CAPACITORS, FIXED, TUBULAR, POROUS TANTALUM CATHODE AND ANODE, GELLED ELECTROLYTE, HERMETICALLY SEALED

BASED ON TYPES CLR79

ESCC Detail Specification No. 3003/005

Issue 4	September 2023

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DCR No.	CHANGE DESCRIPTION
1584	Specification updated to incorporate changes per DCR.

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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. 3003.

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: 300300502566KE

- Detail Specification Reference: 3003005
- Component Type Variant Number: 02 (as required)
- Characteristic code: Rated Capacitance (56µF): 566 (as required)
- Characteristic code: Capacitance Tolerance (±10%): K (as required)
- Rating code: DC Rated Voltage (16V): E (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 10^5	XX5
XX 10^6	XX6
XX 10^7	XX7
XX 10^8	XX8

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

Tolerance (± %)	Code
10	K
20	M

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

DC Rated Voltage U_R (V)	Code
6	Z
6.3	A
8	C
10	D
15	G
16	E
25	F
30	H
40	J
50	K
60	M
63	L
75	P
100	Q
125	R

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	Case Size (Notes 1, 2)	Capacitance Range C_n (µF) (Notes 2, 3)	DC Rated Voltage U_R (V) (Note 2)	Weight Max (g)
02	A	2.7 to 160	6 to 125	2.6
03	B	14 to 560	6 to 125	6.2
04	C	25 to 1500	6 to 125	11.6
05	D	56 to 2200	6 to 125	17.7

NOTES:

1. See Para. 1.6.
2. The following DC Rated Voltage (U_R), rated Capacitance (C_n) and case sizes are available. Electrical characteristics for each component type are as specified below:

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
6	30	A	1	2	9	10	+10	+12	-40	100
6	68	A	1	2	15	15	+14	+16	-40	60
6	140	B	1	3	21	21	+16	+16	-40	40
6	160	A	2	9	41	41	+16	+16	-42	80
6	270	B	1	7	45	41	+17	+20	-44	25
6	330	C	2	8	36	36	+14	+16	-44	20
6	560	B	2	10	106	106	+20	+20	-68	48
6	560	C	2	16	55	50	+18	+20	-64	25
6	1200	D	3	14	90	86	+25	+25	-80	20
6	1500	C	5	20	172	172	+25	+25	-90	36
6	2200	D	6	24	170	170	+25	+25	-90	22
6.3	68	A	1	2	15	15	+14	+16	-40	60
6.3	120	A	1.5	3	21	21	+15	+16	-41	81
6.3	150	A	2	9	34	34	+16	+16	-42	80
6.3	220	B	1	6.5	40	36	+16	+18	-44	30
6.3	470	B	2	10	90	90	+20	+20	-60	46
6.3	560	B	2	10	106	106	+20	+20	-68	48
6.3	560	C	2	16	50	50	+18	+20	-64	25
6.3	1000	D	3	14	72	68	+25	+25	-80	22
6.3	1500	C	5	20	172	172	+25	+25	-90	36
6.3	1800	D	6	24	136	136	+25	+30	-90	13
6.3	2200	D	6	24	170	170	+25	+25	-90	22

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
8	25	A	1	2	7.5	6.0	+10.5	+12	-40	100
8	56	A	1	2	14	14	+14	+16	-40	59
8	120	A	2	6	32	32	+17.5	+20	-44	80
8	120	B	1	2	20	20	+17.5	+20	-44	50
8	220	B	1	7	40	36	+16	+18	-44	30
8	290	C	2	6	34	33	+17.5	+20	-64	25
8	430	B	2	10	64	60	+17.5	+20	-64	54
8	430	C	2	15	46	42	+17.5	+20	-64	25
8	850	D	3	16	60	56	+25	+25	-80	22
10	20	A	1	2	6	6	+10.5	+12	-32	175
10	47	A	1	2	13	13	+14	+16	-36	100
10	68	A	1.5	3	21	21	+15	+16	-40	85
10	82	A	2	6	25	25	+16	+16	-40	84
10	100	A	2	6	30	30	+16	+16	-40	82
10	100	B	1	4	15	15	+14	+16	-36	60
10	150	B	1	7	30	28	+14	+16	-32	45
10	180	B	1	7	30	30	+14	+16	-35	40
10	250	C	2	10	30	30	+14	+16	-40	30
10	300	B	2	10	60	60	+16	+18	-54	52
10	330	B	2	10	65	65	+17	+18	-54	52
10	350	B	2	10	68	68	+18	+18	-60	52
10	390	B	2	10	74	74	+19	+20	-60	54
10	390	C	2	15	44	41	+18	+20	-64	25
10	470	C	2	15	44	44	+18	+20	-65	25
10	680	D	3	16	46	42	+25	+25	-80	20
10	750	D	3	16	50	46	+25	+25	-80	23
10	820	D	3	16	57	53	+25	+25	-80	22
10	850	C	4	16	111	111	+25	+25	-84	36
10	1000	C	4	16	92	92	+25	+25	-80	36
10	1200	C	5	20	137	137	+25	+25	-80	36
10	1500	D	7	25	114	114	+30	+30	-88	23
10	1800	D	7	25	138	138	+30	+30	-88	24

