USER'S MANUAL

NEOCAPACITOR

Technical Note

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NEC

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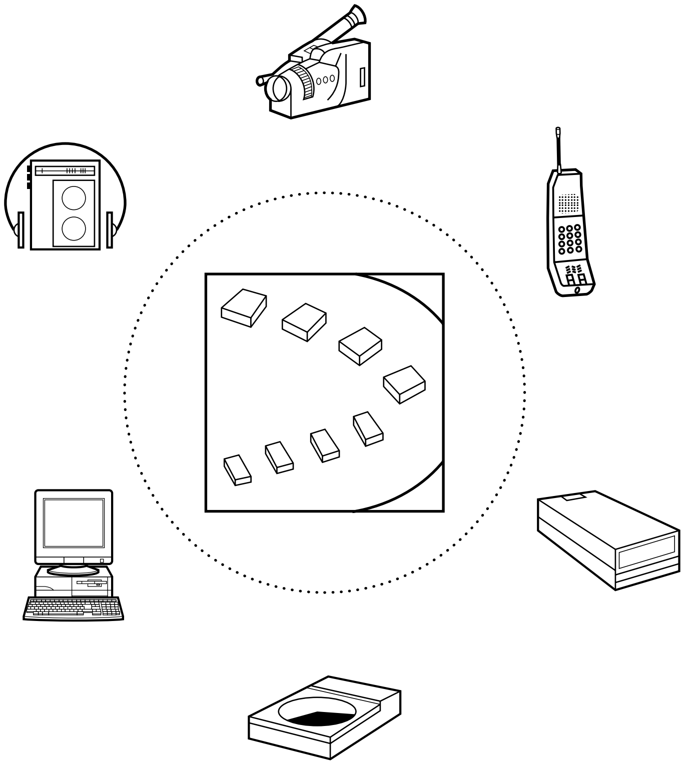


[MEMO]

CONTENTS

[MEMO]

1. WHAT IS NEOCAPACITOR?

There has been increasing demand for LSIs that operate at higher frequency and lower voltage, and also for an increase in scale (integration on one chip). Electronic equipment, especially portable systems, has become increasingly smaller, lighter, and high-performance.

To satisfy these demands and help realize such systems, capacitors need to be smaller in size with higher capacitance and lower impedance.

The NEOCAPACITOR (conducting polymer tantalum capacitor) has been developed to satisfy these demands, in particular the demand for low impedance.

The NEOCAPACITOR is produced by creating a tantalum oxide film on the surface of a body of sintered tantalum powder by means of anodic oxidation, employing a conducting polymer as the counter electrode.

This capacitor offers a small size and high capacitance (equivalent to solid tantalum capacitors) by using a body of sintered tantalum powder for the anode, and a dramatic reduction of impedance as well as ESR by employing a new material, the conducting polymer (polypyrrole), for the cathode.

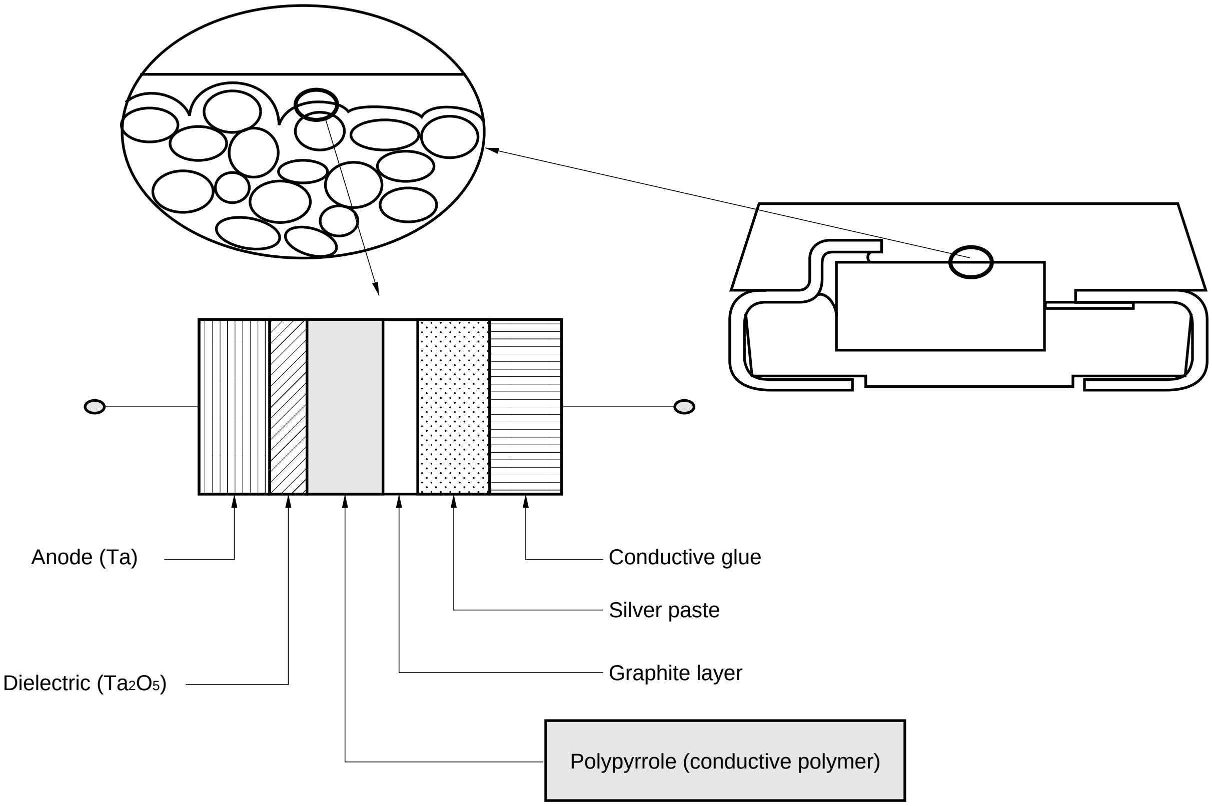


Figure 1. Structure of NEOCAPACITOR

2. WHAT IS POLYPYRROLE?

Polypyrrole is one of the popular conducting polymer.
The molecular structure is shown in Figure 2, and its features are explained in 2.1.

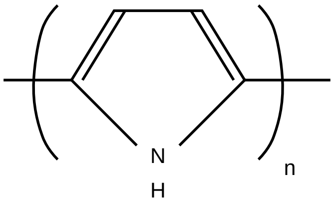


Figure 2. Molecular Structure of Polypyrrole

2.1 Features of Polypyrrole

(1) High conductivity (low resistance)
The conductivity of polypyrrole is about 20 S/cm (0.05 Ω•cm), which is more than 100 times that of manganese dioxide (i.e., its resistance is less than 1/100 of manganese dioxide), and about 10 times that of TCNQ (cathode material for OS Capacitor).
* Refer to **Figure 3 Comparison of Conductivity**.

(2) High temperature for thermal decomposition
Thermal decomposition temperature of polypyrrole is 280 to 300 °C, and is higher than soldering temperature.
(TCNQ: 200 to 235 °C)

(3)
Resistance increase after thermal decomposition
→ Low possibility of smoking or burning even in the case of short circuit failure.

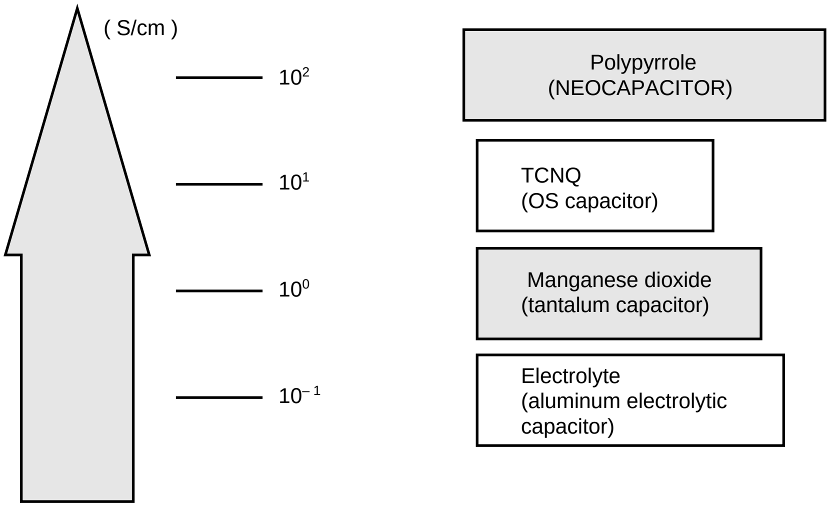


Figure 3. Comparison of Conductivity

3. FEATURES OF NEOCAPACITOR

The NEOCAPACITOR has the following features as a small, high-capacitance, and low-impedance capacitor.

(1) Excellent high-frequency noise absorption (low impedance)
(2) High permissible value of ripple current (low ESR)
(3) Stable temperature characteristics (capacitance, ESR)
(4) Surface mountability (can be soldered by means of reflow soldering)
(5) High capacitance

3.1 Excellent Noise Absorption (Impedance)

The NEOCAPACITOR offers low ESR and excellent impedance vs. frequency characteristics by using a high conducting polymer.

In particular, its characteristics are excellent in the high-frequency region (10 kHz to 10 MHz) where noise must be absorbed.

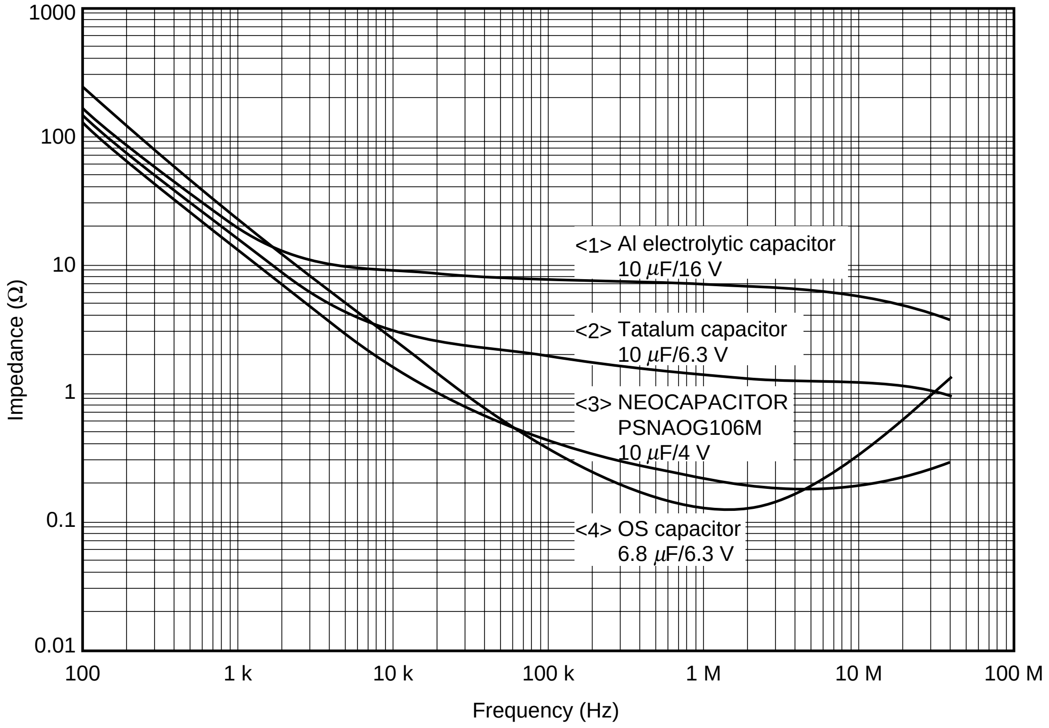


Figure 4. Impedance-Frequency Characteristics

3.2 High Ripple Current (low ESR)

The value of ripple current is one of the basic factors in the performance of a smoothing capacitor. The ripple current is determined by confirming the temperature rise of the capacitor based on the relation between self-heating and heat radiation. NEC defines permissible ripple current as the amount of ripple current which can be passed without causing the surface temperature of the capacitor to rise more than 5 °C.

The temperature rise of the NEOCAPACITOR is low because of low self-heating and the low ESR value as shown below. As a result, the value of the ripple current is high.

The frequency characteristics of ESR are shown below.

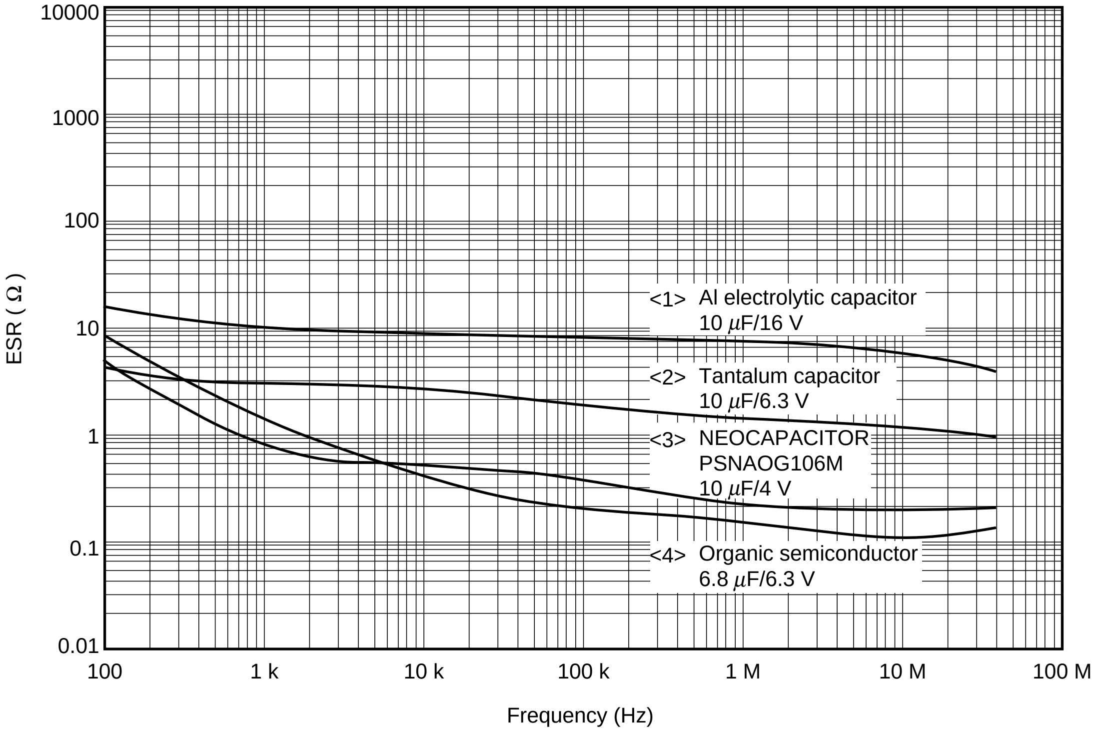


Figure 5. ESR-Frequency Characteristics

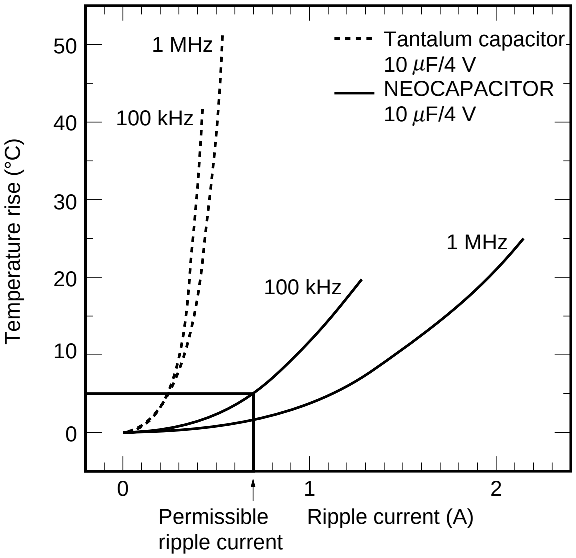


Figure 6. Ripple Current and Temperature Rise

3.3 Stable Temperature Characteristics (Capacitance, ESR)

The capacitance and ESR of the NEOCAPACITOR are barely affected by changes in the ambient temperature.

