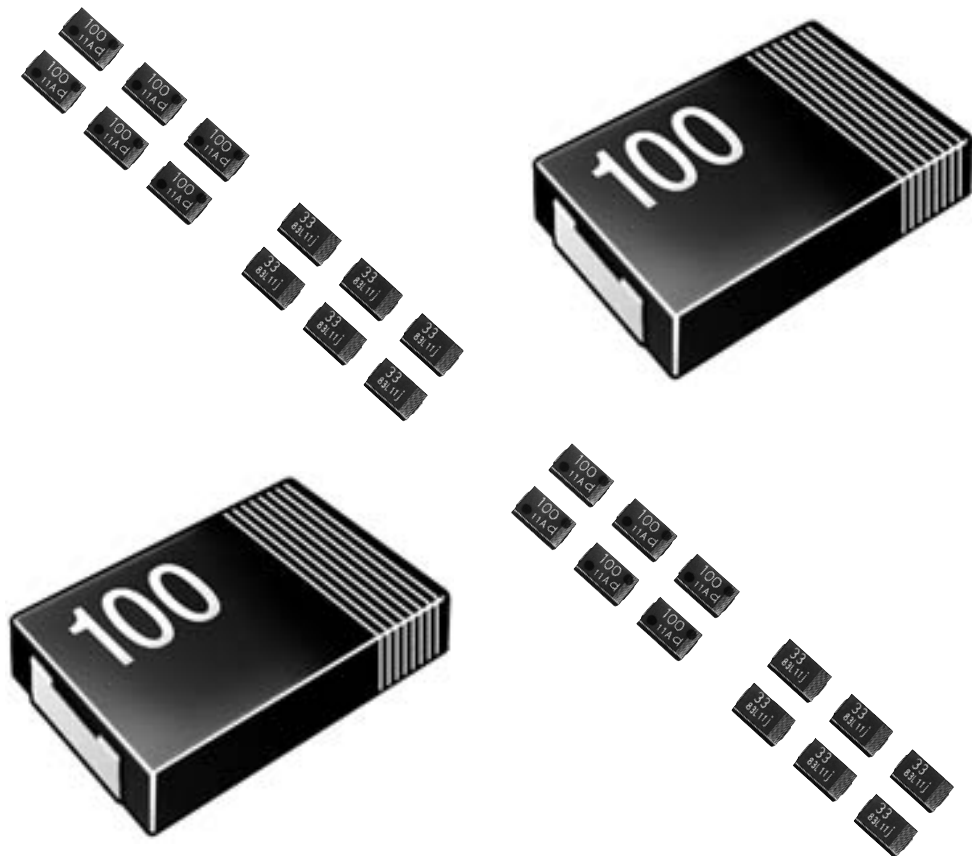


Panasonic
Electronic Components

SP-Cap

**Specialty Polymer
Aluminum Electrolytic Capacitors**



Panasonic Industrial Company

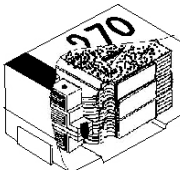
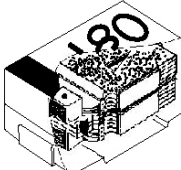
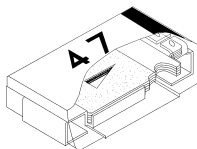
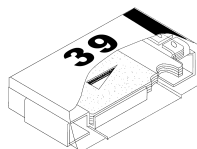
2 Panasonic Way
Secaucus, NJ 07094
1-800-344-2112

<http://www.panasonic.com/pic/ecg>

Revised (April / 2001)

■ Construction and Product Range

SP-Cap

W.V. (V. DC)	Construction				
		UE 7.3 x 4.3 x 4.2	UD 7.3 x 4.3 x 3.1	CD 7.3 x 4.3 x 1.8	FD 7.3 x 4.3 x 1.1
2	Capacitance ESR Ripple current	330/270 μ F 15 m Ω 3000 mA	220/180 μ F 18 m Ω 2000 mA	100 μ F 25 m Ω 1800 mA	68 μ F 35 m Ω 1600 mA
2.5	Capacitance ESR Ripple current	270/220 μ F 15 m Ω 3000 mA	180/150 μ F 18 m Ω 2000 mA	82 μ F 25 m Ω 1800 mA	56 μ F 35 m Ω 1600 mA
4	Capacitance ESR Ripple current	180 μ F 15 m Ω 3000 mA	120 μ F 18 m Ω 2000 mA	56 μ F 25 m Ω 1800 mA	39 μ F 35 m Ω 1600 mA
6.3	Capacitance ESR Ripple current	150 μ F 15 m Ω 3000 mA	100 μ F 18 m Ω 2000 mA	10~47 μ F 60~25 m Ω 1000~1800 mA	33 μ F 35 m Ω 1600 mA
8	Capacitance ESR Ripple current	100 μ F 15 m Ω 3000 mA	68 μ F 18 m Ω 2000 mA	8.2~33 μ F 60~25 m Ω 1000~1800 mA	22 μ F 35 m Ω 1,600 mA
12.5	Capacitance ESR Ripple current	— — —	— — —	4.7~22 μ F 80~40 m Ω 1000~1300 mA	— — —
16	Capacitance ESR Ripple current	— — —	— — —	2.2~8.2 μ F 110~60 m Ω 1000 mA	— — —

ESR spec at 100kHz/20°C (m Ω max.)
Ripple current at 100kHz/105°C (max. mA rms)

Specialty Polymer Aluminum Electrolytic Chip Capacitors (SP Cap)

SP-Cap

As the trend in electronic equipment is to digitalize and become higher frequency, electrolytic capacitors of lower impedance in high frequency regions are required. We believe this capacitor (SP Cap) can meet this requirement.

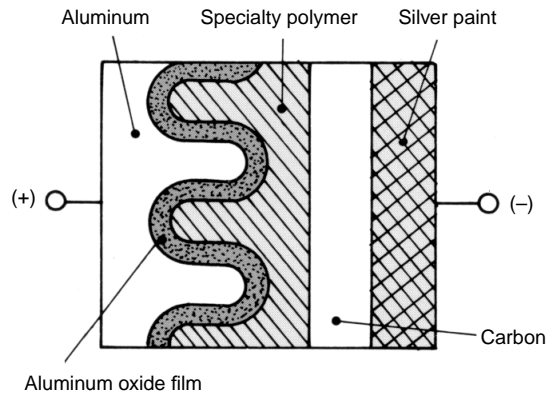
What is a specialty polymer?

Specialty polymer is a so called plastic that carries electricity as if it were metal and possesses a higher electric conductivity by 100 to 10,000 compared with several electrolytes used in conventional electrolytic capacitors.

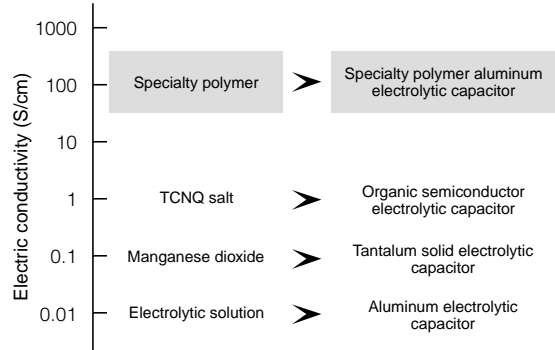
As we found specialty polymers with high electric conductivity even at high temperature and developed the original method to form them on aluminum oxide layers, we could realize the mass production of specialty polymer aluminum electrolytic chip capacitors.

Construction

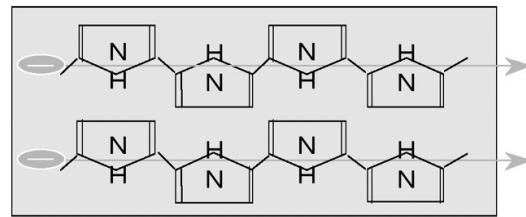
Specialty polymers are used as the solid electrolyte instead of the conventional electrolytic solution.



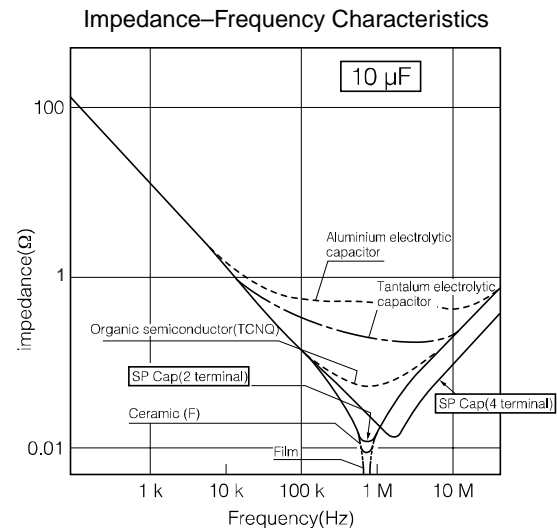
Electrical conductivities of various electrolytes



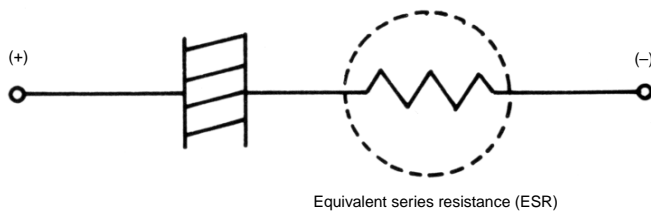
The electrons move very fast on the molecules, therefore the Specialty Polymer Capacitor has a very high conductivity. This results in a low ESR.



