

Ultracapacitor, Ultra-condensador, Extrême-condensateur,
Ultra-Kondensator, 超級電容, 超コンデンサ

POWERED TO MOVE

The world leader in ultracapacitor technology
with proprietary electrode
and manufacturing processes





New Energy Storage System

NESS

CAPacitor

CAP

R&D - since 1998

Global Marketing - since 2000

Mass Production - since 2001

Awards



- 2012** | - Nominated as a Promising Small and Medium-sized Enterprise by Korean government
- 2010** | - Nominated as one of the top 10 companies in Asia Pacific in the Global Cleantech 100 annually held by Cleantech Group LLC
- 2005** | - IEEE Spectrum's "Special Technology Issue Winner Device" in 2005
- Nominated for a primary contractor of "Development of 3V Ultracapacitors and HEV" from Korean government
- Selected as a primary contractor for the research and development of "Freedom Car Project" sponsored by USABC
- 2002** | - KT (Excellent Korean Technology) Mark from the Ministry of Science and Technology of Korea
- Nominated for "Good Company" by KTCGF (Korean Technology Credit Grantee Fund)
- Selected as a primary contractor for "42V System Development Project" conducted by Ministry of Science and Technology of Korea
- Selected as a primary contractor for "Development of Intelligent Transportation System Using Pseudocapacitors" conducted by Ministry of Commerce, Industry and Energy
- 2000** | - IR52 Award from the Minister of Science and Technology of Korea for NESSCAP EDLC (Electric Double Layer Capacitor)
- Power 2000, Chairman's Choice Component Award for EDLC in San Diego

History

- 2013** - Third factory established at Youngcheon site
- 2012** - \$8.5M Financing from I2BF Energy Ltd. and I two BF Arbat Technology Fund Ltd.
- Nominated as a Promising Small and Medium-sized Enterprise by Korean government
- 2011** - QC/T 741 for 48V 166F module, certified by China Quality Certification Centre ("CQC")
- Listed in TSX Venture Exchange (Stock Symbol: NCE)
- 2010** - Launched 16V, 64V, 86V, series modules and 125V module
- Second factory established at Dongtan site
- 2009** - Launched 48V series modules
- I2BF invests in Nesscap Co., Ltd.
- 2008** - Wealthbridge invests in Nesscap Co., Ltd.
- 2007** - ISO/TS 16949/2002, certified by Kiwa INTERNATIONAL CERT Zertifizierung GmbH
- CE Certification approval from TÜV Rheinland Product Safety GmbH
- 2006** - ISO 14001:2004, certified by Korea International Standards Certification
- ABB certifies Nesscap as "Approved Supplier"
- 2004** - Factory expansion and relocation to Giheung site
- 2003** - ISO 9001:2000, certified by DAS Certification Ltd
- Solectria "Super 7" Project - 8000 miles of trouble free hybrid driving with Nesscap ultracapacitor module
- 2002** - Singapore Technologies Kinetics invests in NESS Capacitor Co., Ltd.
- NESS Capacitor Co., Ltd. renamed to Nesscap Co., Ltd.
- 2001** - New enhanced EDLC product-line introduced at 42 Volt System Conference
- Japanese company invests in NESS Capacitor and begins marketing of NESS EDLC in Japan
- Capacitor factory established at Sangal site
- 2000** - NESS EDLC cited for top performance in comparison test at 11th Int'l Seminar on EDLC held at Deerfield
- NESS Capacitor Co., Ltd. spun off from NESS Corp.
- First commercial shipment of large-size EDLC to US market
- 1999** - NESS EDLC makes debut appearance at 10th Int'l Seminar on EDLC held at Deerfield Beach, Florida
- NESS Corporation founded
- 1998** - NESS center officially established at Institute for Advanced Engineering (IAE)
- Feasibility study of energy storage and display device technology

