



# SAMXON SUPERCAP

ELECTRIC DOUBLE LAYER CAPACITORS

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# ISO 9001 ISO 14001



# ACCREDITED

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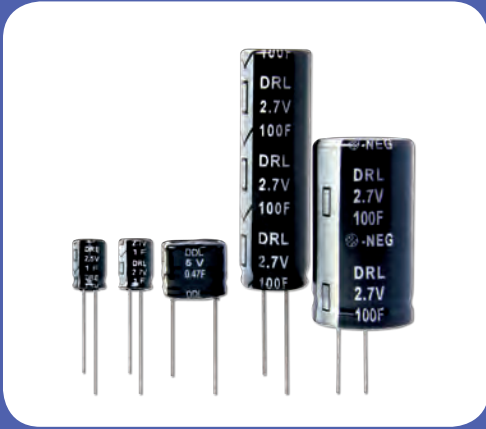
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# EDLC

## Electric Double Layer Capacitors

### Features and Benefits

- Application specific designs
- Customized form factors to meet most mechanical requirements
- Tailored capacitance, ESR, and temperature capability
- Series configurations for higher voltages
- Complete system solutions

### Application Types

- Pulse power
- Bridge or hold-up power
- Main power
- Memory backup

### Application Segments

- Industrial
- Consumer
- Medical
- Automotive
- Military

# Application Guidelines

This document provides basic guidelines for application development using capacitors, also known as EDLC. If questions arise during your development process and are not answered in this document, please contact us.

## Life Time

EDLC has a longer life time than secondary batteries, but their life time is not infinite. The basic end-of-life failure mode for an EDLC is an increase in equivalent series resistance (ESR) and/or a decrease in capacitance. The actual end-of-life criteria are dependent on the application requirements. Prolonged exposure to elevated temperatures, high applied voltage and excessive current will lead to increased ESR and decreased capacitance. Reducing these parameters will lengthen the life time of a supercapacitor. In general, cylindrical EDLC have a similar construction to electrolytic capacitors, having a liquid electrolyte inside an aluminum can sealed with a rubber bung. Over many years, the EDLC will dry out, similar to an electrolytic capacitor, causing high ESR and eventually end-of-life.

## Voltage

EDLC are rated with a nominal recommended working or applied voltage. The values provided are set for long life at their maximum rated temperature. If the applied voltage exceeds this recommended voltage, the result will be reduced life time. If the voltage is excessive for a prolonged time period, gas generation will occur inside the EDLC and may result in leakage or rupture of the safety vent. Short-term over voltage can usually be tolerated by the EDLC.

## Polarity

EDLC are designed with symmetrical electrodes, meaning they are similar in composition. When an EDLC is first assembled, either electrode can be designated positive or negative. Once the EDLC is charged for the first time during the 100% QA testing operation, the electrodes become polarized. Every EDLC either has a negative stripe or sign denoting polarity. Although they can be shorted to zero volts, the electrodes maintain a very small amount of charge. Reversing polarity is not recommended, however previously charged EDLC have been discharged to -2.5V with no measurable difference in capacitance or ESR.

Note: The longer they are held charged in one direction, the more polarized they become. If reversely charged after prolonged charging in one direction, the life of the EDLC may be shortened.

## Ambient Temperature

The standard temperature rating is -25°C to 70°C for DRE series or -40°C to 60°C for DRL series. Temperature in combination with voltage can affect the life time of an EDLC. In general, raising the ambient temperature by 10°C will decrease the life time of an EDLC by a factor of two. As a result, it is recommended to use the EDLC at the lowest temperature possible to decrease internal degradation and ESR increase. At temperature lower than normal room temperature, it is possible to apply voltages slightly higher than the recommended working voltage without significant increase in degradation and reduction in life time. Raising the applied voltage at low temperatures can be useful to offset the increased ESR seen at low temperatures. Increased ESR at higher temperatures is a result of permanent degradation/ electrolyte decomposition inside the EDLC. At low temperatures, however, increased ESR is only a temporary phenomenon due to the increased viscosity of the electrolyte and slower movement of the ions.

# Application Guidelines

## Discharge Characteristics

EDLC discharges with a sloping voltage curve. When determining the capacitance and ESR requirements for an application, it is important to consider both the resistive and capacitive discharge components. In high current pulse applications, the resistive component is the most critical. In low current, long duration applications, the capacitive discharge component is the most critical.

The formula for the voltage drop,  $V_{drop}$ , during a discharge at  $I$  current for  $t$  seconds is:

$$V_{drop} = I(R+t/C)$$

To minimize voltage drop in a pulse application, use an EDLC with low ESR (R value).

To minimize voltage drop in a low current application, use an EDLC with large capacitance (C value).

## Charge Methods

EDLC can be charged using various methods including constant current, constant power, constant voltage or by paralleling to an energy source, i.e. battery, fuel cell, DC converter, etc. If an EDLC is configured in parallel with a battery, adding a low value resistor in series will increase the life of the battery. If a series resistor is used, ensure that the voltage outputs of the EDLC are connected directly to the application and not through the resistor; otherwise the low ESR of the EDLC will be nullified. Many battery systems exhibit decreased life time when exposed to high current discharge pulses.

The maximum recommended charge current  $I$ , for an EDLC where  $V_w$  is the charge voltage and  $R$  is the EDLC ESR is calculated as below:

$$I = V_w/5R$$

Overheating of the EDLC can occur from continuous overcurrent or overvoltage charging.

Overheating can lead to increased ESR, gas generation, decreased life time, leakage, venting or rupture. Contact the factory if you plan to use a charge current or voltage higher than specified.

## Self Discharge and Leakage Current

Self discharge and leakage current are essentially the same thing measured in different ways. Due to the EDLC construction, there is a high-resistance internal current path from the anode to the cathode. This means that in order to maintain the charge on the capacitor a small amount of additional current is required. During charging this is referred to as leakage current. When the charging voltage is removed, and the capacitor is not loaded, this additional current will discharge the EDLC and is referred to as the self discharge current.

