Product Change Notice: ECQ-Ex, ECW-Fx, ECW-Hx, ECQ-UA, ECQ-UL, ECQ-UG Series Film Capacitors

PCN.PG22.04.20.2022 04.20.2022

About This Notice:

We are changing the packaging (outer carton) label for several Series of THT (Radial) Film Capacitors. The notable change is the reduction in the amount of ink printing on the outer carton in order to reduce the risk of non-compliance with RoHS. An adhesive label (named the C3 label) will still be affixed to the package as it has always been and includes part number, package quantity, serial number information, etc.

Effective Date:

July 1, 2022

Change Details:

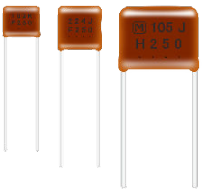
Target Part Code	C3 Label Information	Information on the Carton Box		
		Before	Cancel Item	After
Product Series (ECQE, ECWF, ECWH, ECQUA, ECQUL, ECQUG)	Example 	Bulk packaging  FT packaging 	 	 
Packaging Information	Label Information： ・Part Code ・QTY ・S/N	Information on the carton box： ・C3 Label (Part Code、QTY、S/N) ・Part Code ・QTY mark ・Production Date (Internal Lot. information) ・Packing mark (DATE) ・Qualified mark (DATE)	Cancel Item： ①QTY mark ②Internal Lot. information ③Part Code	Information on the carton box： ・C3 Label (Part Code、QTY、S/N) ・Packing mark (DATE) ・Qualified mark (DATE)
Changed Content	No change	The manual printing mark information is duplicated with C3 label	Cancel manual printing mark with duplicated information on C3 label	After changed

We are removing the highlighted ink printing, as this information overlaps with the content printed on the adhesive C3 Label (left).

Affected Parts:	All part numbers belonging to ECQ-EB, ECQ-EF, ECQ-ET, ECQ-UA, ECQ-UB, ECW-FA, ECW-FD, ECW-FE, ECW-FL, ECW-HA, ECW-HC, ECW-HV Series Film Capacitors.
Datasheet(s):	See Attached.
Notes:	Although the ECQ-UL and ECQ-UG Series are discontinued, this notice may still apply to open orders not yet shipped.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polyester Film Capacitor

ECQE(B) series

Non-inductive construction using metallized polyester film with flame retardant epoxy resin coating

Features

- Self-healing property
- Small size
- Excellent electrical characteristics
- Flame retardant epoxy resin coating
- RoHS compliant

Recommended applications

- General purpose usage
  ※Please contact us when applications are CDI , ignitor etc.

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E							B	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage
2	250 V [DC]
1A	125 V [AC]

Code	Cap. Tol.
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
B	Crimped lead
Z	Cut lead
2	Straight taping (Ammo)
3	Crimped taping (Ammo)
6	Crimped taping (Ammo)

- Odd size taping

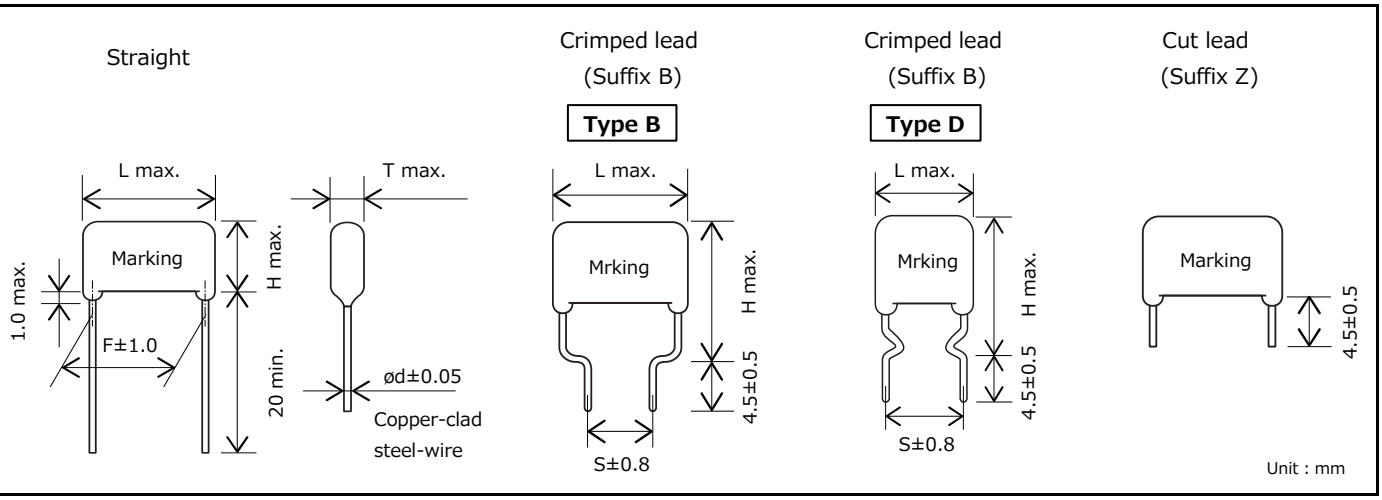
1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E						R		B
Product code		Dielectric & construction		Rated voltage		Capacitance			Odd taping	Cap. Tol.	Suffix

Specifications

Category temp. range (Including temperature-rise on unit surface)	250 V [DC]	−40 ℃ to +105 ℃
	125 V [AC]	
Rated voltage	250 V [DC], 125 V [AC] (250 V [DC] : Derating of rated voltage by 1.25 % / ℃ at more than 85 ℃)	
Capacitance range	250 V [DC]	0.010 μF to 4.7 μF (E12)
	125 V [AC]	0.010 μF to 4.7 μF (E12)
Capacitance tolerance	±5 % (J), ±10 % (K)	
Dissipation factor (tan δ)	tan δ ≦ 1.0 % (20 ℃, 1 kHz)	
Withstand voltage	250 V [DC]	Between terminals : Rated voltage (V) × 150 %, 60 s
	125 V [AC]	Between terminals : Rated voltage (V) × 230 %, 60 s Between terminals to enclosure : 1500 V [AC], 60 s
Insulation resistance (IR)	250 V [DC]	C ≦ 0.33 μF : IR ≧ 9000 MΩ (20 ℃, 100 V [DC], 60 s)
		C > 0.33 μF : IR ≧ 3000 MΩ · μF (20 ℃, 100 V [DC], 60 s)
	125 V [AC]	C ≦ 0.47 μF : IR ≧ 2000 MΩ (20 ℃, 500 V [DC], 60 s)
		C > 0.47 μF : IR ≧ 3000 MΩ · μF (20 ℃, 100 V [DC], 60 s)

∗ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of "Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage".
∗ Voltage to be applied to ECQE1A (B) is only sine wave (50 Hz or 60 Hz).

Dimensions

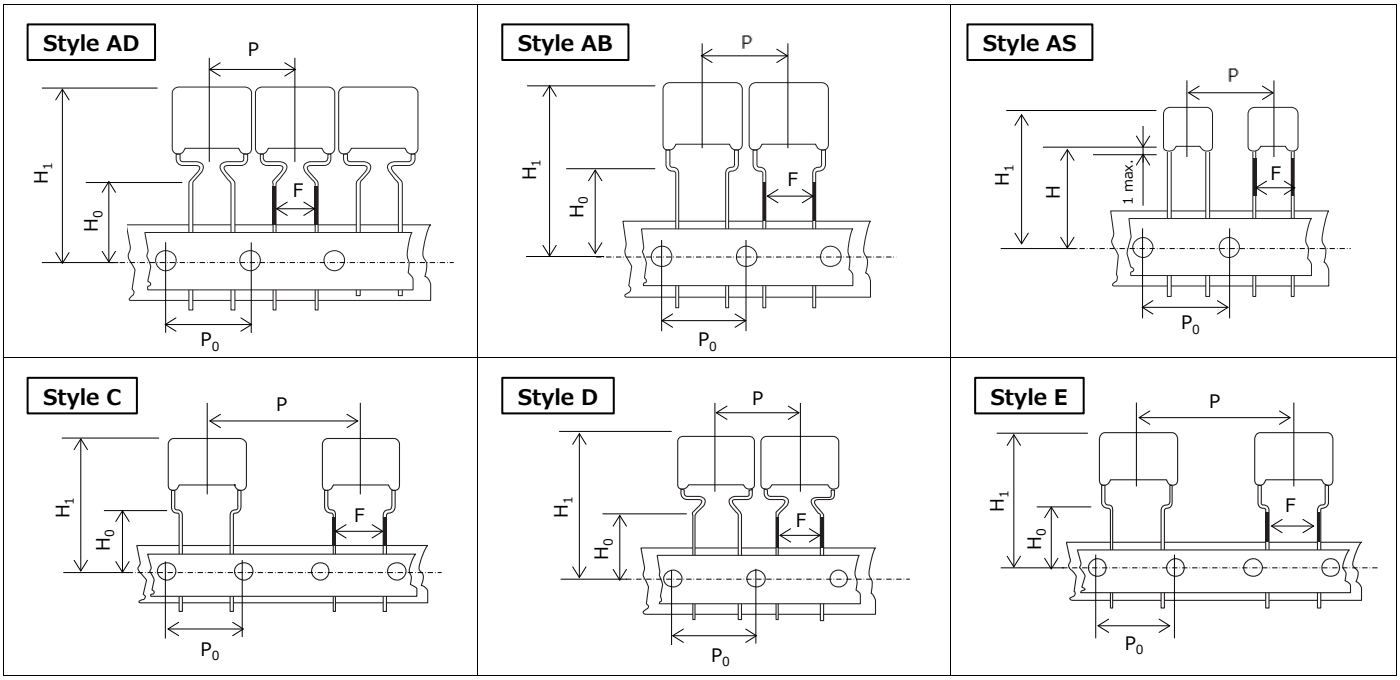


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size list

Unit : mm

	Style					
	AD	AB	AS	C	D	E
P	12.7	12.7	12.7	25.4	15.0	30.0
P_0	12.7	12.7	12.7	12.7	15.0	15.0
F	5.0	5.0	5.0	5.0	7.5	7.5
H_0	16.0	16.0	(H)18.0-20.0	16.0	16.0	16.0
H_1*	34.0	34.0	34.0	39.0	44.0	44.0

*:max.

■ Packaging specifications

Series	R.voltage	Capacitance range (uF)	Taping style						Packing	Suffix
			AD	AB	B	C	D	E		
ECGE(B)	250 V [DC]	0.010 to 0.15			○				Ammo	( ) B2
		0.010 to 0.68	○						Ammo	( ) B3
		0.82 to 1.5				○			Ammo	( ) B3
		0.18 to 0.68					○		Ammo	R( ) B
		0.82 to 4.7						○	Ammo	R( ) B
	125 V [AC]	0.010 to 0.068			○				Ammo	( ) B2
		0.082 to 0.22		○					Ammo	( ) B6
		0.27 to 2.7				○			Ammo	( ) B3
		0.082 to 0.68					○		Ammo	R( ) B
		0.82 to 2.7						○	Ammo	R( ) B

● Lead spacing

Style	Lead spacing
AD	5.0
AB	5.0
AS	5.0
C	5.0
D	7.5
E	7.5

Unit : mm

See the column "Rating ·Dimensions · Quantity" for packaging quantity

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 250 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)							Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE2103□B( )	0.010	7.9	4.2	7.1	12.1	5.0	5.0	0.5	2000	–	–	500
ECQE2123□B( )	0.012	7.9	4.2	7.1	12.1	5.0	5.0	0.5				
ECQE2153□B( )	0.015	7.9	4.2	7.1	12.1	5.0	5.0	0.5				
ECQE2183□B( )	0.018	7.9	4.3	7.2	12.2	5.0	5.0	0.5				
ECQE2223□B( )	0.022	7.9	4.3	7.2	12.2	5.0	5.0	0.5				
ECQE2273□B( )	0.027	7.9	4.3	7.2	12.2	5.0	5.0	0.5				
ECQE2333□B( )	0.033	7.9	4.3	7.2	12.2	5.0	5.0	0.5				
ECQE2393□B( )	0.039	7.9	4.5	7.4	12.4	5.0	5.0	0.5	1500			
ECQE2473□B( )	0.047	7.9	4.5	7.4	12.4	5.0	5.0	0.5				
ECQE2563□B( )	0.056	7.9	4.7	7.7	12.7	5.0	5.0	0.5				
ECQE2683□B( )	0.068	7.9	5.1	8.0	13.0	5.0	5.0	0.5				
ECQE2823□B( )	0.082	7.9	5.4	8.6	13.6	5.0	5.0	0.5				
ECQE2104□B( )	0.10	7.9	5.9	9.0	14.0	5.0	5.0	0.5	1000			
ECQE2124□B( )	0.12	7.9	5.7	10.6	15.6	5.0	5.0	0.5	1500			
ECQE2154□B( )	0.15	7.9	6.3	11.2	16.2	5.0	5.0	0.5	1000			
ECQE2184□B( )	0.18	10.3	5.0	9.7	14.7	7.5	5.0	0.5	1500		1500	
ECQE2224□B( )	0.22	10.3	5.4	10.1	15.1	7.5	5.0	0.5			1000	
ECQE2274□B( )	0.27	10.3	5.9	10.8	15.8	7.5	5.0	0.5	1000			
ECQE2334□B( )	0.33	10.3	6.4	11.3	16.3	7.5	5.0	0.5				
ECQE2394□B( )	0.39	12.3	5.7	10.9	15.9	10.0	5.0	0.6				
ECQE2474□B( )	0.47	12.3	6.2	11.4	16.4	10.0	5.0	0.6				
ECQE2564□B( )	0.56	12.3	6.7	11.9	16.9	10.0	5.0	0.6				
ECQE2684□B( )	0.68	12.3	7.3	12.7	17.7	10.0	5.0	0.6			900	
ECQE2824□B( )	0.82	15.3	6.3	13.3	18.3	12.5	5.0	0.6	–	600	500	
ECQE2105□B( )	1.0	15.3	7.0	14.0	19.0	12.5	5.0	0.6		500	400	
ECQE2125□B( )	1.2	15.3	7.6	14.6	19.6	12.5	5.0	0.6				
ECQE2155□B( )	1.5	15.3	8.6	15.7	20.7	12.5	5.0	0.6		400	300	
ECQE2185□B( )	1.8	20.8	7.6	14.6	19.6	17.5	10.0	0.8		–	400	
ECQE2225□B( )	2.2	20.8	8.4	15.6	20.6	17.5	10.0	0.8				
ECQE2275□B( )	2.7	20.8	9.3	16.7	21.7	17.5	10.0	0.8			–	
ECQE2335□B( )	3.3	20.8	10.5	17.9	22.9	17.5	10.0	0.8			300	
ECQE2395□B( )	3.9	20.8	10.8	19.8	24.8	17.5	10.0	0.8				
ECQE2475□B( )	4.7	20.8	11.9	21.0	26.0	17.5	10.0	0.8			200	

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.68 μF
Type B : 0.82 μF to 4.7 μF

Rating · Dimensions · Quantity

■ Rated voltage [AC] : 125 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)							Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE1A103□B( )	0.010	7.9	4.2	7.1		5.0		0.5				
ECQE1A123□B( )	0.012	7.9	4.2	7.1		5.0		0.5				
ECQE1A153□B( )	0.015	7.9	4.2	7.1		5.0		0.5				
ECQE1A183□B( )	0.018	7.9	4.3	7.2		5.0		0.5	2000			
ECQE1A223□B( )	0.022	7.9	4.3	7.2		5.0		0.5				
ECQE1A273□B( )	0.027	7.9	4.3	7.2	–	5.0	–	0.5			–	
ECQE1A333□B( )	0.033	7.9	4.3	7.2		5.0		0.5				
ECQE1A393□B( )	0.039	7.9	4.5	7.4		5.0		0.5				
ECQE1A473□B( )	0.047	7.9	4.8	7.7		5.0		0.5		–		
ECQE1A563□B( )	0.056	7.9	5.1	8.0		5.0		0.5				
ECQE1A683□B( )	0.068	7.9	5.4	8.6		5.0		0.5				
ECQE1A823□B( )	0.082	10.3	4.6	7.6	12.6	7.5	7.5	0.5	1500		1500	
ECQE1A104□B( )	0.10	10.3	5.1	7.7	12.7	7.5	7.5	0.5				
ECQE1A124□B( )	0.12	10.3	5.3	8.4	13.4	7.5	7.5	0.5				
ECQE1A154□B( )	0.15	10.3	5.7	8.9	13.9	7.5	7.5	0.5				
ECQE1A184□B( )	0.18	10.3	5.6	10.3	15.3	7.5	7.5	0.5			1000	
ECQE1A224□B( )	0.22	10.3	6.1	11.0	16.0	7.5	7.5	0.5	1000			500
ECQE1A274□B( )	0.27	12.3	5.4	10.7	15.7	10.0	7.5	0.6		800		
ECQE1A334□B( )	0.33	12.3	5.9	11.2	16.2	10.0	7.5	0.6		700		
ECQE1A394□B( )	0.39	12.3	6.4	11.6	16.6	10.0	7.5	0.6		600		
ECQE1A474□B( )	0.47	12.3	7.0	12.2	17.2	10.0	7.5	0.6		500	900	
ECQE1A564□B( )	0.56	12.3	6.7	11.9	16.9	10.0	7.5	0.6		600	1000	
ECQE1A684□B( )	0.68	12.3	7.3	12.7	17.7	10.0	7.5	0.6		500	900	
ECQE1A824□B( )	0.82	15.3	6.3	13.3	18.3	12.5	7.5	0.6		600	500	
ECQE1A105□B( )	1.0	15.3	7.0	14.0	19.0	12.5	7.5	0.6		500	400	
ECQE1A125□B( )	1.2	20.8	7.1	14.1	19.1	17.5	10.0	0.8		500		
ECQE1A155□B( )	1.5	20.8	8.0	15.1	20.1	17.5	10.0	0.8			400	
ECQE1A185□B( )	1.8	20.8	8.7	15.9	20.9	17.5	10.0	0.8		400		
ECQE1A225□B( )	2.2	20.8	9.7	17.1	22.1	17.5	10.0	0.8			300	
ECQE1A275□B( )	2.7	20.8	10.9	18.2	23.2	17.5	10.0	0.8		300		
ECQE1A335□B( )	3.3	25.8	9.6	18.7	23.7	22.5	15.0	0.8				
ECQE1A395□B( )	3.9	25.8	10.6	19.7	24.7	22.5	15.0	0.8		–	–	
ECQE1A475□B( )	4.7	25.8	11.8	20.8	25.8	22.5	15.0	0.8				

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.082 μF to 0.68 μF
Type B : 0.82 μF to 4.7 μF

Notice for AC rated

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”.
As for clause 2 of “Electrical Appliance and Material Safety Law”, please use ECQUA type or ECQUL type.

When using these capacitors as a across-the-line capacitor, it shall be required to follow either item 1. or item 2. condition.

1. Capacitor shall be connected in parallel with varistor (Specifi ed varistor voltage in table 1.)
2. Voltage applied for capacitor shall not exceed other than specifi ed in table 1, when using these capacitors

Table 1

Capacitor rated voltage	Varistor voltage	Pulse voltage
125 V [AC]	250 V	250 $V_{0\text{-}p}$

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

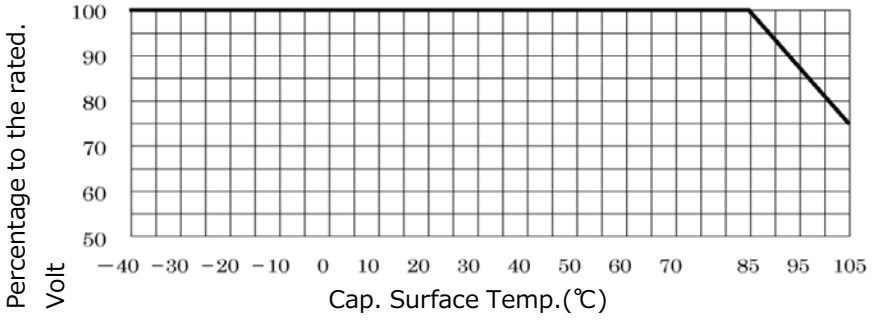
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

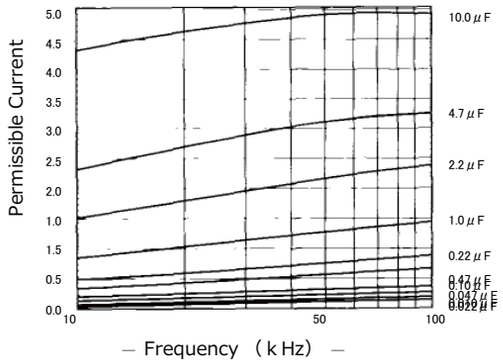
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

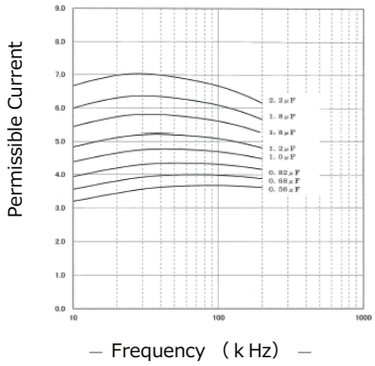
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

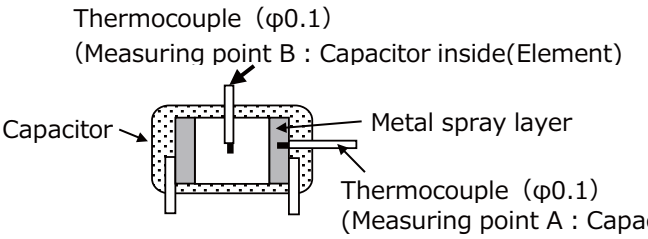
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

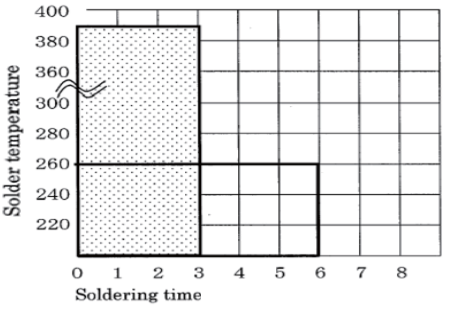
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

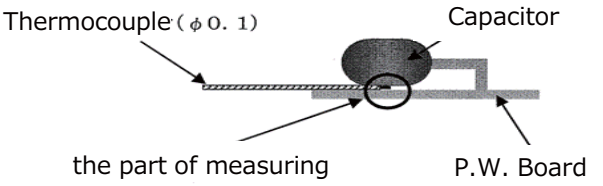
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

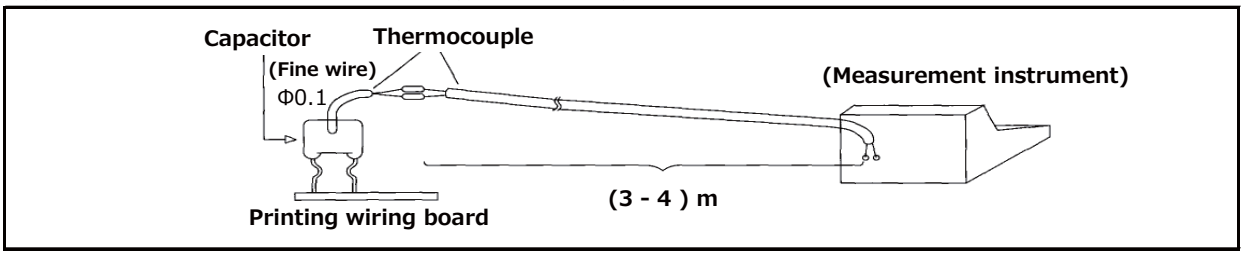
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors

Metallized Polyester Film Capacitor

ECQE(F) series

Non-inductive construction using metallized polyester film with flame retardant epoxy resin coating

Features

- Self-healing property
- Excellent electrical characteristics
- Flame retardant epoxy resin coating
- RoHS compliant

Recommended applications

- General purpose usage
  ※Please contact us when applications are CDI , ignitor etc.

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E							F	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage
1	100 V [DC]
2	250 V [DC]
4	400 V [DC]
6	630 V [DC]
10	1000 V [DC]
12	1250 V [DC]
1A	125 V [AC]
2A	250 V [AC]

Code	Cap. Tol.
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
B	Crimped lead
Z	Cut lead
3	Crimped taping (Ammo)
6	Crimped taping (Ammo)

- Odd size taping

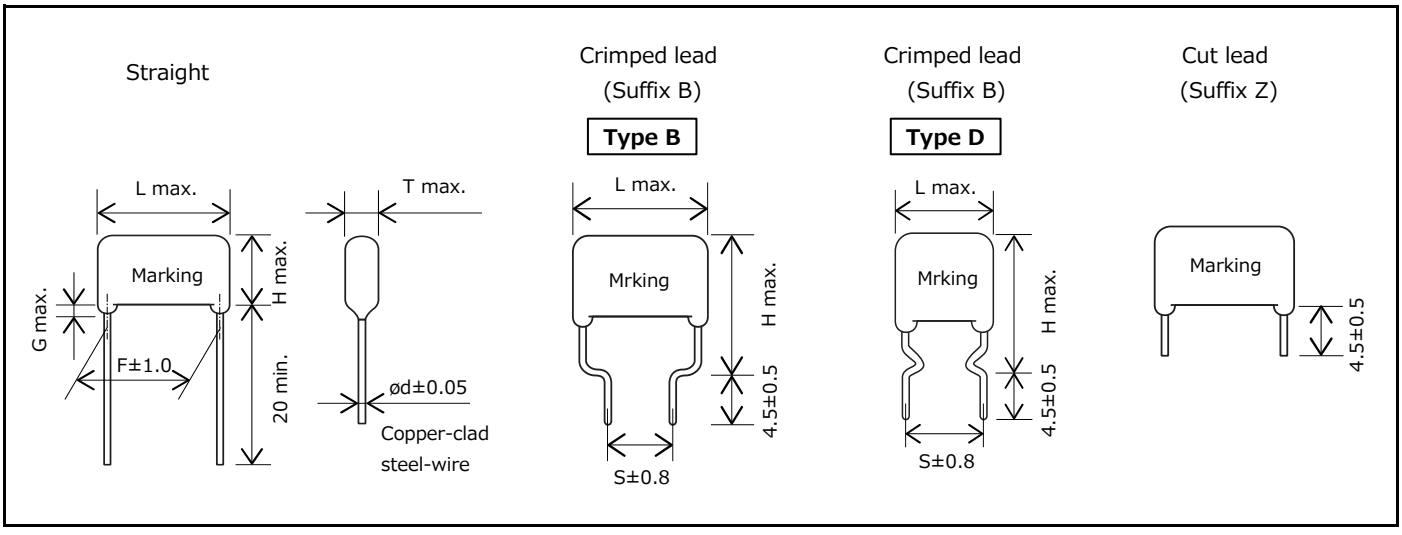
1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E						R		F
Product code		Dielectric & construction		Rated voltage		Capacitance			Odd taping	Cap. Tol.	Suffix

Specifications

Category temp. range (Including temperature-rise on unit surface)	100V to 1250V [DC]	−40 ℃ to +105 ℃
	125 V, 250 V [AC]	−40 ℃ to +105 ℃
Rated voltage	100 V, 250 V, 400 V, 630 V, 1000 V, 1250 V [DC] (Derating of rated voltage by 1.25 %/°C at more than 85 °C) 125 V, 250 V [AC]	
Capacitance range	100 V [DC]	0.56 μF to 10.0 μF (E12)
	250 V [DC]	0.010 μF to 10.0 μF (E12)
	400 V [DC]	0.010 μF to 2.2 μF (E12)
	630 V [DC]	0.0010 μF to 2.2 μF (E12)
	1000 V [DC]	0.010 μF to 0.22 μF (E12)
	1250 V [DC]	0.0010 μF to 0.22 μF (E12)
	125 V [AC]	0.010 μF to 0.068 μF (E12)
	250 V [AC]	0.010 μF to 2.2 μF (E12)
Capacitance tolerance	±5 % (J), ±10 % (K)	
Dissipation factor (tan δ)	tan δ ≦ 1.0 % (20 ℃, 1 kHz)	
Withstand voltage	100V to 630V [DC]	Between terminals : R.voltage (V [DC]) × 150 %, 60 s
	1000 V [DC] 1250 V [DC]	Between terminals : R.voltage (V) × 175 %, 2 s to 5 s or 1000 V [AC], 60 s Between terminals to enclosure : 1500 V [AC], 60 s
	125 V [AC] 250 V [AC]	Between terminals : R.voltage (V) × 230 %, 60 s Between terminals to enclosure : 1500 V [AC], 60 s
Insulation resistance (IR)	100V to 630V [DC]	C ≦ 0.33 μF : IR ≧ 9000 MΩ (20 ℃, 100 V [DC], 60 s)
		C > 0.33 μF : IR ≧ 3000 MΩ · μF (20 ℃, 100 V [DC], 60 s)
	1000 V [DC] 1250 V [DC]	IR ≧ 10000 MΩ (20 ℃, 100 V [DC], 60 s) IR ≧ 2000 MΩ (20 ℃, 500 V [DC], 60 s)
	125 V [AC] 250 V [AC]	C ≦ 0.47 μF : IR ≧ 2000 MΩ (20 ℃, 500 V [DC], 60 s) C > 0.47 μF : IR ≧ 3000 MΩ · μF (20 ℃, 100 V [DC], 60 s)

∗ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of "Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage".
∗ Voltage to be applied to ECQE1A (F) & ECQE2A (F) is only sine wave (50 Hz or 60 Hz).

Dimensions



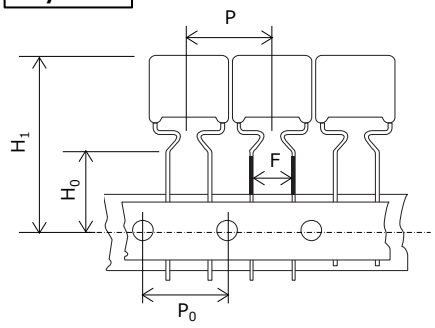
Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

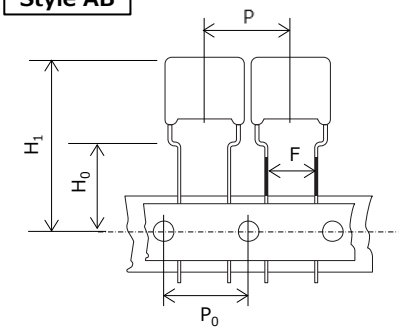
Taping specifications for automatic insertion

■ Taping style

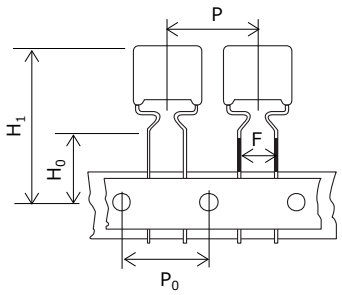
Style AD



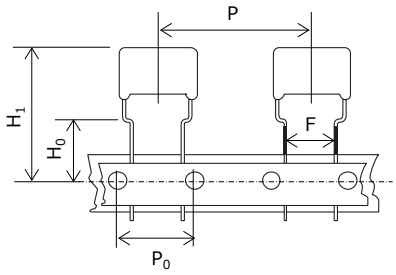
Style AB



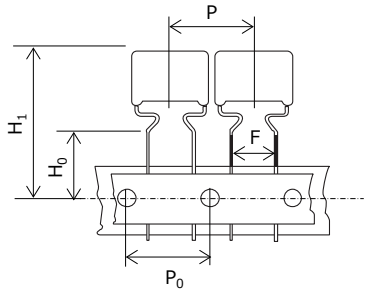
Style B



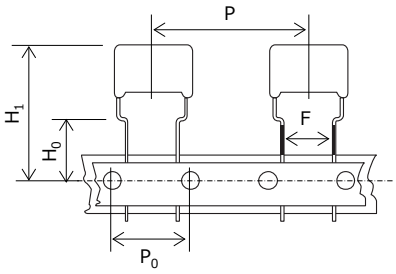
Style C



Style D



Style E



*: H1 dimension is based on insertion machine “Panasert RH series” made by Panasonic.
Consult with Panasonic technical staff when using other insertion machines.

Size list

Unit : mm

	Style					
	AD	AB	B	C	D	E
P	12.7	12.7	15.0	25.4	15.0	30.0
P_0	12.7	12.7	15.0	12.7	15.0	15.0
F	5.0	5.0	5.0	5.0	7.5	7.5
H_0	16.0	16.0	16.0	16.0	16.0	16.0
H_1*	34.0	34.0	39.0	39.0	44.0	44.0

*:max.

■ Packaging specifications

Series	R.voltage	Capacitance range (μF)	Taping style						Packing	Suffix
			AD	AB	B	C	D	E		
ECQE(F)	100 V [DC]	0.56 to 0.68	○						Ammo	( ) F3
		0.82 to 1.0			○				Ammo	( ) F3
		1.2 to 3.3				○			Ammo	( ) F3
		1.2 to 3.3						○	Ammo	R( ) F
	250 V [DC]	0.010 to 0.27	○						Ammo	( ) F3
		0.33			○				Ammo	( ) F3
		0.39 to 1.5				○			Ammo	( ) F3
		0.010 to 0.33					○		Ammo	R( ) F
		0.39 to 1.5						○	Ammo	R( ) F
	400 V [DC]	0.010 to 0.10	○						Ammo	( ) F3
		0.12 to 0.47				○			Ammo	( ) F3
		0.010 to 0.10					○		Ammo	R( ) F
		0.12 to 0.47						○	Ammo	R( ) F
	630 V [DC]	0.0010 to 0.033	○						Ammo	( ) F3
		0.039 to 0.047			○				Ammo	( ) F3
		0.056 to 0.22				○			Ammo	( ) F3
		0.001 to 0.047					○		Ammo	R( ) F
		0.056 to 0.22						○	Ammo	R( ) F
	1000 V [DC]	0.010 to 0.10						○	Ammo	R( ) F
	1250 V [DC]	0.0010 to 0.022						○	Ammo	R( ) F
	125 V [AC]	0.010 to 0.068		○					Ammo	( ) F6
		0.010 to 0.068					○		Ammo	R( ) F
	250 V [AC]	0.010 to 0.033		○					Ammo	( ) F6
		0.010 to 0.047					○		Ammo	R( ) F
		0.056 to 0.22						○	Ammo	R( ) F

See the column “Rating ·Dimensions · Quantity” for packaging quantity

● Lead spacing

Style	Lead spacing
AD	5.0
AB	5.0
B	5.0
C	5.0
D	7.5
E	7.5

Unit : mm

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 100 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE1564□F( )	0.56	12.0	5.5	10.9	15.9	10.0	10.0	1.0	0.6	500	–	–	500
ECQE1684□F( )	0.68	12.0	6.0	11.9	16.9	10.0	10.0	1.0	0.6				
ECQE1824□F( )	0.82	12.0	6.0	13.5	18.5	10.0	10.0	1.0	0.6	–	1,000		
ECQE1105□F( )	1.0	12.0	6.7	14.0	19.0	10.0	10.0	1.0	0.6				
ECQE1125□F( )	1.2	18.5	5.5	12.8	17.8	15.0	10.0	1.0	0.6		500	600	
ECQE1155□F( )	1.5	18.5	6.0	13.4	18.4	15.0	10.0	1.0	0.8			500	
ECQE1185□F( )	1.8	18.5	6.5	14.4	19.4	15.0	10.0	1.0	0.8				
ECQE1225□F( )	2.2	18.5	7.0	15.0	20.0	15.0	10.0	1.0	0.8				
ECQE1275□F( )	2.7	18.5	8.0	15.8	20.8	15.0	10.0	1.0	0.8			400	
ECQE1335□F( )	3.3	18.5	8.5	16.5	21.5	15.0	10.0	1.0	0.8		400		
ECQE1395□F( )	3.9	26.0	7.0	16.4	21.4	22.5	15.0	1.0	0.8				
ECQE1475□F( )	4.7	26.0	7.5	17.0	22.0	22.5	15.0	1.0	0.8				
ECQE1565□F( )	5.6	26.0	8.3	17.5	22.5	22.5	15.0	1.0	0.8		–	–	
ECQE1685□F( )	6.8	26.0	9.0	18.5	23.5	22.5	15.0	1.0	0.8				
ECQE1825□F( )	8.2	26.0	10.0	20.0	25.0	22.5	15.0	1.5	0.8				
ECQE1106□F( )	10.0	26.0	11.5	21.0	26.0	22.5	15.0	1.5	0.8				

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.56 μF to 1.0 μF
Type B : 1.2 μF to 10.0 μF

■ Rated voltage [DC] : 250 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)				
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk	
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight	Crimped lead
ECQE2103□F( )	0.010	10.3	4.3	7.4	12.4	7.5	7.5	1.0	0.6	1000	–	1000	500	500
ECQE2123□F( )	0.012	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2153□F( )	0.015	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2183□F( )	0.018	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2223□F( )	0.022	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2273□F( )	0.027	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2333□F( )	0.033	10.3	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2393□F( )	0.039	10.3	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2473□F( )	0.047	10.3	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2563□F( )	0.056	10.3	4.8	7.9	12.9	7.5	7.5	1.0	0.6					
ECQE2683□F( )	0.068	10.3	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2823□F( )	0.082	10.3	4.9	8.0	13.0	7.5	7.5	1.0	0.6					
ECQE2104□F( )	0.10	10.3	5.8	8.4	13.4	7.5	7.5	1.0	0.6	500				
ECQE2124□F( )	0.12	10.3	6.0	9.0	14.0	7.5	7.5	1.0	0.6					
ECQE2154□F( )	0.15	10.3	6.0	10.8	15.8	7.5	7.5	1.0	0.6					
ECQE2184□F( )	0.18	12.0	5.0	10.3	15.3	10.0	10.0	1.0	0.6					
ECQE2224□F( )	0.22	12.0	5.5	10.5	15.5	10.0	10.0	1.0	0.6					
ECQE2274□F( )	0.27	12.0	6.0	11.5	16.5	10.0	10.0	1.0	0.6					
ECQE2334□F( )	0.33	12.0	6.5	12.0	17.0	10.0	10.0	1.0	0.6	–	1000			
ECQE2394□F( )	0.39	18.5	4.9	12.0	17.0	15.0	10.0	1.0	0.6					
ECQE2474□F( )	0.47	18.5	5.3	12.5	17.5	15.0	10.0	1.0	0.6					
ECQE2564□F( )	0.56	18.5	5.5	13.0	18.0	15.0	10.0	1.0	0.6		500	500		
ECQE2684□F( )	0.68	18.5	6.0	13.5	18.5	15.0	10.0	1.0	0.8					
ECQE2824□F( )	0.82	18.5	6.5	14.5	19.5	15.0	10.0	1.0	0.8					
ECQE2105□F( )	1.0	18.5	7.4	15.0	20.0	15.0	10.0	1.0	0.8			400		
ECQE2125□F( )	1.2	18.5	8.0	15.9	20.9	15.0	10.0	1.0	0.8					
ECQE2155□F( )	1.5	18.5	9.0	16.8	21.8	15.0	10.0	1.0	0.8		400	300		
ECQE2185□F( )	1.8	26.0	7.5	15.5	20.5	22.5	15.0	1.0	0.8	–				
ECQE2225□F( )	2.2	26.0	8.5	16.3	21.3	22.5	15.0	1.0	0.8					
ECQE2275□F( )	2.7	26.0	9.4	17.0	22.0	22.5	15.0	1.0	0.8					
ECQE2335□F( )	3.3	26.0	10.3	18.0	23.0	22.5	15.0	1.5	0.8					
ECQE2395□F( )	3.9	26.0	11.0	20.5	25.5	22.5	15.0	1.5	0.8		–	–		
ECQE2475□F( )	4.7	26.0	12.0	21.5	26.5	22.5	15.0	1.5	0.8					
ECQE2565□F( )	5.6	31.0	11.8	21.0	26.0	27.5	22.5	1.5	0.8					
ECQE2685□F( )	6.8	31.0	13.0	22.4	27.4	27.5	22.5	1.5	0.8					
ECQE2825□F( )	8.2	31.0	14.3	23.5	28.5	27.5	22.5	1.5	0.8				400	
ECQE2106□F( )	10.0	31.0	15.9	25.8	30.8	27.5	22.5	1.5	0.8				300	400