Low impedance characteristics were implemented at high frequencies (10 kHz to 10 MHz)



Equivalent Circuit of An Ideal Capacitor ESR = 0



— Features and Advantages —

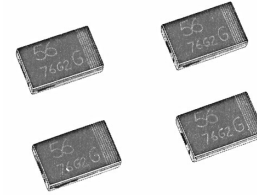
1. Operate at full rated voltage. No derating needed.
2. Very low impedance at high frequency
3. Stable capacitance at high frequency
4. Stable life characteristics
5. High ripple current capability
6. High inrush current capability
7. Withstands reverse shock
8. Stable for solder shock
9. Non-toxic materials
10. Non-flammability

Surface Mount Type

Series: **CD**

SP-Cap

Japan

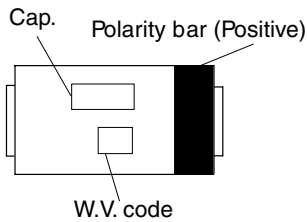


- **Features** Excellent Noise-absorbent Characteristics
Low profile type (1.8mm Height)

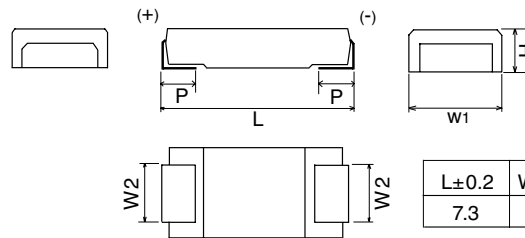
■ **Specification**

Operating Temp. Range	-40 to +105°C	
Rated W.V Range	2 to 16 V. DC	
Nominal Cap.Range	2.2 to 100 μF	
Capacitance Tolerance	± 20 % (120 Hz / +20°C)	
DC Leakage Current	$I \leq 0.04 CV$ or $3 (\mu A)$ 2 minutes (whichever is the greater) (2 W.V. to 4 W.V. : $I \leq 0.06 CV$)	
Dissipation Factor	≤ 0.06 (120 Hz / +20°C)	
Surge Voltage	Rated Working Voltage x 1.25 (15 to 35°C)	
Endurance	After applying rated working voltage for 1000 hours at +105 ±2°C, and then being stabilized at +20°C, capacitor shall meet the following limits.	
	Capacitance change	± 10 % of initial measured value
	D.F.	\leq Initial specified value
Moisture resistance	After storing for 500 hours at +60°C, 90%R.H.	
	Capacitance change	+40%,-20% of initial measured value(2, 2.5 W.V.:+70%,-20%, 4W.V.:+60%,-20% 6.3 W.V.:+50%,-20%)
	D.F.	≤ 200 % of initial specified value
	DC leakage current	\leq Initial specified value

■ **Marking**



■ **Dimensions in mm (not to scale)**



L±0.2	W1±0.2	W2±0.1	H±0.1	P±0.3
7.3	4.3	2.4	1.8	1.3

■ **Standard product**

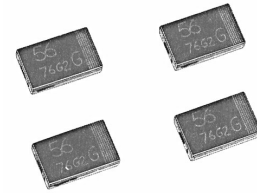
Rated W.V. (V.DC)	Capacitance (± 20%) (μF)	Specification		Part number	Min.Packaging Q'ty (pcs)
		Ripple current (A r.m.s./100kHz +20 to +105°C)	ESR (Ω) (100kHz/+20°C)		
2	100	1.8	0.025	EEFCD0D101R	3500
2.5	82	1.8	0.025	EEFCD0E820R	3500
4	56	1.8	0.025	EEFCD0G560R	3500
6.3	10	1.0	0.060	EEFCD0J100R	3500
	22	1.3	0.045	EEFCD0J220R	3500
	33	1.6	0.035	EEFCD0J330R	3500
	47	1.8	0.025	EEFCD0J470R	3500
8	8.2	1.0	0.060	EEFCD0K8R2R	3500
	15	1.3	0.045	EEFCD0K150R	3500
	22	1.6	0.035	EEFCD0K220R	3500
	33	1.8	0.025	EEFCD0K330R	3500
12.5	4.7	1.0	0.080	EEFCD1B4R7R	3500
	10	1.0	0.060	EEFCD1B100R	3500
	15	1.3	0.050	EEFCD1B150R	3500
	22	1.3	0.040	EEFCD1B220R	3500
16	2.2	1.0	0.110	EEFCD1C2R2R	3500
	4.7	1.0	0.080	EEFCD1C4R7R	3500
	6.8	1.0	0.070	EEFCD1C6R8R	3500
	8.2	1.0	0.060	EEFCD1C8R2R	3500

Surface Mount Type

Series: **FD**

SP-Cap

Japan

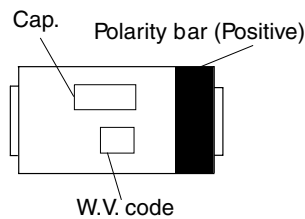


- **Features** Excellent Noise-absorbent Characteristics
Low profile type (1.1mm Height)

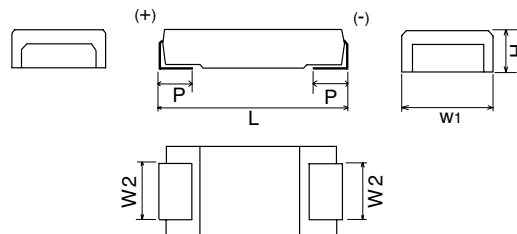
■ Specification

Operating Temp. Range	-40 to +105°C	
Rated W.V Range	2 to 8 V. DC	
Nominal Cap.Range	22 to 68 μF	
Capacitance Tolerance	± 20 % (120 Hz / +20°C)	
DC Leakage Current	$I \leq 0.04 CV$ or $3(\mu A)$ after 2 minutes (whichever is the greater) (2 W.V. to 4 W.V.: $I \leq 0.06 CV$)	
Dissipation Factor	≤ 0.06 (120 Hz / +20°C)	
Surge Voltage	Rated Working Voltage x 1.25 (15 to 35°C)	
Endurance	After applying rated working voltage for 1000 hours at +105 ± 2 °C, and then being stabilized at +20°C, capacitor shall meet the following limits.	
	Capacitance change	± 10 % of initial measured value
	D.F.	\leq Initial specified value
Moisture resistance	After storing for 500 hours at +60°C, 90%R.H.	
	Capacitance change	+40%,-20% of initial measured value (4W.V.: +60%, -20%; 6.3W.V.: +50%, -20%)
	D.F.	≤ 200 % of initial specified value
	DC leakage current	\leq Initial specified value

■ Marking



■ Dimensions in mm (not to scale)



L±0.2	W1±0.2	W2±0.1	H±0.1	P±0.3
7.3	4.3	2.4	1.1	1.3

■ Standard product

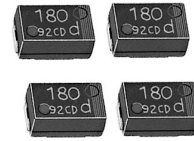
Rated W.V (V.DC)	Capacitance (±20%) (μF)	Specification		Part Number	Min. Packaging Qty. (pcs.)
		Ripple Current (100kHz/ +20 ~ +105°C) (A r.m.s.)	ESR (100kHz/+20°C) (Ω)		
2	68	1.6	0.035	EEFFD0D680R	3500
2.5	56	1.6	0.035	EEFFD0E560R	3500
4	39	1.6	0.035	EEFFD0G390R	3500
6.3	33	1.6	0.035	EEFFD0J330R	3500
8	22	1.6	0.035	EEFFD0K220R	3500

Surface Mount Type

Series: **UD**

SP-Cap

Japan



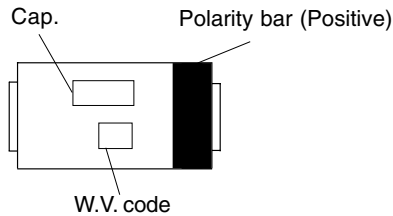
■ Features

- Excellent Noise-absorbent Characteristics
- 3.1mm height

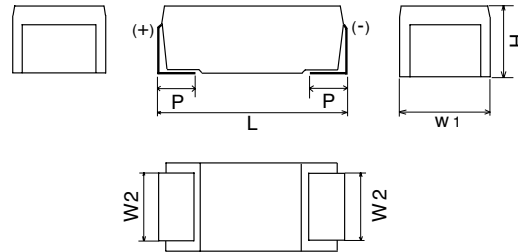
■ Specifications

Operating Temp. Range	-40 to +105°C	
Rated W.V. Range	2 to 8 V. DC	
Nominal Cap. Range	68 to 220 μF	
Capacitance Tolerance	±20 % (120Hz/+20°C)	
DC Leakage Current	I < 0.06 CV after 2minutes (2W.V., 2.5W.V., 4W.V.), I < 0.04 CV after 2 minutes (6.3W.V., 8W.V.)	
Dissipation Factor	0.1 max. (120Hz/+20°C)	
Surge Voltage	Rated Working Voltage x 1.25 (+15 to +35°C)	
Endurance	After applying rated working voltage for 1000 hours at +105 ±2°C, and then being stabilized at +20°C, capacitor shall meet the following limits.	
	Capacitance change	±10% of initial measured value
	D.F.	≤ Initial specified value
	DC leakage current	≤ Initial specified value
Moisture Resistance	After storing for 500 hours at +60°C, 90%R.H.	
	Capacitance change	2, 2.5W.V.: +70%,-20%, 4W.V.: +60%,-20%, 6.3W.V.: +50%,-20%, 8W.V.: +40%,-20% of initial measured value.
	D.F.	≤ 200% of initial specified value
	DC leakage current	≤ initial specified value

■ Marking



■ Dimensions in mm(not to scale)



Series	L±0.2	W1±0.2	W2±0.1	H±0.1	P±0.3
UD	7.3	4.3	2.4	3.1	1.3

■ Standard product

Rated W.V (V.DC)	Capacitance (μF)	Specification		Part Number	Minimum Packaging Quantity (pcs.)
		Ripple current (100kHz/ +20 ~ +105°C) (A r.m.s.)	ESR (100kHz/+20°C) (Ω)		
2	220	2.0	0.018	EEFUD0D221R	2000
	180	2.0	0.018	EEFUD0D181R	2000
2.5	180	2.0	0.018	EEFUD0E181R	2000
	150	2.0	0.018	EEFUD0E151R	2000
4	120	2.0	0.018	EEFUD0G121R	2000
6.3	100	2.0	0.018	EEFUD0J101R	2000
8	68	2.0	0.018	EEFUD0K680R	2000

