

# Type EDL , Electric Double Layer Supercapacitors

## Ultra High Capacitance, Small Case Size Options



Type EDL electric double layer supercapacitors offer extremely high capacitance values (farads) in a variety of packaging options that will satisfy, low profile, surface mount, through hole and high density assembly requirements. The EDL is a cut above the standard electrolytic capacitor in that it can act as a battery without having to deal with the environmental or hazardous material issues that batteries entail.

### Highlights

- Unlimited charging and discharging capability
- Recycling is not necessary
- Long Life - 15 years
- Low ESR
- Will extend battery life up to 1.6 times
- First class performance with economy pricing

### Specifications

Operating Temperature Range	-25 °C to +85 °C
Rated Voltage Range	2.1 Vdc to 5.5 Vdc
Capacitance Range	0.022 F to 70 F

### How To Select an Electric Double Layer Capacitor

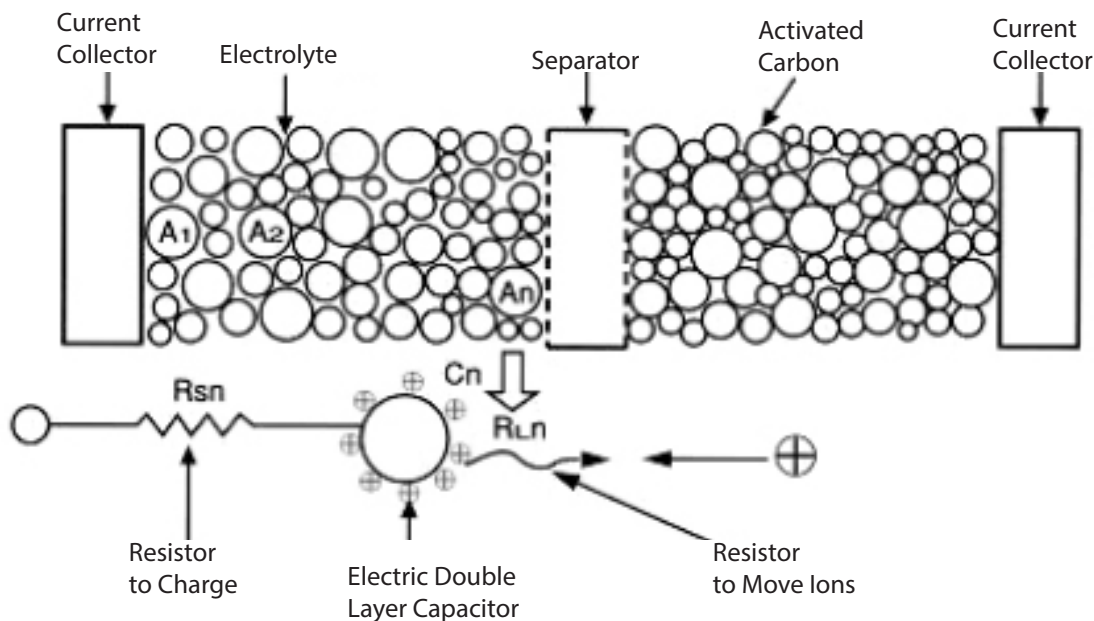
Estimated Initial Backup Time	Back-up time for Type EDL Electric Double Layer Supercapacitors decreases with use and over time especially when the current is large or operating at high temperature. Be sure to specify extra back-up time initially to allow for product changes.																																			
Select the optimum supercapacitor according to applied current	<p>The internal resistance of the supercapacitor prevents drawing high discharge currents. Select the supercapacitor capable of delivering the peak current at switchover to back-up mode using the following table.</p> <table border="1"> <thead> <tr> <th rowspan="2">Series</th> <th colspan="5">Maximum Operating (Discharge) Current</th> </tr> <tr> <th>0.047 F</th> <th>0.1 F to 0.33 F</th> <th>0.47 F to 1.5 F</th> <th>3.3 F to 4.7 F</th> <th>10 F to 50 F</th> </tr> </thead> <tbody> <tr> <td>SG, SD, NF</td> <td>200 µA</td> <td>300 µA</td> <td>1 mA</td> <td>-</td> <td>-</td> </tr> <tr> <td>F</td> <td>200 µA</td> <td>300 µA</td> <td>300 µA</td> <td>-</td> <td>-</td> </tr> <tr> <td>EN</td> <td>-</td> <td>10 µA</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>HW</td> <td>-</td> <td>-</td> <td>-</td> <td>300 mA</td> <td>1 A</td> </tr> </tbody> </table>	Series	Maximum Operating (Discharge) Current					0.047 F	0.1 F to 0.33 F	0.47 F to 1.5 F	3.3 F to 4.7 F	10 F to 50 F	SG, SD, NF	200 µA	300 µA	1 mA	-	-	F	200 µA	300 µA	300 µA	-	-	EN	-	10 µA	-	-	-	HW	-	-	-	300 mA	1 A
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Back Up Time Example	<p>Back-up time is the time it takes for the applied voltage to decay to the cut-off voltage set by the user after applying the application's maximum voltage at application maximum temperature.</p> <p>Example: An F Type EDL, P/N EDLF105B5R5C (Rated at 5.5 V, 1.0 F) is charged to 5.0 Vdc. The circuit requirement is such that it must maintain a memory circuit with a current drain of 10 µA in an ambient temperature of +40 °C. The memory RTC cut-off voltage is 2.0 Vdc.</p> <p>Using minimum capacitance, calculate the back-up time as follows:</p> $t = C\Delta V / I = C[V_0 - (i \cdot R) - V_1] / (i + i_L)$ $C = 1.0 \text{ F} - 20\% = 0.8 \text{ F}, R = 50 \Omega, V_0 = 5 \text{ V}, V_1 = 2 \text{ V}, i = 10 \mu\text{A}$ <p>Therefore,</p> $t = 0.8 (5 - 0.0005 - 2) / ((10 + 2) \times 10^{-6}) = 55 \text{ hours}$ <p>And thus the initial back-up time is 55 hours. After 1000 hours, calculate the back-up time will drop to about 38 hours.</p> <p>t: Back-up time (s)  C: Capacitance of Type EDL (F)  V<sub>0</sub>: Applied voltage (V)  V<sub>1</sub>: Cut-off voltage (V)  i: Current during back-up (A)  i<sub>L</sub>: Leakage current (A)  R: Internal resistance (Ω) at 1 kHz</p>																																			

