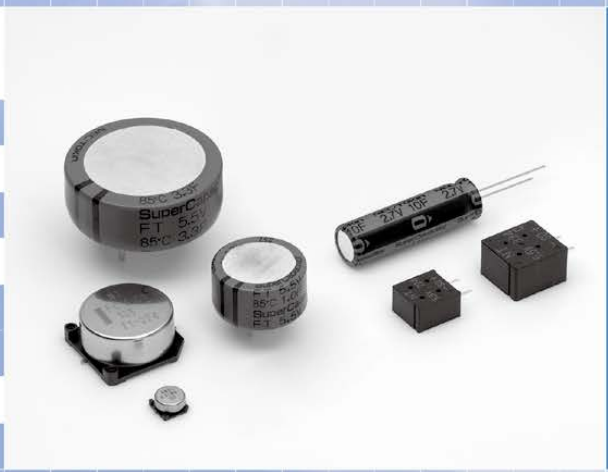
Devices thru Material Innovation

NEC/TOKIN

Vol.14

Super Capacitors



⚠

●All specifications in this catalog and production status of products are subject to change without notice. Prior to the purchase, please contact NEC TOKIN for updated product data.
●Please request for a specification sheet for detailed product data prior to the purchase.
●Before using the product in this catalog, please read "Precautions" and other safety precautions listed in the printed version catalog.

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FOR CORRECT USE OF SUPER CAPACITORS

1. Please confirm the operating conditions and the specifications of the Super Capacitors befor using them.
2. The electrolyte of these Super Capacitors is sealed with material such as rubber. When you use the capacitors for a long time at high temperature, the moisture of the eleotrolyte evaporates and the equivalent series resistance (E.S.R.) increases. The fundamental failure mode is the open mode depending on E.S.R. increase.

   When using a capacitor, please introduce a safe design assuming unexpected capacitor failure, such as redundancy in design and protection from fire and erroneous operation.
3. Please read ‘Notes on Using the Super Capacitor’ on page 60 when you design the circuits using the Super Capacitors.

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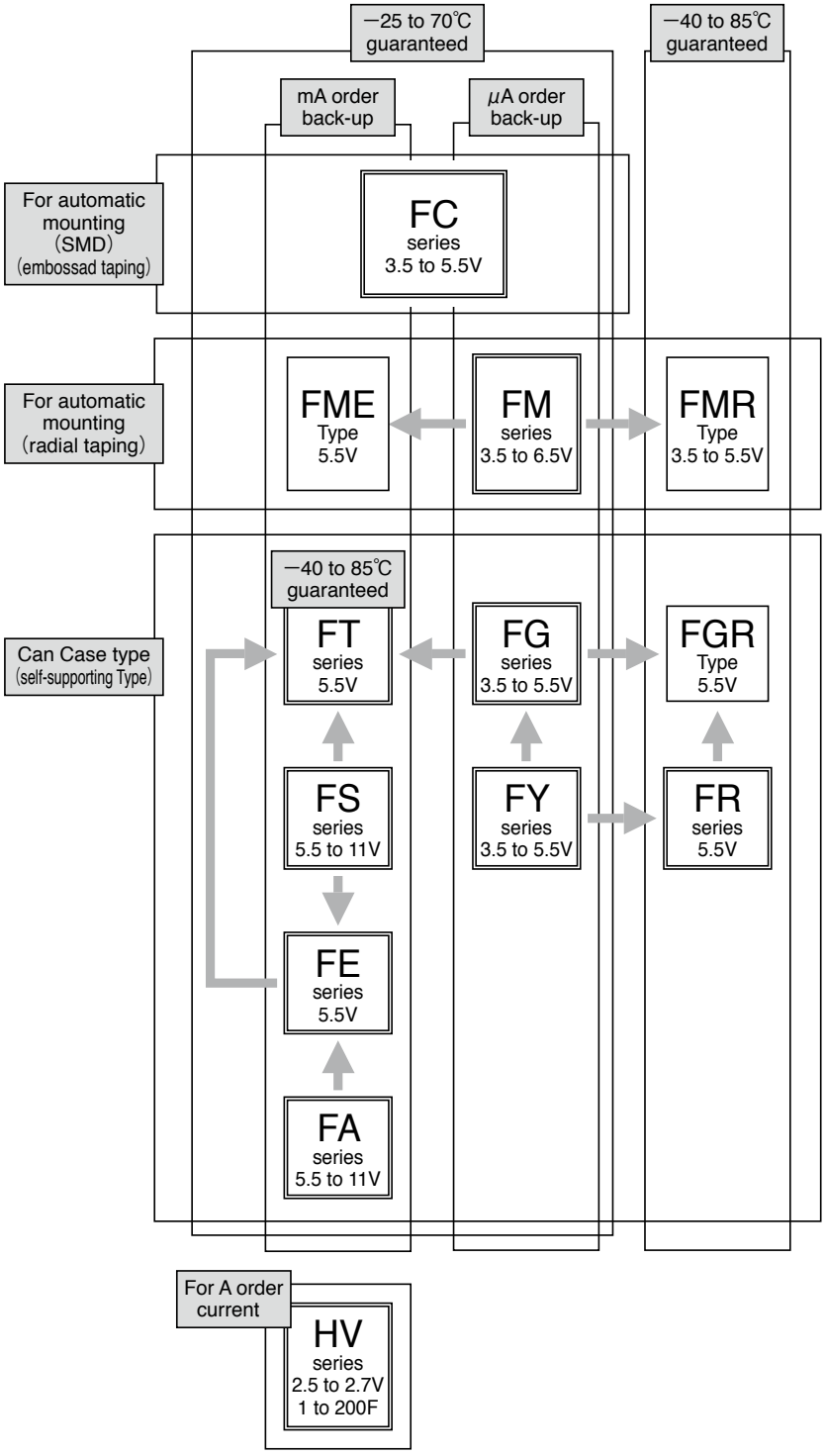
1. Organization of Super Capacitor Series



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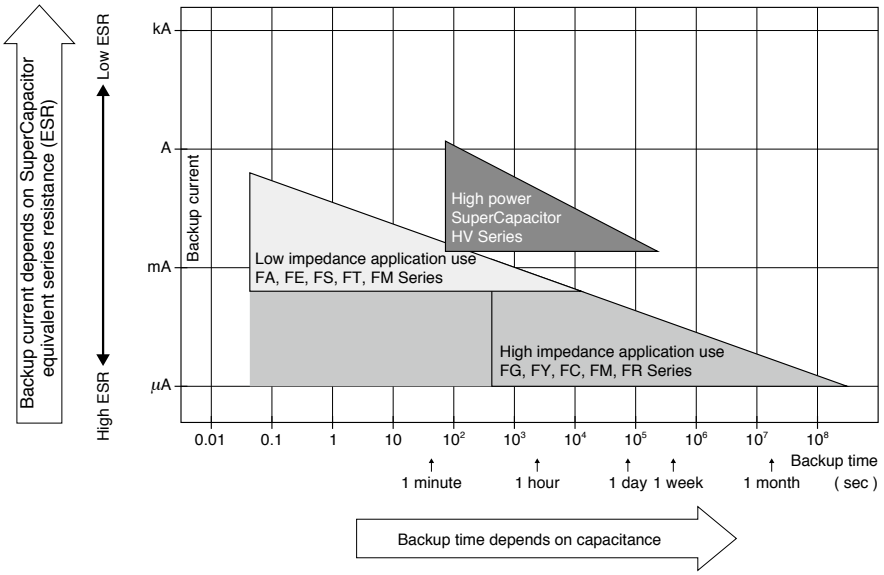
2. Performance for Selection



3. Characteristics of Super Capacitor

Super Capacitor can not be used for applications in AC circuit such as ripple absorption because it has high internal resistance (several hundred mΩ to a hundred Ω) compared to aluminum electrolysis capacitor. Thus its main use would be similar to that of secondary battery such as power back-up in DC circuit. The following list shows the characteristics of Super Capacitors as compared to aluminum electrolyses capacitors for power back-up and secondary batteries.

	Secondary battery		Capacitor	
	NiCd battery	Lithium ion battery	Aluminum electrolysis capacito	Super Capacitor
Back-up ability	◎	◎	△	○
Eco-hazard	Cd	——	——	——
Operating temperature range	−20 to 60 ℃	−20 to 50 ℃	−55 to 105 ℃	−40 to 85 ℃ (FR, FT)
Charge time	few hours	few hours	few minutes	few minutes
Charge/discharge life time	approx. 500 times	approx. 500 to 1000 times	limitless (*1)	limitless (*1)
Restrictions on charge/discharge	yes	yes	none	none
Flow soldering	not applicable	not applicable	applicable	applicable
Automatic mounting	not applicable	not applicable	applicable	applicable (FM and FC series)
Safety risks	leakage, explosion	leakage, combustion, explosion, ignition	heat-up, explosion	gas emission (*2)

(*1) Aluminum electrolysis capacitor and Super Capacitor has limited lifetime. However, when used under proper conditions, both can operate sufficiently within the designed lifetime of the set they are built in.

(*2) There is no harm as it is a mere leak of water vapor which transitioned from water contained in the electrolyte However, application of abnormal voltage surge exceeding maximum operating voltage may result in leakage and explosion.
Except HV series.

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4. Typical Applications

As in the characteristics remarked previously, Super Capacitor has characteristics intermediate between general capacitors and batteries. Because of this, Super Capacitor can be used like a secondary battery when applied to DC circuit. The best suited applications of Super Capacitor are back-up device for the power shut-down of micro computers and RAM's. The list below shows main application examples.

Application Examples of Super Capacitor

Intended use (guideline)	Power supply (guideline)	Application	Examples of equipments	Series
Long time back-up	500 μA and below	・CMOS RAM, IC for clocks	・Measuring device, Control equipment, Communication device, Automotive power source	・FR series (85℃ guaranteed)
		・CMOS micro computer, IC for clocks	・CMOS micro computer ・Static RAM/DTS (digital tuning system)	・FC series ・FG series ・FY series ・FM series
Back-up for 1 hour or less	50 mA and below	・Micro computer, RAM	・VCR, Microwave oven, ・Micro computer ・Memory equipped device	・FT series ・FS series
		・Driving motor	・VCR, Printer, Projector ・Video disk	
		・Subsidiary power supply for driving motor during voltage drop	・Camera	
Back-up for 10 seconds or less	1 A and below	・Power source of toys, LED, buzzer	・Toys, Display device, Alarm device	・FA series ・FE series
		・High current supply for a short amount of time	・Actuator, Relay solenoid, Gas igniter	
Power assist	Up to several A	・Power supply, Subsidiary power supply	・Street sign, Display light , UPS	・HV series

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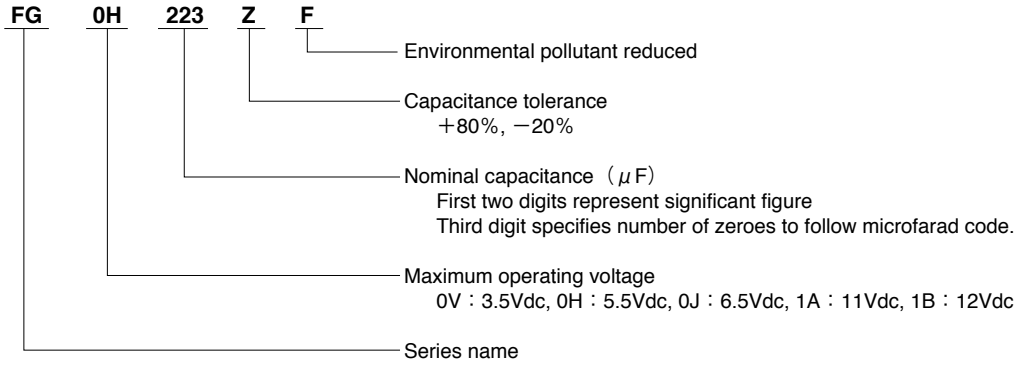
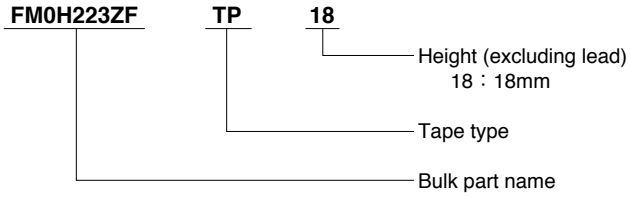
5. Part Number System