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.33 μF
Type B : 0.39 μF to 10.0 μF

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 400 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE4103□F( )	0.010	10.3	4.3	7.4	12.4	7.5	7.5	1.0	0.6	1000	–	1000	500
ECQE4123□F( )	0.012	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE4153□F( )	0.015	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE4183□F( )	0.018	10.3	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE4223□F( )	0.022	10.3	4.8	7.9	12.9	7.5	7.5	1.0	0.6				
ECQE4273□F( )	0.027	10.3	5.5	8.0	13.0	7.5	7.5	1.0	0.6				
ECQE4333□F( )	0.033	10.3	6.0	9.0	14.0	7.5	7.5	1.0	0.6	500			
ECQE4393□F( )	0.039	12.0	4.9	8.0	13.0	10.0	10.0	1.0	0.6				
ECQE4473□F( )	0.047	12.0	5.0	8.3	13.3	10.0	10.0	1.0	0.6				
ECQE4563□F( )	0.056	12.0	5.0	10.0	15.0	10.0	10.0	1.0	0.6				
ECQE4683□F( )	0.068	12.0	5.4	10.5	15.5	10.0	10.0	1.0	0.6				
ECQE4823□F( )	0.082	12.0	5.8	11.0	16.0	10.0	10.0	1.0	0.6				
ECQE4104□F( )	0.10	12.0	6.3	12.0	17.0	10.0	10.0	1.0	0.6				
ECQE4124□F( )	0.12	18.5	5.0	10.0	15.0	15.0	10.0	1.0	0.6	–	500	500	
ECQE4154□F( )	0.15	18.5	5.0	12.4	17.4	15.0	10.0	1.0	0.6				
ECQE4184□F( )	0.18	18.5	5.4	12.5	17.5	15.0	10.0	1.0	0.6				
ECQE4224□F( )	0.22	18.5	5.9	13.0	18.0	15.0	10.0	1.0	0.6				
ECQE4274□F( )	0.27	18.5	6.5	14.3	19.3	15.0	10.0	1.0	0.8				
ECQE4334□F( )	0.33	18.5	7.0	14.9	19.9	15.0	10.0	1.0	0.8				
ECQE4394□F( )	0.39	18.5	7.5	15.4	20.4	15.0	10.0	1.0	0.8			400	
ECQE4474□F( )	0.47	18.5	7.8	17.0	22.0	15.0	10.0	1.0	0.8				
ECQE4564□F( )	0.56	26.0	6.5	16.0	21.0	22.5	15.0	1.0	0.8		–	–	
ECQE4684□F( )	0.68	26.0	7.0	16.5	21.5	22.5	15.0	1.0	0.8				
ECQE4824□F( )	0.82	26.0	7.9	17.3	22.3	22.5	15.0	1.0	0.8				
ECQE4105□F( )	1.0	26.0	8.5	18.0	23.0	22.5	15.0	1.0	0.8				
ECQE4125□F( )	1.2	26.0	9.5	18.9	23.9	22.5	15.0	1.0	0.8				
ECQE4155□F( )	1.5	31.0	9.5	19.0	24.0	27.5	22.5	1.0	0.8				
ECQE4185□F( )	1.8	31.0	11.0	20.5	25.5	27.5	22.5	1.5	0.8				
ECQE4225□F( )	2.2	31.0	11.0	22.0	27.0	27.5	22.5	1.5	0.8				

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.10 μF
Type B : 0.12 μF to 2.2 μF

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)				
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk	
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight	Crimped lead
ECQE6102□F( )	0.0010	10.0	4.5	9.5	14.5	7.5	5.0	1.0	0.6	1000	–	1000	500	500
ECQE6122□F( )	0.0012	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6152□F( )	0.0015	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6182□F( )	0.0018	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6222□F( )	0.0022	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6272□F( )	0.0027	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6332□F( )	0.0033	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6392□F( )	0.0039	10.0	4.5	10.0	15.0	7.5	5.0	1.0	0.6					
ECQE6472□F( )	0.0047	12.0	4.5	10.0	15.0	10.0	7.5	1.0	0.6					
ECQE6562□F( )	0.0056	12.0	4.5	10.0	15.0	10.0	7.5	1.0	0.6					
ECQE6682□F( )	0.0068	12.0	4.9	10.0	15.0	10.0	7.5	1.0	0.6					
ECQE6822□F( )	0.0082	12.0	4.5	10.0	15.0	10.0	7.5	1.0	0.6					
ECQE6103□F( )	0.010	12.0	4.5	7.5	12.5	10.0	10.0	1.0	0.6					
ECQE6123□F( )	0.012	12.0	4.5	7.8	12.8	10.0	10.0	1.0	0.6					
ECQE6153□F( )	0.015	12.0	5.0	8.2	13.2	10.0	10.0	1.0	0.6					
ECQE6183□F( )	0.018	12.0	4.9	10.0	15.0	10.0	10.0	1.0	0.6					
ECQE6223□F( )	0.022	12.0	5.3	10.5	15.5	10.0	10.0	1.0	0.6					
ECQE6273□F( )	0.027	12.0	5.5	10.9	15.9	10.0	10.0	1.0	0.6					
ECQE6333□F( )	0.033	12.0	6.0	11.9	16.9	10.0	10.0	1.0	0.6	500				
ECQE6393□F( )	0.039	12.0	6.0	13.4	18.4	10.0	10.0	1.0	0.6	–	1000			
ECQE6473□F( )	0.047	12.0	6.5	13.5	18.5	10.0	10.0	1.0	0.6					
ECQE6563□F( )	0.056	18.5	5.4	10.5	15.5	15.0	10.0	1.0	0.6		500	500		
ECQE6683□F( )	0.068	18.5	5.8	11.0	16.0	15.0	10.0	1.0	0.6					
ECQE6823□F( )	0.082	18.5	6.5	12.0	17.0	15.0	10.0	1.0	0.6					
ECQE6104□F( )	0.10	18.5	6.3	14.0	19.0	15.0	10.0	1.0	0.6					
ECQE6124□F( )	0.12	18.5	6.3	14.5	19.5	15.0	10.0	1.0	0.8					
ECQE6154□F( )	0.15	18.5	7.5	15.4	20.4	15.0	10.0	1.0	0.8			400		
ECQE6184□F( )	0.18	18.5	8.0	16.0	21.0	15.0	10.0	1.0	0.8					
ECQE6224□F( )	0.22	18.5	9.0	16.5	21.5	15.0	10.0	1.0	0.8		400	300		
ECQE6274□F( )	0.27	26.0	7.0	16.5	21.5	22.5	15.0	1.0	0.8		–	–		
ECQE6334□F( )	0.33	26.0	7.8	17.0	22.0	22.5	15.0	1.0	0.8					
ECQE6394□F( )	0.39	26.0	8.5	17.9	22.9	22.5	15.0	1.0	0.8					
ECQE6474□F( )	0.47	26.0	9.3	18.5	23.5	22.5	15.0	1.0	0.8					
ECQE6564□F( )	0.56	26.0	10.0	20.0	25.0	22.5	15.0	1.5	0.8					
ECQE6684□F( )	0.68	26.0	11.5	21.0	26.0	22.5	15.0	1.5	0.8					
ECQE6824□F( )	0.82	31.0	11.3	20.5	25.5	27.5	22.5	1.5	0.8					
ECQE6105□F( )	1.0	31.0	12.5	21.9	26.9	27.5	22.5	1.5	0.8					
ECQE6125□F( )	1.2	31.0	13.5	23.0	28.0	27.5	22.5	1.5	0.8					
ECQE6155□F( )	1.5	31.0	15.3	24.7	29.7	27.5	22.5	1.5	0.8				400	
ECQE6185□F( )	1.8	31.0	16.8	27.0	32.0	27.5	22.5	1.5	0.8				300	400
ECQE6225□F( )	2.2	31.0	19.5	29.0	34.0	27.5	22.5	1.5	0.8					300

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.047 μF
Type B : 0.0010 μF to 0.0082 μF、0.056 μF to 2.2 μF

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 1000 V, 125 V [AC]*1, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)	
		L max.	T max.	H max.		F	S	G max.	ød	Taping	Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Odd size 7.5 mm	Straight・Crimped lead
ECQE10103□F( )	0.010	15.5	6.0	11.0	16.0	12.5	12.5	1.0	0.6	500	500
ECQE10123□F( )	0.012	15.5	6.0	12.0	17.0	12.5	12.5	1.0	0.6		
ECQE10153□F( )	0.015	15.5	7.0	12.5	17.5	12.5	12.5	1.0	0.6		
ECQE10183□F( )	0.018	15.5	7.5	13.0	20.0	12.5	12.5	1.0	0.8	400	
ECQE10223□F( )	0.022	15.5	7.5	15.5	22.5	12.5	12.5	1.0	0.8		
ECQE10273□F( )	0.027	21.0	6.0	13.0	18.0	17.5	12.5	1.0	0.8	500	
ECQE10333□F( )	0.033	21.0	6.5	14.0	19.0	17.5	12.5	1.0	0.8		
ECQE10393□F( )	0.039	21.0	7.0	14.5	19.5	17.5	12.5	1.0	0.8		
ECQE10473□F( )	0.047	21.0	7.5	15.5	20.5	17.5	12.5	1.0	0.8	400	
ECQE10563□F( )	0.056	21.0	7.5	17.0	22.0	17.5	12.5	1.0	0.8		
ECQE10683□F( )	0.068	21.0	8.5	18.0	23.0	17.5	12.5	1.0	0.8		
ECQE10823□F( )	0.082	21.0	9.0	18.5	23.5	17.5	12.5	1.0	0.8	300	
ECQE10104□F( )	0.10	21.0	10.0	20.0	25.0	17.5	12.5	1.0	0.8		
ECQE10124□F( )	0.12	26.0	9.0	18.5	23.5	22.5	17.5	1.0	0.8	–	
ECQE10154□F( )	0.15	26.0	10.0	20.0	25.0	22.5	17.5	1.5	0.8		
ECQE10184□F( )	0.18	26.0	10.5	22.0	27.0	22.5	17.5	1.5	0.8		
ECQE10224□F( )	0.22	26.0	12.0	23.0	28.0	22.5	17.5	1.5	0.8		

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.022 μF
Type B : 0.027 μF to 0.22 μF

*1 : This type has two rated voltage, one is DC rated voltage another is AC rated voltage.
DC rated voltage is 1000 V [DC], AC rated voltage is 125 V [AC].
Making for rated voltage is “1000 V, 125 V~ ”

When capacitors use in secondary side of power source, and in case of applying voltage in altering current (50 Hz or 60 Hz sine wave) to a capacitor, please refer to the page of “Permissible voltage (R.M.S) in altering current corresponding to DC rated voltage”.

When capacitors use in primary side of power source, the rated voltage is shown 125 V [AC]. Voltage to be applied to capacitors in only sine wave (50 Hz or 60 Hz).

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”. And not complying with clause 2 of “Electrical Appliance and Material Safety Law”, in this case please use ECQUA type or ECQUL type.

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 1250 V、125 V [AC]*1, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	寸法 (mm)								Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	G max.	ød	Taping	Bulk	
				Straight	Crimped lead	Straight	Crimped lead	Straight		Odd size 7.5 mm	Straight	Crimped lead
ECQE12102□F( )	0.0010	15.5	6.0	11.0	16.0	12.5	10.0	1.0	0.6	500	500	500
ECQE12122□F( )	0.0012	15.5	6.0	11.0	16.0	12.5	10.0	1.0	0.6			
ECQE12152□F( )	0.0015	15.5	6.0	11.0	16.0	12.5	10.0	1.0	0.6			
ECQE12182□F( )	0.0018	15.5	6.0	11.0	16.0	12.5	10.0	1.0	0.6			
ECQE12222□F( )	0.0022	15.5	6.0	11.5	16.5	12.5	10.0	1.0	0.6			
ECQE12272□F( )	0.0027	15.5	6.5	12.0	17.0	12.5	10.0	1.0	0.6			
ECQE12332□F( )	0.0033	15.5	6.0	11.5	16.5	12.5	10.0	1.0	0.6			
ECQE12392□F( )	0.0039	15.5	6.5	12.0	17.0	12.5	10.0	1.0	0.6			
ECQE12472□F( )	0.0047	15.5	7.0	12.5	17.5	12.5	10.0	1.0	0.6			
ECQE12562□F( )	0.0056	15.5	7.5	13.0	18.0	12.5	10.0	1.0	0.6	400		
ECQE12682□F( )	0.0068	15.5	7.5	15.0	20.0	12.5	10.0	1.0	0.6			
ECQE12822□F( )	0.0082	21.0	5.0	12.0	17.0	17.5	12.5	1.0	0.6	500		
ECQE12103□F( )	0.010	21.0	5.0	12.5	17.5	17.5	12.5	1.0	0.6			
ECQE12123□F( )	0.012	21.0	5.5	13.0	18.0	17.5	12.5	1.0	0.6			
ECQE12153□F( )	0.015	21.0	6.0	13.5	18.5	17.5	12.5	1.0	0.6			
ECQE12183□F( )	0.018	21.0	6.5	14.5	19.5	17.5	12.5	1.0	0.8			
ECQE12223□F( )	0.022	21.0	7.0	15.0	20.0	17.5	12.5	1.0	0.8			
ECQE12273□F( )	0.027	26.0	6.0	15.5	20.5	22.5	17.5	1.0	0.8	–		
ECQE12333□F( )	0.033	26.0	6.5	16.0	21.0	22.5	17.5	1.0	0.8			
ECQE12393□F( )	0.039	26.0	7.0	16.5	21.5	22.5	17.5	1.0	0.8			
ECQE12473□F( )	0.047	26.0	8.0	17.0	22.0	22.5	17.5	1.0	0.8			
ECQE12563□F( )	0.056	31.0	7.5	17.0	22.0	27.5	22.5	1.0	0.8			
ECQE12683□F( )	0.068	31.0	8.0	17.5	22.5	27.5	22.5	1.0	0.8			
ECQE12823□F( )	0.082	31.0	9.0	18.5	23.5	27.5	22.5	1.0	0.8			
ECQE12104□F( )	0.10	31.0	10.0	19.5	24.5	27.5	22.5	1.0	0.8			
ECQE12124□F( )	0.12	31.0	11.5	20.5	25.5	27.5	22.5	1.5	0.8			
ECQE12154□F( )	0.15	31.0	12.0	23.0	28.0	27.5	22.5	1.5	0.8			
ECQE12184□F( )	0.18	31.0	13.0	24.5	29.5	27.5	22.5	1.5	0.8			
ECQE12224□F( )	0.22	31.0	14.5	26.5	31.5	27.5	22.5	1.5	0.8		400	

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.0010 μF to 0.0068 μF
Type B : 0.0082 μF to 0.22 μF

*1 : This type has two rated voltage, one is DC rated voltage another is AC rated voltage.
DC rated voltage is 1250 V [DC], AC rated voltage is 125 V [AC].
Making for rated voltage is “1250 V, 125 V~ ”

When capacitors use in secondary side of power source, and in case of applying voltage in altering current (50 Hz or 60 Hz sine wave) to a capacitor, please refer to the page of “Permissible voltage (R.M.S) in altering current corresponding to DC rated voltage”.

When capacitors use in primary side of power source, the rated voltage is shown 125 V [AC]. Voltage to be applied to capacitors in only sine wave (50 Hz or 60 Hz).

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”. And not complying with clause 2 of “Electrical Appliance and Material Safety Law”, in this case please use ECQUA type or ECQUL type.

Rating · Dimensions · Quantity

■ Rated voltage [AC] : 125 V, Capacitance tolerance : ±5 %(J), ±10 %(K)
Noise suppression Capacitors (Across-the-line)

Part No.	Cap. (µF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight · Crimped lead
ECQE1A103□F( )	0.010	10.5	4.5	7.5	12.5	7.5	7.5	1.0	0.6	1000	–	1000	500
ECQE1A123□F( )	0.012	10.5	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A153□F( )	0.015	10.5	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A183□F( )	0.018	10.5	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A223□F( )	0.022	10.5	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A273□F( )	0.027	10.5	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A333□F( )	0.033	10.5	4.5	7.8	12.8	7.5	7.5	1.0	0.6				
ECQE1A393□F( )	0.039	10.5	4.5	7.8	12.8	7.5	7.5	1.0	0.6				
ECQE1A473□F( )	0.047	10.5	5.5	8.0	13.0	7.5	7.5	1.0	0.6	500			
ECQE1A563□F( )	0.056	10.5	5.9	8.5	13.5	7.5	7.5	1.0	0.6				
ECQE1A683□F( )	0.068	10.5	6.3	9.4	14.4	7.5	7.5	1.0	0.6				

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 µF to 0.068 µF

Notice for AC rated

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”.
As for clause 2 of “Electrical Appliance and Material Safety Law”, please use ECQUA type or ECQUL type.

When using these capacitors as a across-the-line capacitor, it shall be required to follow either item 1. or item 2. condition.

1. Capacitor shall be connected in parallel with varistor (Specifi ed varistor voltage in table 1.)
2. Voltage applied for capacitor shall not exceed other than specifi ed in table 1, when using these capacitors

Table 1

Capacitor rated voltage	Varistor voltage	Pulse voltage
125 V [AC]	250 V	250 $V_{0\text{-}p}$

Rating · Dimensions · Quantity

■ Rated voltage [AC] : 250 V, Capacitance tolerance : ±5 %(J), ±10 %(K)
Noise suppression Capacitors (Across-the-line)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight · Crimped lead
ECQE2A103□F( )	0.010	12.5	5.5	10.8	15.8	10.0	10.0	1.0	0.6	500	1000	500	500
ECQE2A123□F( )	0.012	12.5	6.0	11.5	16.5	10.0	10.0	1.0	0.6				
ECQE2A153□F( )	0.015	12.5	6.3	9.9	14.9	10.0	10.0	1.0	0.6				
ECQE2A183□F( )	0.018	12.5	6.0	11.9	16.9	10.0	10.0	1.0	0.6				
ECQE2A223□F( )	0.022	12.5	6.0	11.5	16.5	10.0	10.0	1.0	0.6				
ECQE2A273□F( )	0.027	12.5	5.5	10.9	15.9	10.0	10.0	1.0	0.6				
ECQE2A333□F( )	0.033	12.5	6.0	11.9	16.9	10.0	10.0	1.0	0.6				
ECQE2A393□F( )	0.039	12.5	6.0	13.4	18.4	10.0	10.0	1.0	0.6	–			
ECQE2A473□F( )	0.047	12.5	6.5	14.4	19.4	10.0	10.0	1.0	0.6				
ECQE2A563□F( )	0.056	18.5	5.4	10.5	15.5	15.0	10.0	1.0	0.6		500		
ECQE2A683□F( )	0.068	18.5	5.8	11.0	16.0	15.0	10.0	1.0	0.6				
ECQE2A823□F( )	0.082	18.5	6.3	12.0	17.0	15.0	10.0	1.0	0.6				
ECQE2A104□F( )	0.10	18.5	6.3	14.0	19.0	15.0	10.0	1.0	0.6				
ECQE2A124□F( )	0.12	18.5	6.8	14.5	19.5	15.0	10.0	1.0	0.8				
ECQE2A154□F( )	0.15	18.5	7.5	15.4	20.4	15.0	10.0	1.0	0.8		400		
ECQE2A184□F( )	0.18	18.5	8.0	16.0	21.0	15.0	10.0	1.0	0.8				
ECQE2A224□F( )	0.22	18.5	9.0	16.9	21.9	15.0	10.0	1.0	0.8		300		
ECQE2A274□F( )	0.27	26.0	7.0	16.5	21.5	22.5	15.0	1.0	0.8		–		
ECQE2A334□F( )	0.33	26.0	7.8	17.0	22.0	22.5	15.0	1.0	0.8				
ECQE2A394□F( )	0.39	26.0	8.5	17.9	22.9	22.5	15.0	1.0	0.8				
ECQE2A474□F( )	0.47	26.0	9.3	18.5	23.5	22.5	15.0	1.0	0.8				
ECQE2A564P( )( )	0.56	26.0	10.0	20.0	–	22.5	–	1.0	0.8				
ECQE2A684P( )( )	0.68	26.0	11.5	21.0	–	22.5	–	1.0	0.8				
ECQE2A824P( )( )	0.82	26.0	13.0	22.5	–	22.5	–	1.0	0.8				
ECQE2A105P( )( )	1.0	31.0	12.5	21.9	–	27.5	–	1.5	0.8				
ECQE2A125P( )( )	1.2	31.0	13.5	23.0	–	27.5	–	1.5	0.8			300	
ECQE2A155P( )( )	1.5	31.0	15.3	24.7	–	27.5	–	1.5	0.8				
ECQE2A185P( )( )	1.8	31.0	16.8	27.0	–	27.5	–	1.5	0.8				400
ECQE2A225P( )( )	2.2	31.0	19.5	29.0	–	27.5	–	1.5	0.8				300

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type
P()() : Please contact us about special part number.
* Please consult us about Crimped lead type of 0.56 μF to 2.2 μF.

Type D : 0.010 μF ~ 0.047 μF
Type B : 0.056 μF ~ 0.47 μF

Notice for AC rated

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”.
As for clause 2 of “Electrical Appliance and Material Safety Law”, please use ECQUA type or ECQUL type.

When using these capacitors as a across-the-line capacitor, it shall be required to follow either item 1. or item 2. condition.

1. Capacitor shall be connected in parallel with varistor (Specifi ed varistor voltage in table 1.)
2. Voltage applied for capacitor shall not exceed other than specifi ed in table 1, when using these capacitors

Table 1

Capacitor rated voltage	Varistor voltage	Pulse voltage
250 V [AC]	470 V	630 $V_{0\text{-}p}$

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

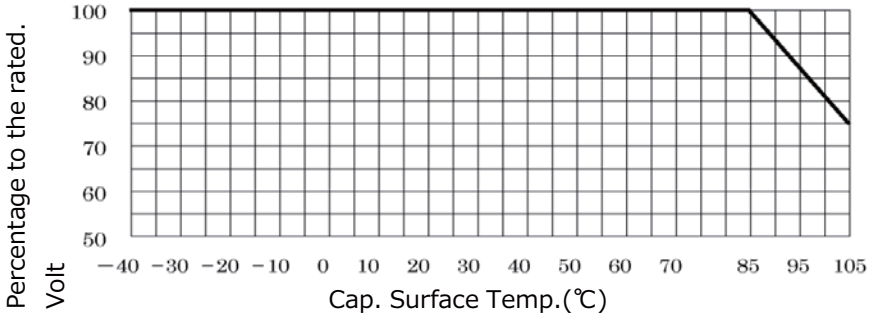
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

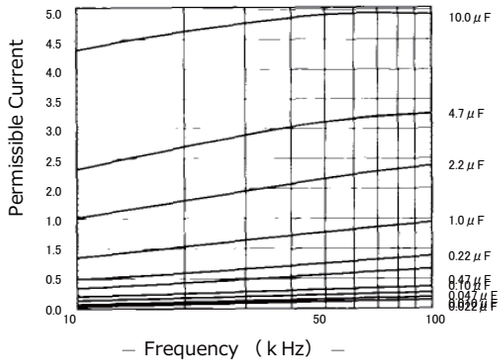
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

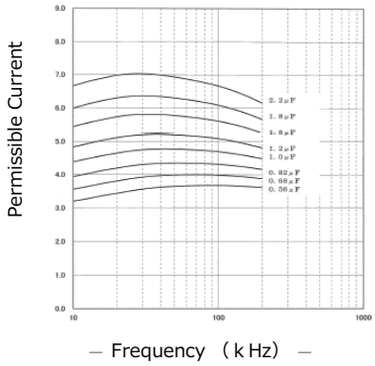
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

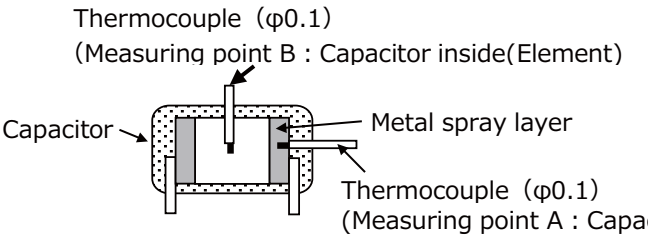
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

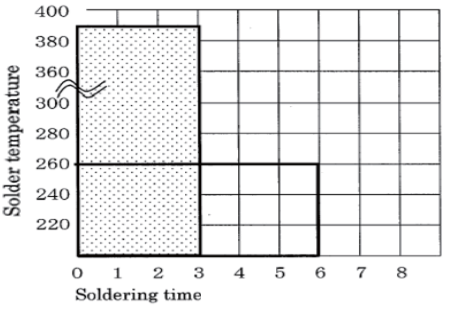
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

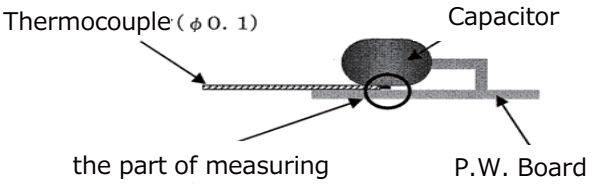
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

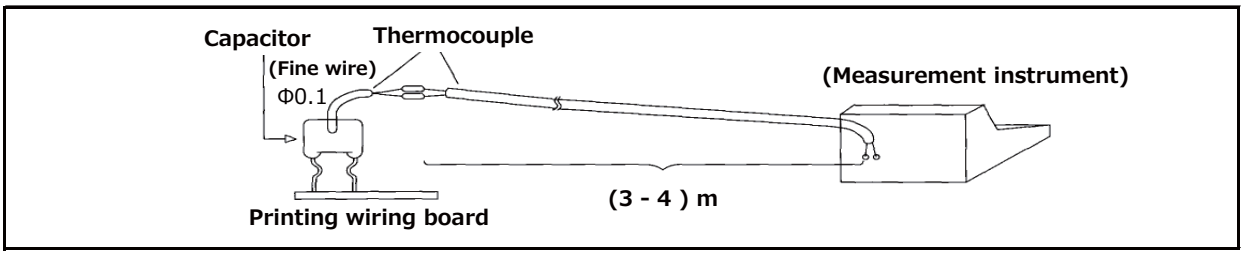
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

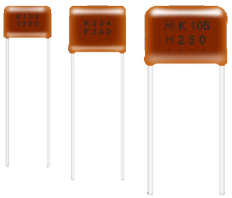
Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polyester Film Capacitor

ECQE(T) series

Non-inductive construction using metallized polyester film with flame retardant epoxy resin coating

Features

- Self-healing property
- Excellent electrical characteristics
- Flame retardant epoxy resin coating
- Moisture resistance 85 °C, 85 % RH for 500 hours
- RoHS compliant

Recommended applications

- General purpose usage
  ※Please contact us when applications are CDI , ignitor etc.

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E							T	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage
2	250 V [DC]
4	400 V [DC]
6	630 V [DC]
1A	125 V [AC]
2A	250 V [AC]

Code	Cap. Tol.
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
B	Crimped lead
Z	Cut lead
3	Crimped taping (Ammo)
6	Crimped taping (Ammo)

- Odd size taping

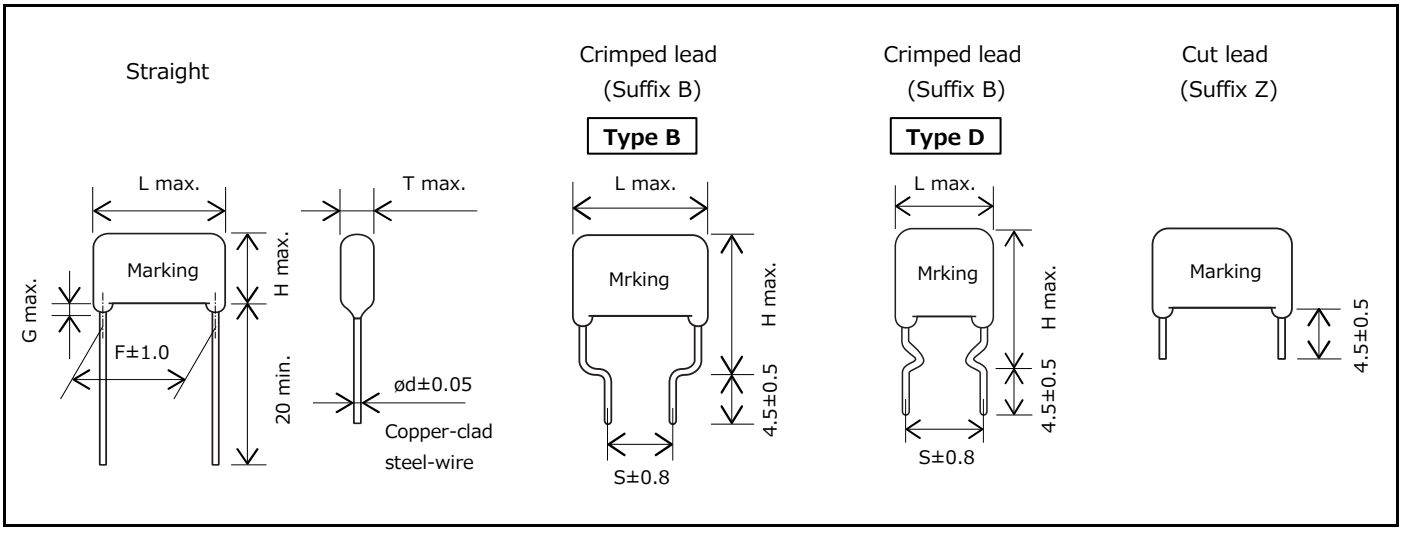
1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	E						R		T
Product code		Dielectric & construction		Rated voltage		Capacitance			Odd taping	Cap. Tol.	Suffix

Specifications

Category temp. range (Including temperature-rise on unit surface)	250V to 630V [DC]	−40 ℃ to +105 ℃
	125 V, 250 V [AC]	−40 ℃ to +105 ℃
Rated voltage	250 V, 400 V, 630 V [DC] (Derating of rated voltage by 1.25 %/°C at more than 85 °C) 125 V, 250 V [AC]	
Capacitance range	250 V [DC]	0.010 μF ~ 10.0 μF (E12)
	400 V [DC]	0.010 μF ~ 2.2 μF (E12)
	630 V [DC]	0.010 μF ~ 2.2 μF (E12)
	125 V [AC]	0.010 μF ~ 0.47 μF (E12)
	250 V [AC]	0.010 μF ~ 0.47 μF (E12)
Capacitance tolerance	±5 % (J), ±10 % (K)	
Dissipation factor (tan δ)	tan δ ≦ 1.0 % (20 ℃, 1 kHz)	
Withstand voltage	250V to 630V [DC]	Between terminals : R.voltage (V) × 150 %, 60 s
	125 V [AC] 250 V [AC]	Between terminals : R.voltage (V) × 230 %, 60 s Between terminals to enclosure : 1500 V [AC], 60 s
Insulation resistance (IR)	250V to 630V [DC]	C ≦ 0.33 μF : IR ≧ 9000 MΩ (20 ℃, 100 V [DC], 60 s)
		C > 0.33 μF : IR ≧ 3000 MΩ · μF (20 ℃, 100 V [DC], 60 s)
	125 V [AC] 250 V [AC]	IR ≧ 2000 MΩ (20 ℃, 500 V [DC], 60 s)

∗ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.
∗ Voltage to be applied to ECQE1A (F) & ECQE2A (F) is only sine wave (50 Hz or 60 Hz).

Dimensions



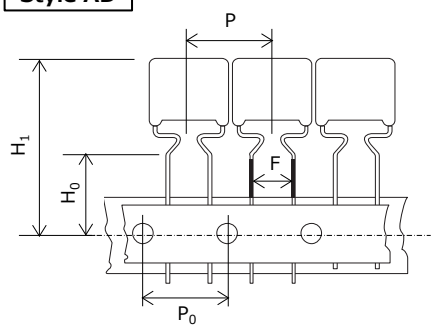
Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

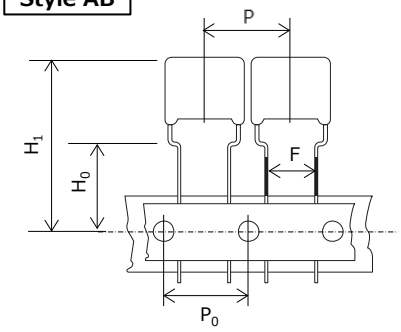
Taping specifications for automatic insertion

■ Taping style

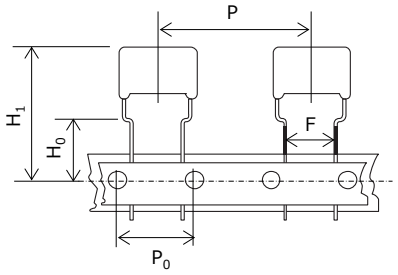
Style AD



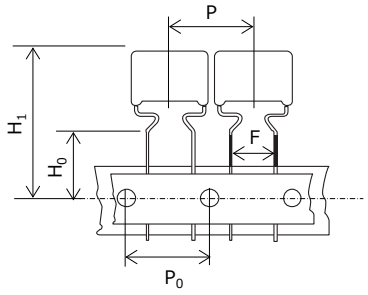
Style AB



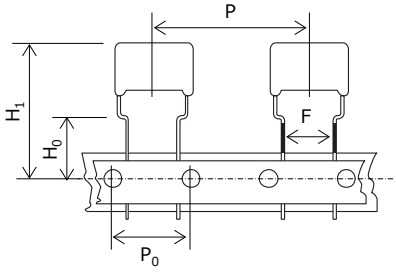
Style C



Style D



Style E



*: H1 dimension is based on insertion machine “Panasert RH series” made by Panasonic.
Consult with Panasonic technical staff when using other insertion machines.

Size list Unit : mm

	Style				
	AD	AB	C	D	E
P	12.7	12.7	25.4	15.0	30.0
P_0	12.7	12.7	12.7	15.0	15.0
F	5.0	5.0	5.0	7.5	7.5
H_0	16.0	16.0	16.0	16.0	16.0
H_1*	34.0	34.0	39.0	44.0	44.0

*:max.

