



**CAPACITORS, LEADLESS SURFACE MOUNTED,  
TANTALUM, SOLID ELECTROLYTE**

**BASED ON TYPE CTC21**

**ESCC Detail Specification No. 3012/002**

Issue 2	January 2014
---------	--------------



### **LEGAL DISCLAIMER AND COPYRIGHT**

European Space Agency, Copyright © 2014. 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
772, 819	Specification upissued to incorporate editorial and technical changes per DCR.

**TABLE OF CONTENTS**

1	GENERAL	6
1.1	SCOPE	6
1.2	RANGE OF COMPONENTS AND TYPE VARIANTS	6
1.3	MAXIMUM RATINGS	6
1.4	PARAMETER DERATING INFORMATION	6
1.5	PHYSICAL DIMENSIONS	6
1.6	FUNCTIONAL DIAGRAM	6
2	APPLICABLE DOCUMENTS	6
3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	6
4	REQUIREMENTS	12
4.1	GENERAL	12
4.2	DEVIATIONS FROM GENERIC SPECIFICATION	12
4.2.1	Deviations from Special In-process Controls	12
4.2.2	Deviations from Final Production Tests (Chart II)	12
4.2.3	Deviations from Burn-in and Electrical Measurements (Chart III)	12
4.2.4	Deviations from Qualification Tests (Chart IV)	12
4.2.5	Deviations from Lot Acceptance Tests (Chart V)	13
4.3	MECHANICAL REQUIREMENTS	13
4.3.1	Dimension Check	13
4.3.2	Weight	13
4.3.3	Adhesion	13
4.4	MATERIALS AND FINISHES	13
4.4.1	Case	13
4.4.2	Termination Material and Finish	13
4.5	MARKING	14
4.5.1	General	14
4.5.2	Polarity	14
4.5.3	The ESCC Component Number	14
4.5.4	Electrical Characteristics and Ratings	14
4.5.5	Traceability Information	15
4.6	ELECTRICAL MEASUREMENTS	15
4.6.1	Electrical Measurements at Room Temperature	15
4.6.2	Electrical Measurements at High and Low Temperatures	15
4.6.3	Circuits for Electrical Measurements (Figure 4)	15
4.7	BURN-IN TESTS	15



4.7.1	Parameter Drift Values	15
4.7.2	Conditions for Burn-in	15
4.7.3	Electrical Circuit for Burn-in (Figure 5)	16
4.8	ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION NO. 3012)	18
4.8.1	Measurements and Inspections on Completion of Environmental Tests	18
4.8.2	Measurements and Inspections at Intermediate Points during Endurance Tests	18
4.8.3	Measurements and Inspections on Completion of Endurance Tests	18
4.8.4	Conditions for Operating Life Tests (Part of Endurance Testing)	18
4.8.5	Electrical Circuit for Operating Life Tests (Figure 5)	18

## 1 GENERAL

### 1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Capacitors, Leadless Surface Mounted, Tantalum, Solid Electrolyte, based on Type CTC21. It shall be read in conjunction with ESCC Generic Specification No. 3012, the requirements of which are supplemented herein.

### 1.2 RANGE OF COMPONENTS AND TYPE VARIANTS

The range of capacitors covered by this specification is given in Table 1(a) and the Type Variants are given in Para. 4.4.2.

### 1.3 MAXIMUM RATINGS

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

### 1.4 PARAMETER DERATING INFORMATION

The derating information applicable to the capacitors specified herein is shown in Figure 1.

### 1.5 PHYSICAL DIMENSIONS

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

### 1.6 FUNCTIONAL DIAGRAM

The functional diagram of 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. 3012 for Capacitors, Leadless Surface Mounted, Tantalum, Solid Electrolyte, Enclosed Anode Connection.

## 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. In addition, the following symbols are used:

$V_T$  = Test Voltage.