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
15	15	A	1	2	5	5	+10.5	+12	-24	155
15	33	A	1	2	10	10	+14	+16	-28	90
15	47	A	1.5	3	20	20	+16	+16	-28	100
15	56	A	1.5	3	22	22	+16	+16	-28	100
15	70	B	1	4	13	13	+14	+16	-28	75
15	120	B	1	7	25	25	+14	+16	-28	50
15	170	C	2	10	25	25	+14	+16	-32	35
15	220	B	2	10	42	42	+16	+16	-35	62
15	270	B	2	12	55	55	+18	+18	-45	60
15	270	C	2	14	43	40	+18	+20	-56	30
15	290	B	2	12	60	60	+18	+18	-54	65
15	540	D	3	18	40	36	+25	+25	-80	23
15	750	C	6	24	95	95	+25	+25	-80	42
15	850	D	8	32	95	95	+25	+25	-80	24
15	1200	D	8	32	103	103	+25	+30	-84	25
16	33	A	1	2	10	10	+14	+16	-28	90
16	47	A	1.5	3	20	20	+16	+16	-28	100
16	56	A	1.5	3	22	22	+16	+16	-28	100
16	120	B	1	7	25	25	+14	+16	-28	50
16	220	B	2	10	42	42	+16	+16	-35	62
16	270	B	2	12	55	55	+18	+18	-45	60
16	330	C	2	14	40	40	+18	+20	-58	30
16	330	C	2	14	40	40	+18	+20	-58	30
16	470	D	3	18	37	33	+25	+25	-75	24
16	560	D	3	18	40	36	+25	+25	-80	23
16	680	C	5	20	80	80	+25	+25	-80	42
16	820	C	6	24	95	95	+25	+25	-80	42
16	1000	D	8	32	92	92	+25	+25	-82	25
16	1200	D	8	32	103	103	+25	+30	-84	25

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
25	10	A	1	2	4	4	+8	+9	-16	220
25	22	A	1	2	7	7	+10	+12	-20	140
25	27	A	1.5	3	11	11	+12	+12	-20	140
25	33	A	1.5	3	13	13	+14	+14	-24	130
25	39	A	2	9	16	16	+16	+16	-28	120
25	43	A	2	9	18	18	+16	+16	-28	120
25	50	B	1	2.0	11	11	+13	+15	-28	70
25	100	B	1	9.0	21	21	+13	+15	-28	50
25	120	C	2	6.0	21	21	+13	+15	-32	38
25	150	B	2	10	35	32	+15	+15	-35	62
25	160	B	2	10	34	34	+15	+15	-35	60
25	180	B	2	10	35	34	+14	+15	-48	60
25	180	C	2	13	28	28	+14	+15	-48	32
25	220	C	2	13	35	33	+18	+20	-52	33
25	330	D	3	20	30	28	+25	+25	-60	27
25	350	D	3	20	35	32	+25	+25	-64	24
25	390	C	7	28	48	48	+25	+25	-70	48
25	390	D	3	20	35	32	+25	+25	-68	24
25	470	C	7	28	48	48	+25	+25	-76	48
25	560	C	7	28	60	60	+25	+25	-80	48
25	680	D	8	32	60	60	+25	+25	-80	24
25	820	D	8	32	82	82	+25	+25	-80	26
25	850	D	8	32	95	95	+25	+25	-80	26

