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# *LS Materials*

## Products, Markets & Applications



## Company & Technology Introduction

### 1. Products

- a. *Products Overview*
- b. *New Products Roadmap*

### 2. UC Markets & Applications

- a. *Automotive*
- b. *Transportation*
- c. *Heavy Machinery*
- d. *Industrial*
- e. *Energy & Grid*



# Company Introduction

## LS Materials

- One of the leading global manufacturers of Ultracapacitors
- 100% Internal Production and Development
- 100% focused on Ultracapacitor market



# Company Introduction

## a. Ultracapacitor is...

**Ultracapacitor is a 100M sprinter**



High Power Density

**LIB is a marathon runner**



High Energy Density

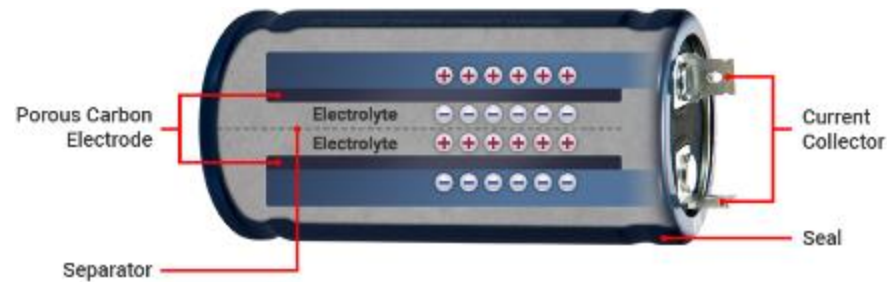
VS

***Ultracapacitors are High Power Density  
electro-statical energy storage devices***



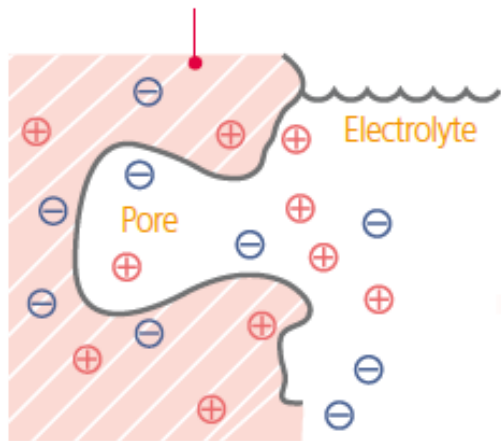
## a. Ultracapacitor is...

### Structure (ultracapacitor cell)



### How UC works

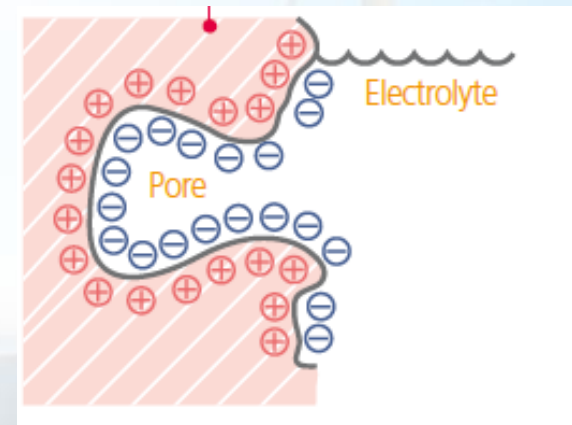
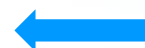
#### Activated Carbon Electrode



Charging



Discharging





# Company Introduction

## a. Ultracapacitor is...

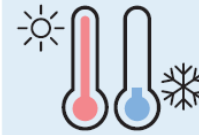
### Advantages



**High power density**  
10times higher power density compared to LIB



**Fast charge & Discharge**  
Charge & discharge within a few Seconds



**Wide operating temp. range**  
-40°C ~ +65°C



**High Safety**  
Safer than batteries due to little chemicals inside



**Long life time**  
More than 10 years  
More than 1million cycles



**Eco-friendliness**  
Less harmful chemicals or heavy metals than batteries

# 1. Products

## a. Products Overview

### a. Products Overview

- *Cells*
  - *Small & Mid-Size*
  - *Large*
- *Modules*
  - *PCB Type*
  - *Busbar Type*
  - *CTC Type*



