Creative Energy & Materials Solution Leader

A creative leader in technology on the foundation of continuous improvement and innovation.

Core Value

Excellence  Customer  Innovation

Business Areas

Small Size Battery  Automotive Battery  ESS Battery  Electronic Materials
ESS Battery Business
As a specialized manufacturer of lithium-ion batteries, Samsung SDI is leading the growth of the ESS market with our customers.

Business History
- 1970: Established Samsung SDI
- 2000: Began Lithium-ion Battery Business
- 2008: Began Battery Business for Automotives
- 2010: Began Battery Business for Energy Storage
- 2011: Long-term Supply Contract for Residential Batteries
- 2017: Total Installation Over 1.3GWh of ESS batteries
- 2013: Established JV Company in China
- 2014: No. 1 Market Share for Residential ESS in Japan
- 2015: Supplied UPS Batteries to Data Centers
- 2012: 1970: Established
- 2011: Long-term Supply Contract for Residential Batteries
- 2008: Began Battery Business for Automotives

Sales & Production Sites
- Germany: Munich
- Korea: Gyeonggi
  - Cheonan
  - Ulsan
  - Suwon
- Japan: Tokyo
- China: Hefei
- China: Xian
- USA: San Jose, CA

Battery Solutions for ESS
Samsung SDI provides optimal lithium-ion battery solutions ranging from residential to utility-scale ESS.

Applications of ESS
- ESS (Energy Storage System)
- EMS (Energy Management System)
- PCS (Power Conversion System)

Product Lineup
- Utility & Commercial
- UPS
- Residential & Telecom
- Module, Rack, Enclosure
- Module, Enclosure
- Module

Lithium-ion Cells
Why Samsung SDI

Samsung SDI designs optimized battery systems through its excellence in cell technology.

Safety First

Multi-layered protection at the cell level resulting in best in class safety.

- **Fuse**
  - Interrupts current in case of an external short
- **Separator**
  - Stops the chemical reaction at excessive temperatures
- **NSD**
  - Protects against shorts induced by penetration.
- **Vent**
  - Degasses in case of excessive internal pressure
- **Aluminum Can**
  - Prevents swelling due to solid cell housing and corrosion due to positive polarity
- **SFL**
  - Prevents short between anode and cathode

Long Cycle Life

Samsung SDI’s prismatic cell has sufficient electrolyte and a stable structure resulting in extended cycle life.

- **Winding**
  - (Prismatic type)
- **Stack & Folding**
  - (Pouch type)

Sustainable Design

Increasing the capacity of the cell while maintaining the same form factor and cell dimensions achieves higher density while retaining battery pack design.

Higher Capacity in Same Form Factor

- **Higher Capacity without Change in Pack Design**

Accurate Lifetime Simulation

Samsung SDI offers optimal battery solutions with its superior lifetime prediction technology.

- **Customer’s Load Profile**
  - Aging Parameter
  - Lifetime Estimation Using Semi-Empirical Simulation Method
  - Operation Planning
  - Optimal Battery Solution

Optimal Battery Solution

- **Samsung SDI Lifetime Simulation**
  - Analysis
  - Simulation
  - Sizing

Introduction | Why Samsung SDI | ESS Battery Solution | Reference
Battery Platform for Utility & Commercial ESS

2017 Innovations

Samsung SDI provides optimized, reliable and innovative battery solutions for ESS applications.

**ENERGY**
- Innovative module/rack arrangement
- By deploying innovative configurations, a 90% capacity increase (Max. 9.1 MWh) in 40ft enclosure has been achieved.

**POWER**
- New cell increases capacity and energy density by 15%
- Increased capacity up to Max. 3.9 MWh in 40ft. standard enclosure.

Product Lineup

<table>
<thead>
<tr>
<th>Model</th>
<th>E2-M076</th>
<th>E2-R068</th>
<th>E2-R084</th>
<th>E2-R091</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Capacity Ah</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Energy kWh</td>
<td>7.6</td>
<td>68</td>
<td>84</td>
<td>91</td>
</tr>
<tr>
<td>Operating Voltage V</td>
<td>70.4~91.3</td>
<td>634~822</td>
<td>774~1,004</td>
<td>845~1,096</td>
</tr>
<tr>
<td>Dimension (W x D x H) mm</td>
<td>370x588x160</td>
<td>442x702x1,792</td>
<td>442x702x2,124</td>
<td>442x702x2,290</td>
</tr>
<tr>
<td>Weight kg</td>
<td>55</td>
<td>550</td>
<td>670</td>
<td>730</td>
</tr>
</tbody>
</table>