In addition to being smaller than other capacitors, NEOCAPACITOR is ideal as a noise absorbing component in portable equipments, such as cellular phones, where the ambient temperature fluctuates significantly.

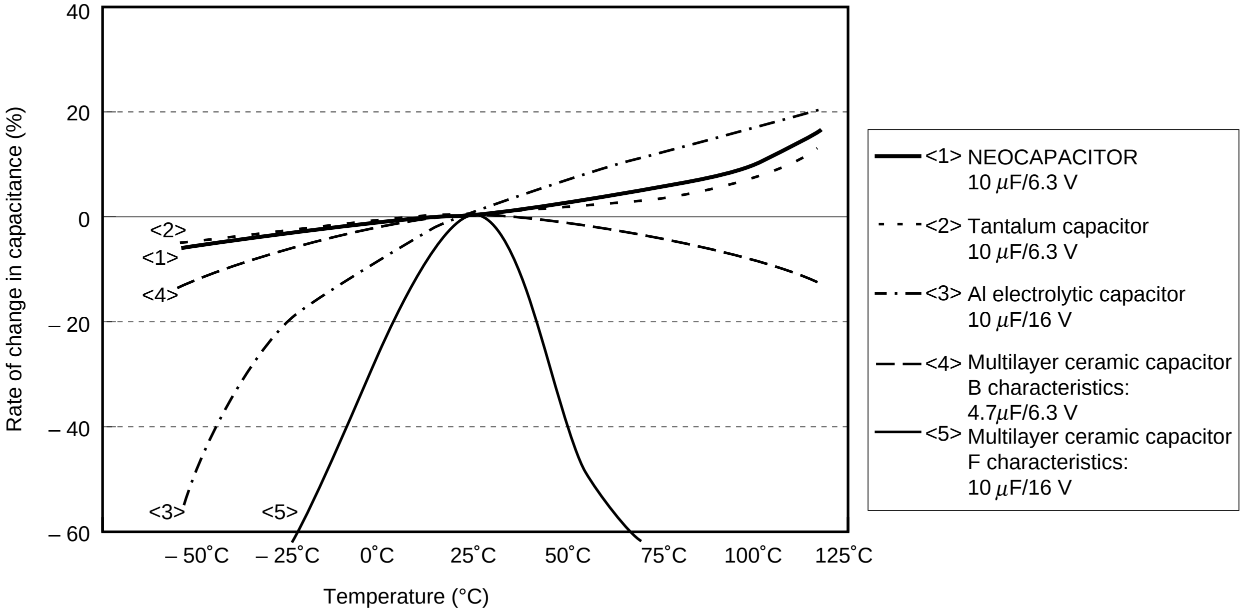


Figure 7. Temperature Characteristics of Capacitance

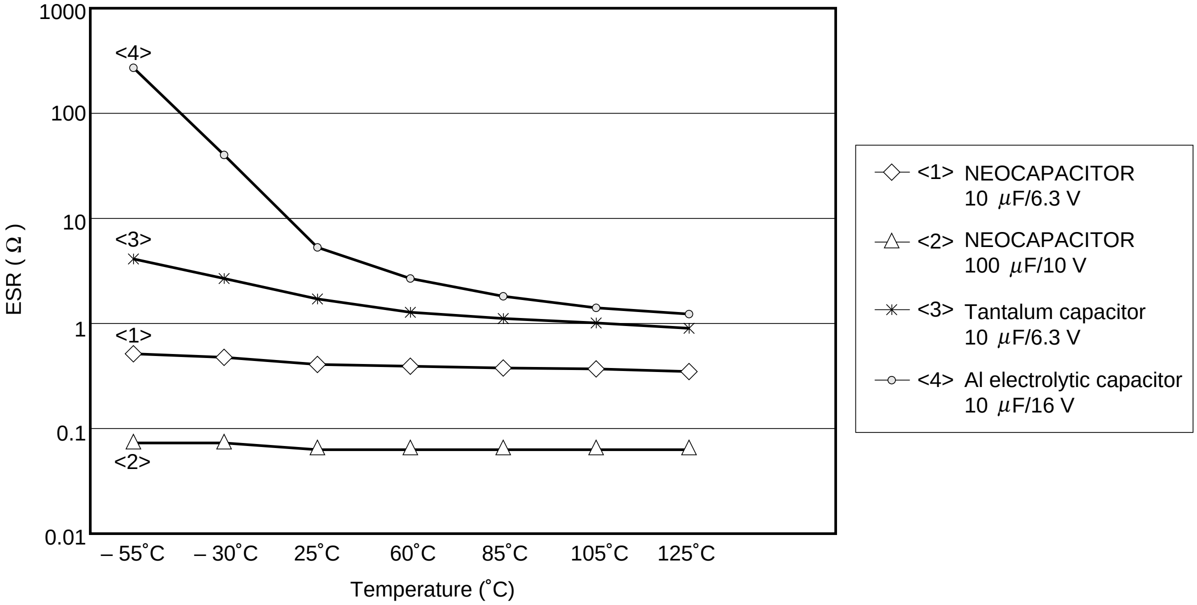


Figure 8. Temperature Characteristics of ESR

3.4 Compatibility with Standard Reflow Soldering

The cathode material (polypyrrole) of NEOCAPACITOR has higher thermal decomposition temperature (280 to 300 °C) than those of other conducting polymers.

NEOCAPACITOR is therefore compatible with conventional reflow soldering (240 °C, 10 seconds) without any changes.

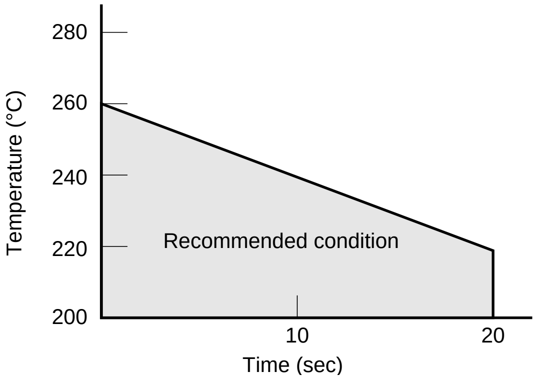


Figure 9. Recommended Temperature/Time Combinations for Reflow Soldering

3.5 Large Capacitance in Small Size

Because a sintered Ta anode and a Ta_2O_5 dielectric layer used in NEOCAPACITOR are basically the same as those of conventional chip Ta capacitor.

Therefore, the same large capacitance is actualized in small size.

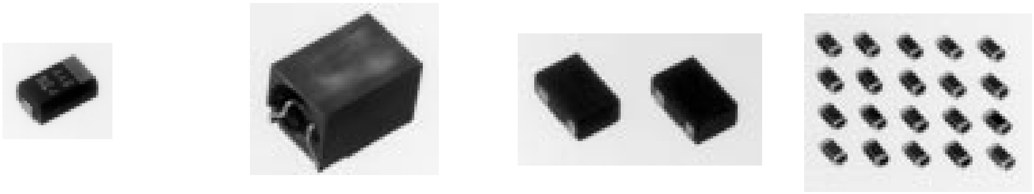
NEOCAPACITOR
10 µF/6.3 V

OS Capacitor
6.8 µF/6.3 V

Functional polymer
aluminum capacitor
10 µF/6.3 V

Multilayer ceramic
capacitor
B characteristic
4.7 µF/6.3 V × 2 pcs.

Figure 10. Comparison of Size (10 µF)



NEOCAPACITOR
100 µF/6.3 V

OS Capacitor
100 µF/10 V

Functional polymer
aluminum capacitor
47 µF/6.3 V × 2 pcs.

Multilayer ceramic
capacitor
B characteristic
4.7 µF/6.3 V × 20 pcs.

Figure 11. Comparison of Size (100 µF)

4. APPLICATIONS EXAMPLES OF NEOCAPACITOR

4.1 Smoothing Capacitor

In spite of small size, NEOCAPACITOR has high permissible ripple current as shown in Table 1. NEOCAPACITOR is the best suited to be the smoothing capacitor for portable equipment.

Table 1. Permissible Ripple Current (at 1 MHz)

Part Number	Permissible Ripple Current
PSNA0G106M	1.0 A_{P-P}
PSNA0J685M	1.0 A_{P-P}
PSNA0J106M	1.0 A_{P-P}
PSNA1A335M	1.0 A_{P-P}
PSNA1A475M	1.0 A_{P-P}
PSNA1C335M	1.0 A_{P-P}
PSNB20G226M	1.5 A_{P-P}
PSNB20J156M	1.5 A_{P-P}
PSNB21A685M	1.5 A_{P-P}
PSNB21A106M	1.5 A_{P-P}
PSNB21C475M	1.5 A_{P-P}
PSNB21C685M	1.5 A_{P-P}

Part Number	Permissible Ripple Current
PSNC0G686M	2.5 A_{P-P}
PSNC0J476M	2.5 A_{P-P}
PSNC1A156M	2.5 A_{P-P}
PSNC1A226M	2.5 A_{P-P}
PSNC1A336M	2.5 A_{P-P}
PSND0G227M	2.5 A_{P-P}
PSND0J157M	2.5 A_{P-P}
PSND1A476M	2.5 A_{P-P}
PSND1A686M	2.5 A_{P-P}
PSND1A107M	2.5 A_{P-P}
PSMD0J157M	2.5 A_{P-P}
PSMD1A107M	2.5 A_{P-P}

<Advantages of NEOCAPACITOR>

(I) Compatibility with surface mounting of power supply circuit

By surface mounting of power supply circuit,

<1> The power supply unit can be installed on the main printed circuit board.

<2> Switching frequency higher than 500 kHz becomes available, and it contributes to miniaturization of the application equipment.

(II) Large capacitance

Large capacitance from 3.3 μF to 220 μF, which cannot be realized with the multilayer ceramic capacitor, is available in NEOCAPACITOR with SMD, and NEOCAPACITOR is applicable to larger extent of load fluctuation.

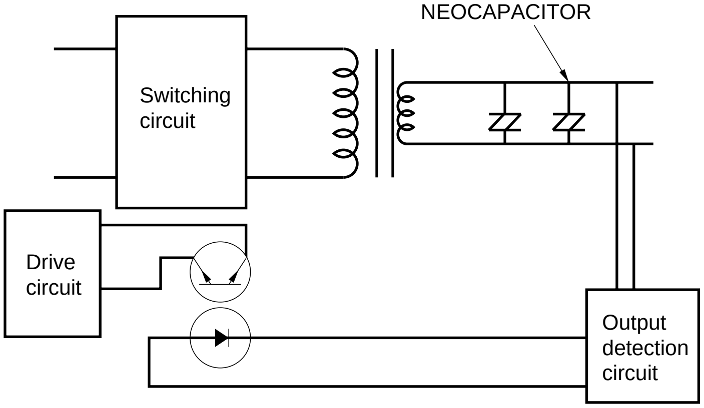


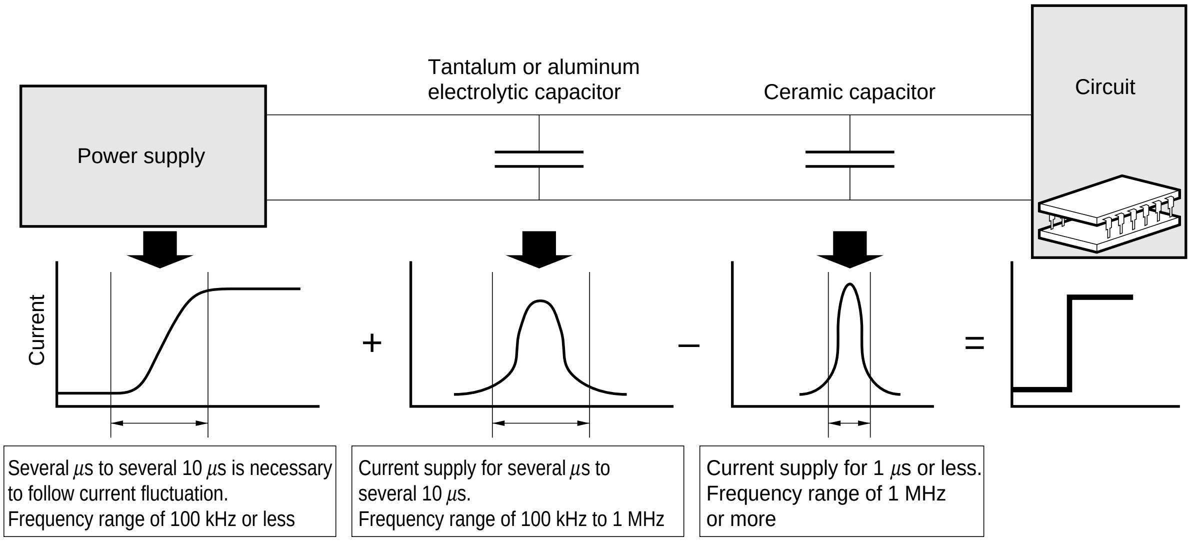
Figure 12. Example of Power Supply Circuit Using Smoothing Capacitor

4.2 Bypass Capacitor

When current consumption in the power supply circuit changes due to load fluctuation, it takes several μsec to several 10 μsec in general to detect the change of current consumption and to supply necessary current.