In order to get a realistic measurement of leakage or self discharge current the EDLC must be charged for in excess of 100 hours. This again is due to the capacitor construction. The EDLC can be modeled as several capacitors connected in parallel, each with an increasing value of series resistance. The capacitors with low values of series resistance is charged quickly thus increasing the terminal voltage to the same level as the charge voltage. However, if the charge voltage is removed these capacitors will discharge into the parallel capacitors with higher series resistance if they are not fully charged. The result of this is that the terminal voltage will fall, giving the impression of high self discharge current. It should be noted that the higher the capacitance value, the longer it will take for the device to be fully charged.

## Series Configurations of EDLC

Individual EDLC is limited to 2.5V for DRE series or 2.7V for DRL series. As many applications require higher voltages, EDLC can be configured in series to increase the working voltage. It is important to ensure that the individual voltage of any single EDLC does not exceed its maximum recommended working voltage as this could result in electrolyte decomposition, gas generation, ESR increase and reduced life time.

Capacitor voltage imbalance is caused, during charge and discharge, by differences in capacitance value and, in steady state, by differences in capacitor leakage current. During charging series connected capacitors will act as a voltage divider so higher capacitance devices will receive greater voltage stress. For example if two 1F capacitors are connected in series, one at +20% of nominal capacitance the other at -20% the worst-case voltage across the capacitors is given by:

$$V_{cap2} = V_{supply} \times (C_{cap1} / (C_{cap1} + C_{cap2}))$$

where  $C_{cap1}$  has the +20% capacitance.

So for a  $V_{supply} = 5V$ ,

$$V_{cap2} = 5V \times (1.2 / (1.2 + 0.8)) = 3V$$

From this it can be seen that, in order to avoid exceeding the EDLC surge voltage rating of 3V, the capacitance values of series connected parts must fall in a  $\pm 20\%$  tolerance range. Alternatively a suitable active voltage balancing circuit can be employed to reduce voltage imbalance due to capacitance mismatch. It should be noted that the most appropriate method of voltage balancing will be application specific.

## Passive Voltage Balancing

Passive voltage balancing uses voltage-dividing resistors in parallel with each EDLC. This allows current to flow around the EDLC at a higher voltage level into the EDLC at a lower voltage level, thus balancing the voltage. It is important to choose balancing resistor values that provide for higher current flow than the anticipated leakage current of the EDLC, bearing in mind that the leakage current will increase at higher temperatures.

Passive voltage balancing is only recommended for applications that don't regularly charge and discharge the EDLC and that can tolerate the additional load current of the balancing resistors. It is suggested that the balancing resistors be selected to give additional current flow of at least **50 times** the worst-case EDLC leakage current ( $3.3k\Omega$  to  $22k\Omega$  depending on maximum operating temperature). Although higher values of balancing resistor will work in most cases they are unlikely to provide adequate protection when significantly mismatched parts are connected in series.

## Active Voltage Balancing

Active voltage balancing circuits force the voltage at the nodes of series connected EDLC to be the same as a fixed reference voltage, regardless of how any voltage imbalance occurs. To ensure accurate voltage balancing, active circuits typically draw much lower levels of current in steady state and only require larger currents when the capacitor voltage goes out of balancing. These characteristics make active voltage balancing circuits ideal for applications that charge and discharge the EDLC frequently as well as those with a finite energy source such as a battery.

# Application Guidelines

## Reverse Voltage Protection

When series connected EDLC are rapidly discharged, the voltage on low capacitance value parts can potentially go negative. As explained previously, this is not desirable and can reduce the operating life of the EDLC. One simple way of protecting against reverse voltage is to add a diode across the capacitor, configured so that it is normally reverse bias. By using a suitably rated zener diode in place of a standard diode the EDLC can also be protected against overvoltage events. Care must be taken to ensure that the diode can withstand the available peak current from the power source.

## Soldering Information

Excessive heat may cause deterioration of the electrical characteristics of the EDLC, electrolyte leakage or an increase in internal pressure. Follow the specific instructions listed below:

In addition:

- Do not dip EDLC body into melted solder.
- Only flux the leads of the EDLC.
- Ensure that there is no direct contact between the sleeve of the EDLC and the PC board or any other component. Excessive solder temperature may cause sleeve to shrink or crack.
- Avoid exposed circuit board runs under the EDLC to prevent electrical shorts.

## Manual Soldering

Do not touch the EDLC's external sleeve with the soldering rod or the sleeve will melt or crack. The recommended temperature of the soldering rod tip is less than 350°C and the soldering duration should be less than 4 seconds. Minimize the time that the soldering iron is in direct contact with the terminals of the EDLC as excessive heating of the leads may lead to higher equivalent series resistance (ESR).

## Wave Soldering

Use a maximum preheating time of 60 seconds for PC boards 0.8mm or thicker. Preheating temperature should be limited to less than 100°C.

Use the following table for wave soldering on leads only:

Solder Bath Temperature(°C)	Solder Exposure Recommended	Time(seconds) Maximum
220°C	7	9
240°C	7	9
250°C	5	7
260°C	3	5



# Application Guidelines

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## Reflow Soldering

Do not use reflow soldering on EDLC using infrared or convection oven heating methods unless the EDLC is specifically rated to withstand reflow soldering temperature.

## Ripple Current

Although EDLC have very low resistance in comparison to other supercapacitors, they do have higher resistance than aluminum electrolytic capacitors and are more susceptible to internal heat generation when exposed to ripple current. Heat generation leads to electrolyte decomposition, gas generation, increased ESR and reduced life time. In order to ensure long life time, the maximum ripple current recommended should not increase the surface temperature of the EDLC by more than **3°C**.

## Circuit Board Design

Avoid cleaning of circuit boards, however if the circuit board must be cleaned use static or ultrasonic immersion in a standard circuit board cleaning fluid for no more than 5 minutes and a maximum temperature of 60°C. Afterwards thoroughly rinse and dry the circuit boards. In general, treat EDLC in the same manner you would an aluminum electrolytic capacitor.