FM, FC, FT, FG, FS, FR, FY, FE, FA Series

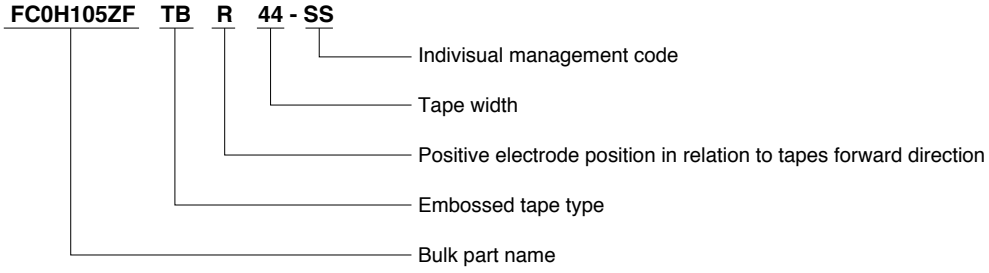
FG Series bulk type



FM Series tape type (Ammo pack)



FC Series tape type (Embossed tape)



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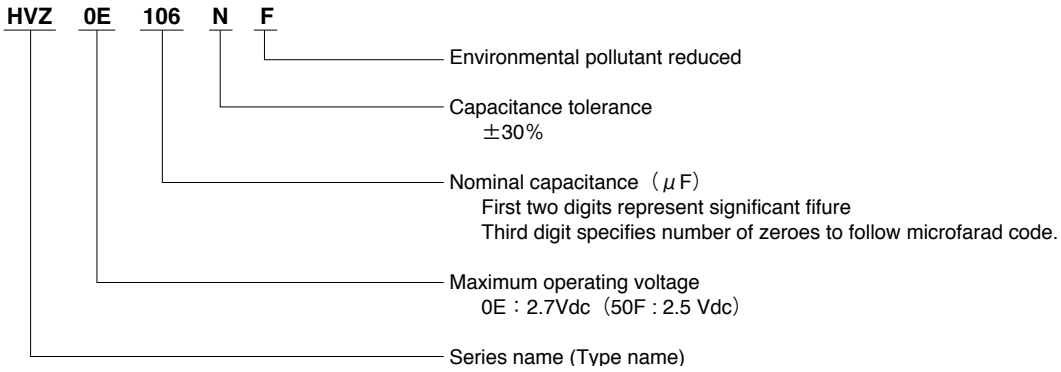
HV Series (HVZ Type)



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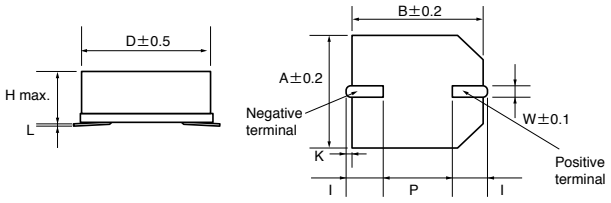
6. Rated Specifications

6.1 FC Series

Features

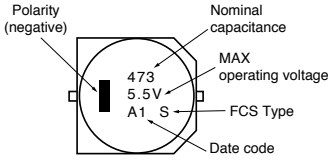
- Enables surface mounting.
- High rated voltage of 5.5V.
- High leakage reliability.

Dimensions

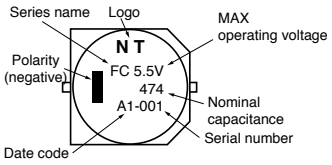


Markings

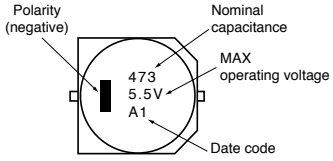
Displays nominal capacitance, MAX operating voltage serial number, polarity and etc.



FCS0H473ZFTBR24
FCS0H104ZFTBR24
FCS0H224ZFTBR24
FCS0V104ZFTBR24
FCS0V224ZFTBR24
FCS0V474ZFTBR24



FC0H474ZFTBR32-SS
FC0H105ZFTBR44-SS



FC0H473ZFTBR24
FC0H104ZFTBR24
FC0H224ZFTBR24
FC0V104ZFTBR24
FC0V224ZFTBR24
FC0V474ZFTBR24

Standard models

● FCS Type

Part Number	Max. Operating Voltage (Vdc)	Nominal Capacitance Discharge system (F)	Max. ESR (at 1kHz) (Ω)	Max. current at 30 minutes (mA)	Voltage Holding Characteristic Min. (V)	Dimension (Unit:mm)									Weight (g)
						D	H	A	B	I	W	P	K	L	
FCS0H473ZFTBR24	5.5	0.047	100	0.071	4.2	10.7	5.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.0
FCS0H104ZFTBR24	5.5	0.10	50	0.15	4.2	10.7	5.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.0
FCS0H224ZFTBR24	5.5	0.22	50	0.33	4.2	10.7	8.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.4
FCS0V104ZFTBR24	3.5	0.10	100	0.09	—	10.7	5.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.0
FCS0V224ZFTBR24	3.5	0.22	50	0.20	—	10.7	5.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.0
FCS0V474ZFTBR24	3.5	0.47	50	0.42	—	10.7	8.5	10.8	10.8	3.9±0.5	1.2	5.0	0.9±0.3	$0^{+0.3}_{-0.1}$	1.4

● FC Type

Part Number	Max. Operating Voltage (Vdc)	Nominal Capacitance Discharge system (F)	Max. ESR (at 1kHz) (Ω)	Max. current at 30 minutes (mA)	Voltage Holding Characteristic Min. (V)	Dimension (Unit:mm)									Weight (g)
						D	H	A	B	I	W	P	K	L	
FC0H473ZFTBR24	5.5	0.047	50	0.071	4.2	10.5	5.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.0
FC0H104ZFTBR24	5.5	0.10	25	0.15	4.2	10.5	5.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.0
FC0H224ZFTBR24	5.5	0.22	25	0.33	4.2	10.5	8.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.4
FC0H474ZFTBR32-SS	5.5	0.47	13	0.71	4.2	16.0	9.5	16.3	16.3	6.8±1.0	1.2	5.0	1.2±0.5	$0^{+0.5}_{-0.1}$	4.0
FC0H105ZFTBR44-SS	5.5	1.0	7	1.50	4.2	21.0	10.5	21.6	21.6	7.0±1.0	1.4	10.0	1.2±0.5	$0^{+0.5}_{-0.1}$	6.7
FC0V104ZFTBR24	3.5	0.10	50	0.09	—	10.5	5.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.0
FC0V224ZFTBR24	3.5	0.22	25	0.20	—	10.5	5.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.0
FC0V474ZFTBR24	3.5	0.47	25	0.42	—	10.5	8.5	10.8	10.8	3.6±0.5	1.2	5.0	0.7±0.3	$0^{+0.3}_{-0.1}$	1.4

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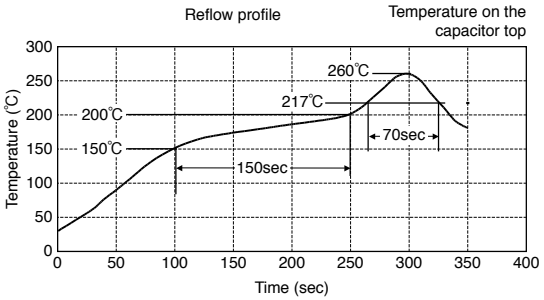
Precautions for use

- This series is exclusively for reflow soldering. It is designed for thermal conduction system such as combination use of infrared ray and heat blow. Consult with NEC TOKIN before applying other methods.
- The reflow condition must be kept within reflow profile graphs shown below.
- Applying reflow soldering is limited to 2 times. After the first reflow, cool down the capacitor thoroughly to 5-35℃ before the second reflow.

Always consult with NEC TOKIN when applying reflow soldering in a more severe condition than the condition described here.

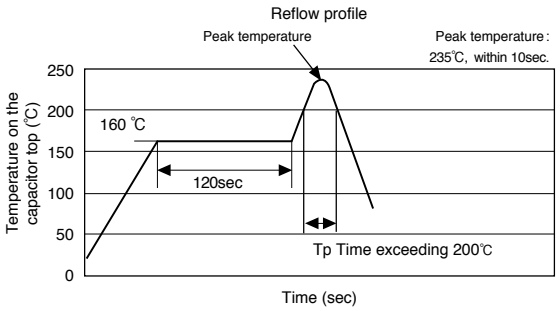
・FCS Type

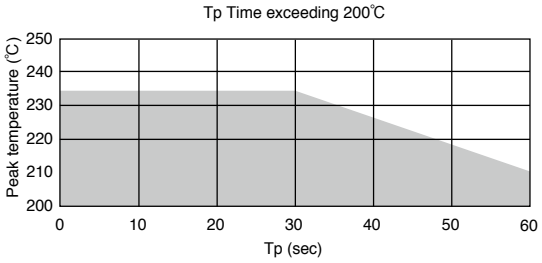


・Above "Reflow Profile" graph indicates temperature at the terminals and capacitor top.

Peak temperature	Below 260℃
Over 255℃	Within 10sec.
Over 230℃	Within 45sec.
Over 220℃	Within 60sec.
Over 217℃	Within 70sec.
Time between 150℃ to 200℃ (temperature zone over 170℃ = within 50sec.)	150sec.

・FC Type





・Above "Reflow Profile" graph indicates temperature at the terminals and capacitor top.

