Ideal for IoT and Wearables
Small Li-Ion (Lithium Titanate) Rechargeable Battery

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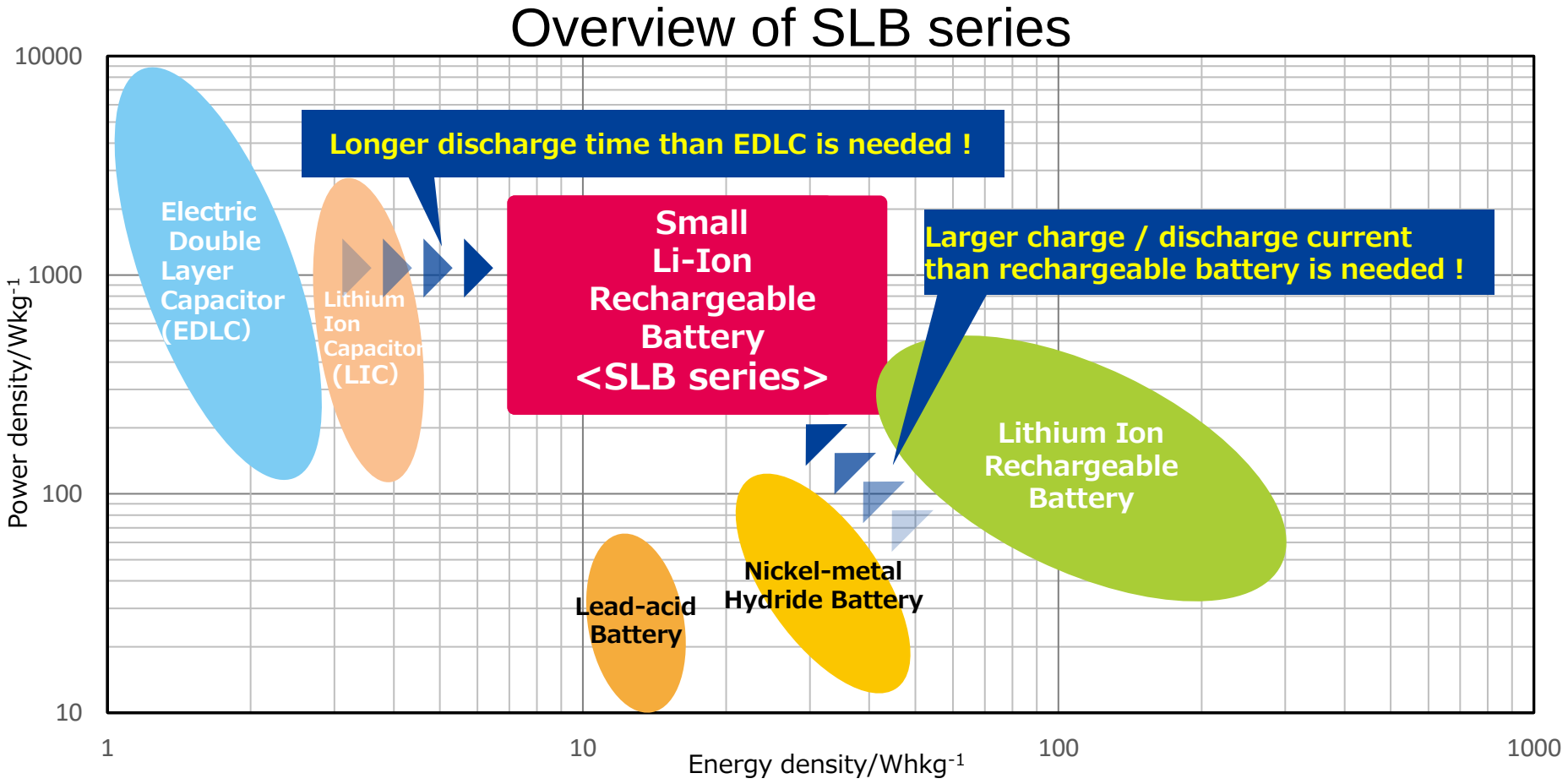
Development background



Electric storage device having high output and large capacity is demanded.
SLB series is a new lithium-ion rechargeable battery that uses lithium titanate (LTO) technology.