## Long Term Storage

Do not store EDLC in any of the following environments:

- High temperature and/or high humidity
- Direct contact with water, salt water, oil or other chemicals
- Direct contact with corrosive materials, acids, alkalis or toxic gases
- Direct exposure to sunlight
- Dusty environment
- Environment subject to excessive shock and/or vibration

## Transportation Information

EDLC are non-regulated by the US DOT (Department of Transport) and IATA. The correct international shipping description is "Electronic Parts - Capacitors".

# Application Guidelines

## Emergency Procedures

If an EDLC is found to be overheating or if you smell a sweet odor, immediately disconnect any power or load to the EDLC. Allow the EDLC to cool down, then dispose of properly. Do not expose your face or hands to an overheating EDLC. Contact the factory for a Material Safety Date Sheet if an EDLC leaks or vents.

If exposed to electrolyte

**Skin Contact:** Wash exposed area thoroughly with soap and water.

**Eye Contact:** Rinse eyes with water for 15 minutes and seek medical attention.

**Ingestion:** Drink milk/water and induce vomiting; seek medical attention.

## General Safety Considerations

EDLC may vent or rupture if overcharged, reverse charged, incinerated or heated above 150°C. Do not crush, mutilate, nail penetrate or disassemble. High case temperature (burn hazard) may result from abuse of EDLC.

**Disposal Procedures**

Do not dispose of unit in trash. Dispose of according to local regulations

## Thermal Performance

Low internal resistance of the energy storage units enables low heat generation within the units during use. As with any electronic components the cooler the part operates the longer the service life. In most applications natural air convection should provide adequate cooling. In severe application requiring maximum service life some forced airflow may be required.

The thermal resistance,  $R_{th}$  of the units has been experimentally determined assuming free convection at ambient (-25°C). The  $R_{th}$  value provided on the data sheet is useful for determining the operating limits for the units. Using the  $R_{th}$  value a module temperature rise can be determined based upon any current and duty cycle.

The temperature rise can be expressed by the following equation.

$$\Delta T = Dc \cdot R_{th} \cdot I^2 \cdot Resr$$

where  $Dc$  = Duty Cycle

$I$  = Current AC or DC (A)

$R_{th}$  = Thermal Resistance (°C/W)





$Resr$  = Equivalent Series Resistance, (Ohms)(dc value used)

This T plus ambient should remain below the specified maximum operating temperature for the module. If forced cooling methods are employed, it is possible to operate the units at higher currents or duty cycles.

## Features :

- Can be used as a rechargeable battery and ideal for backing up purpose.
- Capable of several hundreds of thousands of charge/discharge cycles; free from throwaway disposal.
- Does not contain toxic materials such as nickel and cadmium.

## Series Table

Series	Category	Temp. Range °C		Capacitance (F)	Max. Operating Voltage V.DC	Sleeve Color	Letter Color	Appearance	Page
		Min.	Max.						
DRC	Higher Energy Density	-25°C	+60°C	10~800	2.3	Black	White		P.11
DRE	High Energy High Temperature	-25°C	+70°C	1.0~3000	2.5	Black	White		P.13
DRL	High Energy High Power Type Low ESR	-40°C	+60°C	1.0~3000	2.7	Black	White		P.16
DDL	Higher Voltage	-40°C	+60°C	0.22~11	5.0	Black	White		P.20

## Part Number System

### • Part 1

1 2 3	4 5 6	7	8 9	10	11 12	13 14						
DRE	1 0 5	M	0 E	F	1 2	RR						
Series	Capacitance	Tolerance	Voltage	Case Dia.	Case Len.	Type						
Series	Cap. (F)	Code	Tol. (%)	Code	Vol. (V)	Code	Dia. (mm)	Code	Len. (mm)	Code	Feature	Code
DRC	1.0	105	±20	M	2.3	03	8	F	12	12	Radial bulk	RR
DRE	3.0	305	-20~+50	S	2.5	0E	10	G	20	20	Snap-in	SC
DRL	4.7	475	-10~+20	V	2.7	0T	12.5	I	25	25	Snap-in	SX
	10	106					16	K	30	30	Screw	O5
	22	226					18	L	40	40	Screw	A4
	33	336					22	N	45	45		
	50	506					25	O	50	50		
	90	906					30	P	55	55		
	100	107					35	Q	60	60		
	120	127					60	T	80	80		
	150	157							95	95		
	200	207							100	1L		
	250	257							105	1K		
	350	357							120	1N		
	1200	128							130	1P		
	2500	258							150	1R		

### • Part 2

1 2 3	4 5 6	7	8 9	10	11 12	13 14						
DDL	1 0 5	M	0 H	F	1 E	RR						
Series	Capacitance	Tolerance	Voltage	Case Dia.	Case Len.	Type						
Series	Cap. (F)	Code	Tol. (%)	Code	Vol. (V)	Code	Length x Width (mm)	Code	Len. (mm)	Code	Feature	Code
DDL	0.22	224	±20	M	5.0	0H	9x17.5	F	15.5	1E	Radial bulk	RR
	0.47	474	-20~+50	S	5.5	05	11x21.5	G	19.5	1J		
	0.68	684					13.5x30	I	23.5	2C		
	1	105					20x40	K	29	29		
	1.5	155										
	2.5	255										
	4	405										
	8	805										
	11	116										

## Features:

- Higher energy density (2 times of EDLC)
- Quick charge & discharge
- RoHS directive compliant