**TABLE 1(a) - RANGE OF COMPONENTS**

(1) Rated Voltage (U <sub>R</sub> ) (V)	(2) Capacitance Value (C) (μF)	(3) Tolerance  (± %)	DC Leakage Current (I <sub>L</sub> )			Dissipation Factor (DF)			(10) ESR max 500kHz +25°C (mΩ)	(11) Ripple Current 500kHz +25°C (max) (1) (A)	(12) Ripple Current 1.0kHz +25°C (max) (1) (A)	(13) Case Size	(14) Max. Weight (g)
			(4) +25°C (μA)	(5) +85°C (μA)	(6) +125°C (μA)	(7) -55°C (%)	(8) +25°C (%)	(9) +85°C and +125°C (%)					
6.3	120	10, 20	7.6	76	95	16	8	12	40	3.2	2.5	C	1.8
6.3	150	10, 20	9.4	94	117	20	10	15	35	3.3	2	C	1.8
6.3	270	10, 20	17	170	212	20	10	15	30	4.1	3.4	D	3.3
6.3	330	10, 20	20.8	209	260	24	12	18	25	4.3	3.8	D	3.3
10	82	10, 20	8.2	82	102	16	8	12	45	2.9	1.8	C	1.8
10	100	10, 20	10	100	125	16	8	12	40	3	2.2	C	1.8
10	180	10, 20	18	180	225	16	8	12	35	3.7	3.4	D	3.3
10	220	10, 20	22	220	275	20	10	15	30	3.9	3.4	D	3.3
16	56	10, 20	8.9	89	111	12	6	9	55	2.6	1.8	C	1.8
16	68	10, 20	10.8	108	135	12	6	9	50	2.7	2.2	C	1.8
16	120	10, 20	19.2	192	240	16	8	12	40	3.5	2.8	D	3.3
16	150	10, 20	24	240	300	16	8	12	35	3.6	3.1	D	3.3
20	39	10, 20	7.8	78	97	10	5	7.5	65	2.4	1.7	C	1.8
20	47	10, 20	9.4	94	117	12	6	9	60	2.5	1.8	C	1.8
20	82	10, 20	16.4	164	205	12	6	9	45	3.1	2.5	D	3.3
20	100	10, 20	20	200	250	16	8	12	40	3.3	2.5	D	3.3
25	27	10, 20	6.7	67	83	10	5	7.5	75	2.2	1.2	C	1.8
25	33	10, 20	8.2	82	102	10	5	7.5	70	2.3	1.4	C	1.8



(1) Rated Voltage ( $U_R$ ) (V)	(2) Capacitance Value (C) ( $\mu$ F)	(3) Tolerance  ( $\pm$ %)	DC Leakage Current ( $I_L$ )			Dissipation Factor (DF)			(10) ESR max 500kHz +25°C (m $\Omega$ )	(11) Ripple Current 500kHz +25°C (max) (1) (A)	(12) Ripple Current 1.0kHz +25°C (max) (1) (A)	(13) Case Size	(14) Max. Weight (g)
			(4) +25°C ( $\mu$ A)	(5) +85°C ( $\mu$ A)	(6) +125°C ( $\mu$ A)	(7) -55°C (%)	(8) +25°C (%)	(9) +85°C and +125°C (%)					
25	56	10, 20	14	140	175	12	6	9	55	2.9	2.2	D	3.3
25	68	10, 20	17	170	212	12	6	9	50	3	2.4	D	3.3
40	22	10, 20	8.8	88	110	8	4	6	85	2.1	1.5	C	1.8
40	33	10, 20	13.2	132	165	10	5	7.5	70	2.5	1.9	D	3.3
40	47	10, 20	18.8	188	235	10	5	7.5	60	2.7	2.2	D	3.3
50	15	10, 20	7.5	75	93	6	3	4.5	100	1.9	1.4	C	1.8
50	18	10, 20	9	90	112	8	4	6	90	2	1.4	C	1.8
50	22	10, 20	11	110	137	8	4	6	85	2.3	1.7	D	3.3
63	5.6	10, 20	3.5	35	44	6	3	4.5	155	1.5	0.6	C	1.8
63	6.8	10, 20	4.2	42	53	6	3	4.5	140	1.6	0.7	C	1.8
63	8.2	10, 20	5.1	51	64	6	3	4.5	130	1.6	0.9	C	1.8
63	10	10, 20	6.3	63	78	6	3	4.5	120	1.7	1.1	C	1.8
63	18	10, 20	11.3	113	141	8	4	6	90	2.1	1.5	D	3.3
63	22	10, 20	13.8	138	173	8	4	6	85	2.3	1.7	D	3.3