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<p><b>Life Design</b></p>	<p>Type EDL supercapacitors have a useful lifetime that decreases with increasing operating temperature, humidity, applied-voltage, current and backup-time requirements.</p> <p>Expected lifetime is the product of four factors:</p> <p>Expected Life = (Lifetime)•(Temperature Factor)•(Voltage Factor)•(Moisture Factor)</p>
<p><b>Lifetime</b></p>	<p>The minimum rated life at 85 °C with 5.5 Vdc applied is 1000 hours with maximum permitted end-of-life capacitance change of -30% and a 4 times increase in internal resistance.</p>
<p><b>Temperature Factor</b></p>	<p>To determine the effect of temperature on expected life of a supercapacitor, use the fact that expected lifetime doubles for each 10 °C that the operating temperature is reduced. As an illustration, at 85 °C and full voltage the rated lifetime is 1000 hours. So, at 40 °C the expected lifetime would be multiplied by <math>2^{(85-40)/10} = 2^{4.5} = 22.6</math> times. The Temperature Factor is 22.6, and for 1000-h, 85 °C rated life, the expected 40 °C life would be 22600 hours.</p>
<p><b>Voltage Factor</b></p>	<p>The rate of change of capacitance decreases with decreasing applied voltage. The effect on life extension is roughly proportional to the voltage derating, e.g., 5 V applied to 5.5 V rated supercapacitors extends the life 1.1 times.</p>
<p><b>Moisture Factor</b></p>	<p>Expected life of these supercapacitors is considerably shortened by operation in high humidity. The applications discussed here assume that the relative humidity is no more than 50%.</p>
<p><b>Expected Life Example</b></p>	<p>So, for a 5.5 V supercapacitor at 40 °C charged to 5.V in less than 50% RH the expected life is:</p> <p>Expected Life = (Lifetime) (Temperature Factor) (Voltage Factor) (Moisture Factor)</p> <p>= (1000 h) (22.6) (1.1) (1)</p> <p>= 24800 hours</p> <p>= 2.8 years</p>
<p>RoHS Compliant</p>	