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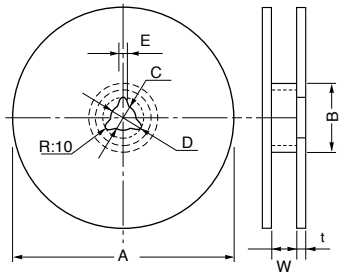
Tape and Reel Dimensions

[Reel Dimensions]

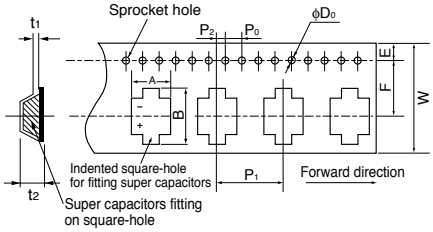


(mm)

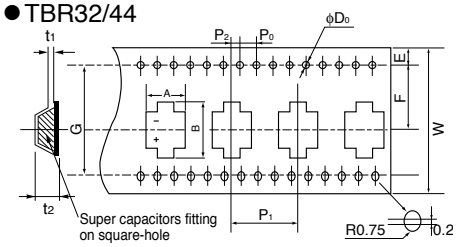
Mark	TBR24		TBR32	TBR44
A	380±2		330±2	380±2
B	Product height 5.5mm	80±1	100±1	100±1
	Product height 8.5mm	100±1		
C	13±0.5		13±0.5	13±0.5
D	21±0.8		21±0.8	21±0.8
E	2±0.5		2±0.5	2±0.5
W	Product height 5.5mm	25.5±0.5	33.5±1.0	45.5±1.0
	Product height 8.5mm	25.5±1.0		
t	2.0		2.0	2.0

Dimensions of indented [square-hole plastic tape]

● TBR24



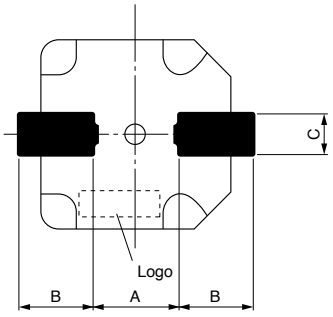
● TBR32/44



(mm)

Mark	TBR24		TBR32	TBR44
W	24.0		32.0	44.0
A	11.4		18.0	23.0
B	13.0		20.0	25.0
P_0	4.0		4.0	4.0
P_1	16.0		24.0	32.0
P_2	2.0		2.0	2.0
F	11.5		14.2	20.2
ϕD_0	1.55		1.55	1.55
t_1	0.4		0.5	0.5
E	1.75		1.75	1.75
t_2	Product height 5.5mm	6.0	10.0	12.0
	Product height 8.5mm	8.4		
G	–		28.4	40.4

Recommended land pattern



Land pattern

(mm)

Part Number	A	B	C
FCS0H473ZFTBR24	5.0	4.9	2.5
FCS0H104ZFTBR24	5.0	4.9	2.5
FCS0H224ZFTBR24	5.0	4.9	2.5
FCS0V104ZFTBR24	5.0	4.9	2.5
FCS0V224ZFTBR24	5.0	4.9	2.5
FCS0V474ZFTBR24	5.0	4.9	2.5
FC0H473ZFTBR24	5.0	4.9	2.5
FC0H104ZFTBR24	5.0	4.9	2.5
FC0H224ZFTBR24	5.0	4.9	2.5
FC0H474ZFTBR32-SS	5.0	10.0	2.5
FC0H105ZFTBR44-SS	10.0	10.5	3.5
FC0V104ZFTBR24	5.0	4.9	2.5
FC0V224ZFTBR24	5.0	4.9	2.5
FC0V474ZFTBR24	5.0	4.9	2.5

Lead terminal

(mm)

Part Number	A	B	C
FCS0H473ZFTBR24	5.0	3.9	1.2
FCS0H104ZFTBR24	5.0	3.9	1.2
FCS0H224ZFTBR24	5.0	3.9	1.2
FCS0V104ZFTBR24	5.0	3.9	1.2
FCS0V224ZFTBR24	5.0	3.9	1.2
FCS0V474ZFTBR24	5.0	3.9	1.2
FC0H473ZFTBR24	5.0	3.6	1.2
FC0H104ZFTBR24	5.0	3.6	1.2
FC0H224ZFTBR24	5.0	3.6	1.2
FC0H474ZFTBR32-SS	5.0	6.8	1.2
FC0H105ZFTBR44-SS	10.0	7.0	1.4
FC0V104ZFTBR24	5.0	3.6	1.2
FC0V224ZFTBR24	5.0	3.6	1.2
FC0V474ZFTBR24	5.0	3.6	1.2

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Specifications

Item \ Series name		FC, FCS 5.5V type, 3.5V type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		
MAX operating voltage		5.5Vdc, 3.5Vdc		
Capacitance		Refer to standard ratings		Refer to “Measurement Conditions”
Capacitance allowance		+80 %, −20 %		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
* Surge	Capacitance	More than 90% of initial specified value		Surge voltage：4.0V (3.5V type, 3.6V type) ：6.3V (5.5V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.047F 300Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F 15Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
* Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3		
	ESR			
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
* Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
* Solder heat resistance	Capacitance	Satisfy initial specified value		Cooled down to ambient temperature after reflow soldering, then the product must fulfill the condition stated left. (See page 10 for reflow condition)
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
* Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−25℃→Room temperature→+70℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
* High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95 %RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
* High temperature load	Capacitance	Within ±30% of initial measured value		Conforms to 4.15 Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		
* Self discharge characteristics (voltage holding characteristics)		5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified	Charging condition	Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours
			Storage	Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

As for items with “*” , it must fulfill the above condition after the reflow soldering. (See page 10 for reflow conditions)

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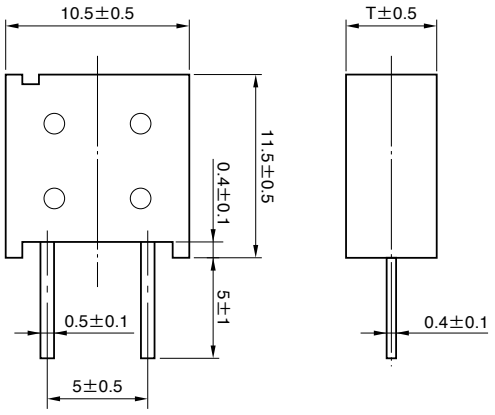
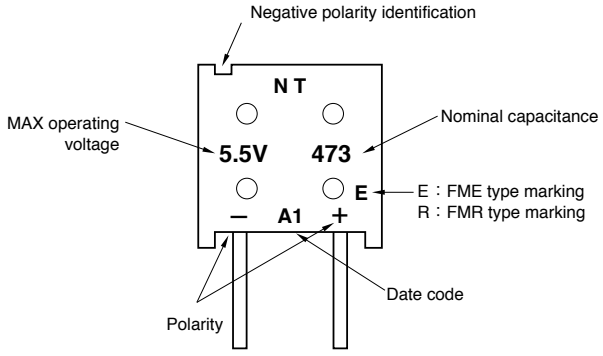
6.2 FM Series

Dimensions

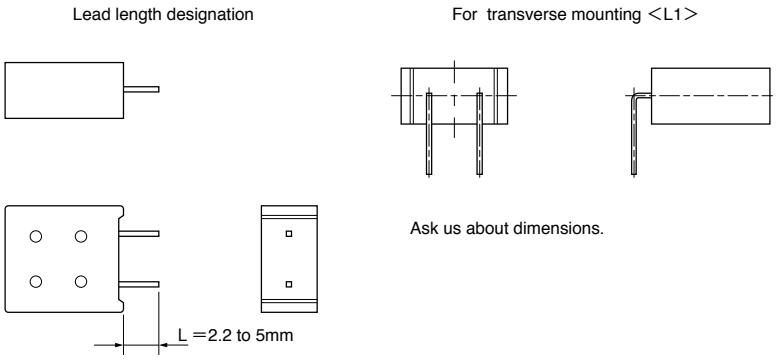


(Unit：mm)

Markings



Lead terminal forming example



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Specifications

● 5.5V Type

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	T (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)					
FM0H103ZF	FM0H103ZFTP18	5.5	0.01	0.014	300	0.015	4.2	5.0	1.3
FM0H223ZF	FM0H223ZFTP18	5.5	0.022	0.028	200	0.033	4.2	5.0	1.3
FM0H473ZF	FM0H473ZFTP18	5.5	0.047	0.06	200	0.071	4.2	5.0	1.3
FM0H104ZF	FM0H104ZFTP18	5.5	0.10	0.13	100	0.15	4.2	6.5	1.6
FM0H224ZF	FM0H224ZFTP18	5.5	—	0.22	100	0.33	4.2	6.5	1.6

● 3.5V Type

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	T (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)				
FM0V473ZF	FM0V473ZFTP18	3.5	0.047	0.06	200	0.042	5.0	1.3
FM0V104ZF	FM0V104ZFTP18	3.5	0.10	0.13	100	0.090	5.0	1.3
FM0V224ZF	FM0V224ZFTP18	3.5	0.22	0.30	100	0.20	6.5	1.6

● 6.5V Type

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	T (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)				
FM0J473ZF	FM0J473ZFTP18	6.5	0.047	0.062	200	0.071	6.5	1.6

● FME Type (Buckup Large Current, mA Order)

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	T (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)				
FME0H223ZF	FME0H223ZFTP18	5.5	0.022	0.028	40	0.033	5.0	1.3
FME0H473ZF	FME0H473ZFTP18	5.5	0.047	0.06	20	0.071	5.0	1.3

● FMR Type (MAX Operating Temperature 85℃ Type)

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	T (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)					
FMR0H473ZF	FMR0H473ZFTP18	5.5	0.047	0.062	200	0.071	4.2	6.5	1.6
FMR0H104ZF	FMR0H104ZFTP18	5.5	0.10	—	50	0.15	4.2	6.5	1.6
FMR0V104ZF	FMR0V104ZFTP18	3.5	0.10	—	50	0.090	—	6.5	1.6

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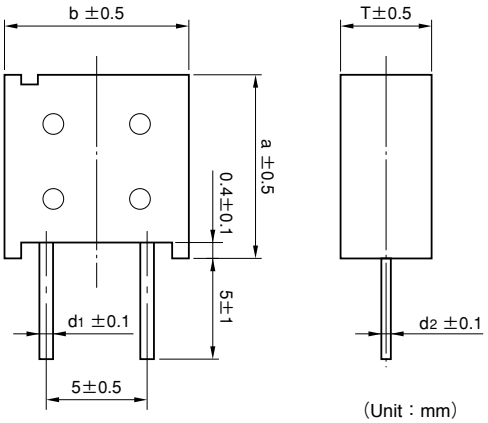
● **FMC Type**

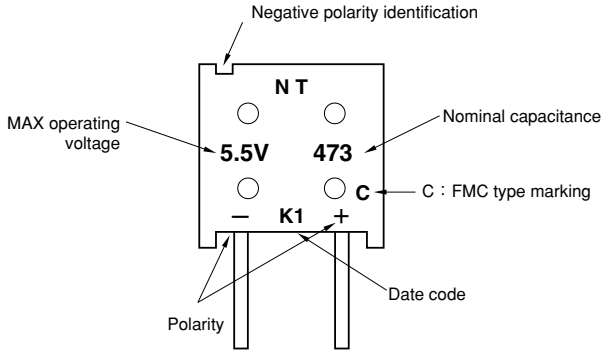
Chip parts applicable to treatment in bond hardening furnace (160±5℃ for 120±10 seonds)

Dimensions



（Unit：mm）

Markings



Specifications

Part Number		MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	a (mm)	b (mm)	T (mm)	d_1 (mm)	d_2 (mm)	Weight (g)
Bulk	Ammo pack		Charge system(F)	Discharge system(F)									
FMC0H473ZF	FMC0H473ZFTP18	5.5	0.047	0.06	100	0.071	4.2	11.5	10.5	5.0	0.5	0.4	1.3
FMC0H104ZF	FMC0H104ZFTP18	5.5	0.10	0.13	50	0.15	4.2	11.5	10.5	6.5	0.5	0.4	1.6
FMC0H334ZF	FMC0H334ZFTP18	5.5	–	0.33	25	0.50	4.2	15.0	14.0	9.0	0.6	0.6	3.5