Bypass capacitor ensures smooth supply of necessary current to the circuit during the load fluctuation of several μsec to several 10 μsec.

To supply required current for the load fluctuation of several 10 mA, a combination of a tantalum or aluminum electrolytic capacitor having relatively large capacitance (3.3 μF or more), and a ceramic capacitor having small capacitance (1 μF or less) is widely used in the power supply. This is because the ceramic capacitor is used to respond to momentary current fluctuations (1 μsec or less) and the tantalum or aluminum electrolytic capacitor is used to supply required current until the power supply catches up to the fluctuation (several μsec to several 10 μsec).



Several μs to several 10 μs is necessary to follow current fluctuation.
Frequency range of 100 kHz or less

Current supply for several μs to several 10 μs.
Frequency range of 100 kHz to 1 MHz

Current supply for 1 μs or less.
Frequency range of 1 MHz or more

Figure 13. Function of Bypass Capacitor

The essential characteristics for bypass capacitors are sufficient capacitance and low ESR.

If the capacitance is small, or the ESR is high current cannot be supplied smoothly as shown in Figure 14 while the power supply catches up to the current fluctuation, and it causes the line voltage to drop.

Because the NEOCAPACITOR has large capacitance and low ESR, it can supply required current smoothly even at abrupt fluctuations of the current consumption in the circuit.

NEOCAPACITOR is ideal as the bypass capacitor in the low-voltage circuit where a small drop of line voltage is not acceptable.

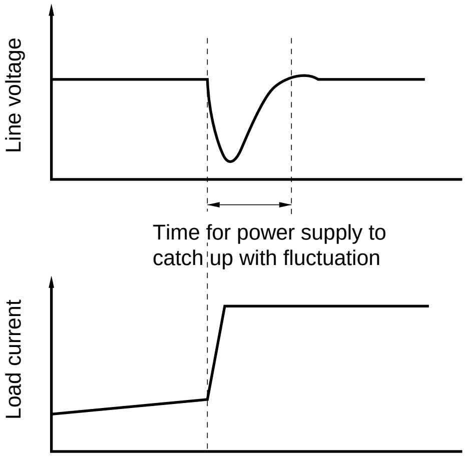


Figure 14. Line Voltage Drop in Case of Inadequate Characteristics of Bypass Capacitor

<Advantages of NEOCAPACITOR>

Table 2 shows a guideline for selecting bypass capacitor.

NEOCAPACITOR has well-balanced combination for capacitance and ESR for using as bypass capacitor, and it reveals good performance even in the circuit where heavy load fluctuation may occur.

Table 2. Guideline for Selecting Bypass Capacitor

Load Fluctuation (mA)	Necessary Capacitance (μF)	Permissible ESR Value (Ω)
1 or less	0.1	50 to100
1 to10	1	5 to10
10 to100	10	0.5 to 1
100 to 1000	100	0.05 to 0.1

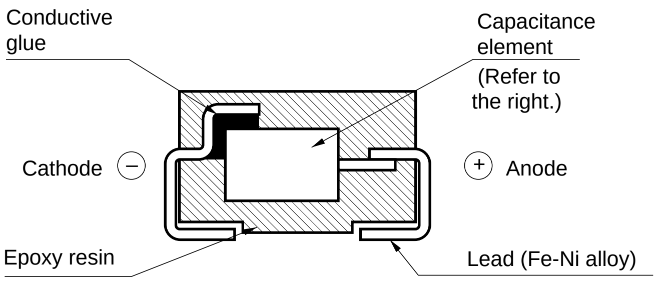
Remark Above values are shown on the assumption that the fluctuation of the line voltage due to load fluctuation is less than 0.1 V.

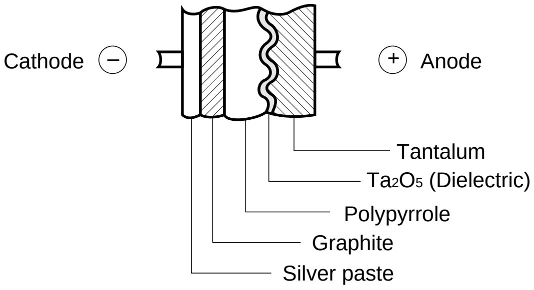
5. PRODUCT SPECIFICATIONS

5.1 PSN Series

Structure

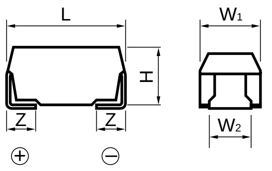
Conductive polymer (polypyrrole) is used as cathode material in NEOCAPACITOR element, instead of MnO_2 for conventional chip tantalum capacitor. Tantalum wire buried into sintered tantalum anode is welded to anode lead frame. Cathode layer of the capacitor element is connected to cathode lead frame with conductive glue. Then the system is molded into epoxy resin encapsulation, and the lead frames are cut and formed.



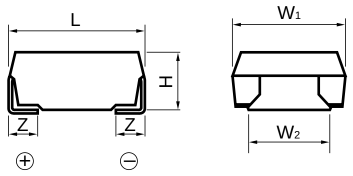


Dimensions

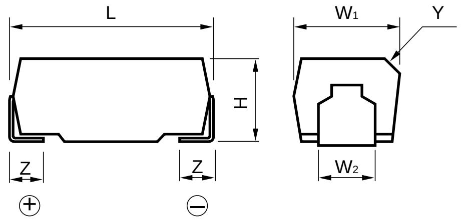
[A case]



[B2 case]



[C and D case]



(Unit: mm)

Case code \ Dimension	L	W_1	W_2	H	Z	Y
A	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.6 ± 0.2	0.8 ± 0.3	–
B2	3.5 ± 0.2	2.8 ± 0.2	2.3 ± 0.1	1.9 ± 0.2	0.8 ± 0.3	–
C	6.0 ± 0.3	3.2 ± 0.3	1.8 ± 0.1	2.5 ± 0.3	1.3 ± 0.3	0.4 C
D	7.3 ± 0.3	4.3 ± 0.3	2.4 ± 0.1	2.8 ± 0.3	1.3 ± 0.3	0.5 C

Product line-up

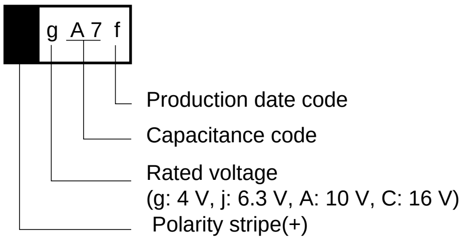
μF \ U_R	4	6.3	10	16
3.3			A	A
4.7			A	B2
6.8		A	B2	B2
10	A	A	B2	
15		B2	C	
22	B2		C	

μF \ U_R	4	6.3	10	16
33			C	
47		C	D	
68	C		D	
100			D	
150		D		
220	D			

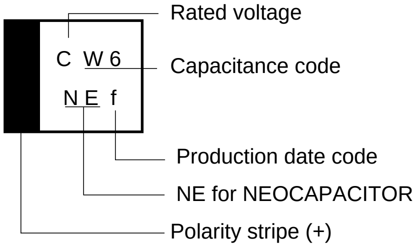
U_R: Rated voltage

Markings

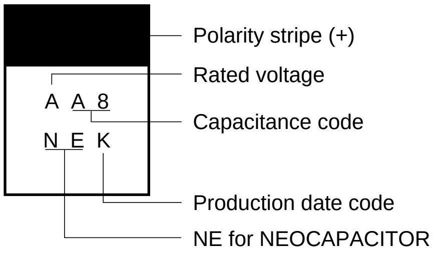
[A case]



[B2 case]



[C and D case]



[Capacitance code]

Code	A	E	J	N	S	W	Code	4	5	6	7	8
Number	1.0	1.5	2.2	3.3	4.7	6.8	Multiplier	10^4	10^5	10^6	10^7	10^8

Example A7: $1.0 \times 10^7 = 10^7$ pF = 10 μF

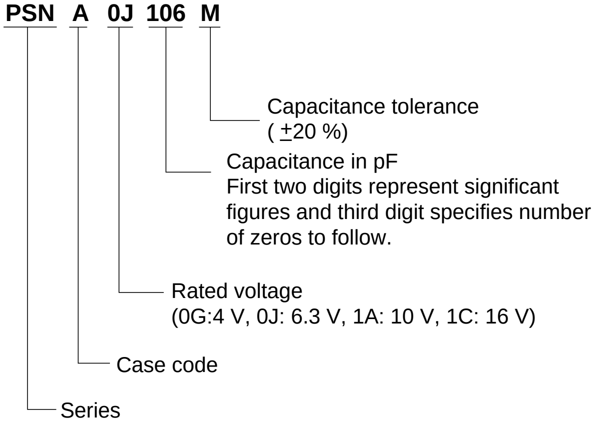
[Production date code]

Month / Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
1995	a	b	c	d	e	f	g	h	j	k	l	m
1996	n	p	q	r	s	t	u	v	w	x	y	z
1997	A	B	C	D	E	F	G	H	J	K	L	M
1998	N	P	Q	R	S	T	U	V	W	X	Y	Z

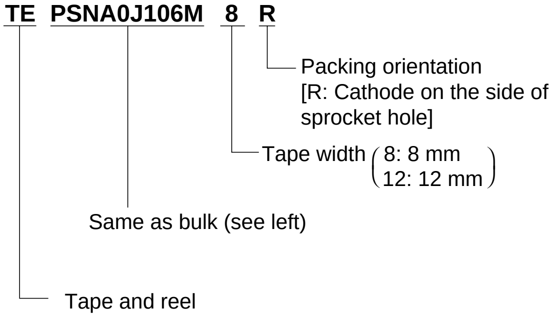
Note Date code will resume beginning in 1999.

Part number system

[Bulk]



[Tape and reel]



Specifications

Item		Performance					Test condition
Operating temperature		–55°C to +85°C					
Rated voltage		4	6.3	10	16	Vdc	85°C
Surge voltage		5.2	8	13	20	Vdc	85°C
Rated capacitance		3.3 μF to 220 μF					1 kHz
Capacitance tolerance		± 20 %					
Leakage current (LC)		0.1 CV (μF × volts) or 3 μA, whichever is greater					Rated voltage for 5 min.
tan δ		See Ratings.					1 kHz
Equivalent series resistance (ESR)		See Ratings.					100 kHz, 20°C
Surge voltage		ΔC/C : ±20% tan δ : initial requirement LC : initial requirement					85°C Rs: 1 kΩ 1000 cycles
Characteristics at high and low temperature	Temp.	– 55°C	+ 85°C				
	ΔC/C	$^{0}_{-20}$%	$^{+50}_{0}$%				
	tan δ	Initial requirement	Initial requirement × 1.5				
	LC	–	Initial requirement × 10				
Rapid change of temperature		ΔC/C : ±20% tan δ : initial requirement LC : initial requirement					–55°C to 85°C 5cycles
Resistance to soldering heat		ΔC/C: ±20% tan δ : initial requirement LC : initial requirement					Reflow: 240°C, 10 seconds
Damp heat, steady state		C : +30% to –20% of rated capacitance tan δ : initial requirement × 1.5 LC : initial requirement					40°C 90 to 95% RH 500 hours
Terminal strength		There shall be no evidence of mechanical damage.					Strength: 4.9N Time: 10 seconds (two directions)
Endurance		ΔC/C : ±20% tan δ : initial requirement × 1.5 LC : initial requirement					85°C Rated voltage applied 1000 hours
Failure rate		1%/ 1000 h					ditto
Permissible ripple current		0.7 Arms, 1 A_{p-p} (A case) 0.9 Arms, 1.5 A_{p-p} (B2 case) 1.5 Arms, 2.5 A_{p-p} (C and D case)					1 MHz

Ratings

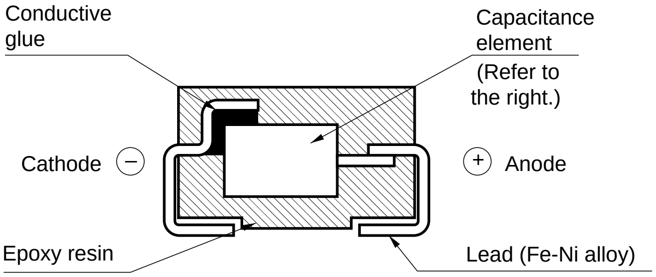
Rated Voltage (Vdc)	Capacitance (μF)	tan δ	Leakage Current (μA)	ESR (mΩ)	Permissible Ripple Current ($A_{p\text{-}p}$)	Case Code	Part Number
4	10	0.15	4.0	600	1	A	PSNA0G106M
	22	0.15	8.8	400	1.5	B2	PSNB20G226M
	68	0.20	27.2	150	2.5	C	PSNC0G686M
	220	0.50	88.0	80	2.5	D	PSND0G227M
6.3	6.8	0.09	4.2	900	1	A	PSNA0J685M
	10	0.15	6.3	600	1	A	PSNA0J106M
	15	0.15	9.5	400	1.5	B2	PSNB20J156M
	47	0.20	29.6	150	2.5	C	PSNC0J476M
	150	0.30	94.5	80	2.5	D	PSND0J157M
10	3.3	0.09	3.3	900	1	A	PSNA1A335M
	4.7	0.09	5.0	900	1	A	PSNA1A475M
	6.8	0.15	6.8	600	1.5	B2	PSNB21A685M
	10	0.15	10.0	400	1.5	B2	PSNB21A106M
	15	0.20	15.0	250	2.5	C	PSNC1A156M
	22	0.20	22.0	200	2.5	C	PSNC1A226M
	33	0.20	33.0	150	2.5	C	PSNC1A336M
	47	0.30	47.0	150	2.5	D	PSND1A476M
	68	0.30	68.0	120	2.5	D	PSND1A686M
	100	0.30	100	80	2.5	D	PSND1A107M
16	3.3	0.09	5.3	900	1	A	PSNA1C335M
	4.7	0.15	7.5	600	1.5	B2	PSNB21C475M
	6.8	0.15	10.9	600	1.5	B2	PSNB21C685M

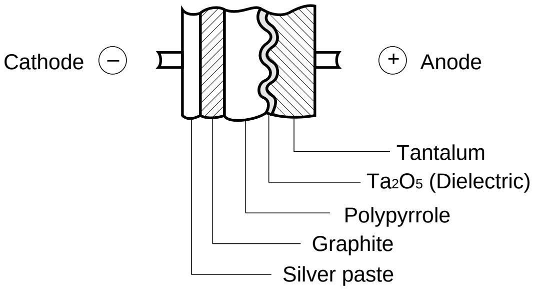
For the test conditions, See **Sepcifications** (p.12).

