CAT.8102B

nichicon

All You Need and More, Right Away CanDo!

Electric Double Layer Capacitors

EVerCAP®

<High Capacitance>

Has significantly higher capacitance.

<Wide Temperature Range>

The capacitors performance is not as affected by temperature.

<High Reliability>

Long cycle life that is suitable for quick charge/discharge with large current.

<Clean Energy Device>

Environmentally friendly because main materials are aluminum and activated carbon.

NICHICON CORPORATION

High capacitance, Low resistance, Longer life. This high performance capacitor will be in the forefront in the development of the next generation of electronics

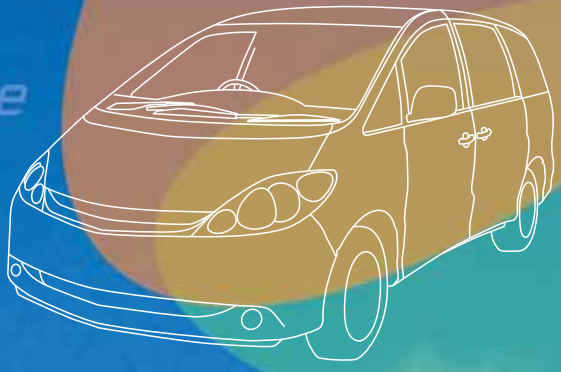
Inverter

Inverter Equipment
Industrial Equipment

<Low Resistance>

Automotive Electronics

Automotive



EVerCAP®

<High Capacity>

Nichicon achieves the high functionality of our parts by combining some of the basic technologies that we have developed.

Technology that meets the user and market needs.

Technology	High Capacity	High Voltage	Low Resistance
① Selection of carbon electrode and electrode manufacturing technology	●		●
② Electrolyte technology		●	●
③ Separator technology			●
④ Correcting electrode and package technology	●	●	●
⑤ Circuit technology with module technology		●	

Features of "EVerCAP®"

Excellent electrode technology was achieved by comprehensive technological development.

- Stable electric performance
- Is capable of over a million charge/discharge cycles.
- High reliability and long cycle life due to our development of the technology involved (electrode, electrolyte, and separator).
- High charge/discharge efficiency were achieved by our low resistance cell assembly technology.
- The Operating temperature range of (-25°C to +60 or 70°C) is wider than batteries.
- Excellent charge/discharge efficiency and is capable of fully discharging to 0V.

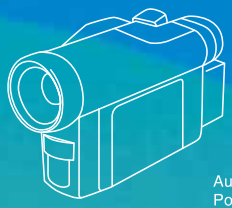
Information & Communication Equipments

Personal Computer
Information-communications Equipment

<High Voltage>

Applications.

- Select from high power density or high energy density types of EDLC. The High power density type will accept large current discharge. The High energy density type is able to provide longer backup time.



Audiovisual Equipment
Power Supply

Digital Equipments

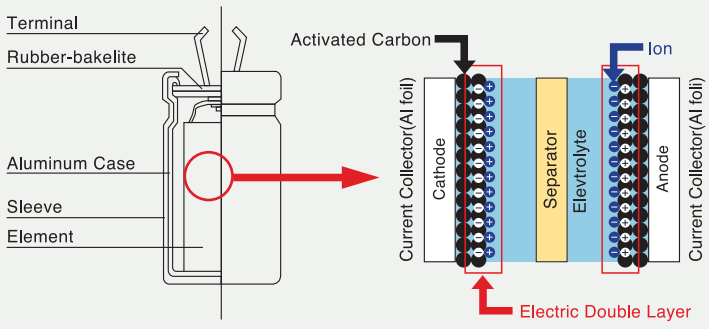
EVerCAP®'s use Environmentally friendly materials. There is no use of hazardous materials such as lead and cadmium, etc.

- The EDLC is the device which is considered by many to be environmentally friendly by not using hazardous materials like a lead and cadmium, etc

※1 :Power density is the amount of output power that you can get from EDLC's based on weight and/or volume. If the power density is high, larger current can be output efficiently.
※2 :Energy density is the amount of output energy during discharge that you can get from EDLC's based on weight and/or volume. If the energy density is high, then a larger current can be output for a longer time.

Principles and structure of EVerCAP®

The Electric Double Layer Capacitor (EDLC) is a charge storage device using electric double layers between solid and liquid interface.
The charge and discharge of EDLC is mainly a physical reaction such as physical adsorption/dispersion at electrode-electrolyte interface.
Therefore, the EDLC has a longer cycle life compared to batteries which use chemical reaction. Longer cycle life is achieved due to the low degradation of the electrode and electrolyte.



Stable and long cycle life capacitor That's an EVerCAP®

Recommended application / Proposed application examples

Energy storage

Substitute for conventional batteries

1. Power supply for standby electricity

EVerCAP® can contribute to Power-saving and environmentally friendly applications that use storage devices for standby electricity such as: Televisions, Air conditioners, Wireless remote controller, or game equipment.

2. Power supply for back-up

As a short time backup to various standard power utilities it is lighter weight and has a longer life when compared to lead-acid batteries used in the same application.

3. Emergency power source for life maintaining equipment

Using the EVerCAP® in power supply for lifeline equipment, the exchange of batteries is not necessary, and a virtually maintenance-free environment is achieved.

4. On-site power supply

Using the EVerCAP®'s with solar batteries, they become the power supply for street lights and flashing road markers.
If electricity is accumulated even in small amounts, or if it is collected from souces that dissipates away as energy that cannot be used with a converter, the EVerCAP® will become a power source. It is also useful for hobbyists or outdoors for power supplies.

High Input/Output Load leveling for system protection

Loading leveling for system protection can be done using the EDLC.

1. Load leveling in Control Systems - To make efficient use of electronic equipment load leveling between daytime and night time usage to assist in power saving. EDLC's can be used for storage in these applications.

① Solar battery system (Regional Management of electric power system, etc.)
② Wind power generation system (Regional Management of electric power system, etc.)
③ Wind power generation system (Longer life can be achieved by leveling the current from largescale generators.)

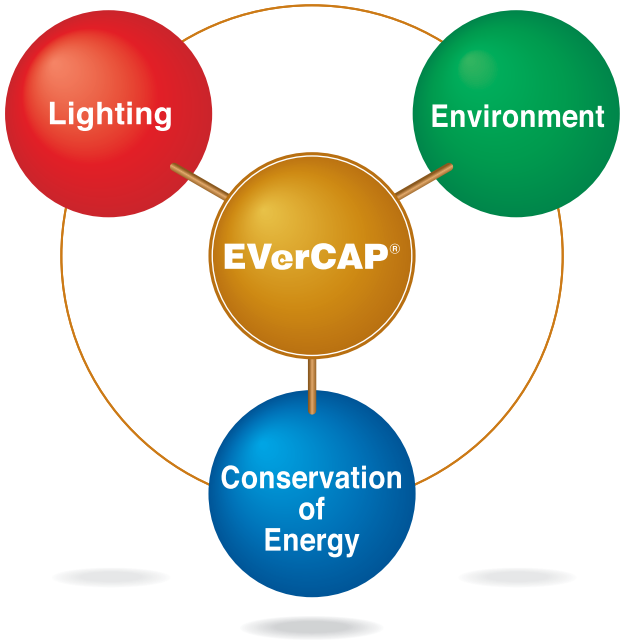
2. Assists in electrically-powered equipment and regenerative power systems for automotive applications.

EVerCAP® can contribute to the regenerative power system for HEV etc.

Other

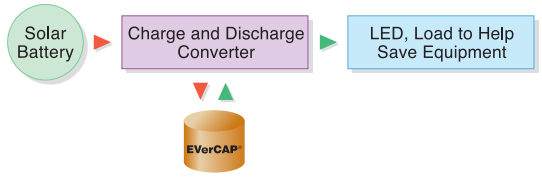
EverCAPs can accumulate and store electricity in small amounts. They can then be used to quickly charge a power supply for outdoor use, for example. So, EverCAPs can amass small amounts of energy and release it in larger amounts.

EVerCAP® Applied Case



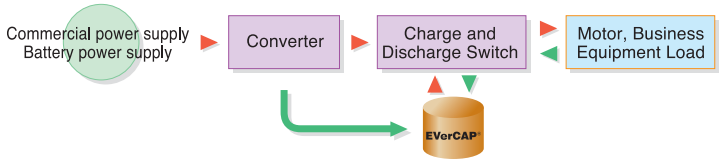
For on-site power supply · back up

A feature of product that is composed of long-life parts such as solar batteries and LED's. The EDLC is used to remove battery exchange. It is assumed that this might be used as an independent power supply because security equipment must operate in case of power outages.



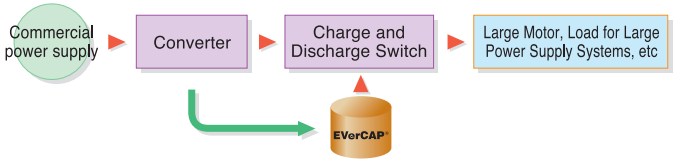
For machinery power

EDLC is used for supplying short inrush current from power supply such as motor for business equipment and actuators. In addition, it also is used for charging during regenerative braking.



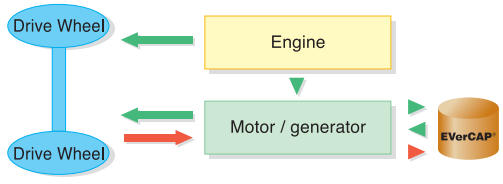
For voltage sag compensator

EDLC can be used in the operation of large-scale equipment as a back up to commercial power. Additionally, there is no need to replace the components for a long time as compared to batteries because the life cycle is much longer.



