HV Series



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
- 2.5 VDC and 2.7 VDC
- Highly reliable against liquid leakage
- · Lead-free and RoHS Compliant



Part Number System

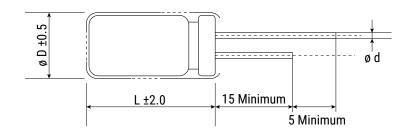
HVZ	0E	105	N	F	-LT
Series	Maximum Operating Voltage	Capacitance Code (F)	Capacitance Tolerance	Environmental	Terminal
HVZ	0E = 2.7 VDC (50 F type has 2.5 VDC)	First two digits represent significant figures. Third digit specifies number of zeros.	N = ±30%	F = Lead-free	-LT = Snap-in Blank = Standard

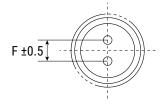


Dimensions - Millimeters

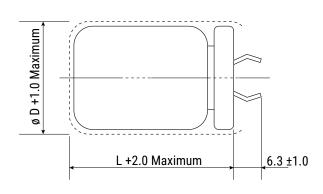
1) Standard Termination (all types except -LT)

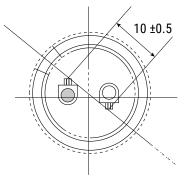


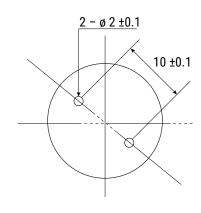




2) Snap-In Termination (-LT only)

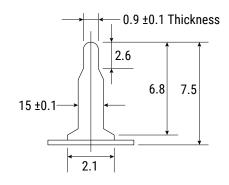






Snap-In (-LT) Terminal Details

Part Number	ø D	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 $m\Omega$ 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)	
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.

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

^(*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.



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 (mΩ)	Maximum Current at 30 Minutes (mA)	Weight (g)	
HVZ0E506NF	2.5	50.0	50.0	40.0	14.0	
HVZ0E105NF	2.7	1.0	300.0	0.8	1.0	
HVZ0E275NF	2.7	2.7	300.0	2.2	1.9	
HVZ0E475NF	2.7	4.7	100.0	3.8	2.5	
HVZ0E106NF	2.7	10.0	100.0	8.0	4.0	
HVZ0E226NF	2.7	22.0	100.0	18.0	10.0	
HVZ0E107NF-LT	2.7	100.0	30.0	81.0	28.0	
HVZ0E207NF-LT	2.7	200.0	30.0	162.0	61.5	



Specifications

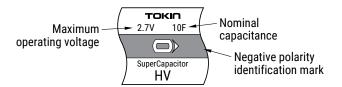
It	tem		HV Type	Test Conditions (conforming to JIS C 5160-2)		
Category Temperature Ran	ge		2 F, 50 F, 100 F, 200 F) 3 F, 2.7 F, 4.7 F, 10 F)			
Maximum Operating Volta	ge	2.7 VDC (50 F type	· · · · · · · · · · · · · · · · · · ·			
Capacitance		Refer to Table 1		Refer to "Measurem	ent Conditions"	
Capacitance Allowance		±30%		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	Phase 2	≥ 70% of initial value	Conforms to 4.13		
	ESR	Pilase 2	≤ 500% of initial value		-25±2°C	
Characteristics in Different Temperature	Capacitance		≤ 150% of initial value	Filase 4.	Category maximum temperature ±2°C	
	ESR	Phase 4	Satisfy initial ratings	Phase 5.	+25±2°C	
	Current (30 minutes value)		≤ 1.5 CV (mA)			
	Capacitance		Within ±20% of initial value			
	ESR	Phase 5	Satisfy initial ratings			
	Current (30 minutes value)		Satisfy initial ratings			
Lead Strength		No pin disconnecti	on	Conforms to 4.5		
	Capacitance			Conforms to 4.9		
	ESR	Satisfy initial ratino	18		10 to 55 Hz	
Vibration Resistance	Current (30 minutes value)		•	Testing Time:	o nours	
	Appearance	No obvious abnorm	nality			
Solderability		Over 3/4 of pin surface should be covered by the new solder			+245±5°C 5±0.5 seconds tom should be dipped.	
	Capacitance		,	Conforms to 4.6		
	ESR	Satisfy initial rating	18	Solder temp:		
Solder Heat Resistance	Current (30 minutes value)		,,	Dipping time: 5±0.5 seconds		
	Appearance	No obvious abnorm	nality	1.6 mm from the bot	tom should be dipped.	
	Capacitance			Conforms to 4.8 Temperature		
	ESR	Satisfy initial rating	gs .	Condition:	-25°C » Room	
Temperature Cycle	Current (30 minutes value)				temperature » Maximum temperature » Room temperature	
	Appearance	No obvious abnorm	nality	Number of cycles:	5 cycles	
	Capacitance	Within ±20% of initi	ial value	Conforms to 4.14 Temperature: +40±2°C		
	ESR	≤ 150% of initial rat	ings			
Humidity Resistance	Current (30 minutes value)	≤ 150% of initial rat	ings	Relative humidity: Testing time:	90 to 95% RH 240±8 hours	
	Appearance	No obvious abnorm	nality			