## Recommended Applications:

- Solar Brick Light
- Wind Power Generation

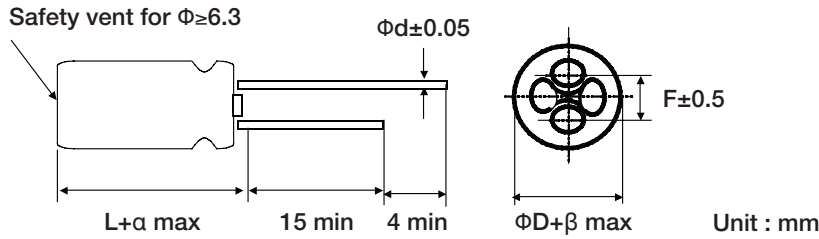
## Specifications

Item	Performance Characteristics	
<b>Temperature</b>		
Operating Temperature Range	-25°C to +60°C	
<b>Capacitance</b>		
Nominal Capacitance Range	10F to 800F	
Capacitance Tolerance	±20% or -20%~+50%	
<b>Voltage</b>		
Rated Voltage	2.3 V.DC	
Surge Voltage	2.5 V.DC	
Maximum Operating Voltage	2.3 V.DC	
<b>Resistance</b>		
ESR, DC	Please see the attached characteristics list (table 1)	
ESR, AC	Please see the attached characteristics list (1kHz/20°C) (table 1)	
<b>Lifespan</b>		
Shelf Life	After 1000 hours storage at +60°C, without load, the capacitor shall meet the specified limits for endurance.	
Endurance	After 1000 hours application of rated voltage at +60°C, the capacitor shall meet the following limits.	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value
<b>Cycles</b>		
Cycles	Capacitors cycles between specified voltage and half rated voltage under constant current at 25°C (20,000 cycles)	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

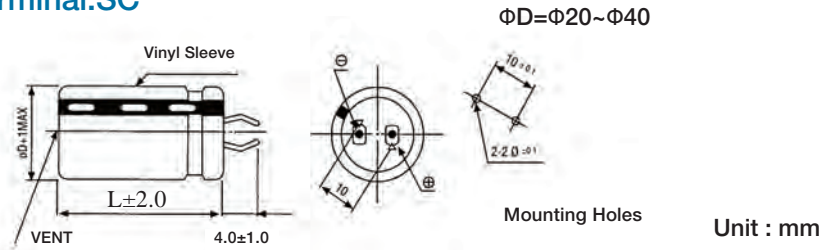
## Case Size Table

### Terminal:RR

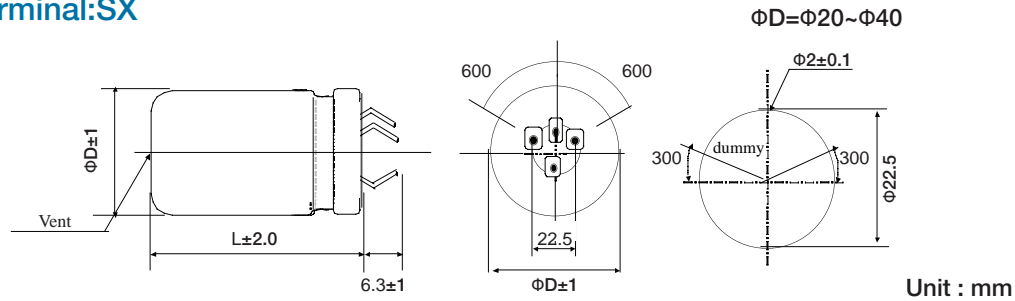


ΦD	10	12.5	16	18	22
F	5.0	5.0	7.5	7.5	10.0
Φd	0.6	0.6	0.8	0.8	1.0
α	2.0				
β	(D<20)0.5		(D≥20)1.0		

### Terminal:SC



### Terminal:SX



## Characteristics List

Part Number	Rated Voltage (V.DC)	Rated Cap. (F)	Size ΦD×L (mm)	ESR, AC(mΩ)(max) at 1kHz/20°C	Leakage Current (mA)
DRC106S03G20RR	2.3	10	10x20	220	5.00
DRC226S03I20RR	2.3	22	12.5x20	120	11.00
DRC306S03I25RR	2.3	30	12.5x25	100	15.00
DRC506S03K25RR	2.3	50	16x25	60	25.00
DRC706S03K35RR	2.3	70	16x35	50	35.00
DRC127S03L40RR	2.3	120	18x40	35	60.00
DRC227S03N47RR	2.3	220	22x47	25	110.00
DRC407S03P45SC	2.3	400	30x45	20	200.00
DRC607S03P60SC	2.3	600	30x60	15	300.00
DRC807S03Q70SC	2.3	800	35x70	10	400.00

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## Features:

- Miniaturized, high capacitance and high temperature
- Quick charge & discharge
- RoHS directive compliant



## Recommended Applications:

- Consumer Electronics
- Industrial and Automation
- Portable Power Tools
- Renewable Energy Systems
- Short Term UPS (Uninterruptible Power Supply) and Telecom Systems

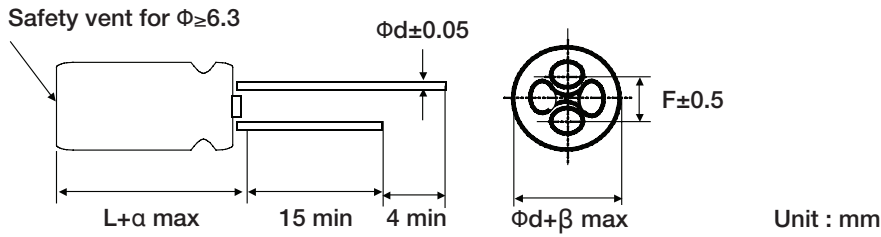
## Specifications

Item	Performance Characteristics	
<b>Temperature</b>		
Operating Temperature Range	-25°C to +70°C	
<b>Capacitance</b>		
Nominal Capacitance Range	1.0F to 500F	1200F to 3000F
Capacitance Tolerance	±20% or -20%~+50%	-10%~+20%
<b>Voltage</b>		
Rated Voltage	2.5 V.DC	
Surge Voltage	2.7 V.DC	
Maximum Operating Voltage	2.5 V.DC	
<b>Resistance</b>		
ESR, DC	Please see the attached characteristics list (table 1)	
ESR, AC	Please see the attached characteristics list (1kHz/20°C) (table 1)	
<b>Power</b>		
Pv	Please see the attached characteristics list (table 2)	
<b>Energy</b>		
Energy Density (Emax)	Please see the attached characteristics list (table 2)	
<b>Lifespan</b>		
Shelf Life	After 1000 hours storage at +70°C, without load, the capacitor shall meet the specified limits for endurance.	
Endurance	After 1000 hours application of rated voltage at 70°C, the capacitor shall meet the following limits.	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value
<b>Cycles</b>		
Cycles	Capacitors cycles between specified voltage and half rated voltage under constant current at 25°C (500,000 cycles)	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value

