



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

BASED ON TYPE CTC21E

ESCC Detail Specification No. 3012/003

Issue 5	October 2020
---------	--------------



LEGAL DISCLAIMER AND COPYRIGHT

European Space Agency, Copyright © 2020. 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
1360	Specification upissued 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	6
1.5	MAXIMUM RATINGS	8
1.6	PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION	10
1.7	FUNCTIONAL DIAGRAM	10
1.8	MATERIALS AND FINISHES	10
1.8.1	Case	10
1.8.2	Terminal Material and Finish	10
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

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 Component Type Variants and 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. [3012](#).

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: 301200301277KB

- Detail Specification Reference: 3012003
- Component Type Variant Number: 01 (as required)
- Characteristic code: Rated Capacitance (270 μ F): 277 (as required)
- Characteristic code: Capacitance Tolerance (\pm 10%): K
- Rating code: DC Rated Voltage (6.3V): B (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, 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 (pF)	Code
XX 10 ⁶	XX6
XX 10 ⁷	XX7

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

Tolerance (\pm %)	Code
10	K
20	M

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

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

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	Terminal Finish (Note 1)	Case Code (Note 2)	Capacitance Range C_n (μ F) (Notes 3, 4)	DC Rated Voltage U_R (V) (Note 3)	Weight Max (g)
01	9	C, D	12 to 680	6.3 to 63	Case Code C: 2
					Case Code D: 3.6
03	10	C, D	12 to 680	6.3 to 63	Case Code C: 2
					Case Code D: 3.6
04	18	C, D	12 to 680	6.3 to 63	Case Code C: 2
					Case Code D: 3.6

NOTES:

1. See Para. 1.8.2.
2. See Para. 1.6.
3. The following Rated Capacitance (C_n) and DC Rated Voltage (U_R) are available in the following cases (and with the following characteristics; see Paras. 2.3.1 and 2.3.2):

(1) DC Rated Voltage (U_R) (V)	(2) Cap. Value (C_n) (μ F)	(3) Case Size	DC Leakage Current (I_L)			Dissipation Factor (DF)			(10) Equivalent Series Resistance (ESR) (m Ω)
			(4) +22 $^{\circ}$ C (μ A)	(5) +85 $^{\circ}$ C (μ A)	(6) +125 $^{\circ}$ C (μ A)	(7) -55 $^{\circ}$ C (%)	(8) +22 $^{\circ}$ C (%)	(9) +85 $^{\circ}$ C and +125 $^{\circ}$ C (%)	
6.3	270	C	17	170	212	32	16	24	45
6.3	330	C	20.8	208	260	40	20	30	45
6.3	560	D	35.3	353	441	48	24	36	35
6.3	680	D	42.8	428	535	60	30	45	35

(1) DC Rated Voltage (U _R) (V)	(2) Cap. Value (C _n) (μF)	(3) Case Size	DC Leakage Current (I _L)			Dissipation Factor (DF)			(10) Equivalent Series Resistance (ESR) (mΩ)
			(4) +22°C (μA)	(5) +85°C (μA)	(6) +125°C (μA)	(7) -55°C (%)	(8) +22°C (%)	(9) +85°C and +125°C (%)	
10	180	C	18	180	225	24	12	18	50
10	220	C	22	220	275	24	12	18	45
10	390	D	39	390	487	40	20	30	35
10	470	D	47	470	587	44	22	33	35
16	120	C	19.2	192	240	20	10	15	55
16	150	C	24	240	300	24	12	18	50
16	270	D	43.2	432	540	32	16	24	45
16	330	D	52.8	528	660	40	20	30	45
20	82	C	16.4	164	205	12	6	9	65
20	100	C	20	200	250	16	8	12	60
20	180	D	36	360	450	24	12	18	50
20	220	D	44	440	550	24	12	18	45
25	39	C	9.7	97	121	10	5	7.5	95
25	47	C	11.7	117	146	12	6	9	85
25	82	D	20.5	205	256	12	6	9	65
25	100	D	25	250	312	16	8	12	60
40	33	C	13.2	132	165	10	5	7.5	100
40	56	D	22.4	224	280	12	6	9	80
40	68	D	27.2	272	340	12	6	9	75
50	22	C	11	110	137	10	5	7.5	125
50	47	D	23.5	235	293	12	6	9	85
63	12	C	7.5	75	93	10	5	7.5	160
63	15	C	9.4	94	118	10	5	7.5	145
63	33	D	20.8	208	260	10	5	7.5	100