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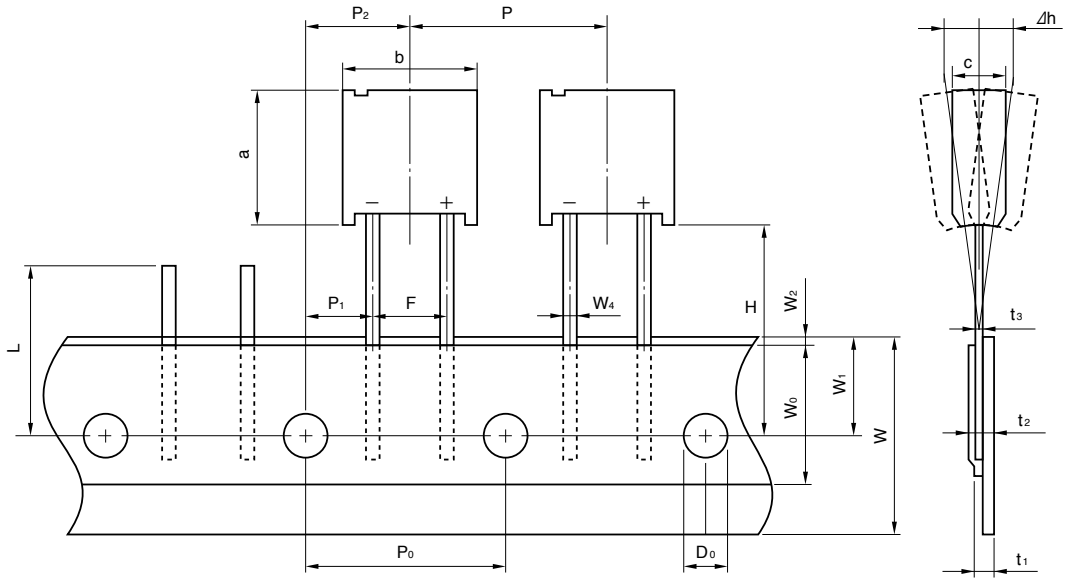
Taping Specification [except FMC0H334ZFTP18]



(Unit : mm)

Item	Symbol	Value	Tolerance	Remarks
Component Height	a	11.5	±0.5	
Component Width	b	10.5	±0.5	
Component Thickness	c	—	±0.5	5.5 V type : 5.0/0.010F to 0.047F, 6.5/0.047F 3.5 V type : 5.0/0.047F to 0.10F, 6.5/0.22F FME type : 5.0/0.022F to 0.047F 6.5 V type : 6.5/0.047F, 0.10F FMR type : 6.5/0.047F FMC type : 5.0/0.047F, 6.5/0.10F
Lead-wire Width	W_4	0.5	±0.1	
Lead-wire Thickness	t_3	0.4	±0.1	
Pitch between Component	P	12.7	±1.0	
Sprocket Hole Pitch	P_0	12.7	±0.3	
Sprocket Hole to Lead	P_1	3.85	±0.7	
〃	P_2	6.35	±1.3	
Lead Spacing	F	5.0	±0.5	
Component Alignment	Δh	2.0 Max.	—	Including tilting caused by bending lead wire.
Tape Width	W	18.0	+1.0 −0.5	
Hold-down tape Width	W_0	12.5 Min.	—	
Sprocket Hole Position	W_1	9.0	±0.5	
Hold-down Tape Position	W_2	3.0 Max.	—	No protrusion of tape.
Component's Bottom Line Position	H	18.0	±0.5	
Sprocket Hole Diameter	D_0	φ4.0	±0.2	
Total tape Thickness	t_1	0.7	±0.2	
〃	t_2	1.5 Max.	—	
Defect Component Cut-off Position	L	11.0 Max.	—	

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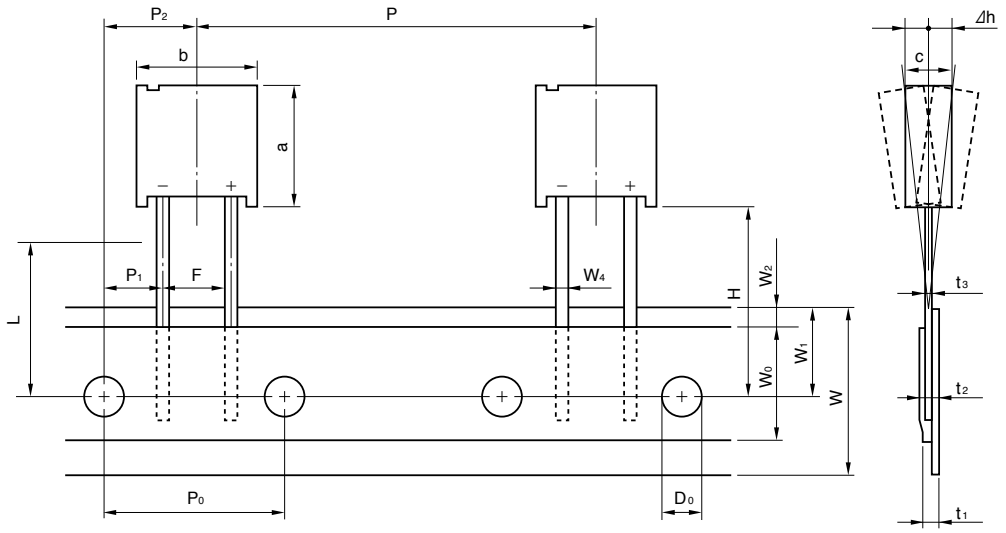
Taping Specification [FMC0H334ZFTP18]



(Unit : mm)

Item	Symbol	Value	Tolerance	Remarks
Component Height	a	15.0	±0.5	
Component Width	b	14.0	±0.5	
Component Thickness	c	9.0	±0.5	
Lead-wire Width	W_4	0.6	±0.1	
Lead-wire Thickness	t_3	0.6	±0.1	
Pitch between Component	P	25.4	±1.0	
Sprocket Hole Pitch	P_0	12.7	±0.3	
Sprocket Hole to Lead	P_1	3.85	±0.7	
〃	P_2	6.35	±1.3	
Lead Spacing	F	5.0	±0.5	
Component Alignment	Δh	2.0 Max.	—	Including tilting caused by bending lead wire
Tape Width	W	18.0	+1.0 −0.5	
Hold-down tape Width	W_0	12.5 Min.	—	
Sprocket Hole Position	W_1	9.0	±0.5	
Hold-down Tape Position	W_2	3.0 Max.	—	No protrusion of tape
Component's Bottom Line Position	H	18.0	±0.5	
Sprocket Hole Diameter	D_0	φ4.0	±0.2	
Total tape Thickness	t_1	0.67	±0.2	
〃	t_2	1.7 Max.	—	
Defect Component Cut-off Position	L	11.0 Max.	—	

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Specifications

Item \ Series name		5.5V type, 3.5V type, 6.5V type FMC type		FME type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		−25℃ to +70℃		
MAX operating voltage		5.5Vdc, 3.5Vdc, 6.5Vdc		5.5Vdc		
Capacitance		5.5V：0.010F to 0.33F 3.5V：0.047F to 0.22F 6.5V：0.047		0.022F, 0.033F, 0.047F		Refer to “Measurement Conditions”
Capacitance allowance		+80 %, −20 %		+80 %, −20 %		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		More than 90% of initial specified value		Surge voltage：4.0V (3.5V type) ：6.3V (5.5V type) ：7.4V (6.5V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.010F 1500Ω ：0.022F 560Ω ：0.033F 510Ω ：0.047F 300Ω ：0.068F 240Ω ：0.10F 150Ω ：0.22F 56Ω ：0.33F 51Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value		Less than 400% of initial measured value	
	Capacitance	Phase 3		Phase 3		
	ESR					
	Capacitance	Phase 5	Less than 200% of initial measured value	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.12 Temperature condition：−25℃→Room temperature→+70℃→Room temperature Number of cycles：5 Cycles
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95 %RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Within ±30% of initial measured value		Conforms to 4.15 Temperature：70±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		Less than 200% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
Self discharge characteristics (voltage holding characteristics)		5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified 6.5V type: Not specified				Charging condition：Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours
						Storage：Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

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Specifications

Item \ Series name		FMR type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−40℃ to +85℃		
MAX operating voltage		5.5Vdc, 3.5Vdc		
Capacitance		0.047F, 0.10F		Refer to “Measurement Conditions”
Capacitance allowance		+80％, −20％		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		Surge voltage：4.0V (3.5V type) ：6.3V (5.5V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.047F 300Ω ：0.10F 150Ω Discharge resistance：0Ω Temperature：85±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase3：−40±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3	More than 30% of initial measured value	
	ESR		Less than 700% of initial measured value	
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−40℃→Room temperature→+85℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95％RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Conforms to 4.15 Temperature：85±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000$^{+48}_{0}$Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		
Self discharge characteristics (voltage holding characteristics)		5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified	Charging condition	Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours
			Storage	Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

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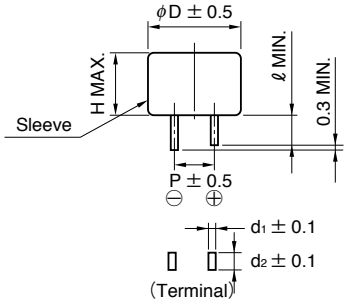
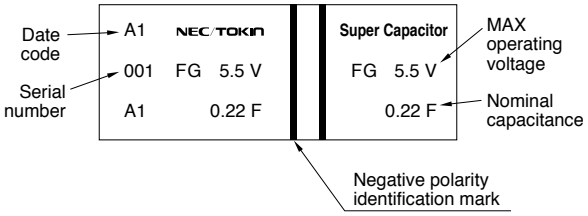
6.3 FG Series

Dimensions



Markings on sleeve



● **FG Type**

Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)				φD	H	P	ℓ	d_1	d_2	
FG0H103ZF	5.5	0.010	0.013	300	0.015	4.2	11.0	5.5	5.08	2.7	0.2	1.2	0.9
FG0H223ZF	5.5	0.022	0.028	200	0.033	4.2	11.0	5.5	5.08	2.7	0.2	1.2	1.0
FG0H473ZF	5.5	0.047	0.060	200	0.071	4.2	11.0	5.5	5.08	2.7	0.2	1.2	1.0
FG0H104ZF	5.5	0.10	0.13	100	0.15	4.2	11.0	6.5	5.08	2.7	0.2	1.2	1.3
FG0H224ZF	5.5	0.22	0.28	100	0.33	4.2	13.0	9.0	5.08	2.2	0.4	1.2	2.5
FG0H474ZF	5.5	0.47	0.60	120	0.71	4.2	14.5	18.0	5.08	2.4	0.4	1.2	5.1
FG0H105ZF	5.5	1.0	1.3	65	1.5	4.2	16.5	19.0	5.08	2.7	0.4	1.2	7.0
FG0H225ZF	5.5	2.2	2.8	35	3.3	4.2	21.5	19.0	7.62	3.0	0.6	1.2	12.1
FG0H475ZF	5.5	4.7	6.0	35	7.1	4.2	28.5	22.0	10.16	6.1	0.6	1.4	27.3
FG0V155ZF	3.5	1.5	2.2	65	1.5	—	16.5	14.0	5.08	3.1	0.4	1.2	5.2

● **FGH Type**

Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance (F)	MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
						φD	H	P	ℓ	d_1	d_2	
FGH0H104ZF	5.5	0.10	100	0.15	4.2	11.0	5.5	5.08	2.7	0.2	1.2	1.0
FGH0H224ZF	5.5	0.22	100	0.33	4.2	11.0	7.0	5.08	2.7	0.2	1.2	1.3
FGH0H474ZF	5.5	0.47	65	0.71	4.2	16.5	8.0	5.08	2.7	0.4	1.2	4.1
FGH0H105ZF	5.5	1.0	35	1.5	4.2	21.5	9.5	7.62	3.0	0.6	1.2	7.2

● **FGR Type**

Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)				φD	H	P	ℓ	d_1	d_2	
FGR0H474ZF	5.5	0.47	0.60	120	0.71	4.2	14.5	18.0	5.08	2.4	0.4	1.2	5.1
FGR0H105ZF	5.5	1.0	1.3	65	1.5	4.2	16.5	19.0	5.08	2.7	0.4	1.2	7.0
FGR0H225ZF	5.5	2.2	2.8	35	3.3	4.2	21.5	19.0	7.62	3.0	0.6	1.2	12.1