Facilities



Head Office and Factory - 1



Factory - 2



Factory - 3

ULTRA CAPACITOR



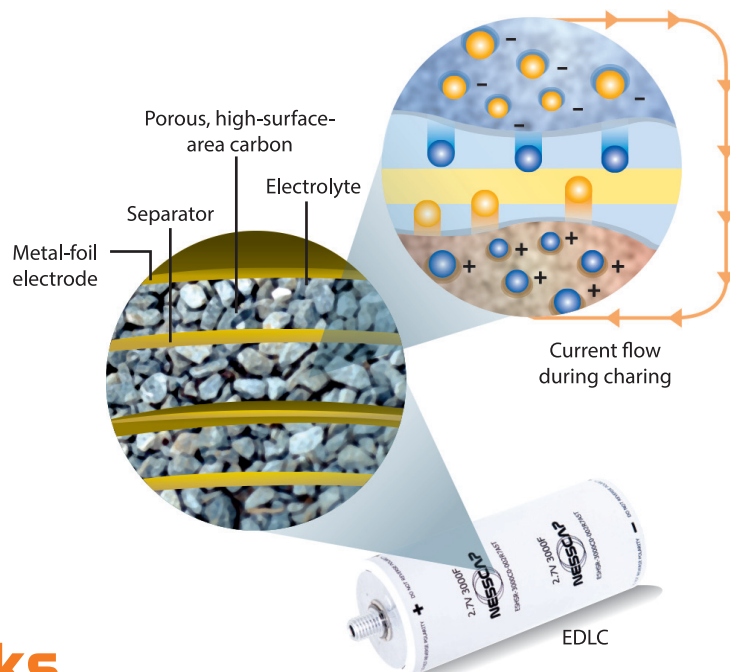
Overview

Ultracapacitor, also known as supercapacitor, supercondenser, electric double layer capacitor (EDLC) or pseudocapacitor, is an electric capacitor that has an unusually high energy density when compared to common capacitors, typically on the order of thousands of times greater than a high capacity electrolytic capacitor.

Compared to batteries, ultracapacitors are capable of more than ten times the power and more than thousand times the cycle life. These are two main reasons why engineers choose ultracapacitors over batteries in different applications. Ultracapacitors are proven energy storage devices that can replace conventional capacitors or batteries in many applications that require much more energy than what conventional capacitors are able to provide and that also require higher power outputs that batteries cannot provide.

Table. Comparison between ultracapacitor and battery

| Parameters | Electrostatic Capacitor | Ultracapacitor | Battery |
|-------------------------------|-------------------------|----------------|-----------|
| Discharge Time | $10^6 \sim 10^3$ sec | 1~30 sec | 0.3~3 hrs |
| Charge Time | $10^6 \sim 10^3$ sec | 1~30 sec | 1~5 hrs |
| Energy Density (Wh/kg) | < 0.1 | 1~10 | 20~100 |
| Power Density (W/kg) | < 10,000 | 10,000 | 50~200 |
| Charge / Discharge Efficiency | ~ 1.0 | ~ 1.0 | 0.7~0.85 |
| Cycle Life | Infinite | > 500,000 | 500~2,000 |



How it works

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Nesscap benefit



Nesscap has a holistic and comprehensive understanding of how to make an ultracapacitor, as evident through its long history in innovation and research. Nesscap's product development is based on that understanding of the interrelationship between all the parts that make up an ultracapacitor cell. Significant resources are allocated to focus on the following critical areas in product development:

- Complete qualification and verification of raw materials and relevant vendors
- Identification of all required manufacturing process control parameters
- Optimization of the operational voltage
- Optimization of electrode formulation to meet market requirements

Market overview

The average market growth rate of ultracapacitor in past 10 years is 25% and most analysts predict growth rate of the market for next 10 years at greater than 30% year over year. Primary area of growth will be in mass customization of power modules and systems for automotive applications, such as micro/mild hybrid vehicle and boardnet stabilization, and green technology applications, such as windmill blade pitch control and smart utility meters. Nesscap's robust ultracapacitors are ideal solutions for these applications.

Nesscap's major markets are in the consumer, industrial and automotive areas. Each of these markets has its own unique requirements and characteristics that must be satisfied. Applications in these markets are listed below.