## Electric Double Layer Supercapacitor Construction



# Type EDL , Electric Double Layer Supercapacitors

## Ratings

Catalog Part Number	Capacitance	Voltage (Vdc)	Max. Resistance @ 1 kHz (Ω)	Case Type	Case Dia. (mm)	Case Length (mm)	Style
EDLHW335D2R3R**	3.3 F	2.3	0.3	Radial Lead	12.5	23	HW 
EDLHW475D2R3R**	4.7 F		0.3		12.5	23	
EDLHW106D2R3R**	10 F		0.2		12.5	35	
EDLHW226D2R3R**	22 F		0.1		18	35	
EDLHW306D2R3R**	30 F		0.1		18	35	
EDLHW506D2R3R**	50 F		0.1		18	40	
EDLHW706D2R1R**	70 F	2.1	0.1		18	50	
EDLF473A5R5C^	0.047 F	5.5	120	Stacked Coin	13.5	9.5	F  +85 °C
EDLF104A5R5C	0.10 F		100		13.5	9.5	
EDLF474B5R5C	0.47 F		75		21.5	9.5	
EDLF684B5R5C	0.68 F		50		21.5	9.5	
EDLF105B5R5C	1.00 F		50		21.5	9.5	
EDLNF104A5R5C^	.10 F	5.5	75	Stacked Coin	13.5	7.5	NF  +70 °C
EDLNF224A5R5C	.22 F		75		13.5	7.5	
EDLNF474B5R5C	.47 F		30		21.5	8.0	
EDLNF105B5R5C	1.0 F		30		21.5	8.0	
EDLNF155B5R5C	1.5 F		30		21.5	8.0	
EDLSG474V5R5C	.47 F	5.5	30	Stacked Coin	19	5.0	SG  +70 °C
EDLSG105V5R5C	1.0 F		30		19	5.0	
EDLSG155V5R5C	1.5 F		30		19	5.0	
EDLSG474H5R5C	.47 F	5.5	30	Stacked Coin	20	6.0	
EDLSG105H5R5C	1.0 F		30		20	6.0	
EDLSG155H5R5C	1.5 F		30		20	6.0	
EDLSD223V5R5C**	.022 F	5.5	150	Stacked Coin	10.5	5.0	SD  +70 °C
EDLSD473V5R5C**	.047 F		120		10.5	5.0	
EDLSD104V5R5C^	.10 F		75		10.5	5.0	
EDLSD224V5R5C	.22 F		75		10.5	5.0	
EDLSD334V5R5C	.33 F		75		10.5	5.0	
EDLSD223H5R5C**	.022 F		5.5		150	Stacked Coin	
EDLSD473H5R5C**	.047 F	120		11.5	5.5		
EDLSD104H5R5C^	.10 F	75		11.5	5.5		
EDLSD224H5R5C	.22 F	75		11.5	5.5		
EDLSD334H5R5C	.33 F	75		11.5	5.5		
EDLEN204A3R3S**	.20 F	3.3		200	SMT Wide Lead		6.8
EDLEN204RL3R3S**	.20 F	3.3	200	SMT Radial Lead	6.8	1.8	

\*\* Product is obsolete and no longer available.

