF	

ESCC Generic Spec. No. 3009		Measurements and Inspections		Symbol	Limits		Unit	
Environmental and Endurance Tests (Note 1)	Test Method and Conditions	Identification	Conditions		Min	Max		
Damp Heat Steady State	Para. 9.9	Initial Measurements	Table 2	C_A	Note 3		pF or % (Note 4)	
		Capacitance						
		Final Measurements	Recovery period 6 to 24 ±2 hours					
		Visual Examination	No damage	-	-	-		
		Capacitance Change	Table 2	$\Delta C_A/C_A$	-1 -2	+1 +2		
Operating Life	Para. 9.10	Initial Measurements	Table 2	C_A	Note 3		pF or % (Note 4)	
		Capacitance						
		Intermediate Measurements	Recovery period 1 hour minimum					
		To be performed at 1000 hours (Chart IV)						
		Capacitance Change	Table 2	$\Delta C_A/C_A$	-1 -3	+1 +3		
		Insulation Resistance	Table 2					
		For $C_n \leq 10000\text{pF}$		R_i	10	-		GΩ
		For $C_n > 10000\text{pF}$		R_i	100	-		MΩ.μF
		Final Measurements	Recovery period 24 ±2 hours					
		Capacitance Change	Table 2	$\Delta C_A/C_A$	-1 -3	+1 +3		pF or % (Note 4)
Temperature Coefficient	Para. 9.11	Tangent of Loss Angle	Table 2	$\text{tg}\delta$	-	Note 5	GΩ MΩ.μF	
		Insulation Resistance	Table 2					
		For $C_n \leq 10000\text{pF}$		R_i	10	-		GΩ
		For $C_n > 10000\text{pF}$		R_i	100	-		MΩ.μF
		Voltage Proof	Table 2	VP	Note 2			
Visual Examination	No damage	-	-	-				
Temperature Coefficient	Para. 9.11	Temperature Coefficient	Table 3	TC	Note 6			

NOTES:

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.
2. As specified in Table 2.
3. Capacitance values recorded during Mounting shall be used as initial measurements.
4. Whichever is greater.
5. Twice the value specified in Table 2.
6. As specified in Table 3.