Electric Double Layer Capacitors
aka Coin Cell Supercapacitors

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ENERGIZING IDEAS

Introduction

- **Objectives**
  - Explain advantages of supercapacitors over rechargeable batteries and aluminum electrolytic capacitors
  - Explain the differences between the EDC/EDS coin cell supercapacitors and conventional electrolytic capacitors
  - Provide product details, including key features and specifications, and options
  - Discuss common applications that can benefit from the higher performance of EDC/EDS coin cell supercapacitors

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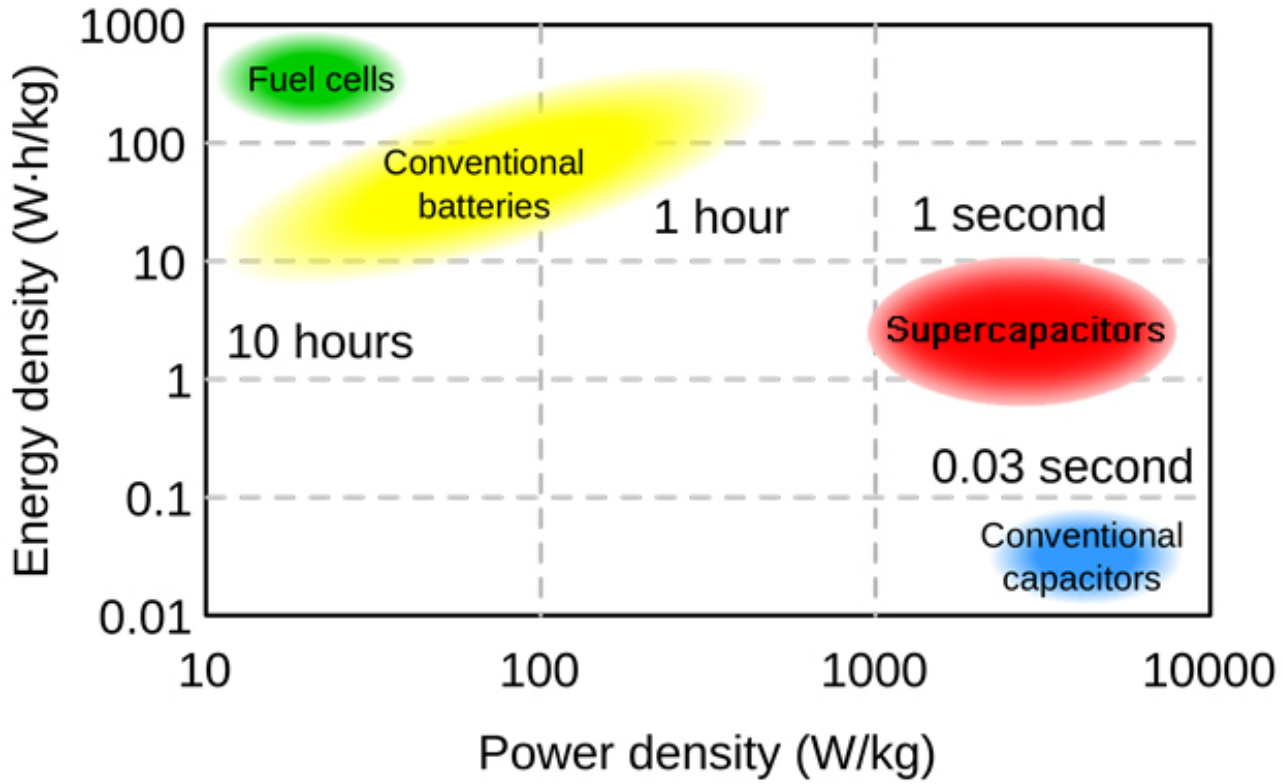
Why supercapacitors