Mobility

| Application | Function | Applicable Products |
|--------------------------------|---|------------------------|
| Hybrid Forklift | Energy Storage System Auxiliary Power Source | Large Cells Modules |
| Hybrid Excavator | | |
| Trains, Trams, Subways | | |
| Heavy Duty Vehicles | | |
| Automated Guided Vehicle (AGV) | | |

APPLICATIONS

Industrial / Consumer



| Application | Function | Applicable Products |
|---|---|--|
| AMR | Peak Pulse Power | Small Cells, Modules |
| Robotic Systems | Memory Backup | Medium & Large Cells Modules |
| Actuator | Emergency Backup Power | Small & medium cells |
| Toys | Battery Replacement | Small & Medium Cells EDLC or Pseudocapacitor Small Modules |
| Portable Electronics (PDAs, Hand Terminals, other Portable Gadgets) | Battery Replacement Peak Pulse Power | |
| Solid-State Drive (SSD) | Memory Backup | |
| Flashlight | Energy storage system | |
| Power Tool | | |

Renewable energy



| Application | Function | Applicable Products |
|-------------------------------|---|---------------------------------|
| Windmill Pitch Control System | Emergency Backup Power | Medium & Large Cells Modules |
| Solar tile / lighting | Battery Replacement Energy Storage System | All Cells Modules |
| Solar light generator | Emergency Backup Power Energy Storage System | Medium & Large Cells Modules |

Automotive



| Application | Function | Applicable Products |
|-------------------------------------|--|---------------------------------|
| X-by-Wire | Electronically Controlled Braking (ECB) Electric Power Steering (EPS) | Medium & Large Cells Modules |
| Engine Start | Peak Power Cold Cranking | Large Cells Modules |
| Fuel-cell Vehicles | In-rush Power Supply Load Leveling | |
| Micro / Mild & Full Hybrid Vehicles | Energy Storage System Peak Power Assist Auxiliary Power Source | |
| Heavy Duty Vehicles | | |
| Transit Bus | | |

Small

| | |
|-------------------|---|
| Capacitance (F) | 3 ~ 50 |
| Voltage (V) | 2.3 and 2.7 |
| Solvent | Propylene carbonate and acetonitrile |
| Terminal type | Radial lead |
| Form factor | Cylindrical |
| Major application | AMR, Consumer electronics, SSD and more |

Nesscap's small-sized EDLC cells range from 3F to 50F in capacitance with operating voltages ranging from 2.3V to 2.7V. These cells can be used in various types of applications which mainly require smaller amounts of capacitance but immediate pulse power, such as, AMR (Automatic Meter Reading), consumer electronics and SSDs (Solid State Drives)



Medium

| | |
|-------------------|--|
| Capacitance (F) | 90 ~ 360 |
| Voltage (V) | 2.3 and 2.7 |
| Solvent | Propylene carbonate and acetonitrile |
| Terminal type | Snap in |
| Form factor | Cylindrical |
| Major application | Flashlight, Windmill pitch control system, Robotics, DVR (Dynamic Voltage Restorer), Indoor crane and more |

Nesscap's medium-sized EDLC cells range from 90F to 360F in capacitance with operating voltages ranging from 2.3V to 2.7V. These 'snap in' type cells offer more durable connectivity & functionality to meet the requirements of industrial applications, such as, windmill pitch control systems, robotics, DVR (Dynamic Voltage Restorer), and indoor cranes. Other applications include power tools and LED flashlights.



Large prismatic

| | |
|-------------------|----------------------------------|
| Capacitance (F) | 600 ~ 5000 |
| Voltage (V) | 2.7 |
| Solvent | Acetonitrile |
| Terminal type | Screw |
| Form factor | Prismatic |
| Major application | Tram, Military, Vehicle and more |

Nesscap's large-sized prismatic EDLC cells range from 600F to 5000F in capacitance with operating voltage of 2.7V. These cells were originally developed and used for heavy duty motive applications such as tram, military, and other vehicles. These cells provide an optimized structural advantage due their prismatic footprint for integration in space constrained applications.



Large cylindrical

| | |
|-------------------|--|
| Capacitance (F) | 650 ~ 3000 |
| Voltage (V) | 2.7 |
| Solvent | Acetonitrile |
| Terminal type | Weldable and Threaded |
| Form factor | Cylindrical |
| Major application | Transit bus, Heavy duty vehicle, Hybrid vehicle, Harbor crane and more |

Nesscap's large-sized cylindrical EDLC cells range from 650F to 300F in capacitance with operating voltage of 2.7V. These cells were developed to meet market requirements for robustness, compact size, high energy density, and long cycle life. These cells incorporate superior leakage protection and industry lead in shock, rotation and vibration safeguards. These cells are available with threaded or weldable terminals.



