

Overview

FC Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are surface mount type components intended for high energy storage applications. The FC Series is designed specifically for reflow soldering, allowing them to be attached to a printed circuit board (PCB) directly.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- · Surface mount without holder
- Wide range of temperature from -25°C to +70°C
- Maintenance free
- Maximum operating voltages of 3.5 and 5.5 VDC
- · Highly reliable against liquid leakage
- · Lead-free and RoHS Compliant



Part Number System

FC	OH	104	Z	F	ТВ	R	24	-SS
Series Surface Mount	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental	Таре Туре	Orientation	Tape Width	C-Spec
FCS FC	0V = 3.5 VDC 0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.	Z = -20/+80%	F = Lead-free	TB = Embossed	R = Positive electrode forward		−SS = 3 digit serial number marked on top Blank = No serial number marking

Алматы (7273)495-231 Ангарск (3955)60-70-56 Архангельск (8182)63-90-72 Астрахань (8512)99-46-04 Барнаул (3852)73-04-60 Белгород (4722)40-23-64 Благовещенск (4162)22-76-07 Брянск (4832)59-03-52 Владивосток (423)249-28-31 Владикаеток (423)249-28-31 Владикаеток (423)249-28-31 Волоград (844)278-03-48 Вологорад (844)278-03-48 Ворогнак (8172)26-41-59 Воронеж (473)204-51-73

Россия +7(495)268-04-70

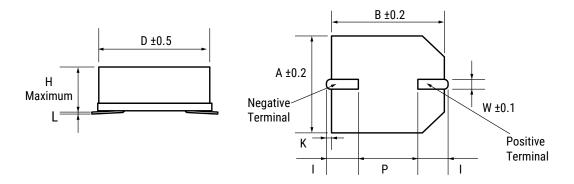
Иваново (4932)77-34-06 Ижевск (3412)26-03-58 Иркутск (395)279-98-46 Казань (843)206-01-48 Калининград (4012)72-03-81 Калуга (4842)92-23-67 Кемерово (3842)65-04-62 Киров (8332)68-02-04 Коломна (4966)23-41-49 Кострома (4962)23-41-49 Кострома (4942)77-07-48 Краснодар (861)203-40-90 Кураснодар (861)203-40-90 Кураснодар (861)203-40-90 Курск (4712)77-13-04 Курск (4712)77-13-04 Курскан (4742)52-20-81 Казахстан +7(7172)727-132 Магнитогорск (3519)55-03-13 Москва (495)268-04-70 Мурманск (8152)59-64-93 Набережные Челны (8552)20-53-41 Нижний Новгород (831)429-08-12 Ноябрьск (3496)41-32-12 Ноябрьск (3496)41-32-12 Новосибирск (3496)41-32-12 Новосибирск (3496)41-32-12 Новосибирск (3496)41-32-12 Новосибирск (349)27-86-73 Омск (3412)21-46-40 Орен (342)244-53-42 Оренбург (352)37-68-04 Пенза (8412)22-31-16 Петрозаводск (8142)55-98-37 Псков (8112)59-10-37 Пермь (342)205-81-47

Киргизия +996(312)96-26-47

Ростов-на-Дону (863)308-18-15 Рязань (4912)46-81-64 Самара (846)206-03-16 Саранск (8342)22-96-24 Санкт-Петербург (812)309-46-40 Саратов (845)249-38-78 Севастополь (8692)22-31-93 Симферополь (3652)67-13-56 Смоленск (4812)29-41-54 Сочи (862)225-72-31 Ставрополь (8652)20-65-13 Сурут (3462)77-98-35 Сыктывкар (8212)25-95-17 Тамбов (4752)50-40-97 Тверь (4822)63-31-35 Тольятти (8482)63-91-07 Томск (3822)98-41-53 Тула (4872)33-79-87 Тюмень (3452)66-21-18 Уланчовск (8422)24-23-59 Улан-Удэ (3012)59-97-51 Уфа (347)229-48-12 Хабаровск (4212)92-98-04 Чебоксары (8352)28-53-07 Челябинск (351)202-03-61 Череповец (8202)49-02-64 Чита (3022)38-34-83 Якутск (4112)23-90-97 Яроспавть (4852)69-52-93



Dimensions – Millimeters



Part Number	D	Н	Α	В	I	W	Р	K	L	Reflow Peak Temperature
FC0H473ZFTBR24	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)	235°C
FC0H104ZFTBR24	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)	235°C
FC0H224ZFTBR24	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)	235°C
FC0H474ZFTBR32-SS	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)	235°C
FC0H105ZFTBR44-SS	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)	235°C
FC0V104ZFTBR24	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)	235°C
FC0V224ZFTBR24	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)	235°C
FC0V474ZFTBR24	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)	235°C
FCS0H473ZFTBR24	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)	260°C
FCS0H104ZFTBR24	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)	260°C
FCS0H224ZFTBR24	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)	260°C
FCS0V104ZFTBR24	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)	260°C
FCS0V224ZFTBR24	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)	260°C
FCS0V474ZFTBR24	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)	260°C



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Capacitor		
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor	
Back-up ability	-	_	-	-	
Eco-hazard	Cd	_	-	-	
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR type)	
Charge Time	Few hours	Few hours	Few seconds	Few seconds	
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time back-up	500 μA and below	CMOS microcomputer, IC for clocks	CMOS microcomputer, static RAM/DTS (digital tuning system)	FC series

Environmental Compliance

All KEMET supercapacitors are RoHS Compliant.



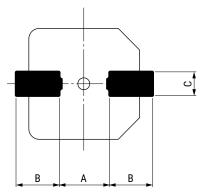


Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage (VDC)	Nominal Capacitance Discharge System (F)	Maximum ESR at 1 kHz (Ω)	Maximum Current at 30 Minutes (mA)	Voltage Holding Characteristic Minimum (V)	Weight (g)
FC0V104ZFTBR24	3.5	0.10	50	0.09	-	1.0
FCS0V104ZFTBR24	3.5	0.10	100	0.09	-	1.0
FC0V224ZFTBR24	3.5	0.22	25	0.20	-	1.0
FCS0V224ZFTBR24	3.5	0.22	50	0.20	-	1.0
FC0V474ZFTBR24	3.5	0.47	25	0.42	-	1.4
FCS0V474ZFTBR24	3.5	0.47	50	0.42	-	1.4
FC0H473ZFTBR24	5.5	0.047	50	0.071	4.2	1.0
FCS0H473ZFTBR24	5.5	0.047	100	0.071	4.2	1.0
FC0H104ZFTBR24	5.5	0.10	25	0.15	4.2	1.0
FCS0H104ZFTBR24	5.5	0.10	50	0.15	4.2	1.0
FC0H224ZFTBR24	5.5	0.22	25	0.33	4.2	1.4
FCS0H224ZFTBR24	5.5	0.22	50	0.33	4.2	1.4
FC0H474ZFTBR32-SS	5.5	0.47	13	0.71	4.2	4.0
FC0H105ZFTBR44-SS	5.5	1.0	7	1.50	4.2	6.7

Part numbers in bold type represent popularly purchased components.

Land Pattern

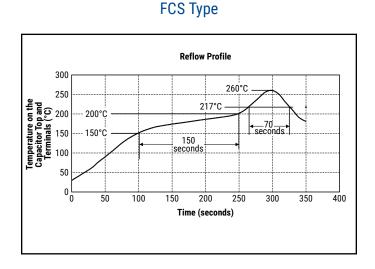


	Land Pattern			L	ead Termin	al
Diameter (mm)	A	В	C	A	В	C
10.5	5.0	4.9	2.5	5.0	3.6	1.2
10.7	5.0	4.9	2.5	5.0	3.9	1.2
16	5.0	10.0	2.5	5.0	6.8	1.2
21	10.0	10.5	3.5	10.0	7.0	1.4

Precautions for Use

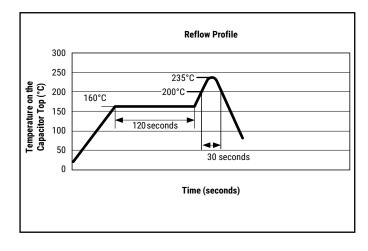
- This series is exclusively for reflow soldering. It is designed for thermal conduction system such as combination use of infrared ray and heat blow. Consult with KEMET before applying other methods.
- The reflow condition must be kept within reflow profile graphs shown below.
- Applying reflow soldering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

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

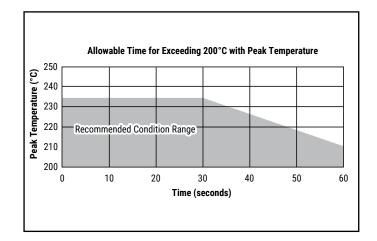


Above "Reflow Profile" graph indicates temperature at the terminals and capacitor top.

Peak Temperature	Below +260°C
Over +255°C	Within 10 seconds
Over +230°C	Within 45 seconds
Over +220°C	Within 60 seconds
Over +217°C	Within 70 seconds
Time between +150°C to +200°C (temperature zone over +170°C within 50 seconds)	150 seconds



Above "Reflow Profile" graph indicates temperature at capacitor top.



FC Type

Specifications

Item		FC 5.5 V Type, 3.5 V Type		Test Conditions (conforming to JIS C 5160-1)		
Category Temperature Range		-25°C to +70°C				
Maximum Operating Voltage	e	5.5 VDC, 3.5 VDC				
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"	
Capacitance Allowance		+80%, -20%		Refer to "Measurem	ent Conditions"	
ESR		Refer to Table 1		Measured at 1 kHz, "Measurement Con		
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"	
	Capacitance	> 90% of initial rati	ngs	Surge voltage: Charge: Discharge:		
* Surge	ESR	≤ 120% of initial rat	tings	Number of cycles: Series resistance:		
Surge	Current (30 minutes value)	≤ 120% of initial ratings			0.10 F 150 Ω 0.22 F 56 Ω 0.47 F 30 Ω 1.0 F 15 Ω	
	Appearance	No obvious abnormality		Discharge Resistance: Temperature:		
	Capacitance	Phase 2	≥ 50% of initial value	Conforms to 4.17		
	ESR		≤ 400% of initial value	Phase 1: Phase 2:	+25 ±2°C -25 ±2°C +25 ±2°C +70 ±2°C +25 ±2°C	
	Capacitance	Phase 3		Phase 4:		
	ESR	Phase 3				
* Characteristics in	Capacitance	_	≤ 200% of initial value	Pliase o.		
Different Temperature	ESR	Phase 5	Satisfy initial ratings			
	Current (30 minutes value)		1.5 CV (mA) or below			
	Capacitance	_	Within ±20% of initial value			
	ESR	Phase 6	Satisfy initial ratings			
	Current (30 minutes value)		Satisfy initial ratings			
	Capacitance			Conforms to 4.13		
* Vibration Resistance	ESR	Satisfy initial ratin	gs	Frequency: Testing Time:		
Vibration Resistance	Current (30 minutes value)				0 Hours	
	Appearance	No obvious abnorn	nality			
	Capacitance	_		Cooled down to am	pient temperature after	
* Solder Heat Resistance	ESR	Satisfy initial ratin	gs	reflow soldering, the	en the product must	
Solder Heat Resistance	Current (30 minutes value)			fulfill the condition (See Precautions fo		
	Appearance	No obvious abnormality				
	Capacitance			Conforms to 4.12 Temperature		
* Temperature Cycle	ESR	Satisfy initial ratin	gs	Condition: -25°C » Room temperature »		
	Current (30 minutes value)	Na abutana abu	1:4	Number of such as	+70°C » Room temperature	
	Appearance	No obvious abnorn		Number of cycles: 5 cycles		

* Must fulfill the above condition after reflow soldering.

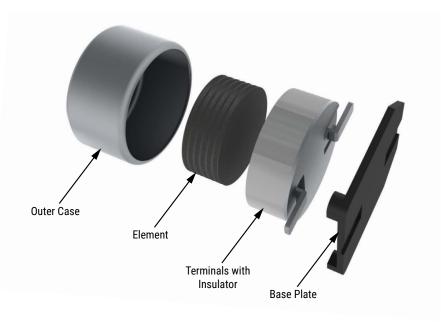


Specifications cont.

ltem		FC 5.5	5 V Type, 3.5 V Type	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance	Within ±20% of init	tial value	Conforms to 4.14		
* High Temperature and	ESR	≤ 120% of initial ra	tings	Temperature: Relative humidity:	+40 ±2°C 90 to 95% RH	
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ra	tings	Testing time:	240 ±8 hours	
	Appearance	No obvious abnorr	nality			
Capacitance		Within ±30% of init	tial value	Conforms to 4.15 Voltage applied:	Maximum operating	
	ESR	< 200% of initial ra	tings		voltage 0 Ω 1,000 +48 (+48/-0)	
* High Temperature Load	Current (30 minutes value)	< 200% of initial ra	tings	Series protection resistance: Testing time:		
	Appearance	No obvious abnorr	nality		hours	
* Self Discharge Characteristics (Voltage Holding Characteristics)		5.5 V type:	Voltage between terminal leads > 4.2 V	Charging condition Voltage applied: Series resistance: Charging time:	5.0 VDC (Terminal at the case side must be negative) 0 Ω 24 hours	
		3.5 V type: Not specified		Storage Let stand for 24 hou described below wit Ambient temperature: Relative humidity:		

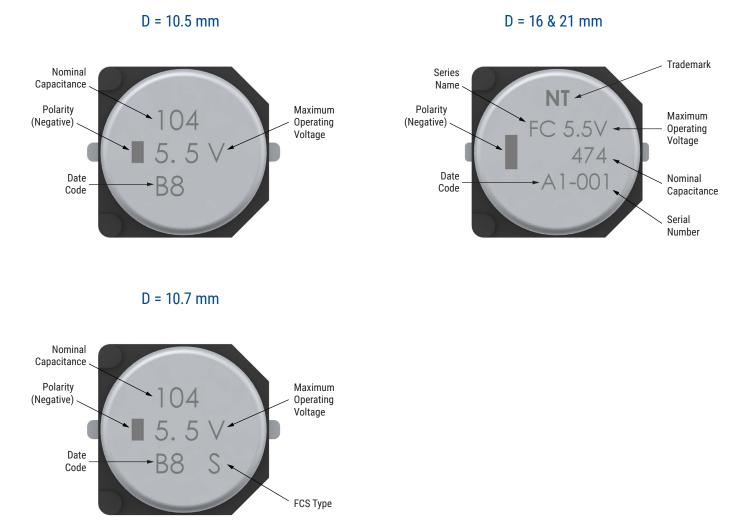
* Must fulfill the above condition after reflow soldering.

Construction





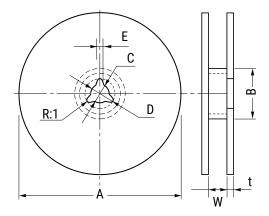
Marking



Displays nominal capacitance, maximum operating voltage serial number, polarity, etc.



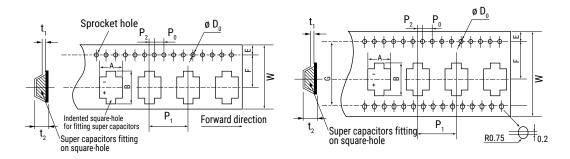
Tape & Reel Packaging Information – Millimeters



Mark	TBR24	1	TBR32	TBR44
А	380±2		330±2	380±2
P	Product height 5.5 mm	80±1	100.1	100.1
В	Product height 8.5 mm	100±1	100±1	100±1
С	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
	Product height 5.5 mm	25.5±0.5	22 E 1 0	45.5±1.0
W	Product height 8.5 mm	25.5±1.0	33.5±1.0	
t	2.0		2.0	2.0



Tape & Reel Packaging Information – Millimeters cont.



Mark	TBR24		TBR32	TBR44
W	24.0		32.0	44.0
А	11.4		18.0	23.0
В	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
ø D _o	1.55		1.55	1.55
t ₁	0.4		0.5	0.5
E	1.75		1.75	1.75
+	Product height 5.5 mm 6.0		10.0	12.0
t ₂	Product height 8.5 mm 8.4		10.0	12.0
G	-		28.4	40.4

Ammo Pack Packaging Information

Part Number	Quantity per Reel
FC0H473ZFTBR24	1,000 pieces/reel
FC0H104ZFTBR24	1,000 pieces/reel
FC0H224ZFTBR24	500 pieces/reel
FC0H474ZFTBR32-SS	200 pieces/reel
FC0H105ZFTBR44-SS	150 pieces/reel
FC0V104ZFTBR24	1,000 pieces/reel
FC0V224ZFTBR24	1,000 pieces/reel
FC0V474ZFTBR24	500 pieces/reel
FCS0H473ZFTBR24	1,000 pieces/reel
FCS0H104ZFTBR24	1,000 pieces/reel
FCS0H224ZFTBR24	500 pieces/reel
FCS0V104ZFTBR24	1,000 pieces/reel
FCS0V224ZFTBR24	1,000 pieces/reel
FCS0V474ZFTBR24	500 pieces/reel



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

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

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con	ГЛ	FF	FS	F	Y	FR	FM, FME	ГМО	FG,	ГСЦ	гт		шу
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

^{3.0 (}V) Product with maximum operating voltage of 3.5 V

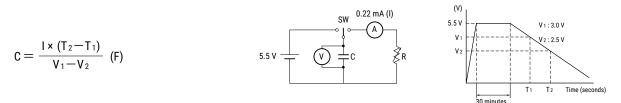


Measurement Conditions cont.

Capacitance (Discharge System)

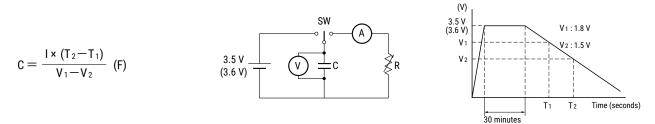
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



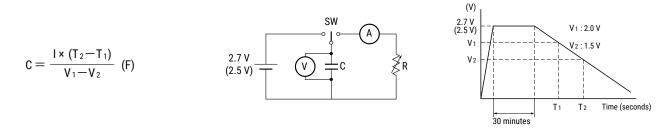
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.

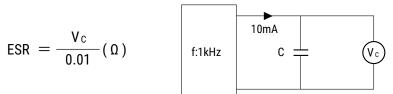




Measurement Conditions cont.