Specifications cont'd

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

Marking





Packaging Quantities

Part Number	Bulk Quantity per Box
HVZ0E105NF	10,000 pieces
HVZ0E275NF	5,000 pieces
HVZ0E475NF	5,000 pieces
HVZ0E106NF	4,000 pieces
HVZ0E226NF	1,500 pieces
HVZ0E506NF	750 pieces
HVZ0E107NF-LT	200 pieces
HVZ0E207NF-LT	200 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 + reflow lead-free solder plating (100% Sn, reflow processed)
- c. Iron + copper base + leaf-free solder plating (100% Sn)

Series	Part Number	Plating	Sleeve
HV	All HV Types	С	PET (Blue)

Recommended Pb-free solder: Sn/3.5Ag/0.75Cu

Sn/3.0Ag/0.5Cu Sn/0.7Cu

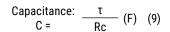
Sn/2.5Ag/1.0Bi/0.5Cu

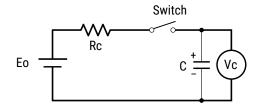


Measurement Conditions

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

Charge K	Sharge Resistor Selection Guide													
Сар	FA	FE	FS	FYD	FY FYH	FYL	FR	FM, FME FMR, FML	FMC	FG FGR	FGH	FT	FC, FCS	HV
0.010 F	_	_	_	_	_	5,000 Ω	-	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	_	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	2,000 Ω	1,000 Ω	2,000 Ω	1,000 Ω	2,000 Ω	-	-	_	-
0.10 F	510 Ω	510 Ω	510 Ω	1,000 Ω	510 Ω	-	1,000 Ω	1,000 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

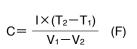


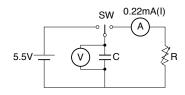
Measurement Conditions cont'd

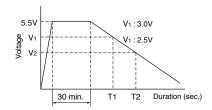
Capacitance (Discharge System)

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.



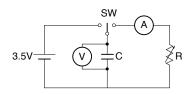


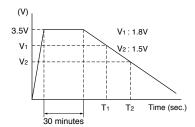


Capacitance (Discharge System - 3.5 V)

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. 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.

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

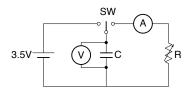


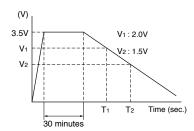


Capacitance (Discharge System - HV Series)

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.

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







Measurement Conditions cont'd

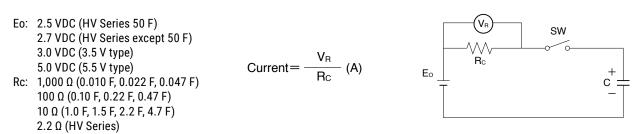
Equivalent Series Resistance (ESR)

ESR shall be calculated from the equation below.

$$ESR = \frac{V_C}{0.01} (\Omega)$$
 f:1kHz C $\frac{10mA}{C}$

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 (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-topin 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.

1.9 Supercapacitors fitted with pressure valves

HV Series supercapacitors are fitted with pressure valves. Make an opening in the top of the pressure valve to avoid any damage to the supercapacitor when the pressure valve is in use. Allow at least a 2 mm opening for models with a diameter of Ø 18 mm or less, and at least a 3 mm opening for models with a diameter of Ø 22 mm.



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

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

See Recommended Reflow Curves in Section - Precautions for Use

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°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.



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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.