4. The following Capacitance Tolerances are available:

- ±10% (K)
- ±20% (M)

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
DC Rated Voltage	U_R	See Para. 1.4.2	V	Note 1
DC Surge Voltage	U_S	$1.3 \times U_R$	V	$T_{amb} \leq +85^\circ\text{C}$
DC Category Voltage	U_C	$0.66 \times U_R$	V	
Ripple Current	I_{ripple}	See Note 2	A	Note 3
Operating Temperature Range	T_{op}	-55 to +125	$^\circ\text{C}$	T_{amb}
Rated Temperature	T_R	+85	$^\circ\text{C}$	
Upper Category Temperature	T_C	+125	$^\circ\text{C}$	
Storage Temperature Range	T_{stg}	-55 to +125	$^\circ\text{C}$	
Soldering Temperature	T_{sol}	+260	$^\circ\text{C}$	Note 4

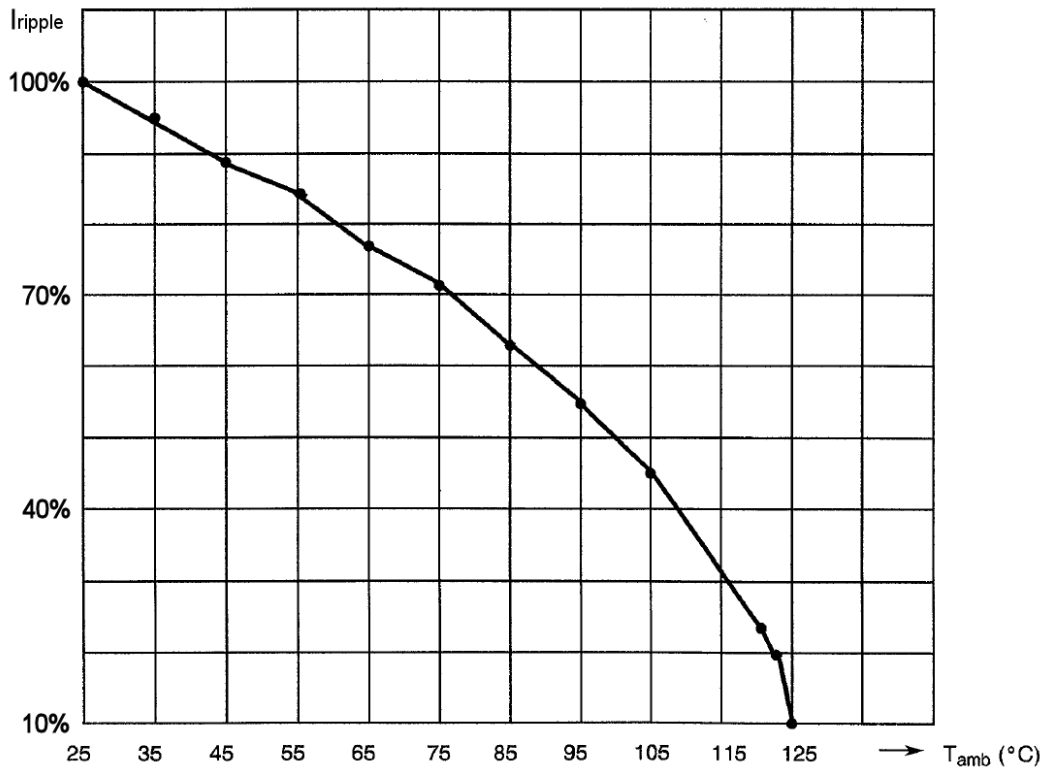
NOTES:

- At $T_{amb} \leq +85^\circ\text{C}$. For $T_{amb} > +85^\circ\text{C}$, derate linearly to U_C at $T_{amb} = +125^\circ\text{C}$.
- Maximum I_{ripple} , which depends on C_n and U_R , shall be as follows at $T_{amb} \leq +25^\circ\text{C}$:

