FS Series

Overview

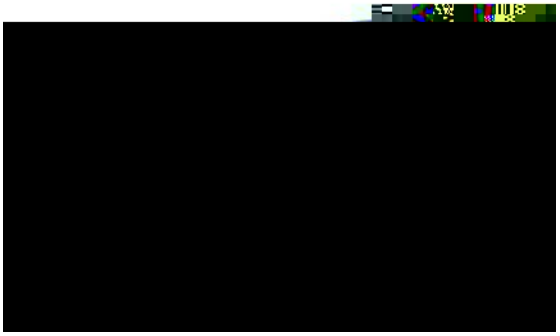
FS Series Supercapacitors, also known as Electric Double-Layer Capacitors (EDLCs), are intended for high energy storage applications.

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 ash memory.

Benefits

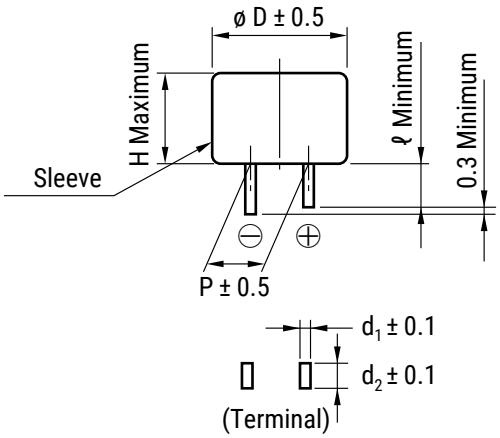
- Wide range of temperature from -25°C to +70°C
- Maintenance free
- 5.5 VDC, 11.0 VDC, and 12.0 VDC
- Highly reliable against liquid leakage
- Lead-free and RoHS Compliant



Part Number System

FS	0H	104	Z	F
Series	Maximum Operating Voltage	Capacitance Code (F)	Capacitance Tolerance	Environmental
FS	0H = 5.5 VDC 1A = 11.0 VDC 1B = 12.0 VDC	First two digits represent signi cant gures. Third digit speci es number of zeros.	Z = -20/+80% fi fi fi	F = Lead-free

Dimensions – Millimeters



Part Number	ø D	H	P	ℓ	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 Ωto 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.

Environmental Compliance

All KEMET supercapacitors are RoHS Compliant.

RoHS Compliant

Table 1 – Ratings & Part Number Reference

Part Number	Maximum Operating Voltage (VDC)	Nominal Capacitance		Maximum ESR at 1 kHz (Ω)	Maximum Current at 30 Minutes (mA)	Weight (g)
		Charge System (F)	Discharge System (F)			
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

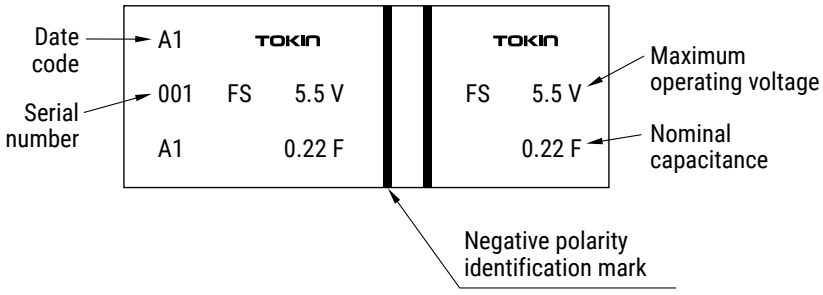
Part numbers in bold type represent popularly purchased components.

Specifications

Specifications cont'd

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

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

List of Plating & Sleeve Type

By changing the solder plating from leaded solder to lead-free solder and the outer tube material of can-cased conventional supercapacitor from polyvinyl chloride to polyethylene terephthalate (PET), our supercapacitor is now even friendlier to the environment.

a. Iron + copper base + lead-free solder plating (Sn-1Cu)
b. SUS nickel base + copper base + re ow lead-free solder plating (100% Sn, re ow processed) fl

Series	Part Number	Plating	Sleeve
FS	All FS Types	a	PET (Blue)

Recommended Pb-free solder :
Sn / 3.5Ag / 0.75Cu
Sn / 3.0Ag / 0.5Cu
Sn / 0.7Cu
Sn / 2.5Ag / 1.0Bi / 0.5Cu

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.

Eo: 3.0 (V) Product with maximum operating voltage of 3.5 V
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)

Rc: See table below (Ω).

Charge Resistor Selection Guide

Measurement Conditions cont'd

Capacitance (Discharge System)

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 eld fi

Based on eld 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 signi cantly 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.

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Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.