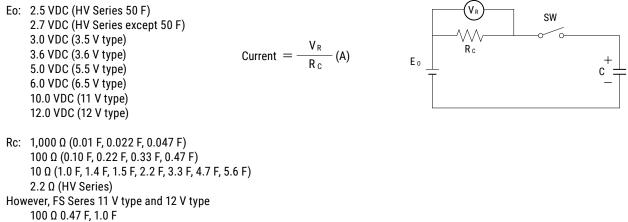
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Notes on Using Supercapacitors or Electric Double-Layer Capacitors (EDLCs)

1. Circuitry Design

1.1 Useful life

The FC Series Supercapacitor (EDLC) uses an electrolyte in a sealed container. Water in the electrolyte can evaporate while in use over long periods of time at high temperatures, thus reducing electrostatic capacity which in turn will create greater internal resistance. The characteristics of the supercapacitor can vary greatly depending on the environment in which it is used. Basic breakdown mode is an open mode due to increased internal resistance.

1.2 Fail rate in the field

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

1.3 Exceeding maximum usable voltage

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)

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

1.5 Series connections

As applied voltage balance to each supercapacitor is lost when used in series connection, excess voltage may be applied to some supercapacitors, 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 supercapacitor (partial pressure resistor/voltage divider) when using supercapacitors in series connection. Also, arrange supercapacitors so that the temperature between each capacitor will not vary.

1.6 Case Polarity

The supercapacitor 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.

1.7 Use next to heat emitters

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

1.8 Usage environment

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



Notes on Using Supercapacitors or Electric Double-Layer Capacitors (EDLCs) cont.

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°C 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°C 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 KEMET 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 supercapacitor is stored according to the following conditions: Temperature: $5 - 35^{\circ}$ C (Standard 25°C), Humidity: 20 - 70% (Standard: 50%). Do not allow the build up of condensation through sudden temperature change.

3.2 Environment conditions

Make sure there are no corrosive gasses such as 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.



Overview

FM Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Rectangular case
- Wide range of temperature from -25°C to +70°C (all types except FMR) and -40°C to +85°C (FMR type)
- Maintenance free
- Maximum operating voltages of 3.5, 3.6, 5.5, and 6.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant
- · Leads can be transverse mounted

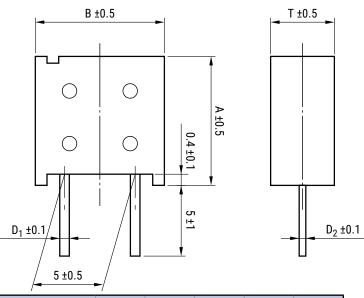


Part Number System

FM	OH	223	Z	F	ТР	18
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental	Таре Туре	Height (excluding lead)
FM FME FMR FMC	0V = 3.5 VDC 0H = 5.5 VDC 0J = 6.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.	Z = -20/+80%	F = Lead-free	TP = AMMO -L1 = Transverse mounting Blank = Bulk	18 = 18 mm Blank = Bulk

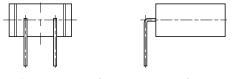


Dimensions – Millimeters



Part Number	Α	В	Т	D ₁	D ₂
FM0H103ZF	11.5	10.5	5.0	0.5	0.4
FM0H223ZF	11.5	10.5	5.0	0.5	0.4
FM0H473ZF	11.5	10.5	5.0	0.5	0.4
FM0H104ZF	11.5	10.5	6.5	0.5	0.4
FM0H224ZF	11.5	10.5	6.5	0.5	0.4
FM0V473ZF	11.5	10.5	5.0	0.5	0.4
FM0V104ZF	11.5	10.5	5.0	0.5	0.4
FM0V224ZF	11.5	10.5	6.5	0.5	0.4
FM0J473ZF	11.5	10.5	6.5	0.5	0.4
FME0H223ZF	11.5	10.5	5.0	0.5	0.4
FME0H473ZF	11.5	10.5	5.0	0.5	0.4
FMR0H473ZF	11.5	10.5	6.5	0.5	0.4
FMR0H104ZF	11.5	10.5	6.5	0.5	0.4
FMR0V104ZF	11.5	10.5	6.5	0.5	0.4
FMR0V334ZF	11.5	10.5	6.5	0.5	0.4
FMR0V474ZF	15.0	14.0	9.0	0.6	0.6
FMC0H473ZF	11.5	10.5	5.0	0.5	0.4
FMC0H104ZF	11.5	10.5	6.5	0.5	0.4
FMC0H334ZF	15.0	14.0	9.0	0.6	0.6

Lead Terminal Forming



Add "L1" to the end of bulk part number for transverse mounting option © KEMET Electronics Corporation • One East Broward Boulevard



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	ncitor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	-	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time back-up	500 μA and below	CMOS microcomputer, IC for clocks	CMOS microcomputer, static RAM/DTS (digital tuning system)	FM series

Environmental Compliance

All KEMET supercapacitors are RoHS compliant.





Table 1 – Ratings & Part Number Reference

Part Number	Maximum Part Number Operating		Nominal Capacitance		Maximum Current at 30	Voltage Holding Characteristic	Weight (g)
Fait Nullibei	Voltage (VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Minimum (V)	weight (g)
FM0V473ZF	3.5	0.047	0.06	200	0.042	-	1.3
FMR0V104ZF	3.5	0.10	-	50	0.090	-	1.6
FM0V104ZF	3.5	0.10	0.13	100	0.090	-	1.3
FM0V224ZF	3.5	0.22	0.30	100	0.20	-	1.6
FM0H103ZF	5.5	0.01	0.014	300	0.015	4.2	1.3
FME0H223ZF	5.5	0.022	0.028	40	0.033	-	1.3
FM0H223ZF	5.5	0.022	0.028	200	0.033	4.2	1.3
FME0H473ZF	5.5	0.047	0.06	20	0.071	-	1.3
FMC0H473ZF	5.5	0.047	0.06	100	0.071	4.2	1.3
FM0H473ZF	5.5	0.047	0.06	200	0.071	4.2	1.3
FMR0H473ZF	5.5	0.047	0.062	200	0.071	4.2	1.6
FMR0H104ZF	5.5	0.10	-	50	0.15	4.2	1.6
FMR0V334ZF	3.6	-	0.33	50	0.3	-	1.6
FMR0V474ZF	3.6	-	0.47	25	0.42	-	3.5
FMC0H104ZF	5.5	0.10	0.13	50	0.15	4.2	1.6
FM0H104ZF	5.5	0.10	0.13	100	0.15	4.2	1.6
FM0H224ZF	5.5	-	0.22	100	0.33	4.2	1.6
FMC0H334ZF	5.5	-	0.33	25	0.50	4.2	3.5
FM0J473ZF	6.5	0.047	0.062	200	0.071	-	1.6



Specifications – All Types Except FMR

Item		FM 5.5 V Type, 3.5 V Type, 6.5 V Type, FMC Type			FME Type		onditions to JIS C 5160-1)
Category Temperature Range		-25°C to +70°C		-25°C to +70°C			
Maximum Operating Voltage		5.5 VDC	, 3.5 VDC, 6.5 VDC	5.5 VDC			
Capacitance		Refer to	Table 1	Refer to	Table 1	Refer to "Measurem	ent Conditions"
Capacitance Allo	owance	+80%, -	20%	+80%, -	20%	Refer to "Measurem	ent Conditions"
ESR		Refer to	Table 1	Refer to	Table 1	Measured at 1 kHz, "Measurement Cond	
Current (30 minu	tes value)	Refer to	Table 1	Refer to	Table 1	Refer to "Measurem	ent Conditions"
	Capacitance	> 90% of	f initial ratings	> 90% o	f initial ratings	Surge voltage: 4.0 V (3.5 V type) 6.3 V (5.5 V type) 7.4 V (6.5 V type) Charge: 30 seconds Discharge: 9 minutes 30 seco	
ESR Surge Current (30 minutes value)		≤ 120% o	of initial ratings	≤ 120%	of initial ratings	Number of cycles: Series resistance:	1,000
		≤ 120% of initial ratings		≤ 120% of initial ratings		0	0.10 F 150 Ω 0.22 F 56 Ω 0.33 F 51 Ω
	Appearance	No obvious abnormality		No obvi	ous abnormality	Discharge resistance: Temperature:	
	Capacitance	Phase	≥ 50% of initial value	Phase	≥ 50% of initial value	Conforms to 4.17	
	ESR	2	≤ 400% of initial value	2	≤ 300% or less than initial value	Phase 2:	+25±2°C -25±2°C +25±2°C
	Capacitance	Phase		Phase		Phase 4. Phase 5:	
	ESR	3		3		Phase 6:	+25±2°C
e l	Capacitance		≤ 200% of initial value		≤ 150% of initial value		
Characteristics in Different	ESR	Phase 5	Satisfy initial ratings	Phase 5	Satisfy initial ratings		
Temperature	Current (30 minutes value)		≤ 1.5 CV (mA)	5	≤ 1.5 CV (mA)		
	Capacitance		Within ±20% of initial value		Within ±20% of initial value		
	ESR	Phase	Satisfy initial	Phase	Satisfy initial ratings		
	Current (30 minutes value)	_ 6	ratings Satisfy initial ratings	6	Satisfy initial ratings	_	
	Capacitance					Conforms to 4.13	
Vibration Resistance Uibration Resistance		Cotiofus	nitial ratinga	Catiof	initial ratinga	Frequency:	
		_ Sausty I	nitial ratings	Satisty	initial ratings	Testing Time:	6 hours
	Appearance	No obvi	ous abnormality	No obvi	ous abnormality		
Solderability		,	No obvious abnormality Over 3/4 of the terminal should be covered by the new solder		4 of the terminal should be by the new solder	Conforms to 4.11 Solder temp: Dipping time:	+245±5°C 5±0.5 seconds tom should be dipped.



Specifications – All Types Except FMR cont.

Item		FM 5.5 V Type, 3.5 V Type, 6.5 V Type, FMC Type	FME Туре	Test Conditions (conforming to JIS C 5160-1)	
	Capacitance	_		Conforms to 4.10	
Solder Heat	ESR	Satisfy initial ratings	Satisfy initial ratings	Solder temp: +260±10°C Dipping time: 10±1 seconds	
Resistance	Current (30 minutes value)				
	Appearance	No obvious abnormality	No obvious abnormality	1.6 mm from the bottom should be dipped.	
	Capacitance			Conforms to 4.12	
Temperature	ESR	Satisfy initial ratings	Satisfy initial ratings	Temperature Condition: -25°C » Room	
Cycle	Current (30 minutes value)			temperature » +70°C » Room temperature	
	Appearance	No obvious abnormality	No obvious abnormality	Number of cycles: 5 cycles	
Hiah	Capacitance	Within ±20% of initial value	Within ±20% of initial value	Conforms to 4.14	
Temperature	ESR	≤ 120% of initial ratings	≤ 120% of initial ratings	Temperature: +40±2°C Relative humidity: 90 to 95% RH	
and High Humidity	Current (30 minutes value)	≤ 120% of initial ratings	≤ 120% of initial ratings	Testing time: 240±8 hours	
Resistance	Appearance	No obvious abnormality	No obvious abnormality		
	Capacitance	Within ±30% of initial value	Within ±30% of initial value	Conforms to 4.15 Temperature: +70±2°C Voltage applied: Maximum operating	
High Temperature	ESR	< 200% of initial ratings	< 200% of initial ratings	voltage	
Load	Current (30 minutes value)	< 200% of initial ratings	< 200% of initial ratings	Series protection resistance: 0 Ω Testing time: 1,000 +48 (+48/-0)	
	Appearance	No obvious abnormality	No obvious abnormality	hours	
				Charging condition Voltage applied: 5.0 VDC (Terminal at the case side must be	
Self Discharge Charac	Characteristics	5.5 V type: Voltage between terminal		negative) Series resistance: 0 Ω Charging time: 24 hours	
	g Characteristics)	leads > 4.2 V 3.5 V type: Not specified 6.5 V type: Not specified		Storage Let stand for 24 hours in condition describe below with terminals opened.	
				Ambient temperature: < 25°C Relative humidity: < 70% RH	



Specifications – FMR Type

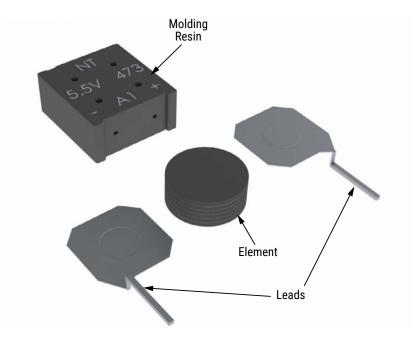
Item			FMR Type	Test Conditions (conforming to JIS C 5160-1)		
Category Temperature Range		-40°C to +85°C				
Maximum Operating Voltage		5.5 VDC, 3.5 VDC, 3	3.6 VDC			
Capacitance		Refer to Table 1		Refer to "Measureme	ent Conditions"	
Capacitance Allowance		+80%, -20%		Refer to "Measureme	ent Conditions"	
ESR		Refer to Table 1		Measured at 1 kHz, 1 "Measurement Cond		
Current (30 minutes value)		Refer to Table 1		Refer to "Measureme	ent Conditions"	
	Capacitance	More than 90% of i	nitial ratings	Surge voltage: Charge:	4.0 V (3.5 & 3.6 V type) 6.3 V (5.5 V type) 30 seconds	
	ESR	Not to exceed 1209	% of initial ratings	Discharge: Number of cycles:	9 minutes 30 seconds 1,000	
Surge	Current (30 minutes value)	Not to exceed 1209	% of initial ratings	Series resistance:	0.10 F 150 Ω 0.33 F 56 Ω	
	Appearance	No obvious abnorn	nality	Discharge resistance: Temperature:	0.47 F 30 Ω 0 Ω 85±2°C	
	Capacitance		50% higher than initial value	Conforms to 4.17	+25±2°C -25 ±2°C -40 ±2°C	
	ESR	Phase 2	400% or less than initial value			
	Capacitance	Dhaas 2	30% or higher than initial value			
	ESR	Phase 3	700% or less than initial value		+25 ±2°C	
Characteristics in	Capacitance		200% or less than initial value	Phase 5:	+85 ±2°C +25 ±2°C	
Different Temperature	ESR	Phase 5	Satisfy initial ratings			
	Current (30 minutes value)	-	1.5 CV (mA) or below			
	Capacitance		Within ±20% of initial value			
	ESR	Phase 6	Satisfy initial ratings			
	Current (30 minutes value)	-	Satisfy initial ratings	-		
Lead Strength (tensile)	·	No terminal damag	je	Conforms to 4.9		
	Capacitance			Conforms to 4.13		
Vibration Resistance	ESR	Satisfy initial ratin	gs	Frequency:		
VIDIATION RESISTANCE	Current (30 minutes value)	-		Testing Time:	6 hours	
	Appearance	No obvious abnorn	nality			
Solderability		Over 3/4 of the tern solder	minal should be covered by the new	Conforms to 4.11 Solder temp: Dipping time:	5±0.5 seconds	
Quantitization					tom should be dipped.	
	Capacitance ESR	Satisfy initial ratin	ac.	Conforms to 4.10 Solder temp:	+260 ±10°C	
Solder Heat Resistance		Sausty miliar rating	ys	Dipping time:	10±1 seconds	
Current (30 minutes value)		No obvious abnorn	nality	1.6 mm from the best	tom should be disped	
	Appearance Capacitance				tom should be dipped.	
	ESR	Satisfy initial rating	ac	Conforms to 4.12 Temperature	-40°C » Room	
Temperature Cycle		Sausiy muai rating	yə	Condition:	temperature » +85°C »	
	Current (30 minutes value)	No obvievo obrazz	nolity	Number of cycles:	Room temperature 5 cycles	
	Appearance	No obvious abnorn	nanty	Number of cycles.	0 090100	



Specifications – FMR Type cont.

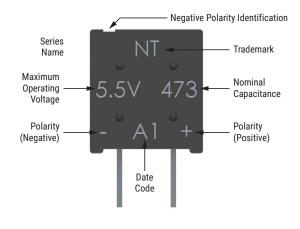
It	Item		FMR Type	Test Conditions (conforming to JIS C 5160-1)		
Capacitance		Within ±20% of ini	tial value	Conforms to 4.14		
High Temperature and	ESR	Not to exceed 120	% of initial ratings	Temperature: Relative humidity:	+40 ±2°C 90 to 95% RH	
High Humidity Resistance	Current (30 minutes value)	Not to exceed 120	% of initial ratings	Testing time:		
	Appearance	No obvious abnor	nality			
	Capacitance	Within ±30% of ini	tial value	Conforms to 4.15 Temperature: Voltage applied:	+85 ±2°C Maximum operating	
High Temperature Load	ESR	Below 200% of init	ial ratings	0 11	voltage 0 Ω 1,000 +48 (+48/-0) hours	
····g·····p·····	Current (30 minutes value)	Below 200% of init	ial ratings	Series protection resistance:		
	Appearance	No obvious abnor	nality	Testing time:		
Self Discharge Characteristics (Voltage Holding Characteristics)		5.5 V type:	Voltage between terminal leads higher than 4.2 V	Charging condition Voltage applied: Series resistance: Charging time:	5.0 VDC (Terminal at the case side must be negative) 0 Ω 24 hours	
		3.5 V type: 3.6 V type:	Not specified	Storage Let stand for 24 hour below with terminals Ambient temperature: Relative humidity:	rs in condition described opened. Lower than 25°C Lower than 70% RH	

Construction





Marking

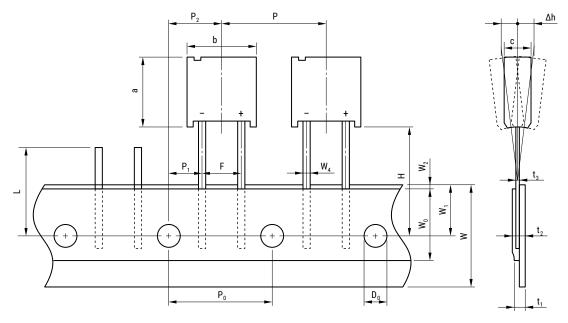


Packaging Quantities

Part Number	Bulk Quantity per Box Straight Lead	Bulk Quantity per Box L1 Lead Option	Ammo Pack Quantity
FM0H103ZF	1,000 pieces	1,000 pieces	1,000 pieces
FM0H223ZF	1,000 pieces	1,000 pieces	1,000 pieces
FM0H473ZF	1,000 pieces	1,000 pieces	1,000 pieces
FM0H104ZF	1,000 pieces	800 pieces	1,000 pieces
FM0H224ZF	1,000 pieces	800 pieces	1,000 pieces
FM0V473ZF	1,000 pieces	1,000 pieces	1,000 pieces
FM0V104ZF	1,000 pieces	1,000 pieces	1,000 pieces
FM0V224ZF	1,000 pieces	800 pieces	1,000 pieces
FM0J473ZF	1,000 pieces	800 pieces	1,000 pieces
FME0H223ZF	1,000 pieces	1,000 pieces	1,000 pieces
FME0H473ZF	1,000 pieces	1,000 pieces	1,000 pieces
FMR0H473ZF	1,000 pieces	1,000 pieces	1,000 pieces
FMR0H104ZF	1,000 pieces	1,000 pieces	1,000 pieces
FMR0V104ZF	1,000 pieces	800 pieces	1,000 pieces
FMR0V334ZF	1,000 pieces	800 pieces	1,000 pieces
FMR0V474ZF	400 pieces	300 pieces	400 pieces
FMC0H473ZF	1,000 pieces	1,000 pieces	1,000 pieces
FMC0H104ZF	1,000 pieces	1,000 pieces	1,000 pieces
FMC0H334ZF	400 pieces	300 pieces	400 pieces