- Bridge the gap between batteries and standard electrolytic capacitors



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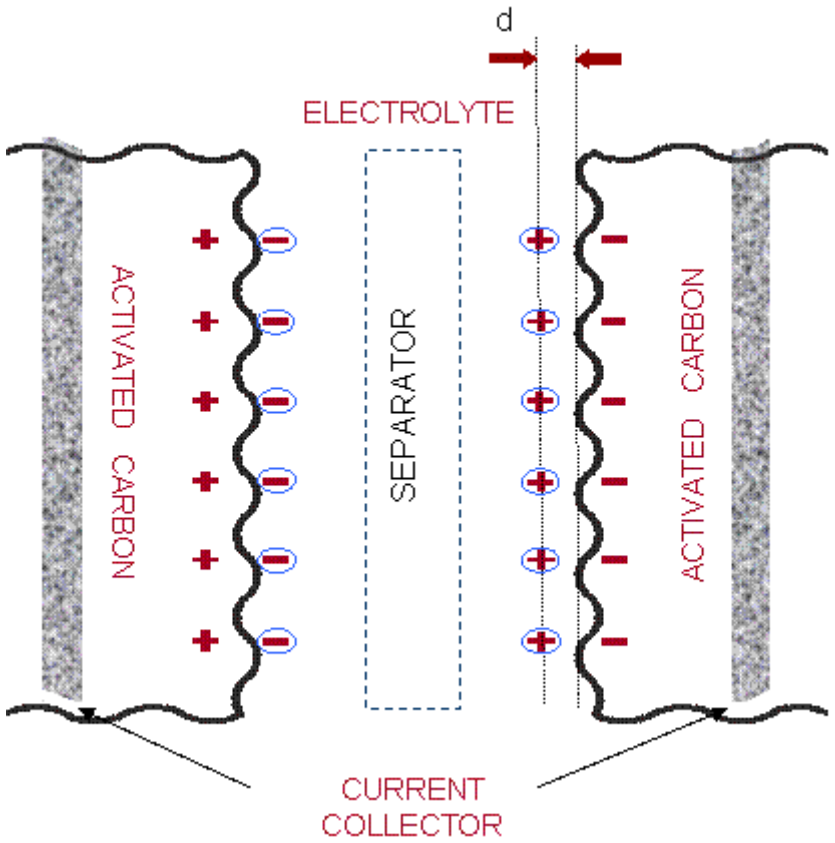
Supercapacitor Construction

- Activated Carbon electrodes
- Aqueous and non aqueous electrolyte (ACN, PC)
- No dielectric like standard capacitors
- Energy stored in carbon/ electrolyte interface area. (Electric Double layer)



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Comparison to Batteries and Capacitors

- Rechargeable Batteries
  - Highest stored energy
  - Long discharge time (1 – 3 hours)
  - Cycles (<10,000)
- Supercapacitors
  - High power density
  - Short charge/discharge time (seconds)
  - Cycles (>1,000,000)
- Capacitors (Aluminum Electrolytic)
  - High Power
  - Highest temperature Range
  - Lowest stored energy
  - Limited cycling

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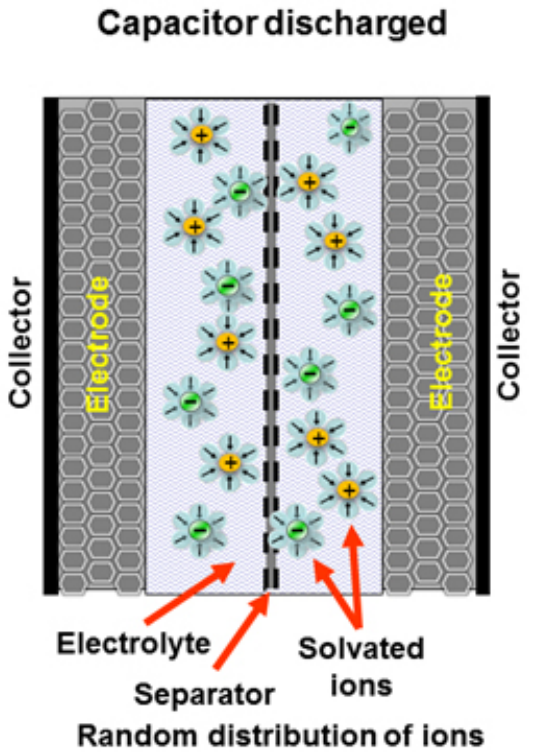
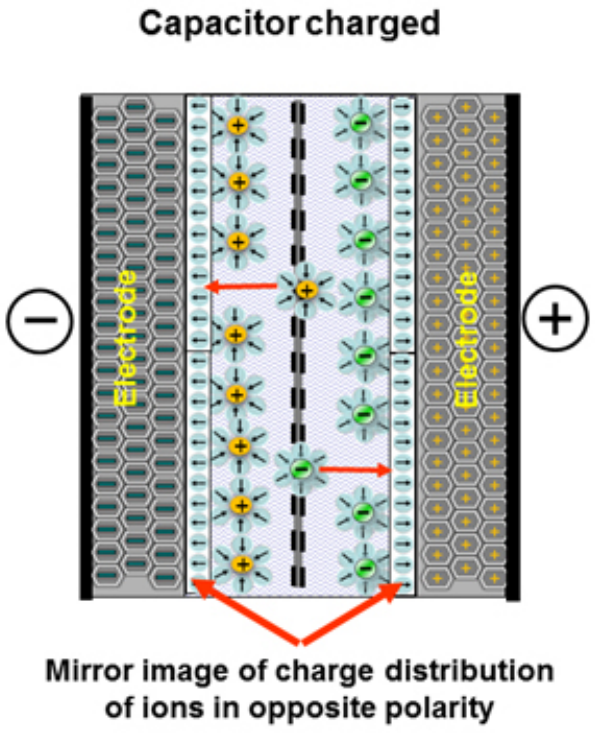
EDC/EDS Coin Cell Supercapacitors offer unique advantages