For Automotive

EDLC is used for assisting in suppliance peak power and for capturing regenerative energy during braking in HEV applications. In the case of Electric Vehicles, it is used for supporting battery power. Also, it is suitable for use in the engine start/stop applications.



ELECTRIC DOUBLE LAYER CAPACITORS "EVerCAP®"

Series	Configuration	Applications	Category Temperature Range (°C)	Rated Voltage Range (V.D.C)	Rated Capacitance Range (F)	Tolerance on Rated Capacitance (%)	Page
UM	04	Radial lead Type, High voltage	−25 to + 70	2.7	0.47 to 47	±20	9
NEW UW	04	Radial lead Type, High voltage, Smaller-sized	−25 to + 70	2.7	1 to 82	±20	10
JC	692	Snap-in Terminal Type, Standard	−25 to + 60	2.5	15 to 150	±20	11
JD	331	Screw Terminal High Energy Density Type	−25 to + 60	2.5	600 to 4000	±20	12
JL	331	Screw Terminal High Power Density Type	−25 to + 60	2.5	400 to 2600	±20	13

APPLICATION GUIDELINES FOR ELECTRIC DOUBLE LAYER CAPACITORS "EVerCAP®"

1.Circuit Design

(1) The EDLC has a specified endurance and an end of life.
(2) The EDLC has a maximum temperature.
(3) Electrical characteristics of the EDLC change depending on the ambient temperature.
(4) Electrical characteristics of the EDLC can be adversely affected by increasing temperature.
(5) The voltage held by the EDLC drops after discharge, depending on the discharging current and the internal resistance of the EDLC.
(6) The voltage of the EDLC is reduced when discharged. To keep a constant voltage as the application circuit use a booster circuit, DC-DC converter etc.
(7) Please note that if high ripple current, high pulse current and/or high charge & discharge currents are applied to a capacitor, greater deterioration than you expect to the capacitor may occur due to internal temperature rise of self-heat generation.
(8) Outer sleeve of the EDLC is not guaranteed as an electrical insulator.
(9) Capacitance of the EDLC is measured by the D.C. discharging method and differs from the one used for other capacitors, and is based on EIAJ RC-2377.
(10) If EDLC is used in series connection, an overvoltage may be applied one the parts due to voltage imbalance. In this case, countermeasure actions are needed for voltage imbalance such as; increasing voltage margin, use of balance resistance, or the use of a voltage control circuit in parallel.
(11) Do not expose the EDLC to following conditions.
① Environmental (climatic) comditions
(a) Being exposed to water, high temperature & high humidity atmosphere, or condensation of moisture.
(b) Being exposed to oil or an atmosphere that is filled with particles of oil.
(c) Being exposed to salty water or an atmosphere that is filled with particles of salt.
(d) In an atmosphere filled with toxic gasses (such as hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, bromine, methyl bromide, ammonia, etc.)
(e) Being exposed to direct sunlight, ozone, ultraviolet ray, or radication.
(f) Being exposed to acidic or alkaline solutions.
② Under severe conditions where vibration and / or mechanical shock exceed the applicable ranges of the specifications.
(12) Do not use the EDLC above the voltage and temperature specified in the data sheet, otherwise the EDLC may be electrically damaged or in worst case, will fail completely.
(13) Do not apply reverse-voltage as the EDLC is polarised.
(14) When designing a P.C. board, please pay attention to the following:
① Have the hole spacing on the P.C. board match the lead spacing of the capacitor.
② There should not be any circuit pattern or circuit wire above the capacitor pressure relief vent.
③ Unless otherwise specified, following clearance should be made above the pressure relief vent.

Case Diameter	Clearance Required
Ø 6.3 to16	2mm or more
Ø 18 to 35	3mm or more
Ø 40 or more	5mm or more

④ In case the vent side is placed toward P.C. board(such as end seal vented parts), make a corresponding hole on the P.C. board to release the gas when vent is operated. The hole should be made to match the capacitor vent position.
⑤ Screw terminal capacitors must be installed with their end seal side facing up. When you install a screw terminal capacitor in a horizontal position, the positive terminal must be in the upper position.
(15) The main chemical solution of the electrolyte and the separator paper used in the capacitors are combustible. The electrolyte is conductive. When it comes in contact with the P.C. board, there is a possibility of pattern corrosion or short circuit between the circuit pattern which could result in smoking or catching fire.
Do not locate any circuit pattern beneath the capacitor end seal.
(16) Do not design a circuit board so that heat generating components are placed near an aluminum electrolytic capacitor or reverse side of P.C. board (under the capacitor).
(17) When you mount capacitors on the double-sided P.C. boards, do not place capacitors on circuit patterns or over on unused holes.
(18) The torque for terminal screw or brackets screws shall be within the specified value on Nichicon's drawings.

2.Mounting

(1) Please confirm polarity before in stalling capacitors on the P.C. board.
(2) Do not drop capacitors on the floor, nor use a capacitor that was dropped.
(3) Do not damage the capacitor while installing.
(4) Please confirm that the lead spacing of the capacitor matches the hole spacing of the P.C. board prior to installation.
(5) Snap-in can type capacitor such as JIS style symbol 692 type should be installed tightly to the P.C. board (allow no gap between the P.C. board an bottom of the capacitor).
(6) Hand soldering.
① Soldering condition shall be confirmed to be within the specification.
② If it is necessary that the leads must be formed due to a mismatch of the lead space to hole space on the board, bend the lead prior to soldering without applying too much stress to the capacitor.
③ If you need to remove parts which were soldered, please melt the solder enough so that stress is not applied to lead.
④ Please pay attention so that solder iron does not touch any portion of capacitor body.
(7) Do not tilt lay down or twist the capacitor body after the capacitor are soldered to the P.C. board.
(8) Do not carry the P.C. board by grasping the soldered capacitor.
(9) Please do not allow anything to touch the capacitor after soldering. If P.C. board are stored in a stack, please make sure P.C. board or the other components do not touch the capacitor.
The capacitors shall not be effected by any radiated heat from the soldered P.C. board or other components after soldering.
(10) Recommended Cleaning Condition
Applicable : Any type, any ratings.
Cleaning Agents
Based Alcohole solvent cleaning agent
Isopropyl Alcohol
Based water solvent cleaning agent
Premium alcohole solvent type
Pine Alpha ST-100S
Techno Care FRW 14to17
Sanelek B-12
Surfactant type
Clean Through 750H, 750L, 710M
Alkaline saponification agent
Aqua Cleaner 210SEP
Cleaning Conditions :
Total cleaning time shall be no greater than 5 minutes by immersion, ultrasonic or other method.
(Temperature of the cleaning agent shall be 60°C maximum.)
After the board cleaning has been completed, the capacitors should be dried using hot air for a minimum of 10 minutes.
If the cleaning solution is infiltrated between the case and the sleeve, the sleeve might soften and swell when hot air temperature is too high. Therefore, hot air temperature should not exceed softening temperature(80°C) of the sleeve.
Insufficient dries after water rinse may cause appearance problems, such as sleeve shrinking, bottom-plate bulging. In addition, a monitoring of the contamination of cleaning agents (electric conductivity, pH, specific gravity, water content, etc.) must be implemented.
After the cleaning, do not keep the capacitors in an atmosphere containing the cleaning agent or in an air tight container.
Depending on the cleaning method, the marking on a capacitor may be erased or blurred.
Consult Nichicon before using a cleaning method or a cleaning agent other than those recommended.
(11) Fixing Material and Coating Material
1) Do not use any affixing or coating materials, which contain halide substance.
2) Remove flux and any contamination, which remains in the gap between the end seal and PC board.
3) Please dry the cleaning agent on the PC board before using affixing or coating materials.
4) Please do not apply any material all around the end seal when using affixing or coating materials.

There are variations of cleaning agents, fixing and coating materials, so please contact those manufacture or our sales office to make sure that the material would not cause any problems.
(12) Others
Wooden package material may be subjected to fumigation by a halogen(e.g. methyl bromide) before they are exported in order to protect them against pests. If devices with aluminum electrolytic capacitors or capacitors themselves are directly fumigated or packed with the pallet that is fumigated, the capacitors may internally corrode due to the halogen contents of fumigation agents.

3.Storage

(1) It is recommended to keep the EDLC under the ambient temperature of 5°C to 35°C and a relative humidity of 75% or below.
(2) Confirm that the environment does not have any of the following conditions :
① Where the EDLC is exposed to water, high temperature & high humidity atmosphere, or condensation of moisture
② Where the EDLC is exposed to oil or an atmosphere that is filled with particles of oil.
③ Where the EDLC is exposed to salty water, high temperature & high humidity atmosphere, or condensation of moisture
④ The atmosphere is filled with toxic acid gasses (e.g. hydrogen sulfide, sulfurous acid, nitrous acid, chlorine, bromine, methyl bromide, etc.)
⑤ The atmosphere is filled with toxic alkaline gasses. (e.g. ammonia)
⑥ Where the EDLC is exposed to acidic or alkaline solutions
(3) If 2 years or more have passed without applying voltage to the part, please contact us because before using the part as characteristics may have been affected by environmental conditions.

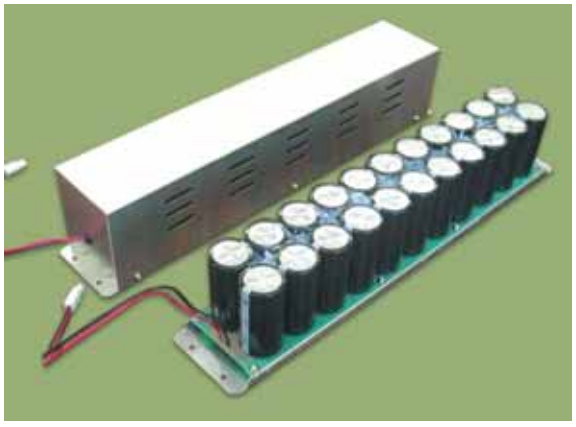
4.Disposal

(1) Take the following methods in disposing of the EDLC, hand them over to a waste disposal agent.
(2) When removing a capacitor from the circuit board or when disposing of capacitor please ensure that the capacitor is properly discharged.