# 1. Products

## a. Products Overview: Small & Mid-Size Cells – PCB Mounting

Capacitance 100F ~ 720F



Ø22 / Ø33 / Ø35 Series Cell

### Terminal Type



Snap-in  
(100F/120F)



Lug  
(320F ~ 720F)



Snap-in  
(4pin, 350F ~ 720F)

### 22Ø Series / 33Ø Series / 35Ø Series

Series	Rated Voltage	Capacitance	Part No.	Max. ESR(DC)	Max. Current
	V	F		mΩ	A
22 Ø	2.8	100	LSUC 002R8S 0100F EA	9.0	74
		120	LSUC 002R8S 0120F EA	9.0	81
	3.0	100	LSUC 003ROS 0100F EA	7.0	88
33 Ø	2.8	360	LSUC 002R8L 0360F CU03	3.2	234
		320	LSUC 002R8L 0320F EM	2.0	273
		350	LSUC 002R8L 0350F EA	3.2	231
35 Ø	2.8	400	LSUC 002R8L 0400F EA	3.0	255
		450	LSUC 002R8L 0450F EA	3.0	268
		600	LSUC 002R8L 0600F EA	3.2	288
	3.0	720	LSUC 002R8L 0720F EA	2.0	413
		360	LSUC 003ROL 0360F LE	1.7	335
		380	LSUC 003ROL 0380F EA	3.2	257
	3.0	430	LSUC 003ROL 0430F EA	3.0	282
		480	LSUC 003ROL 0480F EA	3.0	295



# 1. Products

## a. Products Overview: Large Cells – Busbar Mounting

Capacitance 650F ~ 3400F



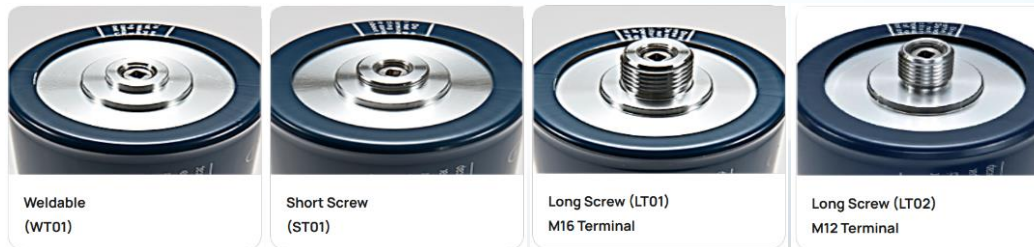
Ø60 Series Cell

### 60Ø Series

Busbar connection type cell

Series	Rated Voltage	Capacitance	Part No.	Max. ESR(DC)	Max. Current
	V	F		mΩ	A
60 Ø	2.7	650	LSUC 002R7C 0650F NH	0.57	640
		1200	LSUC 002R7C 1200F NH	0.33	1160
		1500	LSUC 002R7C 1500F NH	0.28	1426
	2.85	2000	LSUC 002R7C 2000F NH	0.27	1753
		3000	LSUC 002R7C 3000F NH	0.23	2396
		3400	LSUC 02R85C 3400F NH	0.23	2719
3.0	3000	LSUC 003R0C 3000F NH	0.23	2663	
	3400	LSUC 003R0C 3400F NH	0.20	2800	

### Terminal Type



# 1. Products

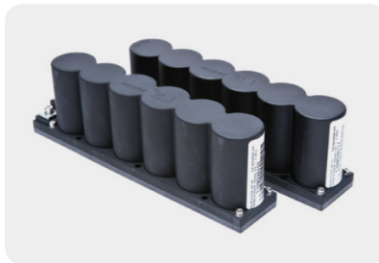
## a. Products Overview: PCB Type Modules

**Capacitance 5F ~ 58F**  
**Voltage 16.8V ~ 168.0V**

### PCB type series

PCB type Series is modules built up with 22 $\varnothing$  & 33 $\varnothing$  series cells on PCB board