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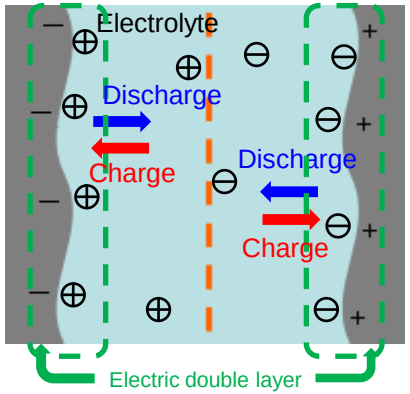
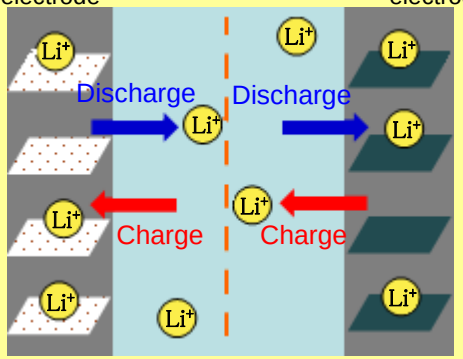
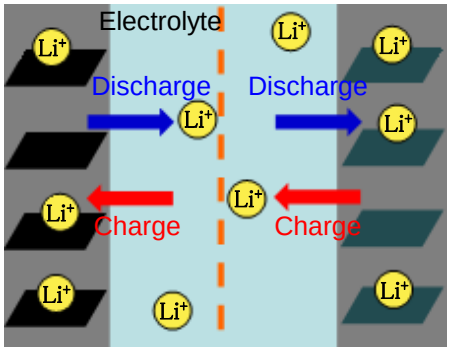
Difference of Electric storage devices

Name	Electric double layer capacitor (EDLC)	SLB series (LTO=LIB)	Lithium-ion Batteries (LIB)
Mechanism	Negative electrode **Physical phenomenon** Positive electrode 	Negative electrode **Chemical reaction** Positive electrode 	Negative electrode **Chemical reaction** Positive electrode 
Voltage	To 2.7V	To 2.8V	To 4V
Energy Density	To 7Wh/kg	To 40Wh/kg	To 300Wh/kg
Power Density	To 10kW/kg	To 3kW/kg	To 1kW/kg
Operating temperature range	-40 to +85℃	-30 to +60℃	-20 to +60℃
Cycle life	1,000,000times over	25,000times over	To 3,000 times
Discharge range	Dischage to 0V	There is a lower limit voltage	There is a lower limit voltage
Safety	No rupture or ignition	No rupture or ignition	Rupture or ignition
Merit	High power,Long life,safety	High power,Long life,safety	High energy density
Demerit	Low energy density	Low energy density	Shrot life time

Advantage over EDLC

Advantage over Batteries

Advantage over Batteries

Advantage over Batteries

Advantage over Batteries

SLB series have long life and excellent safety.

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Special “Negative electrode” of Small Lithium Titanate Rechargeable Battery

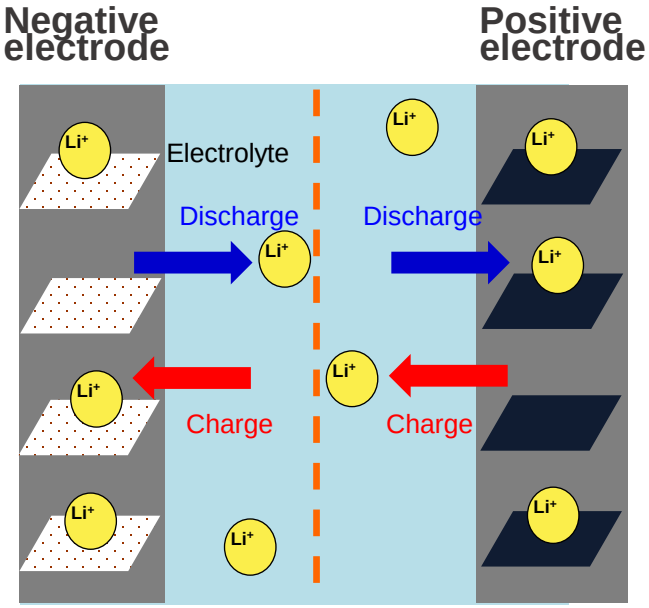
What is the difference between “Small Lithium Titanate Rechargeable Battery” and “Conventional Lithium Ion Rechargeable Battery” ?

→ **Negative electrode**

Negative electrode : Conventional Lithium Ion Rechargeable Battery

Small Lithium Titanate Rechargeable Battery

LTO



point!

Advantages of LTO (Lithium Titanate):

- Material with thermal stability that does not burn.
- Low reactivity with electrolyte → Low heat generation
- Material with low electron conductivity
  → Only little current and heat will generate when short occurs between positive and negative electrode Only a small current and heat are generated.