5.2 PSM Series

Structure

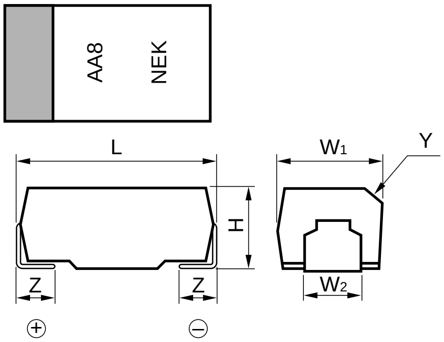
Conductive polymer (polypyrrole) is used as cathode material in NEOCAPACITOR element, instead of MnO_2 for conventional chip tantalum capacitor. Tantalum wire buried into sintered tantalum anode is welded to anode lead frame. Cathode layer of the capacitor element is connected to cathode lead frame with conductive glue. Then the system is molded into epoxy resin encapsulation, and the lead frames are cut and formed.





Dimensions

[D case]



(Unit: mm)

Dimension / Case code	L	W_1	W_2	H	Z	Y
D	7.3 ± 0.3	4.3 ± 0.3	2.4 ± 0.1	2.8 ± 0.3	1.3 ± 0.3	0.5C

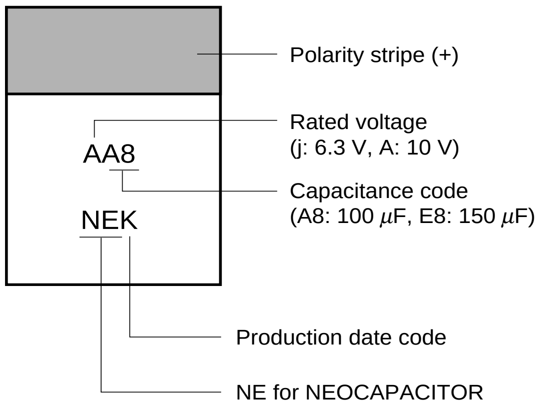
Product line-up

U_R / μF	4	6.3	10	16
68				
100			D	
150		D		
220				
330				

U_R: Rated voltage

Markings

[D case]



[Capacitance code]

Code	A	E	J	N	S	W	Code	5	6	7	8
Number	1.0	1.5	2.2	3.3	4.7	6.8	Multiplier	10^5	10^6	10^7	10^8

Example A8: $1.0 \times 10^8 = 10^8$ pF = 100 μF

[Production date code]

Month Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
1996	n	p	q	r	s	t	u	v	w	x	y	z
1997	A	B	C	D	E	F	G	H	J	K	L	M
1998	N	P	Q	R	S	T	U	V	W	X	Y	Z
1999	a	b	c	d	e	f	g	h	j	k	l	m

Note Date code will resume beginning in 2000.

Part number system

[Bulk]

PSN A 0J 106 M

Capacitance tolerance
(±20 %)

Capacitance in pF
First two digits represent significant figures and third digit specifies number of zeros to follow.

Rated voltage
(0G:4 V, 0J: 6.3 V, 1A: 10 V, 1C: 16 V)

Case code

Series

[Tape and reel]

TE PSNA0J106M 8 R

Packing orientation
[R: Cathode on the side of sprocket hole]

Tape width (8: 8 mm
12: 12 mm)

Same as bulk (see left)

Tape and reel

Specifications

Item		Performance			Test condition
Operating temperature		–55°C to + 105°C			
Rated voltage		6.3	10	Vdc	at 85°C
Category voltage		5	8	Vdc	at 105°C
Surge voltage		8	13	Vdc	at 85°C
Rated capacitance		100 µF, 150 µF			
Capacitance tolerance		± 20%			at 1kHz
Leakage current (LC)		0.1 CV or 3 µA, whichever is greater			5 minutes after application of rated voltage
tan δ		0.3 max.			at 1kHz
Surge voltage		ΔC/C : ±20% tan δ : initial requirement LC : initial requirement			at 85°C Rs = 1 kΩ 1000 cycles
ESR		80 mΩ max.			at 100 kHz 25°C
Characteristics at high and low temperature	Temp.	–55°C	+105°C		
	ΔC/C	$^{0}_{-20}$%	$^{+50}_{0}$%		
	tan δ	Initial requirement	Initial requirement × 1.5		
	Leakage current	–	Initial requirement × 10		
Rapid change of temperature		ΔC/C : ±20% tan δ : initial requirement LC : initial requirement			–55°C to 105°C. 5 cycles
Resistance to soldering heat		ΔC/C: ±20% tan δ : initial requirement LC : initial requirement			Reflow: 240°C, 10 seconds
Damp heat, steady state		C : +30% to –20% of rated voltage tan δ : initial requirement × 1.5 LC : initial requirement			at 40°C 90 to 95% RH 500 hours
Endurance		ΔC/C : ±20% tan δ : initial requirement × 1.5 LC : initial requirement			at 85°C Rated voltage applied 1000 hours at 105°C Category voltage applied 1000 hours
Permissible ripple current		1.5 Arms, 2.5 A (p-p)			at 1MHz

Ratings

Rated Voltage (Vdc)	Capacitance (µF)	tan δ	Leakage Current (µA)	ESR (mΩ)	Permissible Ripple Current (Ap-p)	Case Code	Part Number
6.3	150	0.3	94.5	80	2.5	D	PSMD0J157M
10	100	0.3	100	80	2.5	D	PSMD1A107M

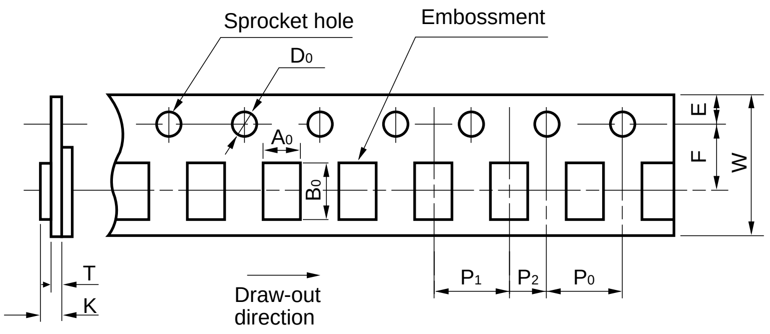
For the test conditions, refer to the above table.

5.3 Carrier Tape Packaging

Taping specifications

Carrier tape packaging conforms to IEC 286-3.

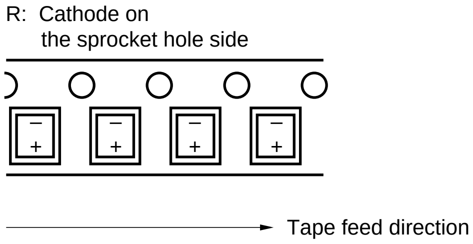
Carrier tape dimensions and standard quantity



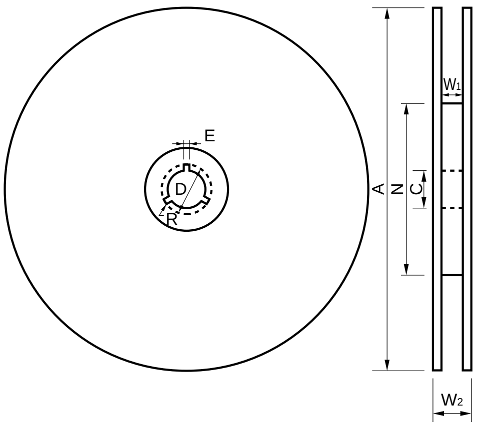
(Unit: mm)

Case Code	A_0 ± 0.2	B_0 ± 0.2	W ± 0.3	F ± 0.05	E ± 0.1	P_1 ± 0.01	P_2 ± 0.05	P_0 ± 0.1	$D_0{}^{+0.1}_{0}$	K ± 0.2	T	Standard Quantity
A	1.9	3.5	8.0	3.5	1.75	4.0	2.0	4.0	ϕ1.5	1.9	0.2	2000
B2	3.3	3.8	8.0	3.5	1.75	4.0	2.0	4.0	ϕ1.5	2.1	0.2	2000
C	3.7	6.4	12.0	5.65	1.5	8.0	2.0	4.0	ϕ1.5	3.0	0.3	500
D	4.8	7.7	12.0	5.65	1.5	8.0	2.0	4.0	ϕ1.5	3.3	0.3	500

Polarity



Reel dimensions



(Unit: mm)

Tape Width	A	N	C	D	E	W_1	W_2	R
8	ϕ178 ± 2.0	ϕ50 MIN	ϕ13 ± 0.5	ϕ21 ± 0.5	2.0 ± 0.5	10.0 ± 1.0	14.5 MAX.	1
12	ϕ178 ± 2.0	ϕ50 MIN	ϕ13 ± 0.5	ϕ21 ± 0.5	2.0 ± 0.5	14.5 ± 1.0	18.5 MAX	1

6. NOTES FOR USAGE

6.1 Difference in Failure Mode

Thanks to the features of polypyrrole, NEOCAPACITOR's self-healing characteristics are superior to those of conventional MnO_2 type tantalum capacitor.

In addition, NEOCAPACITOR is relatively hard to smoke or burn even in the case of short-circuit failure.

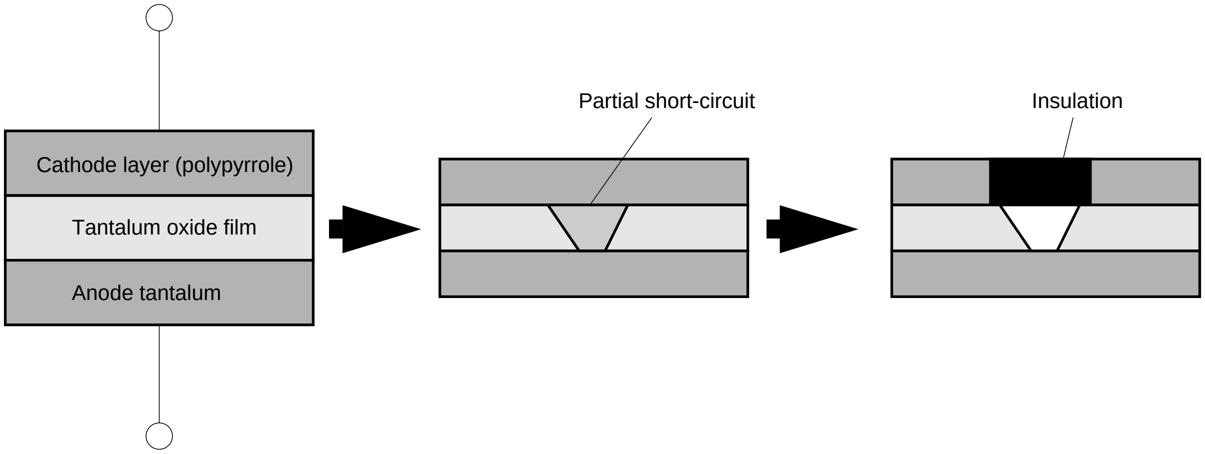
Features of polypyrrole

Polypyrrole has extremely high conductivity (low resistance) and thermally decomposes at about 300°C.

When polypyrrole thermally decomposes, it becomes less-conductive and finally to be insulating.

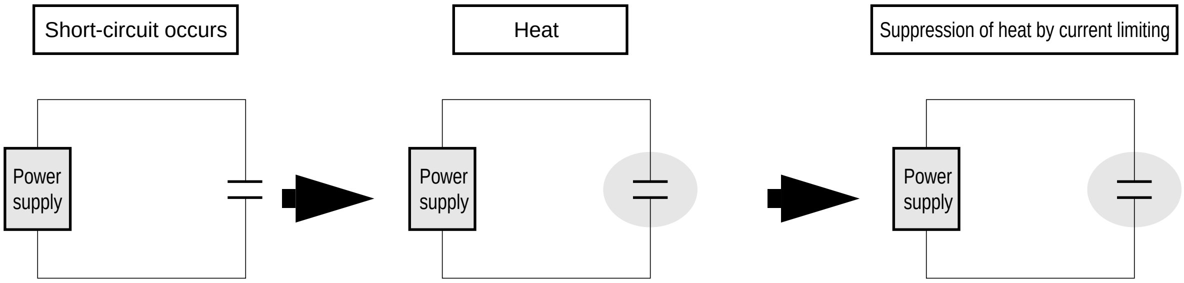
(1) Fewer failures

As a premonitory phenomenon of failure, small current flows through tiny defect in the tantalum oxide layer. Heat is generated by the current flowing through the tiny defect, and the cathode layer of polypyrrole at the defect portion will be decomposed by the heat, and rapidly insulated. Thus catastrofic failure as an avalanche in leakage current can be suppressed to occur by the insulation of polypyrrole cathode layer.