■ Packaging specifications

Series	R.voltage	Capacitance range (μF)	Taping style					Packing	Suffix
			AD	AB	C	D	E		
ECQE(T)	250 V [DC]	0.010 to 0.15	○					Ammo	( ) T3
		0.18 to 0.33			○			Ammo	( ) T3
		0.39 to 1.5			○			Ammo	( ) T3
		0.010 to 0.33				○		Ammo	R( ) T
		0.39 to 1.5					○	Ammo	R( ) T
	400 V [DC]	0.010 to 0.033	○					Ammo	( ) T3
		0.039 to 0.10			○			Ammo	( ) T3
		0.12 to 0.47			○			Ammo	( ) T3
		0.010 to 0.10				○		Ammo	R( ) T
		0.12 to 0.47					○	Ammo	R( ) T
	630 V [DC]	0.010 to 0.047			○			Ammo	( ) T3
		0.056 to 0.22			○			Ammo	( ) T3
		0.010 to 0.047				○		Ammo	R( ) T
		0.056 to 0.22					○	Ammo	R( ) T
	125 V [AC]	0.27 to 0.47			○			Ammo	( ) T3
		0.010 to 0.10		○				Ammo	( ) T6
		0.12 to 0.22			○			Ammo	( ) T6
		0.010 to 0.22				○		Ammo	R( ) T
		0.27 to 0.47					○	Ammo	R( ) T
	250 V [AC]	0.056 to 0.22			○		○	Ammo	( ) T3
		0.010 to 0.047			○			Ammo	( ) T6
		0.010 to 0.047				○		Ammo	R( ) T
		0.056 to 0.22					○	Ammo	R( ) T

See the column “Rating ·Dimensions · Quantity” for packaging quantity

● Lead spacing

Style	Lead spacing
AD	5.0
AB	5.0
C	5.0
D	7.5
E	7.5

Unit : mm

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 250 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)				
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk	
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight	Crimped lead
ECQE2103□T( )	0.010	10.8	4.3	7.4	12.4	7.5	7.5	1.0	0.6	1500	–	1800	500	500
ECQE2123□T( )	0.012	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6			1700		
ECQE2153□T( )	0.015	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2183□T( )	0.018	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2223□T( )	0.022	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2273□T( )	0.027	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2333□T( )	0.033	10.8	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2393□T( )	0.039	10.8	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2473□T( )	0.047	10.8	4.5	7.5	12.5	7.5	7.5	1.0	0.6					
ECQE2563□T( )	0.056	10.8	4.8	7.9	12.9	7.5	7.5	1.0	0.6			1600		
ECQE2683□T( )	0.068	10.8	4.5	7.5	12.5	7.5	7.5	1.0	0.6			1700		
ECQE2823□T( )	0.082	10.8	4.9	8.0	13.0	7.5	7.5	1.0	0.6			1500		
ECQE2104□T( )	0.10	10.8	5.8	8.4	13.4	7.5	7.5	1.0	0.6	1000		1300		
ECQE2124□T( )	0.12	10.8	6.0	9.0	14.0	7.5	7.5	1.0	0.6			1200		
ECQE2154□T( )	0.15	10.8	6.0	10.8	15.8	7.5	7.5	1.0	0.6					
ECQE2184□T( )	0.18	12.5	5.0	10.3	15.3	10.0	10.0	1.0	0.6	–	800	1400		
ECQE2224□T( )	0.22	12.5	5.5	10.5	15.5	10.0	10.0	1.0	0.6			1300		
ECQE2274□T( )	0.27	12.5	6.0	11.5	16.5	10.0	10.0	1.0	0.6		700	1200		
ECQE2334□T( )	0.33	12.5	6.5	12.0	17.0	10.0	10.0	1.0	0.6		600	1100		
ECQE2394□T( )	0.39	19.0	4.9	12.0	17.0	15.0	10.0	1.0	0.6		800	700		
ECQE2474□T( )	0.47	19.0	5.3	12.5	17.5	15.0	10.0	1.0	0.6		700	600		
ECQE2564□T( )	0.56	19.0	5.5	13.0	18.0	15.0	10.0	1.0	0.6		800			
ECQE2684□T( )	0.68	19.0	6.0	13.5	18.5	15.0	10.0	1.0	0.8		700			
ECQE2824□T( )	0.82	19.0	6.5	14.5	19.5	15.0	10.0	1.0	0.8		600	500		
ECQE2105□T( )	1.0	19.0	7.4	15.0	20.0	15.0	10.0	1.0	0.8		500	400		
ECQE2125□T( )	1.2	19.0	8.0	15.9	20.9	15.0	10.0	1.0	0.8					
ECQE2155□T( )	1.5	19.0	9.0	16.8	21.8	15.0	10.0	1.0	0.8		400			
ECQE2185□T( )	1.8	26.5	7.5	15.5	20.5	22.5	15.0	1.0	0.8		–	–		
ECQE2225□T( )	2.2	26.5	8.5	16.3	21.3	22.5	15.0	1.0	0.8					
ECQE2275□T( )	2.7	26.5	9.4	17.0	22.0	22.5	15.0	1.0	0.8					
ECQE2335□T( )	3.3	26.5	10.3	18.0	23.0	22.5	15.0	1.5	0.8					
ECQE2395□T( )	3.9	26.5	11.0	20.5	25.5	22.5	15.0	1.5	0.8					
ECQE2475□T( )	4.7	26.5	12.0	21.5	26.5	22.5	15.0	1.5	0.8					
ECQE2565□T( )	5.6	31.5	11.8	21.0	26.0	27.5	22.5	1.5	0.8					
ECQE2685□T( )	6.8	31.5	13.0	22.4	27.4	27.5	22.5	1.5	0.8					
ECQE2825□T( )	8.2	31.5	14.3	23.5	28.5	27.5	22.5	1.5	0.8				400	
ECQE2106□T( )	10.0	31.5	15.9	25.8	30.8	27.5	22.5	1.5	0.8				300	400

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.33 μF
Type B : 0.39 μF to 10.0 μF

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 400 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE4103□T( )	0.010	10.8	4.3	7.4	12.4	7.5	7.5	1.0	0.6	1500	–	1800	500
ECQE4123□T( )	0.012	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6			1700	
ECQE4153□T( )	0.015	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE4183□T( )	0.018	10.8	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE4223□T( )	0.022	10.8	4.8	7.9	12.9	7.5	7.5	1.0	0.6			1600	
ECQE4273□T( )	0.027	10.8	5.5	8.0	13.0	7.5	7.5	1.0	0.6			1400	
ECQE4333□T( )	0.033	10.8	6.0	9.0	14.0	7.5	7.5	1.0	0.6	1000		1200	
ECQE4393□T( )	0.039	12.5	4.9	8.0	13.0	10.0	10.0	1.0	0.6	–	900	1500	
ECQE4473□T( )	0.047	12.5	5.0	8.3	13.3	10.0	10.0	1.0	0.6				
ECQE4563□T( )	0.056	12.5	5.0	10.0	15.0	10.0	10.0	1.0	0.6				
ECQE4683□T( )	0.068	12.5	5.4	10.5	15.5	10.0	10.0	1.0	0.6		800	1400	
ECQE4823□T( )	0.082	12.5	5.8	11.0	16.0	10.0	10.0	1.0	0.6			1300	
ECQE4104□T( )	0.10	12.5	6.3	12.0	17.0	10.0	10.0	1.0	0.6		700	1200	
ECQE4124□T( )	0.12	19.0	5.0	10.0	15.0	15.0	10.0	1.0	0.6		800	700	
ECQE4154□T( )	0.15	19.0	5.0	12.4	17.4	15.0	10.0	1.0	0.6				
ECQE4184□T( )	0.18	19.0	5.4	12.5	17.5	15.0	10.0	1.0	0.6			600	
ECQE4224□T( )	0.22	19.0	5.9	13.0	18.0	15.0	10.0	1.0	0.6		700		
ECQE4274□T( )	0.27	19.0	6.5	14.3	19.3	15.0	10.0	1.0	0.8		600	500	
ECQE4334□T( )	0.33	19.0	7.0	14.9	19.9	15.0	10.0	1.0	0.8				
ECQE4394□T( )	0.39	19.0	7.5	15.4	20.4	15.0	10.0	1.0	0.8		500	400	
ECQE4474□T( )	0.47	19.0	7.8	17.0	22.0	15.0	10.0	1.0	0.8				
ECQE4564□T( )	0.56	26.5	6.5	16.0	21.0	22.5	15.0	1.0	0.8		–	–	
ECQE4684□T( )	0.68	26.5	7.0	16.5	21.5	22.5	15.0	1.0	0.8				
ECQE4824□T( )	0.82	26.5	7.9	17.3	22.3	22.5	15.0	1.0	0.8				
ECQE4105□T( )	1.0	26.5	8.5	18.0	23.0	22.5	15.0	1.0	0.8				
ECQE4125□T( )	1.2	26.5	9.5	18.9	23.9	22.5	15.0	1.0	0.8				
ECQE4155□T( )	1.5	31.5	9.5	19.0	24.0	27.5	22.5	1.0	0.8				
ECQE4185□T( )	1.8	31.5	11.0	20.5	25.5	27.5	22.5	1.5	0.8				
ECQE4225□T( )	2.2	31.5	11.0	22.0	27.0	27.5	22.5	1.5	0.8				

* □ : Capacitance tolerance code
( ) : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.10 μF
Type B : 0.12 μF to 2.2 μF

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±5 %(J), ±10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE6103□T( )	0.010	12.5	4.5	7.5	12.5	10.0	10.0	1.0	0.6	900	1600	500	500
ECQE6123□T( )	0.012	12.5	4.5	7.8	12.8	10.0	10.0	1.0	0.6				
ECQE6153□T( )	0.015	12.5	5.0	8.2	13.2	10.0	10.0	1.0	0.6	800	1400		
ECQE6183□T( )	0.018	12.5	4.9	10.0	15.0	10.0	10.0	1.0	0.6				
ECQE6223□T( )	0.022	12.5	5.3	10.5	15.5	10.0	10.0	1.0	0.6		1300		
ECQE6273□T( )	0.027	12.5	5.5	10.9	15.9	10.0	10.0	1.0	0.6				
ECQE6333□T( )	0.033	12.5	6.0	11.9	16.9	10.0	10.0	1.0	0.6	700	1200		
ECQE6393□T( )	0.039	12.5	6.0	13.4	18.4	10.0	10.0	1.0	0.6				
ECQE6473□T( )	0.047	12.5	6.5	13.5	18.5	10.0	10.0	1.0	0.6	600	1100		
ECQE6563□T( )	0.056	19.0	5.4	10.5	15.5	15.0	10.0	1.0	0.6	800	600		
ECQE6683□T( )	0.068	19.0	5.8	11.0	16.0	15.0	10.0	1.0	0.6	700			
ECQE6823□T( )	0.082	19.0	6.5	12.0	17.0	15.0	10.0	1.0	0.6	600	500		
ECQE6104□T( )	0.10	19.0	6.3	14.0	19.0	15.0	10.0	1.0	0.6				
ECQE6124□T( )	0.12	19.0	6.3	14.5	19.5	15.0	10.0	1.0	0.8				
ECQE6154□T( )	0.15	19.0	7.5	15.4	20.4	15.0	10.0	1.0	0.8	500	400		
ECQE6184□T( )	0.18	19.0	8.0	16.0	21.0	15.0	10.0	1.0	0.8				
ECQE6224□T( )	0.22	19.0	9.0	16.5	21.5	15.0	10.0	1.0	0.8	400			
ECQE6274□T( )	0.27	26.5	7.0	16.5	21.5	22.5	15.0	1.0	0.8	–	–		
ECQE6334□T( )	0.33	26.5	7.8	17.0	22.0	22.5	15.0	1.0	0.8				
ECQE6394□T( )	0.39	26.5	8.5	17.9	22.9	22.5	15.0	1.0	0.8				
ECQE6474□T( )	0.47	26.5	9.3	18.5	23.5	22.5	15.0	1.0	0.8				
ECQE6564□T( )	0.56	26.5	10.0	20.0	25.0	22.5	15.0	1.5	0.8				
ECQE6684□T( )	0.68	26.5	11.5	21.0	26.0	22.5	15.0	1.5	0.8				
ECQE6824□T( )	0.82	31.5	11.3	20.5	25.5	27.5	22.5	1.5	0.8				
ECQE6105□T( )	1.0	31.5	12.5	21.9	26.9	27.5	22.5	1.5	0.8				
ECQE6125□T( )	1.2	31.5	13.5	23.0	28.0	27.5	22.5	1.5	0.8				
ECQE6155□T( )	1.5	31.5	15.3	24.7	29.7	27.5	22.5	1.5	0.8			400	
ECQE6185□T( )	1.8	31.5	16.8	27.0	32.0	27.5	22.5	1.5	0.8			300	400
ECQE6225□T( )	2.2	31.5	19.5	29.0	34.0	27.5	22.5	1.5	0.8				

* □ : Capacitance tolerance code
( ) : Suffix for lead crimped or taped type

Type D : 0.010 μF to 0.047 μF
Type B : 0.1056 μF to 2.2 μF

Rating · Dimensions · Quantity

■ Rated voltage [AC] : 125 V, Capacitance tolerance : ±5 %(J), ±10 %(K)
Noise suppression Capacitors (Across-the-line)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)			
		L max.	T max.	H max.		F	S	G	ød	Taping			Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Standard 5.0 mm	Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE1A103□T( )	0.010	11.0	4.5	7.5	12.5	7.5	7.5	1.0	0.6	1500	–	1700	500
ECQE1A123□T( )	0.012	11.0	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A153□T( )	0.015	11.0	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A183□T( )	0.018	11.0	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A223□T( )	0.022	11.0	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A273□T( )	0.027	11.0	4.4	7.5	12.5	7.5	7.5	1.0	0.6				
ECQE1A333□T( )	0.033	11.0	4.5	7.8	12.8	7.5	7.5	1.0	0.6				
ECQE1A393□T( )	0.039	11.0	4.5	7.8	12.8	7.5	7.5	1.0	0.6				
ECQE1A473□T( )	0.047	11.0	5.5	8.0	13.0	7.5	7.5	1.0	0.6			1400	
ECQE1A563□T( )	0.056	11.0	5.9	8.5	13.5	7.5	7.5	1.0	0.6	1000		1300	
ECQE1A683□T( )	0.068	11.0	6.3	9.4	14.4	7.5	7.5	1.0	0.6			1200	
ECQE1A823□T( )	0.082	11.0	6.5	9.8	14.8	7.5	7.5	1.0	0.6			1100	
ECQE1A104□T( )	0.10	11.0	6.5	11.8	16.8	7.5	7.5	1.0	0.6				
ECQE1A124□T( )	0.12	13.0	5.9	11.5	16.5	10.0	10.0	1.0	0.6	–	600	1000	
ECQE1A154□T( )	0.15	13.0	6.5	12.0	17.0	10.0	10.0	1.0	0.6				
ECQE1A184□T( )	0.18	13.0	7.0	12.5	17.5	10.0	10.0	1.0	0.6		500	900	
ECQE1A224□T( )	0.22	13.0	7.5	13.4	18.4	10.0	10.0	1.0	0.6			800	
ECQE1A274□T( )	0.27	19.0	6.3	12.0	17.0	15.0	10.0	1.0	0.6		600	500	
ECQE1A334□T( )	0.33	19.0	6.9	12.5	17.5	15.0	10.0	1.0	0.6		500	400	
ECQE1A394□T( )	0.39	19.0	7.4	13.0	18.0	15.0	10.0	1.0	0.6				
ECQE1A474□T( )	0.47	19.0	7.5	15.3	20.3	15.0	10.0	1.0	0.6				

* □ : Capacitance tolerance code　　() : Suffix for lead crimped or taped type　　Type D : 0.010 μF to 0.22 μF　　Type B : 0.27 μF to 0.47 μF

■ Rated voltage [AC] : 250 V, Capacitance tolerance : ±5 %(J), ±10 %(K)
Noise suppression Capacitors (Across-the-line)

Part No.	Cap. (μF)	Dimensions (mm)								Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	G	ød	Taping		Bulk
				Straight	Crimped lead	Straight	Crimped lead	Straight		Odd size 5.0 mm	Odd size 7.5 mm	Straight・Crimped lead
ECQE2A103□T( )	0.010	13.0	5.5	10.8	15.8	10.0	10.0	1.0	0.6	800	1300	500
ECQE2A123□T( )	0.012	13.0	6.0	11.5	16.5	10.0	10.0	1.0	0.6	700	1200	
ECQE2A153□T( )	0.015	13.0	6.3	9.9	14.9	10.0	10.0	1.0	0.6	600	1100	
ECQE2A183□T( )	0.018	13.0	6.0	11.9	16.9	10.0	10.0	1.0	0.6	700	1200	
ECQE2A223□T( )	0.022	13.0	6.0	11.5	16.5	10.0	10.0	1.0	0.6			
ECQE2A273□T( )	0.027	13.0	5.5	10.9	15.9	10.0	10.0	1.0	0.6	800	1300	
ECQE2A333□T( )	0.033	13.0	6.0	11.9	16.9	10.0	10.0	1.0	0.6	700	1200	
ECQE2A393□T( )	0.039	13.0	6.0	13.4	18.4	10.0	10.0	1.0	0.6			
ECQE2A473□T( )	0.047	13.0	6.5	14.4	19.4	10.0	10.0	1.0	0.6	600	1100	
ECQE2A563□T( )	0.056	19.0	5.4	10.5	15.5	15.0	10.0	1.0	0.6	800	600	
ECQE2A683□T( )	0.068	19.0	5.8	11.0	16.0	15.0	10.0	1.0	0.6	700		
ECQE2A823□T( )	0.082	19.0	6.3	12.0	17.0	15.0	10.0	1.0	0.6	600	500	
ECQE2A104□T( )	0.10	19.0	6.3	14.0	19.0	15.0	10.0	1.0	0.6			
ECQE2A124□T( )	0.12	19.0	6.8	14.5	19.5	15.0	10.0	1.0	0.8			
ECQE2A154□T( )	0.15	19.0	7.5	15.4	20.4	15.0	10.0	1.0	0.8	500	400	
ECQE2A184□T( )	0.18	19.0	8.0	16.0	21.0	15.0	10.0	1.0	0.8			
ECQE2A224□T( )	0.22	19.0	9.0	16.9	21.9	15.0	10.0	1.0	0.8	400		
ECQE2A274□T( )	0.27	26.5	7.0	16.5	21.5	22.5	15.0	1.0	0.8	–	–	
ECQE2A334□T( )	0.33	26.5	7.8	17.0	22.0	22.5	15.0	1.0	0.8			
ECQE2A394□T( )	0.39	26.5	8.5	17.9	22.9	22.5	15.0	1.0	0.8			
ECQE2A474□T( )	0.47	26.5	9.3	18.5	23.5	22.5	15.0	1.0	0.8			

* □ : Capacitance tolerance code　　() : Suffix for lead crimped or taped type　　Type D : 0.010 μF to 0.047 μF　　Type B : 0.2056 μF to 0.47 μF

Notice for AC rated

AC rated capacitors complying with clause 1 of “Electrical Appliance and Material Safety Law”.
As for clause 2 of “Electrical Appliance and Material Safety Law”, please use ECQUA type or ECQUL type.

When using these capacitors as a across-the-line capacitor, it shall be required to follow either item 1. or item 2. condition.

1. Capacitor shall be connected in parallel with varistor (Specifi ed varistor voltage in table 1.)
2. Voltage applied for capacitor shall not exceed other than specifi ed in table 1, when using these capacitors

Table 1

Capacitor rated voltage	Varistor voltage	Pulse voltage
125 V [AC]	250 V	250 $V_{0\text{-}p}$
250 V [AC]	470 V	630 $V_{0\text{-}p}$

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

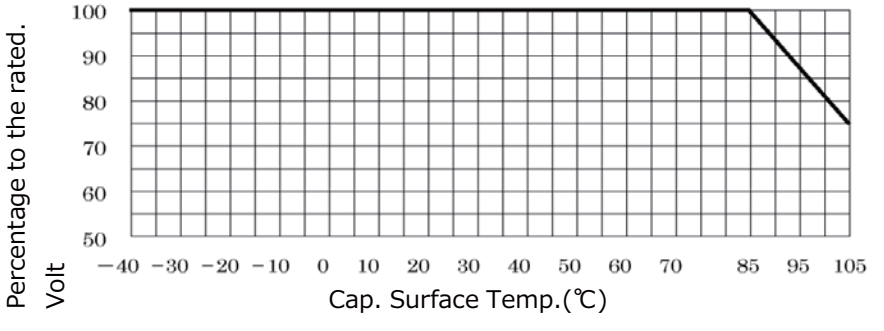
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

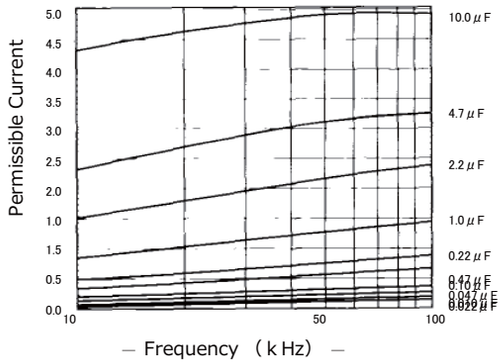
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

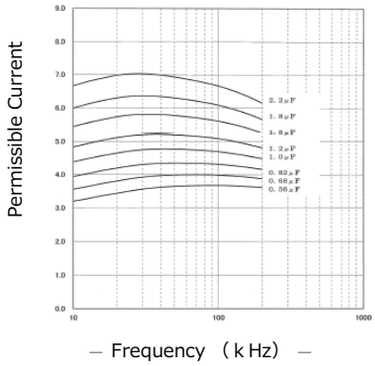
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

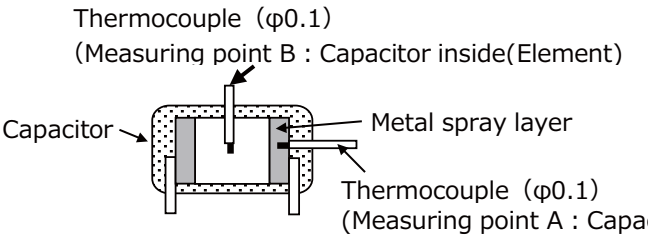
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

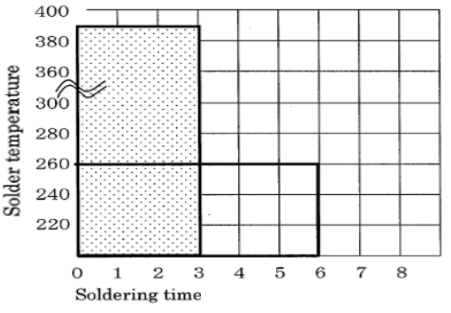
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

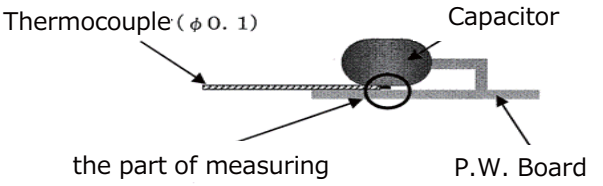
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

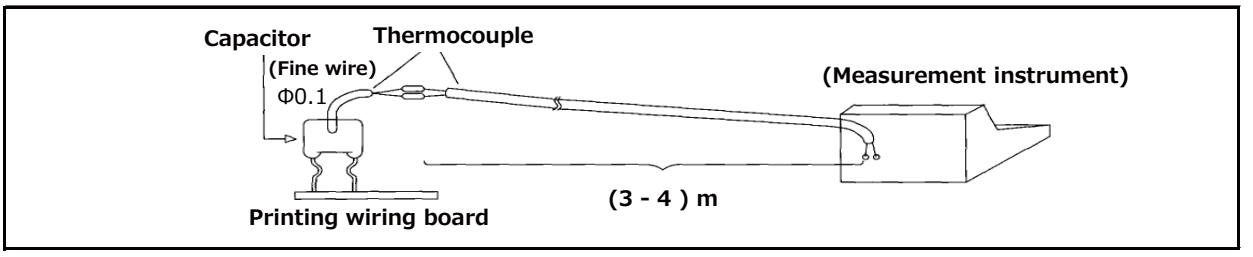
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

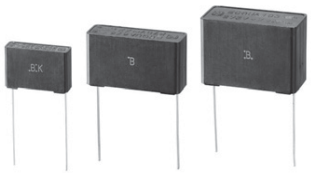
*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

Panasonic INDUSTRY

Plastic Film Capacitors

UPGRADE



Metallized Polypropylene Film Capacitor

ECQUA series **[Class X2]**

In accordance with UL/CSA and European safety regulation class X2 equipped with a safety mechanism.

Features

- High safety (safety function installed)
- High humidity resistance (THB test : 85 ℃, 85 %, 240 V [AC], 1000 h 〈0.1 ≦ C ≦ 1.0 μF〉, 275 V [AC] / 500 h)
- Compact
- Flame-retardant plastic case and non-combustible resin
- RoHS compliant

Recommended applications

- Interference suppressors

Explanation of part number

■ Standard

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	A	A	F					
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	Cap. Tol.
K	±10 %
M	±20 %

Code	Lead form
Blank	Straight
A	Cut lead

■ Special lead space product

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	A	A	F					
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	Cap. Tol.
E	±10 %
L	±20 %

Code	Lead form
D	Cut lead

Applicable standard

＊It is certified as type ECQUA in the following approval.

Approval		Class	Certification organization
UL	UL60384-14	Class X2	UL
CSA	CAN/CSA E60384-14	Class X2	
Europe	EN60384-14	Class X2	VDE or DEMKO
International	IEC60384-14	Class X2	

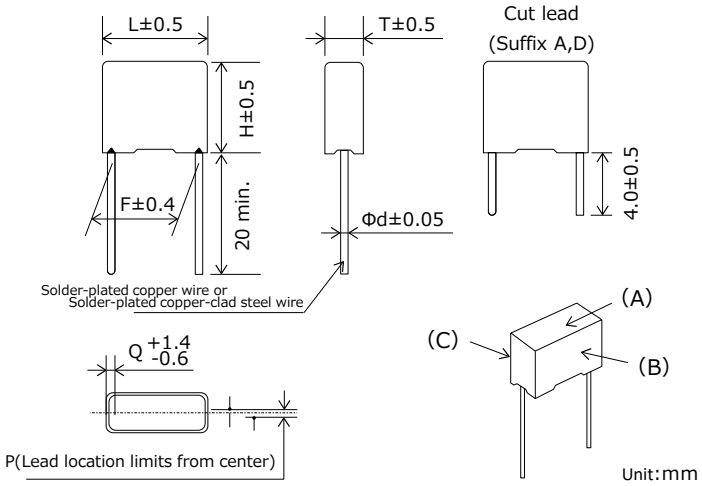
＊When applying this capacitor to European and American safety standards, please use type designation and rating such as ECQUA, 0.1 μF.
＊Approval number (File No.) of safety regulations are subject to revision without notice. Ask factory for a copy of the latest file No.

Specifications

Category temp. range	−40 ℃ to +110 ℃
Rated voltage [AC]	275 V
Capacitance range	0.0082 μF to 10.0 μF
Capacitance tolerance	±10 % (K), ±20 % (M)
Dissipation factor (tan δ)	C ≦ 1.0 μF : tan δ ≦ 0.1 % (20 ℃, 1 kHz) C > 1.0 μF : tan δ ≦ 0.2 % (20 ℃, 1 kHz)
Withstand voltage	Between terminals : 633 V [AC], 1183 V [DC], 60 s Between terminals to enclosure : 2050 V [AC], 60 s
Insulation resistance (IR)	C ≦ 0.33 μF : IR ≧ 15,000 MΩ (20 ℃, 100 V [DC], 60 s) C > 0.33 μF : IR ≧ 5,000 MΩ · μF (20 ℃, 100 V [DC], 60 s) C ≦ 0.47 μF : IR ≧ 2,000 MΩ (20 ℃, 500 V [DC], 60 s)
Maximum AC voltage＊＊	310 V [AC]

＊Use of this capacitor is limited to AC voltage (50 Hz or 60 Hz sine wave).
＊A faint corona discharge may occur inside of the capacitor element at rated voltage, however there is no influence on the reliability of the capacitor.
＊＊Maximum AC voltage including line voltage fluctuation is 310 V [AC].
310 V [AC] is not nominal continuous applied voltage, but only indicates maximum value including in the voltage ofthe power supply.
Basic nominal voltage is considered as 240 V [AC].
This maximum AC voltae is specified in only ECQUA type, not specified in other types.
Please refer to individual product specification, and contact us for further questions regarding design life.

Dimensions



Marking example

Style	(A) side	(B) or (C)side
1	ECQUA103K	15 275V~ X2
2	ECQUA104 275V~X2 10	K
3		ECQUA106 275V~X2 15 K

Note : Only ±10 % as cap. tol. be marked as "K".

Note: ☐ Date code.

Rating · Dimensions · Quantity

● Capacitance tolerance : ±10 %(K), ±20 %(M)

Part No.	Cap. (μF)	Dimensions (mm)							Style	Min. order Q'ty (PCS)	
		L	T	H	F	Φd	P	Q		Straight	Cut lead
NEW ECQUAAF822☐( )	0.0082	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF103☐( )	0.01	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF123☐( )	0.012	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF153☐( )	0.015	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF183☐( )	0.018	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF223☐( )	0.022	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF273☐( )	0.027	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF333☐( )	0.033	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF393☐( )	0.039	15.3	5.0	11.5	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF473☐( )	0.047	15.3	6.0	13.0	12.5	0.6	0±0.8	1.5	1	1000	1000
NEW ECQUAAF563☐( )	0.056	17.5	5.0	12.0	15.0	0.6	0±0.8	1.3	1	1000	1000
NEW ECQUAAF683☐( )	0.068	17.5	5.0	12.0	15.0	0.6	0±0.8	1.3	1	1000	1000
NEW ECQUAAF823☐( )	0.082	17.5	5.0	12.0	15.0	0.6	0±0.8	1.3	1	1000	1000
ECQUAAF104☐( )	0.10	17.5	5.0	12.0	15.0	0.6	0±0.8	1.3	2	1000	1000
NEW ECQUAAF124☐( )	0.12	17.5	6.0	13.0	15.0	0.6	0±0.8	1.3	1	1000	1000
ECQUAAF154☐( )	0.15	17.5	6.0	13.0	15.0	0.6	0±0.8	1.3	2	1000	1000
NEW ECQUAAF184☐( )	0.18	17.5	7.5	14.0	15.0	0.6	0±0.8	1.3	1	1000	1000
ECQUAAF224☐( )	0.22	17.5	7.5	14.0	15.0	0.6	0±0.8	1.3	2	1000	1000
NEW ECQUAAF274☐( )	0.27	17.5	9.0	16.0	15.0	0.6	0±0.8	1.3	1	1000	800
ECQUAAF334☐( )	0.33	17.5	9.0	16.0	15.0	0.6	0±0.8	1.3	2	1000	800
NEW ECQUAAF394☐( )	0.39	26.0	8.5	15.0	22.5	0.8	0±0.8	1.8	1	600	800
ECQUAAF474☐( )	0.47	26.0	8.5	15.0	22.5	0.8	0±0.8	1.8	2	600	800
NEW ECQUAAF564☐( )	0.56	26.0	10.0	17.0	22.5	0.8	0±0.8	1.8	1	500	500
ECQUAAF684☐( )	0.68	26.0	10.0	17.0	22.5	0.8	0±0.8	1.8	2	500	500
NEW ECQUAAF824☐( )	0.82	26.0	12.0	19.0	22.5	0.8	0±0.8	1.8	1	300	300
ECQUAAF105☐( )	1.0	26.0	12.0	19.0	22.5	0.8	0±0.8	1.8	2	300	300
NEW ECQUAAF125☐( )	1.2	31.0	12.0	22.0	27.5	0.8	0±0.8	1.8	1	200	200
ECQUAAF155☐( )	1.5	31.0	12.0	22.0	27.5	0.8	0±0.8	1.8	2	200	200
NEW ECQUAAF185☐( )	1.8	31.0	14.5	24.5	27.5	0.8	0±0.8	1.8	1	200	200
ECQUAAF225☐( )	2.2	31.0	14.5	24.5	27.5	0.8	0±0.8	1.8	2	200	200
NEW ECQUAAF275☐( )	2.7	31.0	19.0	29.0	27.5	0.8	0±0.8	1.8	1	150	150
ECQUAAF335☐( )	3.3	31.0	19.0	29.0	27.5	0.8	0±0.8	1.8	2	150	150
NEW ECQUAAF335ED **NEW ECQUAAF335LD**	3.3	41.0	15.0	30.0	37.5	1.0	0±0.8	1.8	3	—	90
ECQUAAF475☐( )	4.7	31.0	23.0	33.0	27.5	0.8	0±0.8	1.8	2	100	100
NEW ECQUAAF475ED **NEW ECQUAAF475LD**	4.7	41.0	18.0	33.0	37.5	1.0	0±0.8	1.8	3	—	75
NEW ECQUAAF685☐A	6.8	41.0	23.0	37.5	37.5	1.0	0±0.8	1.8	3	—	60
NEW ECQUAAF106☐A	10.0	41.0	28.0	42.5	37.5	1.0	0±0.8	1.8	3	—	50

* ☐ : Capacitance tolerance code

( ) : Suffix for lead crimped

Note) Part number marked with bold is special lead space product.

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

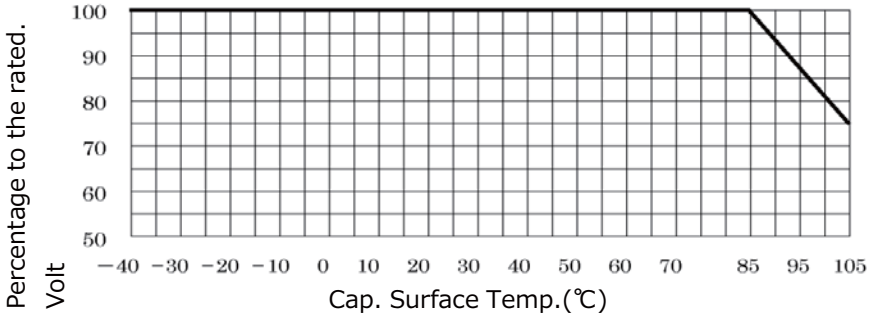
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

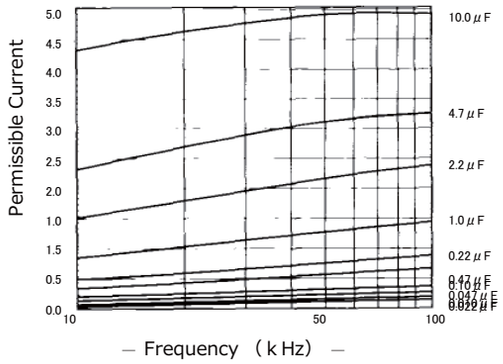
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

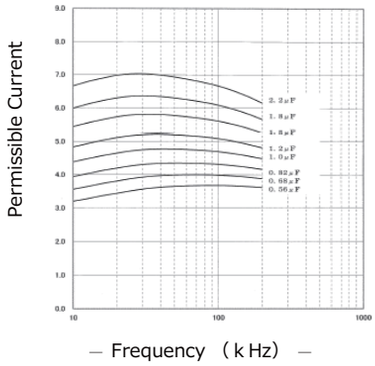
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

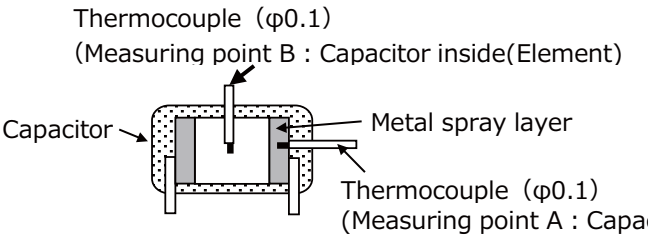
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

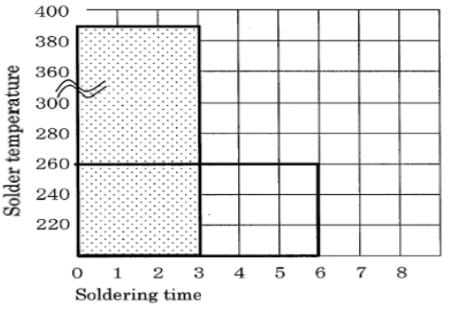
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

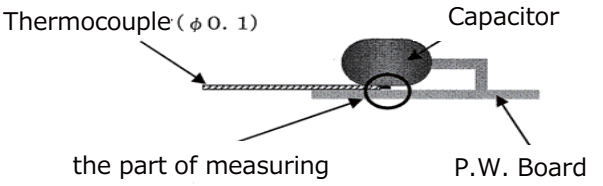
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

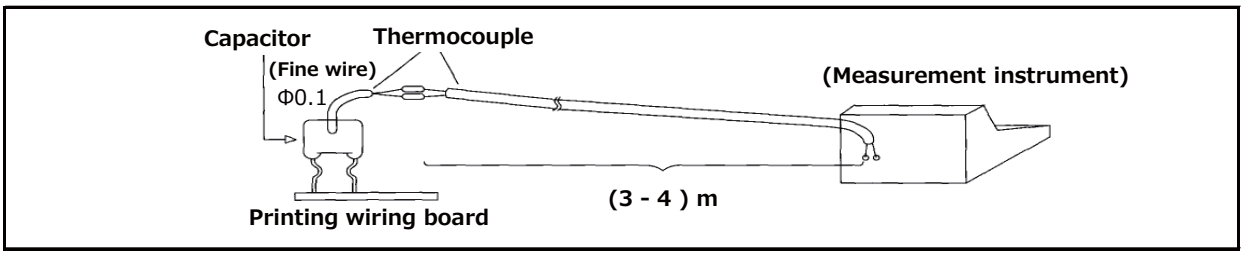
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

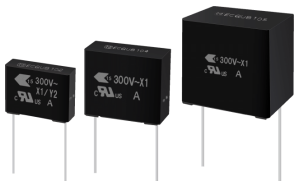
- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors



Safety standard approval
Metallized Polypropylene Film Capacitor

ECQUB series **[Class Y2/X1] [Class X1]**

Non-inductive construction using metallized polypropylene film.
Flame-retardant plastic case and non-combustible resin.

Features

- High safety (with safety function)〔Class X1〕
- High moisture resistance 85℃, 85%, 275 V [AC] 500 h
- Flame-retardant plastic case and non-combustible resin
- RoHS compliant

Recommended applications

- Interference suppressors for electronic equipment

Explanation of part number

■ Standard

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	B	A	F					
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	Cap. Tol.
K	±10 %
M	±20 %

Code	Lead form
Blank	Straight
A	Cut lead

■ Special lead space product

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	B	A	F					
Product code		Dielectric & construction			Rated voltage		Capacitance			Suffix	

Code	Cap. Tol.	Lead form	Length under crimping
VB、VH	±10 %	Crimped lead	4.0 mm
VA、VG	±20 %		
V5、V6	±10 %		4.5 mm
V1、V2	±20 %		

Applicable standard

＊It is certified as type ECQUB in the following approval.

Approval		Class		Certification organization
UL	UL60384-14	Class Y2 / X1	0.001 μF to 0.0068 μF	UL
		Class X1	0.01 μF to 1.0 μF	
CSA	CAN/CSA E60384-14	Class Y2 / X1	0.001 μF to 0.0068 μF	UL
		Class X1	0.01 μF to 1.0 μF	
Europe	EN60384-14	Class Y2 / X1	0.001 μF to 0.0068 μF	DEMKO
		Class X1	0.01 μF to 1.0 μF	

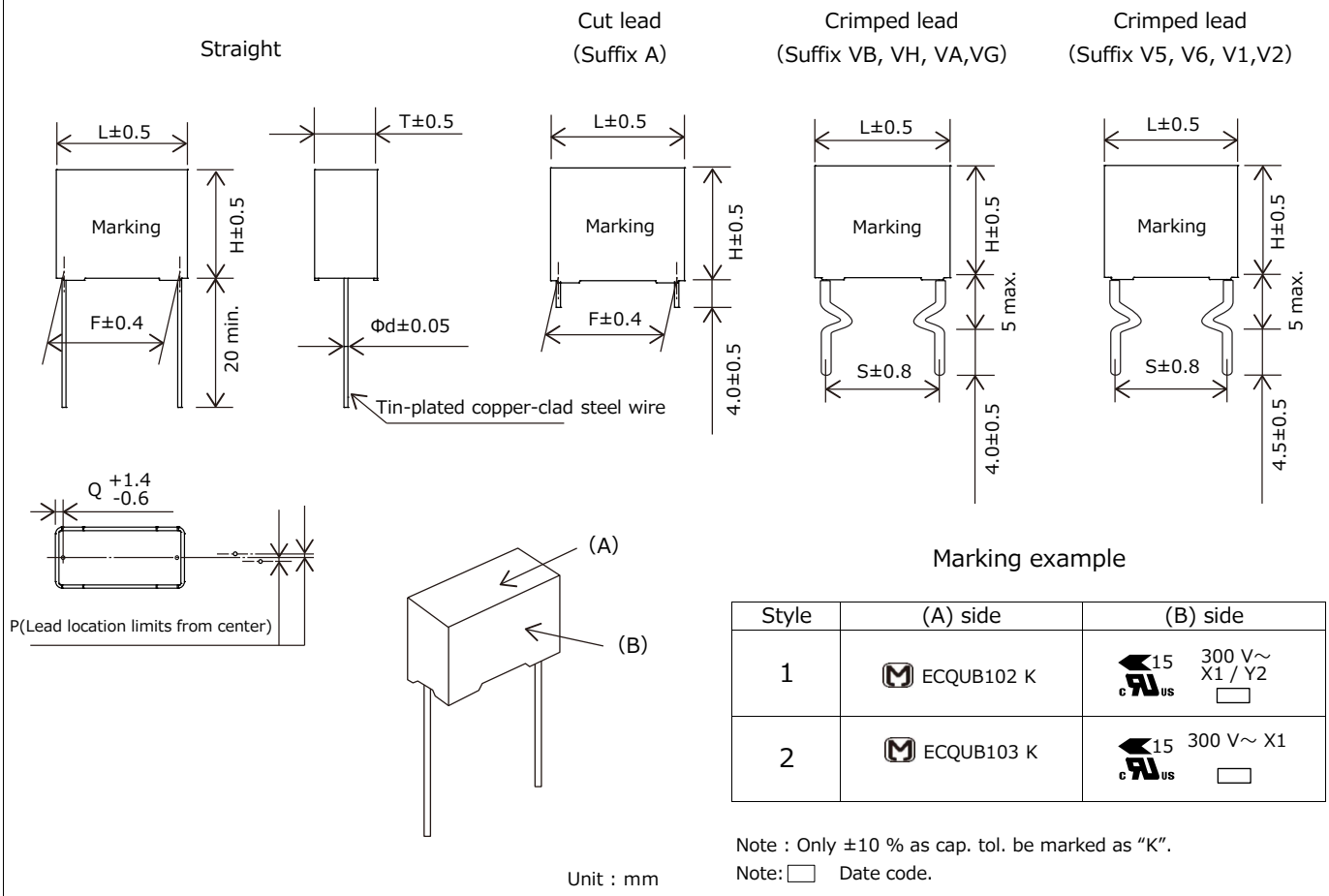
＊When applying this capacitor to European and American safety standards, please use type designation and rating such as ECQUB, 0.1 μF.
＊Approval number (File No.) of safety regulations are subject to revision without notice. Ask factory for a copy of the latest file No.
＊According to standards for each region are based on IEC60384-14.