High safety and reliability

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Main Advantages

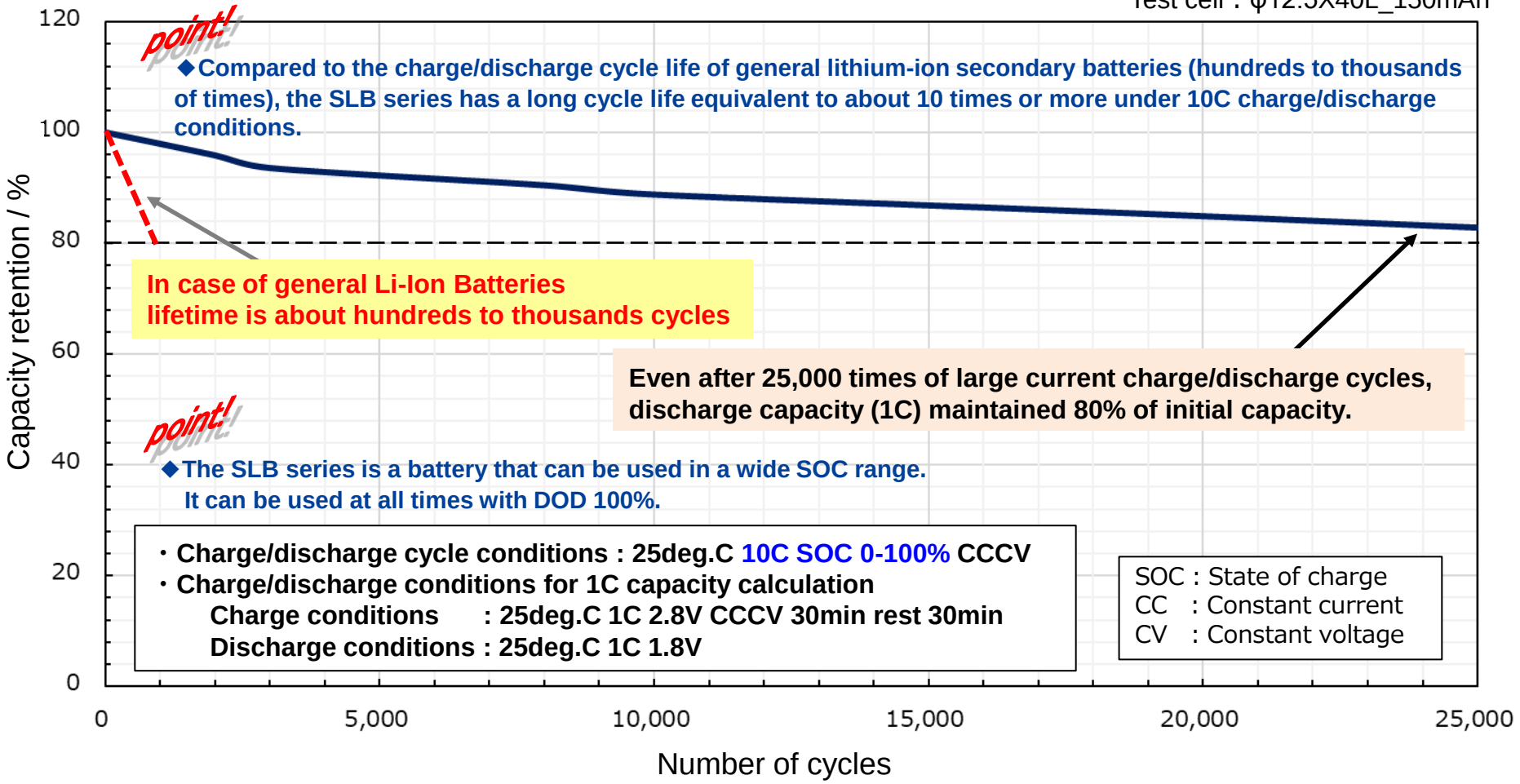
1	Long life	Over 25,000 cycles life time
2	Rapid Charge/discharge	Charge/discharge at large current rate (20C Max.)
3	Low-current charging	Low rate (0.01C) chargeable
4	Low-temperature operation	Can be used at temperatures as low as -30deg.C
5	Safety	Uses highly safe lithium titanium oxide (LTO)