**NOTES:**

1. At  $T_{amb} \leq +25^\circ\text{C}$ . For derating at  $T_{amb} > +25^\circ\text{C}$ , see Figure 1(a).



**TABLE 1(b) - MAXIMUM RATINGS**

No.	Characteristics	Symbol	Maximum Ratings	Units	Remarks
1	Rated Voltage	$U_R$	See Table 1(a), Column 1	Vdc	Note 1
2	Surge Voltage	$U_S$	$1.3 \times U_R$	Vdc	$\leq 85^\circ\text{C}$
3	Category Voltage	$U_C$	$0.66 \times U_R$	Vdc	
4	Operating Temperature Range	$T_{op}$	-55 to +125	$^\circ\text{C}$	$T_{amb}$
5	Rated Temperature	$T_r$	+85	$^\circ\text{C}$	
6	Category Temperature	$T_C$	+125	$^\circ\text{C}$	
7	Storage Temperature Range	$T_{stg}$	-55 to +125	$^\circ\text{C}$	
8	Soldering Temperature	$T_{sol}$	+260	$^\circ\text{C}$	Note 2

**NOTES:**

1. At  $T_{amb} \leq +25^\circ\text{C}$ . For derating at  $T_{amb} > +25^\circ\text{C}$ , see Figure 1(b).
2. Soldering time 10 seconds maximum for reflow soldering.