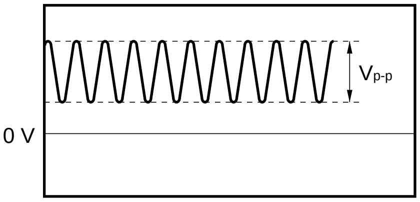
(2) Low possibility of smoking or burning in case of short-circuit failure

Should a short-circuit failure occurs, only a small amount of heat is generated by the short-circuit current because the specific resistance of NEOCAPACITOR is quite low. In addition, if the current flow increases, the entire cathode layer of polypyrrole tends to be insulated by the generated heat, and may suppress further current flow. As the result, possibility of smoking or burning of NEOCAPACITOR in case of short-circuit failure can be quite small (1/20 or less) in comparison with conventional MnO_2 type tantalum capacitor.



AC burning test

Test method

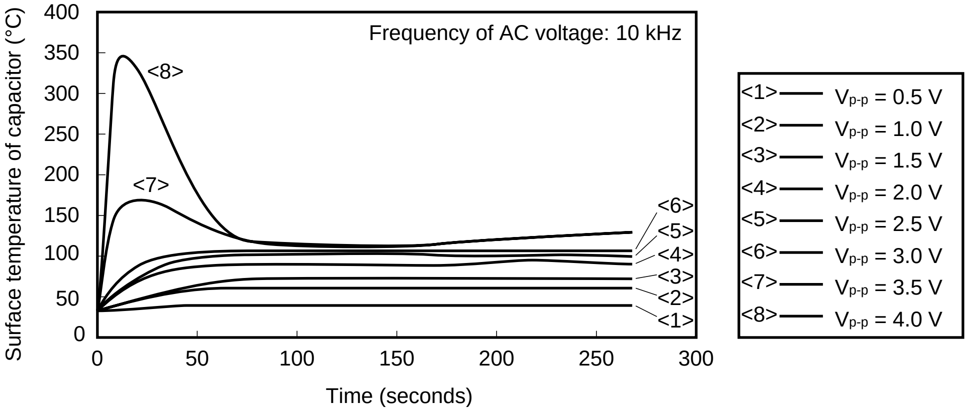


Sine-wave AC voltage is applied to the capacitor as shown on the right, to allow AC current to flow.

The AC current to flow is controled by changing peak AC voltage and the surface temperature of the capacitor is measured.

The evidence of smoking, burning and mechanical damage is visually examined during the test.

NEOCAPACITOR 100 μF/10 V (D case)



Chip Tantalum Capacitor D Case 10 V/100 μF

NEOCAPACITOR reveals quite low possibility of burning caused by AC current flow, because its cathode layer will be insulated when heat is generated by AC current, and the heat generation will be limited by suppression of AC current to flow.

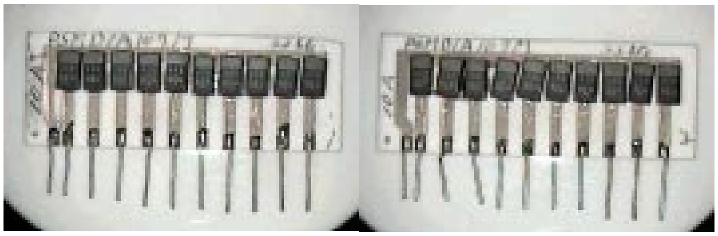
Smoking and burning in marginal test

After forcible short-circuiting by marginal load in high temperature load test, appearance of capacitor is examined for damage.

High-temperature load test (125 °C, rated voltage × 1.5, 125 hours)

- In this test, a fuse shown is the following table was connected individually to the capacitor.

NEOCAPACITOR 100 μF/10 V (D case)



High-temperature load test (125 °C, rated voltage × 1.5, 125 hours): Result after fuse is burnt N = 20 samples

Fuse	0.3 A		1 A		3 A		10 A	
	Number of samples shorted	Number of samples with abnormal appearance	Number of samples shorted	Number of samples with abnormal appearance	Number of samples shorted	Number of samples with abnormal appearance	Number of samples shorted	Number of samples with abnormal appearance
NEOCAPACITOR	20	0	20	0	20	0	20	0

In above marginal test, NEOCAPACITOR is hard to be damaged because its cathode layer becomes insulated by generated heat caused by short-circuit current, and the heat generation becomes to be suppressed.

6.2 Notes on Use

6.2.1 Permissible ripple current

Permissible ripple current shall be derated as follows:

(1) Temperature change

–55°C to +85°C (+105°C: PSM only): Rating value (PSN: p.12, PSM: p.16)

(2) Switching frequency

1 MHz : Rating value (PSN: p.12, PSM: p.16)
500 kHz : 0.9 times rating value
100 kHz : 0.75 times rating value

6.2.2 Mounting

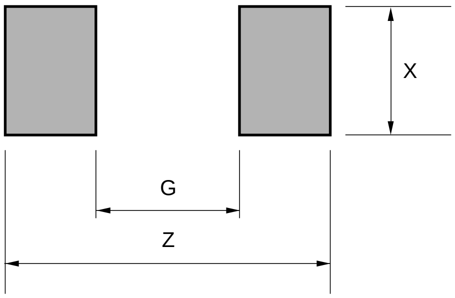
This capacitor is designed to be surface-mounted by means of reflow soldering.

(The conditions under which the capacitor should be soldered with a soldering iron are explained in (2) Using a soldering iron. Because the capacitor is not designed to be soldered by means of laser beam soldering, VPS, or flow soldering, the conditions for these soldering methods are not explained in this document. For the conditions for flow soldering, cantact NEC.)

(1) Reflow soldering

Keep in mind the following points when soldering the capacitor in a soldering oven with a hot plate:

(a) Pattern design (in accordance with IEC1182)



(mm)

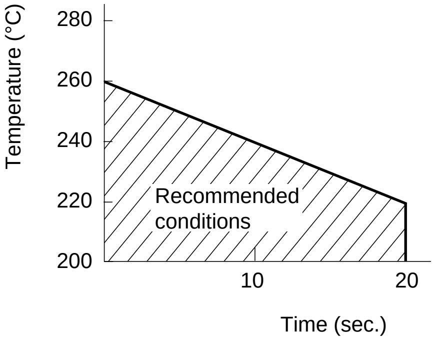
Case	G max.	Z min.	X min.
A	1.1	3.8	1.5
B2	1.4	4.1	2.7
C	2.9	6.9	2.3[Note]
D	4.1	8.2	2.9

Note: Because terminal width of NEC's C case-products is smaller, we recommend smaller dimension than IEC1182.

The above dimensions are recommended. Note that if the pattern is too big, the component may not be mounted in place.

(b) Temperature and time

Keep the peak temperature and time to within the following conditions.



Whenever possible, perform preheating (at 150°C max.) for smooth temperature profile. To maintain the reliability, mount the capacitor at a low temperature and in a short time whenever possible. The peak temperature and time shown above are applicable when the capacitor is to be soldered in a soldering oven or with a hot plate. When the capacitor is soldered by means of infrared reflow soldering, the internal temperature of the capacitor may rise beyond the surface temperature.

(2) Using soldering iron

When soldering the capacitor with a soldering iron, controlling the temperature at the tip of the soldering iron is very difficult. However, it is recommended that the following temperature and time be observed to maintain the reliability of the capacitor:

Iron temperature	300 °C max.
Time	3 seconds max.
Iron power	30 W max.

6.2.3 Cleaning

Generally, several organic solvents are used for flux cleaning of an electronic component after soldering. Many cleaning methods, such as immersion cleaning, rinse cleaning, brush cleaning, shower cleaning, vapor cleaning, and ultrasonic cleaning, are avaiable, and one of these cleaning methods may be used alone or two or more may be used in combination. The temperature of the organic solvent may vary from room temperature to several 10°C, depending on the desired effect. If cleaning is carried out with emphasis placed only on cleaning effect, however, the marking on the electronic component cleaned may be erased, the appearance of the component may be damaged, and in the worst case, the component may be functionally damaged. It is therefore recommended that the NEOCAPACITOR be cleaned under the following conditions:

[Recommended conditions of flux cleaning]

(1) Cleaning solvent .... Chlorosen, isopropyl alcohol
(2) Cleaning method .... Shower cleaning, rinse cleaning, vapor cleaning
(3) Cleaning time .... 5 minutes max.

Note Ultrasonic cleaning

This cleaning method is extremely effective for eliminating dust that has been generated as a result of mechanical processes, but may pose a problem depending on the condition. As a result of an experiment conducted by NEC, it was confirmed that the external terminals of the capacitor were cut when it was cleaned with some ultrasonic cleaning machines. The cause of this phenomenon is considered metal fatigue of the capacitor terminals that occurred due to ultrasonic cleaning. To prevent the terminal from being cut,

decreasing the output power of the ultrasonic cleaning machine or decreasing the cleaning time may be a possible solution. However, it is difficult to specify the safe cleaning conditions because there are many factors involved such as the conversion efficiency of the ultrasonic oscillator, transfer efficiency of the cleaning bath, difference in cleaning effect depending on the location in the cleaning bath, the size and quantity of the printed circuit boards to be cleaned, and the securing states of the components on the boards. It is therefore recommended that ultrasonic cleaning be avoided as much as possible.
If ultrasonic cleaning is essential, make sure through experiments that no abnormality occur as a result of the cleaning. For further information, contact NEC.

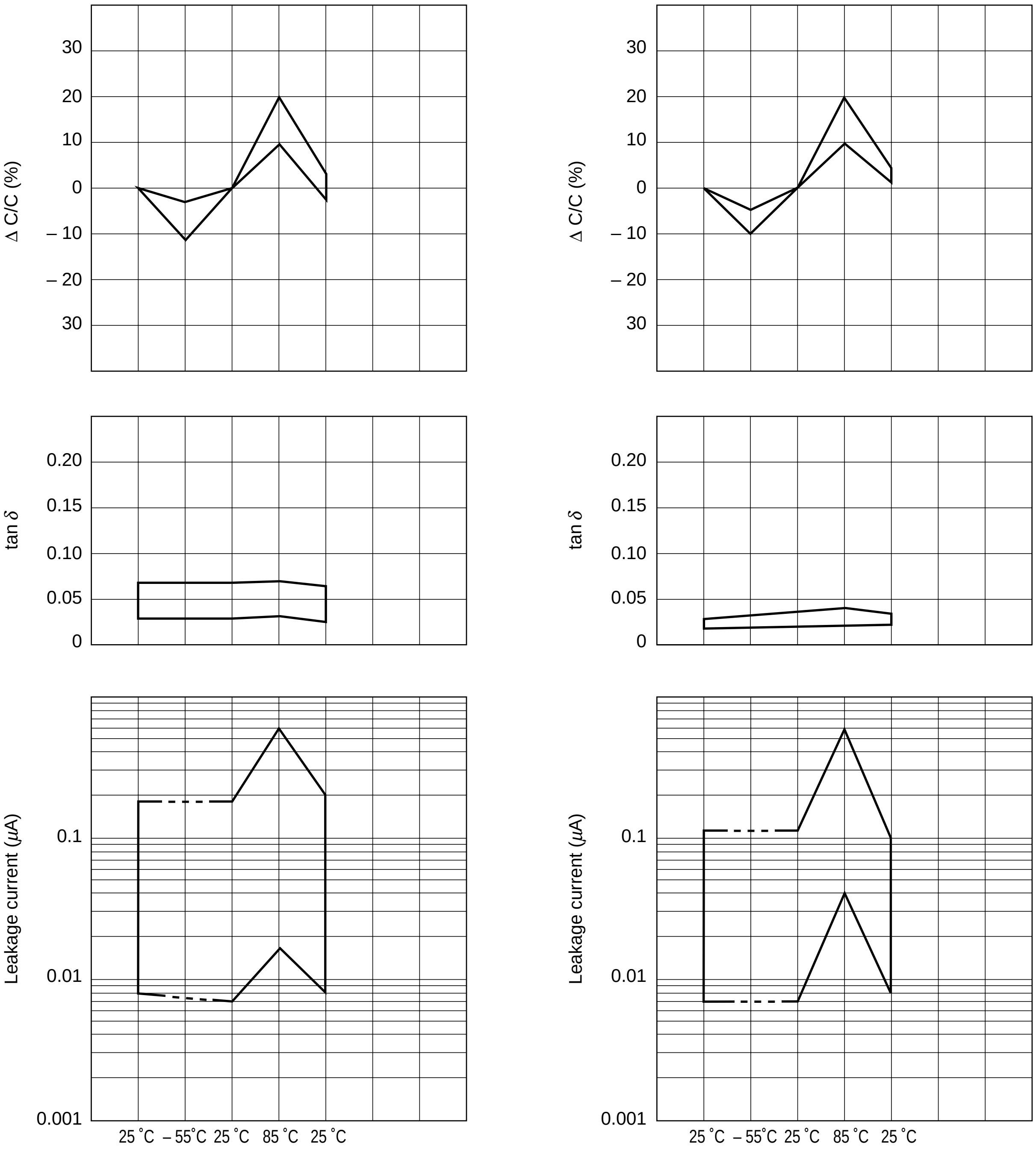
6.2.4 Others

(1) Do not apply excessive vibration and shock to the capacitor.
(2) The solderability of the capacitor may be degraded by humidity. Store the capacitor at (–5 to +40°C) room temperature and (40 to 60% RH) humidity.
(3) Exercise care that no external force is applied to the tape packaged products (if the packaging material is deformed, the capacitor may not be automatically mounted by automatic insertion equipment).