Cycle characteristics

1 Long life：Over 80% of the capacity is maintained after 25,000 cycles of charge/discharge.

1C discharge capacitance change in 10C rate charge/discharge cycle

* Test cell：φ12.5X40L_150mAh



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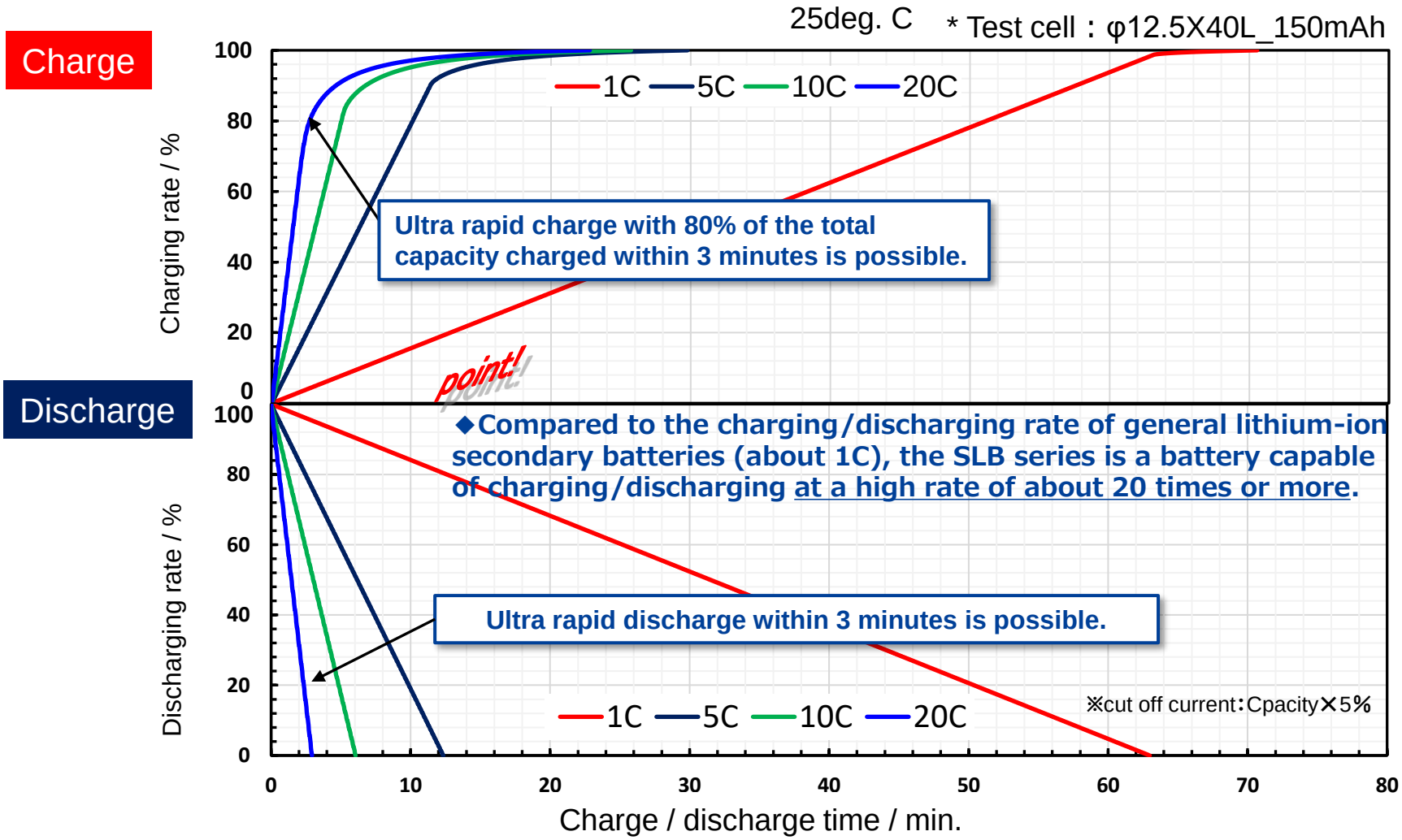
Charge/discharge characteristics

2 Rapid charge/discharge is possible： Power density similar to EDLC.



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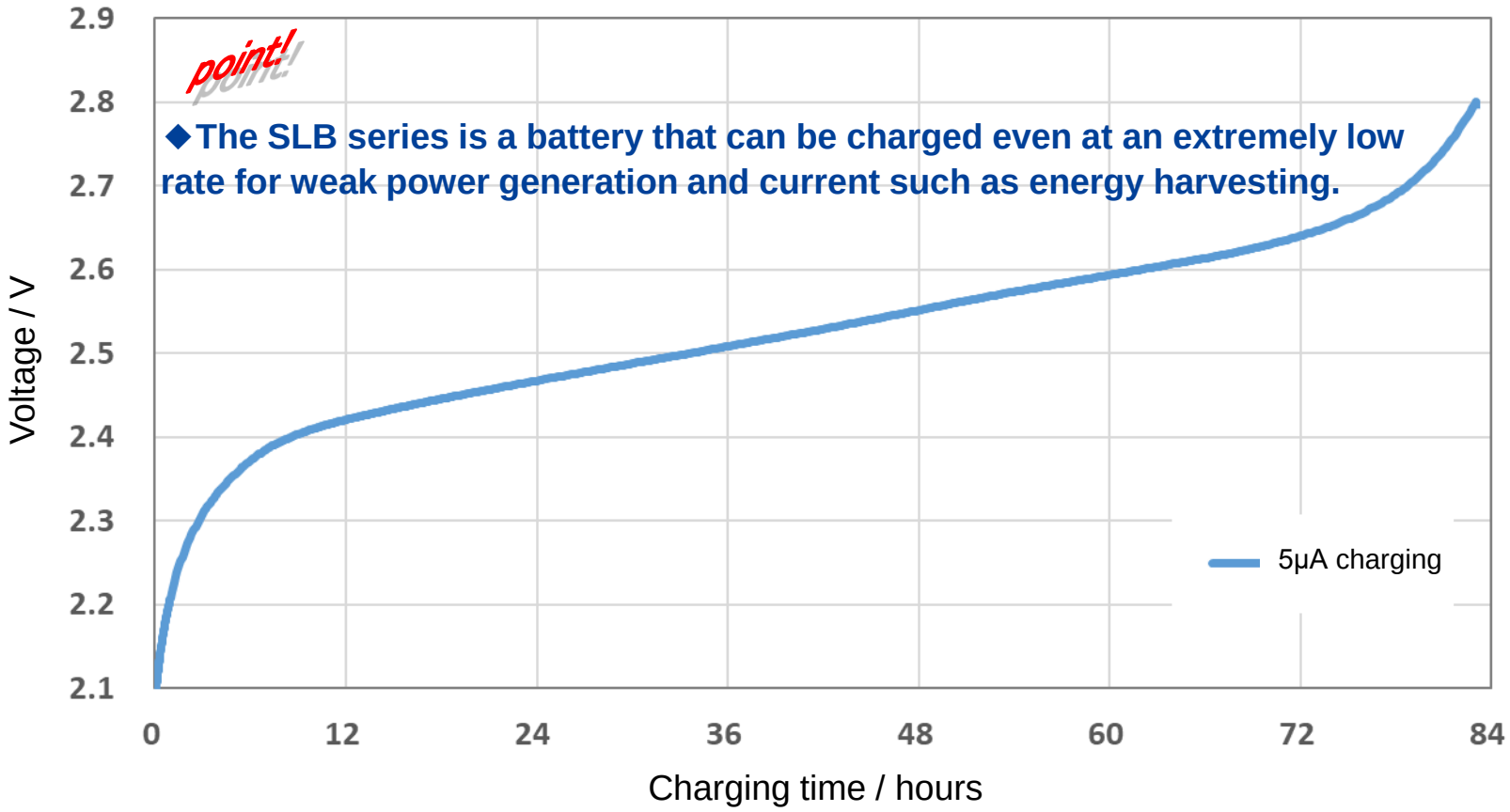
Low current charging