**FIGURE 1 - PARAMETER DERATING INFORMATION**

**FIGURE 1(a) - RIPPLE CURRENT VERSUS TEMPERATURE**

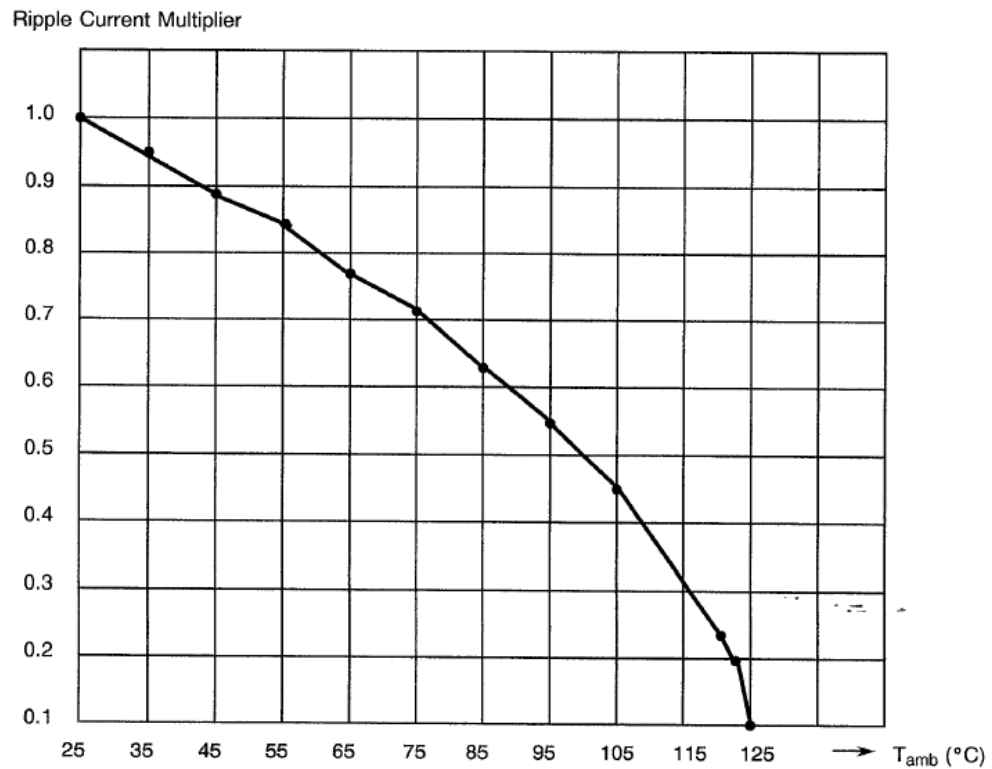
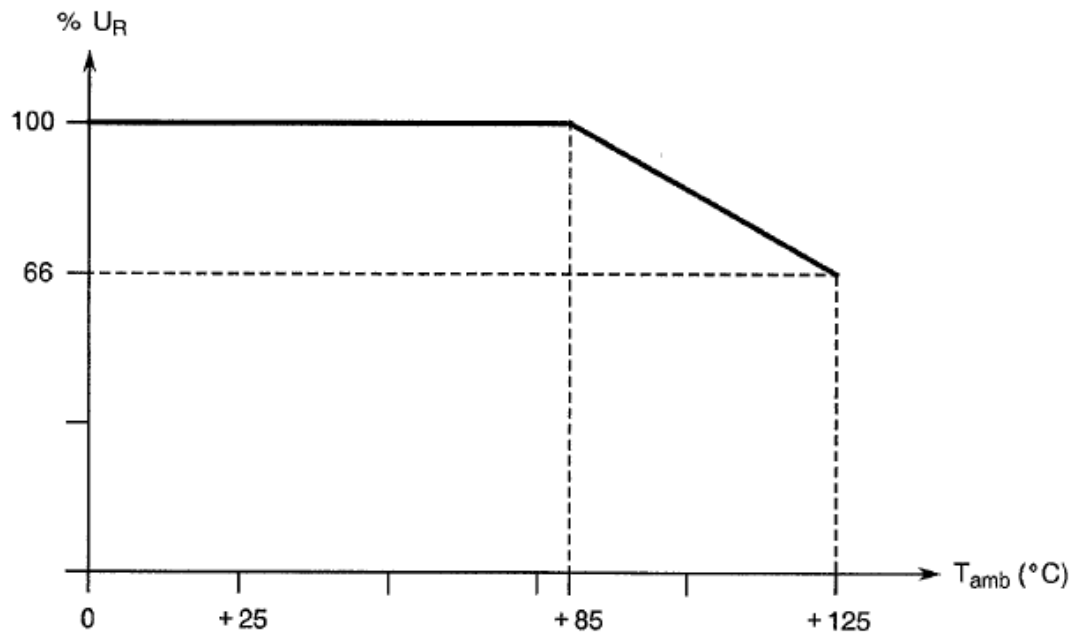
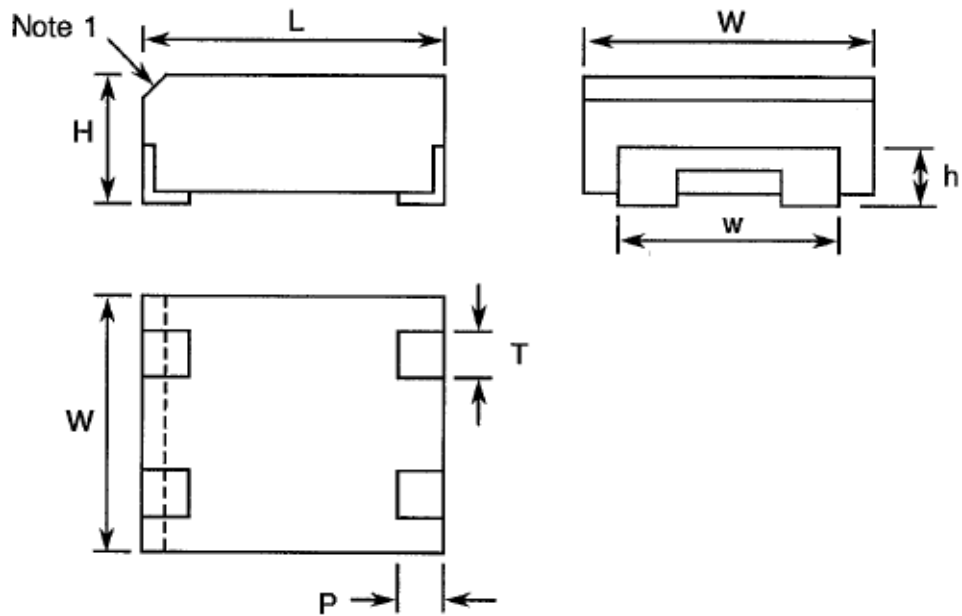