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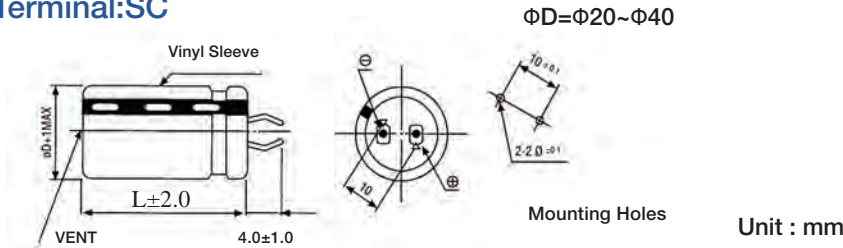
## Case Size Table

### Terminal:RR

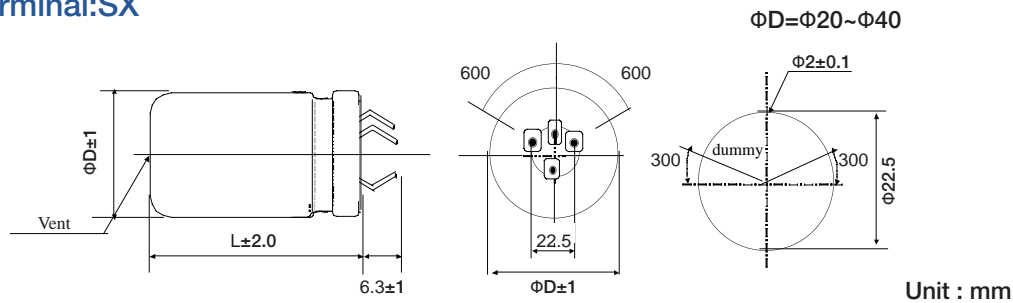


ΦD	8(L<20)	8(L≥20)	10	12.5	16	18
F	3.5	3.5	5.0	5.0	7.5	7.5
Φd	0.5	0.6	0.6	0.6	0.8	0.8
α	(L<20)1.5		(L≥20)2.0			
β	(D<20)0.5		(D≥20)1.0			

### Terminal:SC



### Terminal:SX



## Characteristics List

• Table 1

Part Number	Rated Voltage (V.DC)	Rated Cap. (F)	Size ΦD×L (mm)	ESR, DC(mΩ)(max) at 1kHz/20°C	ESR, AC(mΩ)(max) at 1kHz/20°C	Leakage Current (mA)	Max. Current(A), 1sec	Max. Continuous Current(A)	Short Peak Current (Isc)(A)
DRE105S0EF12RR	2.5	1.0	8x12	1000	500	0.5	1.3	0.3	0.63
DRE206S0EF20RR	2.5	2.0	8x16	550	350	1.0	2.5	0.5	1.19
DRE305S0EF20RR	2.5	3.0	8x20	320	200	1.5	3.8	0.8	1.91
DRE335S0EG20RR	2.5	3.3	10x20	320	200	1.7	4.1	0.8	2.01
DRE505S0EG20RR	2.5	4.7	10x20	290	180	2.5	5.9	1.2	2.49
DRE705S0EG25RR	2.5	7.0	10x25	220	140	3.5	8.8	1.8	3.44
DRE106S0EG30RR	2.5	10	10x30	150	100	5.0	12.5	2.5	5.00
DRE106S0EI25RR	2.5	10	12.5x25	160	100	5.0	12.5	2.5	4.81
DRE226S0EK25RR	2.5	22	16x25	100	60	11.0	27.5	5.5	8.59
DRE306S0EK30RR	2.5	30	16x30	70	40	15.0	37.5	7.5	12.1

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## Characteristics List

• Table 1

Part Number	Rated Voltage (V.DC)	Rated Cap. (F)	Size $\Phi$ D×L (mm)	ESR, DC(m $\Omega$ )(max) at 1kHz/20°C	ESR, AC(m $\Omega$ )(max) at 1kHz/20°C	Leakage Current (mA)	Max. Current(A), 1sec	Max. Continuous Current(A)	Short Peak Current (Isc)(A)
DRE506S0EL40RR	2.5	50	18x40	50	30	25.0	62.5	12.5	17.9
DRE107S0EL60RR	2.5	100	18x60	35	25	50.0	125	25.0	27.8
DRE107S0EN45SC	2.5	100	22x45	35	25	50.0	125	25.0	27.8
DRE157S0EO55SC	2.5	150	25x55	30	22	75.0	188	37.5	34.1
DRE207S0EP50SC	2.5	200	30x50	25	20	100.0	250	50.0	41.7
DRE257S0EP55SC	2.5	250	30x55	22	18	125.0	313	62.5	48.1
DRE357S0EQ60SC	2.5	350	35x60	15	12	175.0	438	87.5	70.0
DRE507S0EQ95O5	2.5	500	35x95	12	10	250.0	625	125.0	89.3
DRE128V0ET80A4	2.5	1200	60x80	0.86	0.75	600.0	1500	300.0	739.1
DRE158V0ET1LA4	2.5	1500	60x100	0.69	0.60	750.0	1875	375.0	922.1
DRE188V0ET1NA4	2.5	1800	60x120	0.65	0.55	900.0	2250	450.0	1036.9
DRE208V0ET1PA4	2.5	2000	60x130	0.52	0.45	1000.0	2500	500.0	1225.5
DRE258V0ET1RA4	2.5	2500	60x150	0.49	0.42	1250.0	3125	625.0	1398.2
DRE308V0ET1RA4	2.5	3000	60x150*	0.50	0.45	1500.0	3750	750.0	1500.0
DRE308V0ET1TA4	2.5	3000	60x170	0.47	0.40	1500.0	3750	750.0	1559.9