3 Low-current charging : Low rate (0.01C) chargeable

Size
φ3×7L (0.35mAh)

Test conditions
Charging current; 5μA (=0.014C)



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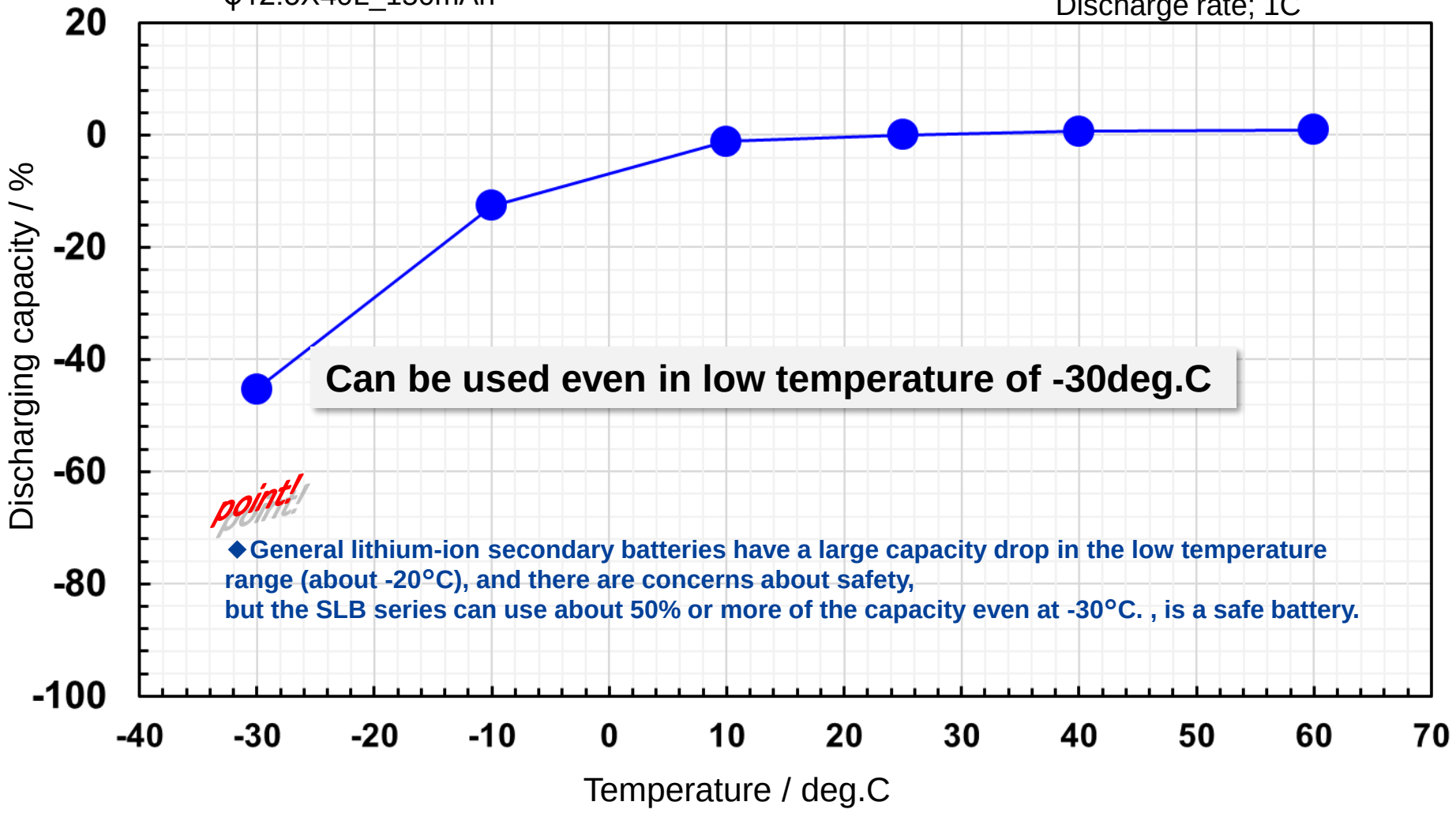
Temperature characteristics

4 Low-temperature operation： Can be used at low temperatures (-30deg.C)

Size
φ12.5X40L_150mAh

Test conditions
Discharge rate; 1C



point!