The above mentioned material is according to EIAJ RCR-2370C (issued in July 2008), titled "Gideline of notabilia for fixed electric double layer capacitors" Please refer to the book for details.

Higher voltages can be achieved by connecting multiple EVerCAP® units in series. Nichicon has the flexibility to meet our customers' demands and requirements.

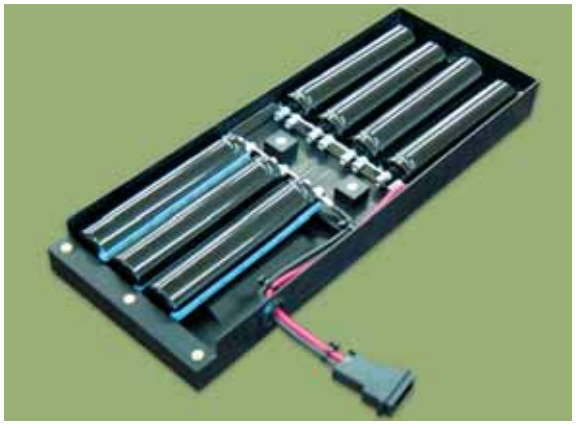
Voltage Sag compensator systems, UPS, in Elevators, and in units for cranes



Rated Voltage : 50V
Capacitance : 10F
Size : 85W × 480L × 90H(mm)
Category Temperature : −25 to +60°C
Maximum Current : 7A

Application example:
- Storage devices for power supply back-up
- Storage devices for an regenerative energy

(2.5V 220F × 22pcs series connection)



Rated Voltage : 15.6V
Capacitance : 170F
Size : 410W × 156L × 39H(mm)
Category Temperature : −25 to +60°C
Maximum Current : 20A

Application example:
- Voltage sag compensator system
- UPS

(2.5V 1200F × 7pcs series connection)

Rated Voltage : 138V
Capacitance : 15F
Size : 560W × 360L × 160H(mm)
Category Temperature : −25 to +60°C
Maximum Current : 150A

Application example:
- Storage device for an regenerative energy
- Voltage sag compensator system
- UPS

(2.5V 900F × 60pcs series connection)

Solar power, wind power generation,Voltage sag compensator system

Application example
- Storage bank for generation system
- Power supply for LED
- Storage device for regenerative energy
- UPS

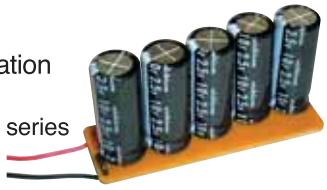
(2.5V 4000F × 20pcs series connection)

Unit
Rated Voltage : 40V
Capacitance : 200F
Size : 700W × 400L × 220H(mm)
Category Temperature : −25 to +60°C

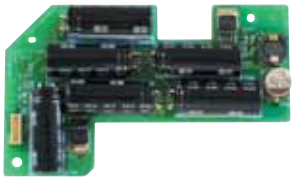
The bank consists on
(11units in series × 3 in parallel)
Rated Voltage : 440V
Capacitance : 55F
Accumulation of electricity energy : 8MJ

Storage unit for separate power source

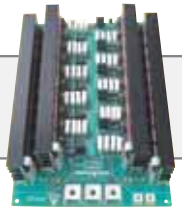
12.5V 2F unit
for office automation equipment
(2.5V 10F × 5pcs series connection)



15V 1.5F unit
for audiovisual equipment products
(2.5V 10F × 6pcs series connection)



Overvoltage protection board



Nichicon offers built-in custom overvoltage protection circuits depending on your requirements.

Example of recommendable applications for "EVerCAP®"

Storage function (as an alternative to a conventional storage battery)

1. Stand-by power source
   Employing "EVerCAP®" as stand-by electric power for remote controllers such as for TV's, air conditioners and console games will allow energy saving therefore contributing to environmental countermeasures.
2. Back-up power supply
   "EVerCAP®" used as a short-time back-up power supply for various regulated power supplies will reduce weight and the service life is longer than current lead storage batteries
3. Self-generation
   "EVerCAP®" can be used as a power source for a street lamp or a repeater indicator of road when used in combination with a compact solar cell, etc.

Solar cell type LED illuminated approach light:

Recommended Use Case Study

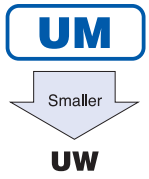
High input/output function (Motor-operated equipment assistant for mechanical motive power systems for vehicles, etc. and regenerative power supply systems) This function exhibits its effectiveness for assistance and regeneration HEV, etc.

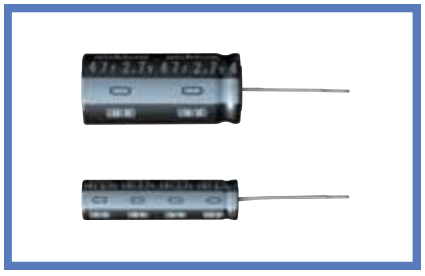
Other

"EVerCAP®" can store electricity even at negligible levels. Immense electric power is produced using a switchboard if electricity is collected from energy that has been unusable and/or discharged.
Therefore, "EVerCAP®" can be fully employed as an outdoor power source for fun as well.

UM Radial Lead Type, High Voltage series

- High voltage type (2.7V).
- Suitable for quick charge and discharge.
- Wide temperature range (–25 to +70°C)
- Compliant to the RoHS directive (2002/95/EC).

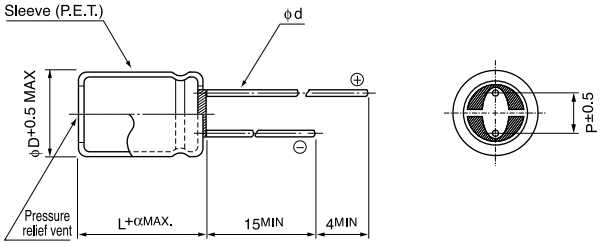




■ Specifications

Item	Performance Characteristics		
Category Temperature Range	–25 to +70°C		
Rated Voltage	2.7V		
Rated Capacitance Range	0.47 to 47F See Note		
Capacitance Tolerance	± 20% (20°C)		
Leakage Current	0.5C (mA) [C : Rated Capacitance (F)] (After 30 minutes' application of rated voltage, 2.7V)		
Stability at Low Temperature	Capacitance (–25°C) / Capacitance (+20°C) × 100 ≧ 70%		
ESR, DCR*	Refer to the list below (20°C). *DC internal resistance		
Endurance	The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 1000 hours at 70°C.	Capacitance charge	Within ±30% of the initial capacitance value
		ESR	300% or less than the initial specified value
		Leakage current	Less than or equal to the initial specified value
Shelf Life	The specifications listed at right shall be met when the capacitors are restored to 20°C after storing the capacitors under no load for 1000 hours at 70°C.	Capacitance charge	Within ±30% of the initial capacitance value
		ESR	300% or less than the initial specified value
		Leakage current	Less than or equal to the initial specified value
Marking	Printed with white color letter on black sleeve.		

■ Drawing



(mm)

φD	6.3	8	10	12.5	16	18
P	2.5	3.5	5.0	5.0	7.5	7.5
φd	0.5	0.6	0.6	0.6※	0.8	0.8

α	(φD<10) 1.5
	(φD≧10) 2.0

※ In case L>25 for the φ12.5 dia unit, lead dia φd=0.8

Type numbering system (Example : 2.7V 10F)

1	2	3	4	5	6	7	8	9	10	11
J	U	M	T	1	1	0	6	M	H	D

Configuration ※
Capacitance tolerance (±20%)
Rated capacitance (10F)
Rated voltage (2.7V)
Series name
Type

※Configuration

φD	Pb-free lead finishing pb-free PET sleeve
6.3	ED
8・10	PD
12.5 to 18	HD

■ Dimensions

Rated Voltage (Code)	Rated Capacitance (F)	Code	ESR (Ω) (at 1kHz)	DCR※ Typical (Ω)	Case Size φD × L (mm)
2.7V (T1)	0.47	474	4	6	6.3 × 9
	1.0	105	2	3	8 × 11.5
	2.2	225	2	1.3	8 × 20
	3.3	335	1	1.0	10 × 20
	4.7	475	0.4	0.6	12.5 × 20
	10	106	0.2	0.25	12.5 × 31.5
	22	226	0.2	0.13	16 × 31.5
	33	336	0.1	0.08	18 × 31.5
	47	476	0.1	0.06	18 × 40

※The listed DCR value is nominal and therefore not a guaranteed value.

Note :
The capacitance calculated from discharge time (ΔT) with constant current (i) after 30minuite charge with rated voltage (2.7V).
The discharge current (i) is 0.01 × rated capacitance (F).
The discharge time (ΔT) measured between 2V and 1V with constant current.
The capacitance calculated bellow.

Capacitance (F) = i × ΔT

UW Radial Lead Type, High Voltage, Smaller-Sized series

UM
Smaller
UW

- High voltage type (2.7V).
- One rank smaller case sized than UM series.
- Wide temperature range (– 25 to +70°C).
- Compliant to the RoHS directive (2002/95/EC).