Surface Mount Type

Series: **UE**

SP-Cap

Japan



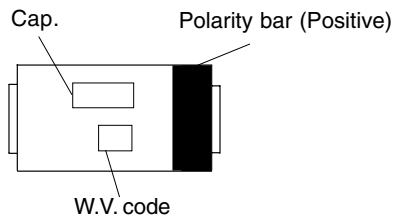
■ Features

- Excellent Noise-absorbent Characteristics
- 4.2mm height

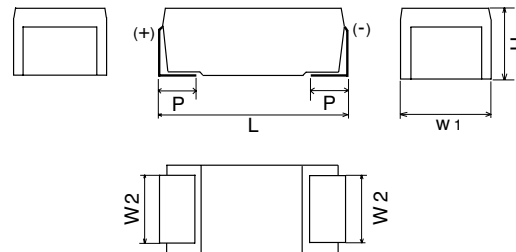
■ Specifications

Operating Temp. Range	-40 to +105°C	
Rated W.V. Range	2 to 8 V. DC	
Nominal Cap. Range	100 to 330 μ F	
Capacitance Tolerance	± 20 % (120Hz/+20°C)	
DC Leakage Current	$I < 0.06 CV$ after 2minutes (2W.V., 2.5W.V., 4W.V.), $I < 0.04 CV$ after 2 minutes (6.3W.V., 8W.V.)	
Dissipation Factor	0.1 max. (120Hz/+20°C)	
Surge Voltage	Rated Working Voltage x 1.25 (+15 to +35°C)	
Endurance	After applying rated working voltage for 1000 hours at +105 $\pm 2^\circ$ C, and then being stabilized at +20°C, capacitor shall meet the following limits.	
	Capacitance change	$\pm 10\%$ of initial measured value
	D.F.	\leq Initial specified value
	DC leakage current	\leq Initial specified value
Moisture Resistance	After storing for 500 hours at +60°C, 90%R.H.	
	Capacitance change	2, 2.5W.V.: +70%,-20%, 4W.V.: +60%,-20%, 6.3W.V.: +50%,-20%, 8W.V.: +40%,-20% of initial measured value.
	D.F.	$\leq 200\%$ of initial specified value
	DC leakage current	\leq initial specified value

■ Marking



■ Dimensions in mm(not to scale)



Series	L ± 0.2	W1 ± 0.2	W2 ± 0.1	H ± 0.1	P ± 0.3
UE	7.3	4.3	2.4	4.2	1.3

■ Standard product

Rated W.V (V.DC)	Capacitance (μ F)	Specification		Part Number	Minimum Packaging Quantity (pcs.)
		Ripple current (100kHz/+20 ~ +105°C) (A r.m.s.)	ESR (100kHz/+20°C) (Ω)		
2	330	3.0	0.015	EEFUE0D331R	2000
	270	3.0	0.015	EEFUE0D271R	2000
2.5	270	3.0	0.015	EEFUE0E271R	2000
	220	3.0	0.015	EEFUE0E221R	2000
4	180	3.0	0.015	EEFUE0G181R	2000
6.3	150	3.0	0.015	EEFUE0J151R	2000
8	100	3.0	0.015	EEFUE0K101R	2000

Application Guidelines

1. Circuit Design

Ensure that operational and mounting conditions follow the specified conditions detailed in the catalog and specification sheets.

1.1 Circuit Type

Do not use the capacitor in time-constant or coupling circuits. In these types of circuits, electrical characteristics such as capacitance can change under certain environmental conditions.

1.2 Polarity

The specialty polymer capacitor has polarity, so be sure to verify the orientation of capacitor before use. If reverse voltage is applied to the capacitor, it not only causes a short in the circuit, but also damages the capacitor.

Design your circuit to eliminate the possibility of reverse voltage conditions. However, if you expect that reverse voltages may occur anyhow, please inform the factory.

1.3 Voltage

Do not apply overvoltages exceeding the rated voltage. Doing so increases leakage current, possibly damaging the capacitor due to internal heating.

Do not use capacitors by series connection for higher voltage use.

Just as with tantalum capacitors, circuit resistance is not a major issue. However, when rush current is flowing, ensure the peak value of the induced voltage does not exceed the capacitor's rated voltage.

1.4 Temperature

Use at or under the rated (guaranteed) temperature. Operation at temperatures exceeding specifications causes large changes in the capacitor's electrical properties, and deterioration that can potentially lead to failure.

When calculating the operating temperature of the capacitor, be sure to include not only the ambient temperature and internal temperature of the unit, but also radiation from heat generating elements inside the unit (power transistors, resistors, etc.), and self-heating due to ripple current.

1.5 Ripple Current

Do not apply ripple current exceeding the capacitor's specified value. Excessive ripple current results in high internal heat generation, causing capacitor failure.

Make sure that the sum of the DC voltage and the peak value of the induced voltage by allowable ripple current does not exceed the rated voltage.

Even when using the capacitor under the permissible ripple current, a reverse voltage may occur if the DC bias voltage is low.

Ripple current must be corrected for frequency.

Use the frequency correction factor given below:

(Frequency correction factor)

Frequency (Hz)	10 k	0.6	Frequency correction factor (Sinewave current, Ambient temperature: Room tempera- ture to 100°C)
	20 k	0.7	
	50 k	0.8	
	100 k	1.0	
	250 k	1.1	
	500 k	1.2	
	1 M	1.3	

Always consider safety when designing equipment and circuits. Plan for worst case failure modes such as short circuits and open circuits which could occur during use.

- (1) Provide protection circuits and protection devices to allow safe failure modes.
- (2) Design redundant or secondary circuits where possible to assure continued operation in case of main circuit failure.

2. Capacitor Handling Techniques

2.1 Capacitor Insertion

- (1) Incorrect land size may cause problems with capacitor placement and mountability. Refer to the land size table for appropriate design dimensions.
- (2) Do not apply excessive force to the capacitor, since this can damage the electrodes and badly affect capacitor mountability. There is also the leakage current, separation of lead wire and element, or damage to the capacitor body, all of which can badly affect the electrical performance of the capacitor.
- (3) Do not grab or otherwise apply force to the capacitor once it is soldered to the PCB.

2.2 Soldering

- (1) When using a soldering iron, set the tip temperature to no more than 350°C, and work in as short a time as possible under 10 seconds. While soldering, do not apply strong force to the capacitor.
- (2) Reflow Soldering:
 - A. The specialty polymer capacitor is designed specifically for reflow soldering.
 - ✳ Consult the factory when performing processes other than reflow soldering.
 - B. Maintain soldering conditions (pre-heating, reflow temperature, time) within the range indicated in the product specifications. If soldering time is lengthened or temperature is higher, the heat can damage the capacitor element and/or the molded case.
 - C. Do not perform reflow soldering more than twice.

2.3 Circuit Board Cleaning

Capacitors can withstand immersion in solvent at 60°C or under for up to 5 minutes (ultrasound okay). Be sure to sufficiently wash (about 3 min. with water) and dry (20 min. at 100°C) the board afterward.

Recommended cleaning solvents include
Pine Alpha ST-100S, Sunelec B-12, DK beclear
CW-5790, Aqua Cleaner 210SEP, Cold Cleaner
P3-375, Telpen Cleaner EC-7R, Clean-thru 750H,
Clean-thru 750L, Clean-thru 710M, Techno Cleaner
219, Techno Care FRW-17, Techno Care FRW-1,
Techno Care FRV-1, IPA (isopropyl alcohol)

*The use of ozone depleting cleaning agents are
not recommended in the interest of protecting the
environment.

3. Precautions for using capacitors

Capacitors should not be used in the following
environments.

- (1)Environment where the capacitor is subject to
direct contact with water, salt water or oil.
- (2)Environment where capacitors are exposed to
direct sunlight.
- (3)High temperature, humid environment where water
vapor is condensing on the capacitor surface.
- (4)Environment where the capacitor is in contact with
chemically active gases.
- (5)Acid or alkaline environment.
- (6)Environment subject to high-frequency induction.
- (7)Environment subject to excessive vibration and
shock.

4. Emergency Procedures

If the capacitor is overheated, the resin case may
emit smoke. If this occurs, immediately switch off the
unit's main power supply to stop operation. Keep your
face and hands away from the capacitor, since the
temperature may be high enough to cause the
capacitor to ignite and burn.

5. Long Term Storage

- (1)The aluminium oxide film deteriorates as a function
of temperature and time.

If used without reconditioning, an abnormally high
current will be required to restore the oxide film.
This current surge could cause the circuit or the
capacitor to fail.

Capacitor should be reconditioned by applying
rated voltage in series with a 1000Ω, current
limiting resistor for a time period of 30 minutes.

During transportation, take care not to subject the
capacitors to excessive vibration or shock. This
will prevent the degradation of capacitor reliability.

- (2)Products are packed in moisture proof packages.
When products absorb excessive moisture,
heat stress while soldering might cause
damage to the resin seal. Therefore, it is desirable
to maintain the following storage conditions:
 - Preferred storage conditions
Temperature : 5~30°C without direct sunlight
Humidity : less than 70%RH
 - Required storage condition after opening a package
Period : less than 14 days at above preferred
conditions

When storing for more than 14 days, it is necessary to
store capacitors in moisture proof condition.