(1) DC Rated Voltage U_R (V)	(2) Capacitance C_n (μF)	(3) Maximum Ripple Current $f = 500\text{kHz}$ I_{ripple} (A)	(4) Maximum Ripple Current $f = 1\text{kHz}$ I_{ripple} (A)
6.3	270	2.9	2
6.3	330	2.9	2
6.3	560	3.6	2.5
6.3	680	3.6	2.5
10	180	2.7	1.9
10	220	2.9	2
10	390	3.6	2.5
10	470	3.6	2.5
16	120	2.6	1.8
16	150	2.9	2
16	270	3.5	2.3
16	330	3.6	2.5
20	82	2.4	1.7
20	100	2.5	1.7
20	180	3	2.1
20	220	3.1	2.2
25	39	2	1.4
25	47	2.1	1.5
25	82	2.6	1.8
25	100	2.7	1.9

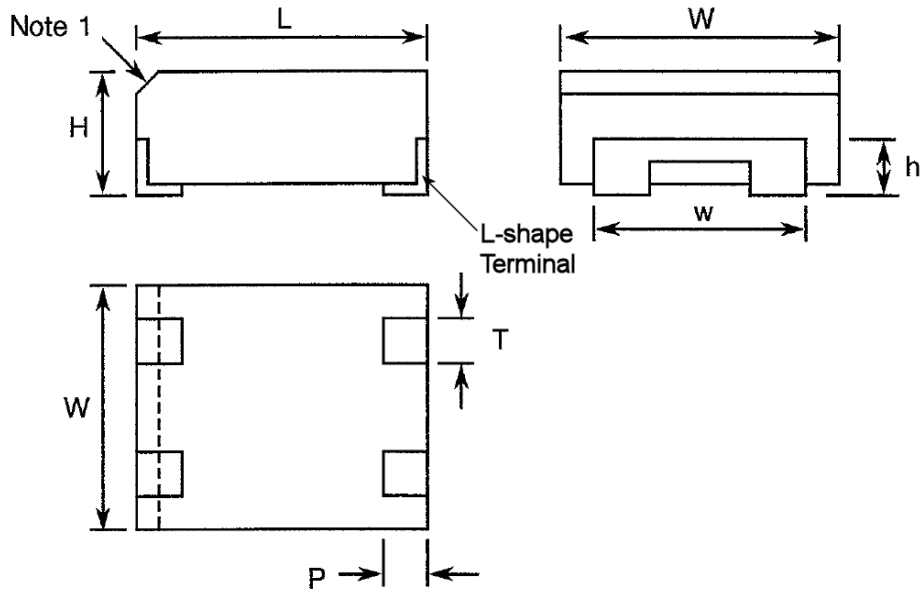
(1) DC Rated Voltage U_R (V)	(2) Capacitance C_n (μ F)	(3) Maximum Ripple Current $f = 500\text{kHz}$ I_{ripple} (A)	(4) Maximum Ripple Current $f = 1\text{kHz}$ I_{ripple} (A)
40	33	1.9	1.3
40	56	2.3	1.6
40	68	2.4	1.7
50	22	1.7	1.2
50	47	2,3	1.6
63	12	1.5	1.1
63	15	1.6	1.1
63	33	2.1	1.5

3. At $T_{\text{amb}} \leq +25^\circ\text{C}$. For $T_{\text{amb}} > +25^\circ\text{C}$, derate maximum I_{ripple} as follows:



4. Duration 5 seconds maximum for wave soldering and 10 seconds maximum for reflow soldering. The solderable area is the terminal pad and up to 1/3 the height of the L-shape terminal (see Para. 1.6).

1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

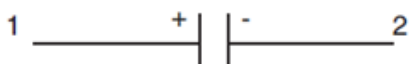


Case Code	Dimensions (mm)													
	L		H		h		W		w		P		T	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
C	10.9	11.9	4.4	5.4	2	-	8.9	9.5	6.7	7.3	1.2	1.8	1.7	2.3
D	10.9	11.9	5.4	6.4	2	-	12.4	13	10.2	10.8	1.2	1.8	2.7	3.3

NOTES:

- Terminal identification: The anode terminal shall be indicated by a 0.8mm 45° chamfer on the body of the component as indicated.

1.7 FUNCTIONAL DIAGRAM



Terminal 1: Anode

Terminal 2: Cathode

1.8 MATERIALS AND FINISHES

1.8.1 Case

The case shall be moulded epoxy.

1.8.2 Terminal Material and Finish

Terminal material shall be brass. Terminal finish shall be as specified in Para. 1.4.2 in accordance with the requirements of ESCC Basic Specification No. [23500](#).