Specifications

Category temp. range	−40 ℃ to +110 ℃	
Rated voltage [AC]	300 V 300 V mentioned above refers to maximum voltage by fluctuating of nominal power supply voltage of 240 V.	
Capacitance range	0.001 μF to 1.0 μF〔0.001 μF to 0.0068 μF (E12), 0.01 μF to 1.0 μF (E6)〕	
Capacitance tolerance	±10% (K), ±20% (M)	
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 ℃, 1 kHz)	
Withstand voltage	Between terminals	C ≦ 0.0068 μF : 1600 V [AC], 2121 V [DC], 60 s 0.0068 μF < C ≦ 1.0 μF : 690 V [AC], 1768 V [DC], 60 s
	Between terminals to enclosure	2100 V [AC], 60 s The capacitor shall be applied the voltage through a resistor of 2 kΩ or more when charge and discharge.
Insulation resistance (IR)	Between terminals	C ≦ 0.33 μF : 15000 MΩ or more at 100 V [DC] C > 0.33 μF : 5000 MΩ･μFor more at 100 V [DC] C ≦ 0.47 μF : 2000 MΩ or more at 500 V [DC]
	Between terminals to enclosure	30000 MΩ or more at 100 V [DC] 500 MΩ 以上 at 500 V [DC]

＊Use of this capacitor is limited to AC voltage (50 Hz or 60 Hz sine wave).
＊A faint corona discharge may occur inside of the capacitor element at rated voltage, however there is no influence on the reliability of the capacitor.

Dimensions



Marking example

Style	(A) side	(B) side
1	ECQUB102 K	15 300 V～ X1 / Y2
2	ECQUB103 K	15 300 V～ X1

Note : Only ±10 % as cap. tol. be marked as “K”.
Note: □ Date code.

Rating · Dimensions · Quantity

Part No.	Cap. (μF)	Dimensions (mm)								STYLE	Min. order Q'ty (PCS)		
		L	T	H	F Straight Cut lead	S Crimped lead	Φd	P	Q		Straight	Cut lead	Crimped lead
ECQUBAF102□( ) ECQUBAF102V◇	0.001	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF122□( ) ECQUBAF122V◇	0.0012	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF152□( ) ECQUBAF152V◇	0.0015	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF182□( ) ECQUBAF182V◇	0.0018	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF222□( ) ECQUBAF222V◇	0.0022	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF272□( ) ECQUBAF272V◇	0.0027	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF332□( ) ECQUBAF332V◇	0.0033	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF392□( ) ECQUBAF392V◇	0.0039	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF472□( ) ECQUBAF472V◇	0.0047	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF562□( ) ECQUBAF562V◇	0.0056	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF682□( ) ECQUBAF682V◇	0.0068	15.3	5.0	11.5	12.5	15.0	0.6	0±0.8	1.4	1	1000	1000	1000
ECQUBAF103□( ) ECQUBAF103V◆	0.01	18.5	5.0	9.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF153□( ) ECQUBAF153V◆	0.015	18.5	6.0	10.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF223□( ) ECQUBAF223V◆	0.022	18.5	6.0	10.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF333□( ) ECQUBAF333V◆	0.033	18.5	6.0	10.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF473□( ) ECQUBAF473V◆	0.047	18.5	7.0	11.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF683□( ) ECQUBAF683V◆	0.068	18.5	8.0	12.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF104□( ) ECQUBAF104V◆	0.1	18.5	8.0	16.5	15.0	12.5	0.6	0±0.8	1.8	2	1000	1000	1000
ECQUBAF154□( )	0.15	18.5	9.0	18.0	15.0	-	0.8	0±0.8	1.8	2	1000	1000	-
ECQUBAF224□( )	0.22	18.5	11.0	20.0	15.0		0.8	0±0.8	1.8	2	500	500	
ECQUBAF334□( )	0.33	26.0	12.0	19.0	22.5		0.8	0±0.8	1.8	2	300	300	
ECQUBAF474□( )	0.47	26.0	14.0	21.0	22.5		0.8	0±0.8	1.8	2	200	200	
ECQUBAF684□( )	0.68	26.0	16.0	23.0	22.5		0.8	0±0.8	1.8	2	200	200	
ECQUBAF105□( )	1.0	26.0	19.0	26.0	22.5		0.8	0±0.8	1.8	2	200	200	

* □ : Capacitance tolerance code
( ) : Suffix for lead crimped
◇ : Special lead space product B, A, 5, or 1
◆ : Special lead space product H, G, 6, or 2

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

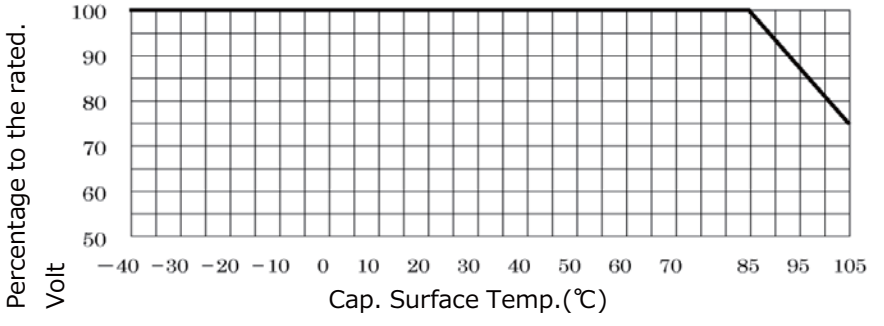
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

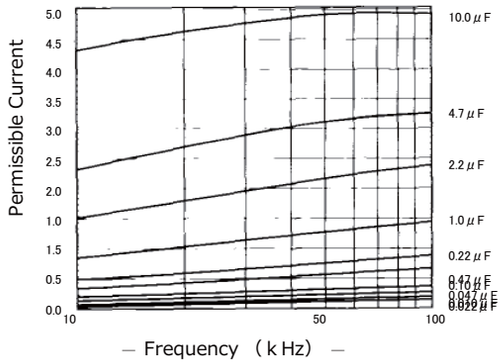
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

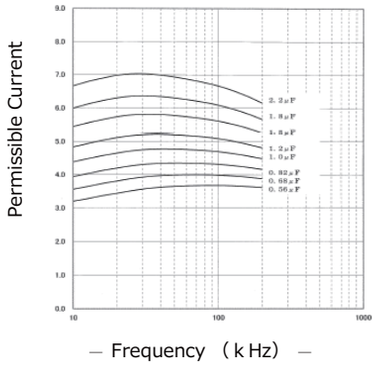
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

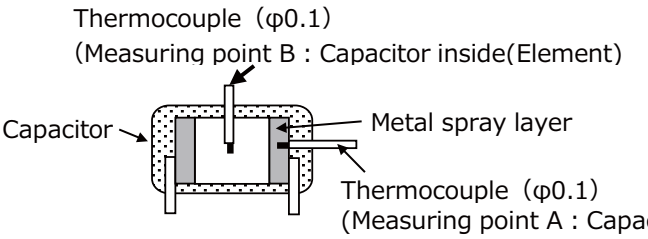
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

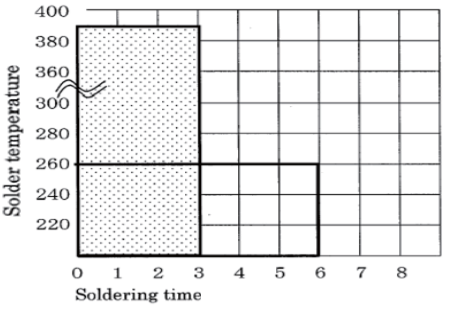
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

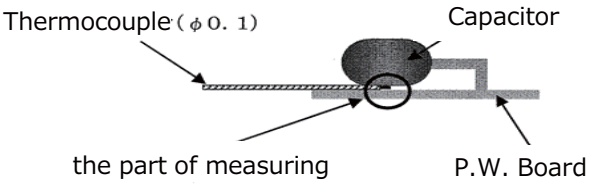
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

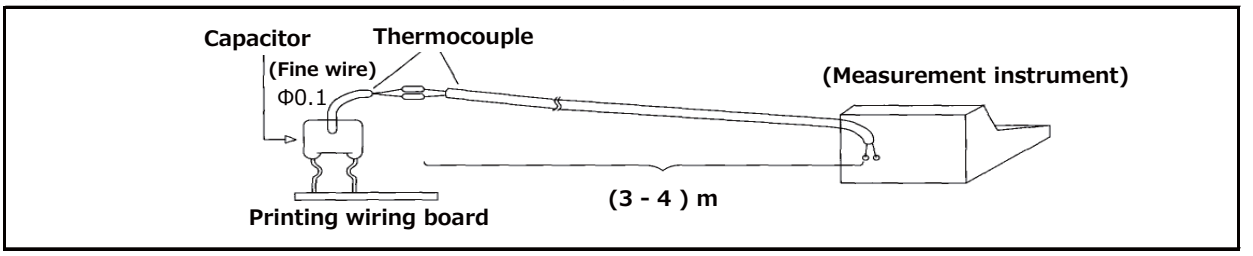
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

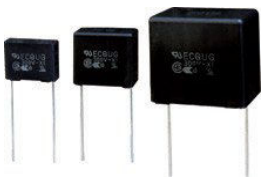
■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors

Discontinued



Metallized Polyester Film Capacitor

ECQUG series [Class X1]

In accordance with UL/CSA and European safety regulation class X1

Features

- Equipped with a safety mechanism
- Flame-retardant plastic case and non combustible resin
- RoHS compliant

Recommended applications

- Interference suppressors

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	3	A				M	G	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix	Suffix

Code	Cap. Tol.
M	±20 %

Code	Lead form
Blank	Straight
A	Cut lead

Applicable standard

∗It is certified as type ECQUG in the following approval.

Approval		Class	Certification organization
UL	UL60384-14	Class X1	UL
CSA	CAN/CSA E60384-14	Class X1	CSA
Europe	EN60384-14	Class X1	VDE
International	IEC60384-14	Class X1	

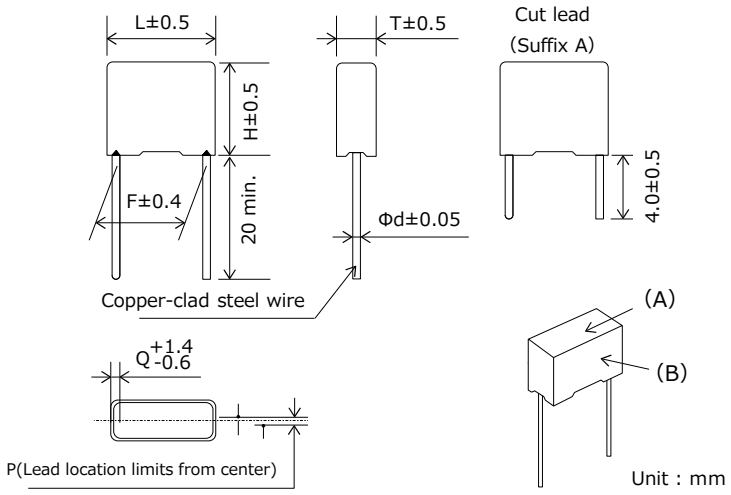
∗ When applying this capacitor to European and American safety standards, please use type designation and rating such as ECQUG, 0.1 μF.
∗ Approval number (File No.) of safety regulations are subject to revision without notice. Ask factory for a copy of the latest file No..
∗ European standards marking are ENEC (VDE). But, there are no problem using this capacitor in a device which will get approvals from certification bodies in Europe, NEMKO, FIMKO, SEMKO, DEMKO, and SEV etc.

Specifications

Category temp. range	−40 ℃ to +100 ℃
Rated voltage [AC]	300 V
Capacitance range	0.010 μF to 1.0 μF (E6)
Capacitance tolerance	±20 % (M)
Dissipation factor (tan δ)	tan δ ≦ 1.0 % (20 ℃、1 kHz)
Withstand voltage	Between terminals : 575 V [AC], 1768 V [DC], 60 s Between terminals to enclosure : 2100 V [AC], 60 s
Insulation resistance (IR)	C ≦ 0.33 μF : IR ≧ 15,000 MΩ (20 ℃, 100 V [DC], 60 s) C > 0.33 μF : IR ≧ 5,000 MΩ · μF (20 ℃, 100 V [DC], 60 s) IR ≧ 2,000 MΩ (20 ℃, 500 V [DC], 60 s)

∗ Use of this capacitor is limited to AC voltage (50 Hz or 60 Hz sine wave).

Dimensions



Marking example

(A) side	(B) side
M 0.01 µF	ECQUG 300V~ X1 SP 10 □

Note : □ Date code.

Rating · Dimensions · Quantity

■ Capacitance tolerance : ±20 %(M)

Part No.	Cap. (µF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L	T	H	F	Φd	P	Q	Straight	Cut lead
ECQU3A103MG( )	0.010	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3	500	500
ECQU3A153MG( )	0.015	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU3A223MG( )	0.022	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU3A333MG( )	0.033	15.0	6.0	13.0	12.5	0.6	0±0.50	1.3		
ECQU3A473MG( )	0.047	15.0	6.0	13.0	12.5	0.6	0±0.50	1.3		
ECQU3A683MG( )	0.068	15.0	8.0	15.0	12.5	0.6	0±0.50	1.3		
ECQU3A104MG( )	0.10	15.0	8.0	15.0	12.5	0.6	0±0.50	1.3		
ECQU3A154MG( )	0.15	18.0	8.0	16.5	15.0	0.8	0±0.50	1.3		
ECQU3A224MG( )	0.22	18.0	9.0	17.5	15.0	0.8	0±0.50	1.3		
ECQU3A334MG( )	0.33	26.0	9.0	18.5	22.5	0.8	0±0.50	1.5		
ECQU3A474MG( )	0.47	26.0	10.5	20.0	22.5	0.8	0±0.75	1.5		
ECQU3A684MG( )	0.68	26.0	12.5	22.0	22.5	0.8	0±0.75	1.5	300	400
ECQU3A105MG( )	1.0	27.0	16.5	25.5	22.5	0.8	0±0.75	2.2		300

∗( ) : Suffix for lead form

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

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PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

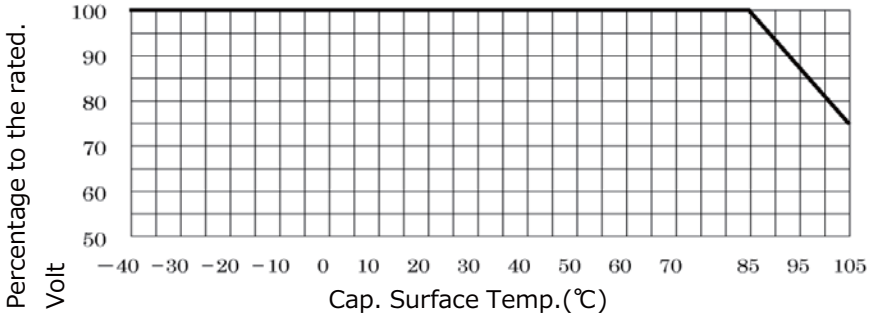
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

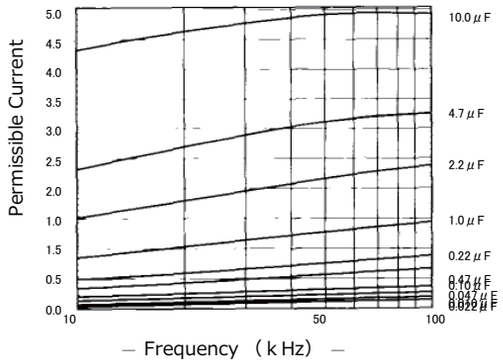
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

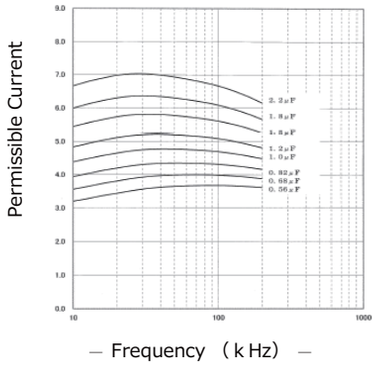
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

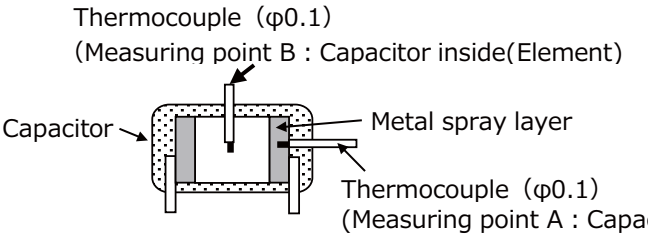
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

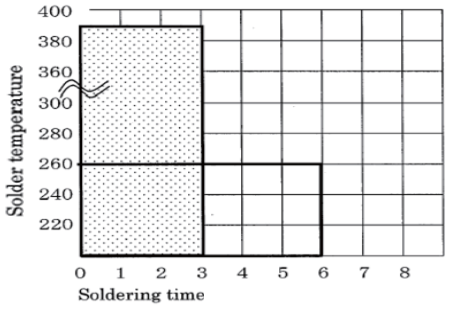
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

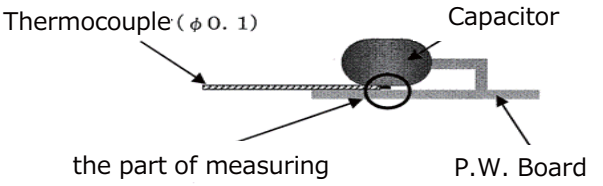
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

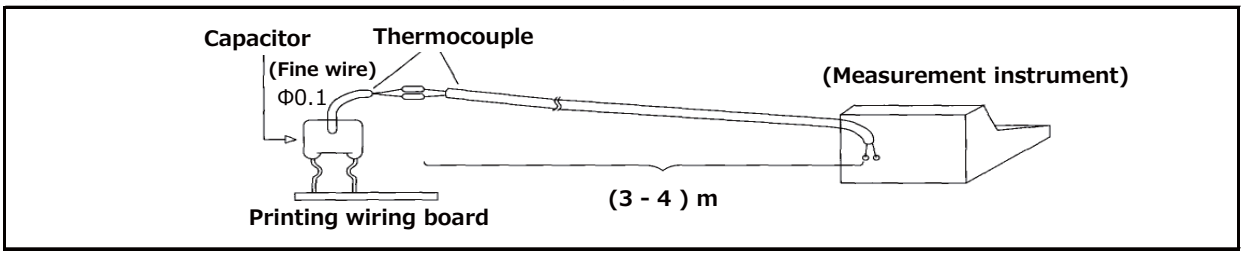
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

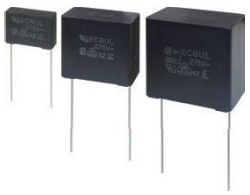
■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors

Discontinued



Metallized Polyester Film Capacitor

ECQUL series [Class X2] [Class Y2/X2]

In accordance with UL/CSA and European safety regulation class X2 or class Y2/X2

Features

- Compact
- Flame-retardant plastic case and non-combustible resin
- RoHS compliant

Recommended applications

- Interference suppressors

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	Q	U	2	A					L	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix	Suffix

Code	Cap. Tol.
K	±10 %
M	±20 %

Code	Lead form
Blank	Straight
A	Cut lead

Applicable standard

＊It is certified as type ECQUL in the following approval.

Approval		Class		Certification organization
UL	UL60384-14	Class Y2/X2	0.0010 μF to 0.0068 μF	UL
		Class X2	0.0082 μF to 2.2 μF	
CSA	CAN/CSA E60384-14	Class Y2/X2	0.0010 μF to 0.0068 μF	CSA
		Class X2	0.0082 μF to 2.2 μF	
	CSA C22.2 No.8-M1986	Electromagnetic Interference (EMI) Filters	1.2 μF to 2.2 μF	
Europe	EN60384-14	Class Y2/X2	0.0010 μF to 0.0068 μF	VDE
		Class X2	0.0082 μF to 2.2 μF	
International	IEC60384-14	Class Y2/X2	0.0010 μF to 0.0068 μF	
		Class X2	0.0082 μF to 2.2 μF	

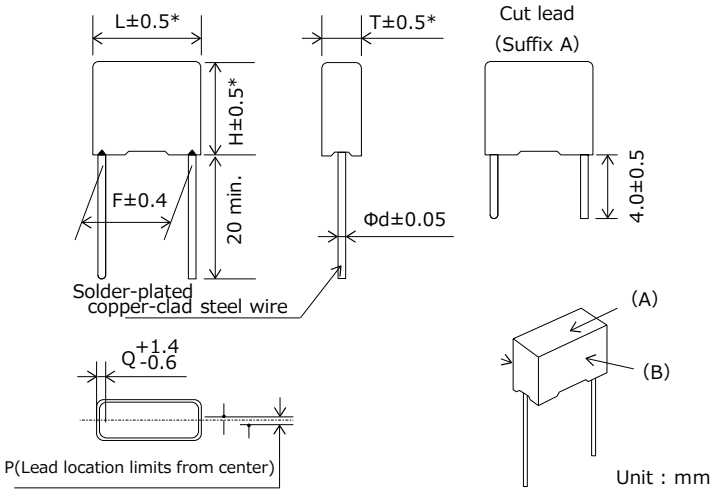
＊ When applying this capacitor to European and American safety standards, please use type designation and rating such as ECQUL, 0.1 μF.
＊ Approval number (File No.) of safety regulations are subject to revision without notice. Ask factory for a copy of the latest file No.
＊ This capacitor is recognized for European standards by VDE only. But, there are no problems using this capacitor in a device which will get approvals from certification bodies in Europe, SEMKO, DEMKO, NEMKO, FIMKO and SEV etc.

Specifications

Category temp. range	−40 ℃ to +100 ℃ (85 ℃ max. on CSA C22.2 No.8 spec.)
Rated voltage [AC]	275 V (250 V on CSA C22.2 No.8 spec.)
Capacitance range	0.0010 μF to 2.2 μF
Capacitance tolerance	±10 % (K), ±20 % (M)
Dissipation factor (tan δ)	tan δ ≦ 1.0 % (20 ℃, 1 kHz)
Withstand voltage	Between terminals : 575 V [AC], 1768 V [DC], 60 s (0.0082 μF to 2.2 μF) Between terminals : 1500 V [AC], 2121 V [DC], 60 s (0.0010 μF to 0.0068 μF) Between terminals to enclosure : 2050 V [AC], 60 s
Insulation resistance (IR)	C ≦ 0.33 μF : IR ≧ 15,000 MΩ (20 ℃, 100 V [DC], 60 s) C > 0.33 μF : IR ≧ 5,000 MΩ · μF (20 ℃, 100 V [DC], 60 s) IR ≧ 2,000 MΩ (20 ℃, 500 V [DC], 60 s)

＊ Use of this capacitor is limited to AC voltage (50 Hz or 60 Hz sine wave).

Dimensions



*: ≧ 1.2 μF ±1.0

Marking example

Style	(A) side	(B) side
1 0.0010 μF to 0.0068 μF	M 0.001 μF K	ECQUL 275V~ X2/Y2
2 0.0082 μF to 1.0 μF	M 0.0082 μF K	ECQUL 275V~ X2
3 1.2 μF to 2.2 μF	M 1.5 μF K	8X 250V~ ECQUL 275V~ X2

Note : Only ±10 % as cap. tol. be marked as "K".
Note : □ Date code.

Rating · Dimensions · Quantity

■ Capacitance tolerance : ±10 %(K)、±20 %(M)

Part No.	Capacitance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L	T	H	F	Φd	P	Q	Straight	Cut lead
ECQU2A102□L( )	0.0010	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A122□L( )	0.0012	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A152□L( )	0.0015	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A182□L( )	0.0018	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A222□L( )	0.0022	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A272□L( )	0.0027	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A332□L( )	0.0033	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A392□L( )	0.0039	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A472□L( )	0.0047	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A562□L( )	0.0056	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A682□L( )	0.0068	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A822□L( )	0.0082	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A103□L( )	0.010	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A123□L( )	0.012	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A153□L( )	0.015	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A183□L( )	0.018	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A223□L( )	0.022	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3		
ECQU2A273□L( )	0.027	15.0	5.0	11.5	12.5	0.6	0±0.50	1.3	500	500
ECQU2A333□L( )	0.033	15.0	6.0	13.0	12.5	0.6	0±0.50	1.3		
ECQU2A393□L( )	0.039	15.0	6.0	13.0	12.5	0.6	0±0.50	1.3		
ECQU2A473□L( )	0.047	15.0	6.0	13.0	12.5	0.6	0±0.50	1.3		
ECQU2A563□L( )	0.056	17.5	4.5	11.5	15.0	0.6	0±0.50	1.3		
ECQU2A683□L( )	0.068	17.5	4.5	11.5	15.0	0.6	0±0.50	1.3		
ECQU2A823□L( )	0.082	17.5	5.5	12.0	15.0	0.6	0±0.50	1.3		
ECQU2A104□L( )	0.10	17.5	5.5	12.0	15.0	0.6	0±0.50	1.3		
ECQU2A124□L( )	0.12	17.5	6.5	14.5	15.0	0.6	0±0.50	1.3		
ECQU2A154□L( )	0.15	17.5	6.5	14.5	15.0	0.6	0±0.50	1.3		
ECQU2A184□L( )	0.18	17.5	8.0	16.0	15.0	0.6	0±0.50	1.3		
ECQU2A224□L( )	0.22	17.5	8.0	16.0	15.0	0.6	0±0.50	1.3		
ECQU2A274□L( )	0.27	17.5	9.5	17.5	15.0	0.8	0±0.50	1.3		
ECQU2A334□L( )	0.33	17.5	9.5	17.5	15.0	0.8	0±0.50	1.3		
ECQU2A394□L( )	0.39	25.5	8.5	17.5	22.5	0.8	0±0.75	1.5		
ECQU2A474□L( )	0.47	25.5	8.5	17.5	22.5	0.8	0±0.75	1.5		
ECQU2A564□L( )	0.56	25.5	10.5	19.5	22.5	0.8	0±0.75	1.5		
ECQU2A684□L( )	0.68	25.5	10.5	19.5	22.5	0.8	0±0.75	1.5		
ECQU2A824□L( )	0.82	25.5	12.0	22.0	22.5	0.8	0±0.75	1.5	300	400
ECQU2A105□L( )	1.0	25.5	12.0	22.0	22.5	0.8	0±0.75	1.5		
ECQU2A125□L( )	1.2	30.5	16.5	26.0	27.5	0.8	0±0.75	1.5	200	200
ECQU2A155□L( )	1.5	30.5	16.5	26.0	27.5	0.8	0±0.75	1.5		
ECQU2A185□L( )	1.8	30.5	19.0	29.5	27.5	0.8	0±0.75	1.5	150	150
ECQU2A225□L( )	2.2	30.5	19.0	29.5	27.5	0.8	0±0.75	1.5		

＊□ : Capacitance tolerance code　　＊( ) : Suffix for lead form

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

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PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

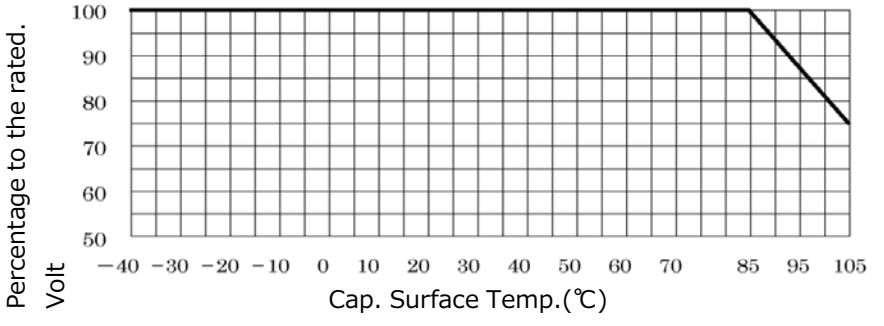
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

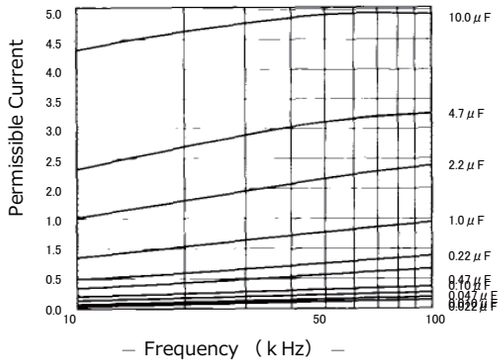
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

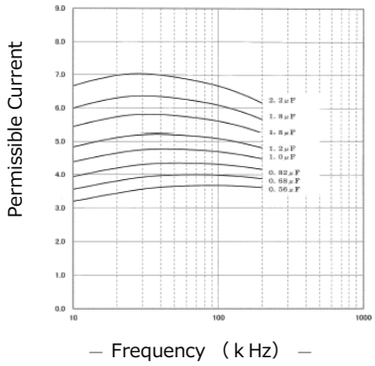
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

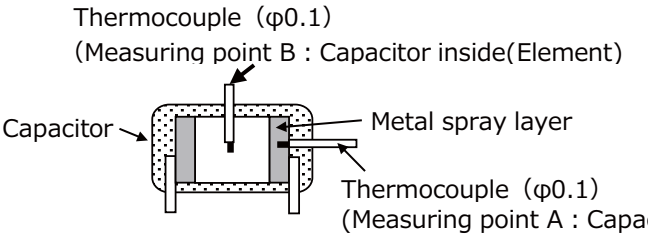
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

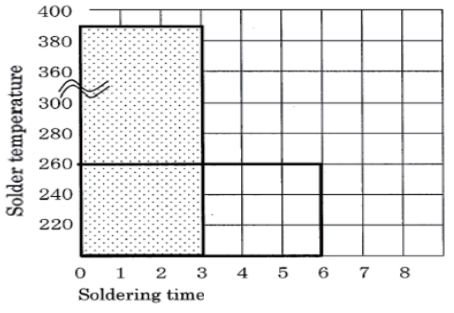
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

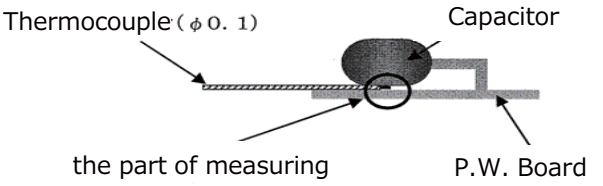
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

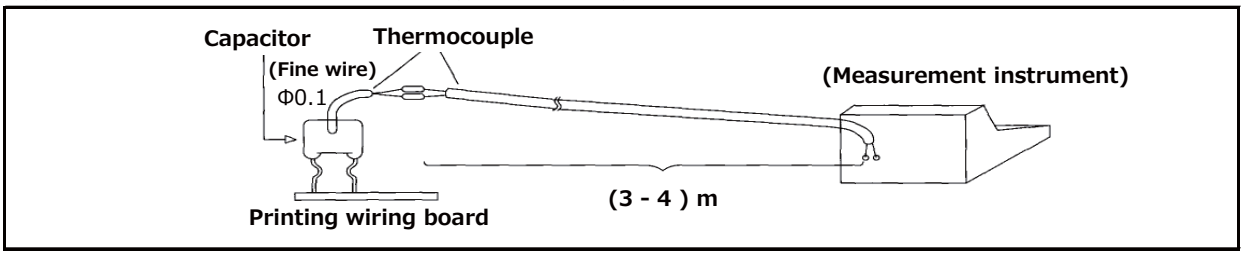
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

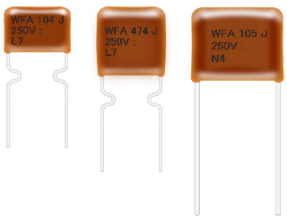
- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polypropylene Film Capacitor

ECWF(A) series

Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating

Features

- Small size
- Excellent frequency characteristics
- Low loss
- Low hum sound noise
- Flame retardant epoxy resin coating
- 85 ℃ , 85 %RH , 500 V, 500 hours (630 V)
- RoHS compliant

Recommended applications

- 250 V、630 V : High frequency and high current circuit
- 450 V : Active filter circuit

Explanation of part number

- 250 V, 450 V (Bulk)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F							A	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage [DC]
2	250 V
2W	450 V

Code	Cap. Tol.
H	±3 %
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead

- 250 V, 450 V (Odd size taping)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F						R		A
Product code		Dielectric & construction		Rated voltage		Capacitance			Odd taping	Cap. Tol.	Suffix

- 630 V (Bulk, Odd size taping)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F	A	2	J				J	
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
2J	630 V

Code	Cap. Tol.
J	±5 %

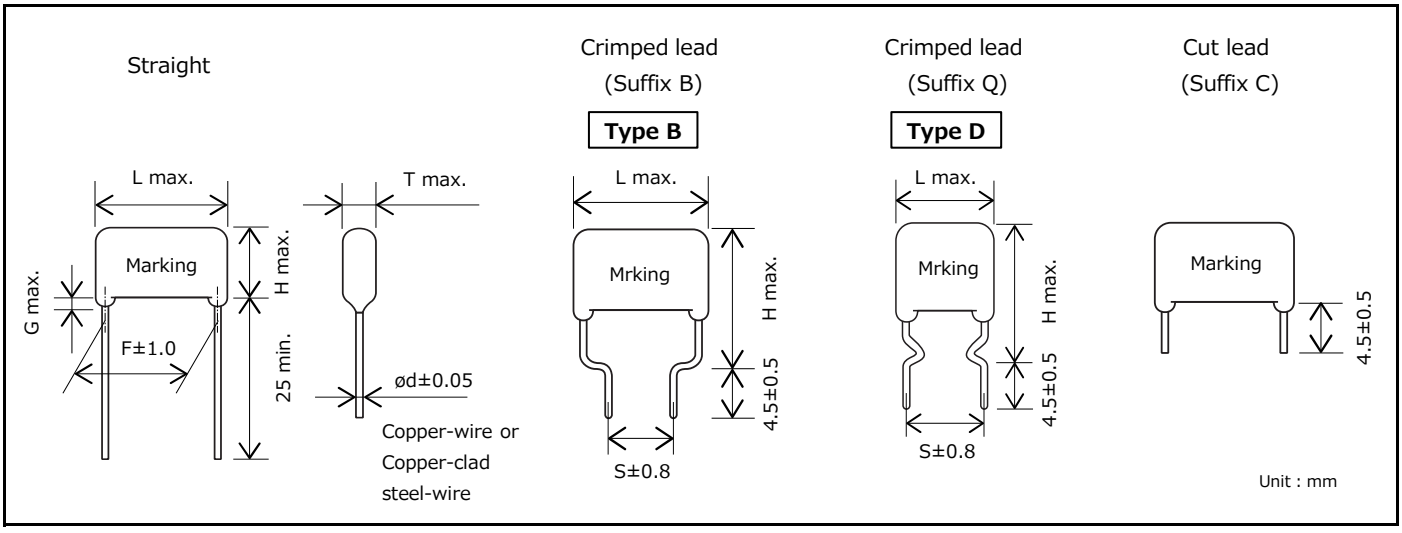
Code	Lead form
Blank	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead
4	Odd size taping

Specifications

Category temp. range (Including temperature-rise on unit surface)	−40 ℃ to +105 ℃	
Rated voltage [DC]	250 V	(Derating of rated voltage by 1.25%/℃ at more than 85 ℃) Peak to peak voltage applied on the capacitor should be less than 240 Vp-p, and zero to peak voltage should be less than 450 Vo-p.
	450 V	
	630 V	(Derating of rated voltage by 1.0%/℃ at more than 85 ℃)
Capacitance range	250 V	0.1 μF to 6.8 μF
	450 V	0.1 μF to 4.7 μF
	630 V	0.1 μF to 2.2 μF
Capacitance tolerance	250 V	±3 % (H), ±5 % (J)
	450 V	±5 % (J), ±10 % (K)
	630 V	±5 % (J)
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 ℃, 1 kHz)	
Withstand voltage	Between terminals : Rated voltage (V) × 150 % 60 s	
Insulation resistance (IR)	250 V	C ≦ 0.33 μF : IR ≧ 9,000 MΩ C > 0.33 μF : IR ≧ 3,000 MΩ･μF (20 ℃, 100 V, 60 s)
	450 V	C ≦ 0.33 μF : IR ≧ 30,000 MΩ C > 0.33 μF : IR ≧ 10,000 MΩ･μF (20 ℃, 100 V, 60 s)
	630 V	C ≦ 0.33 μF : IR ≧ 9,000 MΩ C > 0.33 μF : IR ≧ 3,000 MΩ･μF (20 ℃, 500 V, 60 s)

＊ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.

Dimensions

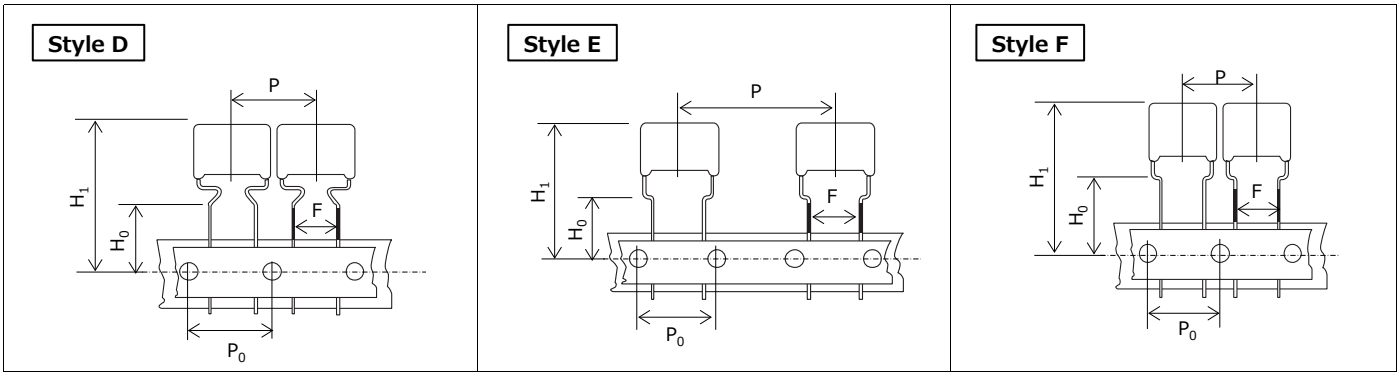


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size Unit : mm

	Style		
	D	E	F
P	15.0	30.0	15.0
P_0	15.0	15.0	15.0
F	7.5	7.5	7.5
H_0	16.0	16.0	16.0
H_1*	44.0	44.0	44.0

*:max.