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
30	8.0	A	1	2	4	4	+8	+12	-16	275
30	15	A	1	2	7	7	+10	+12	-20	175
30	25	A	1.5	3	11	11	+12	+12	-24	160
30	33	A	2	9	12	12	+12	+14	-30	160
30	40	B	1	5	10	10	+10.5	+12	-24	65
30	68	B	1	9	15	15	+13	+15	-24	60
30	100	C	2	12	17	17	+10.5	+12	-28	40
30	120	B	2	10	30	30	+15	+15	-32	60
30	150	B	2	10	32	32	+15	+15	-35	60
30	150	C	2	12	23	23	+14	+15	-48	35
30	170	B	2	12	34	34	+15	+15	-48	65
30	300	C	6	24	43	43	+15	+15	-60	44
30	300	D	3	20	30	28	+25	+25	-60	31
30	330	C	6	24	45	45	+25	+25	-65	52
30	350	C	8	32	48	48	+25	+25	-70	52
30	390	C	8	32	55	55	+25	+25	-75	52
30	430	C	8	32	60	60	+25	+25	-80	54
30	560	D	9	36	40	40	+25	+30	-80	30
40	12	A	1	2	6	6	+8	+10	-24	234
40	15	A	1	2	7	7	+10	+12	-20	175
40	18	A	1.5	4	10	10	+12	+12	-20	200
40	22	A	1.5	4	11	11	+12	+12	-24	190
40	68	B	1	8	15	15	+13	+15	-24	60
40	100	B	2	10	25	25	+15	+15	-40	60
40	120	B	2	12	30	30	+15	+15	-32	62
40	150	C	2	12	23	23	+14	+15	-48	35
40	220	D	3	22	23	22	+23	+23	-58	27
40	270	C	7	28	37	37	+25	+25	-60	52
40	330	C	8	32	43	43	+25	+25	-65	52
40	390	D	8	32	43	43	+25	+25	-75	30
40	470	D	9	36	45	45	+25	+25	-80	30

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
50	5.0	A	1	2	3	3	+5	+6	-16	400
50	10	A	1	2	4	4	+8	+9	-20	250
50	18	A	1.5	3	10	10	+12	+12	-24	200
50	22	A	2	9	11	11	+12	+12	-24	190
50	25	B	1	5	8	8	+10.5	+12	-20	95
50	47	B	1	9	13	13	+13	+15	-24	70
50	60	C	2	12	12	12	+10.5	+12	-16	45
50	82	C	2	10	15	15	+14	+15	-32	45
50	100	B	3	15	25	25	+15	+15	-40	67
50	160	D	3	22	17	17	+23	+23	-50	27
50	270	C	8	32	37	37	+25	+25	-60	52
50	350	D	9	36	40	40	+25	+25	-70	30
50	390	D	9	36	43	43	+25	+25	-75	30
50	430	D	10	40	45	45	+25	+25	-80	31
60	4.0	A	1	2	2.8	2.8	+5	+6	-16	550
60	8.2	A	1	2	4	4	+8	+9	-20	275
60	20	B	1	5	7	7	+10.5	+12	-16	105
60	39	B	1	9	12	12	+10	+12	-24	90
60	50	C	2	12	10	10	+10.5	+12	-16	50
60	68	C	2	10	13	13	+14	+15	-30	50
60	82	B	2	12	22	22	+15	+15	-36	70
60	140	D	3	22	16	16	+20	+20	-40	28
60	220	C	8	32	37	37	+25	+25	-50	55
60	270	D	9	36	26	26	+25	+25	-70	33
60	330	D	10	40	32	32	+25	+25	-72	31
63	10	A	1	2	4	4	+8	+9	-20	250
63	12	A	2	4	7	7	+8	+9	-20	233
63	15	A	2	9	8	8	+9	+9	-22	220
63	47	B	1	9	13	13	+13	+15	-24	70
63	56	B	2	12	18	18	+14	+15	-26	72
63	82	B	2	12	22	22	+15	+15	-36	70
63	100	C	2	11	18	18	+14	+15	-37	42
63	120	C	3	18	20	20	+18	+18	-40	49
63	150	D	3	22	17	17	+20	+20	-45	27
63	220	C	8	32	37	37	+25	+25	-50	55
63	270	D	9	36	26	26	+24	+25	-70	33
63	330	D	10	40	32	32	+25	+25	-72	31