Part No.	Rated Voltage	Capacitance	Max. ESR(DC)	Max. Continuous Current	Leakage Current	Stored Energy	Weight	Balancing	Monitoring	Dimension
	V	F	m $\Omega$	A	mA	Wh	kg			L x W x H (mm)
LSUM 016R8L 0058F EA	16.8	58	22	20	<11.0	2.3	0.7	Active or Passive	-	245 x 47 x 76.6
LSUM 168ROL 0005F EA	168	5.8	240	12	<25.0	22.7	6.5	Passive	Temperature(NTC)/Half Voltage monitoring	235 x 367 x 79



LSUM 016R8L 0058F EA



LSUM 168ROL 0005F EA

# 1. Products

## a. Products Overview: Busbar Type Modules

**Capacitance 4F ~ 500F**  
**Voltage 16.2V ~ 400.0V**

### Busbar type series

Busbar type Series is modules built up with 600 series cells connected with busbar

Part No.	Rated Voltage	Capacitance	Max. ESR(DC)	Max. Continuous Current	Leakage Current	Stored Energy	Weight	Balancing	Monitoring	Dimension
	V	F	mΩ	A	mA	Wh	kg			L x W x H (mm)
LSUM 016R2C 0500F EA	16.2	500	1.7	200	<5.0	18.2	5.6	Active or Passive	Temperature(NTC)	67.2 x 416.2 x 175.9
LSUM 032R4C 0250F EA	32.4	250	3.3	150	<11.0	36.5	10.0	Passive	-	137.1 x 426.6 x 184
LSUM 048R6C 0166F EA DC	48.6	166	5.0	130	<5.0	54.5	14.0	Active or Passive	Temperature(NTC)/Over Voltage	194.5 x 419.5 x 177
LSUM 051R3C 0166F EA	51.3	166	5.0	100	<28.5	60.7	12.0	Active or Passive	Temperature(PTC)/Over Voltage	590.4 x 136 x 171
LSUM 086R4C 0093F EA	86.4	93	11.3	80	<120.0	96.4	27.0	Passive	Temperature(PT100)	517 x 265 x 210.5
LSUM 129R6C 0062F EA	129.6	62	13.2	240	<5.0	144.6	55.0	Active or Passive	Temperature & Voltage(CAN 2.0B)	720 x 405 x 226



LSUM 016R2C 0500F EA



LSUM 032R4C 0250F EA



LSUM 048R6C 0166F EA DC



LSUM 051R3C 0166F EA



LSUM 086R4C 0093F EA



LSUM 129R6C 0062F EA



# 1. Products

## a. Products Overview: CTC Modules

**Capacitance 50F ~ 500F**  
**Voltage 16.2V ~ 108.0V**

**CTC series** CTC (Cell To Cell) series module is available from 16V to 108V, is extendable and customizable without additional costs to the customer

Part No.	Adapted Cell Module			Rated Voltage	Capacitance	Max. ESR(DC)	Max. Continuous Current	Leakage Current	Stored Energy	Weight	Dimension
	Rated Voltage	Capacitance	Series								
	V	F		V	F	mΩ	A	mA	Wh	kg	L x W x H(mm)
LSUM 048R6C 0066F EA YJ	2.7	1200	18	48.6	66	7.2	160	< 2.7 (Active)	21.7	10.3	279 x 418 x 71
LSUM 064R8C 0050F EA YJ			24	64.8	50	9.6	130	< 27 (Passive)	29.2	13.2	362 x 418 x 71
LSUM 048R6C 0083F EA YJ		1500	18	48.6	83	6.1	180	< 3.0 (Active)	27.2	11.5	312 x 418 x 71
LSUM 064R8C 0062F EA YJ			24	64.8	62	8.1	140	< 27 (Passive)	36.2	14.8	406 x 418 x 71
LSUM 048R6C 0111F EA YJ		2000	18	48.6	111	5.9	180	< 4.0 (Active)	36.4	13.5	363 x 418 x 71
LSUM 064R8C 0083F EA YJ			24	64.8	83	7.8	150	< 27 (Passive)	48.4	17.5	474 x 418 x 71
LSUM 048R6C 0166F EA YJ		3000	18	48.6	166	5.0	200	< 5.0 (Active)	54.5	17.2	471 x 418 x 71
LSUM 064R8C 0125F EA YJ			24	64.8	125	6.7	160	< 27 (Passive)	72.9	22.5	618 x 418 x 71
LSUM 016R2C 0250F EA AG	2.7	1500			250	2.0	150	< 3.0 (Active) < 27 (Passive)	9.1	3.9	311 x 166 x 70
LSUM 016R2C 0500F EA AG		3000	6	16.2	500	1.7	200	< 5.0 (Active) < 27 (Passive)	18.2	5.9	470 x 166 x 70