■ Packaging specifications

Series	R.voltage (V) [DC]	Capacitance range (μF)	Taping style			Packing	Suffix
			D	E	F		
ECWF(A)	250	0.10 to 0.47	○			Ammo	R( )A
		0.56 to 3.9		○		Ammo	R( )A
	450	0.10 to 0.47			○	Ammo	R( )A
		0.56 to 2.2		○		Ammo	R( )A
	630	0.10 to 0.68		○		Ammo	J4

See the column “Rating · Dimensions · Quantity” for packing quantity.

● Lead spacing

Style	Lead spacing
D	7.5
E	7.5
F	7.5

Unit : mm

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 250 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)										Min. order Q'ty (PCS)	
		L max.	T max.	H max.			F	S		G max.	ød	Taping	Bulk
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)	Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)	Straight		7.5 mm	Straight・Crimped lead
ECWF2104□A( )	0.10	13.0	5.0	–	14.1	14.1	–	7.5	10.0	–	0.6	1300	500
ECWF2124□A( )	0.12	13.0	5.3		14.4	14.4		7.5	10.0		0.6	1200	
ECWF2154□A( )	0.15	13.0	5.6		14.7	14.7		7.5	10.0		0.6	1100	
ECWF2184□A( )	0.18	13.0	5.9		15.1	15.1		7.5	10.0		0.6		
ECWF2224□A( )	0.22	13.0	6.3		15.4	15.4		7.5	10.0		0.6	1000	
ECWF2274□A( )	0.27	13.0	6.8		15.9	15.9		7.5	10.0		0.6	900	
ECWF2334□A( )	0.33	13.0	7.3		16.4	16.4		7.5	10.0		0.6		
ECWF2394□A( )	0.39	13.0	7.8		16.9	16.9		7.5	10.0		0.6	800	
ECWF2474□A( )	0.47	13.0	8.4		17.6	17.6		7.5	10.0		0.6	700	
ECWF2564□A( )	0.56	18.1	6.9		16.4	18.4		7.5	15.0		0.8	400	
ECWF2684□A( )	0.68	18.1	7.4		17.0	19.0		7.5	15.0		0.8		
ECWF2824□A( )	0.82	18.1	8.0		17.6	19.6		7.5	15.0		0.8		
ECWF2105□A( )	1.0	18.1	8.5	13.3	18.3	20.3	15.0	7.5	15.0	1.5	0.8	300	
ECWF2125□A( )	1.2	18.8	9.5	14.6	19.6	21.6	15.0	7.5	15.0	1.5	0.8		
ECWF2155□A( )	1.5	18.8	10.5	15.6	20.6	22.6	15.0	7.5	15.0	1.5	0.8		
ECWF2185□A( )	1.8	18.8	11.4	16.5	21.5	23.5	15.0	7.5	15.0	1.5	0.8	200	
ECWF2225□A( )	2.2	18.8	12.6	17.6	22.6	24.6	15.0	7.5	15.0	1.5	0.8		
ECWF2275□A( )	2.7	23.8	11.4	17.2	22.2	24.2	20.0	12.5	20.0	1.5	0.8	300	
ECWF2335□A( )	3.3	23.8	12.5	18.3	23.3	25.3	20.0	12.5	20.0	1.5	0.8	200	
ECWF2395□A( )	3.9	23.8	13.5	19.3	24.3	26.3	20.0	12.5	20.0	1.5	0.8		
ECWF2475□A( )	4.7	23.8	14.8	20.6	25.6	27.6	20.0	12.5	20.0	1.5	0.8	–	
ECWF2565□A( )	5.6	23.8	16.2	21.9	26.9	28.9	20.0	12.5	20.0	1.5	0.8		
ECWF2685□A( )	6.8	23.8	17.8	23.5	28.5	30.5	20.0	12.5	20.0	1.5	0.8		

* □ : Capacitance tolerance code () : Suffix for lead crimped or taped type

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 450 V, Capacitance tolerance : ± 5 %(J), ±10 %(K)

Part No.	Capacitance (μF)	Dimensions (mm)										Min. order Q'ty (PCS)	
		L max.	T max.	H max.			F	S		G max.	ød	Taping	Bulk
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)			7.5 mm	Straight・Crimped lead
ECWF2W104□A( )	0.10	13.0	5.1		14.3	14.3		7.5	10.0	1.5	0.6	1200	
ECWF2W124□A( )	0.12	13.0	5.4		14.5	14.5		7.5	10.0	1.5	0.6		
ECWF2W154□A( )	0.15	13.0	5.7		14.9	14.9		7.5	10.0	1.5	0.6	1000	
ECWF2W184□A( )	0.18	13.0	6.1		15.2	15.2		7.5	10.0	1.5	0.6		
ECWF2W224□A( )	0.22	13.0	6.5	–	15.6	15.6	–	7.5	10.0	1.5	0.6		
ECWF2W274□A( )	0.27	13.0	7.0		16.1	16.1		7.5	10.0	1.5	0.6	800	
ECWF2W334□A( )	0.33	13.0	7.6		16.7	16.7		7.5	10.0	1.5	0.6		
ECWF2W394□A( )	0.39	13.0	8.1		17.2	17.2		7.5	10.0	1.5	0.6		
ECWF2W474□A( )	0.47	13.0	8.7		17.9	17.9		7.5	10.0	1.5	0.6	600	
ECWF2W564□A( )	0.56	18.1	7.0	11.5	16.5	18.5	15.0	7.5	15.0	1.5	0.8	400	500
ECWF2W684□A( )	0.68	18.1	7.5	12.1	17.1	19.1	15.0	7.5	15.0	1.5	0.8		
ECWF2W824□A( )	0.82	18.1	8.2	12.7	17.7	19.7	15.0	7.5	15.0	1.5	0.8		
ECWF2W105□A( )	1.0	18.1	9.3	12.6	17.6	19.6	15.0	7.5	15.0	1.5	0.8	300	
ECWF2W125□A( )	1.2	18.8	9.7	14.7	19.7	21.7	15.0	7.5	15.0	1.5	0.8		
ECWF2W155□A( )	1.5	18.8	10.7	15.8	20.8	22.8	15.0	7.5	15.0	1.5	0.8		
ECWF2W185□A( )	1.8	18.8	11.6	16.7	21.7	23.7	15.0	7.5	15.0	1.5	0.8	200	
ECWF2W225□A( )	2.2	18.8	12.8	17.9	22.9	24.9	15.0	7.5	15.0	1.5	0.8		
ECWF2W275□A( )	2.7	26.3	10.6	16.5	21.5	23.5	22.5	15.0	22.5	1.5	0.8	–	
ECWF2W335□A( )	3.3	26.3	11.7	17.5	22.5	24.5	22.5	15.0	22.5	1.5	0.8		
ECWF2W395□A( )	3.9	26.3	12.6	18.4	23.4	25.4	22.5	15.0	22.5	1.5	0.8		
ECWF2W475□A( )	4.7	26.3	13.8	19.6	24.6	26.6	22.5	15.0	22.5	1.5	0.8		

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)										Min. order Q'ty (PCS)		
		L max.	T max.	H max.			F	S		G max.	ød	Taping	Bulk	
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)			7.5 mm	Straight	Crimped lead
ECWFA2J104J( )	0.10	18.2	5.2	10.4	15.4	15.4	15.0	7.5	15.0	1.5	0.6	600		
ECWFA2J124J( )	0.12	18.2	5.5	10.8	15.8	15.8	15.0	7.5	15.0	1.5	0.6			
ECWFA2J154J( )	0.15	18.2	6.0	11.2	16.2	16.2	15.0	7.5	15.0	1.5	0.6	500		
ECWFA2J184J( )	0.18	18.2	6.5	11.7	16.7	16.7	15.0	7.5	15.0	1.5	0.6			
ECWFA2J224J( )	0.22	18.2	7.1	12.3	17.3	17.3	15.0	7.5	15.0	1.5	0.6	400	1000	
ECWFA2J274J( )	0.27	18.2	7.8	12.9	17.9	17.9	15.0	7.5	15.0	1.5	0.6			
ECWFA2J334J( )	0.33	18.2	8.5	13.6	18.6	18.6	15.0	7.5	15.0	1.5	0.6	300		1000
ECWFA2J394J( )	0.39	18.2	9.2	14.3	19.3	19.3	15.0	7.5	15.0	1.5	0.6			
ECWFA2J474J( )	0.47	18.2	10.0	15.1	20.1	20.1	15.0	7.5	15.0	1.5	0.6			
ECWFA2J564J( )	0.56	18.2	10.9	16.0	21.0	21.0	15.0	7.5	15.0	1.5	0.6			
ECWFA2J684J( )	0.68	18.2	12.0	17.1	22.1	22.1	15.0	7.5	15.0	1.5	0.6	200	800	
ECWFA2J824J( )	0.82	26.0	10.1	15.3	20.3	22.3	22.5	15.0	22.5	1.5	0.8	–		
ECWFA2J105J( )	1.0	26.0	11.1	16.2	21.2	23.2	22.5	15.0	22.5	1.5	0.8		600	
ECWFA2J125J( )	1.2	26.0	12.1	17.2	22.2	24.2	22.5	15.0	22.5	1.5	0.8			600
ECWFA2J155J( )	1.5	26.0	13.5	18.6	23.6	25.6	22.5	15.0	22.5	1.5	0.8			
ECWFA2J185J( )	1.8	26.0	14.8	19.8	24.8	26.8	22.5	15.0	22.5	1.5	0.8		500	500
ECWFA2J225J( )	2.2	26.0	16.3	21.4	26.4	28.4	22.5	15.0	22.5	1.5	0.8		400	

() : Suffix for lead crimped or taped type

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

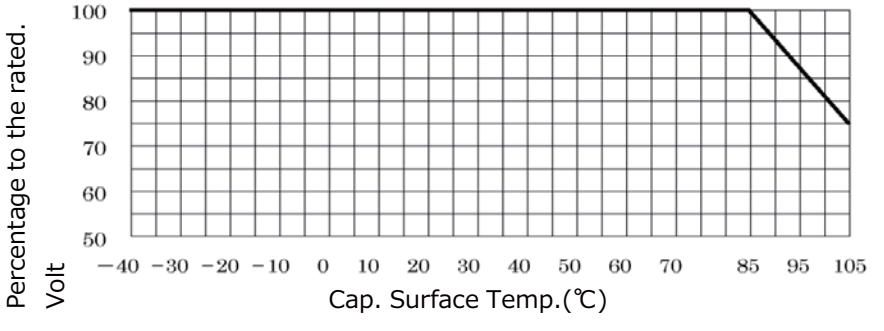
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

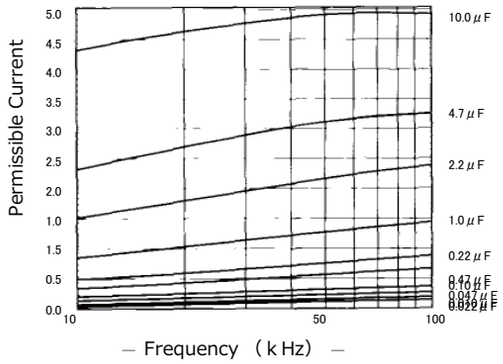
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

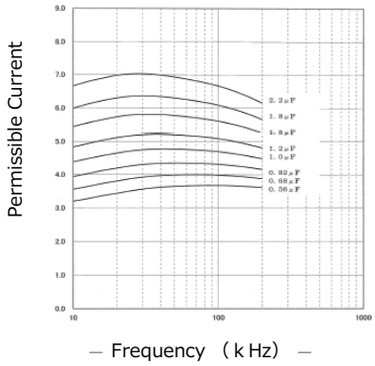
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

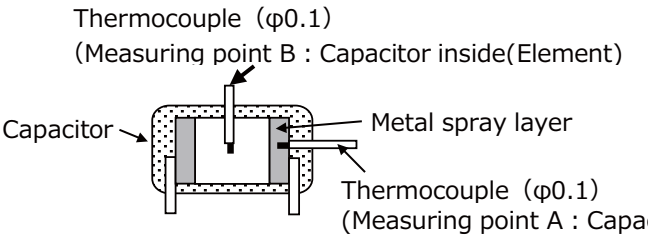
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

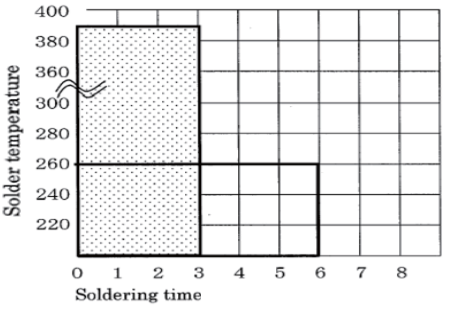
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

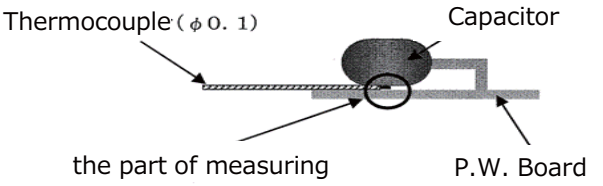
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

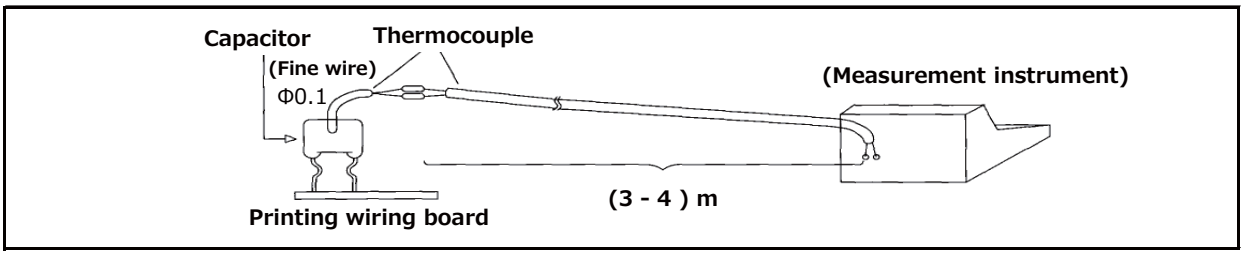
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

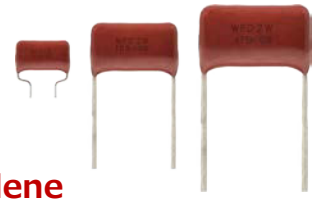
Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

Metallized Polypropylene Film Capacitor

ECWFD series



Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating.

Features

- Small size
- Excellent frequency characteristics
- Low loss
- Flame-retardant epoxy resin coating
- Low hum sound noise
- RoHS compliant

Recommended applications

- Active filter circuit
- High frequency circuit

Explanation of part number

■ Standard product

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F	D							
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
2W	450 V
2J	630 V

Code	Cap. Tol.
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead
3	Crimped taping (Ammo)
4	Odd size taping

■ Short lead space product 450 V (0.47 µF, 0.68 µF, 1.0 µF), 630 V (1.0 µF)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F	D							
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
2W	450 V
2J	630 V

Code	Cap. Tol.
P	±5 % (J)
Q	±10 % (K)

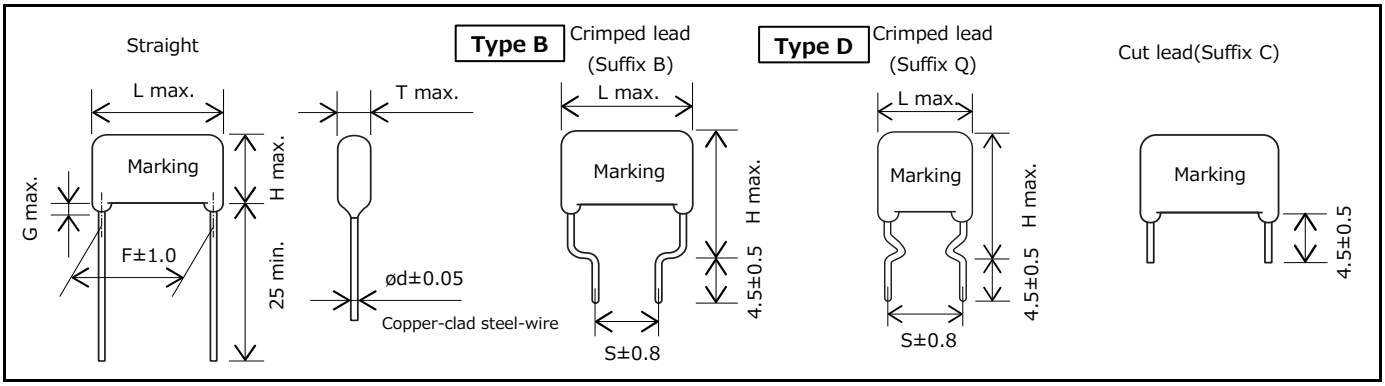
Code	Lead form
1	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead
3	Crimped taping (Ammo)
4	Odd size taping

Specifications

Category temp. range (Including temperature-rise on unit surface)	450 V	−40 ℃ to +110 ℃	
	630 V	−40 ℃ to +105 ℃	
Rated voltage [DC]	450 V	Peak to peak voltage applied on the capacitor should be less than 240 Vp-p, and zero to peak voltage should be less than 450 Vo-p. (Derating of rated voltage by 0.62 %/°C at more than 85 °C)	
	630 V	Peak to peak voltage applied on the capacitor should be less than 400 Vp-p, and zero to peak voltage should be less than 630 Vo-p. (Derating of rated voltage by 1.0%/°C at more than 85 °C)	
Capacitance range	450 V	0.1 μF to 4.7 μF	
	630 V	0.01 μF to 4.7 μF	
Capacitance tolerance	±5% (J), ±10 % (K)		
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 °C, 1 kHz)		
Withstand voltage	Between terminals : Rated voltage (V)×150 % 60 s		
Insulation resistance (IR)	450 V	C ≦ 0.33 μF : IR ≧ 30,000 MΩ C > 0.33 μF : IR ≧ 10,000 MΩ·μF	(20 °C, 100 V, 60 s)
	630 V	C ≦ 0.33 μF : IR ≧ 9,000 MΩ C > 0.33 μF : IR ≧ 3,000 MΩ·μF	(20 °C, 500 V , 60 s)

*: In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of "Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage".

Dimensions

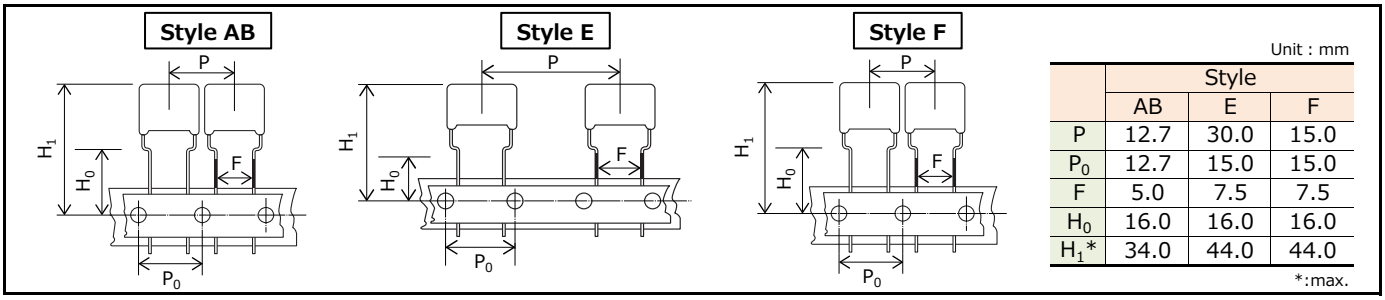


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Unit : mm

	Style		
	AB	E	F
P	12.7	30.0	15.0
P_0	12.7	15.0	15.0
F	5.0	7.5	7.5
H_0	16.0	16.0	16.0
H_1*	34.0	44.0	44.0

*:max.

*: H1 dimension is based on insertion machine "Panasert RH series" made by Panasonic. Consult with Panasonic technical staff when using other insertion machines.

■ Packaging specifications

Series	R. voltage (V) [DC]	Capacitance range (μF)	Taping style AB	Taping style E	Taping style F	Packing	suffix
ECWFD	450	0.10 to 0.39	○			Crimped taping	3
		0.47, 0.68, 1.0	○				P3/Q3
		0.10 to 0.39			○	Odd size taping	4
		0.47, 0.68, 1.0			○		P4/Q4
		0.47 to 2.2		○			4
	630	0.047 to 0.22			○	Odd size taping	4
		0.27 to 0.82		○			4
		1		○			P4/Q4

See the column "Rating ·Dimensions · Quantity" for packaging quantity

● Lead spacing

Style	Lead spacing
AB	5.0
E	7.5
F	7.5

Unit : mm

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 450 V, Capacitance tolerance : ±5 %(J), ± 10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)										Min. order Q'ty (PCS)			
		L max.	T max.	H max.			F	S		G max.	ød	Taping		Bulk	
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)			Standard 5.0 mm	Odd size 7.5 mm	Straight	Crimped lead
ECWFD2W104□( )	0.10	12.6	4.5		13.9	13.9		7.5	10.0		0.6				
ECWFD2W124□( )	0.12	12.6	4.6		14.0	14.0		7.5	10.0		0.6	1500	1400		
ECWFD2W154□( )	0.15	12.6	4.6		14.1	14.1		7.5	10.0		0.6				
ECWFD2W184□( )	0.18	12.6	4.8	–	14.3	14.3	–	7.5	10.0	–	0.6	1400	1300	–	
ECWFD2W224□( )	0.22	12.6	5.0		14.6	14.6		7.5	10.0		0.6		1200		
ECWFD2W274□( )	0.27	12.6	5.3		15.0	15.0		7.5	10.0		0.6	1300			
ECWFD2W334□( )	0.33	12.6	5.6		15.4	15.4		7.5	10.0		0.6	1200	1100		
ECWFD2W394□( )	0.39	12.6	6.0		15.7	15.7		7.5	10.0		0.6	1100	1000		
ECWFD2W474P( )	0.47	12.6	6.5	11.2	16.2	16.2	10.0	7.5	10.0	1.5	0.6	1000	900		
ECWFD2W474Q( )															
ECWFD2W474□( )	0.47	17.5	5.8	9.0	14.0	16.0	15.0	7.5	15.0	1.5	0.8	–	500		
ECWFD2W564□( )	0.56	17.5	6.2	9.4	14.4	16.4	15.0	7.5	15.0	1.5	0.8				
ECWFD2W684P( )	0.68	12.6	7.7	12.4	17.4	17.4	10.0	7.5	10.0	1.5	0.6	800	700		1000
ECWFD2W684Q( )															
ECWFD2W684□( )	0.68	17.5	6.7	9.9	14.9	16.9	15.0	7.5	15.0	1.5	0.8	–	400		
ECWFD2W824□( )	0.82	17.5	7.2	10.4	15.4	17.4	15.0	7.5	15.0	1.5	0.8			1000	
ECWFD2W105P( )	1.0	12.6	9.2	13.9	18.9	18.9	10.0	7.5	10.0	1.5	0.6	700	600		
ECWFD2W105Q( )															
ECWFD2W105□( )	1.0	17.5	7.8	11.0	16.0	18.0	15.0	7.5	15.0	1.5	0.8		400		
ECWFD2W125□( )	1.2	17.5	8.5	11.6	16.6	18.6	15.0	7.5	15.0	1.5	0.8				
ECWFD2W155□( )	1.5	17.5	9.3	12.5	17.5	19.5	15.0	7.5	15.0	1.5	0.8		300		
ECWFD2W185□( )	1.8	17.5	10.1	13.3	18.3	20.3	15.0	7.5	15.0	1.5	0.8				
ECWFD2W225□( )	2.2	17.5	11.1	14.3	19.3	21.3	15.0	7.5	15.0	1.5	0.8	–	200		
ECWFD2W275□( )	2.7	25.3	9.0	13.7	18.7	20.7	22.5	15.0	22.5	1.5	0.8				
ECWFD2W335□( )	3.3	25.3	9.8	14.6	19.6	21.6	22.5	15.0	22.5	1.5	0.8		–	800	
ECWFD2W395□( )	3.9	25.3	10.7	15.4	20.4	22.4	22.5	15.0	22.5	1.5	0.8				
ECWFD2W475□( )	4.7	25.3	11.7	16.4	21.4	23.4	22.5	15.0	22.5	1.5	0.8			600	600

∗□ : Capacitance tolerance code
∗( ) : Suffix for lead crimped

Note) Part number marked with bold is short lead space product.

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±5 %(J), ± 10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)										Min. order Q'ty (PCS)		
		L max.	T max.	H max.			F	S		G max.	ød	Taping	Bulk	
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)			Odd size 7.5 mm	Straight	Crimped lead
ECWFD2J103□( )	0.01	12.6	4.9		8.0	8.0		7.5	10.0		0.6			
ECWFD2J123□( )	0.012	12.6	5.2		8.2	8.2		7.5	10.0		0.6			
ECWFD2J153□( )	0.015	12.6	5.6		8.6	8.6		7.5	10.0		0.6			
ECWFD2J183□( )	0.018	12.6	5.9	-	9.0	9.0	-	7.5	10.0	-	0.6	-	-	1000
ECWFD2J223□( )	0.022	12.6	6.4		9.4	9.4		7.5	10.0		0.6			
ECWFD2J273□( )	0.027	12.6	6.9		9.9	9.9		7.5	10.0		0.6			
ECWFD2J333□( )	0.033	12.6	7.5		10.5	10.5		7.5	10.0		0.6			
ECWFD2J393□( )	0.039	12.6	8.0		11.0	11.0		7.5	10.0		0.6			
ECWFD2J473□( )	0.047	12.6	4.4		12.8	12.8		7.5	10.0		0.6	1300		
ECWFD2J563□( )	0.056	12.6	4.7		13.1	13.1		7.5	10.0		0.6	1200		
ECWFD2J683□( )	0.068	12.6	5.0		13.4	13.4		7.5	10.0		0.6			
ECWFD2J823□( )	0.082	12.6	5.4		13.7	13.7		7.5	10.0		0.6	1000		
ECWFD2J104□( )	0.10	12.6	5.8	-	14.2	14.2	-	7.5	10.0	-	0.6		-	
ECWFD2J124□( )	0.12	12.6	6.2		14.6	14.6		7.5	10.0		0.6	900		
ECWFD2J154□( )	0.15	12.6	6.8		15.2	15.2		7.5	10.0		0.6			
ECWFD2J184□( )	0.18	12.6	7.4		15.7	15.7		7.5	10.0		0.6	700		
ECWFD2J224□( )	0.22	12.6	8.1		16.4	16.4		7.5	10.0		0.6			
ECWFD2J274□( )	0.27	17.8	6.0	11.0	16.0	18.0	15.0	7.5	15.0	1.5	0.8	500		
ECWFD2J334□( )	0.33	17.8	6.6	11.5	16.5	18.5	15.0	7.5	15.0	1.5	0.8			
ECWFD2J394□( )	0.39	17.8	7.1	12.0	17.0	19.0	15.0	7.5	15.0	1.5	0.8	400		
ECWFD2J474□( )	0.47	17.8	7.8	12.7	17.7	19.7	15.0	7.5	15.0	1.5	0.8			
ECWFD2J564□( )	0.56	17.8	8.4	13.3	18.3	20.3	15.0	7.5	15.0	1.5	0.8			
ECWFD2J684□( )	0.68	17.8	9.3	14.2	19.2	21.2	15.0	7.5	15.0	1.5	0.8	300	1000	
ECWFD2J824□( )	0.82	17.8	10.2	15.1	20.1	22.1	15.0	7.5	15.0	1.5	0.8			
ECWFD2J105P( )	1.0	17.8	11.2	16.1	21.1	23.1	15.0	7.5	15.0	1.5	0.8	200		
ECWFD2J105Q( )														
ECWFD2J105□( )	1.0	25.3	8.4	13.5	18.5	20.5	22.5	15.0	22.5	1.5	0.8			
ECWFD2J125□( )	1.2	25.3	9.2	14.3	19.3	21.3	22.5	15.0	22.5	1.5	0.8			
ECWFD2J155□( )	1.5	25.3	10.3	15.5	20.5	22.5	22.5	15.0	22.5	1.5	0.8		800	
ECWFD2J185□( )	1.8	25.3	11.2	16.5	21.5	23.5	22.5	15.0	22.5	1.5	0.8			900
ECWFD2J225□( )	2.2	25.3	12.4	17.7	22.7	24.7	22.5	15.0	22.5	1.5	0.8	–	600	800
ECWFD2J275□( )	2.7	25.3	13.8	19.2	24.2	26.2	22.5	15.0	22.5	1.5	0.8		500	700
ECWFD2J335□( )	3.3	25.3	15.3	20.7	25.7	27.7	22.5	15.0	22.5	1.5	0.8		400	600
ECWFD2J395□( )	3.9	25.3	16.6	22.1	27.1	29.1	22.5	15.0	22.5	1.5	0.8			500
ECWFD2J475□( )	4.7	25.3	18.3	23.9	28.9	30.9	22.5	15.0	22.5	1.5	0.8		300	400

∗□ : Capacitance tolerance code

∗( ) : Suffix for lead crimped

Note) Part number marked with bold is short lead space product.

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

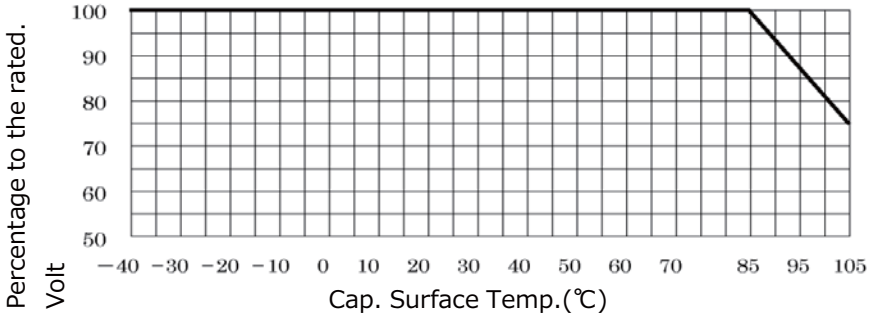
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

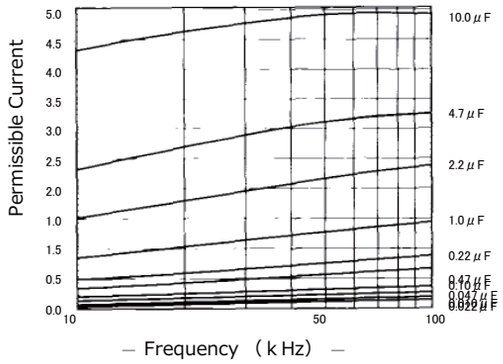
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

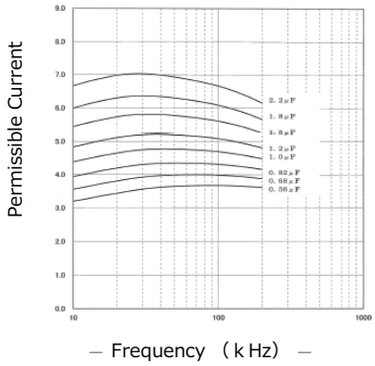
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

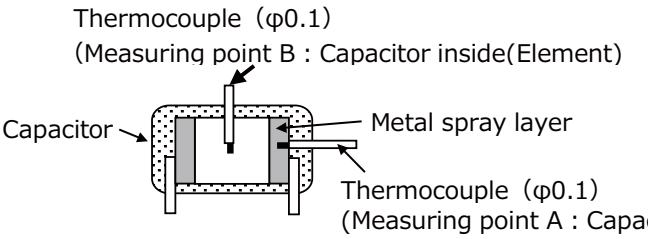
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

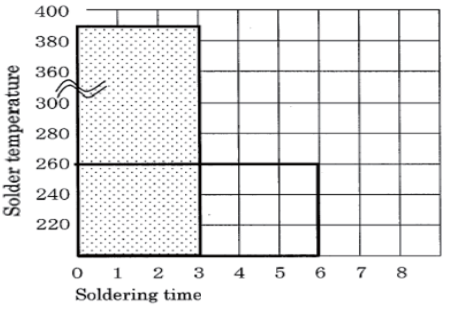
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

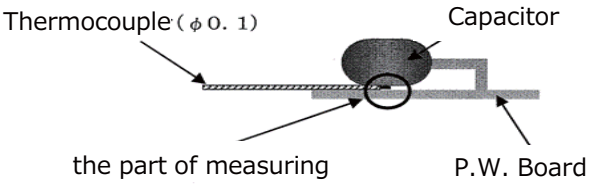
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

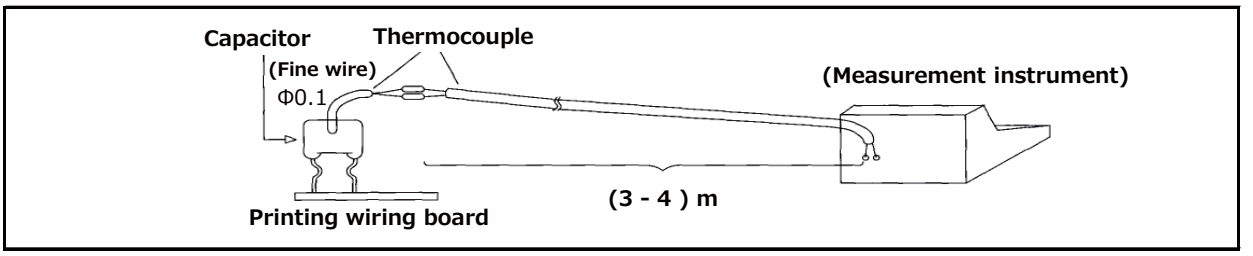
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

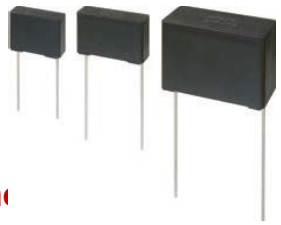
Panasonic INDUSTRY

Plastic Film Capacitors

Metallized Polypropylene Film Capacitor

ECWFE series

Non-inductive construction using metallized polypropylene film with flame retardant plastic case.



Features

- Small size
- Excellent frequency characteristics
- Low loss
- Flame retardant plastic case and non-combustible resin
- Low hum sound noise
- RoHS compliant

Recommended applications

- Active filter circuit
- High frequency circuit

Explanation of part number

■ Standard

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F	E							
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
2W	450 V
2J	630 V

Code	Cap. Tol.
J	±5 %
K	±10 %

Code	Lead form
Blank	Straight
A	Cut lead

■ Special lead space product

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	F	E							
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
2W	450 V
2J	630 V

Code	Cap. Tol.
P	±5 %
Q	±10 %

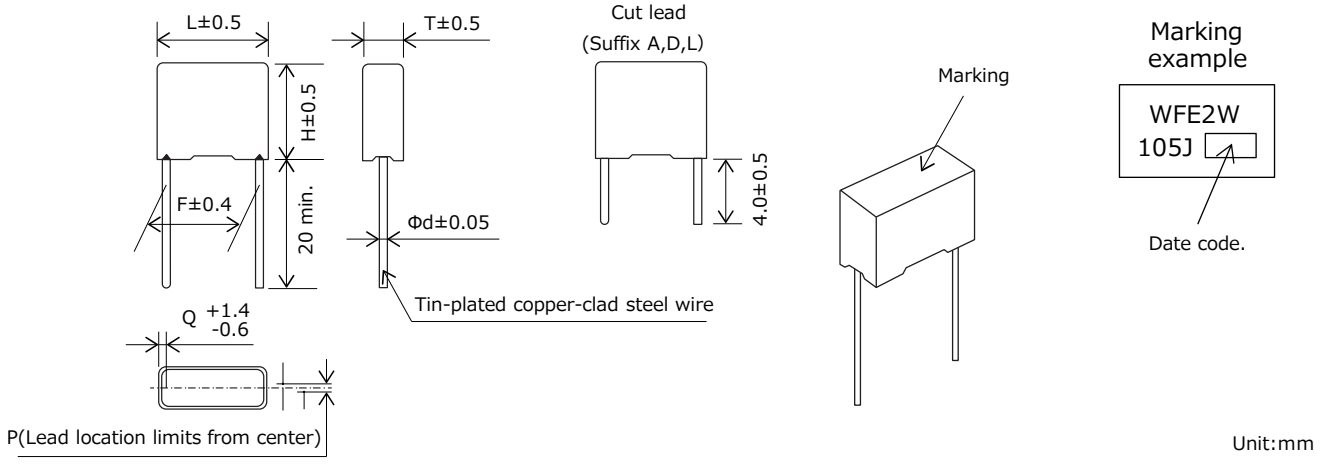
Code	Lead form
1, 5 ,8	Straight
A,D,L	Cut lead

Specifications

Category temp. range (Including temperature-rise on unit surface)	−40 ℃ to +105 ℃	
Rated voltage [DC]	450 V	Peak to peak voltage applied on the capacitor should be less than 240 Vp-p, and zero to peak voltage should be less than 450 Vo-p. (Derating of rated voltage by 1.25 %/℃ at more than 85 ℃)
	630 V	Peak to peak voltage applied on the capacitor should be less than 400 Vp-p, and zero to peak voltage should be less than 630 Vo-p. (Derating of rated voltage by 1.0%/℃ at more than 85 ℃)
Capacitance range	450 V	0.1 μF to 4.7 μF
	630 V	0.1 μF to 2.2 μF
Capacitance tolerance	±5% (J), ±10 % (K)	
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 ℃, 1 kHz)	
Withstand voltage	Between terminals : Rated voltage (V)×150 % 60 s	
Insulation resistance (IR)	450 V	C ≦ 0.33 μF : IR ≧ 30,000 MΩ C > 0.33 μF : IR ≧ 10,000 MΩ･μF (20 ℃, 100 V, 60 s)
	630 V	C ≦ 0.33 μF : IR ≧ 9,000 MΩ C > 0.33 μF : IR ≧ 3,000 MΩ･μF (20 ℃, 500 V, 60 s)

✻ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.