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 *Qualification and Periodic Testing - Chart F4*

(a) Ripple Current

For Qualification Testing and Periodic Testing, an additional subgroup of 12 components with period 24 months shall be added to Chart F4. Where more than 4 test vehicles are selected for the Qualification Test Lot, the minimum quantity of components per test vehicle for this subgroup shall be 3. No failures are allowed. The components in this subgroup shall be submitted to a ripple current test. The following details shall apply:

- Test Conditions:

(a) Test temperature: $T_{amb} = +22 \pm 3^{\circ}\text{C}$. Components suitably mounted in still air.

(b) Applied voltage and current: V_{AC} at $100 \pm 2\text{kHz}$ superimposed on 50% DC Rated Voltage, U_R , such that the peak voltage does not exceed U_R . Rated Ripple Current, I_{ripple} (see Para. 1.5, Note 2, Column 3), shall be applied continuously.

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 the specified ripple current with less than 10% distortion

(c) Test duration: 240 hours minimum.

- Data Points

On completion of testing, components shall be visually examined. There shall be no evidence of damage.

Capacitance, DC Leakage Current, Dissipation Factor and Equivalent Series Resistance shall be measured as specified in Intermediate and End-Point Electrical Measurements.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. [21700](#). The information to be marked shall be:

- (a) Terminal Identification (see Para. 1.6).
- (b) The ESCC qualified components symbol (for ESCC qualified components only).
- (c) The ESCC Component Number (see Para. 1.4.1).
- (d) 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	Limits		Units
				Min	Max	
Capacitance	C	ESCC No. 3012 $f = 1000 \pm 50\text{Hz}$ $V_p \leq 2.2\text{V}$ $V_{ACmax} \leq 1V_{rms}$	$\pm 10\%$ $\pm 20\%$	$0.9C_n$ $0.8C_n$	$1.1C_n$ $1.2C_n$	μF
DC Leakage Current	I_L	ESCC No. 3012	All	-	Note 1	μA
Dissipation Factor	DF	ESCC No. 3012 $f = 1000 \pm 50\text{Hz}$	All	-	Note 2	%
Equivalent Series Resistance	ESR	ESCC No. 3012	All		Note 3	$\text{m}\Omega$

NOTES:

1. See Para. 1.4.2, Note 3, Column 4.
2. See Para. 1.4.2, Note 3, Column 8.
3. See Para. 1.4.2, Note 3, Column 10.

2.3.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	Test Method and Conditions (Note 1)	Tolerance	Limits		Units
				Min	Max	
Capacitance	C	ESCC No. 3012, $f = 1000 \pm 50\text{Hz}$ $V_p \leq 2.2\text{V}$, $V_{ACmax} \leq 1V_{rms}$ $T_{amb} = -55 (+3 -0)^{\circ}\text{C}$: $T_{amb} = +85 \pm 3^{\circ}\text{C}$: $T_{amb} = +125 (+0 -3)^{\circ}\text{C}$:	$\pm 10\%$ $\pm 20\%$ $\pm 10\%$ $\pm 20\%$ $\pm 10\%$ $\pm 20\%$	$0.81C_n$ $0.72C_n$ $0.828C_n$ $0.736C_n$ $0.792C_n$ $0.704C_n$	$1.21C_n$ $1.32C_n$ $1.188C_n$ $1.296C_n$ $1.232C_n$ $1.344C_n$	μF
DC Leakage Current	I_L	ESCC No. 3012 $T_{amb} = +85 \pm 3^{\circ}\text{C}$, $V = U_R \pm 2\%$: $T_{amb} = +125 (+0 -3)^{\circ}\text{C}$, $V = U_C \pm 2\%$:	All	-	Note 2 Note 3	μA
Dissipation Factor	DF	ESCC No. 3012, $f = 1000 \pm 50\text{Hz}$ $T_{amb} = -55 (+3 -0)^{\circ}\text{C}$: $T_{amb} = +85 \pm 3^{\circ}\text{C}$: $T_{amb} = +125 (+0 -3)^{\circ}\text{C}$:	All	-	Note 4 Note 5 Note 5	%

NOTES:

1. Measurements shall be performed on a sample of 5 components from each manufacturing lot and each capacitance value with 0 failures allowed. In the event of any failure a 100% inspection may be performed.

2. See Para. 1.4.2, Note 3, Column 5.
3. See Para. 1.4.2, Note 3, Column 6.
4. See Para. 1.4.2, Note 3, Column 7.
5. See Para. 1.4.2, Note 3, Column 9.