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
75	3.5	A	1	2	2.5	2.5	+5	+6	-16	650
75	6.8	A	1	2	3	3	+8	+9	-20	300
75	8.2	A	1.5	3	6	6	+9	+9	-22	280
75	9.0	A	2	4	6	6	+9	+9	-22	280
75	15	B	1	5	6	6	+8	+9	-16	150
75	33	B	1	9	10	10	+10	+12	-24	90
75	40	C	2	12	9	9	+10.5	+12	-16	60
75	43	B	2	10	15	15	+10.5	+12	-24	89
75	47	B	2	10	15	15	+14	+14	-30	87
75	56	B	2	12	18	18	+15	+15	-30	84
75	56	C	2	10	11	11	+14	+15	-28	60
75	68	B	2	12	21	21	+15	+15	-36	86
75	68	C	2	10	13	13	+14	15	-30	50
75	82	C	2	10	15	15	+15	+15	-32	45
75	100	C	8	32	19	19	+17	+18	-36	60
75	110	D	3	24	11	11	+20	+20	-35	29
75	120	D	3	24	12	12	+20	+20	-36	28
75	150	C	9	36	25	25	+20	+20	-40	60
75	150	D	9	36	17	17	+21	+22	-48	30
75	180	C	9	36	28	28	+22	+22	-50	60
75	220	D	10	40	37	37	+22	+22	-60	32
75	250	D	10	40	40	40	+25	+25	-68	33
100	4.7	A	1	2	3	3	+7	+8	-16	500
100	5.6	A	2	5	6	6	+8	+8	-17	475
100	22	B	1	9	8	8	+8	+8	-16	100
100	30	B	3	15	10	10	+8	+8	-16	99
100	30	C	2	12	7	7	+8	+8	-16	80
100	33	B	3	15	14	14	+8	+8	-16	95
100	33	C	2	10	7	7	+8	+8	-16	93
100	39	B	2	12	10	10	+12	+12	-24	92
100	39	C	2	10	8	8	+8	+8	-16	90
100	43	C	2	10	8	8	+8	+8	-20	70
100	47	C	2	10	9	9	+10	+10	-23	70
100	56	C	2	10	11	11	+14	+15	-28	60
100	68	C	10	40	15	15	+15	+15	-30	60
100	68	D	3	26	8	8	+15	+15	-24	42
100	82	D	3	24	10	10	+18	+18	-24	39
100	86	D	3	24	10	10	+18	+18	-24	30
100	100	D	3	24	11	11	+20	+20	-35	36

U_R (V)	C_n (µF) at 100Hz	Case Size	I_L max (µA) at T_{amb} =		DF max (%) at 100Hz at T_{amb} =		$\Delta C_n/C_n$ (%) at 100Hz at T_{amb} =			Z max (Ω) at 100Hz
			+22ºC	+85 & +125ºC	+22ºC	+85 & +125ºC	+85ºC	+125ºC	-55ºC	-55ºC
125	2.7	A	1	2	3	3	+7	+8	-16	780
125	3.3	A	1	2	3	3	+7	+8	-16	600
125	3.6	A	1	2	3	3	+7	+8	-16	600
125	3.9	A	2	5	3.5	3.5	+8	+8	-16	557
125	14	B	1	7	6	6	+7	+8	-16	167
125	15	B	1	7	6	6	+7	+8	-16	167
125	18	B	2	10	8	8	+8	+8	-16	133
125	25	C	2	10	6	6	+7	+8	-16	93
125	39	C	2	10	8	8	+8	+8	-16	90
125	47	C	2	10	9	9	+10	+10	-23	70
125	56	D	3	28	6	6	+15	+15	-25	47
125	68	D	3	26	8	8	+15	+15	-24	42
125	82	D	3	24	10	10	+18	+18	-24	39

3. 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.

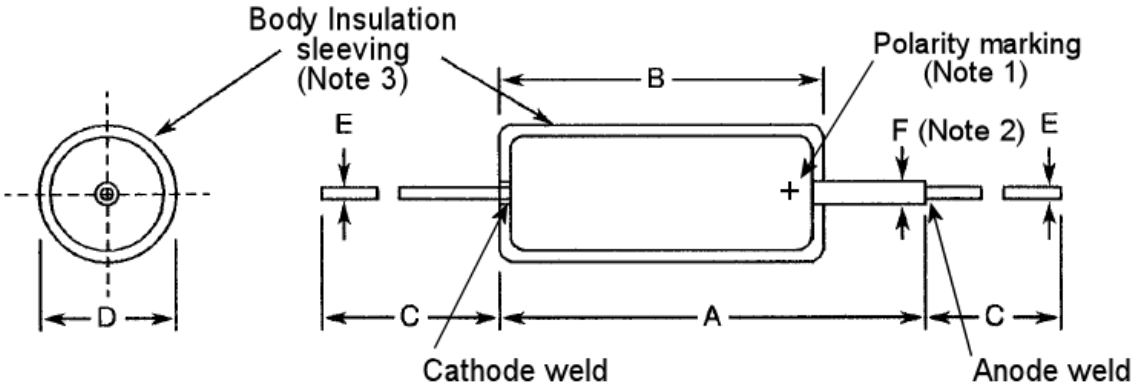
Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