LSUM 048R6C 0166F EA YJ



LSUM 016R2C 0500F EA AG



LSUM 016R2C 0250F EA AG



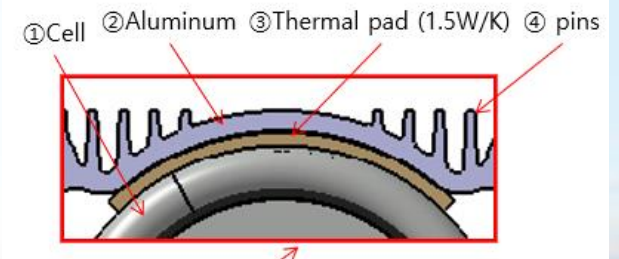
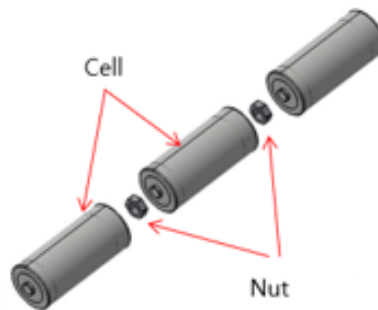
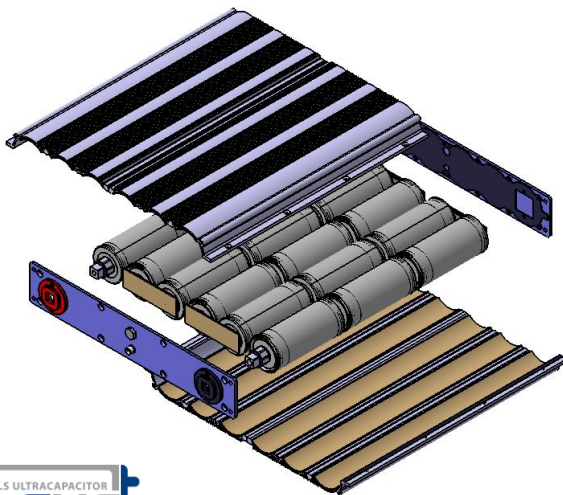
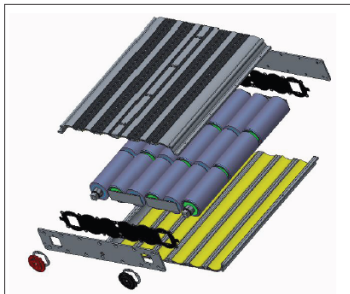


# 1. Products

## a. Products Overview: CTC Modules

### CTC Description

CTC (Cell to Cell) series module can be made up with connected cells (60Ø Series cell) at customer's request  
The CTC module can be made from 16V up to 108V without additional development with extendable module case





# 1. Products

## b. New Products Roadmap

### b. New Products Roadmap

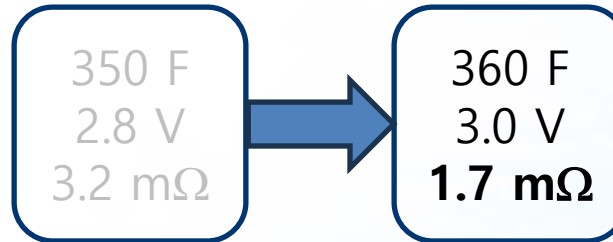
- *Mid-Cell: **360F** Low ESR – **600F** 3V*
- *Large Cell: **3400F** Low ESR – **4000F***
- *DC Module **CAN BUS***
- *19" **Rack Module***