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Specifications

Item \ Series name		FG, FGH type		FGR type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		−40℃ to +85℃		
MAX operating voltage		5.5Vdc, 3.5Vdc		5.5Vdc		
Capacitance		FG：0.010F to 4.7F FGH：0.10F to 1.0F		0.47F to 2.2F		Refer to “Measurement Conditions”
Capacitance allowance		+80 %, −20 %		+80 %, −20 %		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		More than 90% of initial specified value		Surge voltage：6.3V (5.5V type) ：4.0V(3.5V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.010F 1500Ω ：0.022F 560Ω ：0.047F 300Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F, 1.5F 15Ω ：2.2F, 4.7F 10Ω Discharge resistance：0Ω Temperature：85±2℃ (FGR) ：70±2℃ (FG, FGH)
	ESR	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase3：−40±2℃ (FGR) Phase4：+25±2℃ Phase5：+70±2℃ (FG, FGH) ：+85±2℃ (FGR) Phase6：+25±2℃
	ESR		Less than 400% of initial measured value		Less than 400% of initial measured value	
	Capacitance	Phase 3		Phase 3	More than 30% of initial measured value	
	ESR				Less than 700% of initial measured value	
	Capacitance	Phase 5	Less than 200% of initial measured value	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.12 Temperature condition：Category MIN temp→Room temp→Category MAX temp→Room temp Number of cycles：5 Cycles
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95 %RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Within ±30% of initial measured value		Conforms to 4.15 Temp：Category MAX temp ±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}Hours
	ESR	Less than 200% of initial specified value		Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		Less than 200% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
Self discharge characteristics (voltage holding characteristics)		5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified		Voltage between terminal leads higher than 4.2V		Charging condition：Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours Storage：Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

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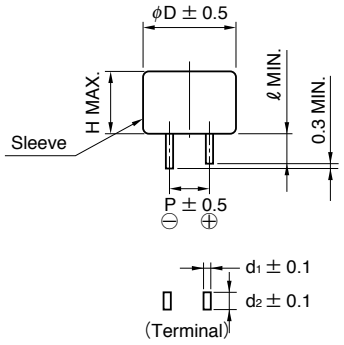
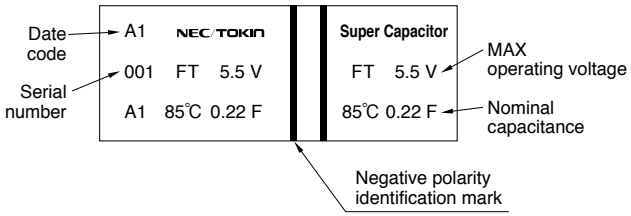
6.4 FT Series

Dimensions



Markings on sleeve



Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)			ϕD	H	P	d_1	d_2	ℓ	
FT0H104ZF	5.5	0.10	0.14	16	0.15	11.5	8.5	5.08	0.4	1.2	2.7	1.6
FT0H224ZF	5.5	0.22	0.28	10	0.33	14.5	12.0	5.08	0.4	1.2	2.2	4.1
FT0H474ZF	5.5	0.47	0.60	6.5	0.71	16.5	13.0	5.08	0.4	1.2	2.7	5.3
FT0H105ZF	5.5	1.0	1.3	3.5	1.5	21.5	13.0	7.62	0.6	1.2	3.0	10.0
FT0H225ZF	5.5	2.2	2.8	1.8	3.3	28.5	14.0	10.16	0.6	1.4	6.1	18.0
FT0H335ZF	5.5	3.3	4.2	1.0	5.0	36.5	15.0	15.00	0.6	1.7	6.1	38.0
FT0H565ZF	5.5	5.6	7.2	0.6	8.4	44.5	17.0	20.00	1.0	1.4	6.1	72.0

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Specifications

Item \ Series name		FT type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−40℃ to +85℃		
MAX operating voltage		5.5Vdc		
Capacitance		0.1F to 5.6F		Refer to “Measurement Conditions”
Capacitance allowance		+80％, −20％		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		Surge voltage：6.3V Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F 15Ω ：2.2F 10Ω ：3.3F 10Ω ：5.6F 10Ω Discharge resistance：0Ω Temperature：85±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase3：−40±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3	More than 30% of initial measured value	
	ESR		Less than 700% of initial measured value	
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−40℃→Room temperature→+85℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95％RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Conforms to 4.15 Temperature：85±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		

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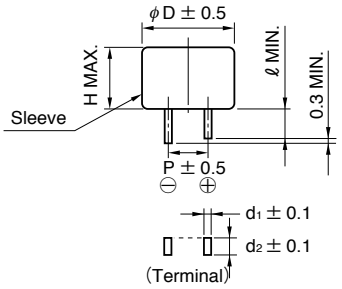
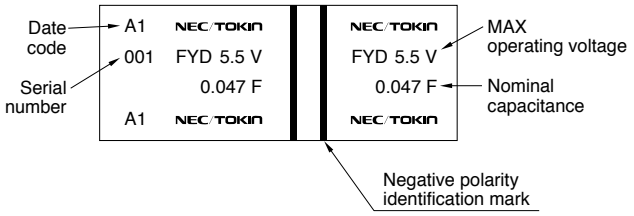
6.5 FY Series

Dimensions



Markings on sleeve



● **FYD Type**

Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)				φD	H	P	ℓ	d_1	d_2	
FYD0H223ZF	5.5	0.022	0.033	220	0.033	4.2	11.5	8.5	5.08	2.7	0.4	1.2	1.6
FYD0H473ZF	5.5	0.047	0.070	220	0.071	4.2	11.5	8.5	5.08	2.7	0.4	1.2	1.7
FYD0H104ZF	5.5	0.10	0.14	100	0.15	4.2	13.0	8.5	5.08	2.2	0.4	1.2	2.4
FYD0H224ZF	5.5	0.22	0.35	120	0.33	4.2	14.5	15.0	5.08	2.4	0.4	1.2	4.3
FYD0H474ZF	5.5	0.47	0.75	65	0.71	4.2	16.5	15.0	5.08	2.7	0.4	1.2	6.0
FYD0H105ZF	5.5	1.0	1.6	35	1.5	4.2	21.5	16.0	7.62	3.0	0.6	1.2	11.0
FYD0H145ZF	5.5	1.4	2.1	45	2.1	4.2	21.5	19.0	7.62	3.0	0.6	1.2	12.0
FYD0H225ZF	5.5	2.2	3.3	35	3.3	4.2	28.5	22.0	10.16	6.1	0.6	1.4	22.9

● **FYH Type**

Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)				φD	H	P	ℓ	d_1	d_2	
FYH0H223ZF	5.5	0.022	0.033	200	0.033	4.2	11.5	7.0	5.08	2.7	0.4	1.2	1.5
FYH0H473ZF	5.5	0.047	0.075	100	0.071	4.2	13.0	7.0	5.08	2.2	0.4	1.2	2.2
FYH0H104ZF	5.5	0.10	0.16	50	0.15	4.2	16.5	7.5	5.08	2.7	0.4	1.2	3.4
FYH0H224ZF	5.5	0.22	0.30	60	0.33	4.2	16.5	9.5	5.08	2.7	0.4	1.2	3.6
FYH0H474ZF	5.5	0.47	0.70	35	0.71	4.2	21.5	10.0	7.62	3.0	0.6	1.2	7.2
FYH0H105ZF	5.5	1.0	1.5	20	1.5	4.2	28.5	11.0	10.16	6.1	0.6	1.4	13.9

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Specifications

Item \ Series name		FY type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		
MAX operating voltage		5.5Vdc		
Capacitance		FYD：0.022F to 2.2F FYH：0.022F to 1.0F		Refer to “Measurement Conditions”
Capacitance allowance		+80％, −20％		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		Surge voltage：6.3V Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.022F 560Ω ：0.047F 300Ω ：0.068F 240Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F, 1.4F 15Ω ：2.2F 10Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3		
	ESR			
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−25℃→Room temperature→+70℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95％RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Conforms to 4.15 Temperature：70±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		
Self discharge characteristics (voltage holding characteristics)		Voltage between terminal leads higher than 4.2V	Charging condition	Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours
			Storage	Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

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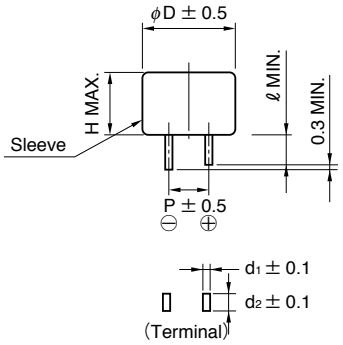
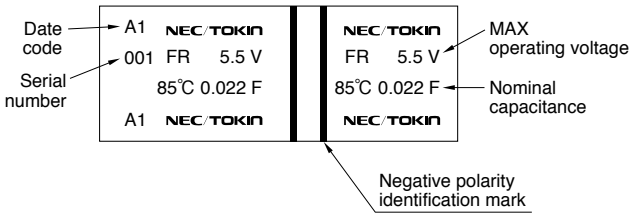
6.6 FR Series

Dimensions



Markings on sleeve



Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Voltage holding characteristics (V)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)				φD	H	P	ℓ	d_1	d_2	
FR0H223ZF	5.5	0.022	0.028	220	0.033	4.2	11.5	14.0	5.08	2.7	0.4	1.2	2.3
FR0H473ZF	5.5	0.047	0.060	110	0.071	4.2	14.5	14.0	5.08	2.4	0.4	1.2	3.9
FR0H104ZF	5.5	0.10	0.15	150	0.15	4.2	14.5	15.5	5.08	2.4	0.4	1.2	4.3
FR0H224ZF	5.5	0.22	0.33	180	0.33	4.2	14.5	21.0	5.08	2.4	0.4	1.2	5.3
FR0H474ZF	5.5	0.47	0.75	100	0.71	4.2	16.5	21.5	5.08	2.7	0.4	1.2	7.5
FR0H105ZF	5.5	1.0	1.6	60	1.5	4.2	21.5	22.0	7.62	3.0	0.6	1.2	13.3

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Specifications

Item \ Series name		FR type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−40℃ to +85℃		
MAX operating voltage		5.5Vdc		
Capacitance		0.022F to 1.0F		Refer to “Measurement Conditions”
Capacitance allowance		+80％, −20％		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		Surge voltage：6.3V (5.5V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.022F 560Ω ：0.047F 300Ω ：0.068F 240Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F 15Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase3：−40±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3	More than 30% of initial measured value	
	ESR		Less than 700% of initial measured value	
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−40℃→Room temperature→+85℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
High temp. and high humidity resistance	Capacitance	Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95％RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
High temperature load	Capacitance	Within ±30% of initial measured value		Conforms to 4.15 Temperature：85±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		
Self discharge characteristics (voltage holding characteristics)		Voltage between terminal leads higher than 4.2V	Charging condition	Voltage applied：5.0Vdc (Terminal at the case's side be negative) Series resistance：0Ω Charging time：24 hours
			Storage	Let stand for 24 hours in condition described below with terminals opened. Ambient temperature：Lower than 25℃ Relative humidity：Lower than 70%RH

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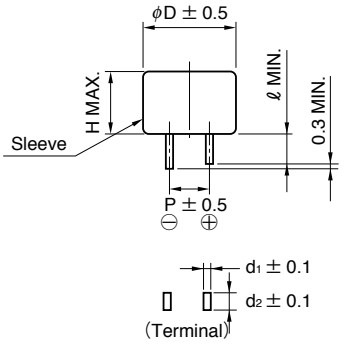
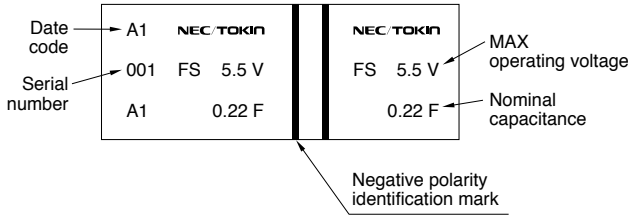
6.7 FS Series