Characteristics	Symbols	Maximum Ratings	Units	Remarks
DC Rated Voltage	U_R	See Para. 1.4.2	V	Note 1
DC Surge Voltage	U_S	1.15 x U_R	V	$T_{amb} \leq +85°C$
DC Category Voltage	U_C	0.67 x U_R	V	
Operating Temperature Range	T_{op}	-55 to +125	°C	T_{amb}
Rated Temperature	T_R	+85	°C	
Upper Category Temperature	T_C	+125	°C	
Storage Temperature Range	T_{stg}	-55 to +125	°C	
Soldering Temperature	T_{sol}	+260	°C	Note 2

NOTES:

1. At $T_{amb} \leq +85°C$. For $T_{amb} > +85°C$, derate linearly to U_C at $T_{amb} = +125°C$.
2. Duration 5 seconds maximum 3mm from body on the cathode side and 3mm from weld on the anode side.

1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

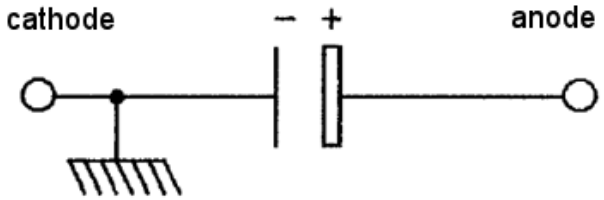


Variant Number	Case Size	Dimensions (mm)						
		A Max	B Max	C Min	D Max	E		F Max
						Min	Max	
02	A	18	12.43	30	5.6	0.59	0.7	1.6
03	B	23	17.2	30	7.6	0.59	0.7	1.6
04	C	26	20.4	30	10	0.59	0.7	1.6
05	D	34	27.9	30	10	0.59	0.7	1.6

NOTES:

1. Terminal identification: a '+' symbol shall be marked on the body at the anode end.
2. The anode lead-out must not be bent.
3. See Para. 1.8.3.

1.7 FUNCTIONAL DIAGRAM



1.8 MATERIALS AND FINISHES

1.8.1 Case

Tantalum, hermetically sealed.

1.8.2 Terminal Material and Finish

Terminal material and finish shall be type E3 in accordance with the requirements of ESCC Basic Specification No. 23500. Leads shall be electrically welded to the case.

1.8.3 Body Insulation Sleeving

Body insulation sleeving shall be of a non-fungus nutrient material (cardboard shall not be used). The material shall not soften, creep or shrink to the extent that it causes any part of the cylindrical case to become uncovered at any test temperature specified herein. At any cross-section, the maximum thickness of the sleeving shall not exceed twice the minimum thickness.

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) Terminal identification (polarity) (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 ±3°C.

Test Step	Characteristics	Symbols	Test Method and Conditions (Note 1)	Tolerance	Limits		Units
					Min	Max	
1	DC Leakage Current	I_L	ESCC No. 3003 V = U_R	All	-	Note 2	µA
2	Capacitance	C_A	ESCC No. 3003 f = 100Hz	 ±10% ±20%	 $0.9C_n$ $0.8C_n$	 $1.1C_n$ $1.2C_n$	µF
3	Dissipation Factor	DF	ESCC No. 3003 f = 100Hz	All	-	Note 2	%

NOTES:

1. Measurements shall be made in the order shown. On completion of electrical measurements, all capacitors shall be discharged through 470Ω resistors for 5 seconds followed by short circuit for 2 minutes.
2. See Para. 1.4.2 Note 2 for characteristic limits.