The EDC/EDS coin cells are very compact, high-capacitance devices. Compared to traditional electrolytics or rechargeable batteries, the EDC/EDS coin cells are…

- Electric double-layer capacitors (EDLC), with very large storage capabilities
- Designed around an activated carbon anode and cathode, with an organic electrolyte
- Especially well suited for charge/discharge cycling, promoting long life energy storage





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EDC/EDS Coin Cell Supercapacitors offer High Capacitance and Compact Size

- Product lines include values from 0.047 to 1.5 Farads
- 3.6, 5.5, 6.3 WVDC Max
- Operating temperature ranges from:

  (*EDS Series*) -25 °C to +85 °C

  (*EDC Series*) -25 °C to +70 °C

- Long life--rated at over 500,000 charge/discharge cycles
- Performance does not degrade with each cycle
- Very compact size
- Direct replacement for recently discontinued devices of similar values from Panasonic and others

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EDC/EDS Series Key Specifications

Operating Temperature Range	–25 °C to +70 °C **(EDC) -** –25 °C to +85 °C **(EDS)**
Rated Voltage Range	5.5 Vdc to 6.3 Vdc **(EDC)** 3.6 Vdc to 5.5 Vdc **(EDS)**
Capacitance Range	0.047 F to 1.5 F
Life, Moisture and Temperature Characteristics	After the following procedures have been performed, measure the capaci tance and ESR at +20 °C.
Life Test:	Apply the max. operating voltage for 1000 h at +70 °C
Capacitance Change **ESR**	±30% of the initial measured value ≤ 4 times the initial specified value
Shelf Life:	Subject the capacitor to 1000 hours without voltage at +70 °C.
Capacitance Change **ESR**	±30% of the initial measured value ≤ 4 times the initial specified value
Moisture Resistance:	Subject the capacitor to 240 hours at +40 °C at 90 to 95% RH without voltage.
Capacitance Change **ESR**	±30% of the initial measured value ≤ 3 times the initial specified value

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Choose from many different SKUs…
0.047 to 1.5 Farads, at 3.6, 5.5 or 6.3VDC

3.6 VDC			5.5 VDC		
CDE Part Number	Cap F	ESR 1 kHz Ω	CDE Part Number	Cap F	ESR 1 kHz Ω
EDS473Z3R6*	0.047	120	EDC473Z5R5*	0.047	120
EDS104Z3R6*	0.1	75	EDC104Z5R5*	0.1	75
EDS224Z3R6*	0.22	75	EDC224Z5R5*	0.22	75
EDS334Z3R6*	0.33	75	EDC334Z5R5*	0.33	75
EDS474Z3R6*	0.47	50	EDC474Z5R5*	0.47	50
EDS105Z3R6*	1	30	EDC105Z5R5*	1	30
EDS155Z3R6*	1.5	30	EDC155Z5R5*	1.5	30

5.5 VDC			6.3 VDC		
EDS104Z5R5C	0.1	120	EDC104Z6R3C	0.1	120
EDS224Z5R5C	0.22	75	EDC224Z6R3C	0.22	75
EDS334Z5R5C	0.33	75	EDC334Z6R3C	0.33	75
EDS474Z5R5C	0.47	50	EDC474Z6R3C	0.47	50
EDS684Z5R5C	0.68	50	EDC684Z6R3C	0.68	50
EDS105Z5R5C	1	30	EDC105Z6R3C	1	30