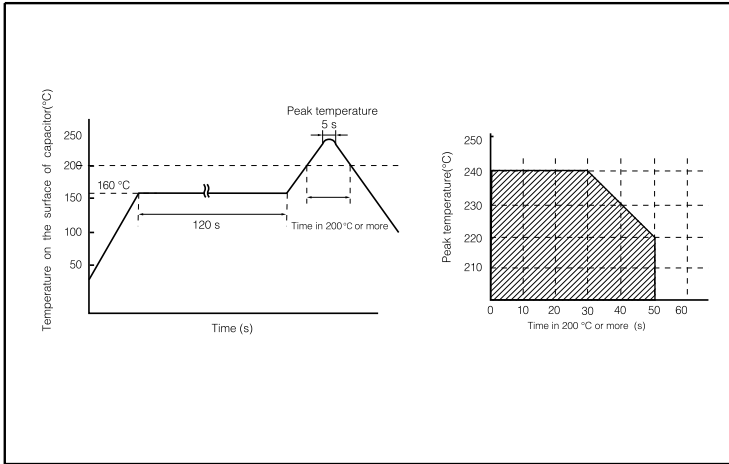
Leakage current of a capacitor increases with long
storage times.

6. Capacitor Disposal

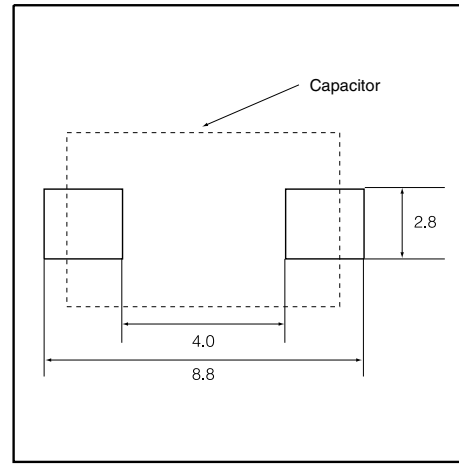
Since capacitors are composed of various metals and
resins, treat them as industrial waste when arranging
for their disposal.

■ Mounting Specifications

- Recommended reflow soldering temperature

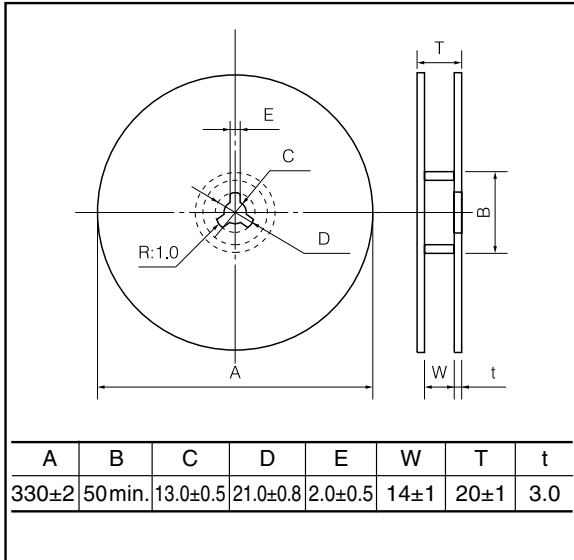


- Typical land pattern (mm)

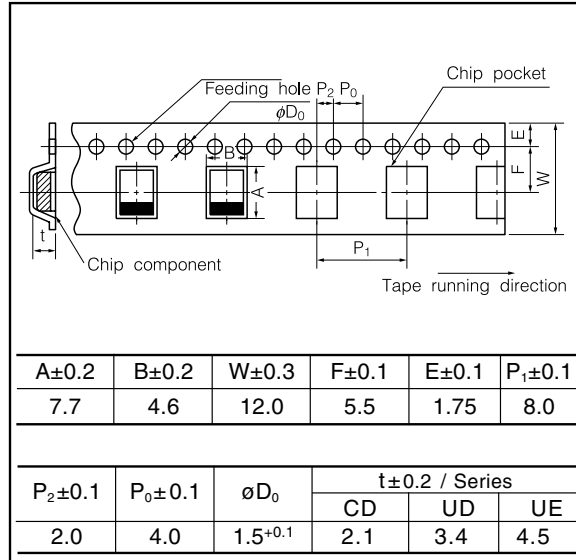


■ Packaging Specifications

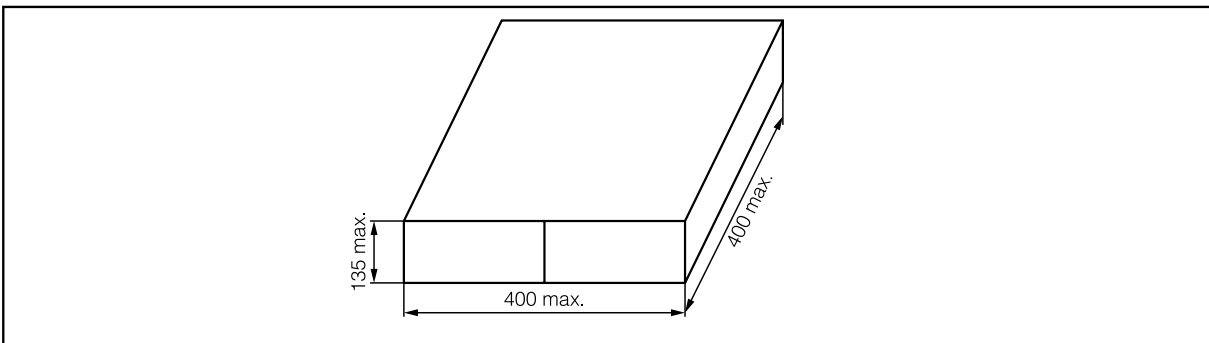
- Reel Dimensions (mm)



- Embossed Taping (mm)



■ Packaging Box Dimensions (mm)

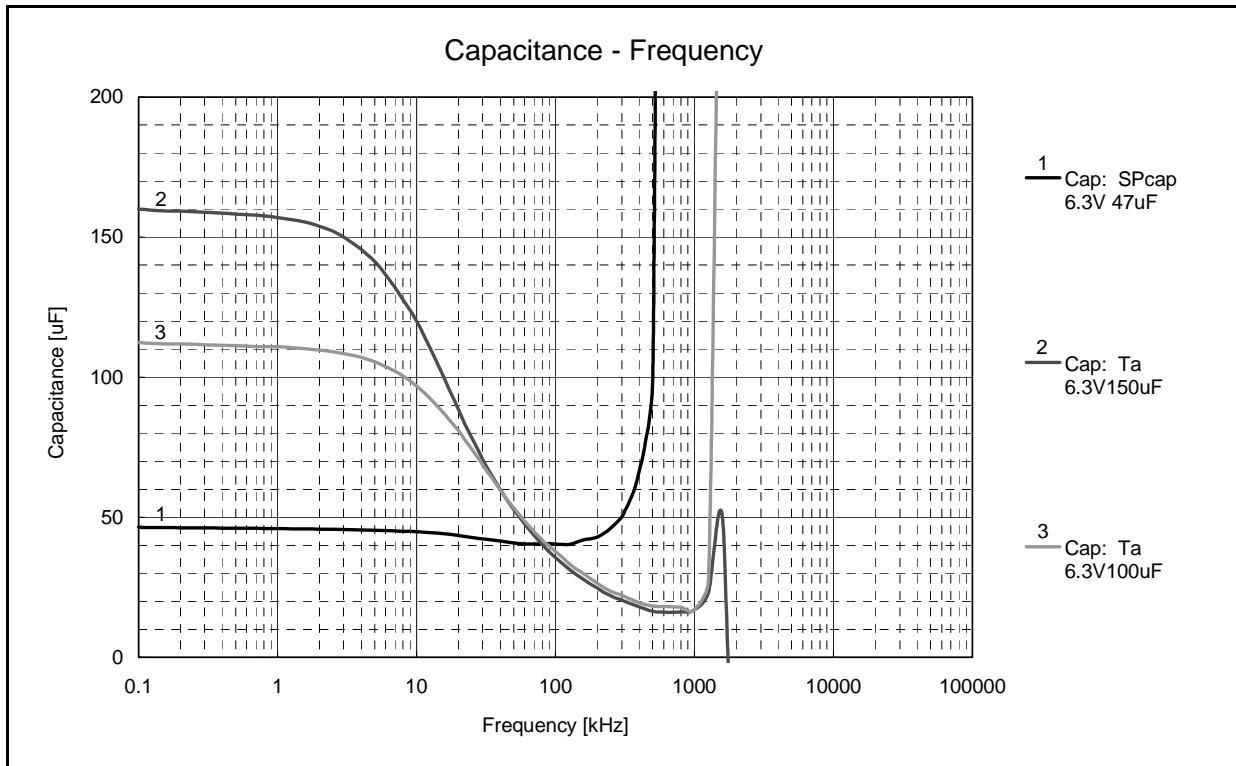
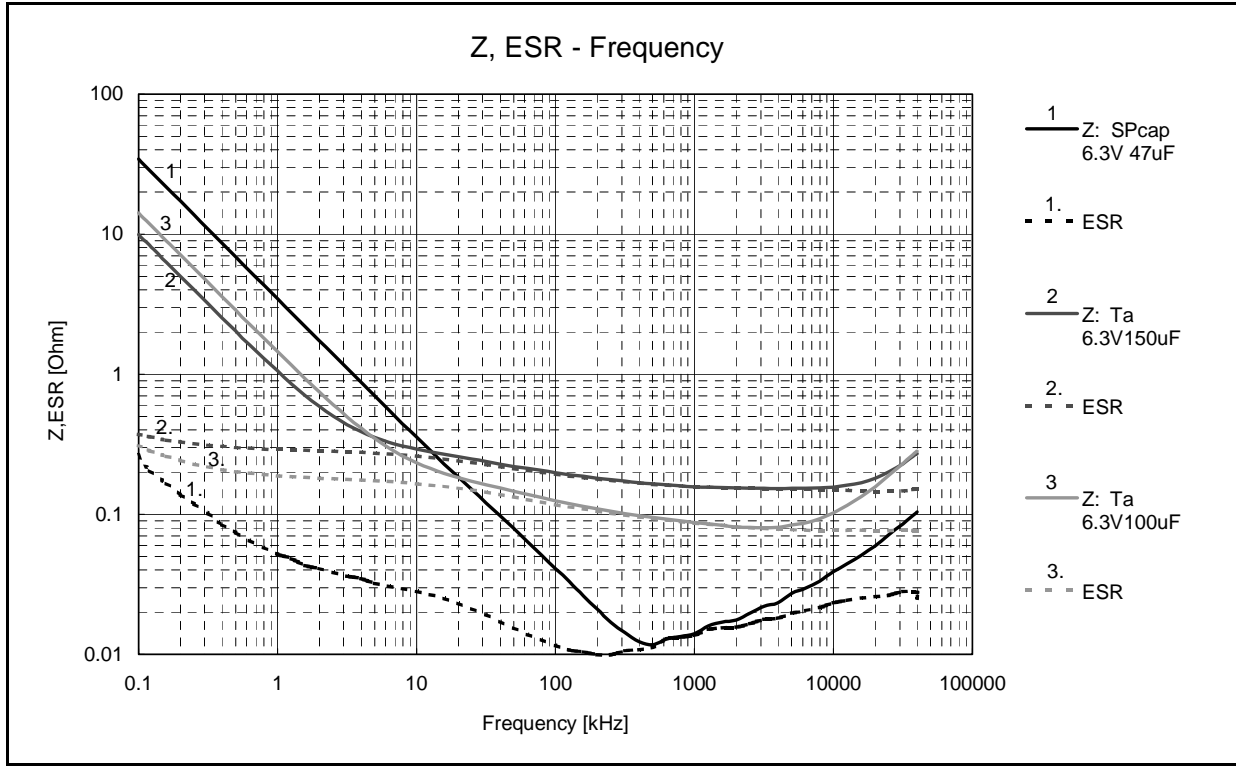