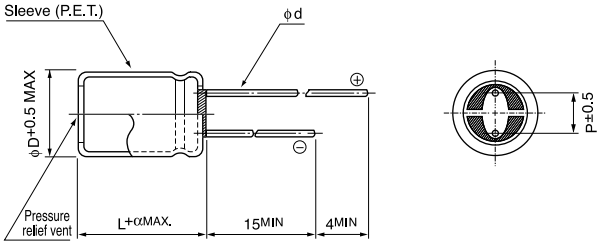
■ Specifications

Item	Performance Characteristics
Category Temperature Range	–25 to +70°C
Rated Voltage	2.7V
Rated Capacitance Range	1 to 82F See Note
Capacitance Tolerance	± 20% (20°C)
Leakage Current	0.5C (mA) [C : Rated Capacitance (F)] (After 30 minutes' application of rated voltage, 2.7V)
Stability at Low Temperature	Capacitance (–25°C) / Capacitance (+20°C) × 100 ≧ 70%
ESR, DCR*	Refer to the list below (20°C). *DC internal resistance
Endurance	The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 1000 hours at 70°C.
Shelf Life	The specifications listed at right shall be met when the capacitors are restored to 20°C after storing the capacitors under no load for 1000 hours at 70°C.
Marking	Printed with white color letter on black sleeve.

Endurance / Shelf Life:

Capacitance charge	Within ±30% of the initial capacitance value
ESR	300% or less than the initial specified value
Leakage current	Less than or equal to the initial specified value

■ Drawing



(mm)

φD	6.3	8	10	12.5	16	18
P	2.5	3.5	5.0	5.0	7.5	7.5
φd	0.5	0.6	0.6※	0.6※	0.8	0.8

α	(φD<10) 1.5
	(φD≧10) 2.0

※ In case L>25 for the φ10 and φ12.5 dia unit, lead dia φd=0.8

Type numbering system (Example : 2.7V 1F)

1	2	3	4	5	6	7	8	9	10	11
J	U	W	T	1	1	0	5	M	C	D

- 11: Configuration ※
- 9: Capacitance tolerance (±20%)
- 6–8: Rated capacitance (1F)
- 5: Rated voltage (2.7V)
- 4: Series name
- 1–3: Type

※Configuration

φD	Pb-free lead finishing pb-free PET sleeve
6.3	CD
8・10	PD
12.5 to 18	HD

■ Dimensions

Rated Voltage (Code)	Rated Capacitance (F)	Code	ESR (Ω) (at 1kHz)	DCR※ Typical (Ω)	Case Size φD × L (mm)
2.7V (T1)	1	105	4	4	6.3 × 9
	1.5	155	3	2.5	8 × 11.5
	2.7	275	2	1.2	8 × 20
	4.7	475	1	0.8	10 × 20
	6.8	685	0.8	0.7	12.5 × 20
	12	126	0.4	0.6	10 × 31.5
	22	226	0.3	0.4	12.5 × 31.5
	33	336	0.2	0.28	16 × 31.5
	47	476	0.2	0.22	18 × 31.5
	82	826	0.1	0.13	18 × 40

※The listed DCR value is nominal and therefore not a guaranteed value.

Note :
The capacitance calculated from discharge time (ΔT) with constant current (i) after 30minuite charge with rated voltage (2.7V).
The discharge current (i) is 0.01 × rated capacitance (F).
The discharge time (ΔT) measured between 2V and 1V with constant current.
The capacitance calculated bellow.

Capacitance (F) = i × ΔT

JC Snap-in Terminal Type series

- Excellent in voltage holding property.
- Suitable for quick charge and discharge.
- Wide temperature range (– 25°C to + 60°C).
- Compliant to the RoHS directive (2002/95/EC).

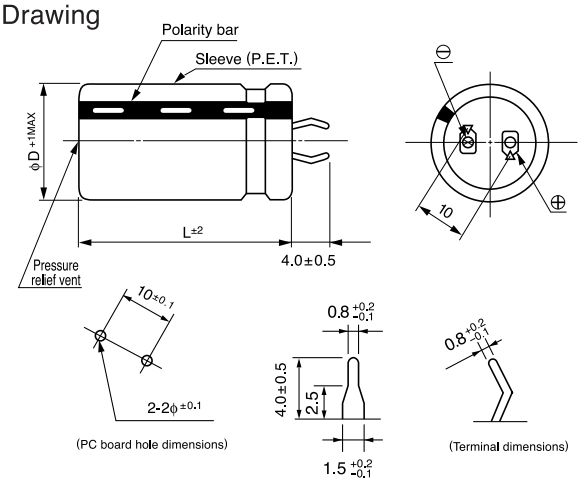
■ Specifications

Item	Performance Characteristics
Category Temperature Range	–25 to +60°C
Rated Voltage	2.5V
Rated Capacitance Range	15 to 150F See Note
Capacitance Tolerance	± 20% (20°C)
Leakage Current	0.5C (mA) [C : Rated Capacitance (F)] (After 30 minutes' application of rated voltage, 2.5V)
Stability at Low Temperature	Capacitance (–25°C) / Capacitance (+20°C) × 100 ≧ 70%
ESR, DCR*	Refer to the list below (20°C). *DC internal resistance
Endurance	The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 2000 hours at 60°C.
Shelf Life	The specifications listed at right shall be met when the capacitors are restored to 20°C after storing the capacitors under no load for 2000 hours at 60°C.
Marking	Printed with white color letter on black sleeve.

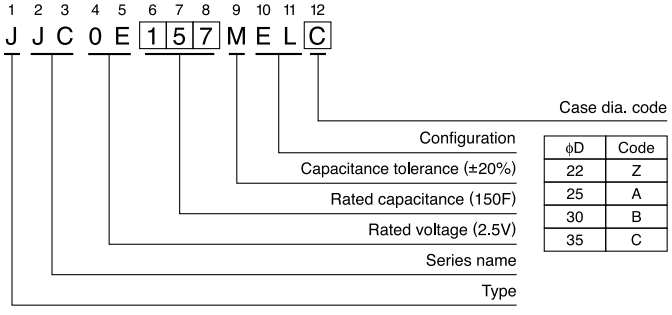
Endurance	
Capacitance charge	Within ±30% of the initial capacitance value
ESR	300% or less than the initial specified value
Leakage current	Less than or equal to the initial specified value

Shelf Life	
Capacitance charge	Within ±30% of the initial capacitance value
ESR	300% or less than the initial specified value
Leakage current	Less than or equal to the initial specified value

■ Drawing



Type numbering system (Example : 2.5V 150F)



φD	Code
22	Z
25	A
30	B
35	C

■ Dimensions

Rated Voltage (Code)	Cap. (F)	Cap. Code	ESR (mΩ) at 1kHz	DCR※ Typical (mΩ)	Case Size φD × L (mm) φ22 (Z)	φ25 (A)	φ30 (B)	φ35 (C)
2.5V (0E)	15	156	120	160	22 × 20			
	18	186	120	140		25 × 20		
	22	226	90	130			30 × 20	
	27	276	90	110	22 × 30		30 × 20	
	33	336	80	90		25 × 30		35 × 20
	39	396	80	80	22 × 35	25 × 30		35 × 20
	47	476	70	60	22 × 40	25 × 35		
	56	566	70	50		25 × 40	30 × 30	
	68	686	60	45				35 × 30
	82	826	60	35		25 × 50	30 × 40	
	100	107	50	30				35 × 35
	120	127	50	25			30 × 50	35 × 40
	150	157	40	22				35 × 50

※The listed DCR value is nominal and therefore not a guaranteed value.

Note :
The capacitance calculated from discharge time (ΔT) with constant current (i) after 30minuite charge with rated voltage (2.5V).
The discharge current (i) is 0.01 × rated capacitance (F).
The discharge time (ΔT) measured between 2V and 1V with constant current.
The capacitance calculated bellow.

Capacitance (F) = i × ΔT

JD Screw Terminal Type, High Energy Density Type series

- High energy density.
- Suitable for electric power storage.
- Compliant to the RoHS directive (2002/95/EC).

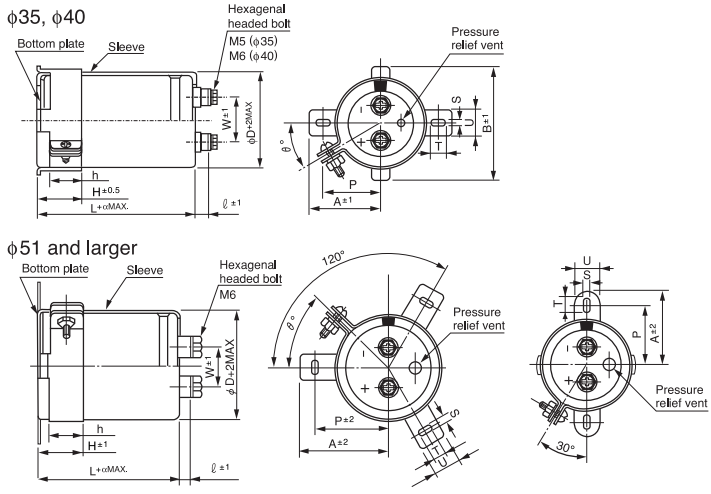
■ Specifications

Item	Performance Characteristics
Category Temperature Range	–25 to +60°C
Rated Voltage	2.5V
Rated Capacitance Range	600 to 4000F See Note
Capacitance Tolerance	± 20% (20°C)
Leakage Current	0.5C (mA) [C : Rated Capacitance (F)] (After 30 minutes' application of rated voltage, 2.5V)
Stability at Low Temperature	Capacitance (–25°C) / Capacitance (+20°C) × 100 ≧ 70% DCR (–25°C) / DCR (+20°C) ≦ 7
DCR*	Refer to the list below (20°C). *DC internal resistance
Endurance	The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 2000 hours at 60°C.
Shelf Life	The specifications listed at right shall be met when the capacitors are restored to 20°C after storing the capacitors under no load for 2000 hours at 60°C.
Marking	Printed with white color letter on black sleeve.