Dimensions



Markings on sleeve



Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Dimension (unit:mm)						Weight
		Charge system (F)	Discharge system (F)			φD	H	P	ℓ	d_1	d_2	(g)
FS0H223ZF	5.5	0.022	0.033	60.0	0.033	11.5	8.5	5.08	2.7	0.4	1.2	1.6
FS0H473ZF	5.5	0.047	0.072	40.0	0.071	13.0	8.5	5.08	2.2	0.4	1.2	2.6
FS0H104ZF	5.5	0.10	0.15	25.0	0.15	16.5	8.5	5.08	2.7	0.4	1.2	4.1
FS0H224ZF	5.5	0.22	0.33	25.0	0.33	16.5	13.0	5.08	2.7	0.4	1.2	5.3
FS0H474ZF	5.5	0.47	0.75	13.0	0.71	21.5	13.0	7.62	3.0	0.6	1.2	10
FS0H105ZF	5.5	1.0	1.3	7.0	1.5	28.5	14.0	10.16	6.1	0.6	1.4	18
FS1A474ZF	11.0	0.47	0.60	7.0	1.41	28.5	25.5	10.16	6.1	0.6	1.4	32
FS1A105ZF	11.0	1.0	1.3	7.0	3.0	28.5	31.5	10.16	6.1	0.6	1.4	35
FS1B105ZF	12.0	1.0	1.3	7.5	3.6	28.5	38.0	10.16	6.1	0.6	1.4	40
FS1B505ZF	12.0	5.0	6.5	4.0	18.0	44.8	60.0	20.00	9.5	1.0	1.4	160

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Specifications

Item \ Series name		FS type		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		
MAX operating voltage		5.5Vdc, 11Vdc, 12Vdc		
Capacitance		5.5V：0.022F to 1.0F 11V：0.47, 1.0 12V：1.0F, 5.0F		Refer to “Measurement Conditions”
Capacitance allowance		+80 %, −20 %		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance	More than 90% of initial specified value		Surge voltage：6.3V (5.5V type) ：12.6V (11V type) ：13.6V (12V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.022F 560Ω ：0.047F 300Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F 15Ω ：5.0F 10Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 50% of initial measured value	Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 400% of initial measured value	
	Capacitance	Phase 3		
	ESR			
	Capacitance	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Conforms to 4.12 Temperature condition：−25℃→Room temperature→+70℃→Room temperature Number of cycles：5 Cycles
	ESR			
	Current (30 minutes value)			
	Appearance	No obvious abnormality		
High temp. and high humidity resistance	Capacitance	More than 90% of initial specified value (5.5V type) Within ±20% of initial measured value (11V type, 12Vtype)		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95 %RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		
	Appearance	No obvious abnormality		
High temperature load	Capacitance	More than 85% of initial specified value (5.5V type) Within ±20% of initial measured value (11V type, 12Vtype)		Conforms to 4.15 Temperature：70±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 200% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		
	Appearance	No obvious abnormality		

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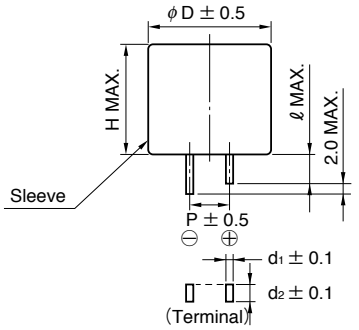
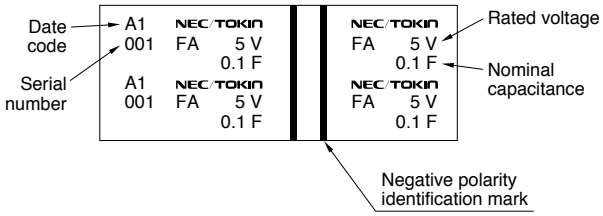
6.8 FA Series, FE Series

● FA Series

Dimensions



Markings on sleeve

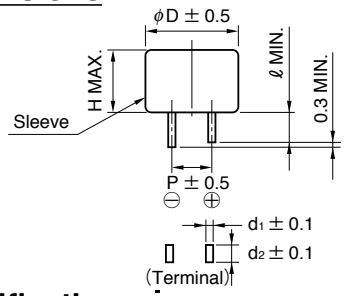


Specifications

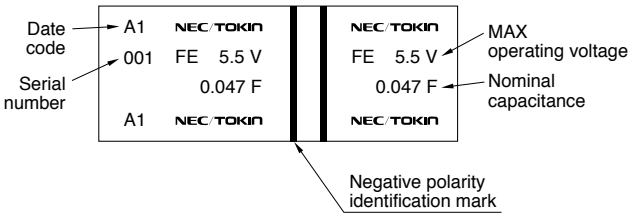
Part Number	MAX operating voltage (Vdc)	Rated voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Dimension (unit:mm)						Weight (g)
			Charge system (F)	Discharge system (F)			φD	H	P	ℓ	d1	d2	
FA0H473ZF	5.5	5	0.047	0.075	20.0	0.071	16.0	15.5	5.1	5.0	0.4	1.2	6.2
FA0H104ZF	5.5	5	0.10	0.16	8.0	0.15	21.5	15.5	7.6	5.5	0.6	1.2	12
FA0H224ZF	5.5	5	0.22	0.35	5.0	0.33	28.5	16.5	10.2	9.5	0.6	1.4	25
FA0H474ZF	5.5	5	0.47	0.75	3.5	0.71	36.5	16.5	15.0	9.5	0.6	1.7	42
FA0H105ZF	5.5	5	1.0	1.6	2.5	1.5	44.5	18.5	20.0	9.5	1.0	1.4	65
FA1A223ZF	11.0	10	0.022	0.035	20.0	0.066	16.0	25.0	5.1	5.0	0.4	1.2	7.5
FA1A104ZF	11.0	10	0.10	0.16	8.0	0.30	28.5	25.5	10.2	9.5	0.6	1.4	32
FA1A224ZF	11.0	10	0.22	0.35	6.0	0.66	36.5	27.5	15.0	9.5	1.0	1.4	55
FA1A474ZF	11.0	10	0.47	0.75	4.0	1.41	44.5	28.5	20.0	9.5	1.0	1.4	83

● FE Series

Dimensions



Markings on sleeve



Specifications

Part Number	MAX operating voltage (Vdc)	Nominal capacitance		MAX ESR (at 1 kHz) (Ω)	MAX current at 30 min. (mA)	Dimension (unit:mm)						Weight (g)
		Charge system (F)	Discharge system (F)			φD	H	P	ℓ	d1	d2	
FE0H473ZF	5.5	0.047	0.075	14.0	0.071	14.5	14.0	5.1	2.2	0.4	1.2	3.9
FE0H104ZF	5.5	0.10	0.16	6.5	0.15	16.5	14.0	5.1	2.7	0.4	1.2	5
FE0H224ZF	5.5	0.22	0.35	3.5	0.33	21.5	15.5	7.6	3.0	0.6	1.2	9.5
FE0H474ZF	5.5	0.47	0.75	1.8	0.71	28.5	16.5	10.2	6.1	0.6	1.4	16
FE0H105ZF	5.5	1.0	1.4	1.0	1.5	36.5	18.5	15.0	6.1	0.6	1.7	38
FE0H155ZF	5.5	1.5	2.1	0.6	2.3	44.5	18.5	20.0	6.1	1.0	1.4	72

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Specifications

Item \ Series name		FA		FE		Test conditions (conforming to JIS C 5160-1)
Category temperature range		−25℃ to +70℃		−40℃ to +70℃		
MAX operating voltage		5.5Vdc, 11Vdc		5.5Vdc		
Capacitance		5.5V：0.047F to 1.0F 11V：0.022F to 0.47F		0.047F to 1.5F		Refer to “Measurement Conditions”
Capacitance allowance		+80 %, −20 %		+80 %, −20 %		Refer to “Measurement Conditions”
ESR		Refer to standard ratings		Refer to standard ratings		Measured at 1kHz, 10mA ; See also “Measurement Conditions”
Current (30-minutes value)		Refer to standard ratings		Refer to standard ratings		Refer to “Measurement Conditions”
Surge	Capacitance			More than 90% of initial specified value		Surge voltage：6.3V (5.5V type) ：12.6V (11V type) Charge：30 sec. Discharge：9min 30sec. Number of cycles：1000 Series resistance：0.047F 300Ω ：0.10F 150Ω ：0.22F 56Ω ：0.47F 30Ω ：1.0F, 1.5F 15Ω Discharge resistance：0Ω Temperature：70±2℃
	ESR			Less than 120% of initial specified value		
	Current (30 minutes value)			Less than 120% of initial specified value		
	Appearance			No obvious abnormality		
Characteristics in different temperature	Capacitance	Phase 2	More than 70% of initial measured value	Phase 2		Conforms to 4.17 Phase1：+25±2℃ Phase2：−25±2℃ Phase3：−40±2℃ (FE type) Phase4：+25±2℃ Phase5：+70±2℃ Phase6：+25±2℃
	ESR		Less than 300% of initial measured value			
	Capacitance	Phase 3		Phase 3	More than 40% of initial measured value	
	ESR				Less than 400% of initial measured value	
	Capacitance	Phase 5	Less than 150% of initial measured value	Phase 5	Less than 200% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		1.5CV (mA) or below		1.5CV (mA) or below	
	Capacitance	Phase 6	Within ±20% of initial measured value	Phase 6	Within ±20% of initial measured value	
	ESR		Satisfy initial specified value		Satisfy initial specified value	
	Current (30 minutes value)		Satisfy initial specified value		Satisfy initial specified value	
Lead strength (tensile)		No terminal damage		No terminal damage		Conforms to 4.9
Vibration resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.13 Frequency：10 to 55 Hz Testing time：6 hours
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Solderability		Over 3/4 of the terminal should be covered by the new solder		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp：245±5℃ Dipping time：5±0.5 sec. 1.6mm from the bottom should be dipped.
Solder heat resistance	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.10 Solder temp：260±10℃ Dipping time：10±1 sec. 1.6mm from the bottom should be dipped.
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
Temperature cycle	Capacitance	Satisfy initial specified value		Satisfy initial specified value		Conforms to 4.12 Temperature condition：−25℃ (−40℃ for FE type)→ Room temperature→ +70℃→Room temperature Number of cycles：5 Cycles
	ESR					
	Current (30 minutes value)					
	Appearance	No obvious abnormality		No obvious abnormality		
High temp. and high humidity resistance	Capacitance	More than 90% of initial specified value		Within ±20% of initial measured value		Conforms to 4.14 Temperature：40±2℃ Relative humidity：90 to 95 %RH Testing time：240±8 hours
	ESR	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Current (30 minutes value)	Less than 120% of initial specified value		Less than 120% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		
High temperature load	Capacitance	More than 85% of initial specified value		Within ±30% of initial measured value		Conforms to 4.15 Temperature：70±2℃ Voltage applied：MAX operating voltage Series protection resistance：0Ω Testing time：1000^{+48}_{0}Hours
	ESR	Less than 120% of initial specified value		Less than 300% of initial specified value		
	Current (30 minutes value)	Less than 200% of initial specified value		Less than 200% of initial specified value		
	Appearance	No obvious abnormality		No obvious abnormality		