7. TYPICAL PERFORMANCE CHARACTERISTICS

- **PSN series: A case**

Characteristics at high/low temperature

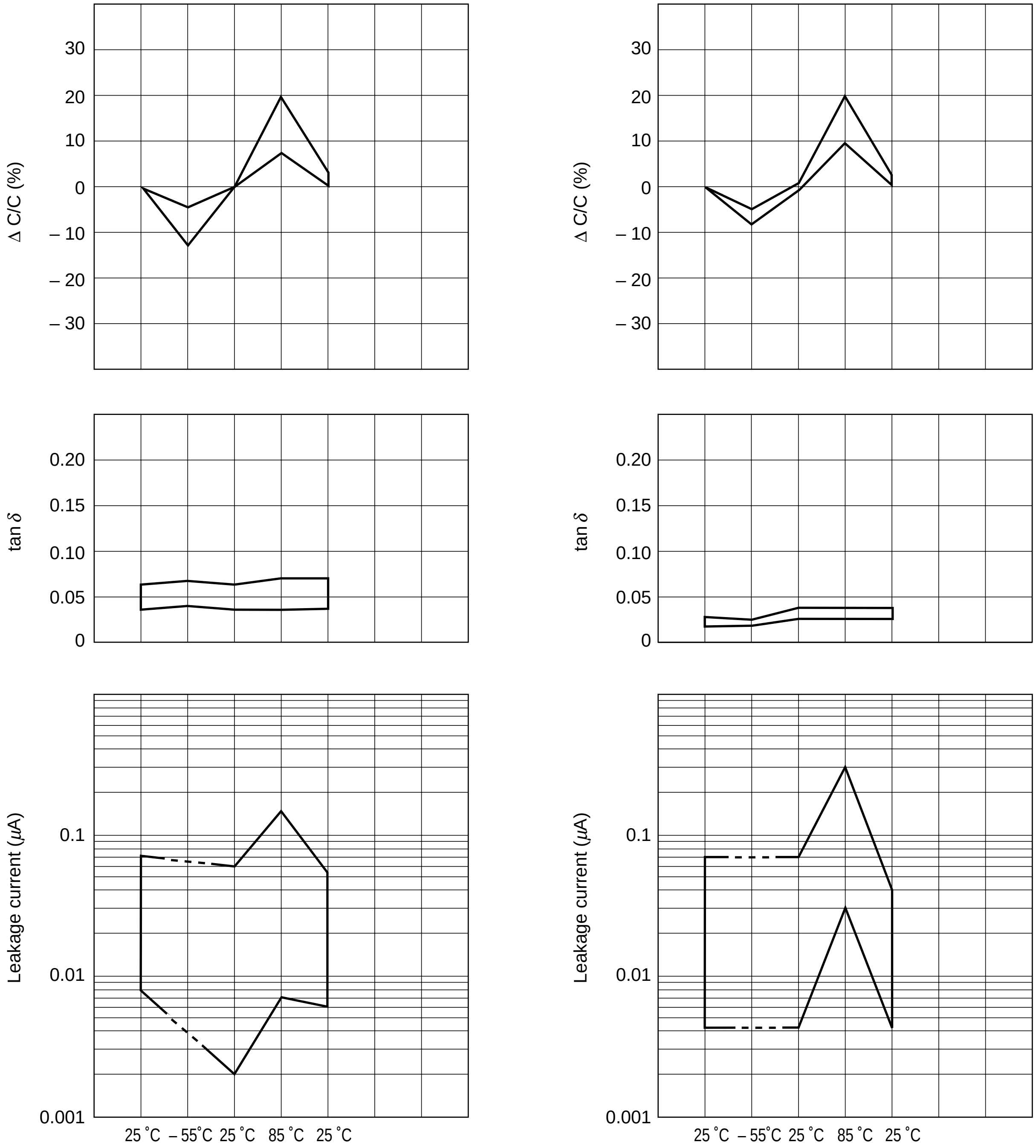


6.8 µF/6.3 V

3.3 µF/16 V

- **PSN series: B2 case**

Characteristics at high/low temperature

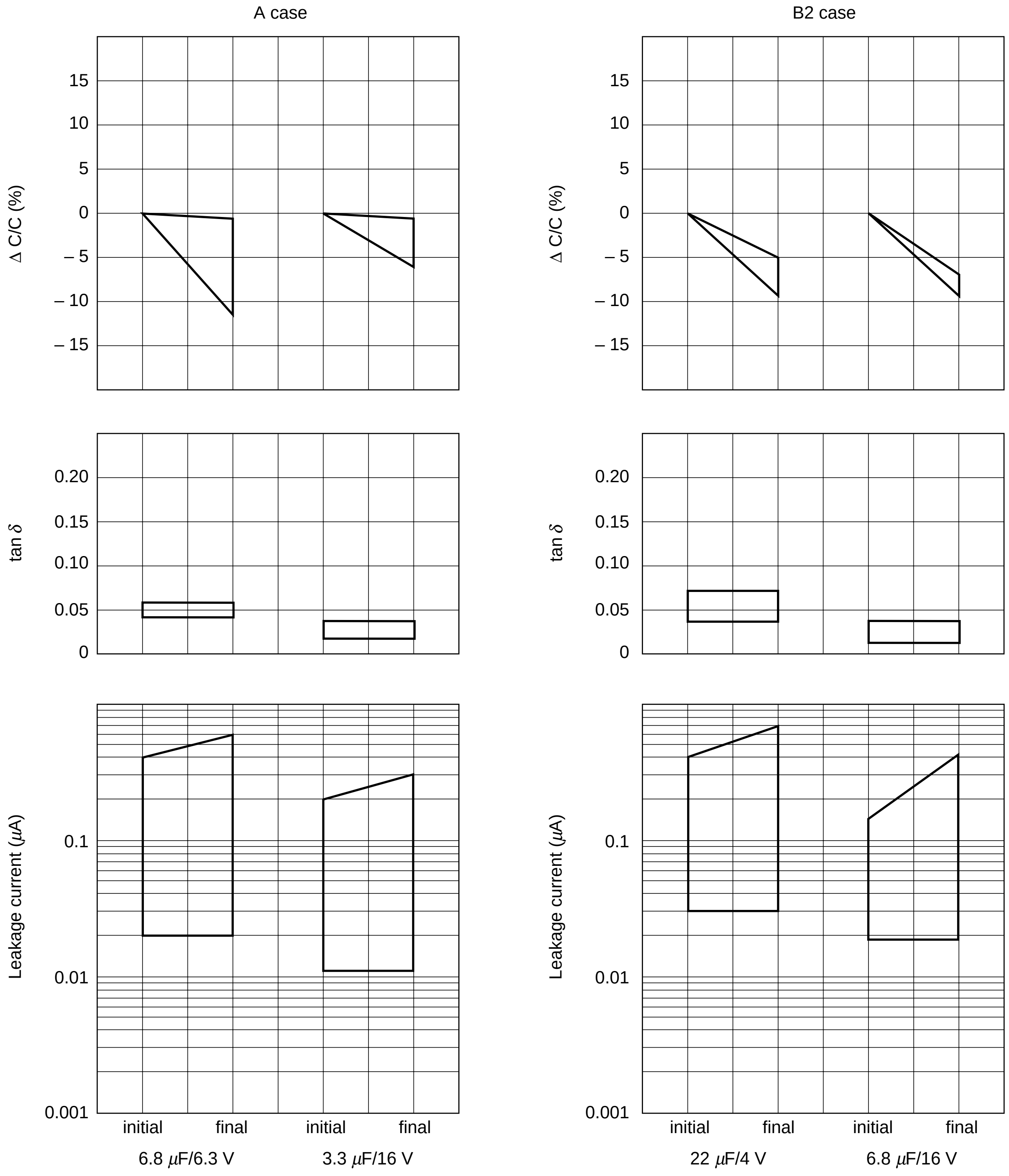


6.8 μF/6.3 V

3.3 μF/16 V

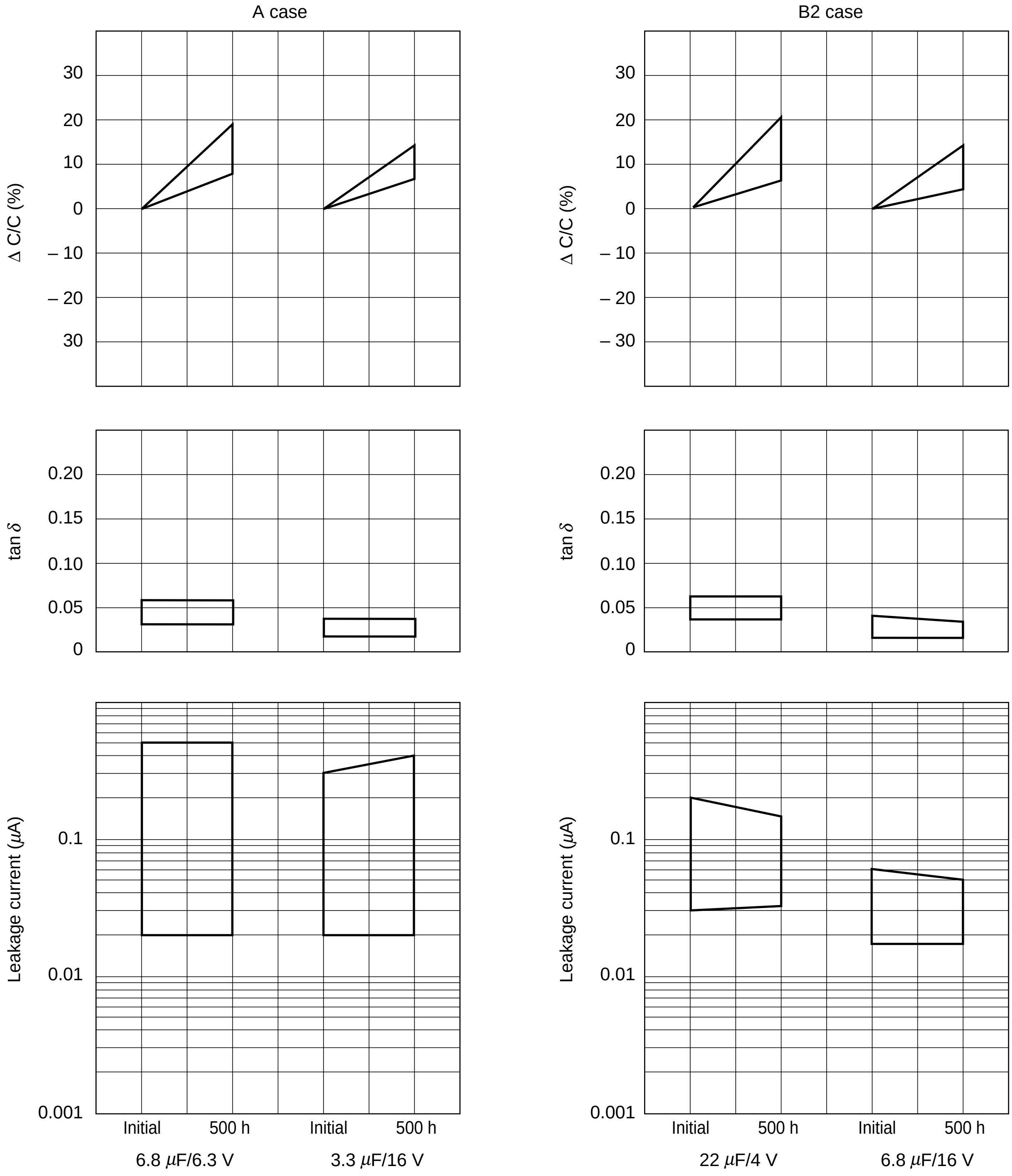
- **PSN series**

Resistance to soldering heat (240°C, 10 seconds, reflow)



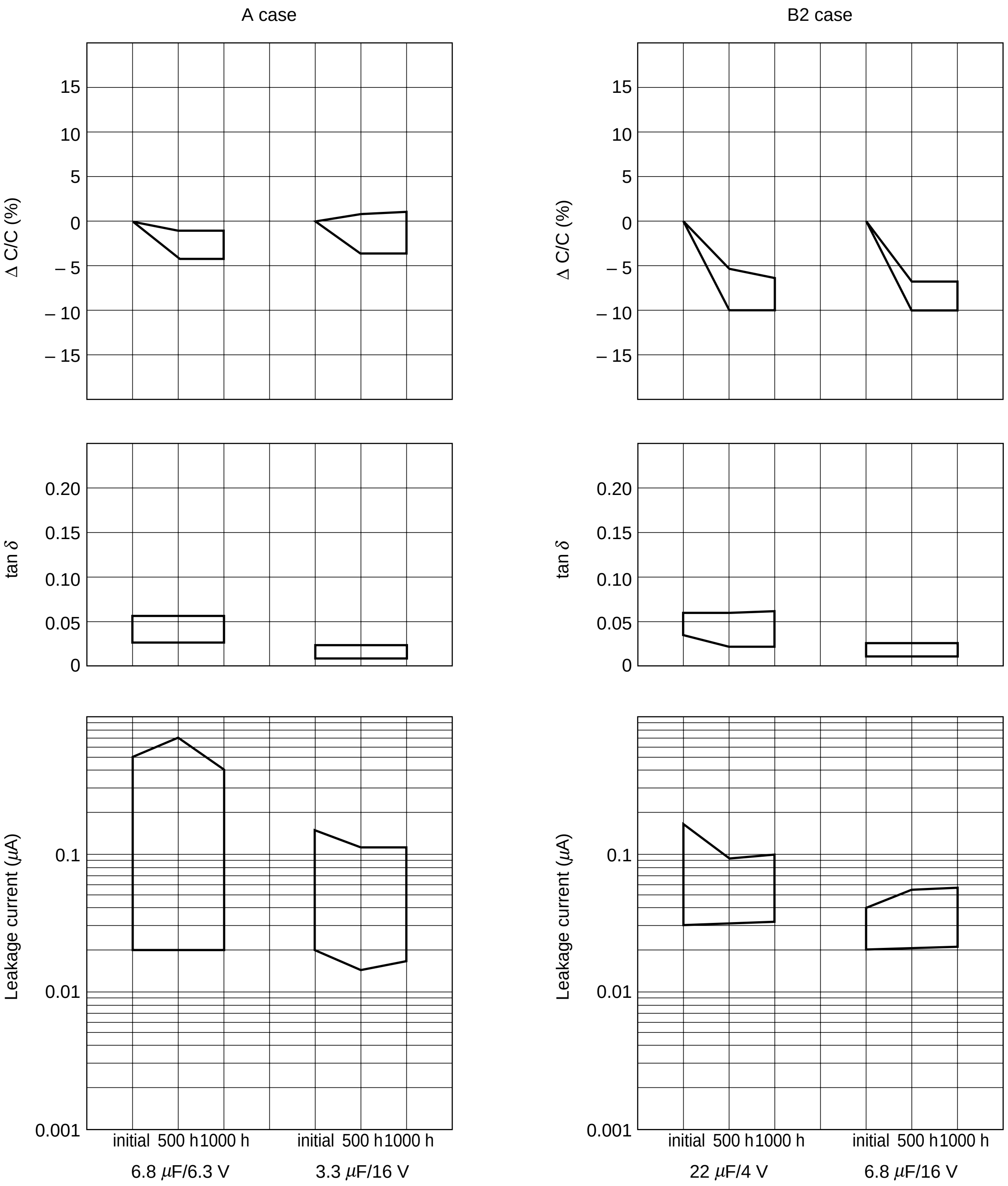
- **PSN series**

Damp heat, steady state (40°C, 90 to 95% RH)