Endurance	
Capacitance charge	Within ±30% of the initial capacitance value
DCR	300% or less than the value given in the dimensions table
Leakage current	Less than or equal to the initial specified value

Shelf Life	
Capacitance charge	Within ±30% of the initial capacitance value
DCR	300% or less than the value given in the dimensions table
Leakage current	Less than or equal to the initial specified value

■ Drawing



• Dimensions of terminal pitch(W) and length(ℓ) and Normal dia. of bolt (mm)

ϕD	W	ℓ	α	Nominal of bolt
35	12.7	6	3	M5
40	18.8	9	3	M6
51	26.0	10	3	M6
63.5	28.6	10	3	M6

• Dimensions of mounting bracket (mm)

Leg shape / Symbol / ϕD	3-Legs		2-Legs			
	51	63.5	35	40	51	63.5
P	32.5	38.1	24	27	33.2	40.5
A	38.5	43	29	32	40	46.5
B	–	–	45	48	–	–
T	7.5	8.0	7.0	7.0	6.0	7.0
S	5.0	5.0	3.5	3.5	4.5	4.5
U	12	14	10	10	14	14
θ°	60	60	30	45	30	30
H	20	25	15	17	25	35
h	15	20	10	12	15	20

Type numbering system (Example : 2.5V 600F)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
J	J	D	0	E	6	0	7	M	S	E	C		

(ϕ35, ϕ40)

Code less	2-leg brackets
BN	No brackets

(ϕ51, ϕ63.5)

Code less	3-leg brackets
BB	2-leg brackets
BN	No brackets

Mouting bracket
Case dia. code (ϕ35)
Configuration ※
Capacitance tolerance (±20%)
Rated capacitance (600F)
Rated voltage (2.5V)
Series name
Type

ϕD	Code
35	C
40	D
51	F
63.5	G

Note :
The capacitance calculated from discharge time (ΔT) with constant current (i) after 30minuite charge with rated voltage (2.5V).
The discharge current (i) is 0.01 × rated capacitance (F).
The discharge time (ΔT) measured between 2V and 1V with constant current.
The capacitance calculated bellow.

Capacitance (F) = i × ΔT

■ Dimensions

Rated Voltage (Code)	Cap. (F)	Cap. code	DCR※ Typical (mΩ)	Case size ϕ (mm)	Case size L (mm)	Ref. Weight (g)
2.5V (0E)	600	607	13.5	35	85	130
	800	807	10.0		105	160
	950	957	8.5		135	210
	1000	108	8.0	40	105	210
	1300	138	6.0		135	250
	2300	238	4.0	51	135	450
	2500	258	3.5		150	500
	4000	408	2.2	63.5	150	800

※The listed DCR value is nominal and therefore not a guaranteed value.

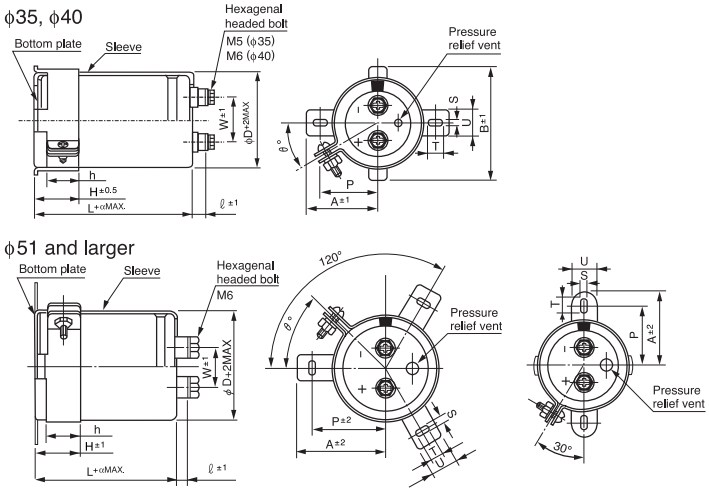
JL series — Screw Terminal Type, High Power Density Type

- High power density.
- Rapid charge-discharge.
- Suitable for regeneration and UPS applications.
- Compliant to the RoHS directive (2002/95/EC).

■ Specifications

Item	Performance Characteristics		
Category Temperature Range	–25 to +60°C		
Rated Voltage	2.5V		
Rated Capacitance Range	400 to 2600F See Note		
Capacitance Tolerance	± 20% (20°C)		
Leakage Current	0.5C (mA) [C : Rated Capacitance (F)] (After 30 minutes' application of rated voltage, 2.5V)		
Stability at Low Temperature	Capacitance (–25°C) / Capacitance (+20°C) × 100 ≧ 70% DCR (–25°C) / DCR (+20°C) ≦ 7		
DCR*	Refer to the list below (20°C). *DC internal resistance		
Endurance	The specifications listed at right shall be met when the capacitors are restored to 20°C after the rated voltage is applied for 2000 hours at 60°C.	Capacitance charge	Within ±30% of the initial capacitance value
		DCR	300% or less than the value given in the dimensions table
		Leakage current	Less than or equal to the initial specified value
Shelf Life	The specifications listed at right shall be met when the capacitors are restored to 20°C after storing the capacitors under no load for 2000 hours at 60°C.	Capacitance charge	Within ±30% of the initial capacitance value
		DCR	300% or less than the value given in the dimensions table
		Leakage current	Less than or equal to the initial specified value
Marking	Printed with white color letter on black sleeve.		

■ Drawing



• Dimensions of terminal pitch(W) and length(ℓ) and Normal dia. of bolt (mm)

ϕD	W	ℓ	α	Nominal of bolt
35	12.7	6	3	M5
40	18.8	9	3	M6
51	26.0	10	3	M6
63.5	28.6	10	3	M6

• Dimensions of mounting bracket (mm)

Symbol \ Leg shape / ϕD	3-Legs		2-Legs			
	51	63.5	35	40	51	63.5
P	32.5	38.1	24	27	33.2	40.5
A	38.5	43	29	32	40	46.5
B	–	–	45	48	–	–
T	7.5	8.0	7.0	7.0	6.0	7.0
S	5.0	5.0	3.5	3.5	4.5	4.5
U	12	14	10	10	14	14
θ°	60	60	30	45	30	30
H	20	25	15	17	25	35
h	15	20	10	12	15	20

Type numbering system (Example : 2.5V 650F)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
J	J	L	0	E	6	5	7	M	S	E	C		

(ϕ35, ϕ40)

Code less	2-leg brackets
BN	No brackets

(ϕ51, ϕ63.5)

Code less	3-leg brackets
BB	2-leg brackets
BN	No brackets

Mouting bracket

Case dia. code (ϕ35)

ϕD	Code
35	C
40	D
51	F
63.5	G

Configuration ※

Capacitance tolerance (±20%)

Rated capacitance (650F)

Rated voltage (2.5V)

Series name

Type

Note :
The capacitance calculated from discharge time (ΔT) with constant current (i) after 30minuite charge with rated voltage (2.5V).
The discharge current (i) is 0.01 × rated capacitance (F).
The discharge time (ΔT) measured between 2V and 1V with constant current.
The capacitance calculated bellow.

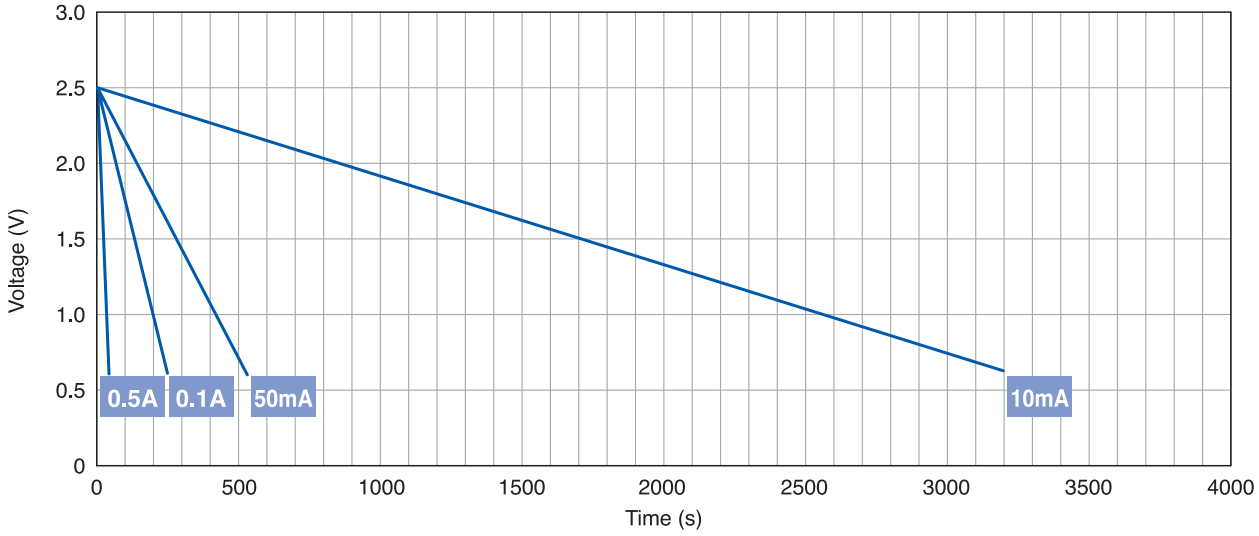
Capacitance (F) = i × ΔT

■ Dimensions

Rated Voltage (Code)	Cap. (F)	Cap. code	DCR※ Typical (mΩ)	Case size ϕ (mm)	Case size L (mm)	Ref. Weight (g)
2.5V (0E)	400	407	6.0	35	85	130
	550	557	4.0		105	160
	650	657	3.5		135	210
	700	707	3.5	40	105	210
	850	857	2.5		135	250
	1500	158	1.8	51	135	450
	1600	168	1.7		150	500
	2600	268	1.3	63.5	150	800

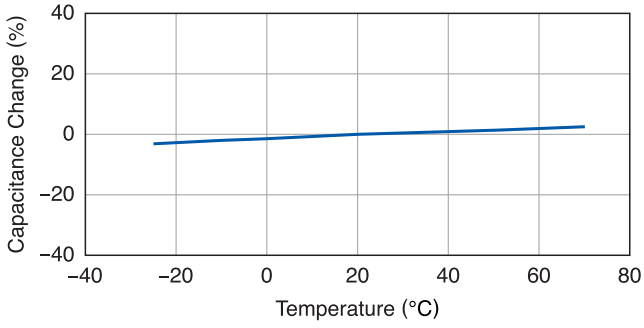
※The listed DCR value is nominal and therefore not a guaranteed value.