Pseudocapacitor

| | |
|-------------------|--------------------------------------|
| Capacitance (F) | 50 ~ 300 |
| Voltage (V) | 2.3 |
| Solvent | Propylene carbonate and acetonitrile |
| Terminal type | Radial lead and Snap in |
| Form factor | Cylindrical |
| Major application | Flashlight, Solar tile and more |

Nesscap's small and medium-sized Pseudocapacitor cells range from 50F to 300F in capacitance with operating voltage of 2.3V. This proprietary technology is one of the first commercially available hybrid capacitor products on the market. A Pseudocapacitor will store approximately twice the energy of a typical EDLC of the same size and weight with lower cost per unit of energy. There is a growing and significant opportunity for Pseudocapacitors especially in portable and handheld products.



Module

| | |
|-------------------|--|
| Capacitance (F) | 1.5 ~ 500 |
| Voltage (V) | 5 ~ 125 |
| Solvent | Acetonitrile |
| Terminal type | Radial lead and screw |
| Form factor | Various |
| Major application | AMR, Consumer electronics, Transit bus, Heavy duty vehicle, Tram, Windmill pitch control system and more |





Nesscap offers multi-cell modules with operating voltages of 5V, 16V, 48V, 64V, 86V, and 125V, to satisfy higher voltage requirements of many integrated systems. These standardized multi-cell modules can simply be connected in series to meet even higher voltage requirement. 5V modules (composed of two 2.7V 3F cells connected in series) are typically used for AMR and other applications which require small amount of capacitance and mainly used for small pulse power. 16V and higher voltage modules are composed of large cylindrical cells target the automotive and industrial application such as transit bus and heavy duty vehicles.