■ Frequency Characteristics

● SP Cap vs. Tantalum

EEFCD0J470 (6.3V 47 μ F) vs. Ta (6.3V 100 μ F) vs. Ta (6.3V 150 μ F)

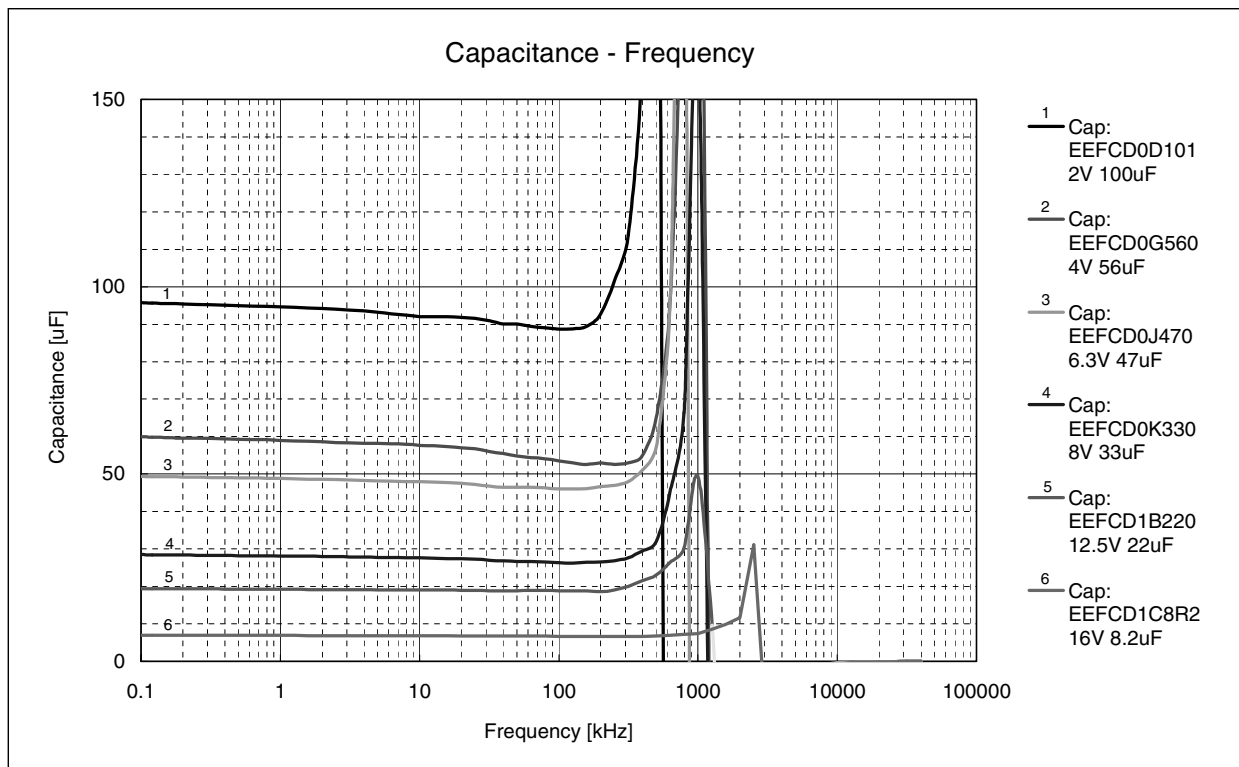
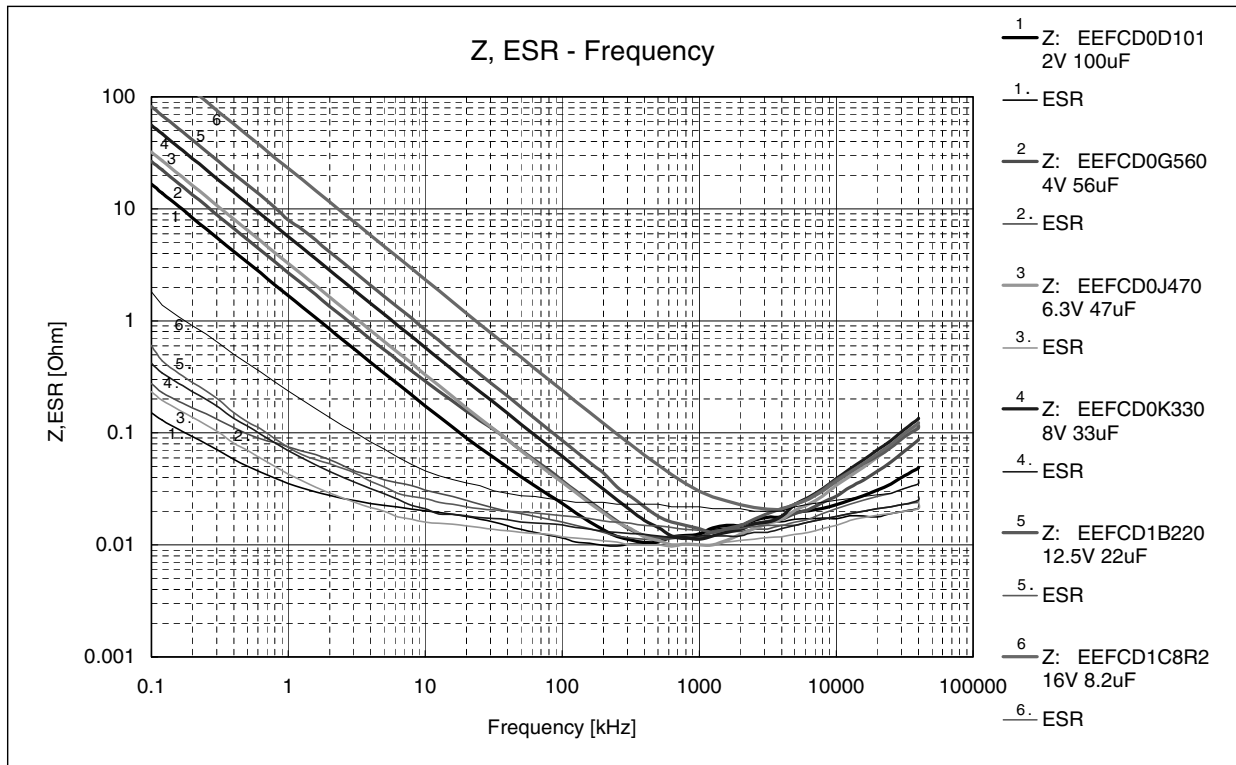
(at room temperature)



Capacitance cannot be measured correctly when the frequency nears the resonant point (100 to 400kHz) due to reactance. Therefore, capacitance curves are not drawn in high frequency area.