# 1. Products

## b. New Products Roadmap: 360F 3.0V – Low ESR

LSUC 002R8L 0360F EA  
**360F 3.0V – 1.7mΩ**



*AVAILABLE NOW*

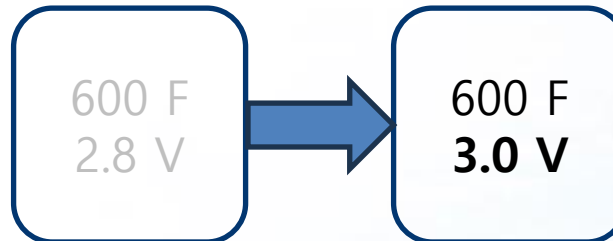
- Same size as 350F
- ESR decreased by 47%
- Energy Density increased by 18%

# 1. Products

## b. New Products Roadmap: 600F 3.0V

LSUC 003R0L 0600F EA

**600F 3.0V**



**AVAILABLE NOW**

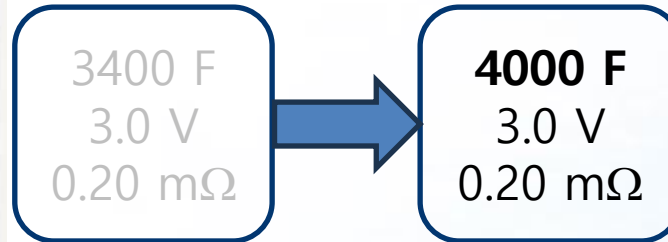
- Same size as 600F
- Voltage increased to 3.0V
- Energy density increased by 15%

# 1. Products

## b. New Products Roadmap: 4000F 3.0V

LSUC 003R0C 4000F NH

**4000F 3.0V**



**SAMPLES AVAILABLE: Q3-2024**

**LAUNCH: Q4-2024**

- Same size as 3400F
- Capacitance increased by 18%

# 1. Products

## b. New Products Roadmap: 188F 54.0V – DC Module CAN Bus

### SPECIFICATIONS

- Module Voltage: 54V
- Module Capacitance: 188F
- +40% Energy Density

### FEATURES

- ✓ 18S UC voltages and temperature measurement
- ✓ 32bit real-time controller
- ✓ IEC 61508 Functional Safety compliant
- ✓ Smart single cell balancing
- ✓ **CAN 2.0B communication interface**
- ✓ Secondary Alarm for Module over voltage using dry contactor
- ✓ Module-to-Module balancing algorithm



**SAMPLES AVAILABLE NOW**

**LAUNCH: Q2-2024**



# 1. Products

## b. New Products Roadmap: 188F 54.0V – DC Module CAN Bus

### SPECIFICATIONS

- Module Voltage: 54V
- Module Capacitance: 188F
- +40% Energy Density

### FEATURES

- ✓ 18S UC voltages and temperature measurement
- ✓ 32bit real-time controller
- ✓ IEC 61508 Functional Safety compliant
- ✓ Smart single cell balancing
- ✓ **CAN 2.0B communication interface**
- ✓ Secondary Alarm for Module over voltage using dry contactor
- ✓ **Module-to-Module balancing algorithm**



**SAMPLES AVAILABLE NOW**

**LAUNCH: Q2-2024**

# 1. Products

## b. New Products Roadmap: 19" Rack Module

### SPECIFICATIONS

- Module Voltage: 144V
- Module Capacitance: 71F
- **Insulation: 72 kVdc (Rack Level)**

### FEATURES

- ✓ 48S UC voltages and temperature measurement
- ✓ 32bit real-time controller
- ✓ IEC 61508 Functional Safety compliant
- ✓ CAN J1939 communication interface
- ✓ Remote FW Update



# 1. Products

## b. New Products Roadmap: 19" Rack Module

### SPECIFICATIONS

- Module Voltage: 144V
- Module Capacitance: 71F
- Insulation: 72 kVdc (Rack Level)