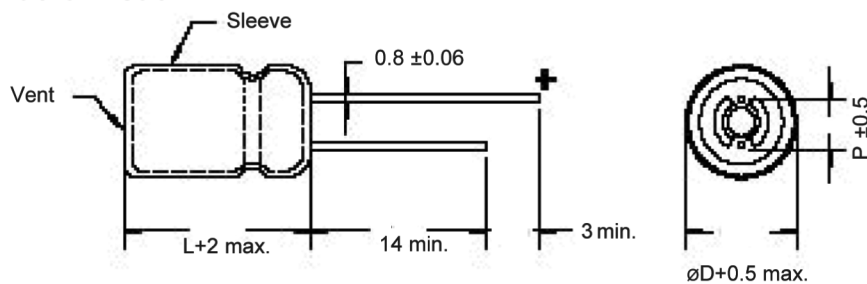
^ Product has been discontinued, replacement part is part-number below discontinued number.

# Type EDL , Electric Double Layer Supercapacitors

## Outline Drawing and Dimensions

Dimensions in mm (not to scale)

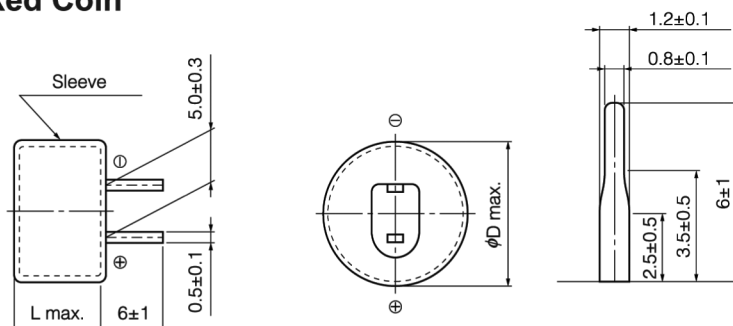
### Style HW 70° C\* Radial Lead



D	P
12.5	5
18	7.5

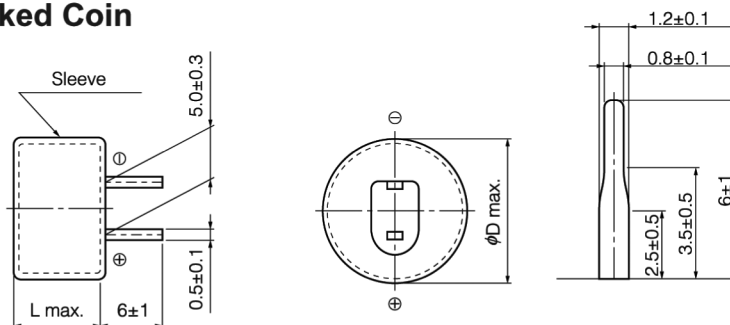
\* 30, 50, 70 F : +60 °C

### Style F 85° C Stacked Coin



Case code	Size	
	D	L
A	13.5	9.5
B	21.5	9.5

### Style NF 70° C Stacked Coin



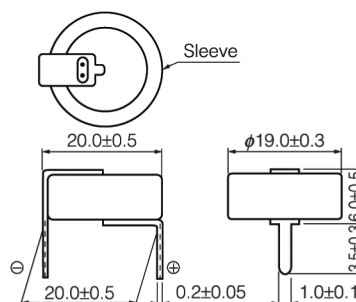
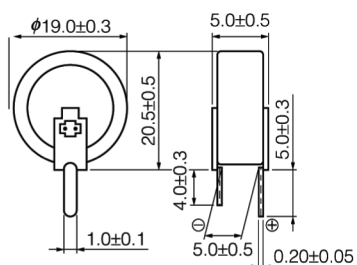
Case code	Size	
	D	L
A	13.5	7.5
B	21.5	8.0