PRODUCTS



Lineup Matrix ■ SINGLE CELLS

| | | Rated Voltage (V) | Rated Capacitance (F) | ESR _r (mohm) | | Max. Current (A) | Leakage Current (mA) | Stored Energy (Wh) | Specific Energy (Wh/kg) | Dimension (mm) | | | | Terminal | Volume (ml) | Weight (g) | Part Number |
|-------------|---|-------------------|-----------------------|-------------------------|-------|------------------|----------------------|--------------------|-------------------------|----------------------------|----------------|-------------------|-------------|-------------|-------------|-----------------------|-----------------------|
| | | | | AC | DC | | | | | 1 sec to 1/2V _r | 72 hours, 25°C | at V _r | Gravimetric | | | | |
| EDLC |  | 2.7 | 3 | <61 | <79 | 3.3 | <0.005 | 0.003 | 2.00 | 8 | 20 | | | Radial lead | 1.0 | 1.5 | ESHSR-0003C0-002R7 |
| | | 2.7 | 5 | <29 | <38 | 5.7 | <0.008 | 0.005 | 2.17 | 10 | 20 | | | Radial lead | 1.6 | 2.3 | ESHSR-0005C0-002R7 |
| | | 2.7 | 6 | <26 | <34 | 6.7 | <0.017 | 0.006 | 2.61 | 8 | 30 | | | Radial lead | 1.5 | 2.3 | ESHSR-0006C0-002R7 |
| | | 2.7 | 10 | <26 | <34 | 10.1 | <0.023 | 0.010 | 3.13 | 10 | 30 | | | Radial lead | 2.4 | 3.2 | ESHSR-0010C0-002R7 |
| | | 2.7 | 25 | <21 | <27 | 20.1 | <0.049 | 0.025 | 3.85 | 16 | 25 | | | Radial lead | 5.0 | 6.5 | ESHSR-0025C0-002R7 |
| | | 2.7 | 50 | <14 | <18 | 35.5 | <0.073 | 0.051 | 4.51 | 18 | 40 | | | Radial lead | 10.2 | 11.3 | ESHSR-0050C0-002R7 |
| |  | 2.7 | 90 | <6 | <8 | 70.6 | <0.20 | 0.091 | 4.23 | 22 | 45 | | | Snap in | 17.1 | 21.5 | ESHLR-0090C0-002R7 |
| | | 2.7 | 100 | <9 | <12 | 61.4 | <0.26 | 0.101 | 4.81 | 22 | 45 | | | Snap in | 17.1 | 21.0 | ESHSR-0100C0-002R7 |
| | | 2.7 | 325 | <1.6 | <1.9 | 271 | <0.45 | 0.329 | 5.06 | 33 | 63 | | | 2X2 in | 55.6 | 65.0 | ESHLR-0325C0-002R7A2 |
| | | 2.7 | 360 | <3.2 | <3.2 | 226 | <0.75 | 0.365 | 5.45 | 36 | 64 | | | Snap in | 65.1 | 67.0 | ESHSR-0360C0-002R7A |
| |  | 2.7 | 600 | <0.64 | <0.83 | 541 | <1.7 | 0.608 | 2.9 | | 90 | 60 | 28 | Screw | 151 | 210 | ESHSP-0600C0-002R7 |
| | | 2.7 | 1700 | <0.50 | <0.65 | 1090 | <2.4 | 1.721 | 4.47 | | 165 | 60 | 28 | Screw | 277 | 385 | ESHSP-1700C0-002R7 |
| | | 2.7 | 3500 | <0.28 | <0.36 | 2091 | <5.5 | 3.544 | 5.17 | | 165 | 60 | 52 | Screw | 515 | 685 | ESHSP-3500C0-002R7 |
| | | 2.7 | 5000 | <0.25 | <0.33 | 2547 | <8.1 | 5.063 | 5.44 | | 165 | 60 | 72 | Screw | 713 | 930 | ESHSP-5000C0-002R7 |
| |  | 2.7 | 650 | <0.50 | <0.60 | 610 | <1.5 | 0.658 | 3.21 | 60 | 52 | | | Weldable | 164 | 205 | ESHSR-0650C0-002R7A5 |
| | | | | | | | | | 3.13 | 60 | 53 | | | Threaded | 223 | 210 | ESHSR-0650C0-002R7A5T |
| | | 2.7 | 1200 | <0.40 | <0.48 | 1000 | <2.7 | 1.215 | 4.34 | 60 | 74 | | | Weldable | 228 | 280 | ESHSR-1200C0-002R7A5 |
| | | | | | | | | | 4.26 | 60 | 75 | | | Threaded | 288 | 285 | ESHSR-1200C0-002R7A5T |
| | | 2.7 | 1600 | <0.34 | <0.41 | 1270 | <3.0 | 1.620 | 4.84 | 60 | 85 | | | Weldable | 259 | 335 | ESHSR-1600C0-002R7A5 |
| | | | | | | | | | 4.76 | 60 | 86 | | | Threaded | 319 | 340 | ESHSR-1600C0-002R7A5T |
| | | 2.7 | 2000 | <0.28 | <0.33 | 1580 | <4.2 | 2.025 | 5.19 | 60 | 102 | | | Weldable | 307 | 390 | ESHSR-2000C0-002R7A5 |
| | | | | | | | | 5.13 | 60 | 103 | | | Threaded | 367 | 395 | ESHSR-2000C0-002R7A5T | |
| | | | | | | | 5.73 | 60 | 138 | | | | Weldable | 410 | 530 | ESHSR-3000C0-002R7A5 | |
| | | | | | | | 5.68 | 60 | 139 | | | | Threaded | 470 | 535 | ESHSR-3000C0-002R7A5T | |

| | | | | | | | | | | | | | | | | | |
|---------------|---|-----|-----|-----|-----|------|--------|-------|------|----|----|--|--|-------------|------|------|--------------------|
| Pseudo |  | 2.3 | 50 | <24 | <36 | 20.5 | <0.076 | 0.037 | 4.87 | 16 | 25 | | | Radial lead | 5 | 7.6 | PSHLR-0050C0-002R3 |
| | | 2.3 | 120 | <18 | <27 | 35.5 | <0.172 | 0.088 | 5.87 | 18 | 40 | | | Radial lead | 10.2 | 15 | PSHLR-0120C0-002R3 |
| | | 2.3 | 300 | <12 | <18 | 53.9 | <0.96 | 0.220 | 8.73 | 22 | 45 | | | Snap in | 19 | 25.2 | PSHLR-0300C0-002R3 |