### FEATURES

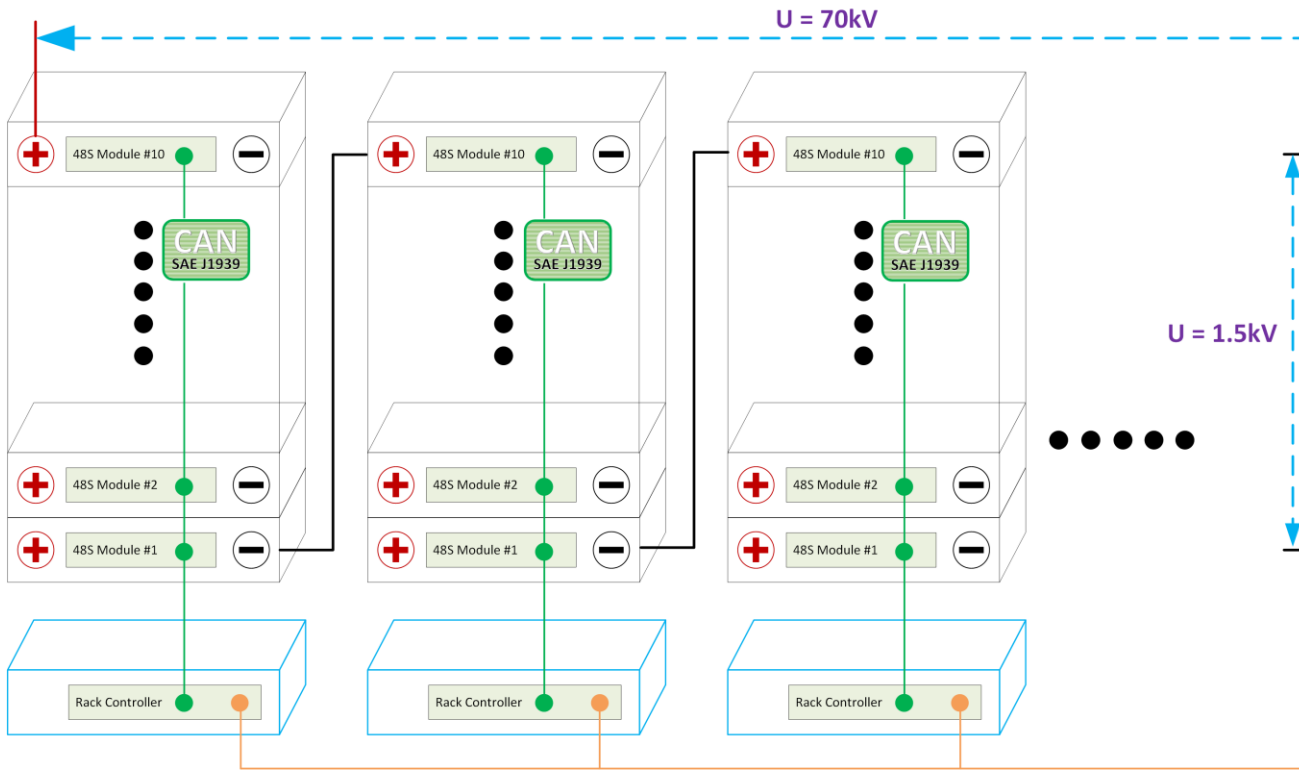
- ✓ Smart single cell balancing
- ✓ Module-to-Module balancing algorithm
- ✓ Scalable to medium-voltage systems
- ✓ SoH/SoA ESTIMATION SOFTWARE



# 1. Products

## b. New Products Roadmap: 19" Rack Module

✓ Scalable to medium-voltage systems



# 2. UC Markets & Applications

## a. Automotive

### a. Automotive

- *Start & Stop*
- *Jump Starter*
- *Mild Hybrid*
- *ADAS & Safety*



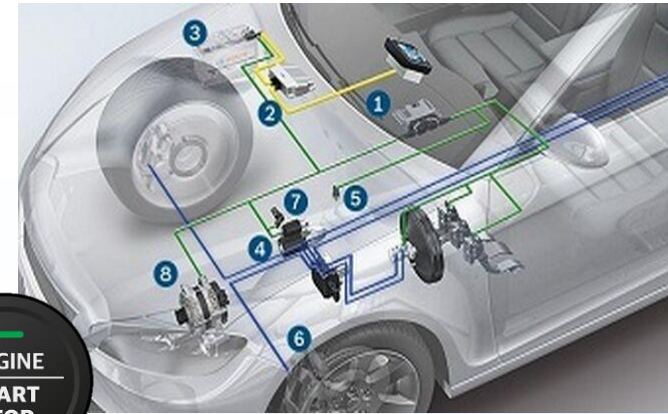


# 2. UC Markets & Applications

## a. Automotive

### Application: **Start & Stop**

Target Customer: **Automotive OEMs, Contract Manufacturers**



#### Main Topics:

- New development: plant/SW impact
- Space and weight
- Cost sensitive
- Custom cell integration