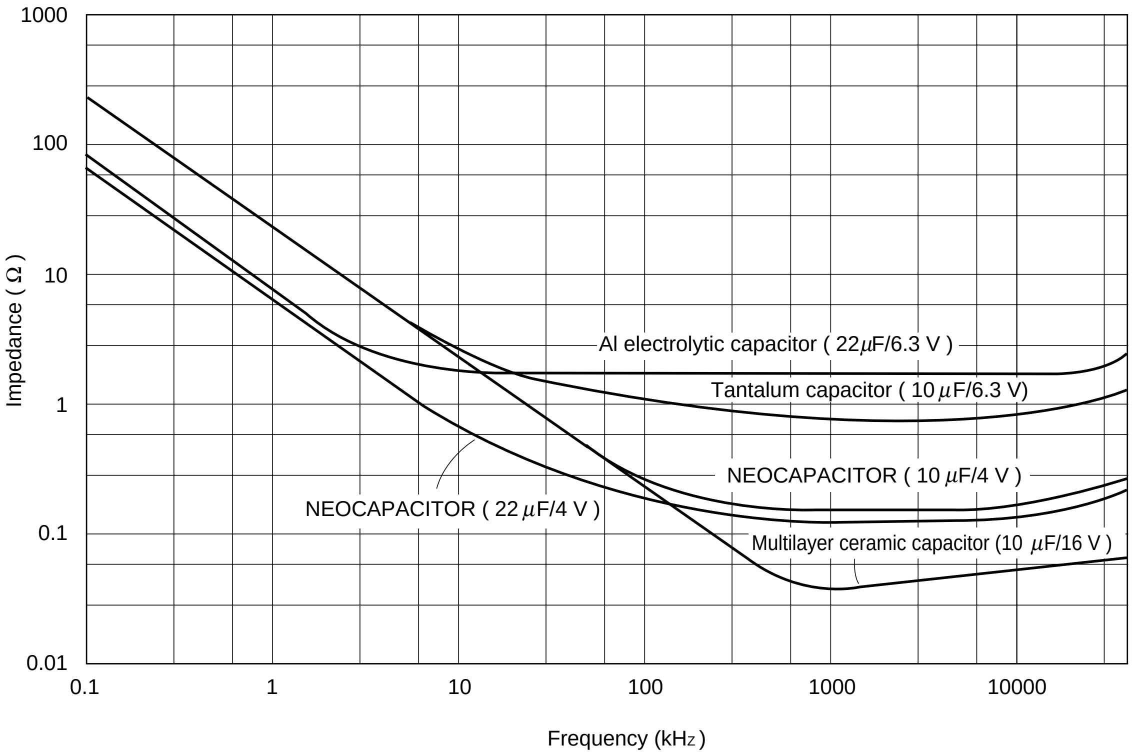


- **PSN series**

Endurance (85°C, rated voltage × 1.3)
(Reference data)

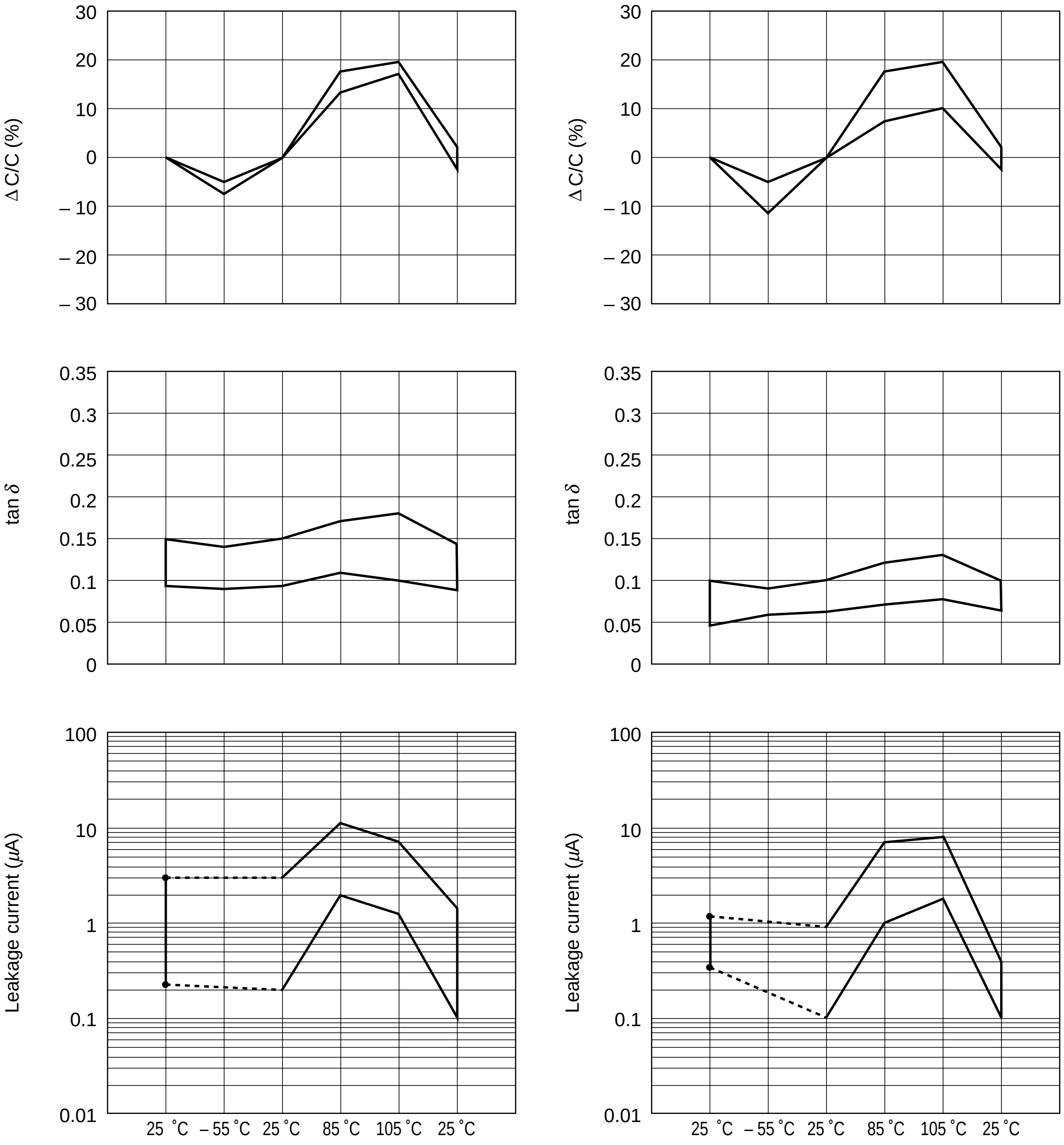


Impedance-frequency characteristics



- **PSM series**

Characteristics at high/low temperature

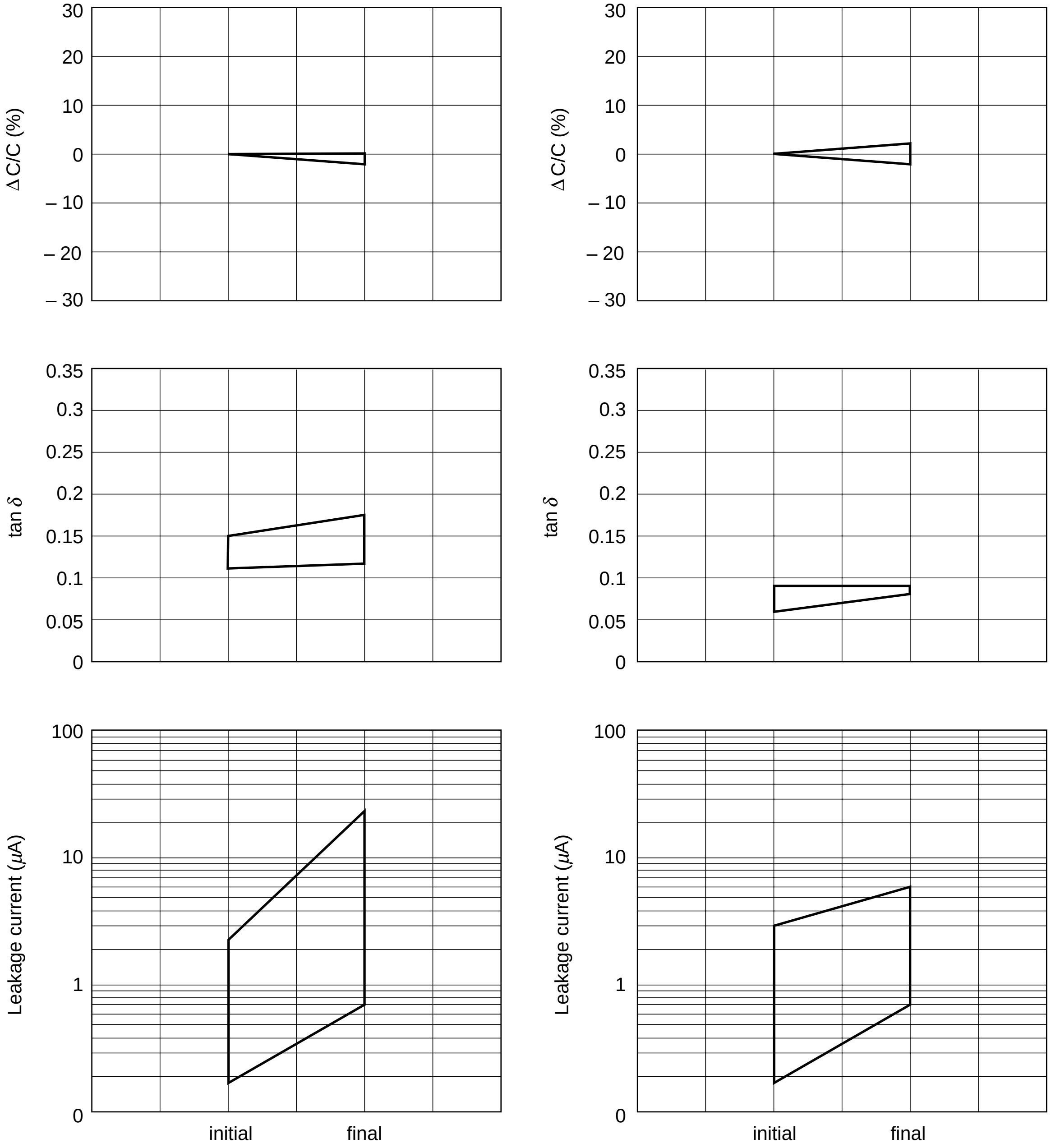


150 μF/6.3 V

100 μF/10 V

- **PSM series**

Damp heat, Steady State (40°C, 90 to 95%RH)

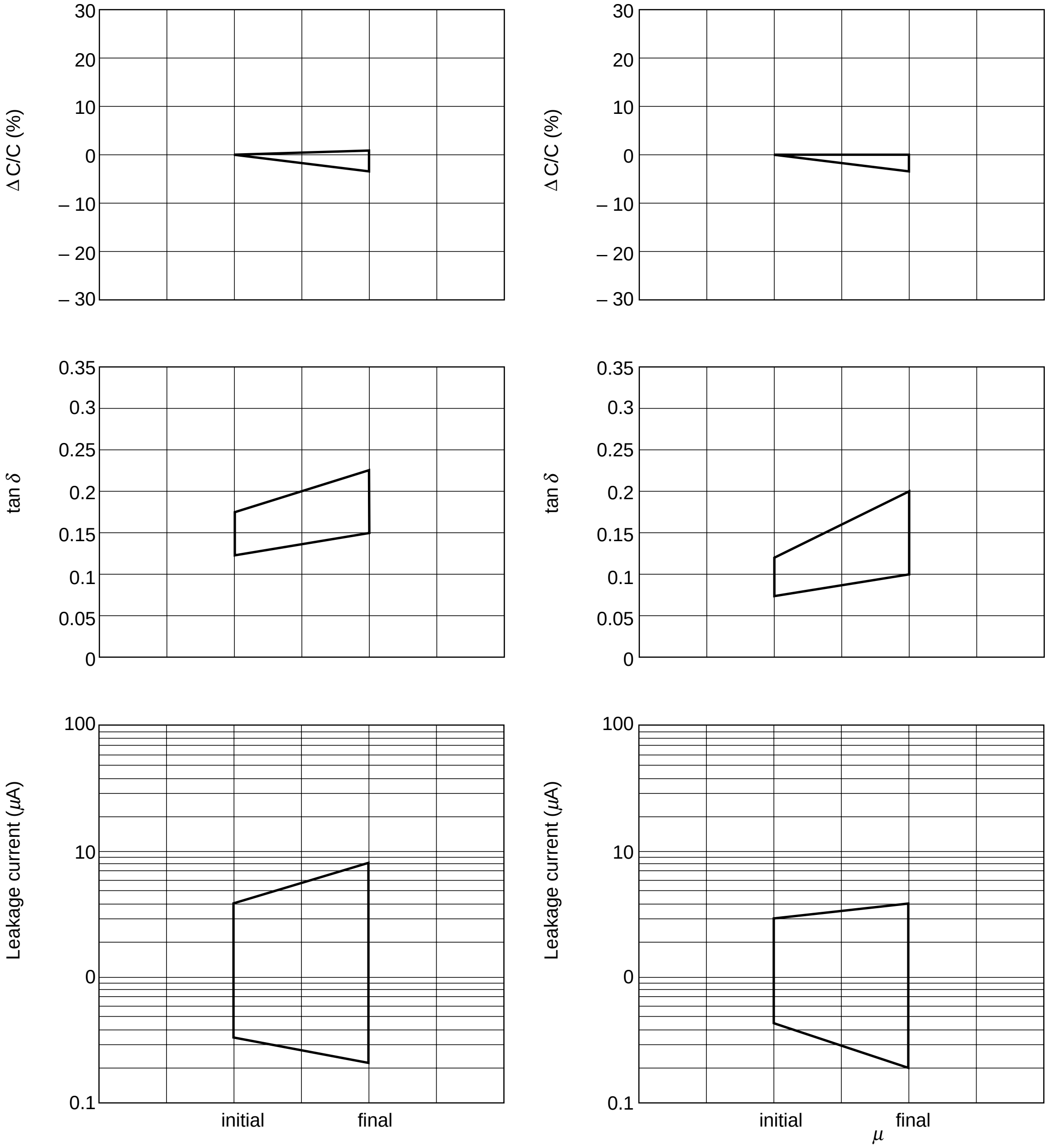


150 µF/6.3 V

100 µF/10 V

- **PSM series**

Surge voltage (85°C, rated voltage × 1.3, charge for 30 seconds, discharge for 6 minutes, 1000 cycles)