Ammo Pack Taping Format (Except FMC0H334ZFTP, FMR0V474ZFTP)

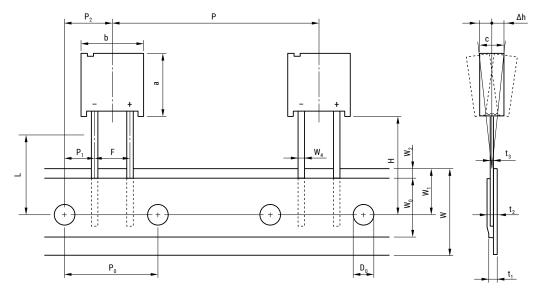


Ammo Pack Taping Specifications (Except FMC0H334ZFTP, FMR0V474ZFTP)

Item	Symbol	Dimensions (mm)
Component Height	а	11.5±0.5
Component Width	b	10.5±0.5
Component Thickness	С	Refer to "Dimensions" table
Lead-Wire Width	W_4	0.5±0.1
Lead-Wire Thickness	t ₃	0.4±0.1
Component Pitch	Р	12.7±1.0
Sprocket Hole Pitch	P ₀	12.7±0.3
Sprocket Hole Center to Lead Center	P ₁	3.85±0.7
Sprocket Hole Center to Component Center	P ₂	6.35±0.7
Lead Spacing	F	5.0±0.5
Component Alignment (side/side)	Δh	2.0 Maximum
Carrier Tape Width	W	18.0+1.0/-0.5
Hold-Down Tape Width	W ₀	12.5 Minimum
Sprocket Hole Position	W ₁	9.0±0.5
Hold-Down Tape Position	W ₂	3.0 Maximum
Height to Seating Plane (lead length)	Н	16.0±0.5/18.0±0.5
Sprocket Hole Diameter	D ₀	ø 4.0±0.2
Carrier Tape Thickness	t ₁	0.7±0.2
Total Thickness (Carrier Tape, Hold-Down Tape and Lead)	t ₂	1.5 Maximum
Cut Out Length	L	11.0 Maximum



Ammo Pack Taping Format (FMC0H334ZFTP, FMR0V474ZFTP)



Ammo Pack Taping Specifications (FMC0H334ZFTP, FMR0V474ZFTP)

Item	Symbol	Dimensions (mm)
Component Height	а	15.0±0.5
Component Width	b	14.0±0.5
Component Thickness	С	9.0±0.5
Lead-Wire Width	W ₄	0.6±0.1
Lead-Wire Thickness	t ₃	0.6±0.1
Component Pitch	Р	25.4±1.0
Sprocket Hole Pitch	P ₀	12.7±0.3
Sprocket Hole Center to Lead Center	P ₁	3.85±0.7
Sprocket Hole Center to Component Center	P ₂	6.35±0.7
Lead Spacing	F	5.0±0.5
Component Alignment (side/side)	Δh	2.0 Maximum
Carrier Tape Width	W	18.0+1.0/-0.5
Hold-Down Tape Width	W ₀	12.5 Minimum
Sprocket Hole Position	W ₁	9.0±0.5
Hold-Down Tape Position	W ₂	3.0 Maximum
Height to Seating Plane (lead length)	Н	16.0±0.5/18.0±0.5
Sprocket Hole Diameter	D ₀	ø 4.0±0.2
Carrier Tape Thickness	t,	0.67±0.2
Total Thickness (Carrier Tape, Hold-Down Tape and Lead)	t ₂	1.7 Maximum
Cut Out Length	L	11.0 Maximum



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

$$\begin{array}{c} \text{Capacitance:} \quad \frac{\tau}{\text{Rc}} \quad \text{(F)} \quad \text{(9)} \\ \end{array}$$

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

Time from start of charging until Vc becomes 0.632 Eo (V) τ: (seconds)

Eo:

Rc: See table below (Ω).

Charge Resistor Selection Guide

Rc

Eo

Con	ГА	FE	FS	F	Y	FR	FM, FME	FMC	FG,	FGH	FT		Η٧
Сар	FA	FC	гэ	FYD	FYH	FR	FMR	FINC	FGR	гоп		FC, FCS	ΠV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	_	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	_	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	_	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	_	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	_	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	_	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	_	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	_	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

^{3.0 (}V) Product with maximum operating voltage of 3.5 V

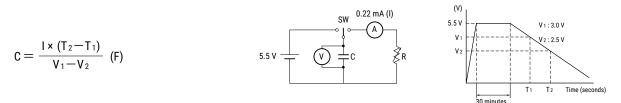


Measurement Conditions cont.

Capacitance (Discharge System)

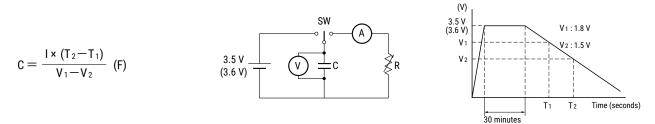
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



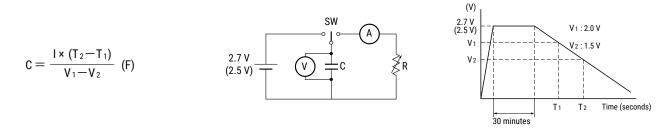
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.

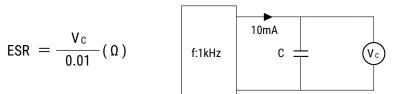




Measurement Conditions cont.

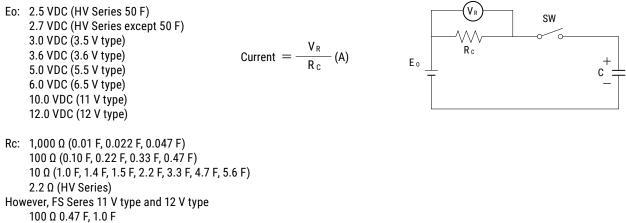
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FG Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -25°C to +70°C (FG and FGH types) and -40°C to +85°C (FGR type)
- Maintenance free
- Maximum operating voltages of 3.5 VDC and 5.5 VDC
- Highly reliable against liquid leakage
- Lead-free and RoHS compliant

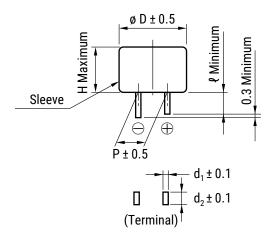


Part Number System

FG	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FG FGH FGR	0V = 3.5 VDC 0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	øD	Н	Р	ę	d ₁	d ₂
FG0H103ZF	11.0	5.5	5.08	2.7	0.2	1.2
FG0H223ZF	11.0	5.5	5.08	2.7	0.2	1.2
FG0H473ZF	11.0	5.5	5.08	2.7	0.2	1.2
FG0H104ZF	11.0	6.5	5.08	2.7	0.2	1.2
FG0H224ZF	13.0	9.0	5.08	2.2	0.4	1.2
FG0H474ZF	14.5	18.0	5.08	2.4	0.4	1.2
FG0H105ZF	16.5	19.0	5.08	2.7	0.4	1.2
FG0H225ZF	21.5	19.0	7.62	3.0	0.6	1.2
FG0H475ZF	28.5	22.0	10.16	6.1	0.6	1.4
FG0V155ZF	16.5	14.0	5.08	3.1	0.4	1.2
FGH0H104ZF	11.0	5.5	5.08	2.7	0.2	1.2
FGH0H224ZF	11.0	7.0	5.08	2.7	0.2	1.2
FGH0H474ZF	16.5	8.0	5.08	2.7	0.4	1.2
FGH0H105ZF	21.5	9.5	7.62	3.0	0.6	1.2
FGH0V474ZF	13.0	7.5	5.08	2.7	0.4	1.2
FGR0H474ZF	14.5	18.0	5.08	2.4	0.4	1.2
FGR0H105ZF	16.5	19.0	5.08	2.7	0.4	1.2
FGR0H225ZF	21.5	19.0	7.62	3.0	0.6	1.2



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	citor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time back-up	500 μA and below	CMOS microcomputer, IC for clocks	CMOS microcomputer, static RAM/DTS (digital tuning system)	FG series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Part Number Operating		Nominal Capacitance		Maximum Current at 30	Voltage Holding Characteristic	Weight (g)
Fait Nulliber	Voltage (VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Minimum (V)	weight (g)
FG0V155ZF	3.5	1.5	2.2	65	1.5	-	5.2
FG0H103ZF	5.5	0.010	0.013	300	0.015	4.2	0.9
FG0H223ZF	5.5	0.022	0.028	200	0.033	4.2	1.0
FG0H473ZF	5.5	0.047	0.060	200	0.071	4.2	1.0
FG0H104ZF	5.5	0.10	0.13	100	0.15	4.2	1.3
FGH0H104ZF	5.5	-	0.10	100	0.15	4.2	1.0
FG0H224ZF	5.5	0.22	0.28	100	0.33	4.2	2.5
FGH0H224ZF	5.5	-	0.22	100	0.33	4.2	1.3
FGH0H105ZF	5.5	-	1.0	35	1.5	4.2	7.2
FGH0H474ZF	5.5	-	0.47	65	0.71	4.2	4.1
FGH0V474ZF	3.5	-	0.47	25	0.42	-	2.6
FG0H474ZF	5.5	0.47	0.60	120	0.71	4.2	5.1
FGR0H474ZF	5.5	0.47	0.60	120	0.71	4.2	5.1
FG0H105ZF	5.5	1.0	1.3	65	1.5	4.2	7.0
FGR0H105ZF	5.5	1.0	1.3	65	1.5	4.2	7.0
FG0H225ZF	5.5	2.2	2.8	35	3.3	4.2	12.1
FGR0H225ZF	5.5	2.2	2.8	35	3.3	4.2	12.1
FG0H475ZF	5.5	4.7	6.0	35	7.1	4.2	27.3

Part numbers in bold type represent popularly purchased components.



Specifications

Category Temperatur Maximum Operating V Capacitance Capacitance Allowand ESR Current (30 minutes v	Voltage nce	-25°C to 5.5 VDC, Refer to +80%,-2 Refer to Refer to	3.5 VDC Table 1 0%	-40°C t 5.5 VDC Refer to +80%,-2				
Capacitance Capacitance Allowand ESR Current (30 minutes v	nce value)	Refer to +80%,-2 Refer to	Table 1 0%	Refer to				
Capacitance Allowand ESR Current (30 minutes v	value)	+80%,-2 Refer to	0%		Table 1			
ESR Current (30 minutes v	value)	Refer to		+80%,-2		Refer to "Measurem	ent Conditions"	
Current (30 minutes v	,		Table 1		20%	Refer to "Measurem	ent Conditions"	
	,	Refer to		Refer to	Table 1	Measured at 1 kHz, 7 "Measurement Cond		
Ca	anaoitanoo		Table 1	Refer to	Table 1	Refer to "Measurem	ent Conditions"	
	apacitance	> 90% of	initial ratings	> 90% o	f initial ratings	Charge: Discharge: Number of cycles:	9 minutes 30 seconds 1,000	
ES Surge	SR	≤ 120% of initial ratings		≤ 120%	of initial ratings	Series resistance:	0.022 F 560 Ω 0.047 F 300 Ω 0.10 F 150 Ω	
Cu	Current (30 ninutes alue)	≤ 120% c	of initial ratings	≤ 120%	of initial ratings	Discharge	0.22 F 56 Ω 0.47 F 30 Ω 1.0 F, 1.5 F 15 Ω 2.2 F, 4.7 F 10 Ω	
Ар	oppearance	No obvious abnormality		No obvious abnormality		resistance: 0 Ω Temperature: 70±2°C (FG, FGH) 85±2°C (FGR)		
Ca	apacitance	Phase	te initial value Phase ≤ 400% of 2	≥ 50% of initial value	Conforms to 4.17 Phase 1:	+25±2°C		
E	SR	2		2	≤ 400% of initial value	Phase 2:	-25±2°C -40±2°C (FGR) +25±2°C +70±2°C (FG, FGH) +85±2°C (FGR) +25±2°C	
Ca	apacitance	Phase 3		Phase 3 Phase	≥ 30% of initial value			
E	SR				≤ 700% of	Phase 5:		
	-		≤ 200% of		initial value ≤ 200% of	Phase 6:		
Characteristics	apacitance		initial value		initial value	_		
in Different ES	SR	Phase	Satisfy initial ratings		Satisfy initial ratings			
m	Current (30 ninutes alue)	5	≤ 1.5 CV (mA)	- 5	≤ 1.5 CV (mA)			
	apacitance		Within ±20% of		Within ±20% of			
	SR	Phase	initial value Satisfy initial	Phase	initial value Satisfy initial			
Cum	Current (30 ninutes alue)	6	ratings Satisfy initial ratings	6	ratings Satisfy initial ratings			
	apacitance				ļ	Conforms to 4.13		
Vibration Cu Resistance m	ESR Vibration Current (30 Satisfy initial ratings		Satisfy initial ratings		Frequency: Testing Time:	10 to 55 Hz 6 hours		
Aj	ppearance	No obvio	ous abnormality	No obvi	ous 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			+245±5°C 5±0.5 seconds tom should be dipped.		

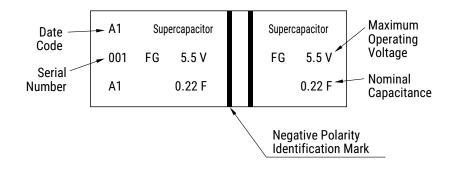


Specifications cont.

lte	em	FG, FGH Type	FGR Type		onditions to JIS C 5160-1)	
Solder Heat Resistance	Capacitance ESR Current (30 minutes value)	Satisfy initial ratings	Satisfy initial ratings	Conforms to 4.10 Solder temp: Dipping time:	+260±10°C 10±1 seconds	
	Appearance	No obvious abnormality	No obvious abnormality	1.6 mm from the bot	tom should be dipped.	
Capacitance		Satisfy initial ratings	Satisfy initial ratings	Conforms to 4.12 Temperature Condition:	Minimum temperature	
Temperature Cycle	Current (30 minutes value)		Satisty mittai ratings		» Room temperature » Category maximum temperature » Room temperature	
Appearance		No obvious abnormality	No obvious abnormality	Number of cycles:	5 cycles	
llink	Capacitance	Within ±20% of initial value	Within ±20% of initial value	Conforms to 4.14	e: +40±2°C v: 90 to 95% RH	
High Temperature	ESR	≤ 120% of initial ratings	≤ 120% of initial ratings	Relative humidity:		
and High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings	≤ 120% of initial ratings	Testing time:		
Reolocanoe	Appearance	No obvious abnormality	No obvious abnormality			
	Capacitance	Within ±30% of initial value	Within ±30% of initial value	Conforms to 4.15 Temperature:	Category maximum temperature ±2°C Maximum operating voltage 0 Ω 1,000+48 (+48/-0) hours	
High	ESR	< 200% of initial ratings	< 200% of initial ratings	Voltage applied:		
Temperature Load	Current (30 minutes value)	< 200% of initial ratings	< 200% of initial ratings	Series protection resistance:		
	Appearance	No obvious abnormality	No obvious abnormality	Testing time:		
Self Discharge Characteristics		5.5 V type: Voltage between terminal		Charging condition Voltage applied: Series resistance: Charging time:	5.0 VDC (Terminal at the case side must be negative) 0 Ω 24 hours	
(Voltage Holding Characteristics)]	leads > 4.2 V 3.5 V type: Not specified	Voltage between terminal leads > 4.2 V	Storage Let stand for 24 hours in condition desc below with terminals opened.		
				Ambient temperature: Relative humidity:		



Marking



Packaging Quantities

Part Number	Bulk Quantity per Box		
FG0H103ZF	2,000 pieces		
FG0H223ZF	2,000 pieces		
FG0H473ZF	2,000 pieces		
FG0H104ZF	1,600 pieces		
FG0H224ZF	800 pieces		
FG0H474ZF	300 pieces		
FG0H105ZF	240 pieces		
FG0H225ZF	90 pieces		
FG0H475ZF	50 pieces		
FG0V155ZF	160 pieces		
FGH0H104ZF	2,000 pieces		
FGH0H224ZF	1,600 pieces		
FGH0H474ZF	600 pieces		
FGH0H105ZF	90 pieces		
FGH0V474ZF	800 pieces		
FGR0H474ZF	300 pieces		
FGR0H105ZF	240 pieces		
FGR0H225ZF	90 pieces		



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

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

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

Time from start of charging until Vc becomes 0.632 Eo (V) τ: (seconds)

Eo:

Rc: See table below (Ω).