#### Features to push:

- Weight saving
- Cranking performance
- Maintenance free
- Battery lifetime

#### Fitting Products:

- LSUC 002R7C 0650/1200F NH
- LSUM 016R2C 0250F EA AG



# 2. UC Markets & Applications

## a. Automotive

Application: **Jump Starter**

Target Customer: **Accessories and Components OEM**



### Main Topics:

- Cost sensitive
- Custom cell integration
- User awareness

### Features to push:

- Peak Current
- Fast Charging
- Weight saving
- Maintenance free

### Fitting Products:

- LSUC 002R8L 0320F EM
- LSUC 002R7C 0650F NH



# 2. UC Markets & Applications

## a. Automotive

### Application: **Mild Hybrid**

Target Customer: **Automotive OEMs, Tier 1**

#### Main Topics:

- New development
- Space and weight
- Power vs Energy
- CAN Bus

#### Features to push:

- Weight saving
- High Power
- Maintenance free
  - Safety

#### Fitting Products:

- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## a. Automotive

Application: **ADAS & Safety**

Target Customer: **Automotive OEMs, Tier 1**



### Main Topics:

- Battery power availability
- Cost
- Space

### Features to push:

- Maintenance free
- Temperature range
  - Reliability

### Fitting Products:

- Small / Medium Cells





# 2. UC Markets & Applications

## b. Transportation

### b. Transportation

- *Subway Energy Recovery*
- *Shuttle Bus*
- *Catenary-Free Tram*





# 2. UC Markets & Applications

## b. Transportation

### Application: **Subway Energy Recovery**

Target Customer: **Railway OEMs, Network Providers**



#### Main Topics:

- On-board / ground installation
- Certification

#### Features to push:

- Smooth grid absorption
  - Energy saving
  - Fast charge
- Maintenance free
  - Safety

#### Fitting Products:

- LSUM 129R6C 0062F EA
- LSUM 051R3C 0166F EA
- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## b. Transportation

### Application: Shuttle Bus

Target Customer: Bus OEMs, Tier-1 Supplier

#### Main Topics:

- On-board / ground installation
- Energy vs Power density

#### Features to push:

- Fast charging
- Long lifecycle
- Maintenance free

#### Fitting Products:

- LSUM 129R6C 0062F EA
- LSUM 048R6C 0166F EA DC
- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## b. Transportation

### Application: **Catenary-Free Tram**

Target Customer: **Tram OEMs, Tier-1 Supplier**



#### Main Topics:

- On-board installation
- Certification

#### Features to push:

- No infrastructure
- Fast charge
- Maintenance free

#### Fitting Products:

- LSUM 129R6C 0062F EA
- LSUM 048R6C 0166F EA DC
- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## c. Heavy Machinery

### c. Heavy Machinery

- *Hybrid Tractor*
- *Hybrid Forklift*
- *Piling Machine*





# 2. UC Markets & Applications

## c. Heavy Machinery

Application: **Hybrid Tractor**

Target Customer: **OEMs, Contract Manufacturers**



### Main Topics:

- CAN Bus
- Environment
- Space
- Cost

### Features to push:

- Lower fuel consumption
- Full electric mode
  - Heavy duty

### Fitting Products:

- LSUM 048R6C 0166F EA YJ
- LSUM 048R6C 0166F EA DC





# 2. UC Markets & Applications

## c. Heavy Machinery

Application: **Hybrid Forklift**

Target Customer: **OEMs**

### Main Topics:

- Cost
- Drivetrain complexity

### Features to push:

- Lower fuel consumption
  - Full duty cycle
  - Safety

### Fitting Products:

- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## c. Heavy Machinery

Application: **Piling Machine**

Target Customer: **OEMs**

### Main Topics:

- Cost
- Drivetrain complexity
- Hydraulic heritage

### Features to push:

- Lower fuel consumption
  - Full duty cycle
  - Safety

### Fitting Products:

- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## d. Industrial

### d. Industrial

- *Peak Shaving in Automation*
- *AGV*
- *UPS – Industrial Grid*
- *UPS – Railway Signaling*