■ Electrical Discharge Characteristics (Example : UW series 2.7V 12F at 20°C)

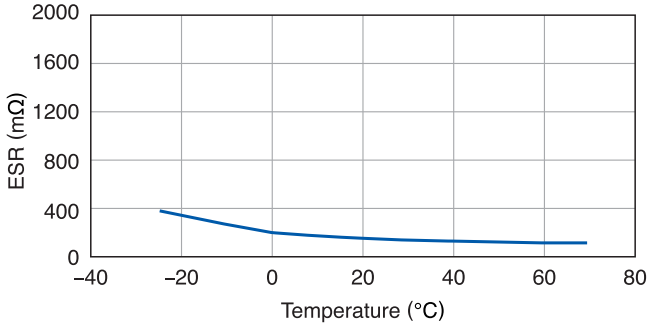


Discharging time depends on discharging current value.

■ Temperature Characteristics (Example : UW series 2.7V 12F)

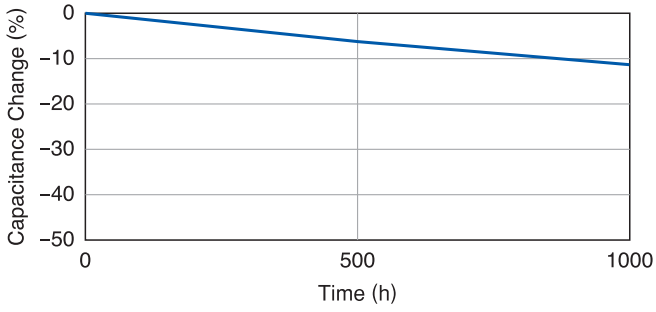


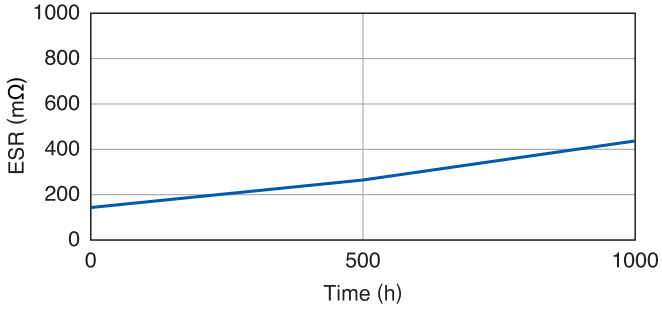
The lower the temperature, the smaller the capacitance.



ESR increases as temperature decreases.

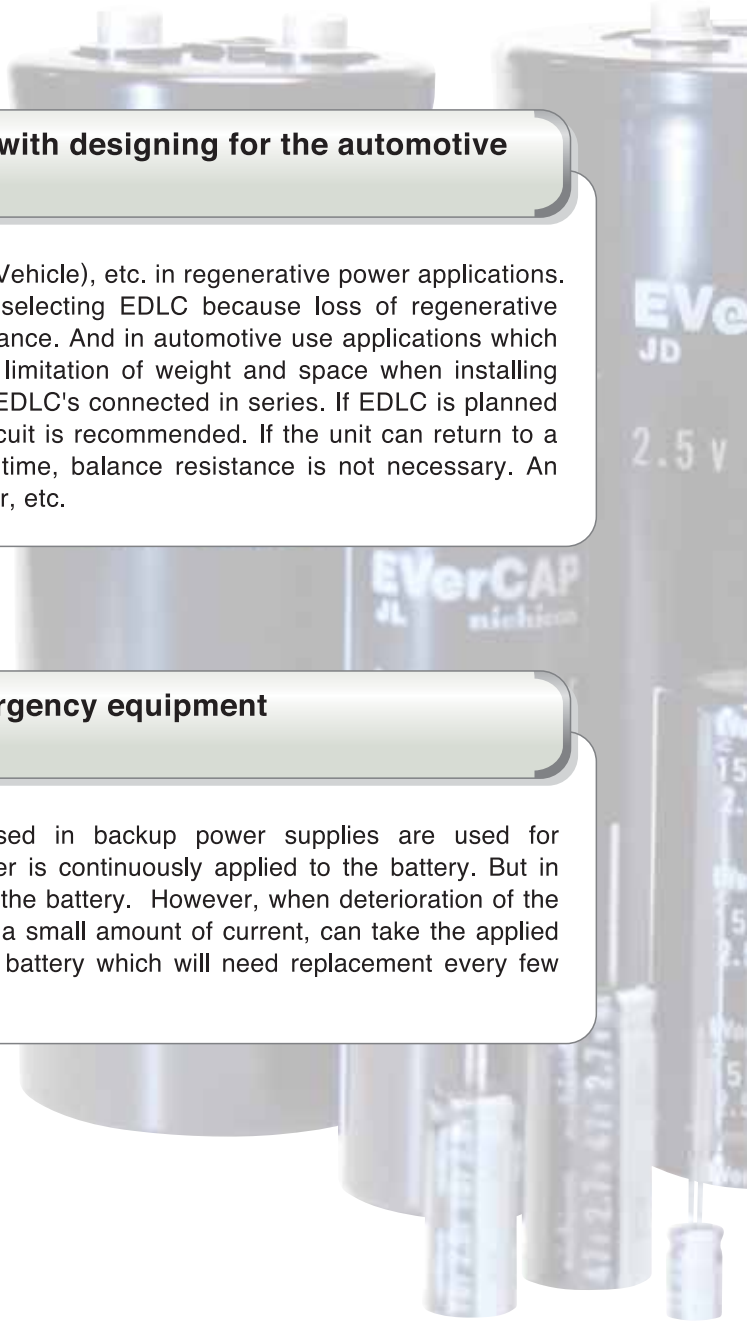
■ Life Test (Example : UW series 2.7V 12F) Condition : application of constant DC voltage (2.7V) at 70°C





Q.1 Can I use EDLC's in a 12V line?

Ans. First of all, please confirm the peak voltage in the power supply line. If a stand-alone EDLC is used where the voltage exceeds the rated voltage, you will need EDLC's connected in series. For example, when you have 16V as the maximum voltage of a generator, the rated voltage of each EDLC is 2.5V, so to calculate the number needed - 16V/2.5V=6.4pcs, in this case round up to the next whole number, in this example you would need 7 pcs in series.



Q.2 What should I consider or keep in mind with designing for the automotive applications such as HEV?

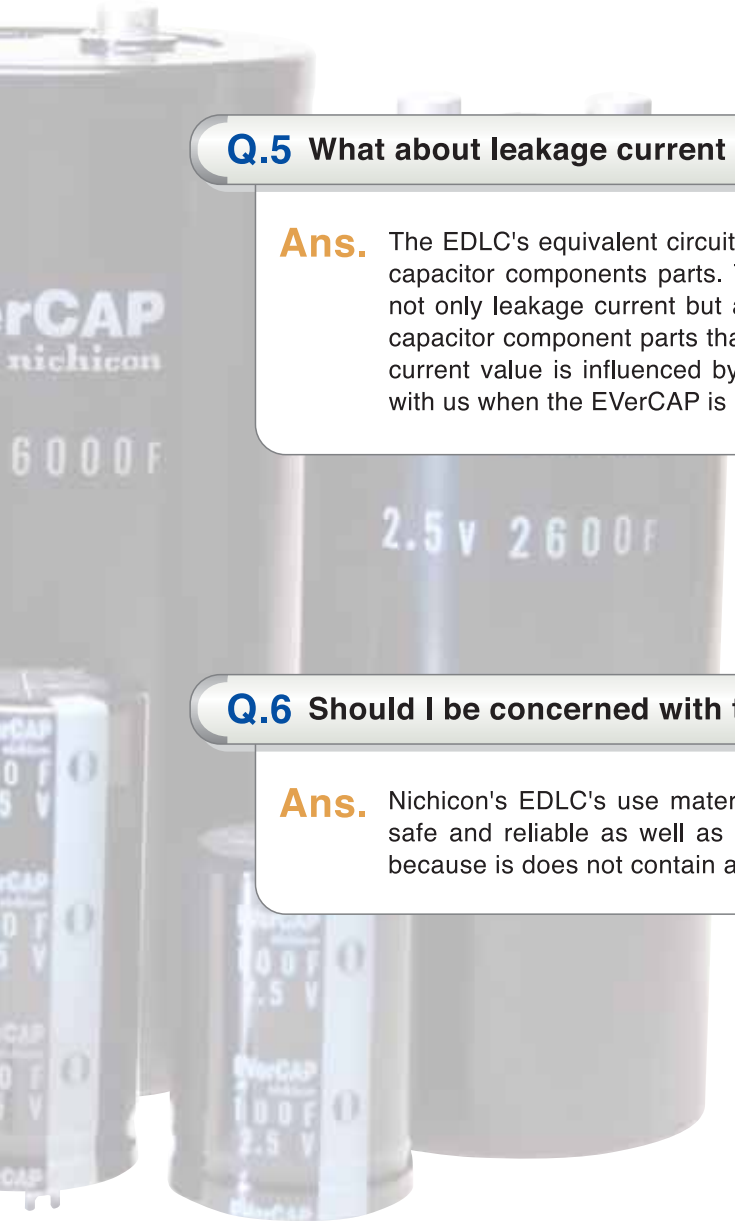
Ans. EDLC is often used for HEV (Hybrid Electric Vehicle), etc. in regenerative power applications. Internal resistance is very important when selecting EDLC because loss of regenerative power is determined based on internal resistance. And in automotive use applications which use EDLC, it is necessary to consider the limitation of weight and space when installing them. In general, you will need two or more EDLC's connected in series. If EDLC is planned for long term usage, a Voltage balancing circuit is recommended. If the unit can return to a steady low voltage, after using, for a short time, balance resistance is not necessary. An example of this technique is the solar race car, etc.