Charge Resistor Selection Guide

Rc

Eo

Con	EA	E E	FS	F	Y	FR	FM, FME	EMO	FG,	ГОЦ	CT.		HV
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

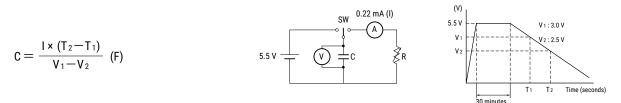
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

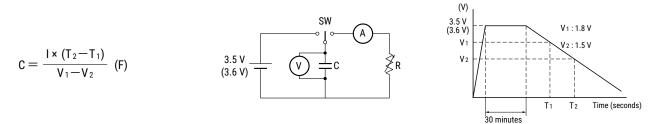
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



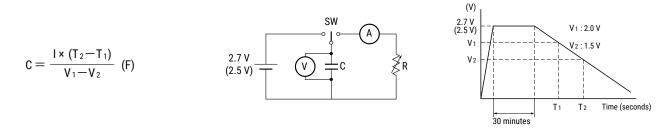
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

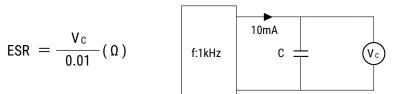
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





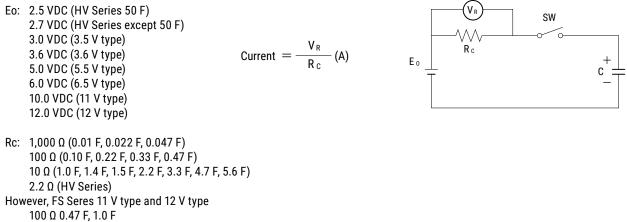
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FT Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -40°C to +85°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

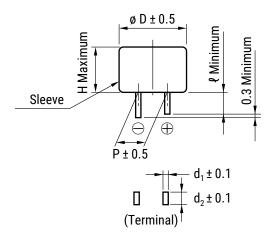


Part Number System

FT	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FT FTW	0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	ø D	Н	Р	ę	d ₁	d ₂
FT0H104ZF	11.5	8.5	5.08	2.7	0.4	1.2
FT0H224ZF	14.5	12.0	5.08	2.2	0.4	1.2
FT0H474ZF	16.5	13.0	5.08	2.7	0.4	1.2
FT0H105ZF	21.5	13.0	7.62	3.0	0.6	1.2
FT0H225ZF	28.5	14.0	10.16	6.1	0.6	1.4
FT0H335ZF	36.5	15.0	15.00	6.1	0.6	1.7
FT0H565ZF	44.5	17.0	20.00	6.1	1.0	1.4
FTW0H104ZF	11.5	8.5	5.08	2.7	0.4	1.2



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	citor
	NiCd Lithium Ion		Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Back-up for 1 hour or less		Embedded memory backup	DVD player, television, game console, set-top box	
	50 mA and below	Motor driver	DVD player, printer, projector, camera	FT series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage	Nominal C	apacitance	Maximum ESR	Maximum Current at 30	Weight (g)	
	(VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)		
FT0H104ZF	5.5	0.10	0.14	16	0.15	1.6	
FT0H224ZF	5.5	0.22	0.28	10	0.33	4.1	
FT0H474ZF	5.5	0.47	0.60	6.5	0.71	5.3	
FT0H105ZF	5.5	1.0	1.3	3.5	1.5	10.0	
FT0H225ZF	5.5	2.2	2.8	1.8	3.3	18.0	
FT0H335ZF	5.5	3.3	4.2	1.0	5.0	38.0	
FT0H565ZF	5.5	5.6	7.2	0.6	8.4	72.0	
FTW0H104ZF	5.5	0.10	0.14	16	0.15	2.0	

Part numbers in bold type represent popularly purchased components.



Specifications

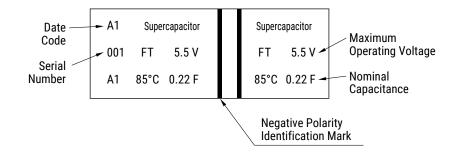
I	tem		FT Туре	Test Conditions (conforming to JIS C 5160-1)			
Category Temperature Ran	ige	-40°C to +85°C					
Maximum Operating Voltag	ge	5.5 VDC					
Capacitance		Refer to Table 1		Refer to "Measurement Conditions"			
Capacitance Allowance		+80%, -20%		Refer to "Measurem	ent Conditions"		
ESR		Refer to Table 1		Measured at 1 kHz, " "Measurement Cond			
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"		
	Capacitance	> 90% of initial rati	ngs		30 seconds 9 minutes 30 seconds		
Surge	ESR	≤ 120% of initial rat	tings	Series resistance:			
Surge	Current (30 minutes value)	≤ 120% of initial rat	tings		1.0 F 15 Ω 2.2 F 10 Ω 3.3 F 10 Ω 5.6 F 10 Ω		
	Appearance	No obvious abnorn	nality	Discharge resistance: Temperature:			
	Capacitance	Phase 2	≥ 50% of initial value	Conforms to 4.17			
	ESR	FildSe Z	≤ 300% of initial value		+25 ±2°C -25 ±2°C -40 ±2°C		
	Capacitance	Phase 3	≥ 30% of initial value				
	ESR		≤ 700% of initial value	Phase 4: Phase 5:	+25 ±2°C		
Characteristics in	Capacitance	Phase 5	≤ 150% of initial value		+85 ±2 C +25 ±2°C		
Different Temperature	ESR		Satisfy initial ratings				
	Current (30 minutes value)		≤ 1.5 CV (mA)				
	Capacitance	_	Within ±20% of initial value				
	ESR	Phase 6	Satisfy initial ratings				
	Current (30 minutes value)		Satisfy initial ratings				
Lead Strength (tensile)		No terminal damag	je	Conforms to 4.9			
	Capacitance	_		Conforms to 4.13			
Vibration Resistance	ESR	Satisfy initial ratin	gs	Testing Time:	10 to 55 Hz 6 hours		
	Current (30 minutes value)						
	Appearance	No obvious abnorn	nality				
Solderability		Over 3/4 of the tern solder	minal should be covered by the new	Conforms to 4.11 Solder temp: Dipping time:	+245 ±5°C 5 ±0.5 seconds		
				1.6 mm from the bot	tom should be dipped.		
	Capacitance			Conforms to 4.10			
Colder Heat Desistants	ESR	Satisfy initial ratin	gs	Solder temp: Dipping time:	+260 ±10°C 10 ±1 seconds		
Soluel Heat Resistance	Solder Heat Resistance Current (30 minutes value)			Dipping time.			
	Appearance	No obvious abnorn	nality	1.6 mm from the bot	tom should be dipped.		
	Capacitance			Conforms to 4.12			
Toma anothing Origin	ESR	Satisfy initial rating	gs	Temperature	-40°C » Room		
Temperature Cycle	Current (30 minutes value)	1		Condition: 	Room temperature		
				Number of cycles:	5 cycles		



Specifications cont.

ltem		FT Туре	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance	Within ±20% of initial value	Conforms to 4.14		
High Temperature and	ESR	≤ 120% of initial ratings	Temperature: +40±2°C Relative humidity: 90 to 95% RH		
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings	Testing time: 240±8 hours		
	Appearance	No obvious abnormality			
	Capacitance	Within ±30% of initial value	Conforms to 4.15 Temperature: +85±2°C Voltage applied: Maximum operating		
High Temperature Load	ESR	< 200% of initial ratings	voltage applied. Maximum operating voltage Series protection		
	Current (30 minutes value)	< 200% of initial ratings	resistance: 0Ω		
	Appearance	No obvious abnormality	Testing time: 1,000+48 (+48/-0) hours		

Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FT0H104ZF	1,000 pieces
FT0H224ZF	400 pieces
FT0H474ZF	400 pieces
FT0H105ZF	90 pieces
FT0H225ZF	50 pieces
FT0H335ZF	30 pieces
FT0H565ZF	20 pieces
FTW0H104ZF	1,000 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

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

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

Time from start of charging until Vc becomes 0.632 Eo (V) τ: (seconds)

Eo:

Rc: See table below (Ω).

Charge Resistor Selection Guide

Rc

Eo

Con	EA	E E	FS	F	Y	FR	FM, FME	EMO	FG,	ГОЦ	CT.		HV
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

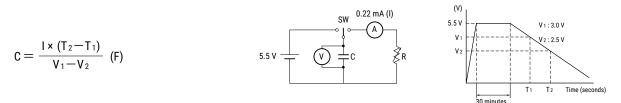
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

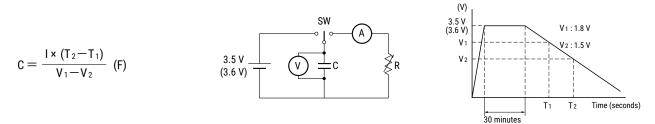
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



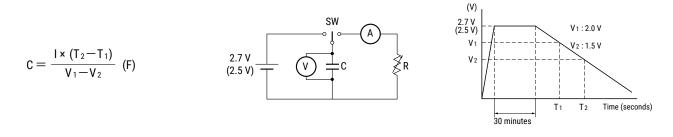
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

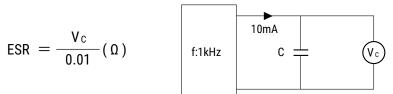
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





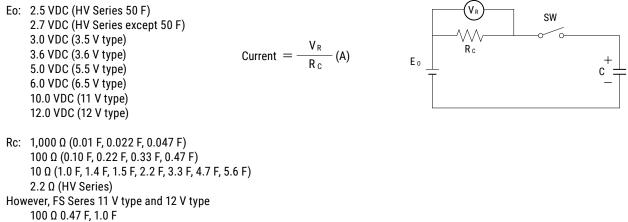
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FY Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -25°C to +70°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

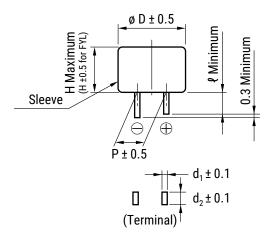


Part Number System

FY	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FYD FYH	0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow μF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	øD	Н	Р	ę	d ₁	d ₂
FYD0H223ZF	11.5	8.5	5.08	2.7	0.4	1.2
FYD0H473ZF	11.5	8.5	5.08	2.7	0.4	1.2
FYD0H104ZF	13.0	8.5	5.08	2.2	0.4	1.2
FYD0H224ZF	14.5	15.0	5.08	2.4	0.4	1.2
FYD0H474ZF	16.5	15.0	5.08	2.7	0.4	1.2
FYD0H105ZF	21.5	16.0	7.62	3.0	0.6	1.2
FYD0H145ZF	21.5	19.0	7.62	3.0	0.6	1.2
FYD0H225ZF	28.5	22.0	10.16	6.1	0.6	1.4
FYH0H223ZF	11.5	7.0	5.08	2.7	0.4	1.2
FYH0H473ZF	13.0	7.0	5.08	2.2	0.4	1.2
FYH0H104ZF	16.5	7.5	5.08	2.7	0.4	1.2
FYH0H224ZF	16.5	9.5	5.08	2.7	0.4	1.2
FYH0H474ZF	21.5	10.0	7.62	3.0	0.6	1.2
FYH0H105ZF	28.5	11.0	10.16	6.1	0.6	1.4
FYL0H103ZF	11.0	5.0	5.08	2.7	0.2	1.2
FYL0H223ZF	11.0	5.0	5.08	2.7	0.2	1.2
FYL0H473ZF	12.0	5.0	5.08	2.7	0.2	1.2



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Capa	icitor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
		Embedded memory backup	DVD player, television, game console, set-top box	EV acriat
Long time back-up	500 μA and below	Motor driver	DVD player, printer, projector, camera	FY series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating	Nominal C	apacitance	Maximum ESR	Maximum Current at 30	Voltage Holding Characteristic		
Part Number	Voltage (VDC)		Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Minimum (V)	Weight (g)	
FYL0H103ZF	5.5	0.01	0.013	300	0.015	4.2	0.9	
FYL0H223ZF	5.5	0.022	0.028	200	0.033	4.2	1.0	
FYH0H223ZF	5.5	0.022	0.033	200	0.033	4.2	1.5	
FYD0H223ZF	5.5	0.022	0.033	220	0.033	4.2	1.6	
FYH0H473ZF	5.5	0.047	0.075	100	0.071	4.2	2.2	
FYL0H473ZF	5.5	0.047	0.061	200	0.071	4.2	1.2	
FYD0H473ZF	5.5	0.047	0.070	220	0.071	4.2	1.7	
FYH0H104ZF	5.5	0.10	0.16	50	0.15	4.2	3.4	
FYD0H104ZF	5.5	0.10	0.14	100	0.15	4.2	2.4	
FYH0H224ZF	5.5	0.22	0.30	60	0.33	4.2	3.6	
FYD0H224ZF	5.5	0.22	0.35	120	0.33	4.2	4.3	
FYH0H474ZF	5.5	0.47	0.70	35	0.71	4.2	7.2	
FYD0H474ZF	5.5	0.47	0.75	65	0.71	4.2	6.0	
FYH0H105ZF	5.5	1.0	1.5	20	1.5	4.2	13.9	
FYD0H105ZF	5.5	1.0	1.6	35	1.5	4.2	11.0	
FYD0H145ZF	5.5	1.4	2.1	45	2.1	4.2	12.0	
FYD0H225ZF	5.5	2.2	3.3	35	3.3	4.2	22.9	

Part numbers in bold type represent popularly purchased components.



Specifications

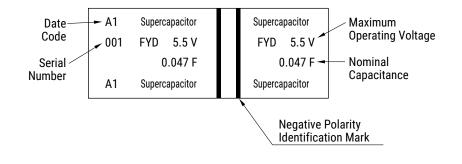
It	tem	FY	Type (FYD, FYH)		onditions to JIS C 5160-1)
Category Temperature Range		-25°C to +70°C			
Maximum Operating Voltag	je	5.5 VDC			
Capacitance	Capacitance			Refer to "Measurem	ent Conditions"
Capacitance Allowance	Capacitance Allowance			Refer to "Measurem	ent Conditions"
ESR		Refer to Table 1		Measured at 1 kHz, "Measurement Cond	
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"
	Capacitance	> 90% of initial rati	> 90% of initial ratings		6.3 V 30 seconds 9 minutes 30 seconds 1,000 0.010 F 1,500 Ω
Surge	ESR	≤ 120% of initial rat	tings	Series resistance:	0.022 F 560 Ω 0.047 F 300 Ω 0.068 F 240 Ω 0.10 F 150 Ω
	Current (30 minutes value)	≤ 120% of initial ra	tings		0.22 F 56 Ω 0.47 F 30 Ω 1.0 F, 1.4 F 15 Ω 2.2 F 10 Ω
	Appearance	No obvious abnormality		Discharge resistance: 0 Ω Temperature: 70 ±2°C	
	Capacitance	Phase 2	≥ 50% of initial value		
	ESR	PlidSe 2	≤ 400% of initial value		-25 ±2°C +25 ±2°C
	Capacitance	Phase 3			
	ESR	1 11030 0			
Characteristics in	Capacitance		≤ 200% of initial value		723126
Different Temperature	ESR	Phase 5	Satisfy initial ratings		
	Current (30 minutes value)		≤ 1.5 CV (mA)	_	
	Capacitance		Within ±20% of initial value	_	
	ESR	Phase 6	Satisfy initial ratings	_	
	Current (30 minutes value)		Satisfy initial ratings		
Lead Strength (tensile)		No terminal damag	je	Conforms to 4.9	
	Capacitance			Conforms to 4.13	10 to 55 Hz
Vibration Resistance	ESR	Satisfy initial rating	gs	Testing Time:	
	Current (30 minutes value)	<u></u>		_	
	Appearance	No obvious abnorn	nality		
Solderability		Over 3/4 of the terminal should be covered by the new solder			5 ±0.5 seconds
					tom should be dipped.
	Capacitance			Conforms to 4.10 Solder temp:	+260 ±10°C
Solder Heat Resistance	ESR	Satisfy initial ratin	gs		10 ±1 seconds
	Current (30 minutes value)	No obviewo obrasi	nolity	1.6 mm from the bottom should be dipped.	
	Appearance	No obvious abnorn	nanty	1.0 mm from the bot	iom snouia de alpped.

Specifications cont.

Item		FY Type (FYD, FYH)	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance	_	Conforms to 4.12	-25°C » Room temperature » +70°C »	
Temperature Cycle	ESR	Satisfy initial ratings	Temperature Condition:		
Temperature Cycle	Current (30 minutes value)			Room temperature	
	Appearance	No obvious abnormality	Number of cycles:	5 cycles	
	Capacitance	Within ±20% of initial value	Conforms to 4.14		
High Temperature and	ESR	≤ 120% of initial ratings	Temperature: Relative humidity:		
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings	Testing time:		
	Appearance	No obvious abnormality	-		
	Capacitance	Within ±30% of initial value	Conforms to 4.15 Temperature:	+70 ±2°C Maximum operating voltage 0 Ω	
	ESR	< 200% of initial ratings	Voltage applied:		
High Temperature Load	Current (30 minutes value)	< 200% of initial ratings	Series protection resistance:		
	Appearance	No obvious abnormality	Testing time:	1,000 +48 (+48/-0) hours	
Self Discharge Characteristics (Voltage Holding Characteristics)			Charging condition Voltage applied: Series resistance: Charging time:	5.0 VDC (Terminal at the case side must be negative) 0 Ω 24 hours	
		Voltage between terminal leads > 4.2 V	Storage Let stand for 24 hour below with terminals Ambient temperature: Relative humidity:	< 25°C	



Marking



Packaging Quantities

Part Number	Bulk Quantity per Box		
FYD0H223ZF	1,000 pieces		
FYD0H473ZF	1,000 pieces		
FYD0H104ZF	800 pieces		
FYD0H224ZF	400 pieces		
FYD0H474ZF	240 pieces		
FYD0H105ZF	90 pieces		
FYD0H145ZF	90 pieces		
FYD0H225ZF	50 pieces		
FYH0H223ZF	1,600 pieces		
FYH0H473ZF	800 pieces		
FYH0H104ZF	600 pieces		
FYH0H224ZF	500 pieces		
FYH0H474ZF	90 pieces		
FYH0H105ZF	50 pieces		
FYL0H103ZF	2,000 pieces		
FYL0H223ZF	2,000 pieces		
FYL0H473ZF	1,600 pieces		



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

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

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con	ГЛ	FF	FS	FS FY FR FM, FME FMC FG,		ГСЦ	гт		шу				
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

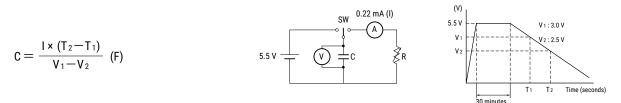
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

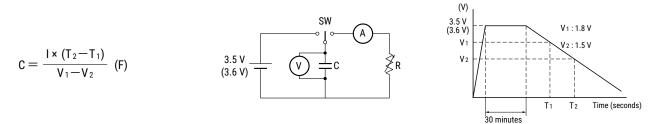
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



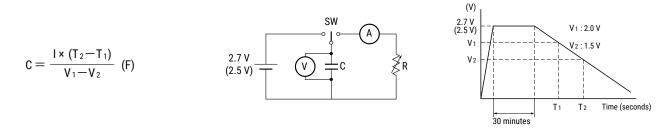
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

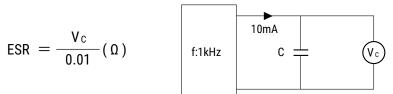
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





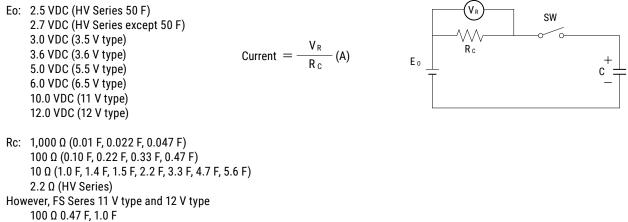
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FR Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -40°C to +85°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

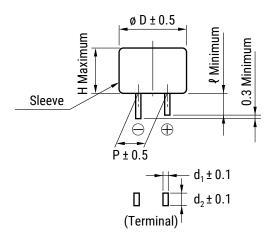


Part Number System

FR	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FR	0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow μF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	ø D	Н	Р	ę	d ₁	d ₂
FR0H223ZF	11.5	14.0	5.08	2.7	0.4	1.2
FR0H473ZF	14.5	14.0	5.08	2.4	0.4	1.2
FR0H104ZF	14.5	15.5	5.08	2.4	0.4	1.2
FR0H224ZF	14.5	21.0	5.08	2.4	0.4	1.2
FR0H474ZF	16.5	21.5	5.08	2.7	0.4	1.2
FR0H105ZF	21.5	22.0	7.62	3.0	0.6	1.2



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	citor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time heads up		Embedded memory backup	DVD player, television, game console, set-top box	
Long time back-up	500 μA and below	Motor driver	DVD player, printer, projector, camera	FR series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating	Nominal C	apacitance	Maximum ESR	Maximum Current at 30	Voltage Holding Characteristic		
	Voltage (VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Minimum (V)	Weight (g)	
FR0H223ZF	5.5	0.022	0.028	220	0.033	4.2	2.3	
FR0H473ZF	5.5	0.047	0.060	110	0.071	4.2	3.9	
FR0H104ZF	5.5	0.10	0.15	150	0.15	4.2	4.3	
FR0H224ZF	5.5	0.22	0.33	180	0.33	4.2	5.3	
FR0H474ZF	5.5	0.47	0.75	100	0.71	4.2	7.5	
FR0H105ZF	5.5	1.0	1.6	60	1.5	4.2	13.3	

Part numbers in bold type represent popularly purchased components.