2.4 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}C$.

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. 3012	Characteristics	Symbols	Limits		Units
			Min	Max	
Mounting Final Measurements	Capacitance DC Leakage Current Dissipation Factor	C I _L DF	Record -	Value Note 1 Note 1	μF μA %
Robustness of Terminations Initial Measurements	Capacitance	C	Note 2		μF
Final Measurements	Capacitance Capacitance Change	C ΔC/C	Record -5	Value +5	μF % (2)
Rapid Change of Temperature Initial Measurements	Capacitance	C	Note 2		μF
Final Measurements	Capacitance Capacitance Change DC Leakage Current Dissipation Factor	C ΔC/C I _L DF	Record -5 -	Value +5 Note 1 Note 1	μF % (2) μA %
Vibration During Last Sweep Cycle	No intermittent contact ≥ 0.5ms, arcing, or open/short circuits	-	-	-	-
Climatic Sequence Initial Measurements	Capacitance	C	Note 2		μF
Dry Heat	DC Leakage Current (at +125°C; U _c)	I _L	-	Note 3	μA
Final Measurements	Capacitance Capacitance Change DC Leakage Current Dissipation Factor	C ΔC/C I _L DF	Record -10 -	Value +10 Note 1 Note 4	μF % (2) μA %
High and Low Temperature Stability					
Step 1 (at +22°C)	Note 1 (All Characteristics)	Note 1	Note 1		
Step 2 (at -55°C)	Note 3 (All Characteristics)	Note 3	Note 3		
Step 3 (at +22°C)	Note 1 (All Characteristics)	Note 1	Note 1		
Step 4 (at +85°C)	Note 3 (All Characteristics)	Note 3	Note 3		
Step 5 (at +125°C)	Note 3 (All Characteristics)	Note 3	Note 3		
Step 6 (at +22°C)	Note 1 (All Characteristics)	Note 1	Note 1		

Test Reference per ESCC No. 3012	Characteristics	Symbols	Limits		Units
			Min	Max	
Surge Voltage					
Initial Measurements	Capacitance	C	Note 2		μF
Final Measurements	Capacitance	C	Record	Value	μF
	Capacitance Change	ΔC/C	-10	+10	% (2)
	DC Leakage Current	I _L	-	Note 1	μA
	Dissipation Factor	DF	-	Note 1	%
Damp Heat, Steady State					
Initial Measurements	Capacitance	C	Note 2		μF
Final Measurements	Capacitance	C	Record	Value	μF
	Capacitance Change	ΔC/C	-10	+10	% (2)
	DC Leakage Current	I _L	-	Note 1	μA
	Dissipation Factor	DF	-	Note 4	%
Operating Life					
Initial Measurements	Capacitance	C	Note 2		μF
Intermediate Measurements (250h and 1000h)(Note 8)	DC Leakage Current (at T1 = +85°C)	I _L	-	Note 5	μA
	DC Leakage Current (at T2 = +125°C)	I _L	-	Note 5	μA
Intermediate Measurements (250h)(Note 9)	DC Leakage Current (at T1 = +85°C)	I _L	-	Note 5	μA
Final Measurements (1000h or 2000h)(Note 10)	Capacitance	C	Record	Value	μF
	Capacitance Change	ΔC/C	-10	+10	% (2)
	DC Leakage Current	I _L	-	Note 6	μA
	Dissipation Factor	DF	-	Note 7	%
Ripple Current (Para. 2.1.1.1(a))					
Final Measurements	Capacitance	C	Note 1		μF
	DC Leakage Current	I _L	-	Note 1	μA
	Dissipation Factor	DF	-	Note 1	%
	Equivalent Series Resistance	ESR	-	Note 1	mΩ

NOTES:

- As specified in Para. 2.3.1.
- Capacitance measured during the final measurements during Mounting may be used as the initial measurement for other tests. In this case, Capacitance Change shall be referred to this initial measurement.
- As specified in Para. 2.3.2.
- 1.2x the limit specified in Para. 2.3.1.
- 1.25x the limit specified in Para. 2.3.2.
- 2x the limit specified in Para. 2.3.1.
- 1.5x the limit specified in Para. 2.3.1.
- Applicable to Qualification Testing, and to Periodic Testing for renewal of qualification after lapse.
- Applicable to Periodic Testing for extension of qualification.
- 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.