# 2. UC Markets & Applications

## d. Industrial

Application: **Peak Shaving  
in Automation**

Target Customer: **System Integrators**



### Main Topics:

- Size
- Environment

### Features to push:

- Smooth grid absorption
  - Heavy duty
- Energy efficiency
- Safe emergency stop

### Fitting Products:

- LSUM 168R0L 0005F EA



# 2. UC Markets & Applications

## d. Industrial

Application: **AGV**

Target Customer: **Logistics Integrators**

### Main Topics:

- Size
- Layout management
- Path critical

### Features to push:

- Low temperature
  - Heavy duty
- 24/7 operation
- Maintenance free

### Fitting Products:

- LSUM 016R8L 0058F EA
  - Mid-size cells





# 2. UC Markets & Applications

## d. Industrial

Application: **UPS / VDP for Industrial Grid**

Target Customer: **System Integrators**



### Main Topics:

- Sags duration
- Monitoring

### Features to push:

- Heavy duty
- Maintenance free
- High Power Density

### Fitting Products:

- LSUM 051R3C 0166F EA
- LSUM 048R6C 0166F EA YJ



# 2. UC Markets & Applications

## d. Industrial

### Application: **UPS for Railway Signaling**

Target Customer: **System Integrators**



#### Main Topics:

- Cost vs Battery
- Energy vs Battery

#### Features to push:

- Maintenance free
- Low temperature
- Beneficial TCO

#### Fitting Products:

- Busbar & CTC type modules



# 2. UC Markets & Applications

## e. Energy & Grid

### e. Energy & Grid

- *Wind Turbine Pitch Control*
- *Power Quality: Frequency Regulation, Grid Stabilization*



# 2. UC Markets & Applications

## e. Energy & Grid

Application: **Wind Turbine Pitch Control**

Target Customer: **Wind Turbine Manufacturers**

### Main Topics:

- Environment
- Shock&Vibration

### Features to push:

- Maintenance Free
- Power Availability

### Fitting Products:

- LSUM 168R0L 0005F EA





# 2. UC Markets & Applications

## e. Energy & Grid

Application: **Power Quality**

- **Frequency Regulation**
- **Virtual Inertia**
- **Voltage Control**
- **Grid Strength**

Target Customer: **System Integrators**

### Main Topics:

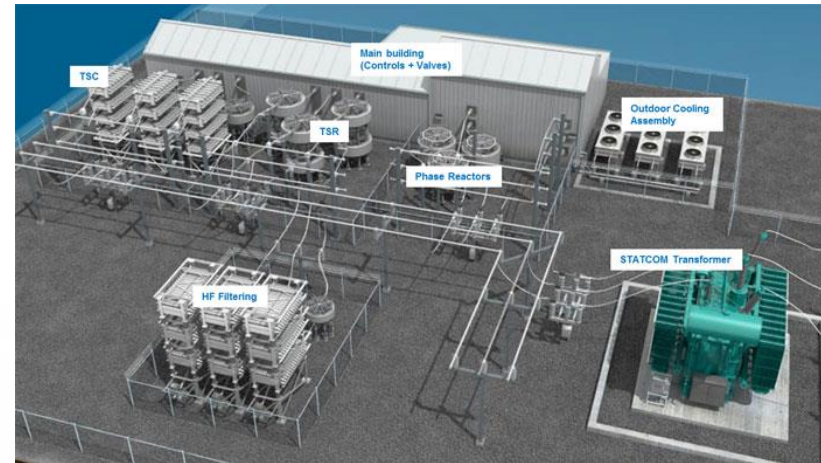
- High level integration
- Monitoring and communication
- Bulky systems

### Features to push:

- High peak power
- High power density
- Fast charge&discharge
- Green technology

### Fitting Products:

- 19" Rack Module
- LSUM 051R3C 0166F EA
- LSUM 048R6C 0166F EA YJ





# Thank You!



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