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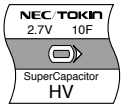
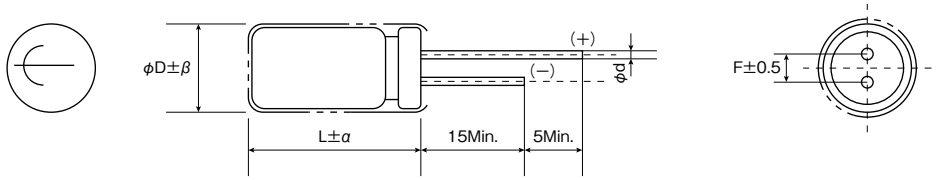
6.9 HV Series (High capacitance Type)

Markings on sleeve

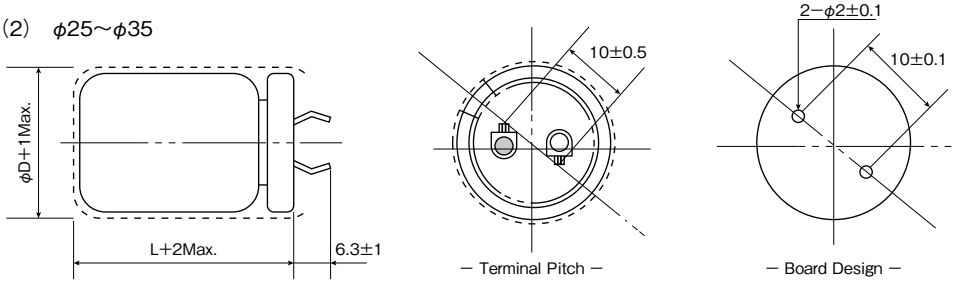


Dimensions

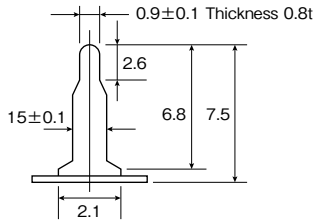
(1) ϕ8～ϕ18



(2) ϕ25～ϕ35



Terminal Details



Standard models

Part Number	MAX operating voltage (Vdc)	Nomical capacitance (F)	MAX ESR (at 1kHz) (mΩ)	MAX current at 30 min. (mA)	Dimension (unit:mm)						Weight (g)
					φD	L	F	d	β	α	
HVZ0E105NF	2.7	1.0	300	0.8	8.0	12.0	3.5	0.6	0.5	2.0	1.0
HVZ0E275NF	2.7	2.7	300	2.2	8.0	22.0	3.5	0.6	0.5	2.0	1.9
HVZ0E475NF	2.7	4.7	100	3.8	10.0	20.0	5.0	0.6	0.5	2.0	2.5
HVZ0E106NF	2.7	10.0	100	8.0	10.0	35.0	5.0	0.6	0.5	2.0	4.0
HVZ0E226NF	2.7	22.0	100	18.0	12.5	35.0	5.0	0.6	0.5	2.0	10.0
HVZ0E506NF	2.5	50.0	50	40.0	18.0	40.0	7.5	0.8	0.5	2.0	14.0
HVZ0E107NF-LT	2.7	100.0	30	81.0	25.0	50.0	—	—	—	—	28.0
HVZ0E207NF-LT	2.7	200.0	30	162.0	35.0	50.0	—	—	—	—	61.5

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Specifications

Items			Specification	Test Condition Conforming JIS C 5160- 2
Operating Temperature Range			−25℃～+60℃ (22F, 50F, 100F, 200F) −25℃～+70℃ (1.0F, 2.7F, 4.7F, 10F)	
Maximum Operating Voltage			2.7Vdc (50F type has 2.5Vdc)	
Nominal Capacitance			1.0F, 2.7F, 4.7F, 10F, 22F, 50F, 100F, 200F	
Capacitance Allowance			±30%	
Equivalent Series Resistance (ESR)			Refer to standard ratings	
Current at 30 minutes			Refer to standard ratings	
Temperature variation of characteristic		Capacitance	More than 70% of initial measured value	
		ESR	Less than 500% of initial measured value	
	Phase 4	Capacitance	Less than 150% of initial measured value	
		ESR	Satisfy initial specified value	
		Current at 30min	Not exceed 1.5CV(mA)	
	Phase 5	Capacitance	Within ±20% of initial measured value	
		ESR	Satisfy initial specified value	
		Current at 30min	Satisfy initial specified value	
Lead strength			No pin disconnection	Conforms to 4.5
Vibration Resistance		Capacitance	Satisfy initial specified value	Conforms to 4.9 Frequency :10～55Hz Test Duration :6 hours
		ESR		
		Current at 30min		
		Appearance	No obvious abnormality	
Solderability			3/4 or more of pin surface Should be covered with new solder	Conforms to 4.7 Temperature: 245±5℃, Time: 5±0.5second Should be dipped up to 1.6mm from lower end of Capacitor
Solder Heat Resistance		Capacitor	Satisfy initial specified value	Conforms to 4.6 Temperature: 245±5℃, Time: 5±0.5second Should be dipped up to 1.6mm from lower end of Capacitor
		ESR		
		Current at 30minutes		
		Appearance	No obvious abnormality	
Temperature Cycle		Capacitor	Satisfy initial specified value	Conforms to 4.8 −25℃→Room Temp→※Max. Temp.→Room Temp 5 cycles * Max. Temperature
		ESR		
		Current at 30minutes		
		Appearance	No obvious abnormality	
Humidity Resistance		Capacitor	Within ±20% of initial measured value	Conforms to 4.14 40±2℃ 90～90%RH, 240±8hours
		ESR	Less than 150% of initial measured value	
		Current at 30minutes	Less than 150% of initial measured value	
		Appearance	No obvious abnormality	
High Temperature Load Life		Capacitor	Within ±30% of initial measured value	Conforms to 4.10 Max. Operation temperature ±2℃ Max. Operating Voltage Series protection resistance : 0Ω 10001000 $^{+48}_{0}$hours Max Operation Temp
		ESR	Less than 200% of initial measured value	
		Current at 30minutes	Less than 200% of initial measured value	
		Appearance	No obvious abnormality	

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7. Packing

1. FM Series

(1) Bulk

- Packing method：Pack in vinyl bags then pack them into cardboard boxes.
- Standard packing quantity：1000pcs (100pcs / vinyl bag×10)
  However：FM0H104ZF-L1 and FM0H224ZF-L1＝800pcs, FMC0H334ZF＝400pcs, FMC0H334ZF-L1＝300pcs

(2) Taping

- Packing method：Ammo pack
- Standard packing quantity：1000pcs However, FMC0H334ZFTP( ) = 400pcs

2. FC Series

Part name	Packing unit
FC0H473ZFTBR24	1000 PCS. / reel
FC0H104ZFTBR24	1000 PCS. / reel
FC0H224ZFTBR24	500 PCS. / reel
FC0H474ZFTBR32-SS	200 PCS. / reel
FC0H105ZFTBR44-SS	150 PCS. / reel
FC0V104ZFTBR24	1000 PCS. / reel
FC0V224ZFTBR24	1000 PCS. / reel
FC0V474ZFTBR24	500 PCS. / reel
FCS0H473ZFTBR24	1000 PCS. / reel
FCS0H104ZFTBR24	1000 PCS. / reel
FCS0H224ZFTBR24	500 PCS. / reel
FCS0V104ZFTBR24	1000 PCS. / reel
FCS0V224ZFTBR24	1000 PCS. / reel
FCS0V474ZFTBR24	500 PCS. / reel

3. FG, FT, FS, FR, FY, FA Series

(1) Bulk (Small type)

- Packing method：Pack in vinyl bags then pack them into cardboard boxes.
- Standard packing quantity: see chart below.

（Unit：Pises）

Series name / Capacitance	FA		FE	FS		FY		FR	FG	FGH	FT
	5.5V type	11V type		5.5V type	11V type, 12V type	FYD	FYH				
0.010F	—	—	—	—	—	—	—	—	2000	—	—
0.022F	—	240	—	1000	—	1000	1600	800	2000	—	—
0.047F	400	—	400	800	—	1000	800	400	2000	—	—
0.10F	—	—	400	600	—	800	600	400	1600	2000	1000
0.22F	—	—	—	400	—	400	500	300	800	1600	400
0.47F	—	—	—	—	—	240	—	240	300	600	400
1.0F	—	—	—	—	—	—	—	—	240	90	—

(2) Bulk (large type)

- Packing method: Pin the terminal onto a conductive mat; then pack it into individual cardboard box with insulation material.
- Standard packing quantity: see chart below.

（Unit：Pises）

Series name / Capacitance	FA		FE	FS		FY		FR	FG	FGR	FT
	5.5V type	11V type		5.5V type	11V type, 12V type	FYD	FYH				
0.10F	90	50	—	—	—	—	—	—	—	—	—
0.22F	50	30	90	—	—	—	—	—	—	—	—
0.47F	30	20	50	90	50	—	90	—	—	300	—
1.0F	20	—	30	50	50	90	50	90	—	240	90
1.4F	—	—	—	—	—	90	—	—	—	—	—
1.5F	—	—	20	—	—	—	—	—	160	—	—
2.2F	—	—	—	—	—	50	—	—	90	90	50
3.3F	—	—	—	—	—	—	—	—	—	—	30
4.7F	—	—	—	—	—	—	—	—	50	—	—
5.0F	—	—	—	—	20	—	—	—	—	—	—
5.6F	—	—	—	—	—	—	—	—	—	—	20

4. HV Series

- Packing method：Pack in plastic bags then pack them into cardboard boxes. 100F and 200F are into cardboard without plastic bags.
- Standard packing quantity：4,000pcs(1F), 2,000pcs(2.7F, 4.7F, 10F), 1,000pcs(22F), 250pcs(50F), 100pcs(100F, 200F)

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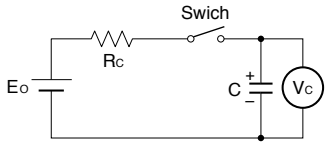
8. Measurement Conditions

(1) Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, short between both pins of the capacitor for 30 minutes or more to let it discharge. In addition, follow the indication of the product when determining the polarity of the capacitor during charging.

Capacitance: $C = \frac{\tau}{R_C}$ (F) (9)



E_O: 3.0 (V) ··· Product with maximum operating voltage 3.5 V
5.0 (V) ··· Product with maximum operating voltage 5.5 V
6.0 (V) ··· Product with maximum operating voltage 6.5 V
10.0 (V) ··· Product with maximum operating voltage 11 V
12.0 (V) ··· Product with maximum operating voltage 12 V

τ : Time from start of charging until Vc becomes $0.632E_0$ (V) (sec)

R_C:See table below (Ω).

	FA	FE	FS	FY		FR	FM, FME FMR	FMC	FG FGR	FGH	FT	FC, FCS
				FYD	FYH							
0.010F	–	–	–	–	–	–	5000 Ω	–	5000 Ω	–	–	–
0.022F	1000 Ω	–	1000 Ω	2000 Ω	2000 Ω	2000 Ω	2000 Ω	–	2000 Ω	–	–	Discharge
0.033F	–	–	–	–	–	–	Discharge	–	–	–	–	–
0.047F	1000 Ω	1000 Ω	1000 Ω	2000 Ω	1000 Ω	1000 Ω	2000 Ω	1000 Ω	2000 Ω	–	–	–
0.10F	510 Ω	510 Ω	510 Ω	1000 Ω	510 Ω	1000 Ω	1000 Ω	1000 Ω	1000 Ω	Discharge	510 Ω	Discharge
0.22F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	–	1000 Ω	Discharge	200 Ω	Discharge
0.33F	–	–	–	–	–	–	–	Discharge	–	–	–	–
0.47F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	–	–	1000 Ω	Discharge	100 Ω	Discharge
1.0F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	–	–	510 Ω	Discharge	100 Ω	Discharge
1.4F	–	–	–	200 Ω	–	–	–	–	–	–	–	–
1.5F	–	51 Ω	–	–	–	–	–	–	510 Ω	–	–	–
2.2F	–	–	–	100 Ω	–	–	–	–	200 Ω	–	51 Ω	–
3.3F	–	–	–	–	–	–	–	–	–	–	51 Ω	–
4.7F	–	–	–	–	–	–	–	–	100 Ω	–	–	–
5.0F	–	–	100 Ω	–	–	–	–	–	–	–	–	–
5.6F	–	–	–	–	–	–	–	–	–	–	20 Ω	–

*Capacitance values according to the constant current discharge method.
*HV series capacitance is measured by discharge system.