**Medium**

<table>
<thead>
<tr>
<th>Model</th>
<th>M2-M076</th>
<th>M2-R068</th>
<th>M2-R084</th>
<th>M2-R091</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Capacity Ah</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>Energy kWh</td>
<td>6.3</td>
<td>56</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>Operating Voltage V</td>
<td>68.2~90.2</td>
<td>634~812</td>
<td>750~992</td>
<td>818~1,082</td>
</tr>
<tr>
<td>Dimension (W x D x H) mm</td>
<td>370x650x160</td>
<td>442x702x1,792</td>
<td>442x702x2,124</td>
<td>442x702x2,290</td>
</tr>
<tr>
<td>Weight kg</td>
<td>51</td>
<td>520</td>
<td>630</td>
<td>690</td>
</tr>
</tbody>
</table>

**Power**

<table>
<thead>
<tr>
<th>Model</th>
<th>P3-M063</th>
<th>P3-R056</th>
<th>P3-R070</th>
<th>P3-R075</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Capacity Ah</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
</tr>
<tr>
<td>Energy kWh</td>
<td>6.3</td>
<td>56</td>
<td>70</td>
<td>75</td>
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<td>51</td>
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<td>630</td>
<td>690</td>
</tr>
</tbody>
</table>

**Specifications**

*Comparison with 2016* 9.1 MWh max. 78 Ah 68 Ah 2017 innovations
Batteries for UPS

Samsung SDI’s lithium-ion battery for UPS is capable of supplying a large current (450A) and is compatible with major global UPS companies.

### Benefits of Lithium-ion Battery for UPS

<table>
<thead>
<tr>
<th>Less Space/Weight</th>
<th>Longer Life</th>
<th>Fast Charge/Discharge Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-acid</td>
<td>3-7 years</td>
<td>- No oversizing required</td>
</tr>
<tr>
<td>Lithium-ion</td>
<td>15 years</td>
<td>- Longer charging time</td>
</tr>
<tr>
<td>(Equal capacity)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Less space for battery room
- No structure reinforcement required
- Battery replacement deferral
- Enhanced reliability
- No oversizing required
- Shorter charging time

**Note:** The comparison above is based on each material’s characteristics.

### Product Lineup

**4C UPS**
- Data center, Factory
- Up to 15min

**6C UPS**
- Data center, Factory
- Up to 10min

**12C UPS**
- Data center, Factory
- Up to 5min

### Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Module</th>
<th>Rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>U4-M020</td>
<td>U6-M020</td>
</tr>
<tr>
<td>Cell Capacity</td>
<td>Ah</td>
<td>67</td>
</tr>
<tr>
<td>Energy</td>
<td>kWh</td>
<td>2.0</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>V</td>
<td>24-33.6</td>
</tr>
<tr>
<td>Dimension (W x D x H)</td>
<td>mm</td>
<td>216x414x163</td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>20</td>
</tr>
</tbody>
</table>

Batteries for Residential & Telecom

### 48V Solution

- Advanced lithium-ion battery
- High performance technology for long duration operation
- Compatible with 48V PCS

**Product Lineup**

**R3-M010**
- 1kWh x 16ea
- Max. 16kWh

**R1-M048**
- 4.8kWh x 39ea
- Max. 188kWh

### Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>R3-M010</th>
<th>R1-M048</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>Battery Module, BMS</td>
<td>Battery Module, BMS</td>
</tr>
<tr>
<td>Energy</td>
<td>kWh</td>
<td>1.0</td>
</tr>
<tr>
<td>Scalability</td>
<td>kWh</td>
<td>16 (16ea)</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>V</td>
<td>42-56</td>
</tr>
<tr>
<td>Dimension (W x D x H)</td>
<td>mm</td>
<td>169x377x86</td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>8</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>℃</td>
<td>-10 – 60</td>
</tr>
</tbody>
</table>
Global Track Record

Since 2010, more than 1.3GWh of Samsung SDI ESS batteries are being successfully operated in over 30 countries.

USA
Austin, TX 36MW / 14MWh
El Cajon/Escondido, CA 37.5MW / 150MWh
Pomona, CA 20MW / 80MWh
Indianapolis, IN 20MW / 20MWh
Clinton, OH 10MW / 4MWh

Canada
Sault Sainte Marie, Ontario 8MW / 8MWh

Australia
Alice Spring 6MW / 2MWh
Western Australia 4MW / 2MWh

Samsung SDI Leads the Global ESS Market

Awarded and completed the world's largest ESS project located in the USA (2016)
Leading the market as the global #1 battery supplier for premium UPS
#1 Residential ESS battery provider in Japan (2013–)