• Table 2

Rated Capacitance(F)	1	2	3	3.3	4.7	7	10	10	22	30
Size( $\Phi$ D×L)	8x12	8x16	8x20	10x20	10x20	10x25	10x30	12.5x25	16x25	16x30
Pd(W/kg)	794	1145	1473	1071	1151	1384	1458	1170	1036	1162
Energy Density (Emax(Wh/kg))	0.9	1.5	1.6	1.3	1.8	2.5	2.5	2.2	2.6	2.8
Maximum Energy (Emax(mAh))	0.87	1.74	2.60	2.86	4.08	6.08	8.68	8.68	19.1	26.0

Rated Capacitance(F)	50	100	100	150	200	250	350	500
Size( $\Phi$ D×L)	18x40	18x60	22x45	25x55	30x50	30x55	35x60	35x95
Pd(W/kg)	1067	984	866	723	652	673	676	534
Energy Density (Emax(Wh/kg))	3.1	4.0	3.5	3.8	3.8	4.3	4.1	3.7
Maximum Energy (Emax(mAh))	43.4	86.8	86.80	130.20	173.60	217.00	303.80	434.03

Rated Capacitance(F)	1200	1500	1800	2000	2500	*3000	3000
Size( $\Phi$ D×L)	60x80	60x100	60x120	60x130	60x150	60x150	60x170
Pd(W/kg)	2647	3005	2655	3063	2794	2300	2284
Energy Density (Emax(Wh/kg))	3.2	3.6	3.6	3.7	4.0	3.9	3.7
Maximum Energy (Emax(mAh))	1041.67	1302.08	1562.5	1736.11	2170.14	2604.2	2604.2

\* High Pd(W/kg) and Energy Density (Emax(Wh/kg))

## Additional Technical Information

I<sub>c</sub>=leakage current after 72 hours at 25°C

I<sub>sc</sub>=short circuit current (maximum peak current)

R<sub>DC</sub>=internal resistance(DC)

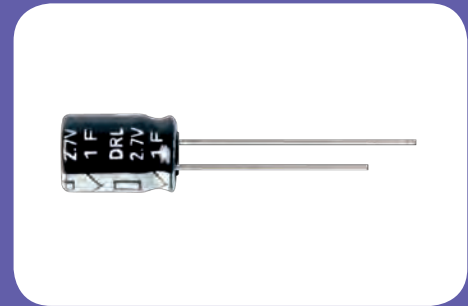
M=capacitor mass(kg)

$Pd=(0.12 \times U^2/R_{DC})/V$       $Emax=(0.5CU^2)/(3600 \times M)$      Maximum Peak Current (1 sec)= $0.5U/(ESR_{DC}+1/C)$

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

## Features:

- Miniaturized, high capacitance and high temperature
- Quick charge & discharge
- RoHS directive compliant



## Recommended Applications:

- Consumer Electronics
- Industrial and Automation
- Portable Power Tools
- Renewable Energy Systems
- Short Term UPS (Uninterruptible Power Supply) and Telecom Systems

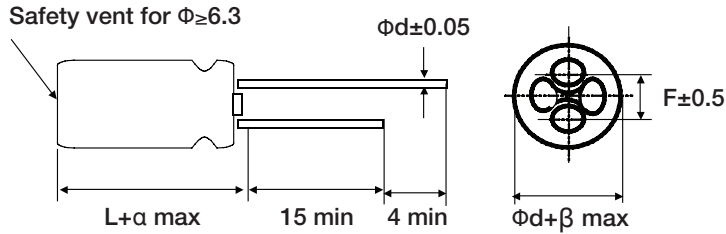
## Specifications

Item	Performance Characteristics	
<b>Temperature</b>		
Operating Temperature Range	-40°C to +60°C	
<b>Capacitance</b>		
Nominal Capacitance Range	1.0F to 500F	1200F to 3000F
Capacitance Tolerance	±20% or -20%~+50%	-10%~+20%
<b>Voltage</b>		
Rated Voltage	2.7 V.DC	
Surge Voltage	2.8 V.DC	
Maximum Operating Voltage	2.7 V.DC	
<b>Resistance</b>		
ESR, DC	Please see the attached characteristics list (table 1)	
ESR, AC	Please see the attached characteristics list (1kHz/20°C) (table 1)	
<b>Power</b>		
Pv	Please see the attached characteristics list (table 2)	
<b>Energy</b>		
Energy Density (E <sub>max</sub> )	Please see the attached characteristics list (table 2)	
<b>Lifespan</b>		
Shelf Life	After 1000 hours storage at +60°C, without load, the capacitor shall meet the specified limits for endurance.	
Endurance	After 1000 hours application of rated voltage at 60°C, the capacitor shall meet the following limits.	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value
<b>Cycles</b>		
Cycles	Capacitors cycles between specified voltage and half rated voltage under constant current at 25°C (500,000 cycles)	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