◆General lithium-ion secondary batteries have a large capacity drop in the low temperature range (about -20°C), and there are concerns about safety,
but the SLB series can use about 50% or more of the capacity even at -30°C. , is a safe battery.

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Safety

5 Safety : There is a very low risk of fire or explosion from internal short circuit.

No.	Test Item	Judgement Criteria	Result
1	Crushing by pressure	No Rupture or ignition	No Rupture or ignition
2	Nail penetration test	No Rupture or ignition	No Rupture or ignition
3	Blunt Nail Test	No Rupture or ignition	No Rupture or ignition
4	External short circuit	No Rupture or ignition	No Rupture or ignition
5	Over charge	No Rupture or ignition	No Rupture or ignition
6	Forced discharge	No Rupture or ignition	No Rupture or ignition

Small Li-Ion Rechargeable Battery

There is a device with very low risk of fire or explosion and high safety.

Safe

Crushing by pressure

Nail penetration

- It was confirmed to be safe with no rupture or ignition in tests of crushing, nailing, external short circuit, overcharging, and forced discharge.

UL1642 Certification for Lithium-ion Battery

IEC

- UL1642 and IEC62133-2: 2017 certified.

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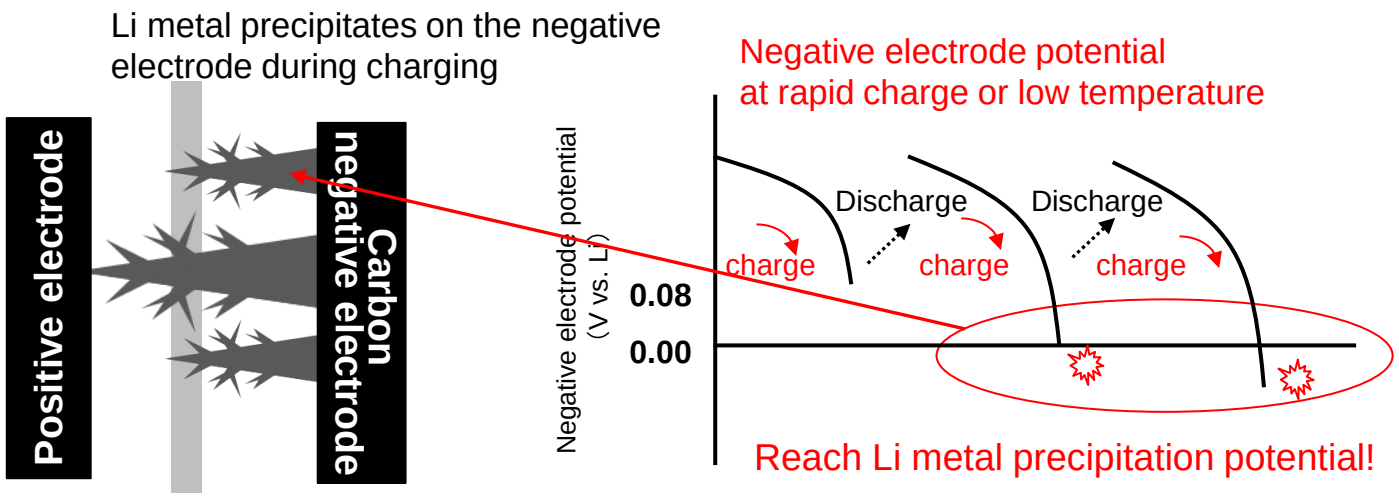
High safety due to materials used

Materials / Technology	Conventional LIB	Small Li-Ion Rechargeable Battery <SLB series>
Negative electrode material	Carbon material (Graphite)	LTO (using incombustible materials) → Thermally stable
Internal short circuit current	Large	Small (When short-circuited, the resistance of the LTO surface is increased due to phase change)
Li metal deposition	Occur (During fast charge,low temperature, the Li deposition potential is reached at long cycle)	None (During fast charge, low temperature, It does not reach the Li deposition potential even in the long cycle)