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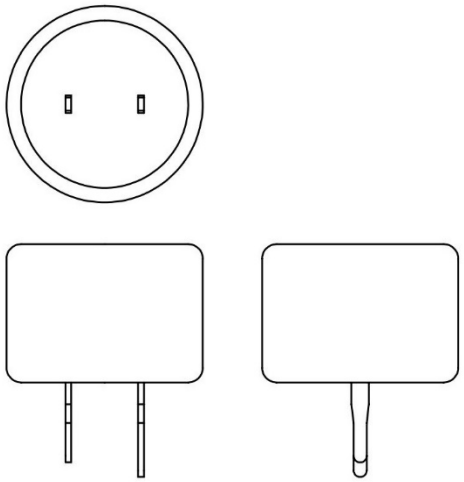
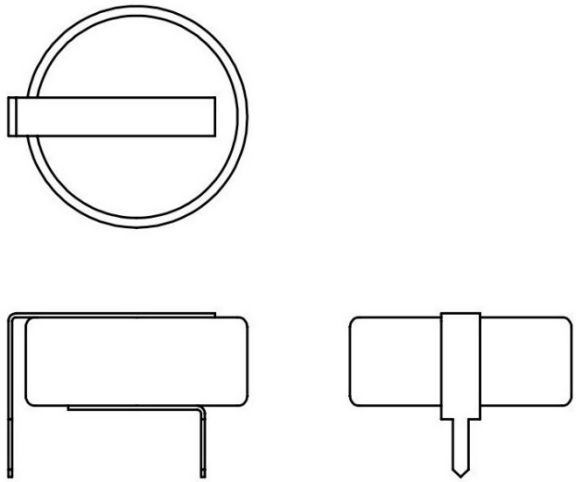
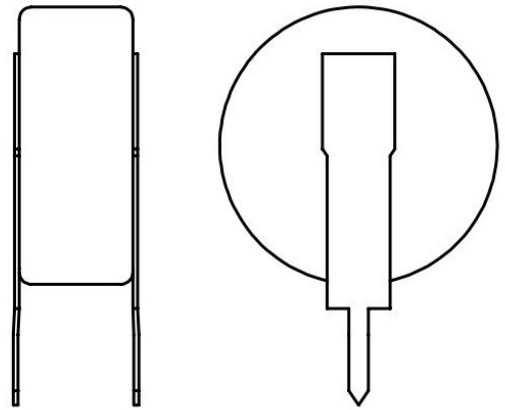
Configurations and Termination Options



RADIAL



HORIZONTAL



VERTICAL

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Cross Reference

CDE +70°C	CDE - EDL	Panasonic	Eaton	Elna
EDC104Z5R5C	EDLNF104A5R5C	EECF5R5U104	KR-5R5C104-R	DB-5R5D104T
EDC104Z5R5H	EDLSD104H5R5C	EECS0HD104H	KR-5R5H104-R	DX-5R5H104U
EDC104Z5R5V	EDLSD104V5R5C	EECS0HD104V	KR-5R5V104-R	DX-5R5V104U
EDC104Z6R3C				DK-6R3D104T
EDC105Z5R5C	EDLNF105B5R5C	EECF5R5U105	KR-5R5C105-R	DB-5R5D105T
EDC105Z5R5H	EDLSG105H5R5C	EECS5R5H105	KR-5R5H105-R	
EDC105Z5R5V	EDLSG105V5R5C	EECS5R5V105	KR-5R5V105-R	DX-5R5V105U
EDC105Z6R3C				DK-6R3D105T
EDC155Z5R5C	EDLNF155B5R5C	EECF5R5U155	KR-5R5C155-R	DB-5R5D155T
EDC155Z5R5H	EDLSG155H5R5C	EECS5R5H155	KR-5R5H155-R	
EDC155Z5R5V	EDLSG155V5R5C	EECS5R5V155	KR-5R5V155-R	DX-5R5V155U
EDC224Z5R5C	EDLNF224A5R5C	EECF5R5U224	KR-5R5C224-R	DB-5R5D224T
EDC224Z5R5H	EDLSD224H5R5C	EECS0HD224H	KR-5R5H224-R	DX-5R5H224U
EDC224Z5R5V	EDLSD224V5R5C	EECS0HD224V	KR-5R5V224-R	DX-5R5V224U
EDC224Z6R3C				
EDC334Z5R5C			KR-5R5C334-R	DB-5R5D334T
EDC334Z5R5H	EDLSD334H5R5C	EECS0HD334H	KR-5R5H334-R	DX-5R5H334U
EDC334Z5R5V	EDLSD334V5R5C	EECS0HD334V	KR-5R5V334-R	DX-5R5V334U
EDC334Z6R3C				
EDC473Z5R5C				DB-5R5D473T
EDC473Z5R5H	EDLSD473H5R5C	EECS0HD473H		DX-5R5H473U
EDC473Z5R5V	EDLSD473V5R5C	EECS0HD473V		DX-5R5V473U
EDC474Z5R5C	EDLNF474B5R5C	EECF5R5U474	KR-5R5C474-R	DB-5R5D474ST
EDC474Z5R5H	EDLSG474H5R5C	EECS5R5H474	KR-5R5H474-R	DX-5R5H474SU
EDC474Z5R5V	EDLSG474V5R5C	EECS5R5V474	KR-5R5V474-R	DX-5R5V474SU
EDC474Z6R3C				DK-6R3D474T
EDC684Z6R3C				DK-6R3D684T