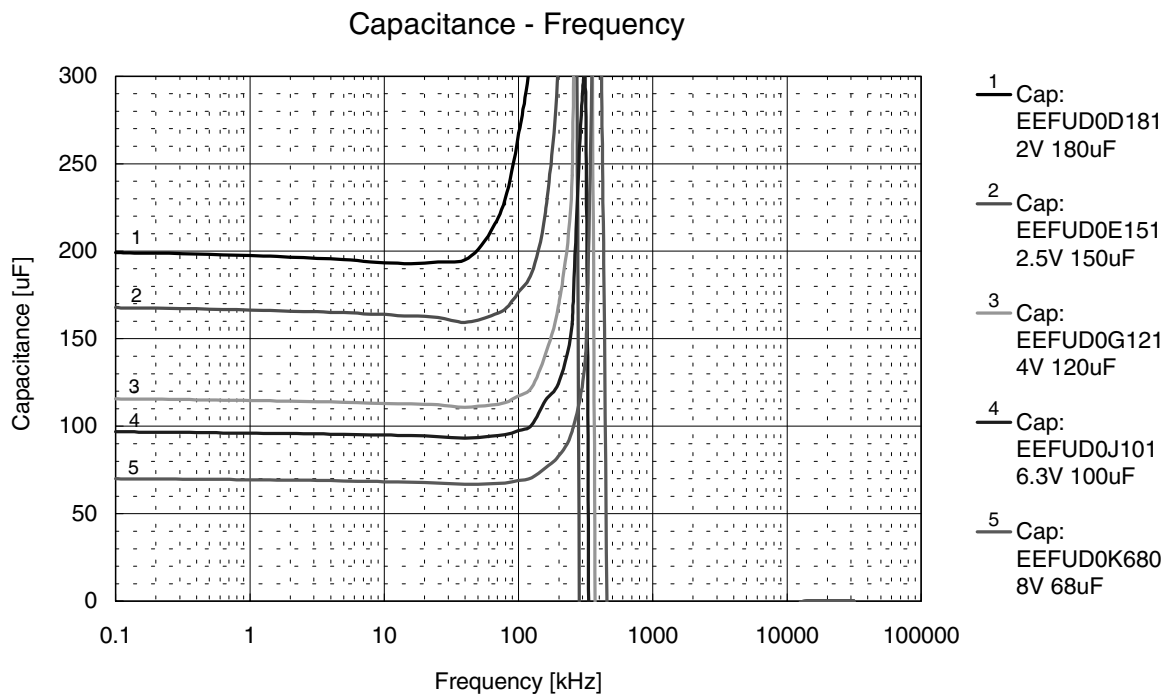
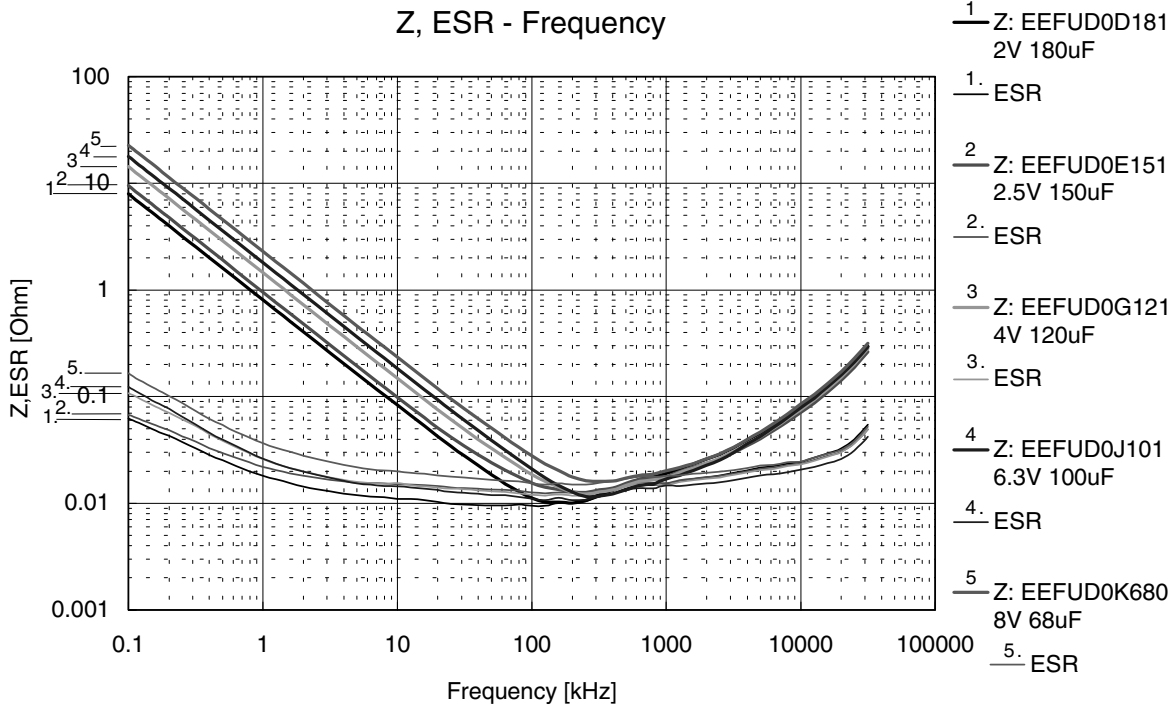
- Frequency Characteristics
- CD Series

(at room temperature)

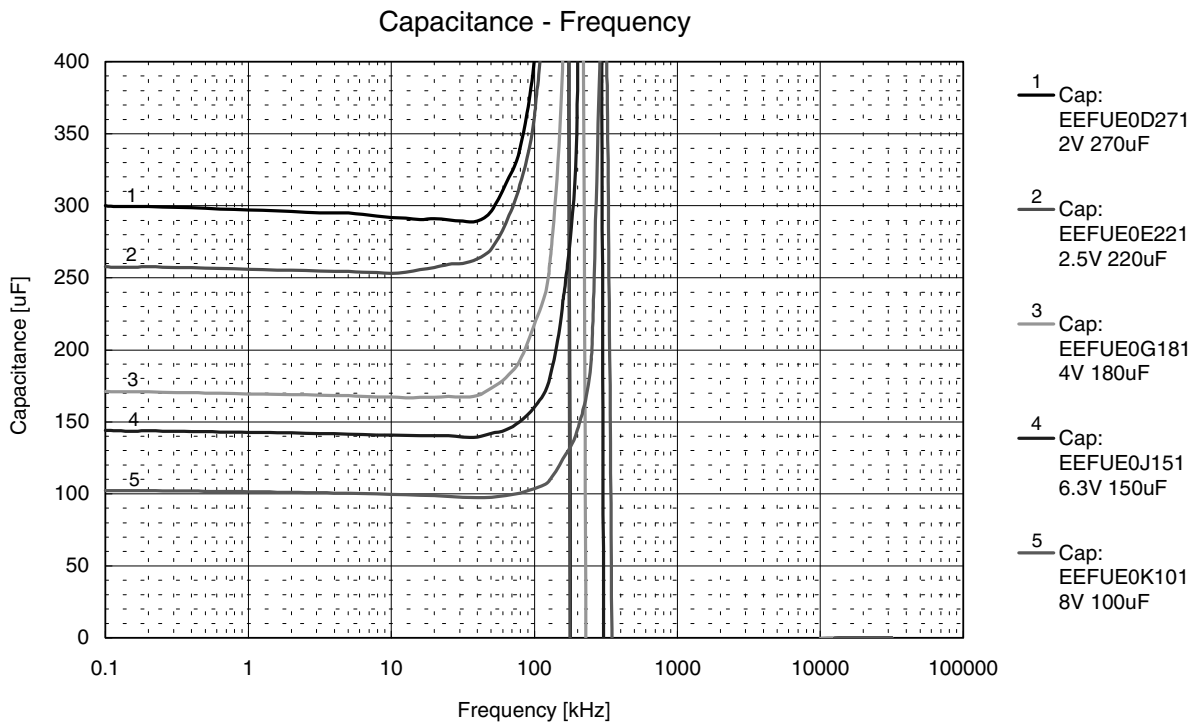
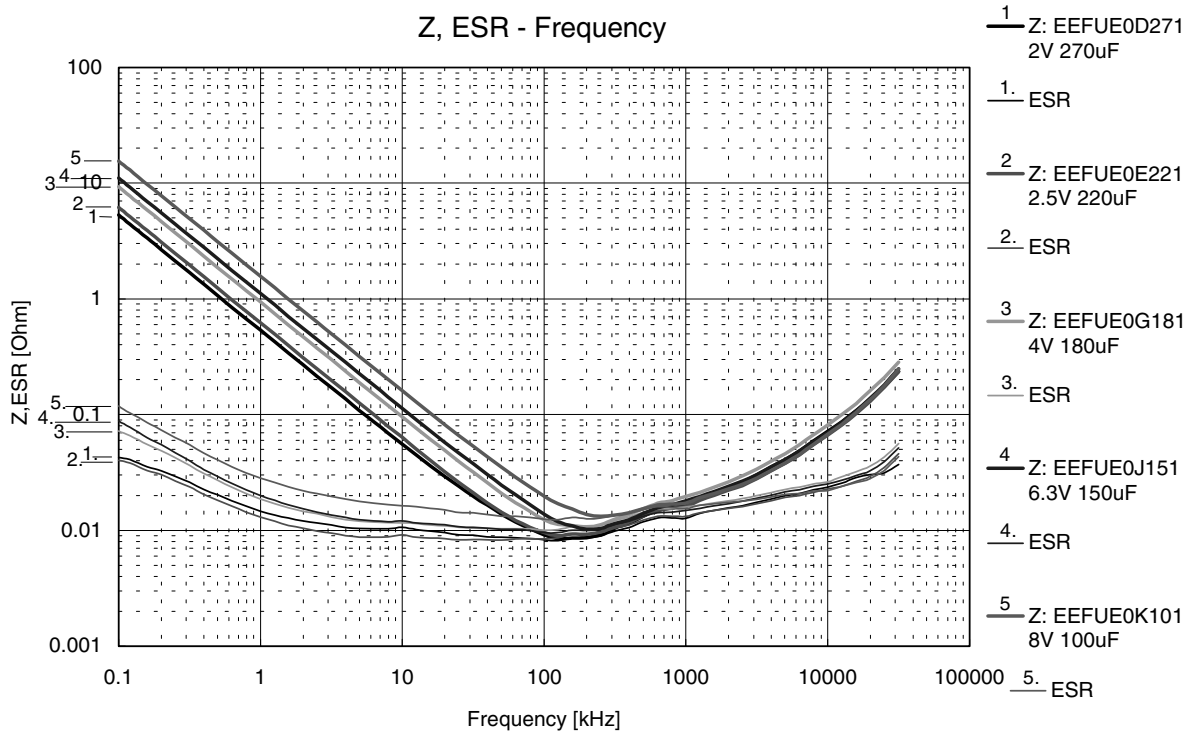


Capacitance cannot be measured correctly when the frequency nears the resonant point (100 to 400kHz) due to reactance. Therefore, capacitance curves are not drawn in high frequency area.