FIGURE 1(b) - RATED VOLTAGE VERSUS TEMPERATURE



**FIGURE 2 - PHYSICAL DIMENSIONS**

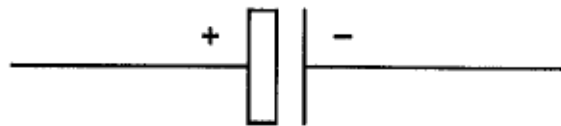


CASE SIZE	DIMENSIONS (mm)												
	L		W		H		w		P		T		h
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
C	10.9	11.9	8.9	9.5	4.4	5.4	6.7	7.3	1.2	1.8	1.7	2.3	2
D	10.9	11.9	12.4	13	5.4	6.4	10.2	10.8	1.2	1.8	2.7	3.3	2

**NOTES:**

1. Chamfer is 0.8mm at 45° and indicates the positive end.

**FIGURE 3 - FUNCTIONAL DIAGRAM**



## 4 REQUIREMENTS

### 4.1 GENERAL

The complete requirements for procurement of the capacitors specified herein shall be as stated in this specification and ESCC Generic Specification No. 3012 for Capacitors, Leadless Surface Mounted, Tantalum, Solid Electrolyte, Enclosed Anode Connection. Deviations from the Generic Specification, applicable to this Detail Specification only, are listed in Para. 4.2.

Deviations from the applicable 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)

(a) Para. 9.4.4, Electrical Measurements at Room Temperature:

- Capacitance and Dissipation factor shall be measured at 1kHz  $\pm$ 50Hz.
- ESR shall be measured as specified in Table 2.

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

(a) Para. 9.4.4, Electrical Measurements at Room Temperature:

- Capacitance and Dissipation factor shall be measured at 1kHz  $\pm$ 50Hz.
- ESR shall be measured as specified in Table 2.

#### 4.2.4 Deviations from Qualification Tests (Chart IV)

(a) An additional subgroup of 12 components shall be added to Chart IV (total 104 components). This subgroup shall be submitted to a ripple current test as follows:

- The capacitors shall be mounted and placed in a still air enclosure at room temperature. A sinusoidal AC voltage (100kHz  $\pm$ 2kHz) shall be superimposed on 50% of rated DC voltage so that the peak voltages do not exceed the value of the rated DC voltage of the capacitor. Rated ripple current (see Column 11 of Table 1(a)) shall be applied continuously, except for measurement periods, for a duration of 240 hours.
- The DC voltage shall be supplied by a regulated power supply, free from surges, having a low internal resistance, and shall be applied to each capacitor through a separate resistor. DC power supply regulation shall remain within  $\pm$ 2% or less. AC power supply shall be within  $\pm$ 5% of current with less than 10% distortion.
- After testing, the capacitors shall be examined for evidence of mechanical damage and shall be measured in accordance with Table 2 of this specification.
- 1 failure is allowed for this subgroup.

(b) Para. 9.19, Solderability: The solderable area is the termination 'pad' and up to 1/3 the height of the tab.

#### 4.2.5 Deviations from Lot Acceptance Tests (Chart V)

- (a) An additional subgroup of 12 components shall be added to Level 1 (total of 34 components). This subgroup shall be submitted to a ripple current test as specified in Para. 4.2.4.
- (b) Para. 9.19, Solderability: The solderable area is the termination 'pad' and up to 1/3 the height of the tab.

### 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. 9.6 of ESCC Generic Specification No. 3012. They shall conform to those shown in Figure 2 of this specification.

#### 4.3.2 Weight

The maximum weight of the capacitors specified herein shall be as follows:

Case Size 'C' - 1.8 grammes.