2.3.2 High and Low Temperatures Electrical Measurements

Test Step	Characteristics	Symbols	Test Method and Conditions (Notes 1, 2)	Tolerance	Limits		Units
					Min	Max	
1	Impedance	Z	IEC 60384-1 Para. 6.6 T_{amb} = -55 (+5 -0)°C f = 100Hz	All	-	Note 3	Ω
2	Capacitance	C_A	ESCC No. 3003 T_{amb} = -55 (+5 -0)°C f = 100Hz	 ±10% ±20%	 Note 4 Note 4	 Note 4 Note 4	µF
3	DC Leakage Current	I_L	ESCC No. 3003 T_{amb} = +85 ±3°C V = U_R	All	-	Note 2	µA
4	Capacitance	C_A	ESCC No. 3003 T_{amb} = +85 ±3°C f = 100Hz	 ±10% ±20%	 Note 4 Note 4	 Note 4 Note 4	µF
5	Dissipation Factor	DF	ESCC No. 3003 T_{amb} = +85 ±3°C f = 100Hz	All	-	Note 3	%
6	DC Leakage Current	I_L	ESCC No. 3003 T_{amb} = +125 (+0 -5)°C V = Uc	All	-	Note 3	µA
7	Capacitance	C_A	ESCC No. 3003 T_{amb} = +125 (+0 -5)°C f = 100Hz	 ±10% ±20%	 Note 4 Note 4	 Note 4 Note 4	µF
8	Dissipation Factor	DF	ESCC No. 3003 T_{amb} = +125 (+0 -5)°C f = 100Hz	All	-	Note 3	%

NOTES:

1. Measurements shall be made in the order shown. On completion of electrical measurements, all capacitors shall be discharged through 470Ω resistors for 5 seconds followed by short circuit for 2 minutes.
2. 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. Measurements shall be made in the order shown.
3. See Para.1.4.2 Note 2 for characteristic limits at the applicable test temperature.
4. Capacitance limits shall be as specified in Para. 2.3.1 with $\Delta C_n/C_n$ adjustment as specified in Para. 1.4.2 Note 2 at the applicable test temperature.

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.

Test Reference per ESCC No. 3003	Characteristics	Symbols	Limits		Units
			Min	Max	
Rapid Change of Temperature					
Initial Measurements	Capacitance	C_A	Note 1		µF
Final Measurements	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-15	+15	%
	Dissipation Factor	DF	-	Note 3	%
Vibration					
During last 30 mins in each axis	No intermittent contact or open/short circuits ≥ 0.5ms	-	-	-	-
Mechanical Shock					
During testing	No intermittent contact or open/short circuits ≥ 0.5ms	-	-	-	-
Climatic Sequence					
Initial Measurements	DC Leakage Current	I_L	Record Value		µA
	Capacitance	C_A	Record Value		µF
	Dissipation Factor	DF	Record Value		%
Final Measurements	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-15	+15	%
	Dissipation Factor	DF	-	Note 3	%
Damp Heat, Steady State					
Initial Measurements	Capacitance	C_A	Record Value		µF
Final Measurements	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-10	+10	%
	Dissipation Factor	DF	-	Note 3	%
	Voltage Proof	VP	1000		Vdc
	Insulation Resistance	R_I	100	-	MΩ
Cold					
Final Measurements	DC Leakage Current	IL	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-5	+5	% (4)
	Dissipation Factor	DF	-	Note 3	%

Test Reference per ESCC No. 3003	Characteristics	Symbols	Limits		Units
			Min	Max	
Reverse Voltage					
Initial Measurements	Capacitance	C_A	Record Value		µF
Final Measurements	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-15	+15	%
	Dissipation Factor	DF	-	Note 3	%
Operating Life					
Initial Measurements	Capacitance	C_A	Note 1		µF
Intermediate Measurements (500h and 1000h Note 5)	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-10	+10	%
	Dissipation Factor	DF	-	Note 3	%
Final Measurements (1000h or 2000h) (Note 6)	DC Leakage Current	I_L	-	Note 2	µA
	Capacitance	C_A	Record Value		µF
	Capacitance Change	ΔC/C	-10	+10	%
	Dissipation Factor	DF	-	Note 3	%
	Voltage Proof	VP	1000		Vdc
	Insulation Resistance	R_I	100	-	MΩ

NOTES:

1. As specified in Para. 2.3.1.
2. 2.5 times the limit specified in Para. 2.3.1.
3. 1.5 times the limit specified in Para. 2.3.1.
4. Related to final Capacitance measurements from Damp Heat, Steady State.
5. 1000 hour intermediate measurements are applicable when a 2000 hour test is being performed.
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.