### Style SG 70° C Stacked Coin



Terminal V

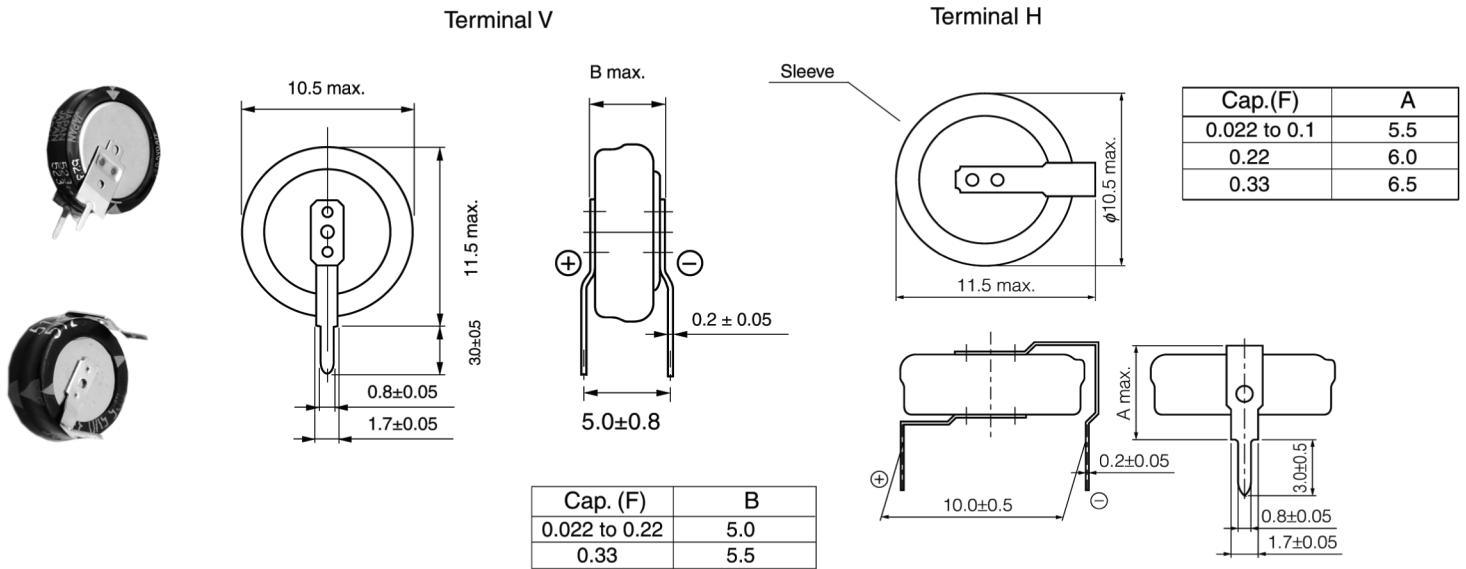
Terminal H



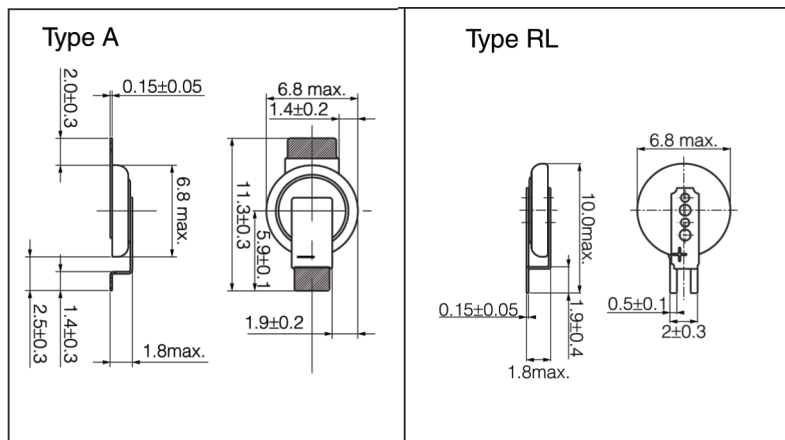
# Type EDL , Electric Double Layer Supercapacitors

## Outline Drawing and Dimensions

### Style SD 70 °C Stacked Coin



### Style EN -10 to +60 °C Surface Mount



#### Notes:

- 1 - Style EN is packaged on 24 mm wide tape and a 330 mm dia. reel, with 2000 pieces per reel.
- 2 - Only Style EN is capable of reflow soldering. Peak reflow soldering temperature is 250 °C for a maximum of 5 seconds, with a maximum of 30 seconds at or above 220 °C.
- 3 - Do not reflow solder when the cell voltage is above 0.3 V.