Specifications

ŀ	tem		FR Type	Test Conditions (conforming to JIS C 5160-1)		
Category Temperature Ran	ge	-40°C to +85°C				
Maximum Operating Voltag	je	5.5 VDC				
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"	
Capacitance Allowance		+80%, -20%		Refer to "Measurem	ent Conditions"	
ESR		Refer to Table 1		Measured at 1 kHz, "Measurement Cond		
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"	
	Capacitance	> 90% of initial rati	ngs	Surge voltage: Charge: Discharge: Number of cycles:	30 seconds 9 minutes 30 seconds	
Surge	ESR	≤ 120% of initial ra	tings	Series resistance:		
ourge	Current (30 minutes value)	≤ 120% of initial ra	tings	Discharge	0.10 F 130 Ω 0.22 F 56 Ω 0.47 F 30 Ω 1.0 F 15 Ω	
	Appearance No ob		No obvious abnormality		0 Ω 85 ±2°C	
	Capacitance	Phase 2 Phase 3	≥ 50% of initial value	Conforms to 4.17		
	ESR		≤ 400% of initial value	Phase 3: Phase 4: Phase 5:	+25 ±2°C -25 ±2°C	
	Capacitance		≥ 30% of initial value		-40 ±2°C	
	ESR		≤ 700% of initial value		+25 ±2°C	
Characteristics in	Capacitance		≤ 200% of initial value		+85 ±2 C +25 ±2°C	
Different Temperature	ESR	Phase 5	Satisfy initial ratings			
	Current (30 minutes value)		≤ 1.5 CV (mA)			
	Capacitance		Within ±20% of initial value			
	ESR	Phase 6	Satisfy initial ratings			
	Current (30 minutes value)		Satisfy initial ratings			
Lead Strength (tensile)		No terminal damage		Conforms to 4.9		
	Capacitance			Conforms to 4.13		
Vibration Resistance	ESR	Satisfy initial ratin	gs		10 to 55 Hz 6 hours	
vibration resistance	Current (30 minutes value)			Testing Time: 6 hours		
	Appearance	No obvious abnorr	nality			
Solderability		Over 3/4 of the terminal should be covered by the new solder			+245 ±5°C 5 ±0.5 seconds tom should be dipped.	
	Capacitance			Conforms to 4.10		
	ESR	Satisfy initial ratin	as	Solder temp: +260 ±10°C		
Solder Heat Resistance	Current (30 minutes value)		J-	Dipping time:	10 ±1 seconds	
	Appearance	No obvious abnorr	nality	1.6 mm from the bot	tom should be dipped.	

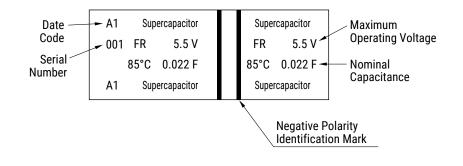


Specifications cont.

Item		FR Type	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance		Conforms to 4.12 Temperature		
Temperature Cycle	ESR	Satisfy initial ratings	Condition:	-40°C » Room	
Temperature Cycle	Current (30 minutes value)		_	temperature » +85°C » Room temperature	
	Appearance	No obvious abnormality	Number of cycles:	5 cycles	
	Capacitance	Within ±20% of initial value	Conforms to 4.14		
High Temperature and	ESR	≤ 120% of initial ratings	Temperature: Relative humidity:	+40 ±2°C 90 to 95% RH	
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings		240 ±8 hours	
	Appearance	No obvious abnormality			
	Capacitance	Within ±30% of initial value	Conforms to 4.15 Temperature: Voltage applied:	+85 ±2°C Maximum operating	
High Temperature Load	ESR	< 200% of initial ratings	Series protection	voltage	
J	Current (30 minutes value)	< 200% of initial ratings	resistance:	0Ω	
	Appearance	No obvious abnormality	Testing time:	1,000 +48 (+48/-0) hours	
Self Discharge Characteristics (Voltage Holding Characteristics)			Charging condition Voltage applied:	5.0 VDC (Terminal at the case side must be negative)	
			Series resistance: Charging time:	0 Ω 24 hours	
		Voltage between terminal leads > 4.2 V	Storage Let stand for 24 hours in condition describe below with terminals opened.		
			Ambient temperature: Relative humidity:		



Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FR0H223ZF	800 pieces
FR0H473ZF	400 pieces
FR0H104ZF	400 pieces
FR0H224ZF	300 pieces
FR0H474ZF	240 pieces
FR0H105ZF	90 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

$$\begin{array}{c} \text{Capacitance:} \quad \frac{\tau}{\text{Rc}} \quad \text{(F)} \quad \text{(9)} \\ \end{array}$$

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V) (seconds)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con EA E			F	FY FR	FM, FME	EMO	FG,	ГОЦ	CT.		HV		
Сар	FA	FE	FS	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	ПV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

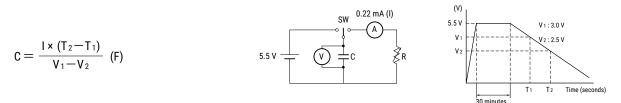
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

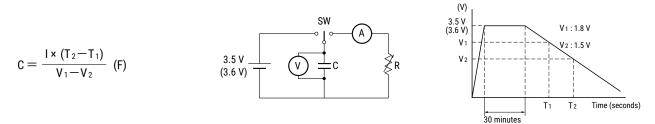
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



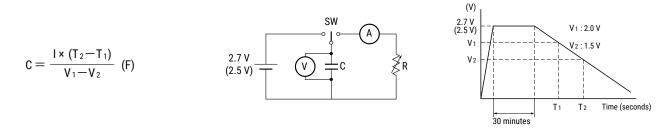
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

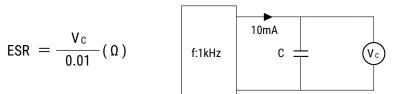
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





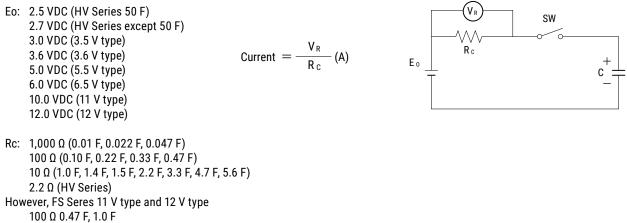
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FS Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -25°C to +70°C
- Maintenance free
- Maximum operating voltages of 5.5, 11.0, and 12.0 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

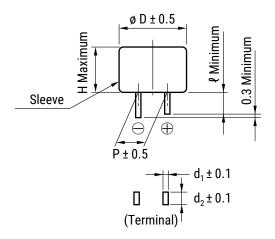


Part Number System

FS	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FS	0H = 5.5 VDC 1A = 11.0 VDC 1B = 12.0 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow μF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	øD	Н	Р	ę	d ₁	d ₂
FS0H223ZF	11.5	8.5	5.08	2.7	0.4	1.2
FS0H473ZF	13.0	8.5	5.08	2.2	0.4	1.2
FS0H104ZF	16.5	8.5	5.08	2.7	0.4	1.2
FS0H224ZF	16.5	13.0	5.08	2.7	0.4	1.2
FS0H474ZF	21.5	13.0	7.62	3.0	0.6	1.2
FS0H105ZF	28.5	14.0	10.16	6.1	0.6	1.4
FS1A474ZF	28.5	25.5	10.16	6.1	0.6	1.4
FS1A105ZF	28.5	31.5	10.16	6.1	0.6	1.4
FS1B105ZF	28.5	38.0	10.16	6.1	0.6	1.4
FS1B505ZF	44.8	60.0	20.00	9.5	1.0	1.4



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	citor
	NiCd	NiCd Lithium Ion		Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series	
Back-up for 1 hour or less		Embedded memory backup	DVD player, television, game console, set-top box	FC earlies	
	50 mA and below	Motor driver	DVD player, printer, projector, camera	FS series	



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage	Nominal Capacitance		Maximum ESR	Maximum Current at 30	Weight (g)	
r ai t Nullibei	(VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	weigilt (g)	
FS0H223ZF	5.5	0.022	0.033	60.0	0.033	1.6	
FS0H473ZF	5.5	0.047	0.072	40.0	0.071	2.6	
FS0H104ZF	5.5	0.10	0.15	25.0	0.15	4.1	
FS0H224ZF	5.5	0.22	0.33	25.0	0.33	5.3	
FS0H474ZF	5.5	0.47	0.75	13.0	0.71	10	
FS0H105ZF	5.5	1.0	1.3	7.0	1.5	18	
FS1A474ZF	11.0	0.47	0.60	7.0	1.41	32	
FS1A105ZF	11.0	1.0	1.3	7.0	3.0	35	
FS1B105ZF	12.0	1.0	1.3	7.5	3.6	40	
FS1B505ZF	12.0	5.0	6.5	4.0	18.0	160	

Part numbers in bold type represent popularly purchased components.



Specifications

Item		FS Type		Test Conditions (conforming to JIS C 5160-1)		
Category Temperature Range		-25°C to +70°C				
Maximum Operating Voltag	je	5.5 VDC, 11 VDC, 12	2 VDC			
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"	
Capacitance Allowance		+80%, -20%		Refer to "Measurem	ent Conditions"	
ESR		Refer to Table 1		Measured at 1 kHz, "Measurement Cond		
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"	
	Capacitance	> 90% of initial ration	ngs		6.3 V (5.5 V type) 12.6 V (11 V type) 13.6 V (12 V type) 30 seconds	
Surge	ESR	≤ 120% of initial rat	ings	Discharge: Number of cycles: Series resistance:	1,000 0.022 F 560 Ω 0.047 F 300 Ω	
	Current (30 minutes value)	≤ 120% of initial rat	0 ≤ 120% of initial ratings 1.			
	Appearance	No obvious abnormality		Discharge resistance: Temperature:		
	Capacitance	Dhase 2	≥ 50% of initial value	Conforms to 4.17		
	ESR	Phase 2	≤ 300% of initial value		+25 ±2°C -25 ±2°C +25 ±2°C +70 ±2°C +25 ±2°C	
	Capacitance	Phase 3				
	ESR	Pliase 3				
Characteristics in	Capacitance	_	≤ 150% of initial value			
Different Temperature	ESR	Phase 5	Satisfy initial ratings			
	Current (30 minutes value)		≤ 1.5 CV (mA)			
	Capacitance		Within ±20% of initial value			
	ESR	Phase 6	Satisfy initial ratings			
	Current (30 minutes value)		Satisfy initial ratings			
Lead Strength (tensile)		No terminal damag	e	Conforms to 4.9		
	Capacitance			Conforms to 4.13		
Vibration Resistance	ESR	Satisfy initial rating	js	Frequency: Testing Time:	10 to 55 Hz 6 hours	
vibration Resistance	Current (30 minutes value)			reating rime.	0 110013	
Appearance		No obvious abnorm	nality			
Solderability		Over 3/4 of the terminal should be covered by the new solder		Conforms to 4.11 Solder temp: Dipping time:		
				1.6 mm from the bot	tom should be dipped.	
	Capacitance	-		Conforms to 4.10	.0(0.10%0	
Solder Heat Resistance	ESR	Satisfy initial rating	JS	Solder temp: Dipping time:	+260 ±10°C 10 ±1 seconds	
	Current (30 minutes value)					
	Appearance	No obvious abnorm	nality	1.6 mm from the bot	tom should be dipped.	

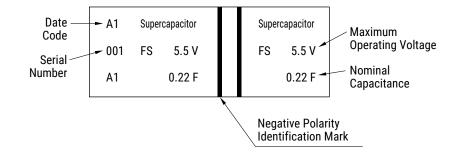


Specifications cont.

Item		FS Type	Test Conditions (conforming to JIS C 5160-1)		
Temperature Cycle	Capacitance ESR Current (30 minutes value)	Satisfy initial ratings	Conforms to 4.12 Temperature Condition:	-25°C » Room temperature » +70°C » Room temperature	
	Appearance	No obvious abnormality	Number of cycles:	5 cycles	
High Temperature and	Capacitance	More than 90% of initial specified value (5.5V type) Within ±20% of initial measured value (11V type, 12V type)	Conforms to 4.14 Temperature: Relative humidity:	+40 ±2°C 90 to 95% RH 240 ±8 hours	
High Humidity Resistance	ESR	≤ 120% of initial ratings	Testing time:		
	Current (30 minutes value)	≤ 120% of initial ratings			
	Appearance	No obvious abnormality			
	Capacitance	Within ±30% of initial value	Conforms to 4.15 Temperature: Voltage applied:	+70 ±2°C Maximum operating	
High Temperature Load	ESR	< 200% of initial ratings		voltage	
	Current (30 minutes value)	< 200% of initial ratings	Series protection resistance: Testing time:	0Ω 1000±48(±48/=0)	
	Appearance	No obvious abnormality	resting time.	1,000 +48 (+48/-0) hours	



Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FS0H223ZF	1,000 pieces
FS0H473ZF	800 pieces
FS0H104ZF	600 pieces
FS0H224ZF	400 pieces
FS0H474ZF	90 pieces
FS0H105ZF	50 pieces
FS1A474ZF	50 pieces
FS1A105ZF	50 pieces
FS1B105ZF	50 pieces
FS1B505ZF	20 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

$$\begin{array}{c} \text{Capacitance:} \quad \frac{\tau}{\text{Rc}} \quad \text{(F)} \quad \text{(9)} \\ \end{array}$$

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V) (seconds)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con	ГЛ	FF	FS	F	Y	FR	FM, FME	ГМО	FG,	ГСЦ	гт		шу
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

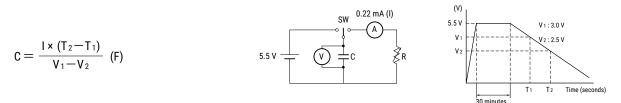
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

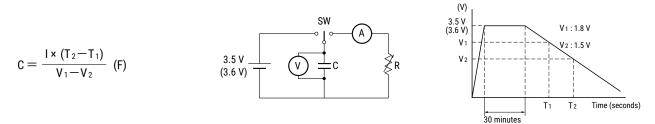
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



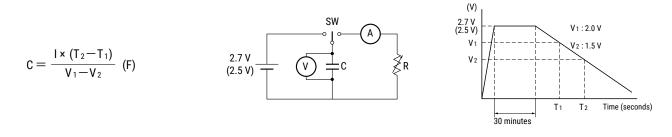
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

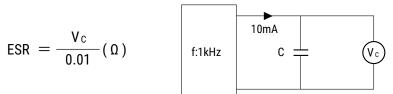
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





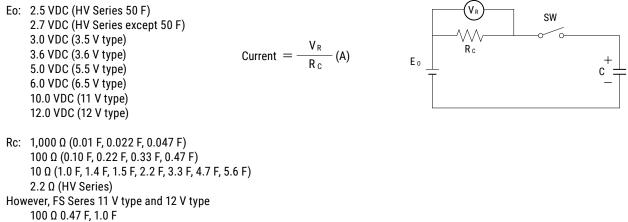
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FA Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -25°C to +70°C
- Maintenance free
- Maximum operating voltages of 5.5 and 11 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

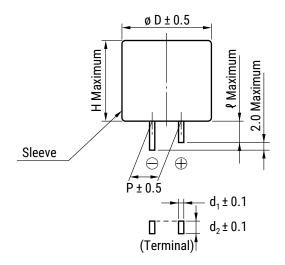


Part Number System

FA	OH	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code)	Capacitance Tolerance	Environmental
FA	0H = 5.5 VDC 1A = 11.0 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.		F = Lead-free



Dimensions – Millimeters



Part Number	ø D	Н	Р	ę	d ₁	d ₂
FA0H473ZF	16.0	15.5	5.1	5.0	0.4	1.2
FA0H104ZF	21.5	15.5	7.6	5.5	0.6	1.2
FA0H224ZF	28.5	16.5	10.2	9.5	0.6	1.4
FA0H474ZF	36.5	16.5	15.0	9.5	0.6	1.7
FA0H105ZF	44.5	18.5	20.0	9.5	1.0	1.4
FA1A223ZF	16.0	25.0	5.1	5.0	0.4	1.2
FA1A104ZF	28.5	25.5	10.2	9.5	0.6	1.4
FA1A224ZF	36.5	27.5	15.0	9.5	1.0	1.4
FA1A474ZF	44.5	28.5	20.0	9.5	1.0	1.4



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Сара	citor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Back-up for 10 seconds or less	1 A and below	Power source of toys, LED, buzzer	Toys, display device, alarm device	
	T A and below	High current supply for a short amount of time	Actuator, relay solenoid, gas igniter	FA series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage	Nominal C	Nominal Capacitance		Maximum Current at 30	Weight (g)	
r ai t Nullibei	Operating Voltage (VDC) Charg System		Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Weight (g)	
FA0H473ZF	5.5	0.047	0.075	20.0	0.071	6.2	
FA0H104ZF	5.5	0.10	0.16	8.0	0.15	12	
FA0H224ZF	5.5	0.22	0.35	5.0	0.33	25	
FA0H474ZF	5.5	0.47	0.75	3.5	0.71	42	
FA0H105ZF	5.5	1.0	1.6	2.5	1.5	65	
FA1A223ZF	11.0	0.022	0.035	20.0	0.066	7.5	
FA1A104ZF	11.0	0.10	0.16	8.0	0.30	32	
FA1A224ZF	11.0	0.22	0.35	6.0	0.66	55	
FA1A474ZF	11.0	0.47	0.75	4.0	1.41	83	



Specifications

Item		FA Туре		Test Conditions (conforming to JIS C 5160-1)	
Category Temperature Rai	nge	-25°C to +70°C			
Maximum Operating Volta	ge	5.5 VDC, 11 VDC			
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"
Capacitance Allowance		+80%, -20%		Refer to "Measurem	ent Conditions"
ESR		Refer to Table 1		Measured at 1 kHz, "Measurement Cond	
Current (30 minutes value)		Refer to Table 1		Refer to "Measurem	ent Conditions"
	Capacitance			Charge:	6.3 V (5.5 V type) 12.6 V (11 V type) 30 seconds 9 minutes 30 seconds
Surge	ESR			Number of cycles: Series resistance:	1,000 0.047 F 300 Ω 0.10 F 150 Ω
	Current (30 minutes value)				0.22 F 56 Ω 0.47 F 30 Ω 1.0 F, 1.5 F 15 Ω
	Appearance			Discharge resistance: Temperature:	
	Capacitance	Phase 2	≥ 70% of initial value	Conforms to 4.17	+25 ±2°C -25 ±2°C
	ESR	Flidse 2	≤ 300% of initial value		
	Capacitance	Phase 3			+25 ±2°C
	ESR	Flidse 5			+70 ±2°C
Characteristics in	Capacitance		≤ 150% of initial value	Phase 6:	+25 ±2°C
Different Temperature	ESR	Phase 5	Satisfy initial ratings		
	Current (30 minutes value)		≤ 1.5 CV (mA)		
	Capacitance		Within ±20% of initial value		
	ESR	Phase 6	Satisfy initial ratings		
	Current (30 minutes value)		Satisfy initial ratings		
Lead Strength (tensile)		No terminal damag	ge	Conforms to 4.9	
	Capacitance			Conforms to 4.13	
Vibration Resistance	ESR	Satisfy initial ratin	gs	Frequency: Testing Time:	10 to 55 Hz 6 hours
vibration Resistance	Current (30 minutes value)			resung rille.	0 110015
	Appearance	No obvious abnorr	nality		

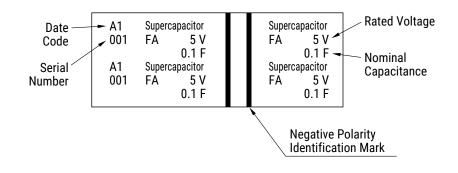


Specifications cont.