Q.3 How does EDLC help when used in emergency equipment such as earthquake sensors?

Ans. Many rechargeable batteries which are used in backup power supplies are used for emergency equipment. In general, AC power is continuously applied to the battery. But in case of emergency, the power is switched to the battery. However, when deterioration of the battery is considered, the EDLC, which uses a small amount of current, can take the applied voltage continuously. This is better than the battery which will need replacement every few years for reliability.

Q.4 How do I estimate or calculate life?

Ans. The estimated life is greatly affected by the ambient temperature and applied voltage. It is possible to estimate the actual life from the results of a high temperature load life test (accelerated test conditions). As a general rule life time increases by 2 times for every 10˚C reduction in temperature. Using Arenius Law (chemical equation of thermal energy), if the temperature is between 40˚C up to the maximum temperature, the calculated value can be used as a reference.



Q.5 What about leakage current (LC) of the EDLC?

Ans. The EDLC's equivalent circuit consists of resistance (electrolyte and electrode) and micro capacitor components parts. The value of the leakage current after 30 minutes contains not only leakage current but also charging current because the charge time of the micro capacitor component parts that have high resistance is delayed. Furthermore, the leakage current value is influenced by how the EDLC's are used and assembled. Please consult with us when the EVerCAP is used in a series connection.

Q.6 Should I be concerned with the safety of the Nichicon EDLC's?

Ans. Nichicon's EDLC's use materials for the electrode and electrolyte which are considered safe and reliable as well as environementally friendly. It is a very safe storage device because is does not contain any heavy metals such as lead.

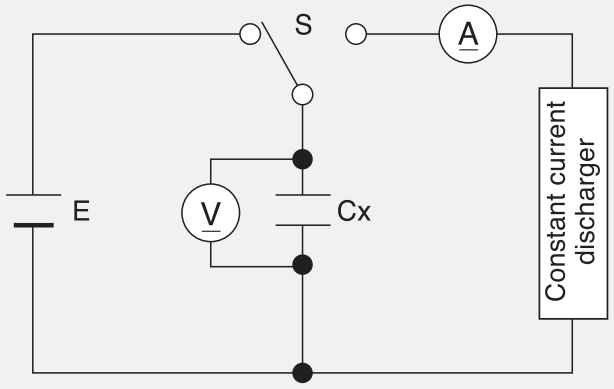
Measurement method of the capacitance

There are various methods for measuring capacitance. Nichicon uses the constant current discharge method. The EDLC is charged at the rated voltage for 30 minutes. It is then discharged with constant current. The capacitance is calculated from the voltage change and the discharging time on a constant current. The unit of capacitance is in Farads (F).

Measurement circuit

Figure1 Measurement circuit of the "constant current method".

E : Constant current constant voltage power supply
Ⓐ : Direct current ammeter
Ⓥ : Direct current voltameter
S : Selector switch
Cx : A test specimen (Constant current discharger)



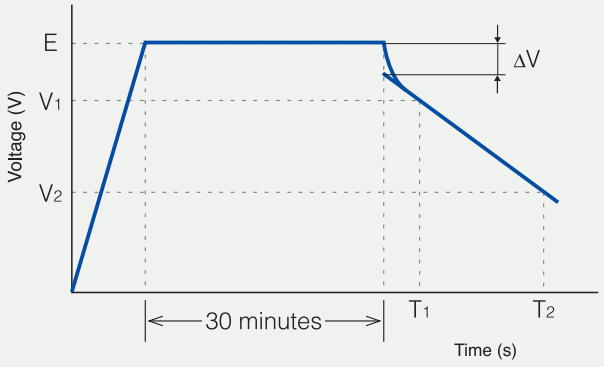
Measurement procedure

① Charge the EDLC to the rated voltage with constant current by using constant current, constant voltage power supply.
② After EDLC has reached the rated voltage, switch to constant voltage mode, charge the EDLC for 30 minutes.
③ Then switch to constant current, discharge the EDLC at the specified constant discharge current value (If it does not have a specified value, it will be 10mA / F).
④ Measure the Voltage between the anode and the cathode with the time between V_1 and V_2 shown in Figure-2. The capacitance is calculated from the following (1).

$$C = I \times (T_2 - T_1) / (V_1 - V_2) \quad \cdots (1)$$

Figure 2 Charge and discharge characteristic of EDLC

C :Rated capacitance [F]
E :Charging voltage [V]
I :Discharge current [A]
V_1:Voltage that measurement start (0.8E) [V]
V_2:Voltage that measurement end (0.4E) [V]
T_1:The time from beginning of dischrge to the time voltage gets V_1 [s]
T_2:The time from beginning of dischrge to the time voltage gets V_2 [s]



*As our setting value, V1 =2.0[V], V2 =1.0[V] , The (1) is indicated in the following.

$$C = I \times (T_2 - T_1) \quad \cdots (2)$$

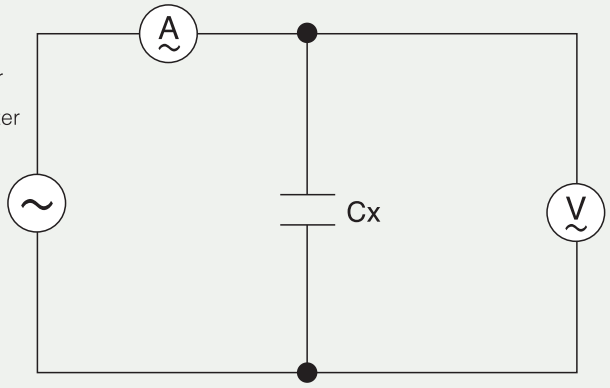
The measurement method of internal resistance

Alternate resistance measurement method

Measurement circuit

Figure 3 Measurement circuit of alternate resistance method

~ : Oscillator
Ⓐ : Alternating current ammeter
Ⓥ : Alternating current voltameter
Cx : A test specimen



Measurement method

The internal resistance Ra of the EDLC is calculated by the following (3)

$$Ra = U / I \quad \cdots (3)$$

Ra : Alternate internal resistance [Ω]
U : Root Mean Square of the VAC [Vrms]
I : Root Mean Square alternating current [Arms]

Here, frequency of the measurement is defined as sets 1kHz,
and the alternating current is defined as between 1mA to 10mA.

Direct current resistance method

Measurement method

The measurement circuit uses the same circuit as Figure1 and the procedure is the same as for constant current discharge method. (shown in P.17)
Then ΔV can be calculated from charge and discharge characteristic of the EDLC shown in Figure2. Direct current resistance of the EDLC can be calculated from the value of ΔV and the following (4).

$$Rd = \Delta V / I \quad \cdots (4)$$

Rd : Direct current resistance [Ω]
ΔV : Drop voltage (IR drop) [V]
I : Discharge current [A]

- Measurement method of Leakage current
  First, charge the EDLC to the rated voltage by using constant current charge. Then, charge the EDLC for 30 min again. This current value considers it as the leakage current for descriptive purposes.

Calculation of energy density

The energy that can be charged to the EDLC is

$$W\,(Wh) = \frac{1}{2} CE^2 X \frac{1}{3600}$$

The energy density indicates the energy per unit volume or weight. It can be calculated by the following.

- The energy density (Wh/L) is shown in the following as defining M as cubage (liter) of the EDLC.

$$Ed\,(Wh / L) = \frac{1}{2} CE^2 X \frac{1}{3600} X \frac{1}{M\,(L)}$$

- The energy density (Wh/kg) is shown in the folllowing as the weight (kg) of the EDLC is M.

$$Ed\,(Wh / kg) = \frac{1}{2} CE^2 X \frac{1}{3600} X \frac{1}{M\,(kg)}$$

Calculation of power density

Power means electricity which can be drawn from the EDLC. Power density means the power per unit volume or weight. Several calculation methods are chosen by each company. Nichicon uses the following formula substituting internal resistance value, which is measured based on "direct current resistance (DCR) ".