Case Size 'D' - 3.3 grammes.

#### 4.3.3 Adhesion

The requirements for adhesion are specified in Para. 9.10 of ESCC Generic Specification No. 3012.

### 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 components 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 Case

The case shall be epoxy moulding.

#### 4.4.2 Termination Material and Finish

The terminations shall be brass.

The termination finishes shall be Type '9' (Variant 01), Type '10' (Variant 03) and Type 18 (Variant 04) in accordance with the requirements of ESCC Basic Specification No. 23500.

4.5 MARKING

4.5.1 General

The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany each component in its primary package.

The information to be marked and the order of precedence, shall be as follows:

- (a) Polarity.
- (b) The ESCC Component Number.
- (c) Electrical Characteristics and Ratings.
- (d) Traceability Information.

4.5.2 Polarity

Polarity shall be defined by a chamfer on the positive end of the body of the capacitor.

4.5.3 The ESCC Component Number

Each component shall bear the ESCC Component Number which shall be constituted and marked as follows:

Example: 301200201B

- Detail Specification Number: 3012002
- Type Variant (see Note): 01
- Testing Level (B or C, as applicable): B

**NOTE:**

For Type Variants, see Para. 4.4.2.

4.5.4 Electrical Characteristics and Ratings

The electrical characteristics and ratings to be marked, in the following order of precedence, are:

- (a) Capacitance value.
- (b) Tolerance.
- (c) Rated voltage

The information shall be constituted and marked as follows:

Example: 127KB

- Capacitance Value (120000000pF): 127
- Tolerance ( $\pm 10\%$ ): K
- Rated Voltage (6.3V): B

4.5.4.1 Capacitance Values

The capacitance values shall be expressed by means of the following codes. The unit quantity for marking shall be picofarads (pF).

Capacitance Value (pF)	Code
XX10 <sup>5</sup>	XX5
XX10 <sup>6</sup>	XX6
XX10 <sup>7</sup>	XX7

4.5.4.2 *Tolerance*

The tolerance on capacitance shall be indicated by the code letters specified hereafter:

Tolerance ( $\pm$ %)	Code Letter
10	K
20	M

4.5.4.3 *Rated Voltage*

The rated voltage shall be indicated by the code letters specified hereafter:

Rated Voltage (V)	Code Letter
6.3	B
10	D
16	E
20	F
25	G
40	K
50	L
63	N

4.5.5 Traceability Information

Each component shall be marked in respect of traceability information 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.

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 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 ( $\Delta$ ) applicable to the scheduled parameters shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit value 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. 3012. The conditions for burn-in shall be as specified in Table 5(a) of this specification.

4.7.3 Electrical Circuit for Burn-in (Figure 5)  
Not applicable.

**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE**

No.	Characteristics	Symbol	ESCC 3012 Test Method	Test Conditions	Limits		Unit
					Min.	Max.	
1	Capacitance	C	Para. 9.4.1.1	f = 1000 ±50Hz V <sub>p</sub> ≤ 2.2V V <sub>m</sub> ≤ 1Vrms	Note 1		µF
2	DC Leakage Current	I <sub>L</sub>	Para. 9.4.1.2	V <sub>m</sub> = U <sub>R</sub> ±2% R <sub>S</sub> = 1.0kΩ	-	Note 2	µA
3	Dissipation Factor	DF	Para. 9.4.1.3	f = 1000 ±50Hz	-	Note 3	%
4	Equivalent Series Resistance	ESR	-	f = 500 ±5Hz V <sub>p</sub> ≤ 2.2V V <sub>acmax</sub> : 0.5Vrms	-	Note 4	mΩ

**NOTES:**

1. See Columns 2 and 3 of Table 1(a).
2. See Column 4 of Table 1(a).
3. See Column 8 of Table 1(a).
4. See Column 10 of Table 1(a).

**TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURE**

No.	Characteristics	Symbol	ESCC 3012 Test Method	Test Conditions (Note 1)	Limits		Unit
					Min.	Max.	
1	Capacitance Change	ΔC/C	Para. 9.4.1.1	f = 1000 ±50Hz V <sub>p</sub> ≤ 2.2V V <sub>m</sub> ≤ 1Vrms T <sub>amb</sub> = -55°C T <sub>amb</sub> = +85°C T <sub>amb</sub> = +125°C	-10 -8 -12	+10 +8 +12	% (2)
2	DC Leakage Current	I <sub>L</sub>	Para. 9.4.1.2	R <sub>S</sub> = 1.0kΩ T <sub>amb</sub> = +85 °C V <sub>m</sub> = U <sub>R</sub> ±2% T <sub>amb</sub> = +125°C V <sub>m</sub> = 0.67U <sub>R</sub>	-	Note 3 Note 4	µA
3	Dissipation Factor	DF	Para. 9.4.1.3	f = 1000 ±50Hz T <sub>amb</sub> = -55°C T <sub>amb</sub> = +85°C T <sub>amb</sub> = +125°C	- - -	Note 5 Note 6 Note 6	%



**NOTES:**

1. Inspection level II, single sampling, AQL 0.65% of IEC Publication No. 410 for each capacitance value. Each capacitance value shall be considered as constituting a complete lot.
2. With respect to the values measured in Table 2.
3. See Column 5 of Table 1(a).
4. See Column 6 of Table 1(a).
5. See Column 7 of Table 1(a).
6. See Column 9 of Table 1(a).

**FIGURE 4 – CIRCUITS FOR ELECTRICAL MEASUREMENTS**

Not applicable

**TABLE 4 - PARAMETER DRIFT VALUES**

No.	Characteristics	Symbol	Spec. and/or Test Method	Test Conditions	Change Limits ( $\Delta$ )	Unit
1	Capacitance Change	$\Delta C/C$	As per Table 2	As per Table 2	$\pm 5$	%
2	DC Leakage Current Change	$\Delta I_L/I_L$	As per Table 2	As per Table 2	Notes 1 and 2	$\mu A$

**NOTES:**

1. Leakage currents  $< 0.1\mu A$  are considered as a  $0.1\mu A$  value.
2.  $2x$  initial value measured or  $(0.25x \text{ Table 2 Item 2}) + 0.05\mu A$ , whichever is smaller.

**TABLE 5(a) - CONDITIONS FOR BURN-IN**

No.	Characteristics	Symbol	Conditions	Unit
1	Ambient Temperature	$T_{amb}$	+85 (+0 -3)	$^{\circ}C$
2	Test Voltage	$V_T$	$U_R$	V

**TABLE 5(b) - CONDITIONS FOR OPERATING LIFE TESTS**

No.	Characteristics	Symbol	Conditions	Unit
1	Ambient Temperature 1	$T_{amb1}$	+85 (+0 -3)	$^{\circ}C$
2	Test Voltage 1	$V_{T1}$	$U_R$	V
3	Ambient Temperature 2	$T_{amb2}$	+125 (+0 -3)	$^{\circ}C$
4	Test Voltage 2	$V_{T2}$	$U_C$	V

**FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND OPERATING LIFE TESTS**

Not applicable.

- 4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION No. 3012)
- 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 Tests (Part of Endurance Testing)  
The requirements for operating life testing are specified in Section 9 of ESCC Generic Specification No. 3012. The conditions for operating life testing shall be as specified in Table 5(b) 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**