# Type EDL , Electric Double Layer Supercapacitors

## Applications and Recommended Series

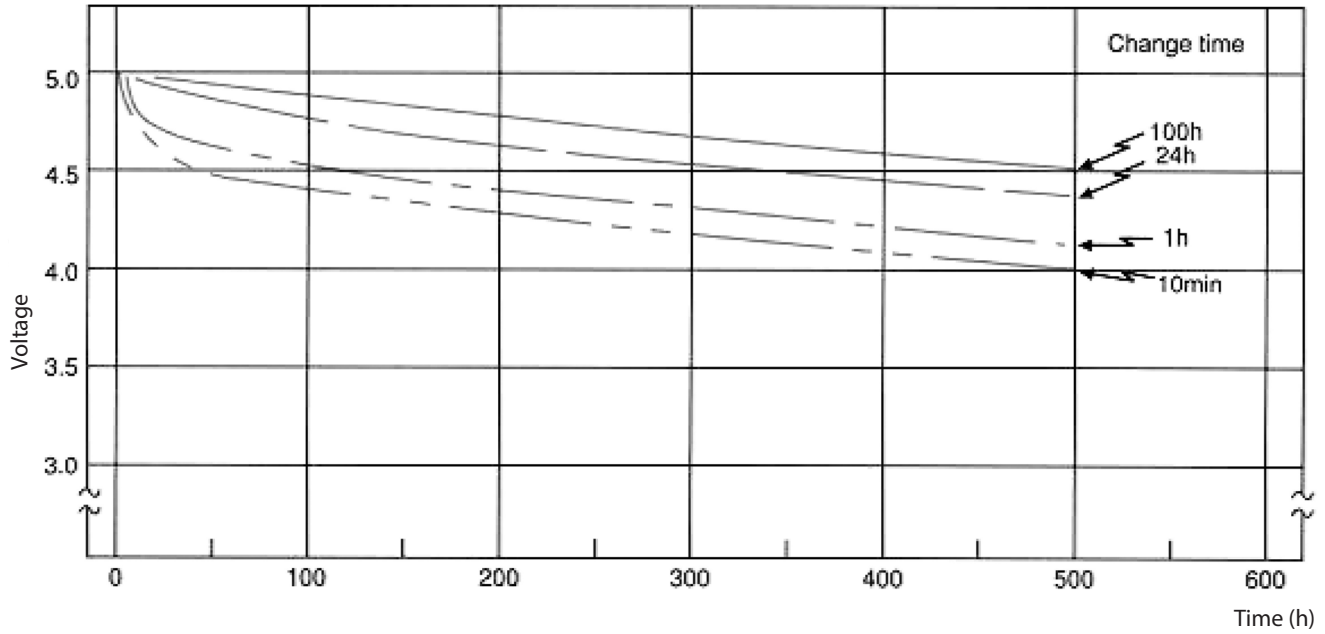
Application	Function	Recommended Series	Component
Mobile Phones	Real-Time Clock Back-Up	EN	
PDA	Real-Time Clock Back-Up		
DSC	Real-Time Clock Back-Up	EN, SD	
DVD Recorder	Real-Time Clock and Channel Back-Up	SD, SG	
Digital TV	Real-Time Clock and Channel Back-Up	SD, SG NF	
PC, Server	Real-Time Clock and Channel Back-Up	F	
Mobile Phone Base Station	Real-Time Clock and Channel Back-Up		
Inkjet Printer	Time and Impact Back-Up	SD, SG, NF	
Electric Power Gas and Water Meters	Real-Time Clock and Data Back-Up	F	
LED Light with Solar Battery	LED Lighting at Night	HW	
Toys	Motor Drives		
Toy Games	Real-Time Clock Back-Up	EN	
Robot	Real-Time Clock and Data Back-Up	F	
Car Audio Memory	Real-Time Clock Back-Up		