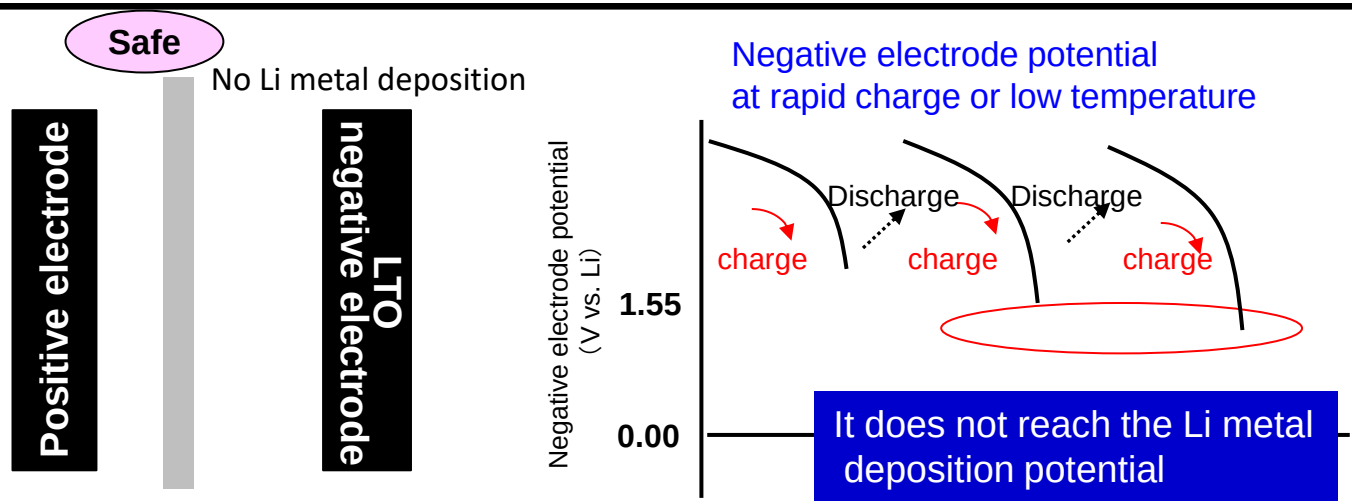
No short circuit due to lithium deposition

In case of general LIB



In addition to breakage of separator during charging, short circuit due to Li metal deposition may occur.

In case of Small Li-Ion Rechargeable Battery <SLB series>



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Specifications of Small Li-Ion Rechargeable Battery

Part number		SLB03070LR35 	SLB03090LR80 	SLB04255L040 	SLB08115L140 	SLB12400L151 
Size	φ	**3.0 mm**	**3.3 mm**	**4.0 mm**	**8.0 mm**	**12.5 mm**
	L	**7.0 mm**	**9.0 mm**	**25.5 mm**	**11.5 mm**	**40.0 mm**
Nominal voltage		2.4V	2.4V	2.4V	2.4V	2.4V
Voltage range		**2.8 - 1.8V**	**2.8 - 1.8V**	**2.8 - 1.8V**	**2.8 - 1.8V**	**2.8 - 1.8V**
Nominal capacity		**0.35mAh**	**0.80mAh**	**4mAh**	**14mAh**	**150mAh**
Max.charge/ discharge current (C rate)		**7mA (20C)**	**16mA (20C)**	**80mA (20C)**	**280mA (20C)**	**3,000mA (20C)**
ESR (at 1kHz)		Max. 12 Ω	Max. 8 Ω	Max. 0.6 Ω	Max. 0.24 Ω	Max. 0.06 Ω
Temperature range		-30 ～ +60ºC	-30 ～ +60ºC	-30 ～ +60ºC	-30 ～ +60ºC	-30 ～ +60ºC
Energy density		17Wh/L	25Wh/L	30Wh/L	58Wh/L	73Wh/L
Weight		0.12g	0.16g	0.75g	1.2g	9.0g

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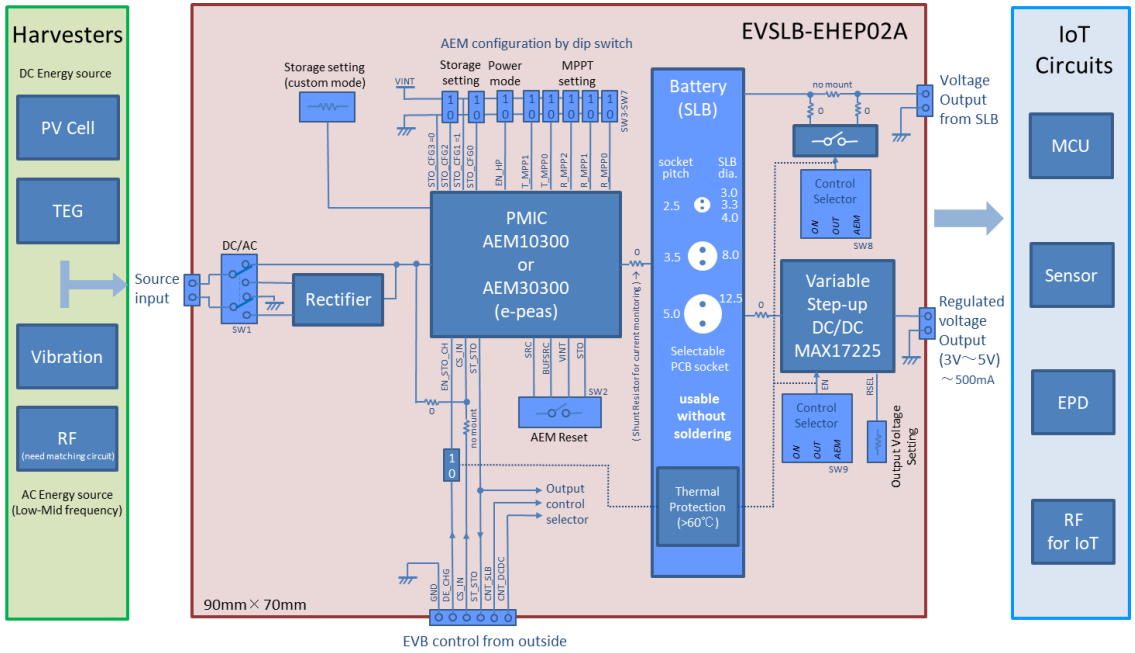
SLB Series Energy Harvesting Evaluation Board