No.	ESCC Generic Spec. No. 3012		Measurements and Inspections		Symbols	Limits		Units
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max	
01	Mounting	Para. 9.9	<b>Final Examination</b> Terminals	Good tinning	-	-	-	-
			<b>Final Measurements</b> Capacitance	Table 2 Item 1	C	Record Values		
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	Table 2	
			Dissipation Factor	Table 2 Item 3	DF	-	Table 2	
02	Rapid Change of Temperature	Para. 9.3.2	<b>Initial Measurements</b> Capacitance	Value recorded in 01	C	Table 2 Item 1		
			<b>Final Measurements</b> Visual Examination	Recovery period of 4 hours min. -	-	-	-	-
			Capacitance Change	Table 2 Item 1	ΔC/C	-5	+5	%
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	Table 2	
			Dissipation Factor	Table 2 Item 3	DF	-	Table 2	
03	External Visual Inspection	Para. 9.5	<b>Final Inspection</b> Visual Inspection	ESCC No. 20500	-	-	-	-
04	Adhesion	Para. 9.10	<b>Initial Measurements</b> Capacitance	Value recorded in 01	C	Table 2 Item 1		
			<b>Final Measurements</b> Visual Examination	No damage or loosening from the substrate	-	-	-	-
			Capacitance Change	Table 2 Item 1	ΔC/C	-5	+5	%
05	Vibration	Para. 9.11	<b>Measurements during test</b>	During Last Cycle				
				No Intermittent Contact > 0.5ms, arcing or open or shorts	-	-	-	-
			<b>Final Examination</b> Visual Examination	No damage	-	-	-	-
06	Shock or Bump	Para. 9.12	<b>Final Examination</b> Visual Examination	No damage	-	-	-	-

No.	ESCC Generic Spec. No. 3012		Measurements and Inspections		Symbols	Limits		Units	
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max		
07	Climatic Sequence	Para. 9.13	<b>Initial Measurements</b>						
			Capacitance	Value recorded in 01 After Dry Heat (2)	C	Table 2 Item 1			
			DC Leakage Current	Table 3 Item 2	I <sub>L</sub>	-	Table 3		
			<b>Final Measurements</b>	After recovery of 1 to 24 hours					
			Visual Inspection	ESCC No. 20500	-	-	-		-
			Capacitance Change	Table 2 Item 1	ΔC/C	-10	+10		%
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	Table 2		
	Dissipation Factor	Table 2 Item 3	DF	-	(3)				
08	High and Low Temperature Stability	Para. 9.14	<b>Measurements during test</b>						
			Electrical Measurements	Tables 2 & 3	-	Tables 2 & 3			
09	Surge Voltage	Para. 9.15	<b>Final Measurements</b>						
			Capacitance	Table 2 Item 1	C	-10	+10		% (4)
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	Table 2		
			Dissipation Factor	Table 2 Item 3	DF	-	Table 2		
10	Damp Heat Steady State	Para. 9.16	<b>Initial Measurements</b>						
			Capacitance	Table 2 Item 1	C	Table 2			
			<b>Final Measurements</b>	After recovery of 1 to 2 hours					
			Visual Examination	-	-	-	-		-
			Capacitance Change	Table 2 Item 1	ΔC/C	-10	+10		%
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	Table 2		
	Dissipation Factor	Table 2 Item 3	DF	-	(3)				

No.	ESCC Generic Spec. No. 3012		Measurements and Inspections		Symbols	Limits		Units	
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max		
11	Operating Life	Para. 9.17	<b>Initial Measurements</b>	Value recorded in 01	C	Table 2 Item 1			
			Capacitance						
			<b>Intermediate Measurements at 250 and 1000 hrs</b>	After recovery or 1 to 2 hours	I <sub>L</sub>	-	(5)		
			DC Leakage Current (2)						Table 3 Item 2
			<b>Final Measurements at 1000 and 2000 hrs</b>						
			Capacitance Change	Table 2 Item 1	ΔC/C	-10	+10	%	
			DC Leakage Current	Table 2 Item 2	I <sub>L</sub>	-	(6)		
Dissipation Factor	Table 2 Item 3	DF	-	(7)	%				
Visual Examination	No damage	-	-	-	-				
12	Permanence of Marking	Para. 9.18	<b>Final Examination</b>	No corrosion or obliteration of marking	-	-	-	-	
			Visual Examination						
13	Solderability	Para. 9.19 and Para. 4.2.4 of this spec	<b>Final Examination</b>	No damage	-	-	-	-	
			Visual Examination						

**NOTES:**

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.
2. While still at the high temperature.
3. 1.2x the value specified in Table 2 of this specification.
4. Compared to the values measured in Table 2 of this specification.
5. 1.25x the value specified in Table 3 of this specification.
6. 2x the value specified in Table 2 of this specification.
7. 1.5x the value specified in Table 2 of this specification.