- Frequency Characteristics
- UD Series



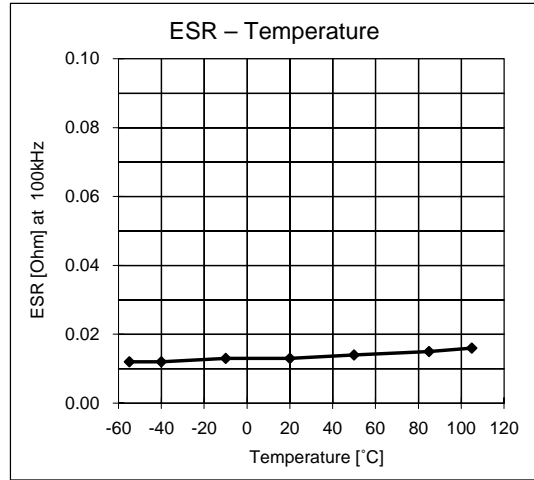
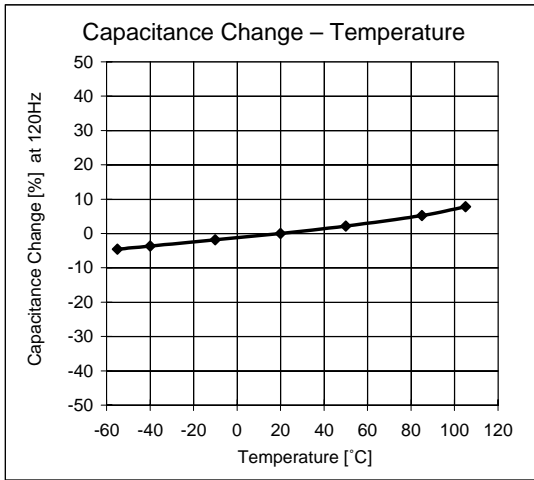
- Frequency Characteristics
- UE Series



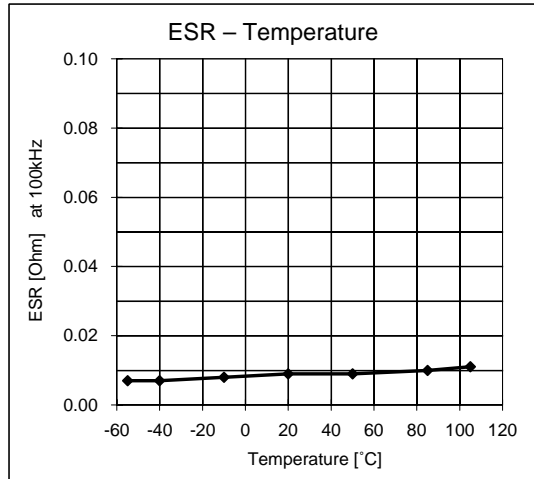
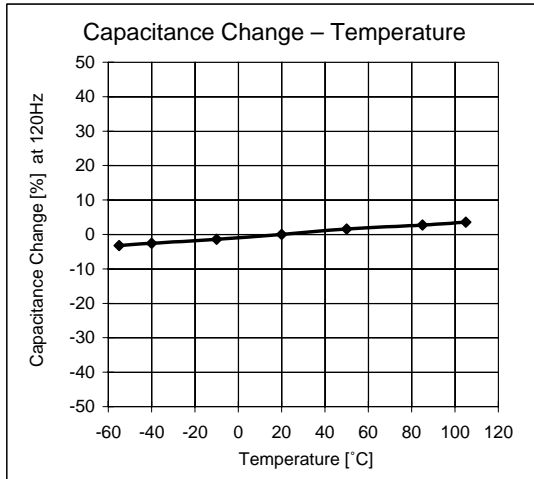
■ Temperature Characteristics

● 2 Volts

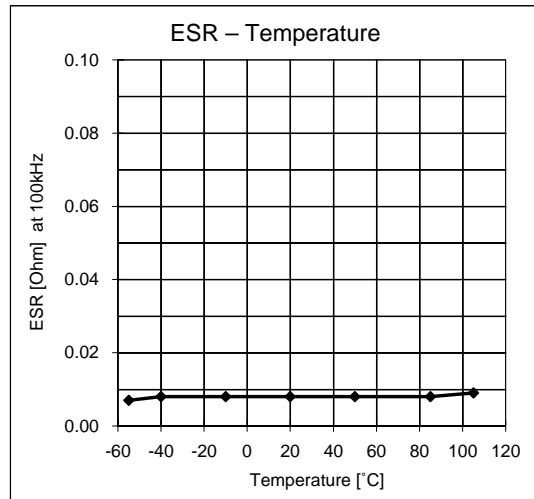
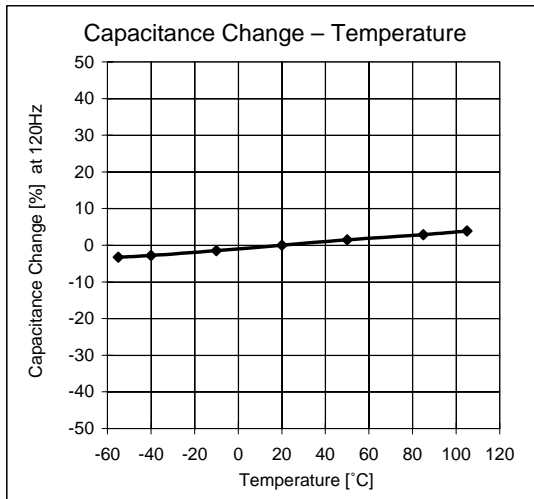
○ 100 μ F : CD Series (EEFCD0D101R)



○ 180 μ F : UD Series (EEFUD0D181R)



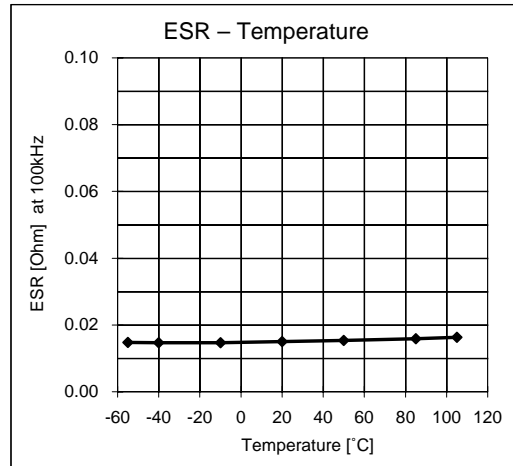
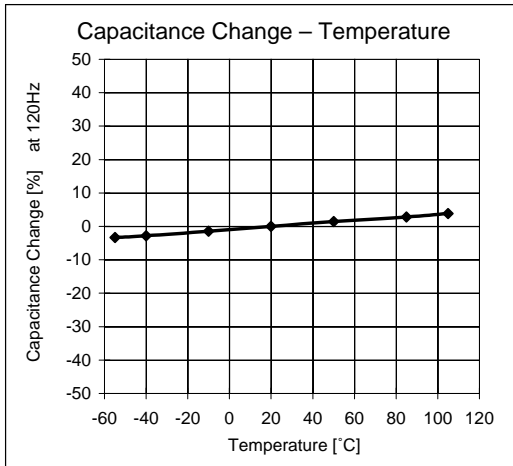
○ 270 μ F : UE Series (EEFUE0D271R)



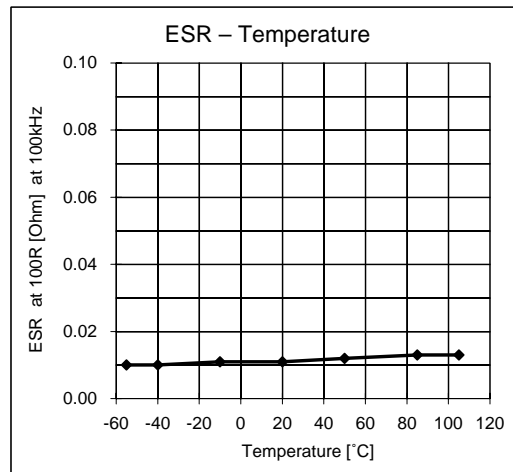
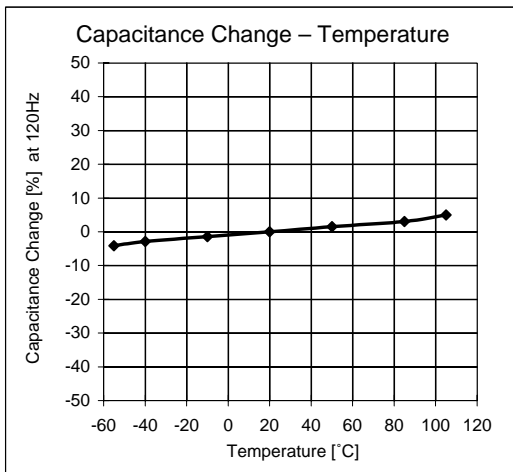
■ Temperature Characteristics