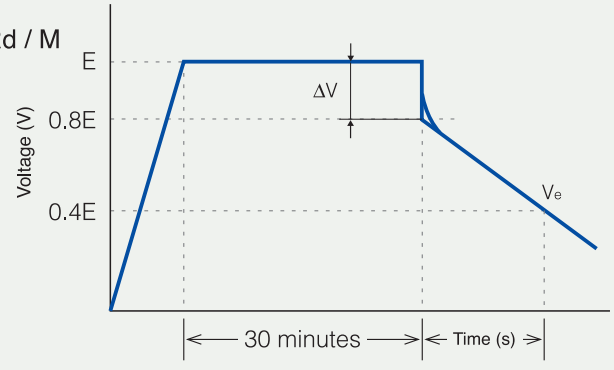
- The power density (W / L) is shown in the following as the volume (liter) of the EDLC is M.

$$Pb\,(W / L) = \frac{1}{2}(E - \Delta V + Ve) X I / M$$

$$= \frac{1}{2}(E - 0.2E + 0.4E) X 0.2E / Rd / M$$

$$= \frac{1}{2} X 1.2E X 0.2E / Rd / M$$

$$= (0.12 X E^2 / Rd) / M$$



- The power density (W / kg) is shown in the folllowing as the weight (kg) of the EDLC is M.

$$Pd\,(W / kg) = \frac{1}{2}(E - \Delta V + Ve) X I / M$$

$$= (0.12 X E^2 / Rd\,) / M$$

*The calculation method of the power density follows JEITA standard EIAJ RCR-2370C.

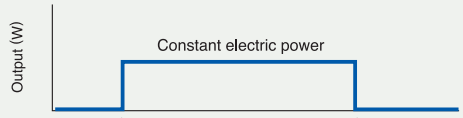
Calculation example -1

An example of Solar Lighting that is powered using EDLC's.

The following calculation is an example of what is needed to light a high intensity LED rated at 12V, 0.2A for 6 hours. All of the EDLC's in this example are connected in parallel, none are in series.

<Condition>

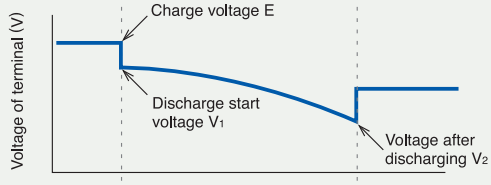
- Rated output : 12V 0.2A (2.4W)
- EDLC charge voltage : 2.5V
- Voltage after discharging : 1.0V
- Load time : 6 hours
- DC/DC converter efficiency : 70% (average efficiency) (includes loss of self-discharge)



<Requirement energy>

Requirement energy W_L = 2.4 (W) / 0.7 X 6 (h) X 3600 (s) = 74,057 (J) • • • ①
Discharge energy from EDLC's Wc = C / 2 X (V_1^2-V_2^2) (J) • • • ②
If it is put as W_L = Wc from ①, ②.
C = 74,057 X 2 / (2.5^2 - 1.0^2)
= 28,212 (F)

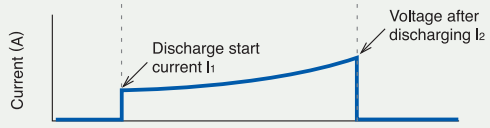
In this case, EDLC select from the high energy desity type for the usage in which a small current supply a long time. We recommend a 4,000F, ϕ63.5 X 150L, with a internal resistance of 2mΩ be selected from JD series,



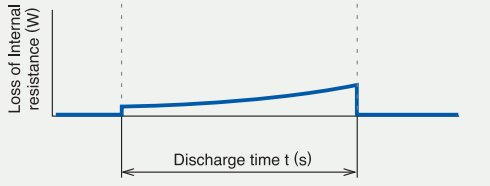
<The number of EDLC's that are required>

n = 28,212 (F) / 4000 (F) = 7.05 pcs ≒ 8 pcs
Capacitance C, Internal resistance (DCR) as 1pc in series X 8pcs in parallel is,
C = 4000 X 8 = 32,000F
DCR = 0.002 ÷ 8 = 0.00025Ω

In this case, the voltage drop of the discharge start (E-V_1) is equal to the product of the discharge current of I_1 of the units internal resistance (DCR) as shown in the following calculation.
E - V_1 = I_1 X DCR • • • ③
The product with the discharge start voltage V_1 by discharge start current I_1 is 2.4W as rating output.
V_1 X I_1 = 2.4 / 0.7 • • • ④



If it resolves these two equations ③,④ for the V_1,
V_1^2 - E X V_1 + 2.4 / 0.7 X DCR = 0
V_1^2 - 2.5 X V_1 + 0.000857 = 0
V_1 = (2.5 ± √(2.5^2 - 4 X 0.000857)) / 2
V_1 = 2.4997V, 0.000686 0.000686V will not hold.
V_1 = 2.4997V
From ①, ②
t = 32,000 / 2 X (2.4997^2 - 1.0^2) / 2.4 X 0.7
t = 24,493 (s) = 6.80 (h)
Therefore if 2.5V / 4000F 8pcs are chosen,
it was confirmed to be correct for the application.



<If high power density type "JL series" with the same size as JD series is selected>

- Voltage of cell : 2.5V
- Size of cell : ϕ63.5 X 150L
- Capacitance of cell : 2600F
- Internal resistance of cell : 0.001Ω

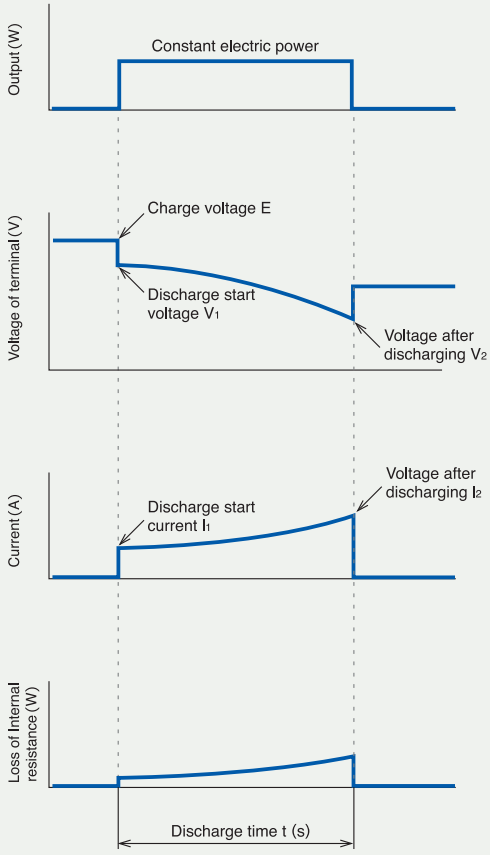
<The number of necessary EDLC>

n = 28,212 / 2,600 = 10.85pcs ≒ 11pcs
Capacitance C, Internal resistance DCR as 1pc in series X 11pcs in parallel is,
C = 2600 X 11 = 28,600F
DCR = 0.001 / 11 = 0.0000909Ω
If it resolves these two equations ③, ④
V_1 = 2.4999V
t = 28,600 / 2 X (2.4999^2 - 1.0^2) / 2.4 X 0.7
t = 21,895 (s) = 6.08 (h)
As a result, if JL series 2.5V / 2600F is chosen, 11pcs in parallel are needed to meet 6 hours-lighting.
Therefore in case of an application which requires small current and long life, high energy density type "JD series" is more suitable.

Calculation example -2

An example of lighing using the Voltage Sag Compensator Module

The following calculation is an example of what is needed to maintain power for 6 seconds using an EDLC system rated at 950W, 30V.



＜Condition＞

- Rated output : 950W
- Charge voltage of EDLC : 30V
- Voltage after discharging : 15V
- Discharge time : 6s
- DC/DC converter efficiency : 80% (average efficiency)
  (includes the loss of voltage equalization circuit)

＜Selecting the correct EDLC＞

JL series 2.5V 550F

- Rated voltage : 2.5V
- Size : φ35 X 105L
- Rated capacitance : 550F
- DCR : 0.005Ω

With an average cell voltage of 2.2V, to achieve 30V of charge voltage,
30 / 2.2 = 13.6
EDLC would need 14pcs in series.
Capacitance C, DCR using 14pcs
in series X 1pc in parallel is,
C = 550 / 14 = 39.2F
DCR = 0.005 X 14 = 0.070Ω

＜Calculation of Load time＞

Compensation energy W_L = 950 / 0.8 X t (J) ・・・・・・・・・①
Discharge energy from EDLC's = C / 2 X (V_1^2 - V_2^2) (J) ・・・②
Compensation energy = Discharge energy from EDLC's, W_L = Wc
E-V_1 = I_1 X DCR ・・・・③
V_1 X I_1 = 950 / 0.8 ・・・④
If it resolves these two equations ③、④ for the V_1,
V_1^2 - E X V_1 + 950 / 0.8 X DCR = 0
V_1^2 - 30 X V_1 + 83.1 = 0
V_1 = (30 ±√(30² - 4 X 83.1)) / 2
V_1 = 26.9V, 3.09V 3.09V will not hold. V_1 = 26.9V
From ①, ②
t = 39.2 / 2 X (26.9² - 15²) / 950 X 0.8
t = 8.22 (s)
Therefore an EDLC bank of 14pcs in series can satisfy necessary compensation time of 6 seconds.

＜If the high energy density type "JD series" that is the same size as JL series is selected＞

- Rated voltage : 2.5V
- Size : φ35 X 105L
- Rated capacitance : 800F
- DCR : 0.013Ω

Capacitance C, DCR using 14pcs in series X 1pc in parallel is,
C = 800 / 14 = 57.1F
DCR = 0.013 X 14 = 0.182Ω
If it resolves these two equations ③,④
V_1 = 17.9V
t = 57.1 / 2 X (17.9² - 15²) / 950 X 0.8
t = 2.29 (s)
As a result, JD series 2.5V / 800F cannot satisfy the load time of 6 seconds.
Therefore if it needs large current instantly, it is better to use the high power density type JL series which has low internal resistance (DCR).

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