Case Size Table

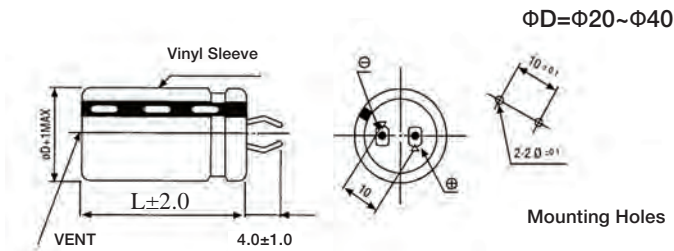
Terminal:RR



Unit : mm

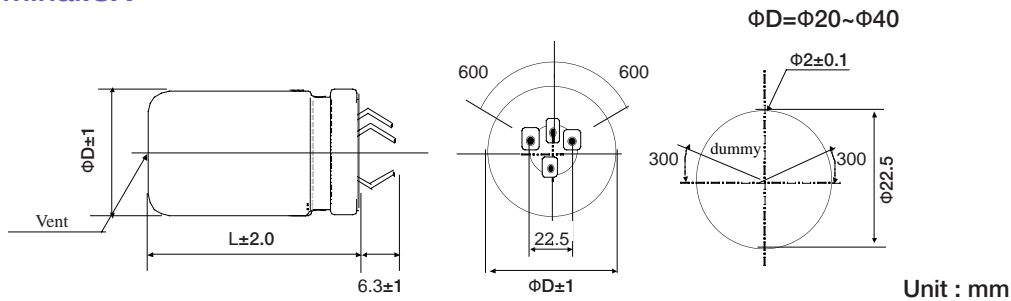
ΦD	8(L<20)	8(L≥20)	10	12.5	16	18
F	3.5	3.5	5.0	5.0	7.5	7.5
Φd	0.5	0.6	0.6	0.6	0.8	0.8
α	(L<20)1.5		(L≥20)2.0			
β	(D<20)0.5		(D≥20)1.0			

Terminal:SC



Unit : mm

Terminal:SX



Unit : mm

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

## Characteristics List

• Table 1

Part Number	Rated Voltage (V.DC)	Rated Cap. (F)	Size $\Phi$ D×L (mm)	ESR, DC(m $\Omega$ )(max) at 1kHz/20°C	ESR, AC(m $\Omega$ )(max) at 1kHz/20°C	Leakage Current (mA)	Max. Current(A), 1sec	Max. Continuous Current(A)	Short Peak Current (Isc)(A)
DRL105S0TF12RR	2.7	1.0	8x12	850	400	0.5	1.4	0.3	0.73
DRL205S0TF16RR	2.7	2.0	8x16	470	280	1.0	2.7	0.5	1.39
DRL305S0TF20RR	2.7	3.0	8x20	250	160	1.5	4.1	0.8	2.31
DRL335S0TG20RR	2.7	3.3	10x20	270	160	1.7	4.5	0.9	2.36
DRL505S0TG20RR	2.7	4.7	10x20	250	140	2.5	6.3	1.3	2.92
DRL705S0TG25RR	2.7	7.0	10x25	200	100	3.5	9.5	1.9	3.94
DRL106S0TG30RR	2.7	10	10x30	130	80	5.0	13.5	2.7	5.87
DRL106S0TI25RR	2.7	10	12.5x25	140	80	5.0	13.5	2.7	5.63
DRL226S0TK25RR	2.7	22	16x25	85	40	11.0	29.7	5.9	10.35
DRL306S0TK30RR	2.7	30	16x30	60	30	15.0	40.5	8.1	14.5
DRL506S0TL40RR	2.7	50	18x40	40	25	25.0	67.5	13.5	22.5
DRL107S0TL60RR	2.7	100	18x60	28	20	50.0	135	27.0	35.5
DRL107S0TN45SC	2.7	100	22x45	28	18	50.0	135	27.0	35.5
DRL157S0TO55SC	2.7	150	25x55	25	16	75.0	203	40.5	42.6
DRL207S0TP50SC	2.7	200	30x50	20	15	100.0	270	54.0	54.0
DRL257S0TP55SC	2.7	250	30x55	18	13	125.0	338	67.5	61.4
DRL357S0TQ60SC	2.7	350	35x60	12	10	175.0	473	94.5	90.9
DRL507S0TQ95O5	2.7	500	35x95	10	8	250.0	675	135.0	112.5
DRL128V0TT80A4	2.7	1200	60x80	0.7	0.60	600.0	1620	324.0	880.4
DRL158V0TT1LA4	2.7	1500	60x100	0.6	0.50	750.0	2025	405.0	1065.8
DRL188V0TT1NA4	2.7	1800	60x120	0.55	0.45	900.0	2430	486.0	1221.1
DRL208V0TT1PA4	2.7	2000	60x130	0.45	0.40	1000.0	2700	540.0	1421.1
DRL258V0TT1RA4	2.7	2500	60x150	0.42	0.36	1250.0	3375	675.0	1646.3
DRL308V0TT1RA4	2.7	3000	60x150*	0.43	0.38	1500.0	4050	810.0	1768.6
DRL308V0TT1TA4	2.7	3000	60x170	0.4	0.35	1500.0	4050	810.0	1840.9

\* High Pd(W/kg) and Energy Density (E<sub>max</sub>(Wh/kg))

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

## Characteristics List

• Table 2

Rated Capacitance(F)	1	2	3	3.3	4.7	7	10	10	22	30
Size(ΦD×L)	8x12	8x16	8x20	10x20	10x20	10x25	10x30	12.5x25	16x25	16x30
Pd(W/kg)	1338	1756	2647	1580	1645	1934	2057	1755	1650	1768
Energy Density (Emax(Wh/kg))	1.3	1.9	2.3	1.6	2.2	3.1	3.1	2.8	3.6	3.7
Maximum Energy (Emax(mAh))	1.01	2.03	3.04	3.34	4.76	7.09	10.1	10.1	22.3	30.4

Rated Capacitance(F)	50	100	100	150	200	250	350	500
Size(ΦD×L)	18x40	18x60	22x45	25x55	30x50	30x55	35x60	35x95
Pd(W/kg)	1770	1625	1595	1144	1092	1078	1115	848
Energy Density (Emax(Wh/kg))	4.1	5.3	5.2	5.0	5.1	5.6	5.4	4.9
Maximum Energy (Emax(mAh))	50.6	101	101.00	151.80	202.50	253.10	354.3	506.25