Table 3 Capacitance measurement

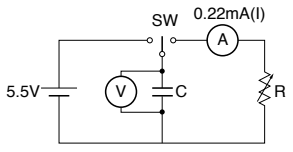
Capacitance (Discharge System)

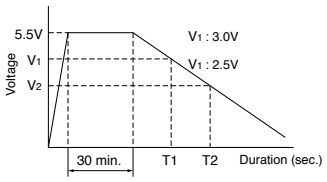
In the diagram below, charging is performed for a duration of 30 minutes, once the voltage of the condensor terminal reaches 5.5 V.

Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA for 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

Note: The current value is 1 mA discharged per 1F.

Capactance : $C = \frac{I \times (T_2 - T_1)}{V_1 - V_2}$ (F)





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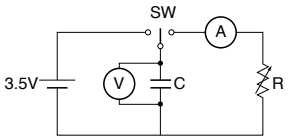
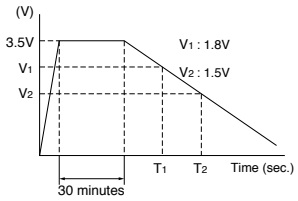
Capacitance (Discharge System:3.5V)

In the diagram below, charging is performed for a duration of 30 minutes, once the voltage of the capacitor terminal reaches 3.5V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5V upon discharge at 1 mA per 1F, and calculate the static capacitance according to the equation shown below.

$$C = \frac{I \times (T_2 - T_1)}{V_1 - V_2} \quad (F)$$

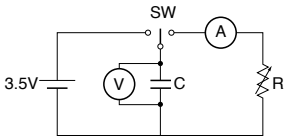


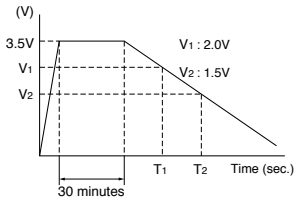


Capacitance (Discharge System:HVseries)

In the diagram below, charging is performed for a duration of 30 minutes, once the voltage of the capacitor terminal reaches Max. operating voltage.
Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5V upon discharge at 1 mA per 1F, and calculate the static capacitance according to the equation shown below.

$$C = \frac{I \times (T_2 - T_1)}{V_1 - V_2} \quad (F)$$

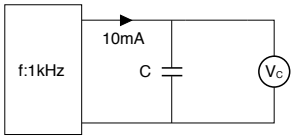




Equivalent series resistance (ESR)

ESR shall be calculated from the equation below.

$$ESR = \frac{V_C}{0.01} \ (\Omega)$$

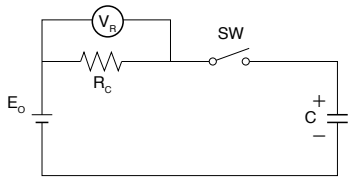


Current (at 30 minutes after charging)

Current shall be calculated from the equation below.
Prior to measurement, both lead terminals must be short-circuited for a minimum of 30 minutes.
The lead terminal connected to the metal can case is connected to the negative side of the power supply.

Eo：2.5Vdc (HVseries 50F)
2.7Vdc (HVseries except 50F)
3.0Vdc (3.5V type)
5.0Vdc (5.5V type)
Rc：1000Ω (0.010F, 0.022F, 0.047F)
100Ω (0.10F, 0.22F, 0.47F)
10Ω (1.0F, 1.5F, 2.2F, 4.7F)
2.2Ω (HVseries)

$$Current = \frac{V_R}{R_C} \ (A)$$



Self-discharge characteristic (0H: 5.5V products)

The self-discharge characteristic is measured by charging a voltage of 5.0 Vdc (charge protection resistance: 0Ω) according to the capacitor polarity for 24 hours, then releasing between the pins for 24 hours and measuring the pin-to-pin voltage.
The test should be carried out in an environment with an ambient temperature of 25℃ or below and relative humidity of 70% RH or below.

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9. ⚠Notes on Using Super Capacitor (Electric Double-Layer Capacitor)

1. Circuitry design

1.1 Useful life

The electrical double layered capacitor (super capacitor) uses electrolyte and is sealed with rubber etc. Water in the electrolyte can evaporate in use over long periods at high temperatures, thus reducing electrostatic capacity which in turn will create greater internal resistance. The characteristics of the super capacitor can vary greatly depending on the environment it is used in. Therefore, controlling the usage environment will ensure prolonged life of the part.
Basic breakdown mode is an open mode due to increased internal resistance.

1.2 Fail rate in the field (Except HV series)

Based on field data, the fail rate is calculated at approx. 0.006Fit. We estimate that unreported failures are ten times this amount. Therefore, we assume that the fail rate is below 0.06Fit.

1.3 Voltage application when maximum usable voltage is exceeded

Performance may be compromised, and in some cases leakage or damage may occur if applied voltage exceeds maximum working voltage.

1.4 Use of capacitor as a smoothing capacitor (ripple absorption) in electrical circuits

As super capacitors contain a high level of internal resistance, they are not recommended for use as electrical smoothing capacitors in electrical circuits.
Performance may be compromised, and in some cases leakage or damage may occur if a super capacitor is used in ripple absorption.

1.5 Series connections

As applied voltage balance to each super capacitor is lost when used in series connection, excess voltage may be applied to some super capacitors, which will not only negatively affect its performance but may also cause leakage and/or damage.
Allow ample margin for maximum voltage or attach a circuit for applying equal voltage to each super capacitor (partial pressure resistor/voltage divider) when using super capacitors in series connection.
Also, arrange super capacitors so that the temperature between each capacitor will not vary.

1.6 Outer sleeve insulation

The outer sleeve wrapped around the super capacitor indicates that it is sealed, however the outer sleeve is not guaranteed for insulation purposes. Therefore, it cannot be used where insulation is necessary.

1.7 Polar characteristics

The super capacitor is manufactured so that the terminal on the outer case is negative (-). Align the (-) symbol during use. Even though discharging has been carried out prior to shipping, any residual electrical charge may negatively affect other parts.

1.8 Use next to heat emitters

Useful life of the super capacitor will be significantly affected if used near heat emitting items (coils, power transistors, and posistors etc) where the super capacitor itself may become heated.

1.9 Usage environment

This device cannot be used in any acidic, alkaline or similar type of environment.

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1.10 Super capacitors fitted with pressure valves

HV series super capacitors are fitted with pressure valves Make an opening in the top of the pressure valve to avoid any damage to the super capacitor when the pressure valve is in use. Allow at least a 2mm opening for models with a diameter of ϕ18mm or less, and at least a 3mm opening for models with a diameter of ϕ22mm.

2. Mounting

2.1 Mounting onto a reflow furnace

Except for the FC series, it is not possible to mount this capacitor onto an IR / VPS reflow furnace. Do not immerse the capacitor into a soldering dip tank.

2.2 Flow soldering conditions

Keep solder under 260℃ and soldering time to within 10 seconds when using the flow automatic soldering method. (Except for the FC and HV series)

2.3 Installation using a soldering iron

Care must be taken to prevent the soldering iron from touching other parts when soldering. Keep the tip of the soldering iron under 400℃ and soldering time to within 3 seconds. Always make sure that the temperature of the tip is controlled. Internal capacitor resistance is likely to increase if the terminals are overheated.

2.4 Lead terminal processing

Do not attempt to bend or polish the capacitor terminals with sand paper etc. Soldering may not be possible if the metallic plating is removed from the top of the terminals.

2.5 Cleaning, Coating, and Potting

Except for the FM series, cleaning, coating, and potting must not be carried out. Consult us if this type of procedure is necessary.

Terminals should be dried at less than the maximum operating temperature after cleaning.

3. Storage

3.1 Temperature and Humidity

Make sure that the super capacitor is stored according to the following conditions: Temp.: 5～35℃ (Standard 25), Humidity: 20～70% (Standard: 50%). Do not allow the build up of condensation through sudden temperature change.

3.2 Environment conditions

Make sure that there are no corrosive gasses like sulfur dioxide as penetration of the lead terminals is possible.

Always store this item in an area with low dust and dirt levels.

Make sure that the packaging will not be deformed through heavy loading, movement and/or knocks.

Keep out of direct sunlight, and away from radiation, static electricity, and magnetic fields.

3.3 Maximum storage period

This item may be stored up to one year from the date of delivery if stored at the conditions stated above.

This product should be safe to use even after being stored for over a 1 year period. However, depending on the storage conditions, we recommend that the soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within thecapacitor. Do not attempt to dismantle as direct skin contact with the electrolyte will cause burning.

This product should be treated as industrial waste and not is not to be disposed of by fire.

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When using our products, the following precautions should be taken.

(1) Safety designing of an apparatus or a system allowing for failures of electronic components used in the system

In general, failures will occur in electronic components at a certain probability. NEC TOKIN makes every effort to improve the quality and reliability of electronic component products. However, it is impossible to completely eliminate the probability of failures. Therefore, when using NEC TOKIN's electronic component products, systems should be carefully designed to ensure redundancy in the event of an accident which would result in injury or death, fire, or social damage, to ensure the prevention of the spread of fire, and the prevention of faulty operation. (Please refer to pre-cautions to be taken when using SuperCapacitor capacitors for the details of failures.)

(2) Quality level of various kinds of parts, and equipment in which the parts can be utilized
Electronic components have a standard quality level unless otherwise specified.

NEC TOKIN classifies the level of quality of electronic component products into three levels, in order from a lower level, a standard quality level, a special quality level, and a custom quality level in which a customer individually specifies a quality assurance program. Each of the quality levels has recommended applications.
If a user wants to use the electronic parts having a standard quality level in applications other than the applications specified for the standard quality level, they should always consult a member of our company's sales staff before using the electronic parts.

Standard quality level	:	Computers, office automation equipment, communications equipment, measuring instruments, AV equipment, household electrical appliances, machine tools, personal equipment, industrial robots
Special quality level	:	Transportation equipment (automobiles, railways, shipping, or the like), traffic signals, disaster prevention/crime prevention systems, safety devices, and medical equipment which is not directly intended for life-support purposes
Custom quality level	:	Equipment for airplanes, aerospace equipment, nuclear power control systems, and medical equipment, apparatus or systems for life-support purposes

Unless otherwise shown, the quality level of NEC TOKIN's electronic component products included in documents such as catalogues, data sheets or data books is the standard quality level.

(3) This manual is subject to change without notice.

The contents of this manual are based on data which is correct as of February 2015, and they may be changed without notice. If our products are used for mass-production design, please cousult with a member of our company's sales staff by way of precaution.

(4) Reprinting and copying of this manual without prior written permission from NEC TOKIN Corporation are not permitted.

(5) Industrial property problems

In the event any problems associated with industrial property of a third party arising as a result of the use of our products, NEC TOKIN assumes no responsibility for problems other than problems directly associated with the constitution and manufacturing method of the products.

(6) Should any of these products come under the category of strategic goods or services (according to Japan's foreign trade and foreign exchange regulations), the sender must obtain an export license from the Japanese Government befor said products can be exported outside Japan.

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