Dimensions



Rating · Dimensions · Quantity

■ Rated voltage [DC] : 450 V, Capacitance tolerance : ±5 %(J), ± 10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L	T	H	F	Φd	P	Q	Straight	Cut lead
ECWFE2W104□( )	0.10	13.0	5.0	10.5	10.0	0.6	0±0.8	1.5	1000	1000
ECWFE2W104P( )	0.10	17.5	5.0	10.5	15.0	0.6	0±0.8	1.25		
ECWFE2W104Q( )										
ECWFE2W154□( )	0.15	13.0	5.0	10.5	10.0	0.6	0±0.8	1.5		
ECWFE2W154P( )	0.15	17.5	5.0	10.5	15.0	0.6	0±0.8	1.25		
ECWFE2W154Q( )										
ECWFE2W224□( )	0.22	13.0	6.0	12.0	10.0	0.6	0±0.8	1.5		
ECWFE2W224P( )	0.22	17.5	5.0	10.5	15.0	0.6	0±0.8	1.25		
ECWFE2W224Q( )										
ECWFE2W334□( )	0.33	13.0	6.0	12.0	10.0	0.6	0±0.8	1.5		
ECWFE2W334P( )	0.33	17.5	5.0	10.5	15.0	0.6	0±0.8	1.25		
ECWFE2W334Q( )										
ECWFE2W474P( )	0.47	13.0	7.0	12.5	10.0	0.6	0±0.8	1.5		
ECWFE2W474Q( )										
ECWFE2W474□( )	0.47	17.5	6.0	11.5	15.0	0.8	0±0.8	1.3		
ECWFE2W684□( )	0.68	17.5	7.0	12.5	15.0	0.8	0±0.8	1.3		
ECWFE2W105□( )	1.0	17.5	7.0	12.5	15.0	0.8	0±0.8	1.3		
ECWFE2W155□( )	1.5	17.5	10.0	15.5	15.0	0.8	0±0.8	1.3		600
ECWFE2W155P( )	1.5	31.0	9.0	19.0	27.5	0.8	0±0.8	1.75	400	300
ECWFE2W155Q( )										
ECWFE2W225□( )	2.2	17.5	10.0	15.5	15.0	0.8	0±0.8	1.3	1000	600
ECWFE2W225P( )	2.2	31.0	11.0	21.0	27.5	0.8	0±0.8	1.75	200	200
ECWFE2W225Q( )										
ECWFE2W335□( )	3.3	26.0	10.0	17.0	22.5	0.8	0±0.8	1.8	500	300
ECWFE2W335P( )	3.3	31.0	13.0	23.0	27.5	0.8	0±0.8	1.75	200	200
ECWFE2W335Q( )										
ECWFE2W475□( )	4.7	26.0	12.0	19.0	22.5	0.8	0±0.8	1.8	300	200
ECWFE2W475P( )	4.7	31.0	15.5	25.5	27.5	0.8	0±0.8	1.75	150	100
ECWFE2W475Q( )										

∗□ : Capacitance tolerance code
∗( ) : Suffix for lead crimped

Note) Part number marked with bold is special lead space product.
The capacitance of 0.10 μF, 0.15 μF, 0.22 μF, 0.33 μF, 3.3 μF, 4.7 μF are "5" or "D"
The capacitance of 0.47 μF is "1" or "A"
The capacitance of 1.5 μF, 2.2 μF are "8" or "L"

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 630 V [DC], Capacitance tolerance : ±5 %(J), ± 10 %(K)

Part No.	Cap. (μF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L	T	H	F	Φd	P	Q	Straight	Cut lead
ECWFE2J104□( )	0.10	17.5	5.0	10.5	15.0	0.6	0±0.8	1.3	1000	1000
ECWFE2J104P( )	0.10	26.0	6.0	13.0	22.5	0.8	0±0.8	1.75	900	700
ECWFE2J104Q( )										
ECWFE2J154□( )	0.15	17.5	6.0	11.5	15.0	0.6	0±0.8	1.3	1000	1000
ECWFE2J154P( )	0.15	26.0	6.0	13.0	22.5	0.8	0±0.8	1.75	900	700
ECWFE2J154Q( )										
ECWFE2J224□( )	0.22	17.5	7.0	12.5	15.0	0.6	0±0.8	1.3	1000	1000
ECWFE2J224P( )	0.22	26.0	6.0	13.0	22.5	0.8	0±0.8	1.75	900	700
ECWFE2J224Q( )										
ECWFE2J334□( )	0.33	17.5	8.5	14.5	15.0	0.6	0±0.8	1.3	1000	800
ECWFE2J334P( )	0.33	26.0	7.0	14.0	22.5	0.8	0±0.8	1.75	700	500
ECWFE2J334Q( )										
ECWFE2J474□( )	0.47	17.5	10.0	15.5	15.0	0.6	0±0.8	1.3	1000	600
ECWFE2J474P( )	0.47	26.0	8.0	15.0	22.5	0.8	0±0.8	1.75	600	400
ECWFE2J474Q( )										
ECWFE2J684□( )	0.68	17.5	11.0	17.5	15.0	0.6	0±0.8	1.3	600	600
ECWFE2J105□( )	1.0	26.0	10.0	17.0	22.5	0.8	0±0.8	1.8	500	300
ECWFE2J105P( )	1.0	31.0	9.0	19.0	27.5	0.8	0±0.8	1.75	400	
ECWFE2J105Q( )										
ECWFE2J155□( )	1.5	26.0	12.0	19.0	22.5	0.8	0±0.8	1.8	300	200
ECWFE2J155P( )	1.5	31.0	11.0	21.0	27.5	0.8	0±0.8	1.75	200	
ECWFE2J155Q( )										
ECWFE2J225□( )	2.2	26.0	16.0	23.0	22.5	0.8	0±0.8	1.8		
ECWFE2J225P( )	2.2	31.0	13.0	23.0	27.5	0.8	0±0.8	1.75		
ECWFE2J225Q( )										

∗□ : Capacitance tolerance code
∗( ) : Suffix for lead crimped

Note) Part Number marked with bold is Special Lead space product.
The capacitance of 0.10 μF, 0.15 μF, 0.22 μF, 0.33 μF, 0.47 μF, 1.0 μF, 1.5 μF, 2.2 μF are "5" or "D"

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

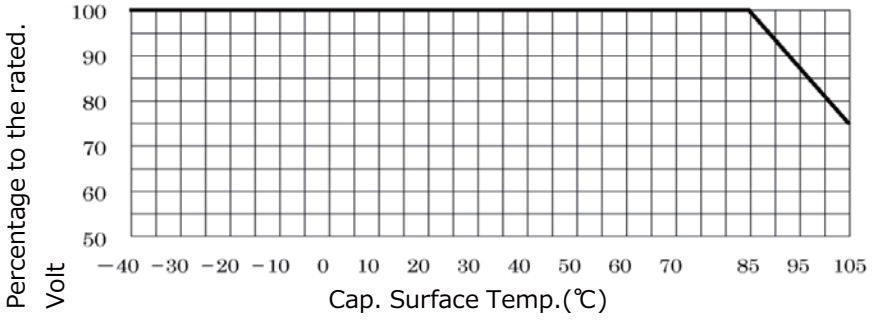
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

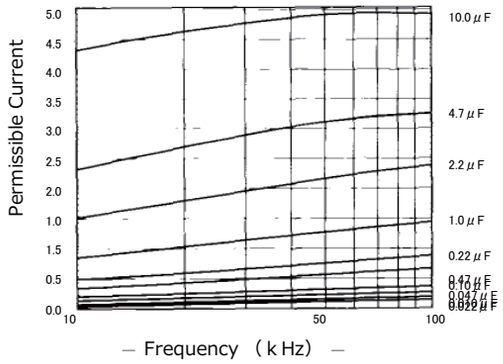
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

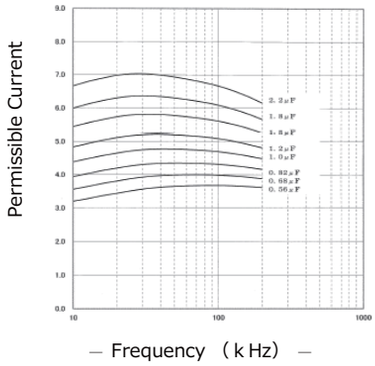
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

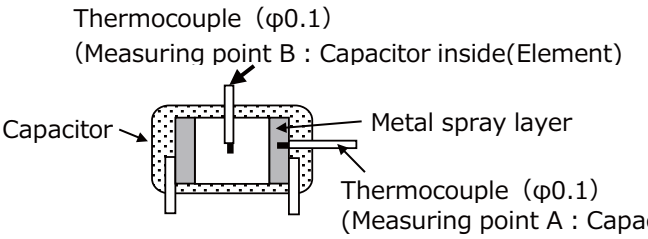
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

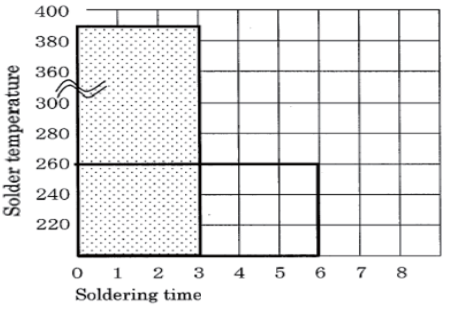
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

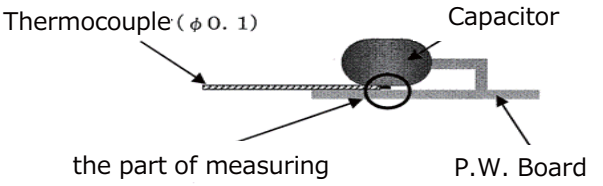
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

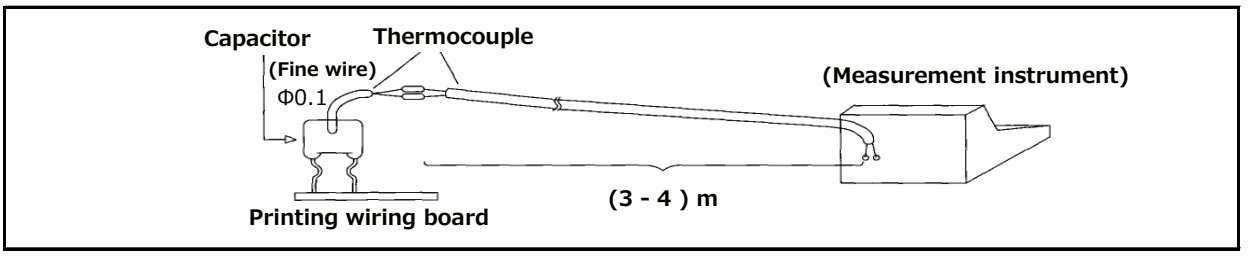
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

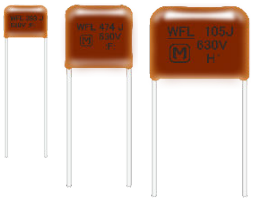
- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polypropylene Film Capacitor

ECWF(L) series

Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating

Features

- Small size
- Excellent frequency characteristics
- Low loss
- Flame retardant epoxy resin coating
- 85 ℃, 85 % RH, W.V. × 1.0 for 500 hours
- RoHS compliant

Recommended applications

- Lighting
- High frequency and high current circuit

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11
E	C	W	F						L	
Product code		Dielectric & construction		Rated voltage	Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage [DC]
4	400 V
6	630 V

Code	Cap. Tol.
H	±3 %
J	±5 %

Code	Lead form
Blank	Straight
B	Crimped lead
C	Cut lead

- Odd size taping

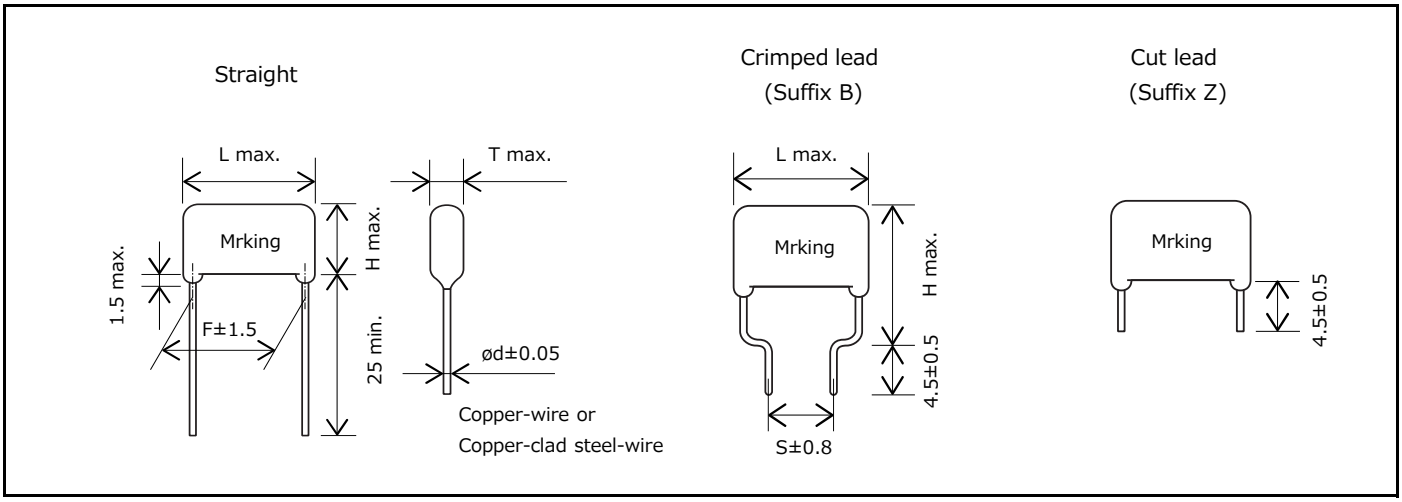
1	2	3	4	5	6	7	8	9	10	11
E	C	W	F					R		L
Product code		Dielectric & construction		Rated voltage	Capacitance			Odd taping	Cap. Tol.	Suffix

Specifications

Category temp. range (Including temperature-rise on unit surface)	−40 ℃ to +105 ℃	
Rated voltage [DC]	400 V, 630 V	
Capacitance range	400 V	0.022 μF to 2.4 μF (E12)
	630 V	0.010 μF to 1.3 μF (E12)
Capacitance tolerance	±3 % (H), ±5 % (J)	
Dissipation factor (tan δ)	tan δ ≦ 0.05 % (20 ℃、1 kHz)	
	tan δ ≦ 0.20 % (20 ℃、10 kHz)	
Withstand voltage	Between terminals : R.voltage (V) × 150 % 60 s	
Insulation resistance (IR)	400 V	C ≦ 0.33 μF : IR ≧ 9000 MΩ (20 ℃, 100 V, 60 s)
	630 V	C > 0.33 μF : IR ≧ 3000 MΩ · μF (20 ℃, 500 V, 60 s)

＊ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.

Dimensions

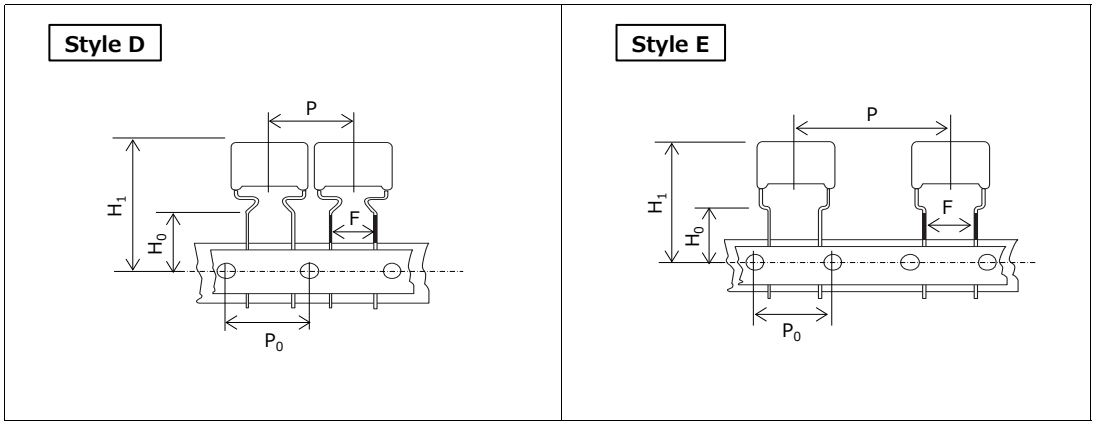


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size Unit : mm

	Style	
	D	E
P	15.0	30.0
P_0	15.0	15.0
F	7.5	7.5
H_0	16.0	16.0
H_1*	44.0	44.0

*:max.

■ Packaging specifications

Series	R.voltage (V) [DC]	Capacitance range (μF)	Taping style		Packing	Suffix
			D	E		
ECWF(L)	400	0.022 to 0.091	○		Ammo	R( ) L
		0.10 to 1.0		○	Ammo	R( ) L
	630	0.010 to 0.043	○		Ammo	R( ) L
		0.047 to 0.43		○	Ammo	R( ) L

See the column “Rating · Dimensions · Quantity” for packing quantity.

● Lead spacing

Style	Lead spacing
D	7.5
E	7.5

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 400 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	ød	Taping	Bulk	
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight	Crimped lead
ECWF4223□L( )	0.022	12.5	5.8	8.6	13.6	10.0	7.5	0.6	1100		
ECWF4243□L( )	0.024	12.5	6.0	8.8	13.8	10.0	7.5	0.6			
ECWF4273□L( )	0.027	12.5	6.2	9.0	14.0	10.0	7.5	0.6	1000		
ECWF4303□L( )	0.030	12.5	6.4	9.3	14.3	10.0	7.5	0.6			
ECWF4333□L( )	0.033	12.5	6.7	9.5	14.5	10.0	7.5	0.6	900		
ECWF4363□L( )	0.036	12.5	5.7	8.4	13.4	10.0	7.5	0.6			
ECWF4393□L( )	0.039	12.5	5.8	8.6	13.6	10.0	7.5	0.6	1100		
ECWF4433□L( )	0.043	12.5	6.0	8.8	13.8	10.0	7.5	0.6			
ECWF4473□L( )	0.047	12.5	6.2	9.0	14.0	10.0	7.5	0.6			
ECWF4513□L( )	0.051	12.5	6.4	9.2	14.2	10.0	7.5	0.6	1000		
ECWF4563□L( )	0.056	12.5	6.6	9.4	14.4	10.0	7.5	0.6			
ECWF4623□L( )	0.062	13.0	6.8	9.6	14.6	10.0	7.5	0.8			
ECWF4683□L( )	0.068	13.0	7.0	9.9	14.9	10.0	7.5	0.8	900		
ECWF4753□L( )	0.075	13.0	7.3	10.1	15.1	10.0	7.5	0.8			
ECWF4823□L( )	0.082	13.0	7.5	10.4	15.4	10.0	7.5	0.8			
ECWF4913□L( )	0.091	13.0	7.8	10.7	15.7	10.0	7.5	0.8	800		
ECWF4104□L( )	0.10	15.5	6.5	11.0	16.0	12.5	7.5	0.8	500		
ECWF4114□L( )	0.11	15.5	6.8	11.3	16.3	12.5	7.5	0.8			
ECWF4124□L( )	0.12	15.5	7.0	11.5	16.5	12.5	7.5	0.8			
ECWF4134□L( )	0.13	15.5	7.2	11.8	16.8	12.5	7.5	0.8	400		
ECWF4154□L( )	0.15	15.5	7.6	12.2	17.2	12.5	7.5	0.8			
ECWF4164□L( )	0.16	15.5	7.8	12.4	17.4	12.5	7.5	0.8			
ECWF4184□L( )	0.18	15.5	8.2	12.8	17.8	12.5	7.5	0.8			
ECWF4204□L( )	0.20	15.5	8.6	13.3	18.3	12.5	7.5	0.8		500	
ECWF4224□L( )	0.22	15.5	9.0	13.6	18.6	12.5	7.5	0.8			
ECWF4244□L( )	0.24	18.0	8.3	13.0	18.0	15.0	10.0	0.8			500
ECWF4274□L( )	0.27	18.0	8.8	13.4	18.4	15.0	10.0	0.8			
ECWF4304□L( )	0.30	18.0	9.2	13.9	18.9	15.0	10.0	0.8	300		
ECWF4334□L( )	0.33	18.0	9.6	14.3	19.3	15.0	10.0	0.8			
ECWF4364□L( )	0.36	18.0	9.9	14.7	19.7	15.0	10.0	0.8			
ECWF4394□L( )	0.39	18.0	10.3	15.1	20.1	15.0	10.0	0.8			
ECWF4434□L( )	0.43	18.0	10.7	15.6	20.6	15.0	10.0	0.8			
ECWF4474□L( )	0.47	18.0	11.2	16.1	21.1	15.0	10.0	0.8	200		
ECWF4514□L( )	0.51	20.5	10.3	16.8	21.8	17.5	12.5	0.8	300		
ECWF4564□L( )	0.56	20.5	10.7	17.3	22.3	17.5	12.5	0.8			
ECWF4624□L( )	0.62	20.5	11.3	17.9	22.9	17.5	12.5	0.8			
ECWF4684□L( )	0.68	20.5	11.8	18.5	23.5	17.5	12.5	0.8			
ECWF4754□L( )	0.75	20.5	12.3	19.1	24.1	17.5	12.5	0.8	200		
ECWF4824□L( )	0.82	23.0	11.8	18.5	23.5	20.0	12.5	0.8			
ECWF4914□L( )	0.91	23.0	12.4	19.2	24.2	20.0	12.5	0.8			
ECWF4105□L( )	1.0	23.0	13.0	19.8	24.8	20.0	12.5	0.8			
ECWF4115□L( )	1.1	23.0	13.6	20.5	25.5	20.0	12.5	0.8			
ECWF4125□L( )	1.2	28.0	12.3	19.1	24.1	25.0	17.5	0.8			
ECWF4135□L( )	1.3	28.0	12.8	19.6	24.6	25.0	17.5	0.8			
ECWF4155□L( )	1.5	28.0	13.7	20.7	25.7	25.0	17.5	0.8			
ECWF4165□L( )	1.6	28.0	14.2	21.2	26.2	25.0	17.5	0.8	–		
ECWF4185□L( )	1.8	28.0	15.2	22.2	27.2	25.0	17.5	0.8			
ECWF4205□L( )	2.0	28.0	16.0	23.1	28.1	25.0	17.5	0.8			
ECWF4225□L( )	2.2	28.0	16.8	24.0	29.0	25.0	17.5	0.8		400	
ECWF4245□L( )	2.4	28.0	17.5	24.8	29.8	25.0	17.5	0.8			

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	ød	Taping	Bulk	
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight	Crimped lead
ECWF6103□L( )	0.010	12.5	5.2	8.0	13.0	10.0	7.5	0.6	1200	500	500
ECWF6113□L( )	0.011	12.5	5.4	8.2	13.2	10.0	7.5	0.6			
ECWF6123□L( )	0.012	12.5	5.5	8.3	13.3	10.0	7.5	0.6			
ECWF6133□L( )	0.013	12.5	5.6	8.5	13.5	10.0	7.5	0.6	1100		
ECWF6153□L( )	0.015	12.5	5.9	8.7	13.7	10.0	7.5	0.6			
ECWF6163□L( )	0.016	12.5	6.0	8.9	13.9	10.0	7.5	0.6			
ECWF6183□L( )	0.018	12.5	6.2	9.1	14.1	10.0	7.5	0.6	1000		
ECWF6203□L( )	0.020	12.5	6.5	9.3	14.3	10.0	7.5	0.6			
ECWF6223□L( )	0.022	12.5	6.2	9.0	14.0	10.0	7.5	0.6			
ECWF6243□L( )	0.024	12.5	6.4	9.2	14.2	10.0	7.5	0.6			
ECWF6273□L( )	0.027	13.0	6.6	9.5	14.5	10.0	7.5	0.8			
ECWF6303□L( )	0.030	13.0	6.9	9.7	14.7	10.0	7.5	0.8	900		
ECWF6333□L( )	0.033	13.0	7.1	10.0	15.0	10.0	7.5	0.8			
ECWF6363□L( )	0.036	13.0	7.3	10.2	15.2	10.0	7.5	0.8			
ECWF6393□L( )	0.039	13.0	7.6	10.4	15.4	10.0	7.5	0.8	800		
ECWF6433□L( )	0.043	13.0	7.9	10.7	15.7	10.0	7.5	0.8			
ECWF6473□L( )	0.047	15.5	6.4	10.8	15.8	12.5	7.5	0.8	500		
ECWF6513□L( )	0.051	15.5	6.6	11.0	16.0	12.5	7.5	0.8			
ECWF6563□L( )	0.056	15.5	6.8	11.2	16.2	12.5	7.5	0.8	400		
ECWF6623□L( )	0.062	15.5	7.1	11.5	16.5	12.5	7.5	0.8			
ECWF6683□L( )	0.068	15.5	7.4	11.8	16.8	12.5	7.5	0.8			
ECWF6753□L( )	0.075	15.5	7.7	12.1	17.1	12.5	7.5	0.8			
ECWF6823□L( )	0.082	15.5	8.0	12.4	17.4	12.5	7.5	0.8			
ECWF6913□L( )	0.091	15.5	8.3	12.7	17.7	12.5	7.5	0.8			
ECWF6104□L( )	0.10	18.0	7.7	12.1	17.1	15.0	10.0	0.8			
ECWF6114□L( )	0.11	18.0	8.0	12.4	17.4	15.0	10.0	0.8			
ECWF6124□L( )	0.12	18.0	8.3	12.7	17.7	15.0	10.0	0.8	300		
ECWF6134□L( )	0.13	18.0	8.5	13.0	18.0	15.0	10.0	0.8			
ECWF6154□L( )	0.15	18.0	9.1	13.5	18.5	15.0	10.0	0.8			
ECWF6164□L( )	0.16	18.0	9.3	13.8	18.8	15.0	10.0	0.8			
ECWF6184□L( )	0.18	18.0	9.8	14.2	19.1	15.0	10.0	0.8			
ECWF6204□L( )	0.20	18.0	10.3	14.7	19.7	15.0	10.0	0.8			
ECWF6224□L( )	0.22	18.0	10.8	15.5	20.5	15.0	10.0	0.8			
ECWF6244□L( )	0.24	18.0	11.2	15.9	20.9	15.0	10.0	0.8	200		
ECWF6274□L( )	0.27	20.5	10.4	16.7	21.7	17.5	12.5	0.8	300		
ECWF6304□L( )	0.30	20.5	10.9	17.2	22.2	17.5	12.5	0.8			
ECWF6334□L( )	0.33	20.5	11.4	17.7	22.7	17.5	12.5	0.8	200		
ECWF6364□L( )	0.36	20.5	11.9	18.5	23.5	17.5	12.5	0.8			
ECWF6394□L( )	0.39	20.5	12.4	19.0	24.0	17.5	12.5	0.8			
ECWF6434□L( )	0.43	20.5	13.0	19.5	24.5	17.5	12.5	0.8			
ECWF6474□L( )	0.47	20.5	13.5	20.1	25.1	17.5	12.5	0.8	–		
ECWF6514□L( )	0.51	28.0	11.1	17.3	22.3	25.0	17.5	0.8			
ECWF6564□L( )	0.56	28.0	11.6	17.8	22.8	25.0	17.5	0.8			
ECWF6624□L( )	0.62	28.0	12.1	18.7	23.7	25.0	17.5	0.8			
ECWF6684□L( )	0.68	28.0	12.7	19.3	24.3	25.0	17.5	0.8			
ECWF6754□L( )	0.75	28.0	13.3	19.9	24.9	25.0	17.5	0.8			
ECWF6824□L( )	0.82	28.0	13.9	20.5	25.5	25.0	17.5	0.8			
ECWF6914□L( )	0.91	28.0	14.6	21.2	26.2	25.0	17.5	0.8			
ECWF6105□L( )	1.0	28.0	15.5	22.3	27.3	25.0	17.5	0.8			
ECWF6115□L( )	1.1	28.0	16.3	23.0	28.0	25.0	17.5	0.8		400	400
ECWF6125□L( )	1.2	28.0	17.0	23.7	28.7	25.0	17.5	0.8			
ECWF6135□L( )	1.3	28.0	17.6	24.4	29.4	25.0	17.5	0.8			

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

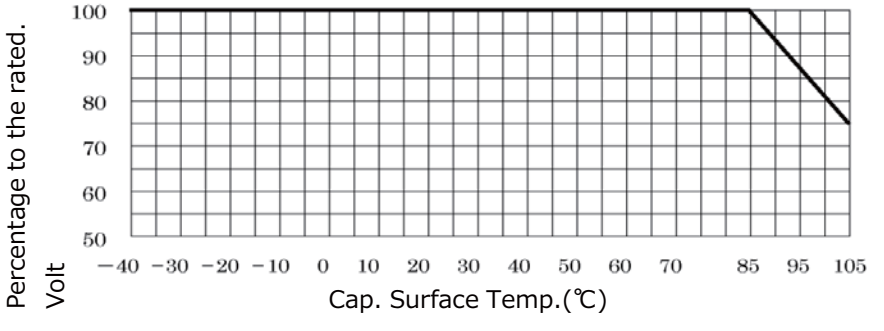
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

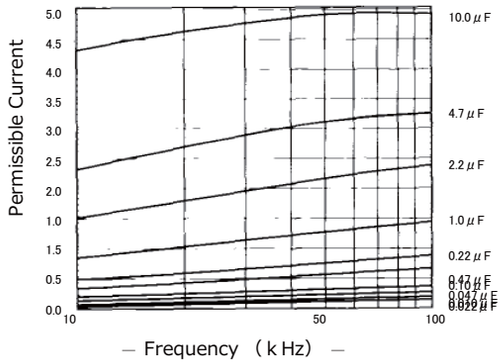
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

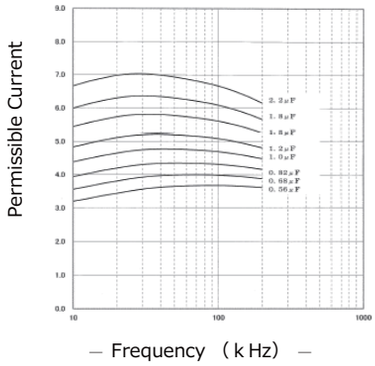
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

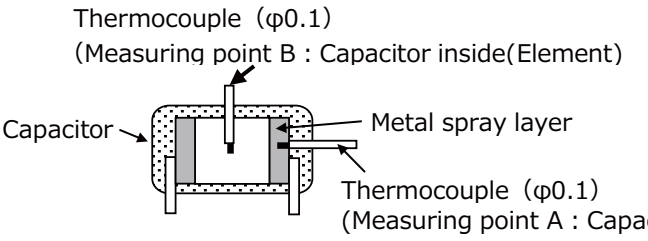
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

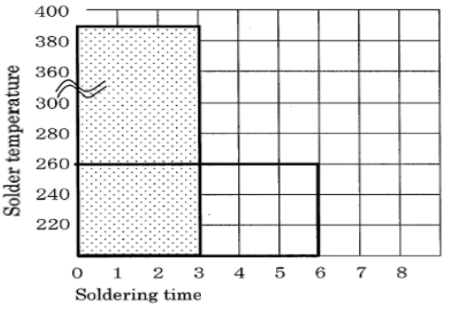
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

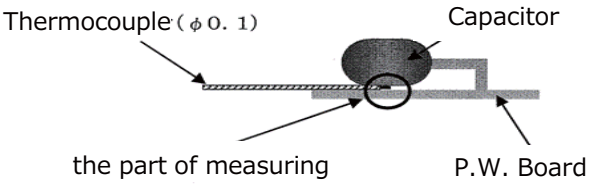
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

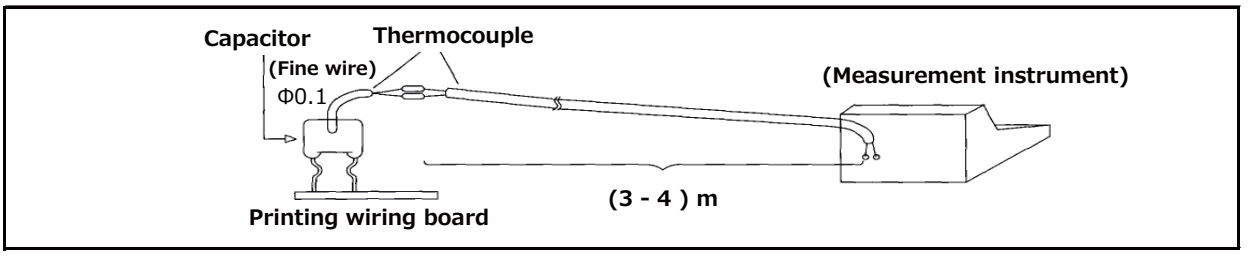
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

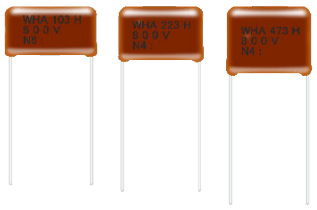
Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polypropylene Film Capacitor

ECWH(A) series

Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating

Features

- Small size
- Excellent electrical characteristics
- Low loss
- Low hum sound noise
- Flame retardant epoxy resin coating
- RoHS compliant

Recommended applications

- General resonance circuit

Explanation of part number

- Rated voltage 800 V (Bulk)

1	2	3	4	5	6	7	8	9	10	11
E	C	W	H	8				H	A	
Product code		Dielectric & construction		Rated voltage	Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage [DC]
8	800 V

Code	Cap. Tol.
H	±3 %

Code	Lead form
Blank	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead

- Rated voltage 800 V (Odd size taping)

1	2	3	4	5	6	7	8	9	10	11
E	C	W	H	8				R	H	A
Product code		Dielectric & construction		Rated voltage	Capacitance			Odd taping	Cap. Tol.	Suffix

- Rated voltage 1600 V

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	H	A	3	C					
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix

Code	R.voltage [DC]
3C	1600 V

Code	Cap. Tol.
H	±3 %
J	±5 %

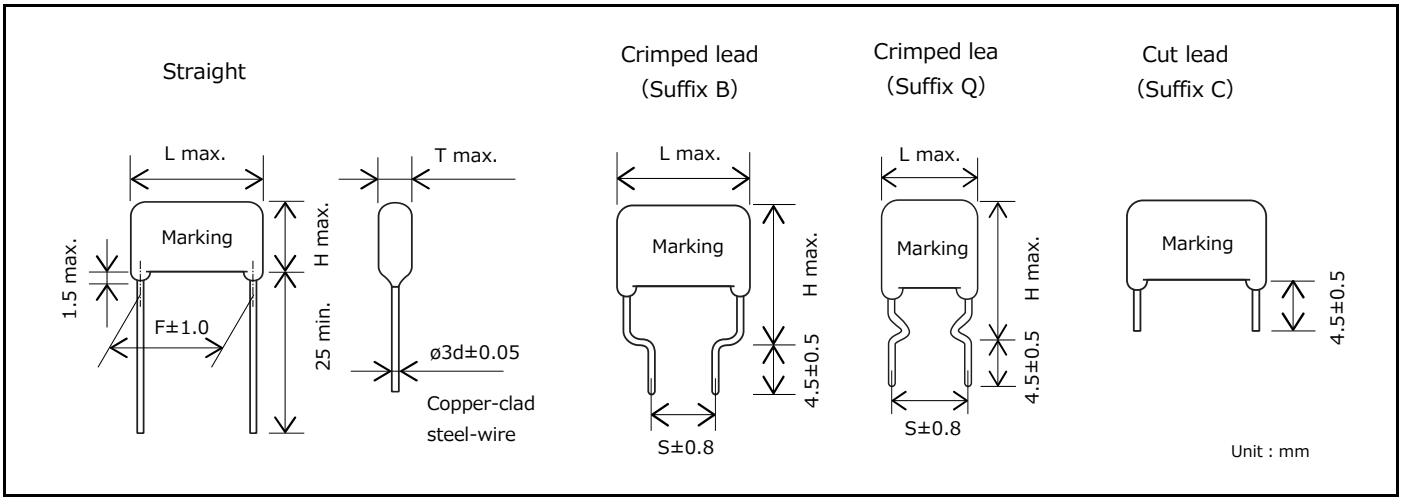
Code	Lead form
Blank	Straight
B	Crimped lead
Q	Crimped lead
C	Cut lead
4	Odd size taping

Specifications

Category temp. range (Including temperature-rise on unit surface)	−40 ℃ to +105 ℃	
Rated voltage [DC]	800 V、1600 V	
Capacitance range	800 V	0.010 μF to 0.047 μF
	1600 V	0.0010 μF to 0.047 μF
Capacitance tolerance	800 V	±3% (H)
	1600 V	±3% (H), ±5 % (J)
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 ℃, 1 kHz)	
Withstand voltage	Between terminals : Rated voltage (V) × 150 % 60 s	
Insulation resistance (IR)	IR ≧ 30,000 MΩ (20 ℃, 500 V, 60 s)	

＊ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of "Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage".

Dimensions

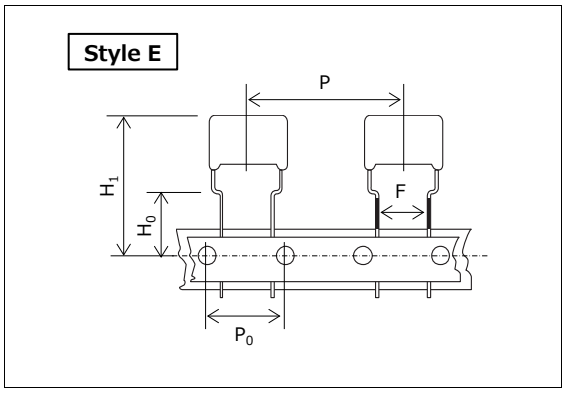


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size Unit : mm

	Style
	E
P	30.0
P_0	15.0
F	7.5
H_0	16.0
H_1*	44.0

*:max.

■ Packaging specifications

Series	R.voltage (V) [DC]	Capacitance range (μF)	Taping style E	Packing	Suffix
ECWH(A)	800	0.010 to 0.047	○	Ammo	RHA
	1600	0.0010 to 0.047	○	Ammo	( )4

Refer to the page of taping specifications.