# Type EDL , Electric Double Layer Supercapacitors

## Performance Data

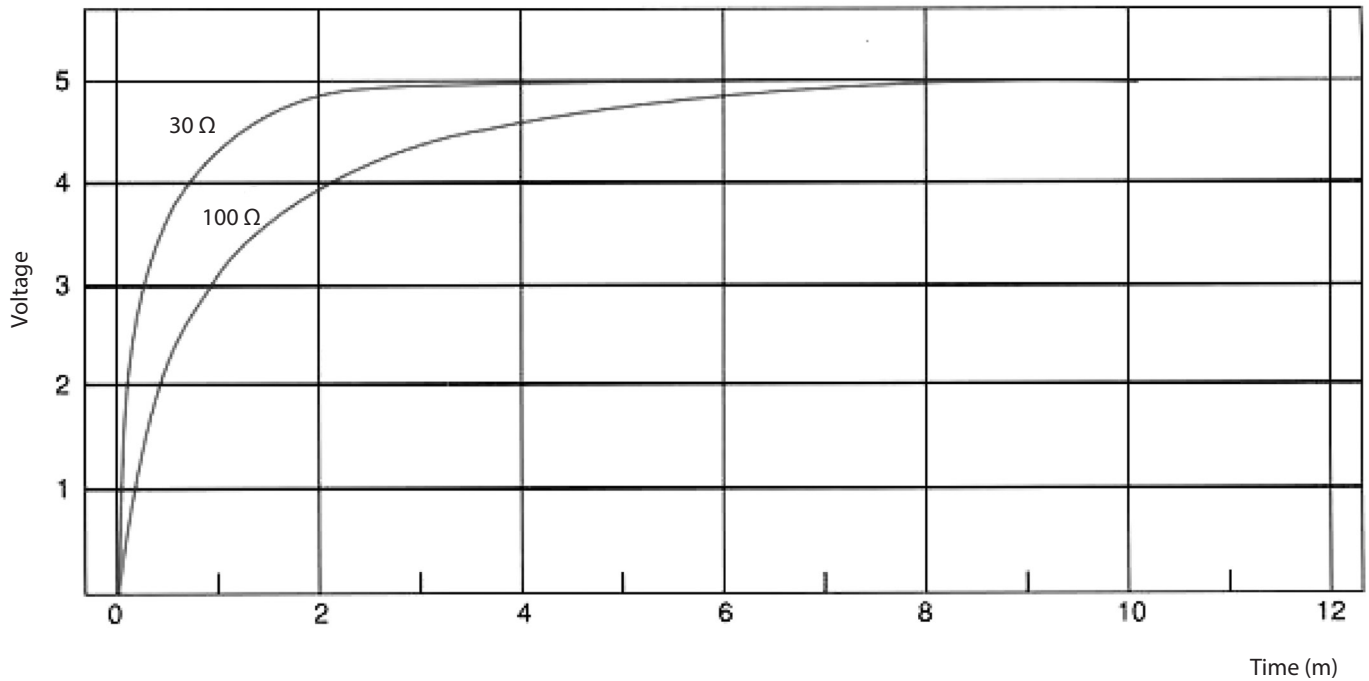
### Self-Discharging Characteristics Versus Charging Time

Part number: EDLF105B5R5C (5.5 V 1.0 F) Charge voltage: 5V



### Charging Characteristics

Part number: EDLF105B5R5C (5.5 V 1.0 F) @ +20 °C





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