Lineup Matrix ■ Modules

| | Rated Voltage (V) | Rated Capacitance (F) | ESR, (mohm) | | Max. Current (A) | Leakage Current (mA) | Stored Energy (Wh) | Specific Energy (Wh/kg) | Dimension (mm) | | | | Terminal | Weight (g) | Part Number | |
|---------------------|-------------------|-----------------------|-------------|-------|------------------|----------------------|--------------------|-------------------------|----------------|-----|-----|------|----------|---------------------|-------------|----------------------------|
| | | | AC | DC | | | | | D | L | W | T | | | | |
| | | | | | | | | | | | | | | | | 1 sec to 1/2V _r |
| Std. Modules | | 5 | 1.5 | <110 | <143 | 2.2 | <0.02 | 0.005 | 1.47 | 10 | 23 | 17.5 | | Radial lead | 3.4 | EMHSR-0001C5-005R0 |
| | | 5 | 2.5 | <53 | <69 | 4.4 | <0.04 | 0.009 | 1.80 | 12 | 23 | 21.5 | | Radial lead | 5 | EMHSR-0002C5-005R0 |
| | | 16 | 108 | <3.6 | <4.3 | 580 | <1.5 | 3.9 | 1.30 | 227 | 136 | 70 | | Internally threaded | 3.0kg | EMHSR-0108C0-016R0V |
| | | 16 | 108 | <3.6 | <4.3 | 580 | <1.5 | 3.9 | 1.05 | 422 | 73 | 68.5 | | Internally threaded | 3.7kg | EMHSR-0108C0-016R0S |
| | | 16 | 200 | <2.9 | <3.5 | 930 | <2.7 | 7.2 | 1.75 | 422 | 73 | 91 | | Internally threaded | 4.1kg | EMHSR-0200C0-016R0S |
| | | 16 | 166 | <2.5 | <3.0 | 1160 | <3.0 | 9.7 | 2.10 | 422 | 73 | 102 | | Internally threaded | 4.6kg | EMHSR-0266C0-016R0S |
| | | 16 | 333 | <2.0 | <2.4 | 1450 | <4.2 | 12.1 | 2.37 | 422 | 73 | 119 | | Internally threaded | 5.1kg | EMHSR-0333C0-016R0S |
| | | 16 | 500 | <1.6 | <1.9 | 2020 | <5.2 | 18.2 | 3.03 | 422 | 73 | 155 | | Internally threaded | 6.0kg | EMHSR-0500C0-016R0S |
| | | 48 | 36 | <10.8 | <13.0 | 580 | <1.5 | 11.8 | 1.38 | 430 | 200 | 68.5 | | Internally threaded | 8.5kg | EMHSR-0036C0-048R0S |
| | | 48 | 66 | <8.6 | <10.4 | 920 | <2.7 | 21.7 | 2.17 | 430 | 200 | 91 | | Internally threaded | 10.0kg | EMHSR-0066C0-048R0S |
| | | 48 | 88 | <7.3 | <8.9 | 1160 | <3.0 | 28.9 | 2.51 | 430 | 200 | 127 | | Internally threaded | 11.5kg | EMHSR-0088C0-048R0S |
| | | 48 | 111 | <6.0 | <7.1 | 1460 | <4.2 | 36.4 | 2.91 | 430 | 200 | 144 | | Internally threaded | 12.5kg | EMHSR-0111C0-048R0S |
| | | 48 | 166 | <4.8 | <5.6 | 2030 | <5.2 | 54.5 | 3.63 | 430 | 200 | 180 | | Internally threaded | 15.0kg | EMHSR-0166C0-048R0S |
| | | 64 | 83 | <8.1 | <9.5 | 1460 | <4.2 | 48.4 | 3.22 | 420 | 297 | 121 | | Internally threaded | 15.0kg | EMHSR-0083C0-064R0S |
| | | 64 | 125 | <6.4 | <7.5 | 2030 | <5.2 | 72.9 | 3.83 | 430 | 297 | 157 | | Internally threaded | 19.0kg | EMHSR-0125C0-064R0S |
| | | 86 | 62 | <10.8 | <12.7 | 1460 | <4.2 | 64.2 | 3.05 | 542 | 297 | 123 | | Internally threaded | 21.0kg | EMHSR-0062C0-086R0S |
| | | 86 | 93 | <8.4 | <7.5 | 2030 | <5.2 | 96.4 | 3.70 | 542 | 297 | 159 | | Internally threaded | 26.0kg | EMHSR-0093C0-086R0S |
| | | 125 | 62 | <12.7 | <15.0 | 1850 | <5.2 | 134.5 | 2.36 | 560 | 426 | 245 | | Internally threaded | 57.0kg | EMHSR-0062C0-125R0S |

POWERED TO MOVE NESSCAP

The world leader in ultracapacitor technology with proprietary electrode and manufacturing processes.





ISO/TS 16949:2002



ISO 14001:2004



ISO 9001:2000



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