Item		FA Туре	Test Conditions (conforming to JIS C 5160-1)	
Solderability		Over 3/4 of the terminal should be covered by the new solder	Conforms to 4.11 Solder temp: +245 ±5°C Dipping time: 5 ±0.5 seconds	
			1.6 mm from the bottom should be dipped.	
	Capacitance		Conforms to 4.10	
Solder Heat Resistance	ESR	Satisfy initial ratings	Solder temp: +260 ±10°C Dipping time: 10 ±1 seconds	
	Current (30 minutes value)			
	Appearance	No obvious abnormality	1.6 mm from the bottom should be dipped.	
	Capacitance		Conforms to 4.12	
	ESR	Satisfy initial ratings	Temperature Condition: -25°C » Room	
Temperature Cycle	Current (30 minutes value)		temperature » +70°C » Room temperature	
	Appearance	No obvious abnormality	Number of cycles: 5 cycles	
	Capacitance	> 90% of initial value	Conforms to 4.14	
High Temperature and	ESR	≤ 120% of initial ratings	Temperature: +40 ±2°C Relative humidity: 90 to 95% RH	
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings	Relative humidity: 90 to 95% RH Testing time: 240 ±8 hours	
	Appearance	No obvious abnormality		
	Capacitance	> 80% of initial value	Conforms to 4.15 Temperature: +70 ±2°C Voltage applied: Maximum operating	
High Temperature Load	ESR	< 120% of initial ratings	voltage	
	Current (30 minutes value)	< 200% of initial ratings	Series protection resistance: 0 Ω	
	Appearance	No obvious abnormality	Testing time: 1,000 +48 (+48/-0) hours	



Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FA0H473ZF	400 pieces
FA0H104ZF	90 pieces
FA0H224ZF	50 pieces
FA0H474ZF	30 pieces
FA0H105ZF	20 pieces
FA1A223ZF	240 pieces
FA1A104ZF	50 pieces
FA1A224ZF	30 pieces
FA1A474ZF	20 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

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

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V) (seconds)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con	Cap FA		FS	FY	FR	FM, FME	FMC	FG,	FGH	FT		HV	
Сар	ГА	FE	гэ	FYD	FYH	ГК	FMR	FINC	FGR	гоп		FC, FCS	ΠV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

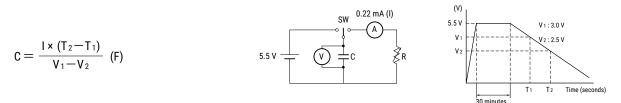
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

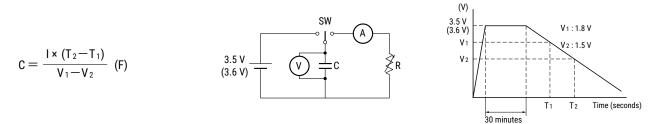
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



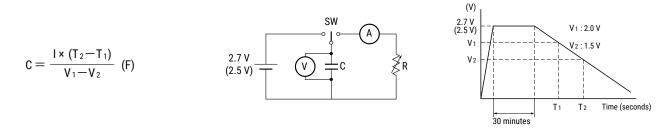
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

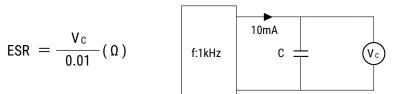
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





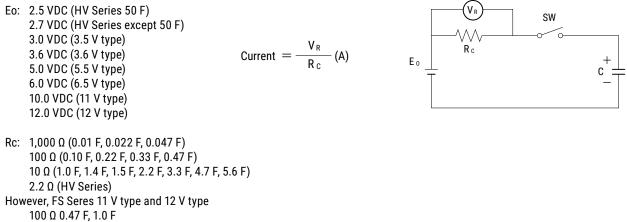
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FE Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -40°C to +70°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

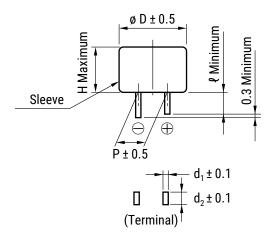


Part Number System

FE	ОН	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental
FE	0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow μF code.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Part Number	øD	Н	Р	ę	d ₁	d ₂
FE0H473ZF	14.5	14.0	5.1	2.2	0.4	1.2
FE0H104ZF	16.5	14.0	5.1	2.7	0.4	1.2
FE0H224ZF	21.5	15.5	7.6	3.0	0.6	1.2
FE0H474ZF	28.5	16.5	10.2	6.1	0.6	1.4
FE0H105ZF	36.5	18.5	15.0	6.1	0.6	1.7
FE0H155ZF	44.5	18.5	20.0	6.1	1.0	1.4



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Secondar	y Battery	Сара	icitor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	-	-	-
Eco-hazard	Cd	-	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series	
Back-up for 10 seconds or less	1 A and below	Power source of toys, LED, buzzer	Toys, display device, alarm device	FE series	
		High current supply for a short amount of time	Actuator, relay solenoid, gas igniter		



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage	Nominal C	apacitance	Maximum ESR	Maximum Current at 30	Woight (g)	
Part Nulliber	(VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Weight (g)	
FE0H473ZF	5.5	0.047	0.075	14.0	0.071	3.9	
FE0H104ZF	5.5	0.10	0.16	6.5	0.15	5	
FE0H224ZF	5.5	0.22	0.35	3.5	0.33	9.5	
FE0H474ZF	5.5	0.47	0.75	1.8	0.71	16	
FE0H105ZF	5.5	1.0	1.4	1.0	1.5	38	
FE0H155ZF	5.5	1.5	2.1	0.6	2.3	72	



Specifications

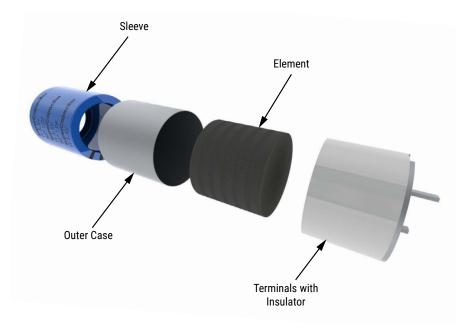
It	em		FE Туре	Test Conditions (conforming to JIS C 5160-1)			
Category Temperature Rang	ge	-40°C to +70°C					
Maximum Operating Voltag	e	5.5 VDC					
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"		
Capacitance Allowance	Capacitance Allowance			Refer to "Measurem			
ESR	ESR			Measured at 1 kHz, "Measurement Conc			
Current (30 minutes value)	Current (30 minutes value)			Refer to "Measurem	ent Conditions"		
	Capacitance	> 90% of initial rati	ngs		6.3 V 30 seconds 9 minutes 30 seconds		
Surge	ESR	≤ 120% of initial rat	tings	Number of cycles: Series resistance:			
Surge	Current (30 minutes value)	≤ 120% of initial rat	tings		0.22 F 56 Ω 0.47 F 30 Ω 1.0 F, 1.5 F 15 Ω		
	Appearance	No obvious abnorn	nality	Discharge resistance: Temperature:			
	Capacitance	Phase 2	≥ 70% of initial value	Conforms to 4.17			
	ESR	1 11030 2	≤ 300% of initial value		+25 ±2°C -25 ±2°C		
	Capacitance	Phase 3	≥ 40% of initial value	Phase 3:	-40 ±2°C		
	ESR		≤ 400% of initial value		+25 ±2°C +70 ±2°C		
Characteristics in	Capacitance	-	≤ 200% of initial value		+25 ±2°C		
Different Temperature	ESR	Phase 5	Satisfy initial ratings	_			
	Current (30 minutes value)		≤ 1.5 CV (mA)	_			
	Capacitance ESR	Phase 6	Within ±20% of initial value	_			
	Current (30 minutes value)	FildSe 0	Satisfy initial ratings Satisfy initial ratings	-			
Lead Strength (tensile)		No terminal damag	, ,	Conforms to 4.9			
	Capacitance			Conforms to 4.13			
	ESR	Satisfy initial ratings		Frequency:			
Vibration Resistance	Current (30 minutes value)		5	Testing Time:	6 hours		
	Appearance	No obvious abnorn	nality				
Solderability		Over 3/4 of the tern solder	ninal should be covered by the new	Conforms to 4.11 Solder temp: +245 ±5°C Dipping time: 5 ±0.5 seconds			
	1			1.6 mm from the bot	tom should be dipped.		
	Capacitance	-		Conforms to 4.10 Solder temp:	+260 ±10°C		
Solder Heat Resistance	ESR	Satisfy initial rating	gs		10 ±1 seconds		
	Current (30 minutes value)						
Appearance		No obvious abnorn	nality		tom should be dipped.		
	Capacitance	-		Conforms to 4.12 Temperature			
Temperature Cycle	ESR	Satisfy initial rating	gs	Condition:	-40°C » Room		
	Current (30 minutes value)				temperature » +70°C » Room temperature		
	Appearance	No obvious abnorn	nality	Number of cycles:	5 cycles		



Specifications cont.

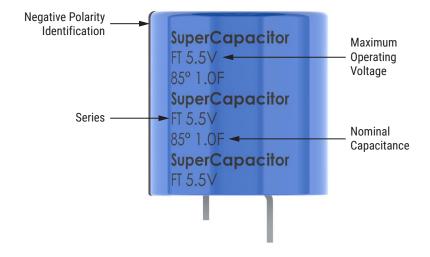
ltem		FE Туре	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance	Within ±30% of initial value	Conforms to 4.14		
High Temperature and	ESR	≤ 120% of initial ratings	Temperature: +40 ±2°C Relative humidity: 90 to 95% RH		
High Humidity Resistance	Current (30 minutes value)	≤ 120% of initial ratings	Testing time: 240±8 hours		
	Appearance	No obvious abnormality			
	Capacitance	Within ±30% of initial value	Conforms to 4.15 Temperature: +70 ±2°C Voltage applied: Maximum operating		
High Temperature Load	ESR	< 200% of initial ratings	voltage applied. Maximum operating voltage Series protection		
	Current (30 minutes value)	< 200% of initial ratings	resistance: 0Ω Testing time: 1,000 +48 (+48/-0)		
	Appearance	No obvious abnormality	hours		

Construction





Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FE0H473ZF	400 pieces
FE0H104ZF	400 pieces
FE0H224ZF	90 pieces
FE0H474ZF	50 pieces
FE0H105ZF	30 pieces
FE0H155ZF	20 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

$$\begin{array}{c} \text{Capacitance:} \quad \frac{\tau}{\text{Rc}} \quad \text{(F)} \quad \text{(9)} \\ \end{array}$$

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

 τ : Time from start of charging until Vc becomes 0.632 Eo (V)

(seconds)

Eo:

Rc: See table below (Ω) .

Charge Resistor Selection Guide

Rc

Eo

Con	ГЛ	FF	FS	F	Y	FR	FM, FME	ГМО	FG,	ГСЦ	гт		шу
Сар	FA	FE	F9	FYD	FYH	FR	FMR	FMC	FGR	FGH	FT	FC, FCS	HV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

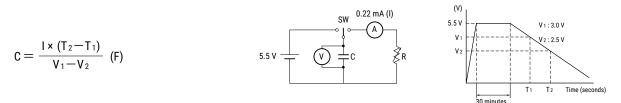
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

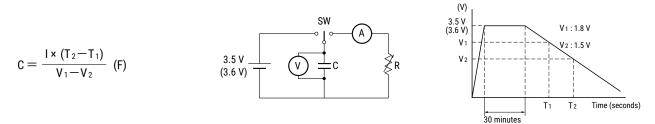
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



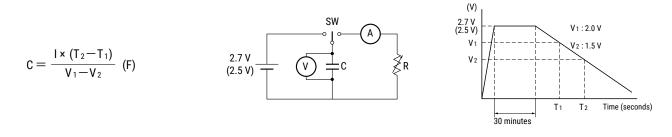
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

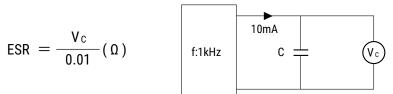
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





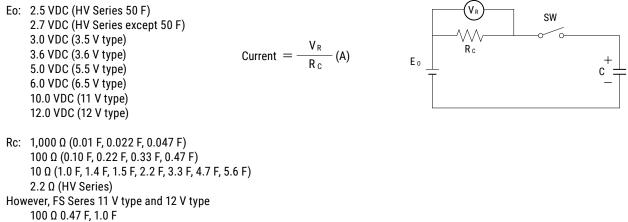
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

HV Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

Benefits

- Wide range of temperature from -25°C to +60°C and -25°C to +70°C
- Maintenance free
- Maximum operating voltages of 2.5 and 2.7 VDC
- Highly reliable against liquid leakage
- Lead-free and RoHS compliant



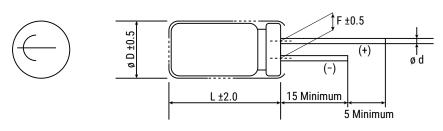
Part Number System

HVZ	OH	104	Z	F	-LT
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental	Terminal
HVZ	0E = 2.7 VDC (50 F type has 2.5 VDC)	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.	N = ±30%	F = Lead-free	-LT = Snap-in Blank = Standard

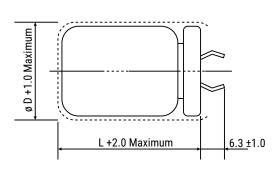


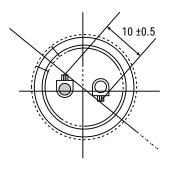
Dimensions – Millimeters

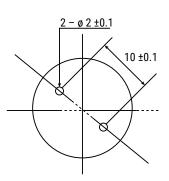
1) Standard Termination ØD 8 - 18



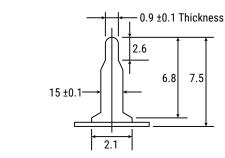
2) Snap-In Termination ØD 25 - 35







Snap-In (-LT) Terminal Details



Part Number	øD	L	F	d
HVZ0E105NF	8.0	12.0	3.5	0.6
HVZ0E275NF	8.0	22.0	3.5	0.6
HVZ0E475NF	10.0	20.0	5.0	0.6
HVZ0E106NF	10.0	35.0	5.0	0.6
HVZ0E226NF	12.5	35.0	5.0	0.6
HVZ0E506NF	18.0	40.0	7.5	0.8
HVZ0E107NF-LT	25.0	50.0	-	-
HVZ0E207NF-LT	35.0	50.0	-	-



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Secondar	ry Battery	Capa	icitor
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	_	-	-
Eco-hazard	Cd	_	-	-
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +85°C (FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Power Assist	Up to several A	Power supply, subsidiary power supply	Street sign, display light, UPS	HV series



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage (VDC)Nominal Capacitance (F)Maximum ESR at 1 kHz (Ω)			Maximum Current at 30 Minutes (mA)	Weight (g)
HVZ0E506NF	2.5	50.0	50	40.0	14.0
HVZ0E105NF	2.7	1.0	300	0.8	1.0
HVZ0E275NF	2.7	2.7	300	2.2	1.9
HVZ0E475NF	2.7	4.7	100	3.8	2.5
HVZ0E106NF	2.7	10.0	100	8.0	4.0
HVZ0E226NF	2.7	22.0	100	18.0	10.0
HVZ0E107NF-LT	2.7	100.0	30	81.0	28.0
HVZ0E207NF-LT	2.7	200.0	30	162.0	61.5



Specifications

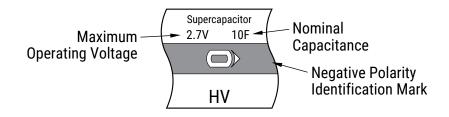
			FT Туре	Test Conditions (conforming to JIS C 5160-1)		
Category Temperature Range		-25°C to +60°C (22 F -25°C to +70°C (1.0 F				
Maximum Operating Voltage		2.7 VDC (50 F type h	as 2.5 VDC)			
Capacitance		Refer to Table 1		Refer to "Measureme	ent Conditions"	
Capacitance Allowance		±30%		Refer to "Measureme	ent Conditions"	
ESR		Refer to Table 1		Measured at 1 kHz, 1 "Measurement Cond		
Current (30 minutes value)		Refer to Table 1		Refer to "Measureme	ent Conditions"	
Ca	pacitance	Dhara 0	≥ 70% of initial value	Conforms to 4.13		
ES	R	Phase 2	≤ 500% of initial value		-25 ±2°C	
Са	pacitance		≤ 150% of initial value	Phase 4:	Category meximum tenperature ±2°C	
Characteristics in ES	R	Phase 4	Satisfy initial ratings	Phase 5:	+25 ±2°C	
D'//	ırrent (30 minutes value)		≤ 1.5 CV (mA)	_		
Са	pacitance		Within ±20% of initial value			
ES	R	Phase 5	Satisfy initial ratings	_		
Cu	ırrent (30 minutes value)		Satisfy initial ratings	-		
Lead Strength		No pin disconnection		Conforms to 4.5		
Ca	pacitance			Conforms to 4.9		
ES	R	Satisfy initial ratings		Frequency:		
Vibration Resistance Cu	ırrent (30 minutes value)			Testing Time:	6 hours	
Ар	pearance	No obvious abnorma	ality	_		
Solderability		Over 3/4 of the terminal should be covered by the new solder			5 ±0.5 seconds	
0-				1.6 mm from the bottom should be dipped.		
ES	ipacitance	Satisfy initial ration	`	Conforms to 4.6 Solder temp:	+245 ±5°C	
Solder Heat Resistance	Irrent (30 minutes value)	Satisfy initial ratings		Dipping time:	5 ±0.5 seconds	
	· · · · · · · · · · · · · · · · · · ·	No obvious obnorma	ality	1.6 mm from the bott	om should be dipped.	
Appearance Capacitance		No obvious abnormality		Conforms to 4.8 Temperature	-25°C » Room	
Temperature Cycle ES	·R	Satisfy initial ratings		Condition:	temperature » Category	
	Irrent (30 minutes value)				Maximum temperature » Room temperature	
Appearance		No obvious abnorma	ality	Number of cycles:	5 cycles	
	pacitance	Within ±20% of initial value		Conforms to 4.14		
ES		≤ 150% of initial ratio		Temperature:		
Humidity Resistance	Irrent (30 minutes value)	≤ 150% of initial ratio	•	Relative humidity:	90 to 95% RH 240±8 hours	
	ppearance	No obvious abnorma	-	resting time:		



Specifications cont.