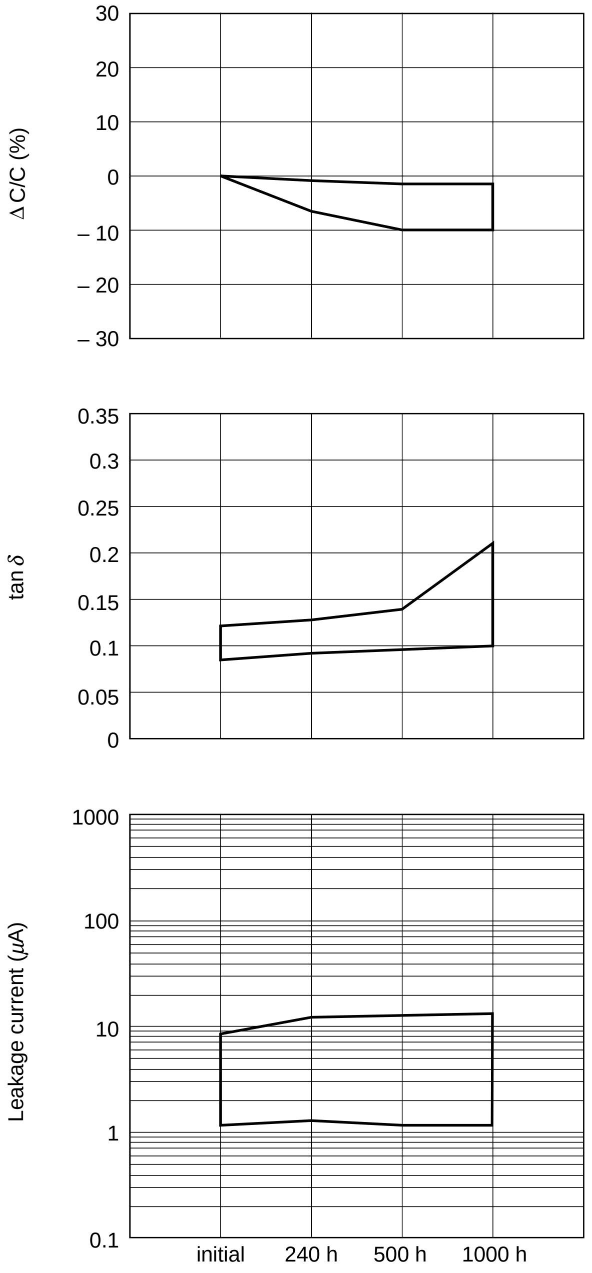


150 µF/6.3 V

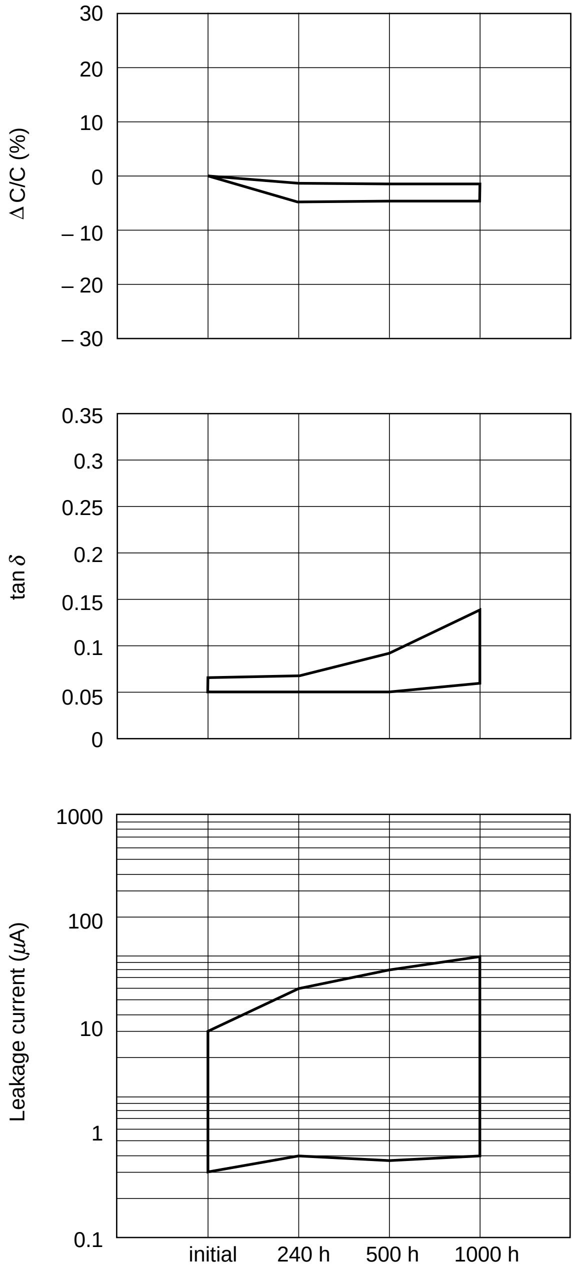
100 µF/10 V

- **PSM series**

Endurance (105°C, rated voltage)



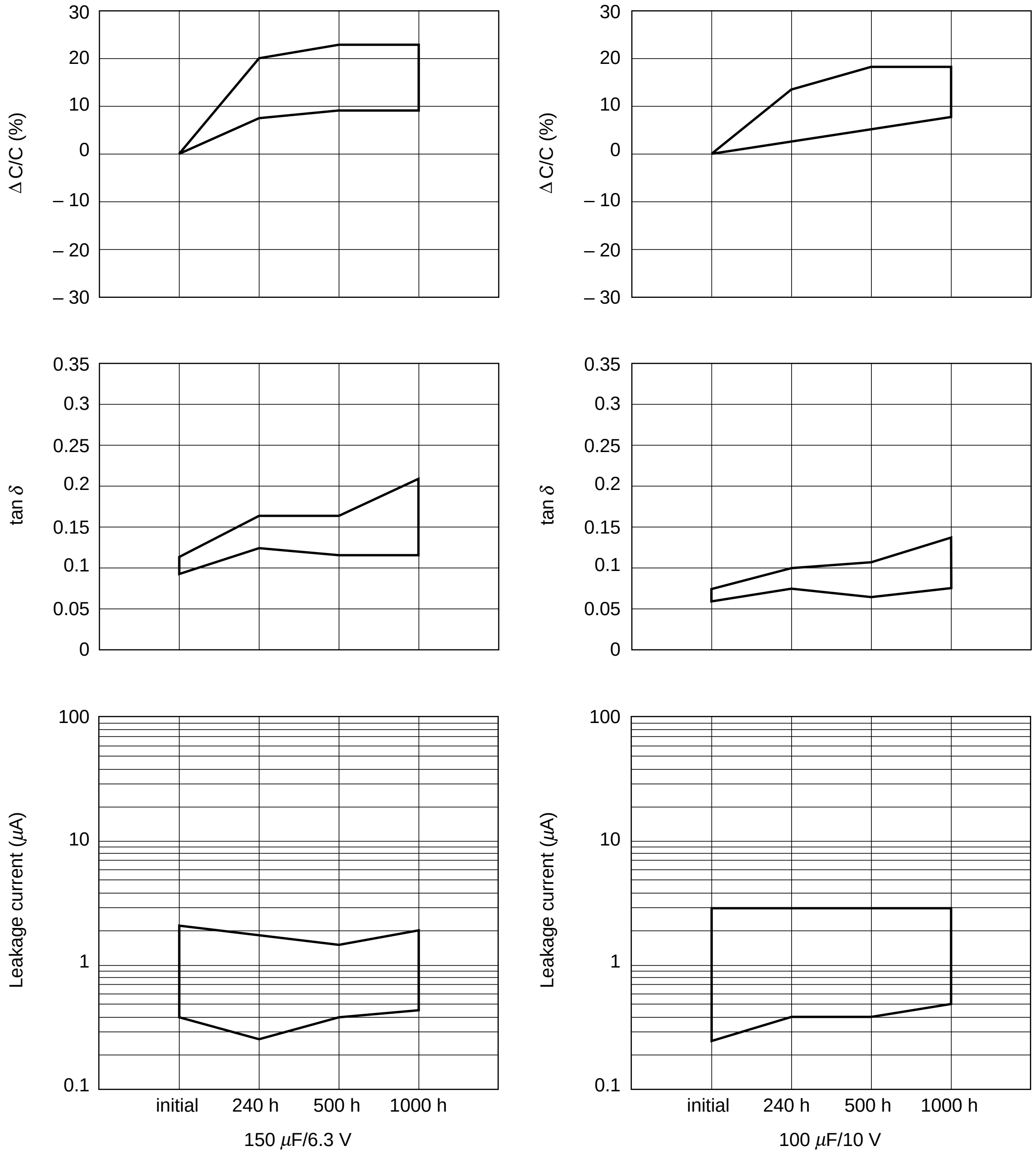
150 μF/6.3 V



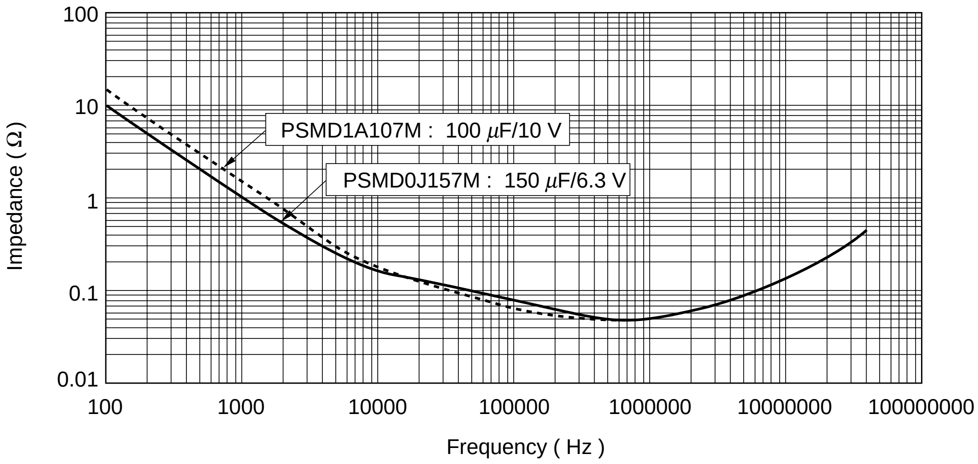
100 μF/10 V

- **PSM series**

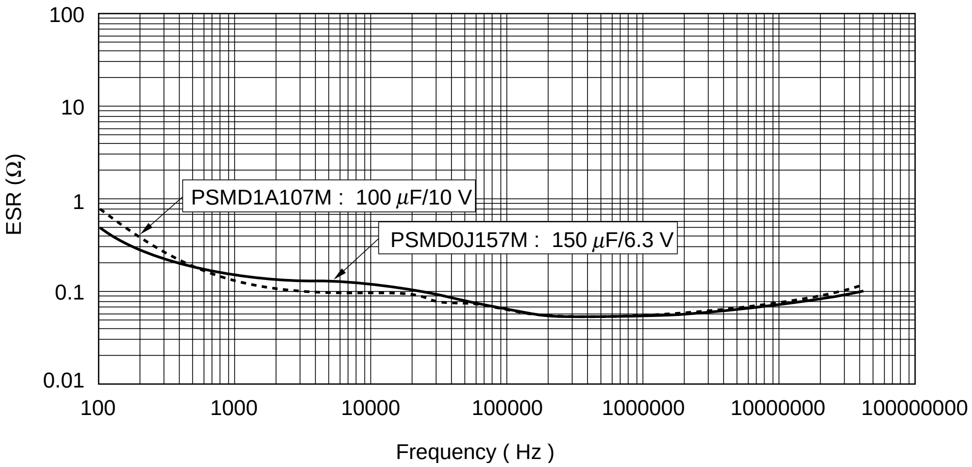
Damp heat, steady state (40°C, 90 to 95%RH)



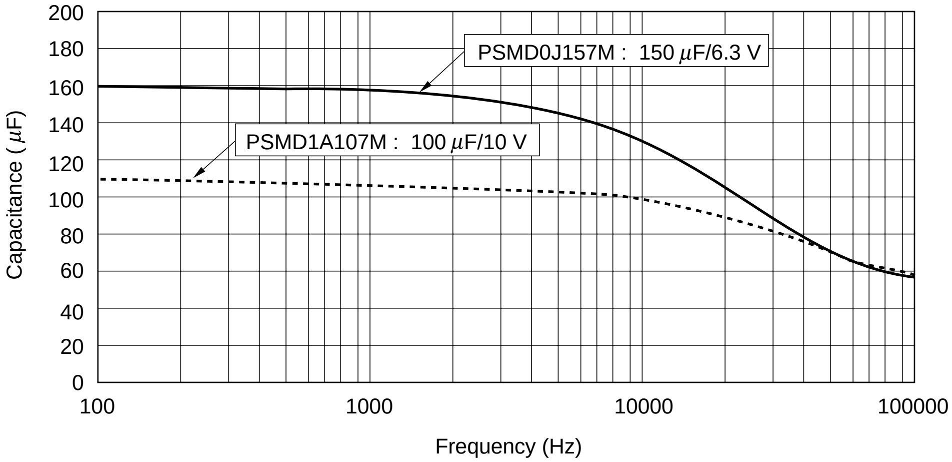
- **Impedance-frequency characteristics (Reference data)**



- **ESR-frequency characteristics (Reference data)**



- **Capacitance-frequency characteristics (Reference data)**



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NEC devices are classified into the following three quality grades:

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Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.

M4 96.5