● Lead spacing

Style	Lead spacing
E	7.5

Unit : mm

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 800 V, Capacitance tolerance : ±3 %(H)

Part No.	Capacitance (μF)	Dimensions (mm)									Min. order Q'ty (PCS)	
		L max.	T max.	H max.			F	S		ød	Taping	Bulk
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)		7.5 mm	Straight・Crimped lead
ECWH8103HA( )	0.010	15.4	5.4	9.8	14.8	14.8	12.5	7.5	12.5	0.6	500	500
ECWH8123HA( )	0.012	15.4	5.8	10.2	15.2	15.2	12.5	7.5	12.5	0.6		
ECWH8153HA( )	0.015	15.4	6.2	10.6	15.6	15.6	12.5	7.5	12.5	0.6		
ECWH8183HA( )	0.018	15.7	6.6	11.0	16.0	18.0	12.5	7.5	12.5	0.8		
ECWH8223HA( )	0.022	15.7	7.1	11.5	16.5	18.5	12.5	7.5	12.5	0.8	400	
ECWH8273HA( )	0.027	15.7	7.6	12.0	17.0	19.0	12.5	7.5	12.5	0.8		
ECWH8333HA( )	0.033	15.7	8.4	12.8	17.8	19.8	12.5	7.5	12.5	0.8	300	
ECWH8393HA( )	0.039	15.7	8.9	13.3	18.3	20.3	12.5	7.5	12.5	0.8		
ECWH8473HA( )	0.047	15.7	9.7	14.1	19.1	21.1	12.5	7.5	12.5	0.8		

＊H : Capacitance tolerance code　＊( ) : Suffix for lead crimped or taped type

■ Rated voltage [DC] : 1600 V,　Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capaci-tance (μF)	Dimensions (mm)									Min. order Q'ty (PCS)		
		L max.	T max.	H max.			F	S		ød	Taping	Bulk	
				Straight	Crimped lead (Suffix B)	Crimped lead (Suffix Q)		Crimped lead (Suffix B)	Crimped lead (Suffix Q)		7.5 mm	Straight	Crimped lead
ECWHA3C102□( )	0.0010	17.8	5.2	–	13.0	13.0	–	10.0	15.0	0.6	600	–	1000
ECWHA3C112□( )	0.0011	17.8	5.4		13.1	13.1		10.0	15.0	0.6			
ECWHA3C122□( )	0.0012	17.8	5.5		13.2	13.2		10.0	15.0	0.6	500		
ECWHA3C132□( )	0.0013	17.8	5.7		13.4	13.4		10.0	15.0	0.6			
ECWHA3C152□( )	0.0015	17.8	5.9		13.7	13.7		10.0	15.0	0.6			
ECWHA3C162□( )	0.0016	17.8	6.1		13.9	13.9		10.0	15.0	0.6			
ECWHA3C182□( )	0.0018	17.8	6.4		14.1	14.1		10.0	15.0	0.6			
ECWHA3C202□( )	0.0020	17.8	6.6		14.3	14.3		10.0	15.0	0.6	400		
ECWHA3C222□( )	0.0022	17.8	6.7		14.5	14.5		10.0	15.0	0.6			
ECWHA3C242□( )	0.0024	17.8	7.0		14.7	14.7		10.0	15.0	0.6			
ECWHA3C272□( )	0.0027	17.8	5.2		13.0	13.0		10.0	15.0	0.6	600		
ECWHA3C302□( )	0.0030	17.8	5.5		13.2	13.2		10.0	15.0	0.6	500		
ECWHA3C332□( )	0.0033	17.8	5.6		13.4	13.4		10.0	15.0	0.6			
ECWHA3C362□( )	0.0036	17.8	5.7		13.5	13.5		10.0	15.0	0.6			
ECWHA3C392□( )	0.0039	17.8	6.0		13.8	13.8		10.0	15.0	0.6			
ECWHA3C432□( )	0.0043	17.8	6.2		13.9	13.9		10.0	15.0	0.6			
ECWHA3C472□( )	0.0047	17.8	6.4	9.1	14.1	14.1	15.0	10.0	15.0	0.6		1000	
ECWHA3C512□( )	0.0051	17.8	6.6	9.4	14.4	14.4	15.0	10.0	15.0	0.6	400		
ECWHA3C562□( )	0.0056	17.8	6.8	9.6	14.6	14.6	15.0	10.0	15.0	0.6			
ECWHA3C622□( )	0.0062	17.8	7.1	9.8	14.8	14.8	15.0	10.0	15.0	0.6			
ECWHA3C682□( )	0.0068	17.8	6.1	12.1	17.1	17.1	15.0	10.0	15.0	0.6	500		
ECWHA3C752□( )	0.0075	17.8	6.5	12.4	17.4	17.4	15.0	10.0	15.0	0.6	400		
ECWHA3C822□( )	0.0082	17.8	6.8	12.7	17.7	17.7	15.0	10.0	15.0	0.6			
ECWHA3C912□( )	0.0091	17.8	7.1	13.0	18.0	18.0	15.0	10.0	15.0	0.6		1000	
ECWHA3C103□( )	0.010	20.3	6.4	12.3	17.3	17.3	17.5	10.0	17.5	0.6	500		
ECWHA3C113□( )	0.011	20.3	6.6	12.5	17.5	17.5	17.5	10.0	17.5	0.6	400		
ECWHA3C123□( )	0.012	20.3	6.8	12.8	17.8	17.8	17.5	10.0	17.5	0.6			
ECWHA3C133□( )	0.013	20.3	7.1	13.0	18.0	18.0	17.5	10.0	17.5	0.6			
ECWHA3C153□( )	0.015	20.3	7.6	13.5	18.5	18.5	17.5	10.0	17.5	0.6			
ECWHA3C163□( )	0.016	20.3	7.9	13.8	18.8	18.8	17.5	10.0	17.5	0.6			
ECWHA3C183□( )	0.018	20.6	8.2	14.1	19.1	21.1	17.5	10.0	17.5	0.8	300		
ECWHA3C203□( )	0.020	20.6	8.7	14.6	19.6	21.6	17.5	10.0	17.5	0.8		800	
ECWHA3C223□( )	0.022	20.6	9.1	15.0	20.0	22.0	17.5	10.0	17.5	0.8			
ECWHA3C243□( )	0.024	20.6	9.6	15.4	20.4	22.4	17.5	10.0	17.5	0.8			
ECWHA3C273□( )	0.027	20.6	10.0	15.9	20.9	22.9	17.5	10.0	17.5	0.8			
ECWHA3C303□( )	0.030	20.6	10.7	16.5	21.5	23.5	17.5	10.0	17.5	0.8	200		
ECWHA3C333□( )	0.033	20.6	11.2	17.0	22.0	24.0	17.5	10.0	17.5	0.8			
ECWHA3C363□( )	0.036	20.6	11.7	17.5	22.5	24.5	17.5	10.0	17.5	0.8			
ECWHA3C393□( )	0.039	20.6	12.1	18.0	23.0	25.0	17.5	10.0	17.5	0.8			
ECWHA3C433□( )	0.043	20.6	12.8	18.6	23.6	25.6	17.5	10.0	17.5	0.8		600	
ECWHA3C473□( )	0.047	20.6	13.4	19.2	24.2	26.2	17.5	10.0	17.5	0.8			800

＊□ : Capacitance tolerance code　＊( ) : Suffix for lead crimped or taped type

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

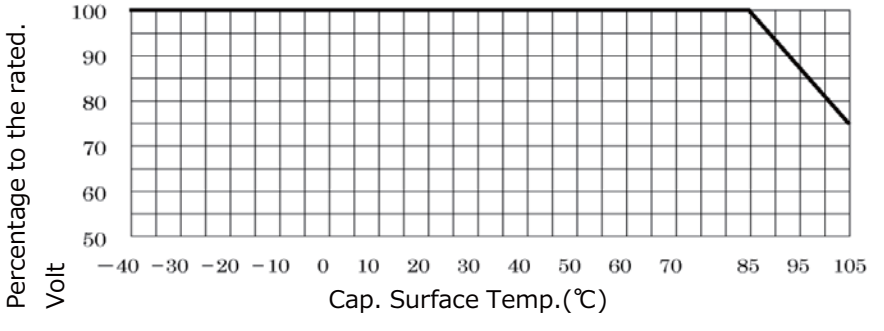
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

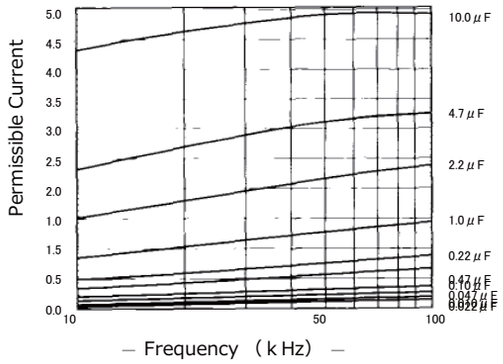
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

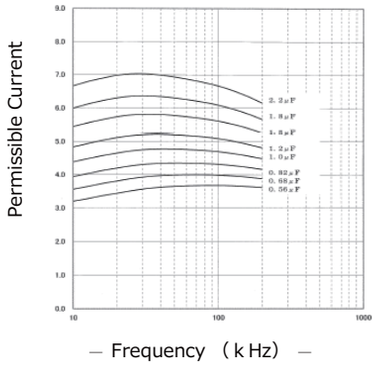
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

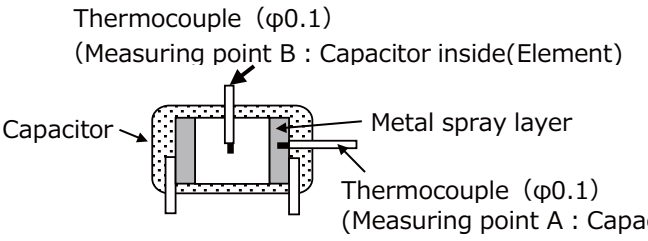
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

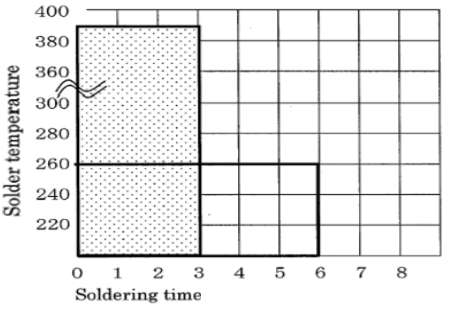
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

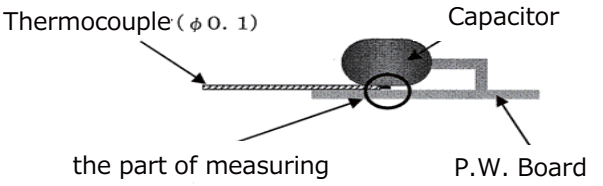
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

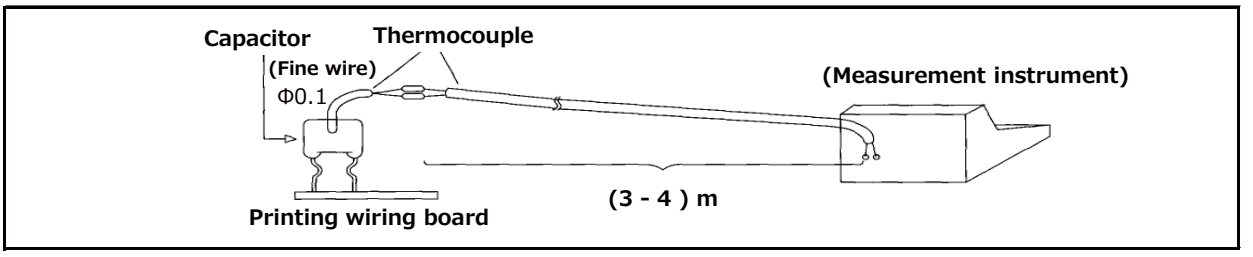
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

Panasonic INDUSTRY

Plastic Film Capacitors

Metallized Polypropylene Film Capacitor

ECWH(C) series

Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating

Features

- Excellent electrical characteristics
- Low loss
- Flame-retardant epoxy resin coating
- RoHS compliant

Recommended applications

- General resonance circuit (630 V, 1250 V)
- Resonance circuit for microwave oven and IH cooker (630 V, 1250 V)
- General high voltage circuit (3000 V)

Explanation of part number

- Rated voltage 630 V (Bulk)

1	2	3	4	5	6	7	8	9	10	11
E	C	W	H	6				H	C	
Product code		Dielectric & construction		Rated voltage	Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage [DC]
6	630 V

Code	Cap. Tol.
H	±3 %

Code	Lead form
Blank	Straight
C	Cut lead

- Rated voltage 630 V (Odd size taping)

1	2	3	4	5	6	7	8	9	10	11
E	C	W	H	6				R	H	C
Product code		Dielectric & construction		Rated voltage	Capacitance			Odd taping	Cap. Tol.	Suffix

- Rated voltage 1250 V (Cut lead)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	H	C	3	B				J	A
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix 1

Code	R.voltage [DC]
3B	1250 V

Code	Cap. Tol.
J	±5 %

Code	Lead form
A	Cut lead

- Rated voltage 3000 V (Bulk)

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	H	C	3	F				J	
Product code		Dielectric & construction			Rated voltage		Capacitance			Cap. Tol.	Suffix 1

Code	R.voltage [DC]
3F	3000 V

Code	Cap. Tol.
J	±5 %

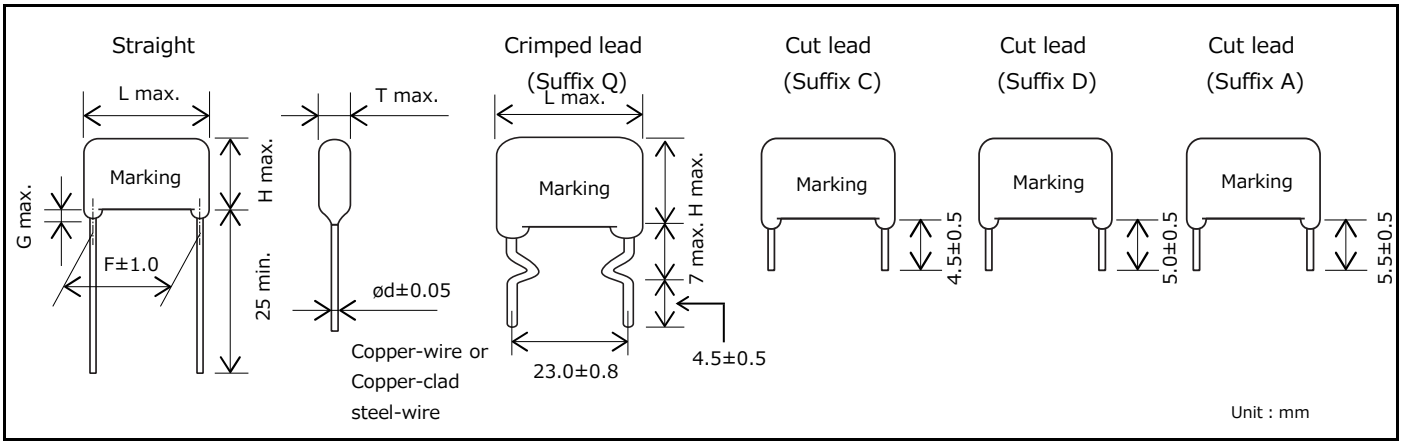
Code	Lead form
Blank	Straight
D	Cut lead
Q	Crimped lead

Specifications

Category temp. range (Including temperature-rise on unit surface)	630 V	−40 ℃ to +105 ℃ : General resonance circuit
		−40 ℃ to +85 ℃ : When using compulsive air cooling for a resonance circuit
	1250 V	−40 ℃ to +105 ℃ : General resonance circuit
		−40 ℃ to +85 ℃ : When using compulsive air cooling for a resonance circuit
	3000 V	−40 ℃ to +85 ℃ : General resonance circuit
Rated voltage [DC]	630 V, 1250 V, 3000 V	
Capacitance range	630 V	0.10 μF to 0.33 μF
	1250 V	0.08 μF to 0.12 μF
	3000 V	0.0024 μF to 0.01 μF
Capacitance tolerance	630 V	±3% (H)
	1250 V	±5 % (J)
	3000 V	±5 % (J)
Dissipation factor (tan δ)	630 V	tan δ ≦ 0.05 % (20 ℃, 1 kHz)
	1250 V	tan δ ≦ 0.1 % (20 ℃, 10 kHz)
	3000 V	tan δ ≦ 0.1 % (20 ℃, 1 kHz)、tan δ ≦ 0.1 % (20 ℃, 10 kHz)
Withstand voltage	630 V	Between terminals : Rated voltage (V) × 150 % 60 s
	1250 V	
	3000 V	Between terminals : Rated voltage : 6615 V [DC] 3 s
Insulation resistance (IR)	630 V	IR ≧ 30,000 MΩ (20 ℃、500 V, 60 s)
	1250 V	
	3000 V	IR ≧ 50,000 MΩ (20 ℃、500 V, 60 s)

＊ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.

Dimensions

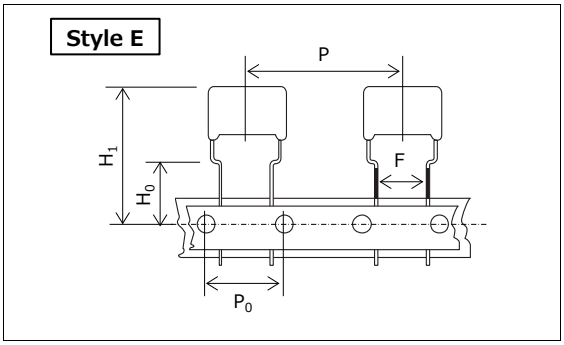


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size Unit : mm

	Style
	E
P	30.0
P_0	15.0
F	7.5
H_0	16.0
H_1*	44.0

*:max.

■ Packaging specifications

Series	R.voltage (V) [DC]	Capacitance range (μF)	Taping style E	Packing
ECWH(C)	630	0.10 ~ 0.21	○	Ammo

● Lead spacing

Style	Lead spacing
E	7.5

Unit : mm

See the column “Rating · Dimensions · Quantity” for packing quantity.

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 630 V, Capacitance tolerance : ±3 %(H)

Part No.	Capacitance (μF)	Dimensions (mm)						Min. order Q'ty (PCS)	
		L max.	T max.	H max.	F	G max.	ød	Taping	Bulk
								7.5 mm	Straight・Crimped lead
ECWH6104HC( )	0.10	20.7	8.6	13.5	17.5	1.5	0.8	350	1000
ECWH6114HC( )	0.11	20.7	9.0	13.9	17.5	1.5	0.8	300	
ECWH6124HC( )	0.12	20.7	9.4	14.3	17.5	1.5	0.8		
ECWH6184HC( )	0.18	20.7	11.5	16.3	17.5	1.5	0.8	250	
ECWH6214HC( )	0.21	20.7	12.4	17.2	17.5	1.5	0.8	200	
ECWH6244HC( )	0.24	20.7	13.2	18.1	17.5	1.5	0.8	-	700
ECWH6274HC( )	0.27	20.7	14.0	18.9	17.5	1.5	0.8		
ECWH6284HC( )	0.28	20.7	14.3	19.1	17.5	1.5	0.8		
ECWH6304HC( )	0.30	20.7	14.8	19.6	17.5	1.5	0.8		
ECWH6324HC( )	0.32	20.7	14.5	20.9	17.5	1.5	0.8		
ECWH6334HC( )	0.33	20.7	14.7	21.1	17.5	1.5	0.8		

() : Suffix for lead crimped or taped type

■ Rated voltage [DC] : 1250 V, Capacitance tolerance : ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)						Min. order Q'ty (PCS)
		L max.	T max.	H max.	F	G max.	ød	Bulk
								Straight・Crimped lead
ECWHC3B803JA	0.08	20.7	12.0	19.0	17.5	1.5	0.8	700
ECWHC3B104JA	0.10	20.7	13.5	20.6	17.5	1.5	0.8	
ECWHC3B114JA	0.11	20.7	14.2	21.3	17.5	1.5	0.8	600
ECWHC3B124JA	0.12	20.7	14.9	21.9	17.5	1.5	0.8	

■ Rated voltage [DC] : 3000 V, Capacitance tolerance : ±5 %(J)

Part No.	Capacitance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)
		L max.	T max.	H max.	F	S Crimped lead (Suffix Q)	G max.	ød	Bulk
									Straight・Crimped lead
ECWHC3F242J( )	0.0024	25.8	6.1	10.9	22.5	23.0	1.5	0.8	1000
ECWHC3F362J( )	0.0036	25.8	7.2	11.9	22.5	23.0	1.5	0.8	
ECWHC3F392J( )	0.0039	25.8	7.5	12.2	22.5	23.0	1.5	0.8	
ECWHC3F432J( )	0.0043	25.8	6.5	11.2	22.5	23.0	1.5	0.8	
ECWHC3F562J( )	0.0056	25.8	7.3	12.0	22.5	23.0	1.5	0.8	
ECWHC3F822J( )	0.0082	25.8	7.5	15.3	22.5	23.0	1.5	0.8	
ECWHC3F103J( )	0.01	25.8	8.2	16.1	22.5	23.0	1.5	0.8	

() : Suffix for lead crimped or taped type

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

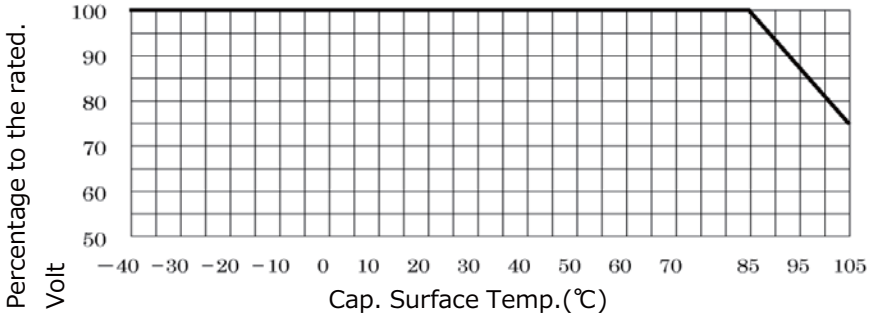
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

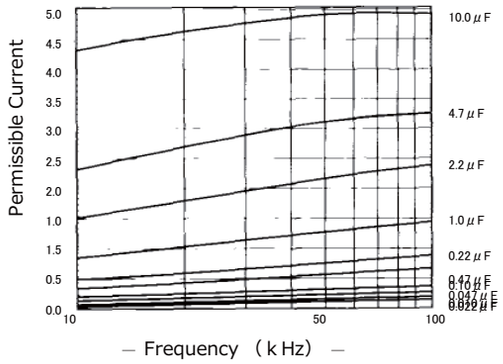
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

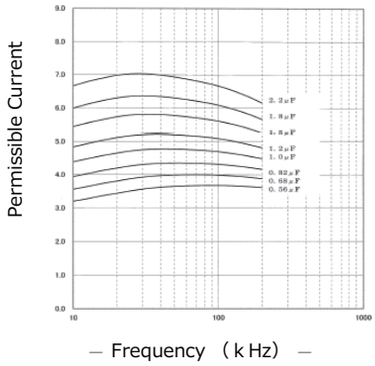
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)		48 *(7.5P)	131 *(7.5P)	273 *(10.0P)
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)				
393 (0.039)			78 *(10.0P)	116 *(15.0P)
473 (0.047)				
563 (0.056)				
683 (0.068)				
823 (0.082)				
104 (0.10)			37 *(15.0P)	63 *(22.5P)
124 (0.12)				
154 (0.15)				
184 (0.18)		33 *(10.0P)		
224 (0.22)				
274 (0.27)				
334 (0.33)				
394 (0.39)		18 *(15.0P)	22 *(22.5P)	48 *(27.5P)
474 (0.47)				
564 (0.56)	22 *(10.0P)			
684 (0.68)				
824 (0.82)				
105 (1.0)				
125 (1.2)	11 *(15.0P)		18 *(27.5P)	
155 (1.5)				
185 (1.8)		10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)	6 *(22.5P)	8 *(27.5P)		
475 (4.7)				
565 (5.6)				
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

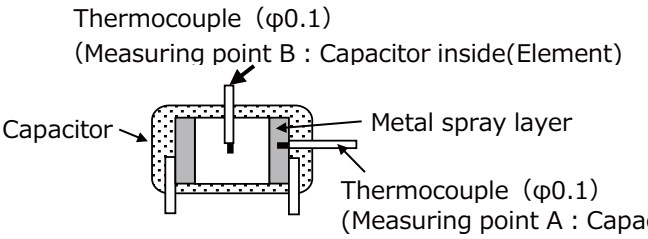
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

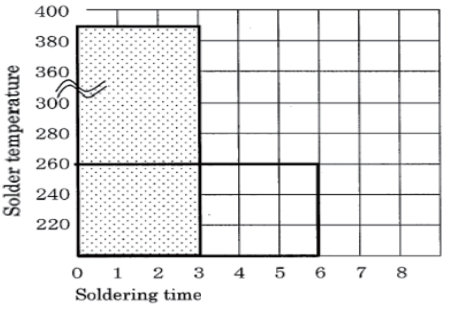
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

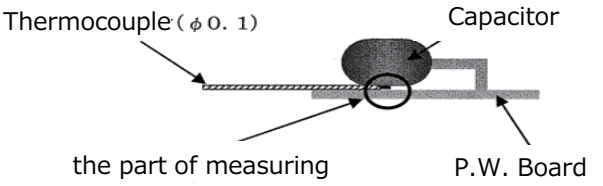
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

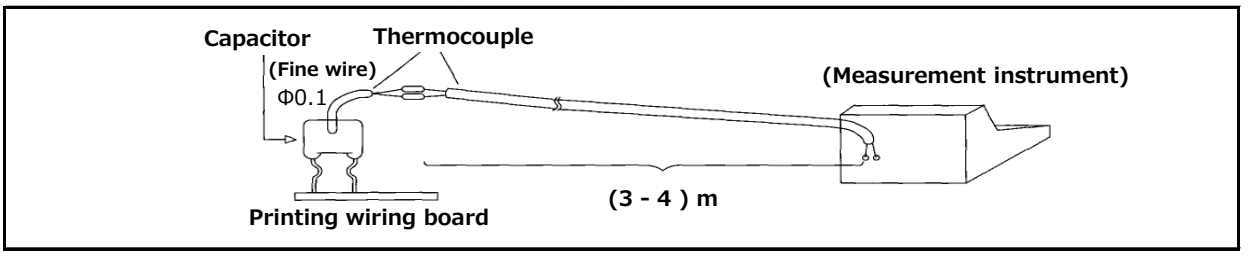
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

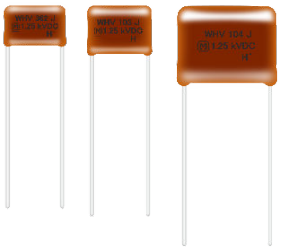
- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.

■ AEC-Q200 compliant

The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

Panasonic INDUSTRY

Plastic Film Capacitors



Metallized Polypropylene Film Capacitor

ECWH(V) series

Non-inductive construction using metallized polypropylene film with flame retardant epoxy resin coating

Features

- Low-loss
- Excellent electrical characteristics
- Flame retardant epoxy resin coating
- RoHS compliant

Recommended applications

- High frequency high voltage circuit (General resonance, inverter circuit)

Explanation of part number

1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	H							V	
Product code		Dielectric & construction		Rated voltage		Capacitance			Cap. Tol.	Suffix 1	Suffix 2

Code	R.voltage [DC]
10	1000 V
12	1250 V
16	1600 V
20	2000 V

Code	Cap. Tol.
H	±3 %
J	±5 %

Code	Lead form
Blank	Straight
B	Crimped lead
C	Cut lead

■ Odd size taping

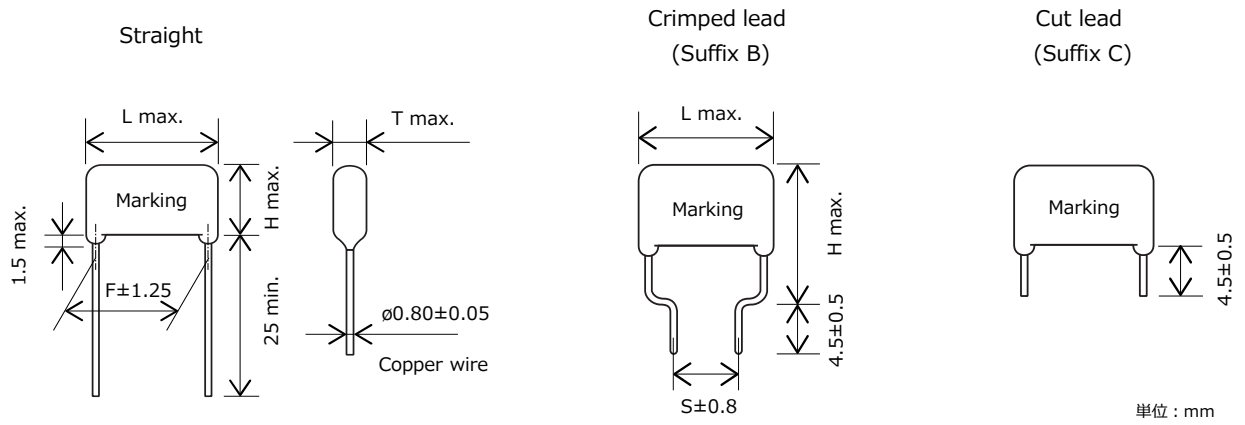
1	2	3	4	5	6	7	8	9	10	11	12
E	C	W	H						R		V
Product code		Dielectric & construction		Rated voltage		Capacitance			Odd taping	Cap. Tol.	Suffix

Specifications

Category temp. range (Including temperature-rise on unit surface)	−40 ℃ to +105 ℃		
Rated voltage [DC]	1000 V	–	(Derating of rated voltage by 1.25 %/℃ at more than 85 ℃)
	1250 V	1000 Vp-p	
	1600 V	1200 Vp-p	
	2000 V	1500 Vp-p	
Capacitance range	1000 V	0.0075 μF to 0.10 μF	
	1250 V	0.0036 μF to 0.10 μF	
	1600 V	0.0013 μF to 0.056 μF	
	2000 V	0.001 μF to 0.015 μF	
Capacitance tolerance	±3% (H)、±5 % (J)		
Dissipation factor (tan δ)	tan δ ≦ 0.1 % (20 ℃, 1 kHz)		
	tan δ ≦ 0.2 % (20 ℃, 10 kHz)		
Withstand voltage	Between terminals : Rated volage (V) × 150 % 60 s Between terminals toenclosure : 1500 V [AC] 60 s		
Insulation resistance (IR)	IR ≧ 30,000 MΩ (20 ℃, 500 V, 60 s)		

＊ In case of applying voltage in alternating current (50 Hz or 60 Hz sine wave) to a capacitor with DC rated voltage, please refer to the page of “Permissible voltage (R.M.S) in alternating current corresponding to DC rated voltage”.

Dimensions

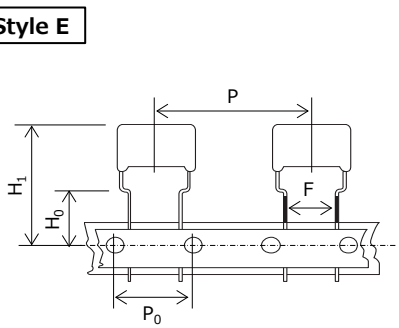


Packaging specifications for bulk package

■ Packing quantity : 100 pcs./bag

Taping specifications for automatic insertion

■ Taping style



Size Unit : mm

	Style
	E
P	30.0
P_0	15.0
F	7.5
H_0	16.0
H_1*	44.0

*:max.

■ Packaging specifications

Series	R.voltage (V) [DC]	Capacitance range (μF)	Taping style E	Packing	Suffix
ECWH(V)	1000	0.0075 to 0.10	○	Ammo	R( ) V
	1250	0.0036 to 0.051	○	Ammo	R( ) V
	1600	0.0013 to 0.020	○	Ammo	R( ) V
	2000	0.0010 to 0.015	○	Ammo	R( ) V

See the column “Rating · Dimensions · Quantity” for packing quantity.

● Lead spacing

Style	Lead spacing
E	7.5

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 1000 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capaci-tance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L max.	T max.	H max.		F	S	ød	Taping	Bulk
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight・Crimped lead
ECWH10752□V( )	0.0075	18.0	6.0	12.5	17.5	15.0	10.0	0.8	500	500
ECWH10822□V( )	0.0082	18.0	6.0	12.5	17.5	15.0	10.0	0.8		
ECWH10912□V( )	0.0091	18.0	6.0	13.0	18.0	15.0	10.0	0.8		
ECWH10103□V( )	0.010	18.0	6.5	13.0	18.0	15.0	10.0	0.8		
ECWH10113□V( )	0.011	18.0	6.5	13.5	18.5	15.0	10.0	0.8		
ECWH10123□V( )	0.012	18.0	6.5	13.5	18.5	15.0	10.0	0.8		
ECWH10133□V( )	0.013	18.0	7.0	13.5	18.5	15.0	10.0	0.8		
ECWH10153□V( )	0.015	18.0	7.0	14.0	19.0	15.0	10.0	0.8		
ECWH10163□V( )	0.016	18.0	7.5	14.0	19.0	15.0	10.0	0.8		
ECWH10183□V( )	0.018	18.0	7.5	14.5	19.5	15.0	10.0	0.8		
ECWH10203□V( )	0.020	18.0	8.0	15.0	20.0	15.0	10.0	0.8	400	
ECWH10223□V( )	0.022	18.0	8.5	15.0	20.0	15.0	10.0	0.8		
ECWH10243□V( )	0.024	18.0	8.5	15.5	20.5	15.0	10.0	0.8		
ECWH10273□V( )	0.027	18.0	9.0	16.0	21.0	15.0	10.0	0.8	300	
ECWH10303□V( )	0.030	18.0	9.5	16.5	21.5	15.0	10.0	0.8		
ECWH10333□V( )	0.033	23.0	7.5	16.0	21.0	20.0	15.0	0.8	400	
ECWH10363□V( )	0.036	23.0	7.5	16.0	21.0	20.0	15.0	0.8		
ECWH10393□V( )	0.039	23.0	8.0	16.5	21.5	20.0	15.0	0.8		
ECWH10433□V( )	0.043	23.0	8.5	16.5	21.5	20.0	15.0	0.8		
ECWH10473□V( )	0.047	23.0	8.5	17.0	22.0	20.0	15.0	0.8		
ECWH10513□V( )	0.051	23.0	9.0	17.5	22.5	20.0	15.0	0.8	300	
ECWH10563□V( )	0.056	23.0	9.5	17.5	22.5	20.0	15.0	0.8		
ECWH10623□V( )	0.062	23.0	9.5	18.0	23.0	20.0	15.0	0.8		
ECWH10683□V( )	0.068	23.0	10.0	19.0	24.0	20.0	15.0	0.8		
ECWH10753□V( )	0.075	23.0	10.5	19.5	24.5	20.0	15.0	0.8		
ECWH10823□V( )	0.082	23.0	11.0	20.0	25.0	20.0	15.0	0.8		
ECWH10913□V( )	0.091	23.0	11.5	20.5	25.5	20.0	15.0	0.8		
ECWH10104□V( )	0.10	23.0	12.0	21.0	26.0	20.0	15.0	0.8		

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 1250 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capaci-tance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	ød	Taping	Bulk	
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight	Crimped lead
ECWH12362□V( )	0.0036	18.0	6.0	12.5	17.5	15.0	10.0	0.8	500	500	500
ECWH12392□V( )	0.0039	18.0	6.0	12.5	17.5	15.0	10.0	0.8			
ECWH12432□V( )	0.0043	18.0	6.0	13.0	18.0	15.0	10.0	0.8			
ECWH12472□V( )	0.0047	18.0	6.0	13.0	18.0	15.0	10.0	0.8			
ECWH12512□V( )	0.0051	18.0	6.5	13.0	18.0	15.0	10.0	0.8			
ECWH12562□V( )	0.0056	18.0	6.5	13.5	18.5	15.0	10.0	0.8			
ECWH12622□V( )	0.0062	18.0	6.5	13.5	18.5	15.0	10.0	0.8			
ECWH12682□V( )	0.0068	18.0	7.0	13.5	18.5	15.0	10.0	0.8			
ECWH12752□V( )	0.0075	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH12822□V( )	0.0082	18.0	7.5	14.0	19.0	15.0	10.0	0.8			
ECWH12912□V( )	0.0091	18.0	7.5	14.5	19.5	15.0	10.0	0.8			
ECWH12103□V( )	0.010	18.0	8.0	15.0	20.0	15.0	10.0	0.8	400		
ECWH12113□V( )	0.011	18.0	8.5	15.0	20.0	15.0	10.0	0.8			
ECWH12123□V( )	0.012	18.0	8.5	15.5	20.5	15.0	10.0	0.8			
ECWH12133□V( )	0.013	18.0	9.0	15.5	20.5	15.0	10.0	0.8			
ECWH12153□V( )	0.015	18.0	9.5	16.0	21.0	15.0	10.0	0.8			
ECWH12163□V( )	0.016	23.0	7.5	16.0	21.0	20.0	15.0	0.8	500		
ECWH12183□V( )	0.018	23.0	7.5	16.0	21.0	20.0	15.0	0.8			
ECWH12203□V( )	0.020	23.0	8.0	16.5	21.5	20.0	15.0	0.8	400		
ECWH12223□V( )	0.022	23.0	8.5	16.5	21.5	20.0	15.0	0.8			
ECWH12243□V( )	0.024	23.0	8.5	17.0	22.0	20.0	15.0	0.8			
ECWH12273□V( )	0.027	23.0	9.0	17.5	22.5	20.0	15.0	0.8			
ECWH12303□V( )	0.030	23.0	9.5	18.0	23.0	20.0	15.0	0.8			
ECWH12333□V( )	0.033	23.0	10.0	18.5	23.5	20.0	15.0	0.8	300		
ECWH12363□V( )	0.036	23.0	10.0	19.0	24.0	20.0	15.0	0.8			
ECWH12393□V( )	0.039	23.0	10.5	19.5	24.5	20.0	15.0	0.8			
ECWH12433□V( )	0.043	23.0	11.0	20.0	25.0	20.0	15.0	0.8			
ECWH12473□V( )	0.047	23.0	11.5	20.5	25.5	20.0	15.0	0.8			
ECWH12513□V( )	0.051	23.0	12.0	21.0	26.0	20.0	15.0	0.8			
ECWH12563□V( )	0.056	28.0	11.5	20.0	25.0	25.0	17.5	0.8	–		
ECWH12623□V( )	0.062	28.0	12.0	21.0	26.0	25.0	17.5	0.8			
ECWH12683□V( )	0.068	28.0	12.5	21.5	26.5	25.0	17.5	0.8			
ECWH12753□V( )	0.075	28.0	13.5	22.0	27.0	25.0	17.5	0.8			
ECWH12823□V( )	0.082	28.0	14.0	22.5	27.5	25.0	17.5	0.8			
ECWH12913□V( )	0.091	28.0	14.5	23.0	28.0	25.0	17.5	0.8		400	
ECWH12104□V( )	0.10	28.0	15.5	24.0	29.0	25.0	17.5	0.8			