Item		FT Туре	Test Conditions (conforming to JIS C 5160-1)		
	Capacitance	Within ±30% of initial value	Conforms to 4.10 Temperature: Category Maximum temperature ±2°C Voltage applied: Maximum operating		
High Temperature Load	ESR	< 200% of initial ratings	voltage Series protection		
	Current (30 minutes value)	< 200% of initial ratings	resistance: 0 Ω Testing time: 1,000+48 (+48/-0)		
	Appearance	No obvious abnormality	hours		

Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
HVZ0E105NF	4,000 pieces
HVZ0E275NF	2,000 pieces
HVZ0E475NF	2,000 pieces
HVZ0E106NF	2,000 pieces
HVZ0E226NF	1,000 pieces
HVZ0E506NF	250 pieces
HVZ0E107NF-LT	100 pieces
HVZ0E207NF-LT	100 pieces



Measurement Conditions

Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, the capacitor is discharged by shorting both pins of the device for at least 30 minutes. In addition, use the polarity indicator on the device to determine correct orientation of capacitor for charging.

$$\begin{array}{c} \text{Capacitance:} \quad \frac{\tau}{\text{Rc}} \quad \text{(F)} \quad \text{(9)} \\ \end{array}$$

Switch

С

Vc

5.0 (V) Product with maximum operating voltage of 5.5 V

6.0 (V) Product with maximum operating voltage of 6.5 V

- 10.0 (V) Product with maximum operating voltage of 11 V
- 12.0 (V) Product with maximum operating voltage of 12 V

Time from start of charging until Vc becomes 0.632 Eo (V) τ: (seconds)

Eo:

Rc: See table below (Ω).

Charge Resistor Selection Guide

Rc

Eo

Con	E A	FF	те го	F	Y	FR	FM, FME	EMO	FG,	FGH	CT.		Η٧
Сар	FA	FE	FS	FYD	FYH	FR	FMR	FMC	FGR	FGR	FT	FC, FCS	ΠV
0.010 F	-	-	-	-	-	-	5,000 Ω	-	5,000 Ω	-	-	-	-
0.022 F	1,000 Ω	-	1,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	2,000 Ω	-	2,000 Ω	-	-	Discharge	-
0.033 F	-	-	-	-	-	-	Discharge	-	-	-	-	-	-
0.047 F	1,000 Ω	1,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	1,000 Ω	2000 Ω	1,000 Ω	2,000 Ω	-	-	-	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	1,000 Ω	1000 Ω	1,000 Ω	1,000 Ω	Discharge	510 Ω	Discharge	-
0.22 F	200 Ω	200 Ω	200 Ω	510 Ω	510 Ω	510 Ω	0H: Discharge 0V: 1000 Ω	-	1,000 Ω	Discharge	200 Ω	Discharge	-
0.33 F	-	-	-	-	-	-	-	Discharge	-	-	-	-	-
0.47 F	100 Ω	100 Ω	100 Ω	200 Ω	200 Ω	200 Ω	-	-	1,000 Ω	Discharge	100 Ω	Discharge	-
1.0 F	51 Ω	51 Ω	100 Ω	100 Ω	100 Ω	100 Ω	-	-	510 Ω	Discharge	100 Ω	Discharge	Discharge
1.4 F	-	-	-	200 Ω	-	-	-	-	-	-	-	-	-
1.5 F	-	51 Ω	-	-	-	-	-	-	510 Ω	-	-	-	-
2.2 F	-	-	-	100 Ω	-	-	-	-	200 Ω	-	51 Ω	-	-
2.7 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
3.3 F	-	-	-	-	-	-	-	-	-	-	51 Ω	-	-
4.7 F	-	-	-	-	-	-	-	-	100 Ω	-	-	-	Discharge
5.0 F	-	-	100 Ω	-	-	-	-	-	-	-	-	-	-
5.6 F	-	-	-	-	-	-	-	-	-	-	20 Ω	-	-
10.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
22.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
50.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
100.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge
200.0 F	-	-	-	-	-	-	-	-	-	-	-	-	Discharge

*Capacitance values according to the constant current discharge method.

*HV Series capacitance is measured by discharge system.

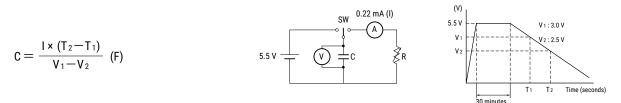
^{3.0 (}V) Product with maximum operating voltage of 3.5 V



Capacitance (Discharge System)

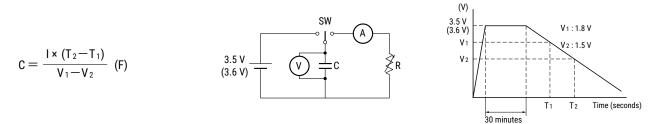
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA per 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

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



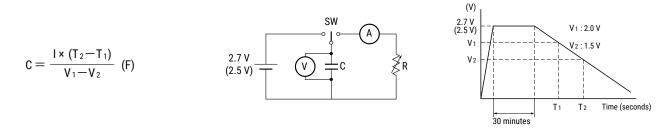
Capacitance (Discharge System – 3.5 V, 3.6 V)

As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 3.5 V (3.6 V). Then, use a constant current load device and measure the time for the terminal voltage to drop from 1.8 to 1.5 V upon discharge at 1.0 mA per 1.0 F, for example, and calculate the static capacitance according to the equation shown below.



Capacitance (Discharge System – HV Series)

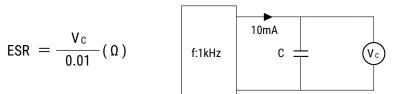
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches maximum operating voltage. Then, use a constant current load device and measure the time for the terminal voltage to drop from 2.0 to 1.5 V upon discharge at 1.0 mA per 1.0 F, and calculate the static capacitance according to the equation shown below.





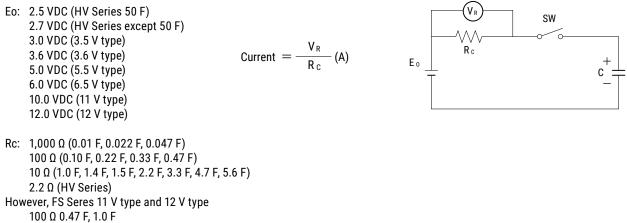
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



10 Ω 5.0 F

Self-Discharge Characteristic (0H - 5.5 V Products)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FMD Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for power back up in the automotive applications.

Enhancements to the design and selected material upgrades were introduced to deliver 1,000 hours at 85°C/85% RH rated voltage and Automotive Testing Protocol with extended maximum operational temperature life up to 85°C. These capacitors are manufactured in an ISO TS 16949 certified plant and are subjected to PPAP/ PSW, as well as change control.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

FMD type Automotive grade Supercapacitor can be stable under harsh environmental conditions such as high humidity and high temperture.

Benefits

- · AEC-Q200 rev E compliant
- TS 16949 certified plant
- Subject to PPAP/PSW and change control
- Wide range of temperature from -40°C to +85°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- · Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

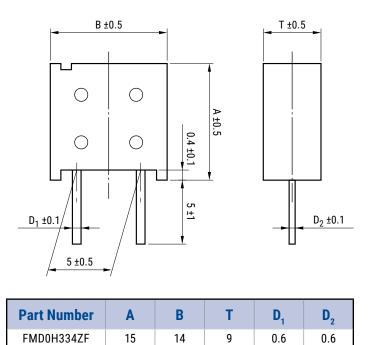


Part Number System

FMD	OH	334	Z	F	ТР	18
Series	Maximum Operating Voltage	Capacitance Code	Capacitance Tolerance	Environmental	Таре Туре	Height (excluding lead)
FMD	0H = 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeros to follow µF code.		F = Lead-free	TP = Ammo Blank = Bulk	18 = 18 mm Blank = Bulk



Dimensions – Millimeters



Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating	Nominal Capacitance		Maximum ESR	Maximum Current at 30	Voltage Holding Characteristic	Reference
	Voltage (VDC)	Charge System (F)	Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Minimum (V)	Weight (g)
FMD0H334ZF	5.5	-	0.33	25	0.50	4.2	3.8



Specifications

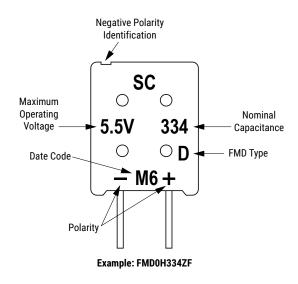
Item		Specifications	Те	est Conditions	
Category tempe	erature range		-40°C to +85°C		
MAX operating	voltage		Refer to standard ratings		
Capacitance			Refer to standard ratings	Refer to "Measurement Cond	ditions"
Capacitance all	lowance		+80%, -20%	Refer to "Measurement Cond	ditions"
ESR	ESR		Refer to standard ratings	Measured at 1 kHz, 10 mA, S	See also "Measurement Conditions
Current (30 min	Current (30 minute value)		Refer to standard ratings	Refer to "Measurement Cond	ditions"
Self discharge	characteristics (vo	oltage holding	Voltage between terminal leads	Charging	Voltage applied: 5.0 VDC Series resistance: 0 Ω Let stand for 24 hours
characteristics		Strage holding	higher than 4.2 V	Storage	Let stand for 24 hours in described below with terminals opened Ambient temperature: Lower than 25°C Relative humidity: Lower than 70°C
High		Capacitance	Within ±30% of initial measured value	Temperature: 85 ±2°C	
Temperature Exposure	MIL-STD-202 Method 108	ESR	Less than 200% of initial limit		
(Storage)		Current	Less than 200% of initial limit	 Testing time: 1,000⁺⁴⁸ -0 hour 	rs
		.	Within ±30% of	Temperature condition: Low	er −40°C » Upper +85°C
Temperature	JESD22	Capacitance	initial measured value	Dwell Time: 30 minutes	
Cycling			Less than 200% of initial limit	Transition time: Maximum 1 minute	
			Less than 200% of initial limit	Number of cycles: 1,000 Cycles	
				Temperature: 85±2°C	
		Capacitance	Within ±30% of initial measured value	Relative humidity: 80 to 85%RH	
Biased humidity	MIL-STD- 202 Method 103			Voltage applied: MAX operating voltage	
numurty	include roo	ESR	Less than 200% of initial limit	Series protection resistance: 0 Ω	
		Current	Less than 200% of initial limit	Testing time: 1,000 ⁺⁴⁸ _0 hours	
		Capacitance	Within ±30% of initial measured value	Temperature: 85±2°C	
Operational	MIL-STD-202	ESR	Less than 200% of initial limit	Voltage applied: MAX operating voltage	
life	Method 108	0	Less than 200% of initial limit	Series protection resistance: 0 Ω	
		Current	Less than 200% of Initial limit	Testing time: 1,000 ⁺⁴⁸ -0 hours	
Lead strength	MIL-STD-202		No terminal domage	Test leaded device lead integrity only.	
(Tensile)	Method 211		No terminal damage	A (454 g), C (227 g)	
		Capacitance			
Mechanical shock	MIL-STD-202 Method 213	ESR	Satisfy initial limit	Figure 1 of Method 213 Cond	dition C
SHOOK	Method 210	Current			
				Conforms to Method A1 (Thi Solder temp: 245±5°C	rough Hole Technology)
Solderability	J-STD-002			Dipping time: 5 +0/-0.5 seco	ond
-		Appearance	Minimum 95% of the terminal should be covered by the new solder	1.6mm from the bottom sho	uld be dipped.
		Capacitance		Frequency: 10 to 2,000 Hz (5	ō g's)
Vibration	MIL-STD-202 Method 204	ESR	Satisfy initial limit	Testing time: 12 hours	
	Method 204	Current			



Specifications cont.

	Item		Specifications	Test Conditions	
		Capacitance			Solder temp: 260±10°C
		ESR]		Dipping time: 3 seconds
Resistance to Soldering Heat	MIL-STD- 202 Method 210	Satist Current	Satisfy initial limit		2.0 mm from the bottom should be dipped. Condition B no pre-heat of samples. Note: Single Wave Solder. Procedure 1 with solder within 1.5 mm of device body for Leaded.
		Capacitance	Dhaaa?	More than 50% of initial measured	
		ESR	Phase2	Less than 400% of initial measured	
		Capacitance	Phase3	More than 30% of initial measured	Phase1: +25±2°C
		ESR	Pliases	Less than 700% of initial measured	Phase2: -25±2°C
Temperature	IEC-62391-1	Capacitance		Less than 200% of initial measured	Phase3: -40±2°C
Stability	IEC-02391-1	ESR	Phase5	Satisfy initial specified value	Phase4: +25±2°C
		Current		1.5 CV (mA) or below	Phase5: +85±2°C
		Capacitance		Within ±20% of initial measured value	Phase6: +25±2°C
		ESR	Phase6	Satisfy initial specified value	
		Current		Satisfy initial specified value	

Marking

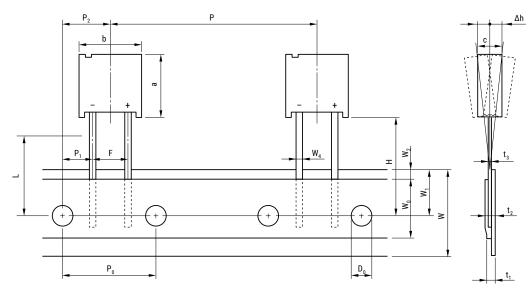


Packaging Quantities

Part Number	Bulk Quantity per Box Straight Lead	Ammo Pack Quantity
FMD0H334ZF	400 pieces	400 pieces



Ammo Pack Taping Format



Ammo Pack Taping Specifications

Item	Symbol	Dimensions (mm)
Component Height	а	15.0±0.5
Component Width	b	14.0±0.5
Component Thickness	С	9.0±0.5
Lead-Wire Width	W ₄	0.6±0.1
Lead-Wire Thickness	t ₃	0.6±0.1
Component Pitch	Р	25.4±1.0
Sprocket Hole Pitch	P ₀	12.7±0.3
Sprocket Hole Center to Lead Center	P ₁	3.85±0.7
Sprocket Hole Center to Component Center	P ₂	6.35±0.7
Lead Spacing	F	5.0±0.5
Component Alignment (side/side)	Δh	2.0 Maximum
Carrier Tape Width	W	18.0+1.0/-0.5
Hold-Down Tape Width	W ₀	12.5 Minimum
Sprocket Hole Position	W ₁	9.0±0.5
Hold-Down Tape Position	W ₂	3.0 Maximum
Height to Seating Plane (lead length)	Н	16.0±0.5/18.0±0.5
Sprocket Hole Diameter	D ₀	ø 4.0±0.2
Carrier Tape Thickness	t ₁	0.67±0.2
Total Thickness (Carrier Tape, Hold-Down Tape and Lead)	t ₂	1.7 Maximum
Cut Out Length	L	11.0 Maximum

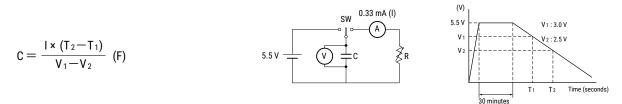


Measurement Conditions

Capacitance (Discharge System)

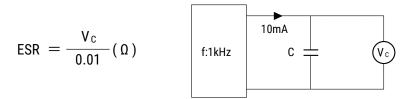
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.33 mA per 0.33 F, for example, and calculate the static capacitance according to the equation shown below.

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



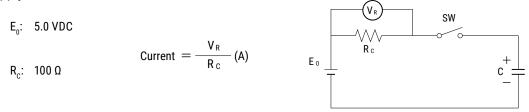
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



Self-Discharge Characteristic

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) 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° C or below and relative humidity of 70% RH or below. The soldering is checked.

Dismantling

There is a small amount of electrolyte stored within the capacitor. 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.



Overview

FUOH Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for power back up in the automotive applications.

Enhancements to the design and selected material upgrades were introduced to deliver 1,000 hours at 85°C/85% RH rated voltage and up to 4,000 hours at 85°C operational life.

These capacitors are manufactured in an ISO TS 16949 certified plant and are subjected to PPAP/PSW, as well as change control.

Applications

Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

FUOH series Automotive grade Supercapacitor can be stable under harsh environmental conditions such as high humidity and high temperture.