Rated Capacitance(F)	1200	1500	1800	2000	2500	*3000	3000
Size(ΦD×L)	60x80	60x100	60x120	60x130	60x150	60x150	60x170
Pd(W/kg)	4311	4535	4172	4668	4318	3555	3965
Energy Density (Emax(Wh/kg))	4.2	4.7	4.8	4.9	5.2	5.3	5.5
Maximum Energy (Emax(mAh))	1215.0	1518.8	1822.5	2025.00	2531.25	3037.5	3037.5

\* High Pd(W/kg) and Energy Density (Emax(Wh/kg))

## Additional Technical Information

$I_C$ =leakage current after 72 hours at 25°C

$I_{SC}$ =short circuit current (maximum peak current)

$R_{DC}$ =internal resistance(DC)

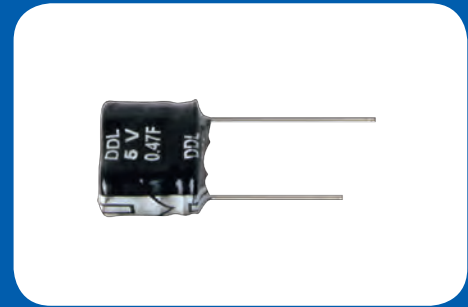
$M$ =capacitor mass(kg)

$Pd=(0.12xU^2/R_{DC})/M$        $Emax=(0.5CU^2)/(3600xM)$       Maximum Peak Current (1 sec)= $0.5U/(ESR_{DC}+1/C)$

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

## Features:

- Miniaturized, high capacitance and high temperature
- Quick charge & discharge
- RoHS directive compliant



## Recommended Applications:

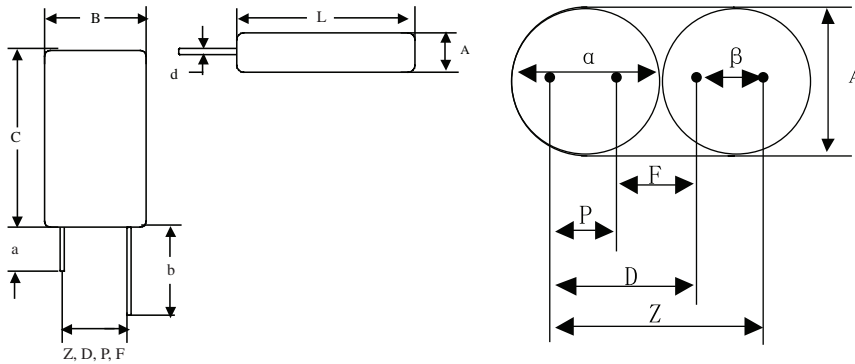
- Consumer Electronics
- Industrial and Automation
- Portable Power Tools
- Renewable Energy Systems
- Short Term UPS (Uninterruptible Power Supply) and Telecom Systems

## Specifications

Item	Performance Characteristics	
<b>Temperature</b>		
Operating Temperature Range	-40°C to +60°C	
<b>Capacitance</b>		
Nominal Capacitance Range	0.22F to 11F	
Capacitance Tolerance	±20% or -20%~+50%	
<b>Voltage</b>		
Rated Voltage	5.0 V.DC	
Surge Voltage	5.5 V.DC	
Maximum Operating Voltage	5.0 V.DC	
<b>Resistance</b>		
ESR, AC	Please see the attached characteristics list (table 1)	
<b>Lifespan</b>		
Shelf Life	After 1000 hours storage at +60°C, without load, the capacitor shall meet the specified limits for endurance.	
Endurance	After 1000 hours application of rated voltage at 60°C, the capacitor shall meet the following limits.	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value
<b>Cycles</b>		
Cycles	Capacitors cycles between specified voltage and half rated voltage under constant current at 25°C (500,000 cycles)	
	Capacitance Change	±30% of initial measured value
	Internal Resistance	≤4 times of initial specified value

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

Case Size Table



Note: Longer lead is positive

Dimensions(mm)

Size Code	A max.	B max.	L max.	d $\pm 0.05$	a min.	b min.	Z= $\alpha + \beta$ $\pm 0.50$	D= $\alpha$ $\pm 0.50$	P= $\beta$ $\pm 0.50$	F= $\alpha - \beta$ $\pm 0.50$
F1E	9.0	17.5	15.5	0.50	15.0	19.0	11.80	8.30	3.50	4.80
F1J	9.0	17.5	19.5	0.50	15.0	19.0	11.80	8.30	3.50	4.80
F2C	9.0	17.5	23.5	0.60	15.0	19.0	11.80	8.30	3.50	4.80
G2C	11.0	21.5	23.5	0.60	15.0	19.0	15.30	10.30	5.00	5.30
I2C	13.5	30	23.5	0.60	15.0	19.0	20.70	15.70	5.00	11.00
K29	20.0	40	29	0.80	15.0	19.0	26.80	19.30	7.50	11.80

Characteristics List

• Table 1

Part Number	Rated Voltage (V.DC)	Rated Cap. (F)	Size (mm)	ESR, AC( $\Omega$ )(max) at 1kHz/20°C	Leakage Current (mA)
DDL224S0HF1ERR	5.0	0.22	9x17.5x15.5	2.5	0.2
DDL474S0HF1ERR	5.0	0.47	9x17.5x15.5	1.5	0.5
DDL684S0HF1JRR	5.0	0.68	9x17.5x19.5	1.8	0.7
DDL105S0HF1JRR	5.0	1.00	9x17.5x19.5	1.1	1.0
DDL155S0HF2CRR	5.0	1.50	9x17.5x23.5	0.6	1.5
DDL255S0HG2CRR	5.0	2.50	11x21.5x23.5	0.5	2.5
DDL405S0HI2CRR	5.0	4.00	13.5x30x23.5	0.4	4.0
DDL805S0HK29RR	5.0	8.00	20x40x29	0.2	8.0
DDL116S0HK29RR	5.0	11.00	20x40x29	0.2	11.0

Specifications are subject to change without notice. Should a safety or technical concern arise regarding the product, please be sure to contact our sales offices or agents immediately.

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