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 1600 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capaci-tance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)		
		L max.	T max.	H max.		F	S	ød	Taping	Bulk	
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight	Crimped lead
ECWH16132□V( )	0.0013	18.0	6.5	13.0	18.0	15.0	10.0	0.8	500	500	500
ECWH16152□V( )	0.0015	18.0	6.5	13.5	18.5	15.0	10.0	0.8			
ECWH16162□V( )	0.0016	18.0	7.0	13.5	18.5	15.0	10.0	0.8			
ECWH16182□V( )	0.0018	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH16202□V( )	0.0020	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH16222□V( )	0.0022	18.0	6.5	13.5	18.5	15.0	10.0	0.8			
ECWH16242□V( )	0.0024	18.0	7.0	13.5	18.5	15.0	10.0	0.8			
ECWH16272□V( )	0.0027	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH16302□V( )	0.003	18.0	7.5	14.0	19.0	15.0	10.0	0.8	400		
ECWH16332□V( )	0.0033	18.0	7.5	14.5	19.5	15.0	10.0	0.8			
ECWH16362□V( )	0.0036	18.0	7.0	13.5	18.5	15.0	10.0	0.8	500		
ECWH16392□V( )	0.0039	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH16432□V( )	0.0043	18.0	7.0	14.0	19.0	15.0	10.0	0.8			
ECWH16472□V( )	0.0047	23.0	6.5	14.5	19.5	20.0	15.0	0.8			
ECWH16512□V( )	0.0051	23.0	6.5	15.0	20.0	20.0	15.0	0.8			
ECWH16562□V( )	0.0056	23.0	6.5	15.0	20.0	20.0	15.0	0.8			
ECWH16622□V( )	0.0062	23.0	7.0	15.0	20.0	20.0	15.0	0.8			
ECWH16682□V( )	0.0068	23.0	7.0	15.5	20.5	20.0	15.0	0.8			
ECWH16752□V( )	0.0075	23.0	7.5	15.5	20.5	20.0	15.0	0.8	400		
ECWH16822□V( )	0.0082	23.0	7.5	16.0	21.0	20.0	15.0	0.8			
ECWH16912□V( )	0.0091	23.0	8.0	16.0	21.0	20.0	15.0	0.8			
ECWH16103□V( )	0.010	23.0	8.0	16.5	21.5	20.0	15.0	0.8			
ECWH16113□V( )	0.011	23.0	8.5	17.0	22.0	20.0	15.0	0.8			
ECWH16123□V( )	0.012	23.0	9.0	17.0	22.0	20.0	15.0	0.8	300		
ECWH16133□V( )	0.013	23.0	9.0	17.5	22.5	20.0	15.0	0.8			
ECWH16153□V( )	0.015	23.0	9.5	18.0	23.0	20.0	15.0	0.8			
ECWH16163□V( )	0.016	23.0	10.0	18.5	23.5	20.0	15.0	0.8			
ECWH16183□V( )	0.018	23.0	10.5	19.5	24.5	20.0	15.0	0.8			
ECWH16203□V( )	0.020	23.0	11.0	20.0	25.0	20.0	15.0	0.8			
ECWH16223□V( )	0.022	28.0	9.5	18.0	23.0	25.0	17.5	0.8	–		
ECWH16243□V( )	0.024	28.0	10.0	18.5	23.5	25.0	17.5	0.8			
ECWH16273□V( )	0.027	28.0	10.5	19.5	24.5	25.0	17.5	0.8			
ECWH16303□V( )	0.030	28.0	11.0	20.0	25.0	25.0	17.5	0.8			
ECWH16333□V( )	0.033	28.0	11.5	20.5	25.5	25.0	17.5	0.8			
ECWH16363□V( )	0.036	28.0	12.5	21.5	26.5	25.0	17.5	0.8			
ECWH16393□V( )	0.039	28.0	13.5	22.0	27.0	25.0	17.5	0.8			
ECWH16433□V( )	0.043	28.0	14.5	22.5	27.5	25.0	17.5	0.8			
ECWH16473□V( )	0.047	28.0	15.0	23.5	28.5	25.0	17.5	0.8			
ECWH16513□V( )	0.051	28.0	15.5	24.0	29.0	25.0	17.5	0.8		400	
ECWH16563□V( )	0.056	28.0	16.0	24.5	29.5	25.0	17.5	0.8			

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Rating · Dimensions · Quantity

■ Rated voltage [DC] : 2000 V, Capacitance tolerance : ±3 %(H), ±5 %(J)

Part No.	Capaci-tance (μF)	Dimensions (mm)							Min. order Q'ty (PCS)	
		L max.	T max.	H max.		F	S	ød	Taping	Bulk
				Straight	Crimped lead	Straight	Crimped lead		7.5 mm	Straight・Crimped lead
ECWH20102□V( )	0.0010	18.0	6.5	13.5	18.5	15.0	10.0	0.8	500	500
ECWH20112□V( )	0.0011	18.0	6.5	13.5	18.5	15.0	10.0	0.8		
ECWH20122□V( )	0.0012	18.0	7.0	13.5	18.5	15.0	10.0	0.8		
ECWH20132□V( )	0.0013	18.0	7.0	14.0	19.0	15.0	10.0	0.8		
ECWH20152□V( )	0.0015	18.0	7.5	14.0	19.0	15.0	10.0	0.8	400	
ECWH20162□V( )	0.0016	18.0	7.5	14.5	19.5	15.0	10.0	0.8		
ECWH20182□V( )	0.0018	18.0	8.0	14.5	19.5	15.0	10.0	0.8		
ECWH20202□V( )	0.0020	18.0	8.0	15.0	20.0	15.0	10.0	0.8		
ECWH20222□V( )	0.0022	18.0	8.5	15.0	20.0	15.0	10.0	0.8		
ECWH20242□V( )	0.0024	18.0	8.5	15.5	20.5	15.0	10.0	0.8		
ECWH20272□V( )	0.0027	18.0	9.0	16.0	21.0	15.0	10.0	0.8	300	
ECWH20302□V( )	0.0030	18.0	9.5	16.0	21.0	15.0	10.0	0.8		
ECWH20332□V( )	0.0033	18.0	8.5	15.5	20.5	15.0	10.0	0.8	400	
ECWH20362□V( )	0.0036	18.0	9.0	15.5	20.5	15.0	10.0	0.8	300	
ECWH20392□V( )	0.0039	18.0	9.0	16.0	21.0	15.0	10.0	0.8		
ECWH20432□V( )	0.0043	18.0	9.5	16.0	21.0	15.0	10.0	0.8		
ECWH20472□V( )	0.0047	23.0	7.0	15.5	20.5	20.0	15.0	0.8	500	
ECWH20512□V( )	0.0051	23.0	7.5	16.0	21.0	20.0	15.0	0.8	400	
ECWH20562□V( )	0.0056	23.0	7.5	16.0	21.0	20.0	15.0	0.8		
ECWH20622□V( )	0.0062	23.0	8.0	16.5	21.5	20.0	15.0	0.8		
ECWH20682□V( )	0.0068	23.0	8.5	16.5	21.5	20.0	15.0	0.8		
ECWH20752□V( )	0.0075	23.0	9.5	18.0	23.0	20.0	15.0	0.8	300	
ECWH20822□V( )	0.0082	23.0	10.0	18.0	23.0	20.0	15.0	0.8		
ECWH20912□V( )	0.0091	23.0	10.0	19.0	24.0	20.0	15.0	0.8		
ECWH20103□V( )	0.010	23.0	10.5	19.5	24.5	20.0	15.0	0.8		
ECWH20113□V( )	0.011	23.0	11.0	20.0	25.0	20.0	15.0	0.8		
ECWH20123□V( )	0.012	23.0	11.5	20.5	25.5	20.0	15.0	0.8		
ECWH20133□V( )	0.013	23.0	12.0	21.0	26.0	20.0	15.0	0.8		
ECWH20153□V( )	0.015	23.0	12.0	21.5	26.5	20.0	15.0	0.8		

* □ : Capacitance tolerance code
() : Suffix for lead crimped or taped type

Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications. Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.

- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation. Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.

- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.

- The products and product specifications described in this online catalog are subject to change for improvement without prior notice. Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.

- The technical information in this online catalog provides examples of our products' typical operations and application circuits. We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.

- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance with the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.

- When you use the inventory of our products for which it is unclear whether those products are compliant with the RoHS Directive/REACH Regulation, please select "Sales Inquiry" in the website inquiry form and contact us.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

PRECAUTION AND WARNING

- Please consult us in case that demand the specification of our company without fail and do the confirmation of the use condition and that exceeds the entry value and be indistinct when you use it.
- The film capacitors contain a film based dielectric which may be flammable under certain operating conditions. When in use, they can either emit smoke and/or ignite should the product be defective. It is recommended covering the surrounding resin with flame-resistant materials or case as needed particularly.
- In the event of troubles of other parts on the circuit such as shortening and opening, provide with proper means for preventing excessive voltage, current or temperature exceeding the rating from being applied to the film capacitor.
- Prior to use, please make sure that failure of the film capacitors does not have any negative effects on other surrounding electronic circuit components and devices that would possibly cause damage. Proper safety measures should be taken using fail-safe protective circuit designs to help prevent other devices of becoming unsafe.

  Example:
  a. State in which basic performance of automobiles (run, turn and stop)
  b. False operations
  c. Smoke emission/ignitions
- The Film Capacitor listed in this catalog(except for automotive series) are designed and manufactured specifically for general electronic devices, including audio-video equipment, home appliance, office equipment and data communication equipment etc.. Accordingly, it is strongly recommended that the user contact us in advance it the parts are to be used for the following devices(items 1 -12), which require having advanced security measures. The capacitor for automotive can be used for automobiles such as xEV.

  (1) Transport Equipment (motor vehicles, airplanes, trains, ships, traffic signal controllers)
  (2) Medical Equipment (life-support equipment, pacemakers for the heart, dialysis controllers)
  (3) Aircraft Equipment, Aerospace Equipment (airplanes, artificial satellites, rockets, etc.)
  (4) Submarine Equipment (submarine repeating equipment, etc.)
  (5) Generation Control Equipment (equipment for atomic/hydraulic/heat power plants)
  (6) Information Processing Equipment (large scale computer system)
  (7) Electric Heating Appliance, Burning Apparatus
  (8) Rotary Motion Equipment
  (9) Security Systems
  (10) Robots
  (11) Lighting Equipment
  (12) And any similar types of equipment
- If used in a specific appliance that requires an extremely high reliability directly relating with any life-supporting equipment like electronic aviation controllers, automotive driving controllers and engine controllers, please consult us and use within the conditions designated in the specification. However the chip type capacitor should not be used in these appliances.

Note:

1. Technical information in this catalog is intended to convey examples of typical performances and/or applications, and is not intended to convey patents rights, if any.
2. For the products, which are controlled items subject to the Foreign Exchange and Foreign Trade Control Law, the export permission according to the Law is necessary.
3. Note of ozone depleting substances of class1 (ODS) under the Montreal Protocol is used in manufacturing process of Device Solutions Business Division, Panasonic Corporation.

⚠Guidelines and precautions (Common)

(Target product：ECQE、ECWF、ECWH、ECQU、ECHU、ECWU、ECPU)

1. Operating voltage

For the film capacitor varies the maximum applicable voltage depending on the applied voltage waveform, current waveform, frequency, ambient temperature (capacitor surface temperature), capacitance value, etc. Use within the specified values by checking the voltage waveform, current waveform, and frequency applied to both ends of the capacitor prior to use. (In the case of high frequency, the permissible voltage varies with the type of the capacitor. For details please see the relevant specifications.)

1.1 Rated voltage (Note 1)

- The rated voltage refers to the maximum voltagethat can be applied continuously within the category temperature range. If used beyond the rating, it may induce insulation breakdown of the film and cause short circuit. The product lifetime abut the maximum rated condition depends on the kind of the capacitor.
- In a metalized capacitor, which has a self-healing action, short circuit or other failure may not occur immediately after application of a voltage over the rated voltage, but the insulation resistance is lowered, and it may lead to smoke or fire depending on the circuit conditions.
- A noise suppression capacitor (AC rated voltage) should not be used at high frequency circuit.
  Smoke and ignition may be caused by conditions for use.
- The rated voltage of the capacitor for electronic appliance is usually indicated in the DC voltage except for special purposes.

1.2 Derating of rated voltage where operating temperature is high

In film capacitors, the usable upper limit temperature (the capacitor surface temperature) is determined by the kind of dielectric materials.

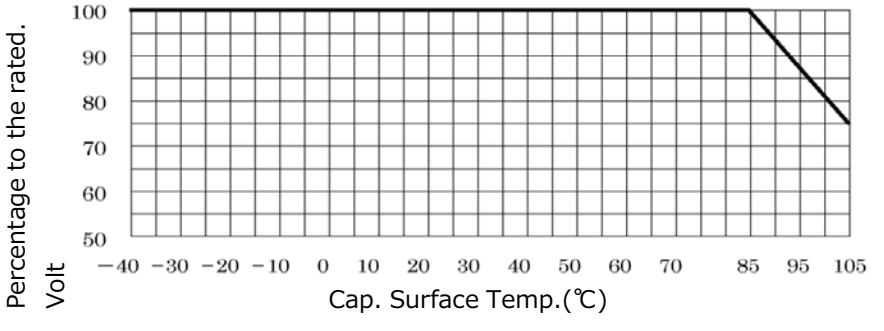
When used beyond the rated upper limit temperature (usable upper limit temperature), it is necessary to voltage derate the in certain types (models), while other types (models) cannot be used beyond the rated upper limit temperature. Be sure to confirm the type of capacitors before using, and when using beyond the rated upper limit temperature, be sure to reduce the voltage and make sure the capacitor surface temperature is within the usable upper limit temperature as below. When using at high frequency, however, since the capacitor itself has its own temperature rise, and hence the following derating ratio cannot be applied.

<Rated upper limit temperature, Upper category temperature, and derating ratio of upper category temperature by types in DC use> (Example)

Dielectric	Type	Rated upper limit temperature	Upper category temperature	Rated voltage by the temperature beyond Rated upper limit temperature
Polyester(PET)	ECQE(F) ECQE(B) ECQE(T)	85℃	105℃	1.25%/℃
Polypropylene (PP)	ECWF(A) rated voltage DC250V ECWF(L) ECWH(A) ECWH(C)	105℃	105℃	No need derating of rated voltage
	ECWF(A) rated voltage DC450V ECWF(A) rated voltage DC630V ECWH(V) ECWFE rated voltage DC450V	85℃	105℃	1.25%/℃
	ECWFD rated voltage DC630V ECWFE rated voltage DC630V	85℃	105℃	1.0%/℃
	ECWFD rated voltage DC450V	85℃	110℃	0.62%/℃
	ECWFG rated voltage DC630V	85℃	110℃	1.0%/℃
polyethylene naphthalate(PPS)	ECWU(X)	105℃	105℃	No need derating of rated voltage
	ECWU(C)	85℃	125℃	1.25%/℃
	ECWU(V16)	85℃	85℃	No need derating of rated voltage
polyphenylene sulfide(PPS)	ECHU(X) rated voltage DC16V ECHU(X) rated voltage DC50V (capacitance 0.0001μF～0.10μF)	125℃	125℃	No need derating of rated voltage
	ECHU(X) rated voltage DC50V (capacitance 0.12μF～0.22μF)	105℃	125℃	1.25%/℃
	ECHU(C)	105℃	105℃	No need derating of rated voltage
Acrylic resin	ECPU(A)	85℃	85℃	No need derating of rated voltage

・ The AC rated voltage items are unnecessary for voltage derating by the temperature.
Rated upper limit temperature : The upper limit temperature which can't reduce the voltage and can use continuously. (including own temperature rise)
Upper category temperature : The upper limit temperature which can reduce the voltage and use continuously. (including own temperature rise)

● **(Example)** Derating of rated voltage to operating temperature. Rated upper limit temperature 85℃, Upper category temperature 105℃, Derating of rated voltage to which is 1.25 %/℃ at more than 85 ℃



1.3 Permissible voltage (R.M.S) in current corresponding to DC Rated Voltage

- A noise suppression capacitor (AC rated voltage) should be used at the primay side power supplies. The design which premised on use by 50Hz or 60Hz sine wave.
- In case of applying voltage in alternating current (50Hz or 60Hz sine wave) to a capacitor, permissible voltage(R.M.S).The capacitor of DC rating should not be used at the primary side power supplies.

1.4 Derating of rated voltage when using at high frequency

When using at high frequency, there is a risk of thermal runaway (smoke, fire) due to self heat generation in the capacitor. Derate the operating voltage according to the example below.

For use at high frequency, we recommend ECHU(X)/(C), ECWF(A)/(L), and ECWH(A)/(C)/(V) types.

<Derating example of operating voltage>

Capacitor used : ECWF2154JA (250 VDC, 0.15 μF)

Operating frequency : 40 kHz (sine wave)

Permissible current (entry the value from specification) : 40 kHz, 2.0 Arms

$$V = \frac{I}{2\pi fC} = \frac{2.0}{2\times 3.14\times 40\times 10^{3}\times 0.15\times 10^{-6}} = 53 \text{ Vrms}$$

Therefore, the operating voltage at sine wave 40 kHz is lower than to 53 Vrms (derating ratio 58%), as compared with AC permitted voltage of 125 Vrms at commercial frequency.

(It is necessary to derate until the self heating temperature rise of the capacitor is below the specified value.)

Notes

(1) Use the peak value (Vo-p) of the Pulse voltage applied between the both terminals of the capacitor within the DC rated voltage.

(2) When using at high frequency, it may lead to breakdown due to withstand voltage deterioration by self heat generation. Therefore, measure the self heating temperature rise value of the capacitor, and make sure it is within the specified.

(3) Protection for safety should be required in the case of the voltage over the rated voltage (permitted voltage) may be applied to the capacitor due to abnormal action such as trouble elsewhere in the circuit.

2. Permitted current

Film capacitors are low in internal impedance, and hence a very large current may flow depending on the circuit. In particular, when turning power switch on and off, make sure a very high pulse current may flow.

When a current exceeding the permissible range flows into capacitor, this can cause the capacitance value to deteriorate or an open circuit condition, temperature rise occurs due to self heat generation, this cause can deterioration of withstand voltage and result in short circuit, possibly leading to smoke or fire.

In the application, make sure current is within permissible current or self heating temperature is within permissible self heating temperature rise limit shown on each delivery specifications.

2.1 Permissible current

The permissible current must be considered by dividing into pulse current (peak current) and continuous current (rms current) depending on the breakdown mode, and when using, therefore, make sure the both currents are within the permissible values.

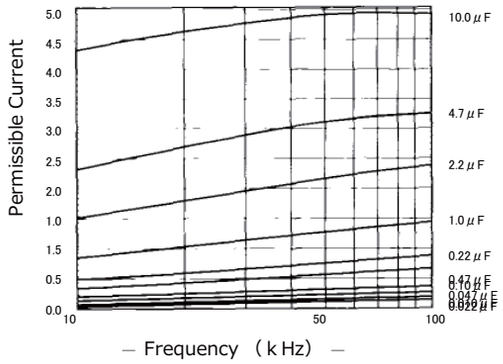
2.2 Permissible current to operating frequency

The film capacitor varies in the frequency characteristic of the dissipation factor (tanδ) depending on the dissipation factor, and hence the permissible rms current for operating frequency differs depending on the capacitor type. In particular, when operating at high frequency, the dissipation factor (tanδ) increases, and when using over the permissible current, it may include the thermal runaway, possibly leading to smoke or fire. Shown below are typical examples of permissible current by frequency (rms value) of the ECQE(F) type using polyester film and ECWF(A) type using polypropylene film. For detail inquire us by presenting the operating conditions, or make sure the own temperature rise of the capacitor and the capacitor surface temperature are within the permissible range in the worst operating conditions.

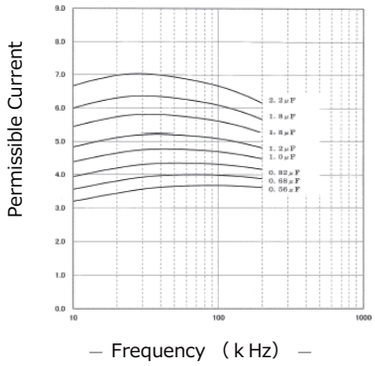
2.3 The capacitance and the permissible currents

The permissible rms current varies with the capacitance value. The permissible current (rms) values by the frequencies and by the capacitance of representative types are shown below. In actual use, inquire us for detail by measuring the voltage and current waveforms, ambient temperature, and own temperature rise.

Type : ECQE(F) (Polyester)
Rated Voltage : 250 VDC ⇒ 150 Vrms 60Hz (at sine wave)
Operating temp. : - 40 ℃ to 85 ℃ (Cap. surface)



Type : ECWF (A) (Polypropylene)
Rated Voltage : 250 VDC ⇒ 125 Vrms 60Hz (at sine wave)
Operating temp. : - 25 ℃ to 85 ℃ (Cap. surface)



(Note)
The graphs illustrated are for reference only. Waveform of current and temperature rise of capacitor are key factors to determine permissible current. For actual application, consult our sales representative or sales office.

2.4 Permissible current to pulse current

- When used in switching circuits or snubber circuits a momentary high current pulse may cause local heat generation. This causing the capacitance value to deteriorate or an open circuit condition.
  Local heat generation may also induce smoke or fire.
  The pulse permissible current (10000 times) isobtained by the product of dV/dt (V/μs) value that is entering to the specification and capacitance (μF).
- The dV/dt (V/μs) value of a film capacitor is determined by the element structure, and in the metalized type, in particular, the internal evaporated electrode and external takeout electrode are connected by metalized contact (metal spraying), and hence due caution is needed because the upper limit of dV/dt value is low.
- The dV/dt values corresponding to rated voltage and capacitance value of representative types are shown in page 6. When used in a high current pulse circuit, check the pulse permissible current (Ao-p).
- Please contact with us, If pulses are applied more than 10,000 times.

<How to determine pulse permissible current>

- When voltage V(V) is applied to capacitor C (F for farad), the electric charge Q(C) is expressed in formula ①.
  Q=C.V.....①
- The charging current I(A)flow in the capacitor at this time is expressed in formula ②.
  I=dQ/dt.....②
- Differentiating both sides of formula ① by timet and putting into formula ② yields formula ③.
  dQ/dt=C.dV/dt
  I=C.dV/dt .....③
- Therefore, the pulse current is determined as theproduct of the capacitance value C (μF) andvoltage change dV/dt per μs.

product of the capacitance value C (μF) and
voltage change dV/dt per μs.
(Example) In the case of ECQE4224KF (permissible dV/dt)
Rated voltage : 400VDC,
Capacitance : 0.22μF,
permissible dV/dt value : 37
pulse permissible current : 0.22 (μF)×37≒8 Ao-p
(however, number of repetitions is 10,000 times or less), that is, momentary pulse current can be used up to 8 Ao-p.
Make sure the rms current is within the permissible value.

[ECQE (F) Permissible dV/dt value<within 10,000pulses>]

Unit : V/μs

(Cap. :μ F)	Type			
	ECQE(F) 100VDC	ECQE(F) 250VDC	ECQE(F) 400VDC	ECQE(F) 630VDC
103 (0.010)				
123 (0.012)				
153 (0.015)				
183 (0.018)				
223 (0.022)				
273 (0.027)				
333 (0.033)			131 *(7.5P)	273 *(10.0P)
393 (0.039)		48		
473 (0.047)				
563 (0.056)			78 *(10.0P)	
683 (0.068)				116 *(15.0P)
823 (0.082)				
104 (0.10)				
124 (0.12)				
154 (0.15)		*(7.5P)		
184 (0.18)				
224 (0.22)		33 *(10.0P)	37 *(15.0P)	
274 (0.27)				
334 (0.33)				63 *(22.5P)
394 (0.39)				
474 (0.47)				
564 (0.56)		18 *(15.0P)		
684 (0.68)	22 *(10.0P)		22 *(22.5P)	
824 (0.82)				48 *(27.5P)
105 (1.0)				
125 (1.2)			18 *(27.5P)	
155 (1.5)				
185 (1.8)	11 *(15.0P)	10 *(22.5P)		
225 (2.2)				
275 (2.7)				
335 (3.3)				
395 (3.9)				
475 (4.7)				
565 (5.6)	6 *(22.5P)	8 *(27.5P)		
685 (6.8)				
825 (8.2)				
106 (10.0)				

⚠ Caution!
Protective means for safety should be provided in case the pulse and rms current may exceed the

* Asterisk denotes the lead pitch.
The value of dV/dt is mainly determined by the lead spacing (element width) and element sectional area.

3. Operating temperature range

3.1 Own temperature rise

When the film capacitor is used in an AC circuit, especially in high frequency application, the capacitorgenerates heat by itself from the flow of current. If the self heat generation is large, the capacitor may deteriorate, and smoke or fire may be occur. Check the self heating temperature rise value in actual conditions of use, and use within the limit specified.

Measure the own temperature rise value in indoor, wind-free condition.

* The details of self heating temperature rise value are described in the specification. (Please contact us details as the specifies value varies by each type.)

3.2 Operating temperature range

The operating temperature range of the film capacitors varies with the dielectric material (kind of films), and the usable temperature range is specified in the each model.

It must be noted, however, that the temperature range mentioned in the catalogue is the surface temperature of the film capacitor, not the ambient temperature of the capacitor.

In actual use, make sure the sum of the ambient temperature +capacitor's self heating temperature rise value (within specified value), that is, the capacitor surface temperature should be within the rated operating temperature.

⚠ **Caution!**

When used above the specified operating temperature, dissipation factor (tanδ) increase, and the self heat generation may exceed the permissible value, possibly causing deterioration of dielectric film, short circuit, andsmoke or fire.

If there is cooling plate of other part or any resistance heated to high temperature near the film capacitor, the capacitor may be locally heated by the radiation heat, exceeding the operating temperature range, and smoke or fire may be caused.

Check the capacitor surface temperature at the heat source side.

4. Other cautions

4.1 Flame retardation

- The dielectric film is not a flame retardant material.
- In the ECQE , ECWF, and ECWH types, flame retardant epoxy resin (94V-0) is used in the coating resin.

4.2 Environments of use

4.2.1 When used in humid environments

When used for a long period in humidenvironments, the elements absorb moisture through the coating with the passing of the time. The water oxidizes the electrode (evaporated film and metalized contact), and leads to trouble. Also, make sure the capacitance value can be very large depending on type of the capacitor.

4.2.2 When using in high temperature environment

When ECQUG is used in high temperature environment (more than 70℃), it may be possible to cause leaking oil from the capacitor. However, the quality and reliability of the capacitor is not affected by the leaking oil. But, please don't use the part which may cause a point of tact obstacle by oil and this condenser by a same set.

4.2.3 Cautions on gas atmosphere

When using in the oxidizing gas such as hydrogen chloride, hydrogen sulfide and sulfurous acid, the evaporated electrode (Aluminum) or metalized contact (zinc compound) may be oxidized, may result in smoke or fire. Avoid such atmosphere.

4.2.4 When using by resin coating

When using resin coating or resin potting components to improve humidity resistance or gas resistance, or to fix parts in place. Please contact with us.

- The solvent or the constituent in the resin may permeate into the metalized contact or electrode (aluminum foil or evaporated film) to deteriorate characteristics.
- When hardening the resin, chemical reaction heat (curing heat generation) occurs, which may adversely affect the capacitor.
- In the case of the lead type capacitors, be sure to test and evaluate enough for the thermal stress to the capacitor.

4.2.5 Other

- When using in the following conditions, the characteristic may be deterioration. Please don't use at such conditions.
  - ·The place that took water or oil.
  - ·The place that exposed to the direct sunlight.
  - ·The place that radiated ozone, ultraviolet rays and radiation rays.
- Please consider so that dust doesn't collect. That will be the cause of the characteristic deterioration (short circuit, etc.).

4.3 Changes in capacitance value over time

- The capacitor characteristics change characteristic depending on its ambient conditions and environmental conditions. In natural conditions, there is a certain capacitance change due to the humidity of the circumstance. The degree of such capacitance changes varies with the dielectric material, coating material, and structure.Therefore, we ship considering these changes, but we only guarantee capacitance value until delivery (without each arrangements.)
- For use in a circuit where time constant and capacitanceprecision are required, use the products of polypropylene film ECWFD/(A)/(L) , ECWH(A) or film ECHU(X)/(C) which vary less with time.

4.4 Hum (Buzz)

- Hum produced by capacitors due to mechanical vibration of the film is caused by the coulomb force which exists between electrodes of opposite polarity. A louder hum is produced when applied voltage waveform has distortion, and/or higher frequency component, etc. Although Hum does not spoil characteristics of capacitors, when being used around the audio frequency, please check it.

4.5 Storing method, storing conditions

- It must be noted that the solderbility of the external electrodemay deterioratedwhen stored in an atmosphere filled with moisture, dust, or a reactive oxidizing gas (hydrogen chloride, hydrogen sulfide, sulfuric acid).
- Should not location with particularly high temperature and high humidity, and store in conditions not exceeding 35 ℃ and 85 % RH.
- When it is kept for a long term, the solderbility of the external electrode may deteriorate for oxidation of electrode surface.So our recommend keeping-period is within 6month. Further, it's different in the condition depending on the items, so please inquire for details.

4.6 Handling Pre cautions

- Sudden charging or discharging may causedeterioration of capacitor such as shorting and opening due to charging or discharging current. When charging or discharging, pass through a resistance of 20 to 1000 Ω/V or more.
- When connecting multiple film capacitors in parallel inwithstandvoltagetestorlifetest,connecta resistance of 20 to 1000 Ω/V or more in series to each capacitor.
- Be careful not to scratch the capacitor surface with sharp edges (such as screwdriver, soldering iron, pincers, chassis).Don’t apply excessive load to the lead wire (at the time of re-processing of lead wire, etc.).
- If the capacitor is dropped by mistake, its characteristics may be damaged. Don’t use such a capacitor. (If reusing, check the quality sufficiently.)
- In the case of leaded type capacitor, be careful not to apply excessive force to the lead wire root area, which may cause cracking or separation in the coating resin near the root area.
- No dust or water should be permitted to remain on the surface of capacitor terminals as this may cause electrical leakage or corrosion.
- When used for noise suppression between lines and between line to earth when voltage is more than 30VAC and more than 45VDC, covering peripheral resin part by flame retardant material or flame retardant case (for avoiding fire) is recommended.
- Chip type capacitor is developed assuming normal use of surface mounting parts.Abnormal use (ex: piling up two capacitors, mounting capacitor in upright position, etc.) should not be permitted.Please consult us in advance if used in different way from normal.

4.7 Additional Points

- The precautions in using film capacitors follow the JEITA RCR-2350 D “Safety Application Guide for fixd plastic film capacitors for use in electronic equipment”. Please refer to the above guideline.
- Product specifications, materials and other points mentioned in the catalog may be changed without notification.

(Note 1) Rated voltage

The maximum voltage that can be applied continuously in spite of temperature is called as the rated voltage in our company. It's different from the standards of JIS and IEC.

∗ Definition of our company

The maximum voltagethat can be applied continuously within the category temperature range.

∗ Even when needing derating voltage at high temperature, the voltage after derating is called the rated

Therefore the maximum voltage that can be applied continuously at upper category temperature is being also called the rated voltage.

⚠Guidelines and precautions (Lead type)

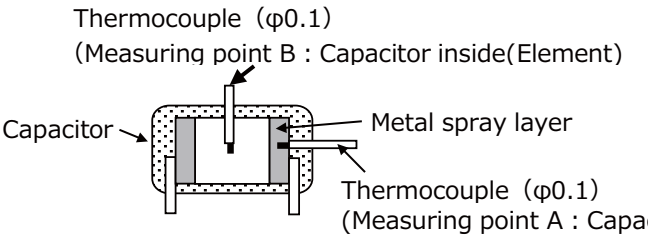
(Target product：ECQE、ECWF、ECWH、ECQU)

1. Soldering

The heat resisting temperature of the film capacitor varies with the type of dielectric film, structure of the capacitor, manufacturing method, etc.

When mounting, set the mounting temperature so that the capacitor inside (element) temperature is be lower than the mounting heat resisting temperature given below.

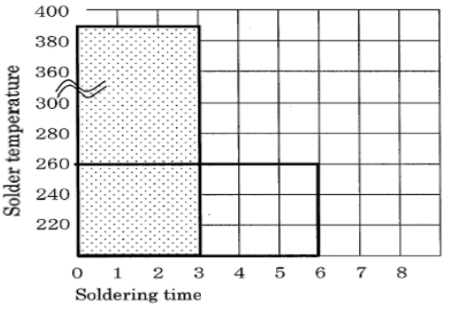
If the capacitors go through the high temperature both after soldering , be sure to check the temperature till decreasing.



Dielectric	Type	Mounting heat resisting temperature	
		Measuring point A	Measuring point B
Polypropylene	ECWF(L) 400V 0.022μF～0.11μF, 630V 0.01μF～0.043μF ECWF(A)	135℃	125℃
	ECWF(L) 400V 0.12μF～2.4μF, 630V 0.047μF～1.3μF ECWFE 630V,ECWFG 630V	145℃	125℃
	ECWH(A) ,ECWH(V), ECWFD 630V	135℃	125℃
	ECWH(C)	140℃	125℃
	ECWFD 450V	135℃	—
	ECQUA,ECWFE 450V	125℃	—
	ECQE(F)	—	120℃
	ECQE(B), ECQE(T), ECQUL, ECQUG	160℃	—

<Cautions for mounting>

- Solder within the following temperature condition range. (Dipping times is within twice, the second dipping should be carried after the capacitor itself has returned to the normal temeprerature)(Example)



Notice:
The soldering condition shows one example. The temperature of the capacitors depend on several parameters for example soldering machine size , machine structure, temperature control method, etc..
Should measure the temperature of the capacitors and confirm the temperature under the above table.

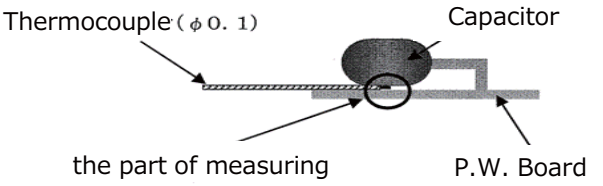
Conditions

P. W. Board	Thickness t= 0.8mm or more
Pre-heating	Measurement temperature 120 ℃ within 1 minute (Back side of the P. W. Board around the capacitor)
Capacitor	Raised from P,W. board (Crimped lead)

- The film capacitor has lower mounting heatresistingtemperature than other capacitors,therefore the following cautions are needed.

  Avoid passing through an adhesive curing oven. After adhesive curing, the capacitor should be inserted in the P.W. board and solder. (When passing an adhesive curing oven, breakage of coating resin or deterioration in capacitor characteristic may be caused.)
- Avoid reflow soldering. (When use in reflow soldering, breakage of coating resin or deterioration in capacitor characteristic may be caused.)

- When using in multilayer Printed wiring board, or in the case of a capacitor with a copper lead wire, please contact with us. (In the case of copper lead wire, the thermal conductivity of the copper wire is high, and the internal temperature of the capacitor rises rapidly and may exceed the mounting heat resisting temperature.)



2. Washing the mounted boards

The film capacitor varies significantly in the effect of washing depending on the structure and material, and generally it is less affected by CFC or alcohol derivative washing solvent, and is likely to be affected by highly polar solvent.

The lead type film capacitor is coated with an epoxy resin excellent in chemical resistance, and is hardly affected by detergent, but it is recommended to be washed for short duration.

Applicability of detergents in film capacitors is listed for reference.

<List of applicability of detergents>

Washing condition			Lead type	Box type ECWFE ECWFG ECQUA ECQUL ECQUG
Solvent	Alcohol	Ethanol Ultrasonic washing or immersion washing for 5 min	○	○
		Isopropyl alcohol (IPA) Ultrasonic washing or immersion washing for 5 min	○	○
	Silicon	FRW-17Ultrasonic washing for 5 min, 60 ℃ ⇒FRW-1NUltrasonic washing for 5 min, 60 ℃ ⇒FRW-100Steam drying for 1 min, 100 ℃	○	○
	Halogen	HCFC141b-MS Ultrasonic washing or immersion washing for 5 min	○	○
	Petroleum hydrocarbon	P3 Cold Cleaner 225S Ultrasonic washing for 5 min 60 ℃ ⇒ IPA ultrasonic rinsing for 5 min at ordinary temperature ⇒ hot air drying for 5 min, 40 ℃	○	○
		Toluene Ultrasonic washing or immersion washing for 5 min	○	○
	Terpene	Terpene Cleaner EC-7 Spray washing for 5 min at ordinary temperature ⇒ purified water spraying for 5 min, 50℃ ⇒ hot air drying for 5 min, 80℃	○	○
Water	Purified water	Ultrasonic washing for 5 min 60 ℃ ⇒ wind-free dryingfor 5 min, 85 ℃	○	○
	Surface active	Clean Through 750H Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Clean Through 750L Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through 710M Ultrasonic washing for 5 min, 60℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	—
		Clean Through LC-841 Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Pine Alpha ST-100S Ultrasonic washing for 5 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
		Aqua Cleaner 210SET Shower washing for 1 min, 60 ℃ ⇒ purified water ultrasonic washing for 5 min, 60 ℃ ⇒ hot air drying for 5 min, 85 ℃	○	○
○ : Washing enabled × : Washing disabled — : Not confirmed				

<Wash-free flux>

Wash-free	Low residue flux	ULF-500VS	○	○
	Inactivated flux	AM-173	○	○

3. Temperature measuring in soldering of film capacitor

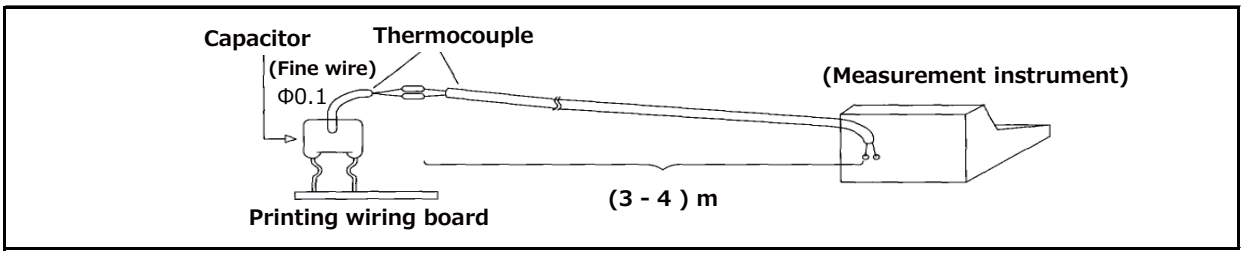
When using film capacitor of low heat resisting temperature in mounting, measure the element temperature profile in mounting in the following manner, and make sure the soldering is done below the heat resisting

<Preparation of measuring sample>

Open a hole of about Φ0.3 mm to 0.8 mm in the top of the capacitor to the middle of the element, and insert thermocouple (Φ0.1T wire), and fix with adhesive.

<Measurement of temperature profile>

As shown below, connect a thermocouple (3 - 4)m of same type as the thermocouple attached to the capacitor, to the thermocouple of the capacitor as shown below. Mount the sample on the mounting printed wiring board, and pass into the soldering andmountingprocess,andmeasurethe temperature profile



4. Capacitor for prevention of AC power supply (across the line) noise

- When using a capacitor across the line as means for prevention of noise, not only is the supply voltage is always applied, but also abnormal surge such as lightning is applied, which may lead to smoke or fire. Therefore, the across-the-line capacitors are strictly regulated in safety standard in each nation, and it is necessary to use the product conforming to the standard.

For using across the line in Japan, use the following models or the above overseas authorized ones.

ECQE(F) 1000VDC (125VAC) rating
ECQE(F) 1250VDC (125VAC) rating
ECQE(F)/(B)/(T) 125VAC (1A) rating
ECQE(F)/(T) 250VAC (2A) rating

However, when using the ECQE(F)1A/2A, ECQE(B)1A , ECQE(T)1A/2A rating model as across-the-line capacitor, at least one of the following conditions must be satisfied.

1. A varistor with the voltage of the value or lessshown in the following table should be connected to the capacitor in parallel.
2. A pulse voltage more than the value shown in the table below should not be applied across the capacitor.

(Note) When using together with varistor, check the varistor specification, and select the one free from surge deterioration

Cap. Rated Voltage	Varistor Voltage	Pulse Voltage
125VAC (1A)	250V	250Vo-p
250VAC (2A)	470V	630Vo-p

When Safety standard approval capacitor is used for necessary equipment, please use items of the following table.

<Representative examples of models authorized in major safety standards in the world>

Shape	Type	Standard
Plastic case type	ECQUA	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUL	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)
Plastic case type	ECQUG	UL 60384-14(USA), CSA E60384-14(Canada), EN 60384-14(Europe)

*Please contact us about CQC(China).

- In the case of the voltage dropper usage, when an abnormal voltage of the surge voltage etc. is applied the capacitance decrease is caused, such as the fuse function in the capacitor operates.In the worst case, the capacitor does not work as voltage dropper. So, please notice an abnormal voltage. At that time, high voltage may be applied to the load side. Therefore, please provide protective means for safety.