Benefits

- · AEC-Q200 rev E compliant
- TS 16949 certified plant
- Subject to PPAP/PSW and change control
- Wide range of temperature from -40°C to +85°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- · Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

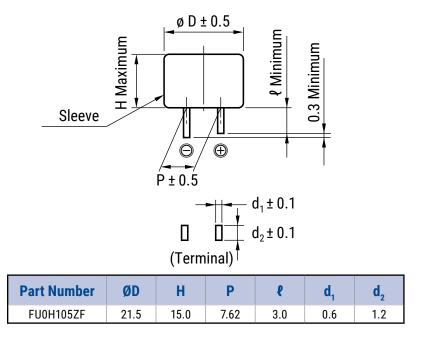


Part Number System

FUOH	105	Z	F
Series/Maximum Operating Voltage	Capacitance Code (µF)	Capacitance Tolerance	Environmental
FU0H = FU / Series 0H / 5.5 VDC	First two digits represent significant figures. Third digit specifies number of zeroes.	Z = -20/+80%	F = Lead-free



Dimensions – Millimeters



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Capacitor	
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor
Back-up ability	-	-	-	-
Eco-hazard	Cd	-	-	-
Operating Temperature Range	-20 to +60°C	−20 to +50°C	-55 to +105°C	-40 to +85°C (FMD, FU0H, FR, FT, FMR Type)
Charge Time	Few hours	Few hours	Few seconds	Few seconds
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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



Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time back-up	500 μA and below	Memory, RTC backup for automotive	CMOS microcomputer, static RAM/DTS (digital tuning system)	FMD, FU0H series

Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

		Electrical				
Part Number		Nominal Capacitance Discharge System (F)		Maximum Current at 30 Minutes (mA)	Weight (g)	
FU0H105ZF	5.5	1.0	10	1.5	10.0	



Specifications

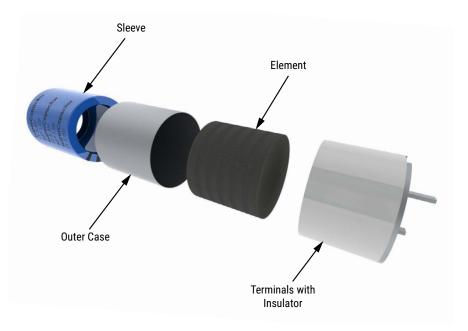
Item		Specifications	Test Conditions		
Category temperature range		-40°C to +85°C			
MAX operating	voltage		Refer to standard ratings		
Capacitance			Refer to standard ratings	Refer to "Measurement Conditions"	
Capacitance all	lowance		+80%, -20%	Refer to "Measurement Conditions"	
ESR			Refer to standard ratings	Measured at 1 kHz, 10 mA, See also "Measurement Conditions	
Current (30 min	ute value)		Refer to standard ratings	Refer to "Measurement Conditions"	
High Temperature	MIL-STD-202	Capacitance	Within ±30% of initial measured value	Temperature: 85 ±2°C	
Exposure	Method 108	ESR	Less than 200% of initial limit	Testing time: $1,000^{+48}$ hours	
(Storage)		Current	Less than 200% of initial limit		
Temperature	JESD22	Capacitance	Within ±30% of initial measured value	Temperature condition: Lower -40°C » Upper +85°C Dwell Time: 30 minutes	
Cycling	Method JA-104	ESR	Less than 200% of initial limit	Transition time: Maximum 1 minute	
	JA-104	Current	Less than 200% of initial limit	Number of cycles: 1,000 Cycles	
			Within ±30% of initial measured value	Temperature: 85±2°C Relative humidity: 80 to 85%RH	
Biased humidity	MIL-STD- 202 Method 103	ESR	Less than 200% of initial limit	Voltage applied: MAX operating voltage Series protection resistance: 0 Ω	
		Current	Less than 200% of initial limit	Testing time: 1,000 ⁺⁴⁸ -0 hours	
On constitution of		Capacitance	Within ±30% of initial measured value	Temperature: 85±2°C	
Operational life	MIL-STD- 202 Method 108	ESR	Less than 200% of initial limit	Voltage applied: MAX operating voltage Series protection resistance: 0 Ω	
		Current	Less than 200% of initial limit	Testing time: 4,000 ⁺⁴⁸ ₋₀ hours	
Lead strength (Tensile)	MIL-STD-202 Method 211		No terminal damage	Test leaded device lead integrity only. A (454 g), C (227 g)	
		Capacitance			
	Mechanical MIL-STD-202 shock Method 213 ESR Current		Satisfy initial limit	Figure 1 of Method 213 Condition C	
SHOCK					
Solderability	J-STD-002	Appearance	Minimum 95% of the terminal should be covered by the new solder	Conforms to Method A1 (Through-hole Technology) Solder temp: 245±5°C Dipping time: 5 +0/-0.5 second 1.27 mm from the bottom of the body should be dipped.	
		Capacitance			
Vibration	MIL-STD-202 Method 204	ESR	Satisfy initial limit	Frequency: 10 to 2,000 Hz (5 g's) Testing time: 12 hours	
	method 204	Current]		



Specifications cont.

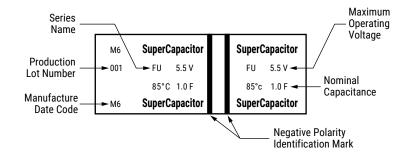
Item		Specifications		Test Conditions	
		Capacitance			Solder temp: 260±10°C
		ESR			Dipping time: 3 seconds
Resistance to Soldering Heat	MIL-STD- 202 Method 210	Current	Satisfy initial limit		2.0 mm from the bottom should be dipped. Condition B no pre-heat of samples. Note: Single Wave Solder. Procedure 1 with solder within 1.5 mm of device body for Leaded.
		Capacitance	Phase2	More than 50% of initial measured	
		ESR	Phasez	Less than 400% of initial measured	_
		Capacitance	Dhaaa2	More than 30% of initial measured	Phase1: +25±2°C
		ESR	Phase3	Less than 700% of initial measured	Phase2: -25±2°C
Temperature	IEC-62391-1	Capacitance		Less than 200% of initial measured	Phase3: -40±2°C
Stability	IEC-02391-1	ESR	Phase5	Satisfy initial specified value	Phase4: +25±2°C
		Current	-	1.5 CV (mA) or below	Phase5: +85±2°C
		Capacitance		Within ±20% of initial measured value	Phase6: +25±2°C
		ESR	Phase6	Satisfy initial specified value	
		Current		Satisfy initial specified value	

Construction





Marking



Packaging Quantities

Part Number	Bulk Quantity per Box
FU0H105ZF	90 pieces

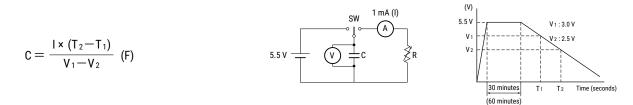
Measurement Conditions

Capacitance (Discharge System)

As shown in the diagram below, charging is performed for a duration of 30 minutes^{*1} once the voltage of the capacitor 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 1mA per 1F^{*2}, for example, and calculate the static capacitance according to the equation shown below.

Note: *1: Products with 1.0F or more capacitance should be charged for 60 minutes.

*2: The current value is 1mA discharged per 1F

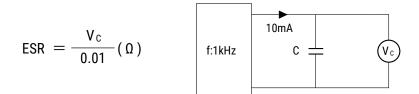




Measurement Conditions cont.

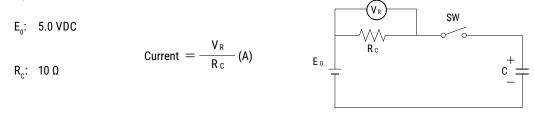
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.





Overview

FMU Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high temperature automotive applications.

Enhancements to the design and selected material upgrades were introduced to deliver 1,000 hours at 85°C/85% RH rated voltage and and to AEC-Q200 compliance with maximum operational temperature life up to 105°C.

These capacitors are manufactured in an ISO TS 16949 certified plant and are subjected to PPAP/PSW, as well as change control.

Applications

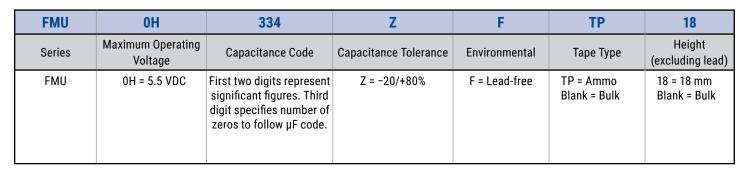
Supercapacitors have characteristics ranging from traditional capacitors and batteries. As a result, supercapacitors can be used like a secondary battery when applied in a DC circuit. These devices are best suited for use in low voltage DC hold-up applications such as embedded microprocessor systems with flash memory.

FMU type Automotive grade Supercapacitor can be stable under harsh envermental conditions such as high humidity and high temperture.

Benefits

- · AEC-Q200 rev E compliant
- TS 16949 certified plant
- Subject to PPAP/PSW and change control
- Wide range of temperature from -40°C to +105°C
- Maintenance free
- Maximum operating voltage of 5.5 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS compliant

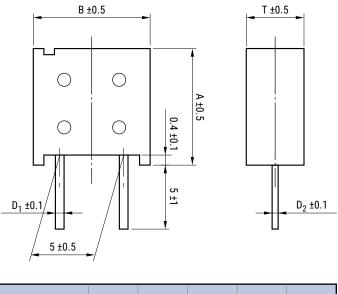
Part Number System







Dimensions – Millimeters



Part Number	Α	В	Т	D ₁	D ₂
FMU0H334ZF	15.0	14.0	9.0	0.6	0.6

Environmental Compliance

All KEMET supercapacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage	Nominal Capacitance		Maximum ESR	Maximum Current at 30	Reference	
Part Number Operating Voltage (VDC) Charge System (F)		Discharge System (F)	at 1 kHz (Ω)	Minutes (mA)	Weight (g)		
FMU0H334ZF	5.5	-	0.33	25	0.50	3.8	



Performance Characteristics

Supercapacitors should not be used for applications such as ripple absorption because of their high internal resistance (several hundred m Ω to a hundred Ω) compared to aluminum electrolytic capacitors. 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 supercapacitors as compared to aluminum electrolytic capacitors for power back-up and secondary batteries.

	Seconda	ry Battery	Capacitor		
	NiCd	Lithium Ion	Aluminum Electrolytic	Supercapacitor	
Back-up Ability	-	_	-	-	
Eco-Hazard	Cd	_	-	-	
Operating Temperature Range	-20 to +60°C	-20 to +50°C	−55 to +105°C	-40 to +105°C (FMU Type)	
Charge Time	Few hours	Few hours	Few seconds	Few seconds	
Charge/Discharge Life Time	Approximately 500 times	Approximately 500 to 1,000 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 electrolytic capacitors and supercapacitors have limited lifetime. However, when used under proper conditions, both can operate within a predetermined lifetime.

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

Typical Applications

Intended Use (Guideline)	Power Supply (Guideline)	Application	Examples of Equipment	Series
Long time back-up	500 µA and below	Memory, RTC backup for automotive	Automotive applications, medical, measurement and infrastructure, telecommunications equipment, medical equipment	FMU Series



Specifications

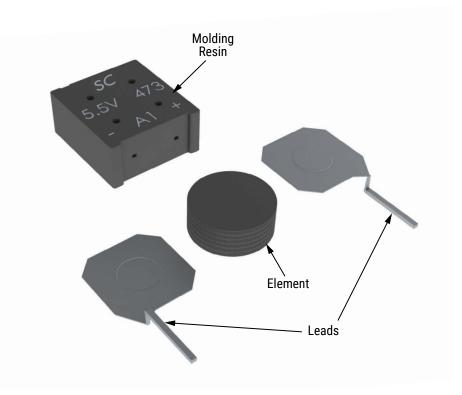
Item		Specifications	Test Conditions		
Category temperature range		-40°C to +105°C			
MAX operating	voltage		Refer to standard ratings		
Capacitance			Refer to standard ratings	Refer to "Measurement Conditions"	
Capacitance all	owance		+80%, -20%	Refer to "Measurement Conditions"	
ESR			Refer to standard ratings	Measured at 1 kHz, 10 mA, See also "Measurement Conditions	
Current (30 min	ute value)		Refer to standard ratings	Refer to "Measurement Conditions"	
High Temperature	MIL-STD-202	Capacitance	Within ±30% of initial measured value	Temperature: 105 ±2°C	
Exposure	Method 108	ESR	Less than 200% of initial limit	Testing time: 1,000 ⁺⁴⁸ _n hours	
(Storage)		Current	Less than 200% of initial limit		
		Canacitanoo	Within ±30% of	Temperature condition: Lower -40°C » Upper +105°C	
Temperature	JESD22 Method	Capacitance	initial measured value	Dwell Time: 30 minutes	
Cycling	JA-104	ESR	Less than 200% of initial limit	Transition time: Maximum 1 minute	
		Current	Less than 200% of initial limit	Number of cycles: 1,000 Cycles	
		Capacitance		Temperature: 85 ±2°C	
			Within ±30% of initial measured value	Relative humidity: 80 to 85%RH	
	MIL-STD- 202 Method 103			Voltage applied: MAX operating voltage	
Humany	ESR Current		Less than 200% of initial limit	Series protection resistance: 0 Ω	
			Less than 200% of initial limit	Testing time: 1,000 ⁺⁴⁸ -0 hours	
	Capacitance Within ±30% of initial means		Within ±30% of initial measured value	Temperature: 105 ±2°C	
Operational MIL-STD- 202		ESR	Less than 200% of initial limit	Voltage applied: MAX operating voltage	
Life	Method 108		Less then 000% of initial limit	Series protection resistance: 0 Ω	
		Current	Less than 200% of initial limit	Testing time: 1,000 ⁺⁴⁸ -0 hours	
Lead Strength	MIL-STD-202			Test leaded device lead integrity only.	
(Tensile)	Method 211		No terminal damage	A (454 g), C (227 g)	
		Capacitance			
Mechanical Shock	MIL-STD-202 Method 213	ESR	Satisfy initial limit	Figure 1 of Method 213 Condition C	
Shock Meth	Method 213	Current	1		
Solderability	J-STD-002	Appearance	Minimum 95% of the terminal should be covered by the new solder	Conforms to Method A1 (Through Hole Technology) Solder temp: 245±5°C Dipping time: 5 +0/-0.5 second	
		Capacitance			
Vibration	MIL-STD-202 Mothod 204	ESR	Satisfy initial limit	Frequency: 10 to 2,000 Hz (5 g's) Testing time: 12 hours	
	Method 204	Current			



Specifications cont.

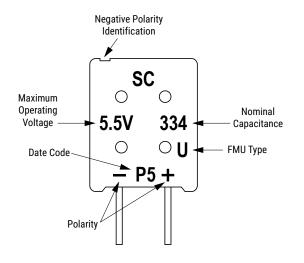
ltem		Specifications		Test Conditions	
		Capacitance			Solder temp: 260 ±10°C
		ESR			Dipping time: 3 seconds
Resistance to Soldering Heat MIL-STD- 202 Method 210 Current Satisfy initial limit		mit	2.0 mm from the bottom should be dipped. Condition B no pre-heat of samples. Note: Single Wave Solder. Procedure 1 with solder within 1.5 mm of device body for Leaded.		
		Capacitance	Dhasa 0	More than 50% of initial measured	
		ESR	Phase 2	Less than 400% of initial measured	-
	Capacitance	Phase 3	More than 30% of initial measured	Phase 1: +25±2°C	
Temperature	ESR		Less than 700% of initial measured	Phase 2: -25±2°C	
	Capacitance		Less than 200% of initial measured	Phase 3: -40±2°C	
Stability		ESR	Phase 5	Satisfy initial specified value	Phase 4: +25±2°C
		Current		1.5 CV (mA) or below	Phase 5: +105±2°C
		Capacitance		Within ±20% of initial measured value	Phase 6: +25±2°C
		ESR	Phase 6	Satisfy initial specified value	
		Current		Satisfy initial specified value	

Construction





Marking

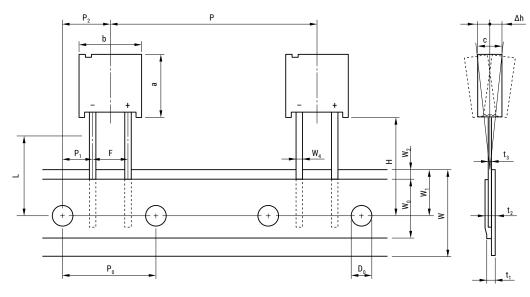


Packaging Quantities

Part Number	Bulk Quantity per Box Straight Lead	Ammo Pack Quantity
FMUD0H334ZF	400 pieces	400 pieces



Ammo Pack Taping Format



Ammo Pack Taping Specifications

Item	Symbol	Dimensions (mm)
Component Height	а	15.0±0.5
Component Width	b	14.0±0.5
Component Thickness	С	9.0±0.5
Lead-Wire Width	W ₄	0.6±0.1
Lead-Wire Thickness	t ₃	0.6±0.1
Component Pitch	Р	25.4±1.0
Sprocket Hole Pitch	P	12.7±0.3
Sprocket Hole Center to Lead Center	P ₁	3.85±0.7
Sprocket Hole Center to Component Center	P ₂	6.35±0.7
Lead Spacing	F	5.0±0.5
Component Alignment (side/side)	Δh	2.0 Maximum
Carrier Tape Width	W	18.0+1.0/-0.5
Hold-Down Tape Width	W ₀	12.5 Minimum
Sprocket Hole Position	W ₁	9.0±0.5
Hold-Down Tape Position	W ₂	3.0 Maximum
Height to Seating Plane (lead length)	Н	16.0±0.5/18.0±0.5
Sprocket Hole Diameter	D ₀	ø 4.0±0.2
Carrier Tape Thickness	t,	0.67±0.2
Total Thickness (Carrier Tape, Hold-Down Tape and Lead)	t ₂	1.7 Maximum
Cut Out Length	L	11.0 Maximum

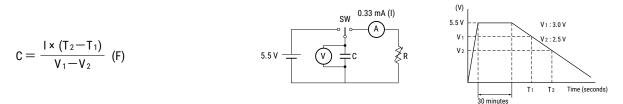


Measurement Conditions

Capacitance (Discharge System)

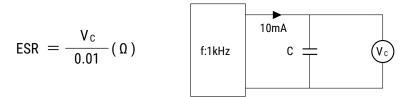
As shown in the diagram below, charging is performed for a duration of 30 minutes once the voltage of the capacitor terminal reaches 5.5 V. Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.33 mA per 0.33 F, for example, and calculate the static capacitance according to the equation shown below.

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



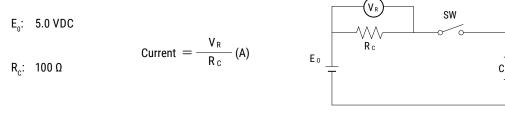
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.



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.



Алматы (7273)495-231 Ангарск (3955)60-70-56 Архангельск (8182)63-90-72 Астрахань (8512)99-46-04 Барнаул (3852)73-04-60 Белгород (4722)40-23-64 Благовещенск (4162)22-76-07 Брянск (4832)59-03-52 Владивосток (423)249-28-31 Владикаеток (423)249-28-31 Владикаеток (423)249-28-31 Волоград (844)278-03-48 Вологорад (844)278-03-48 Ворорнеж (473)204-51-73 Екатеринбург (343)384-55-89

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