● 6.3 Volts

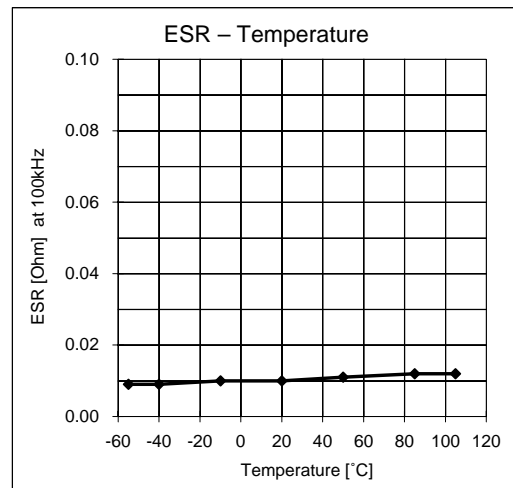
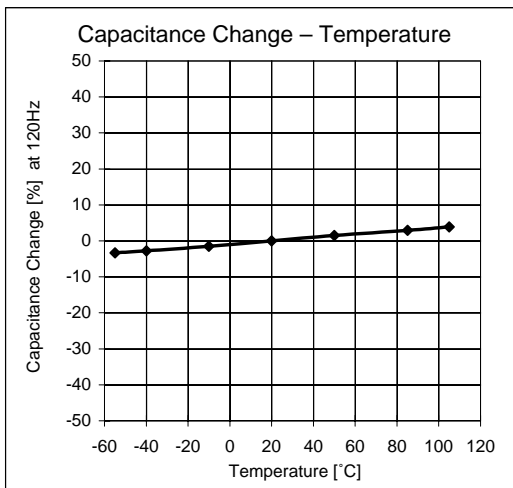
○ 47 μ F : CD Series (EEFCD0J470R)



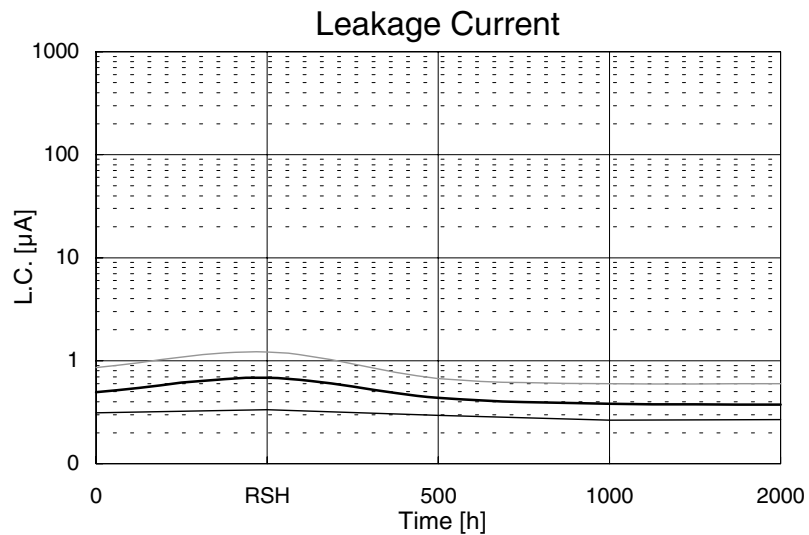
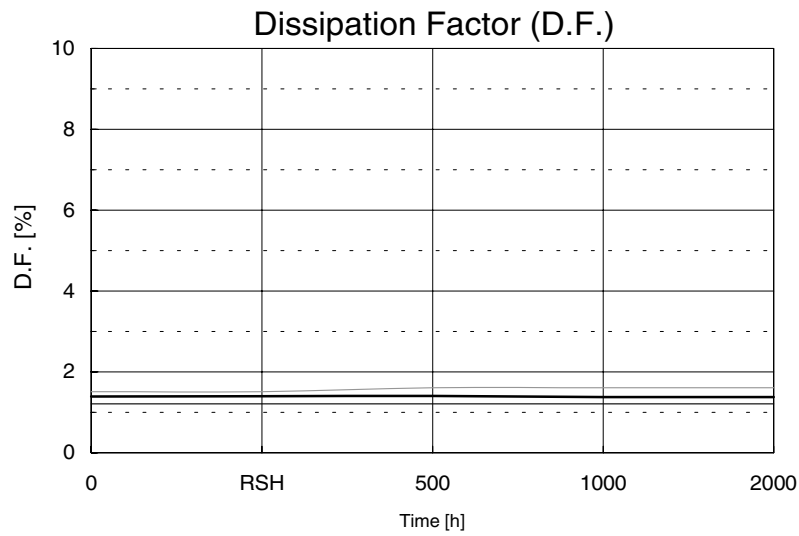
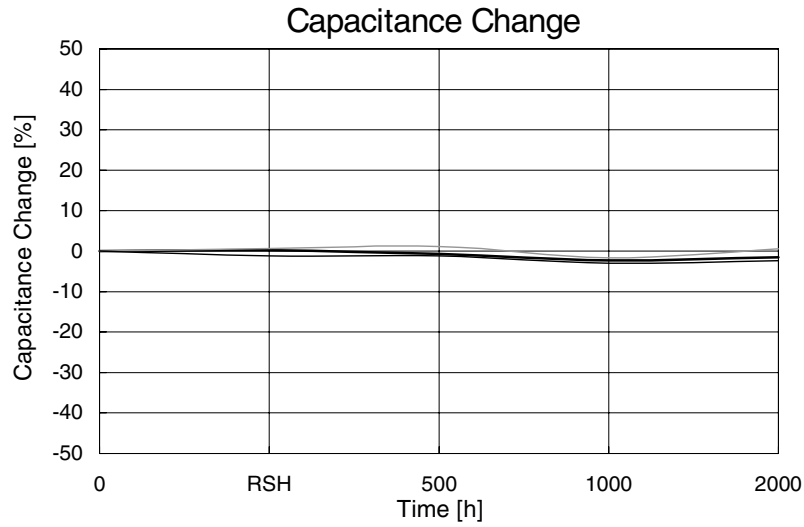
○ 100 μ F : UD Series (EEFUD0J101R)



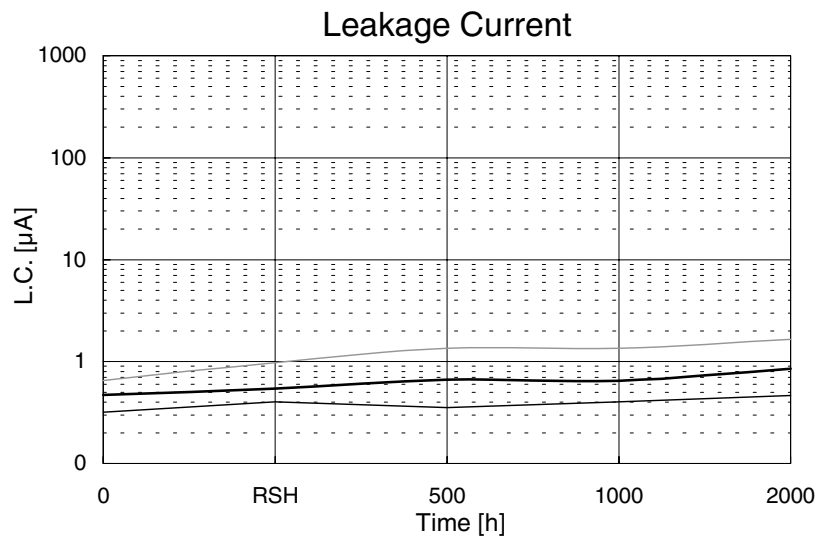
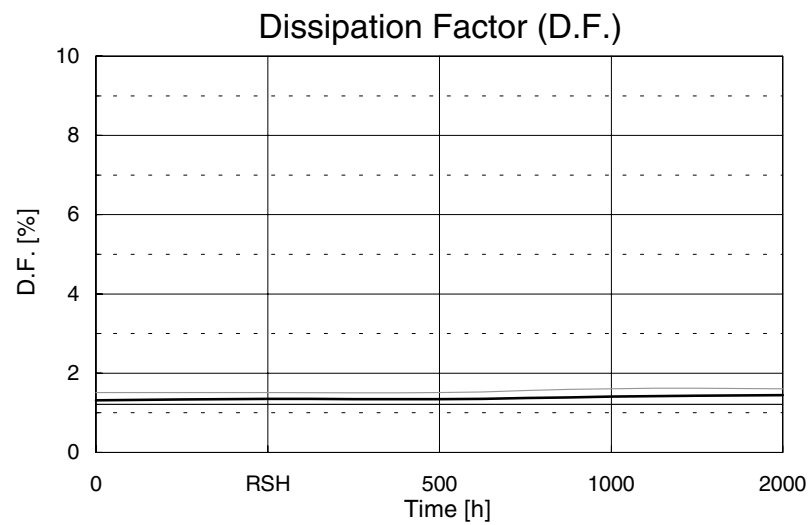
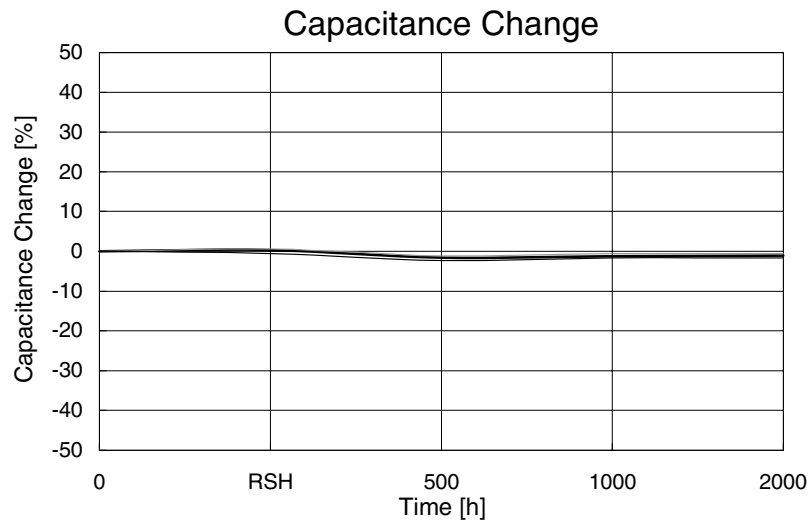
○ 150 μ F : UE Series (EEFUE0J151R)



■ Endurance Test
 UD Series
 Part No. EEFUD0D181 (2V 180 μ F)
 at 105°C / Rated voltage



- Shelf Life Test
- UE Series
- Part No. EEFUE0D271 (2V 270 μ F)
- at 105°C / without load



Memo

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Electronic Components Group

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