CDE +85°C	CDE - EDL	Panasonic	Eaton	Elna
EDS104Z3R6C				
EDS104Z3R6H				
EDS104Z3R6V				
EDS104Z5R5C	EDLF104A5R5C	EECF5R5H104	KW-5R5C104-R	DH-5R5D104T
EDS105Z3R6C				
EDS105Z3R6H	EDLRG105H3R6C	EECRG0V105H		
EDS105Z3R6V	EDLRG105V3R6C	EECRG0V105V		
EDS105Z5R5C	EDLF105B5R5C	EECF5R5H105	KW-5R5C105-R	DH-5R5D105T
EDS155Z3R6C				
EDS155Z3R6H		EECRG0V155H		
EDS155Z3R6V		EECRG0V155V		
EDS224Z3R6C				
EDS224Z3R6H	EDLRD224H3R6C	EECRG0V224H		
EDS224Z3R6V	EDLRD224V3R6C	EECRG0V224V		
EDS224Z5R5C			KW-5R5C224-R	DH-5R5D224T
EDS334Z3R6C				
EDS334Z3R6H				
EDS334Z3R6V				
EDS334Z5R5C			KW-5R5C334-R	
EDS473Z3R6C				
EDS473Z3R6H				
EDS473Z3R6V				
EDS474Z3R6C				
EDS474Z3R6C				
EDS474Z3R6H				
EDS474Z3R6V				
EDS474Z5R5C	EDLF474B5R5C	EECF5R5H474		DH-5R5D474T
EDS684Z5R5C	EDLF684B5R5C	EECF5R5H684	KW-5R5C684-R	DH-5R5D684T

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General Uses for Supercapacitors

- Due to their much faster charge/discharge times and number of cycles permitted, supercaps are being used in place of batteries to provide frequent short bursts of energy.

- When supercapacitors are placed in parallel with batteries they reduce the stress on the battery by providing quick bursts of energy to the load. This greatly extends battery life and can lower the overall size and cost of the battery. In some applications, supercapacitors may even replace battery.

- Provide sustained memory backup during power outages without use of batteries.

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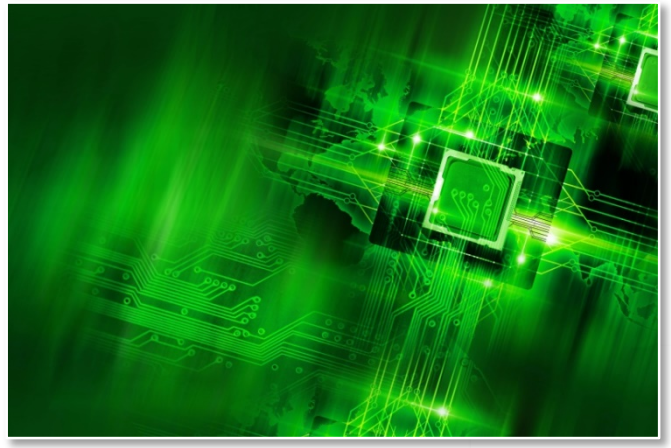
Applications

- On-board CPU memory backup circuits
- RTC – Real Time Clock - Battery Backup
- Smart Utility Meters - AMR
- Solar Battery Backup and Energy Storage
- IoT - Energy harvesting/storage
- Industrial controls
- Telematics



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Summary

EDC/EDS Coin Cell Supercapacitors are an economical solution to satisfying the need for on-board very high capacitance storage.

- Standard values available from 0.047 to 1.5 Farads in the range of 3.6 to 6.3 WVDC
- 10 year/500,000+ cycle operating life exceeds typical end-product life
- Unlike batteries, performance does not degrade with each charge/discharge
- Very compact size aids product design flexibility
- Provides instantaneous backup power for memory circuitry

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