Power supply board to combine SLB series with various energy harvesters
Easily evaluate energy harvesting power supplies by connecting to various circuits



Evaluation Board Features

Solar (DC), vibration power generation (AC), etc.
Input from various harvesters are possible

Supports power collection settings optimized for harvester characteristics

Compatible with all 5 types of SLB series
No soldering required, easy to use

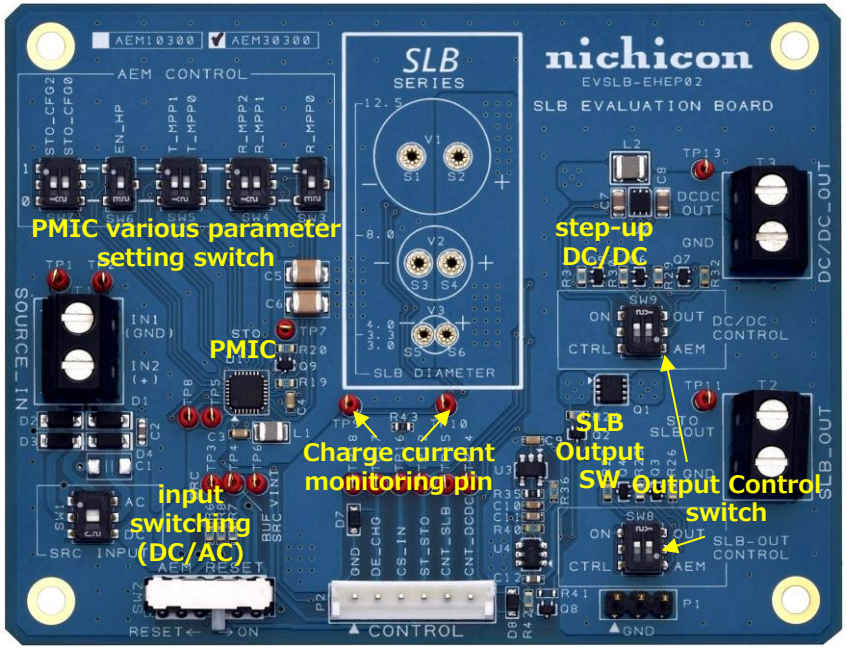
Supports 2 outputs (SLB direct, via DC/DC)
DC/DC voltage is configurable between 3V-5V

High customizability for optimizing the power consumption

SLB Series Energy Harvesting Evaluation Board

Power supply board to combine SLB series with various energy harvesters
Easily evaluate energy harvesting power supplies by connecting to various circuits

All SLB series installable
(No soldering required)



EH device connection terminal

DC/DC output terminal

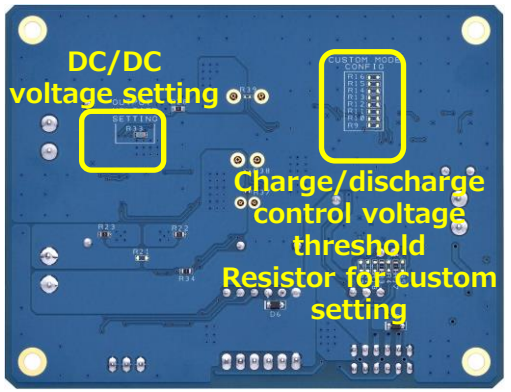
SLB direct voltage output terminal

PMIC Reset SW

External Control Terminal

GND Pin (for observation)

Back Side



SLB series original evaluation board

Various original evaluation boards are available to reduce evaluation work hours.
- Various energy harvesters and loads can be combined with the SLB series for evaluation.
- The SLB series can also be used in series and parallel connections.

№	Function	Product No.	Overview	Remarks
1	Power supply utilized energy harvesting	EVSLB-EHEP02A	Evaluation board that connected with energy harvester (PV panels, vibration generators, etc.) to charge the generated power in the SLB and supply the power to a load (SLB direct/boost stabilization).	Available for purchase online
2	Maintenance free power supply system with SLB and PV	EVSLB-AAA	A board the size of an AAA battery with PV energy harvesting and SLB control functions. Also includes USB type-C quick charge port.	
3	SLB voltage regulator with charger circuit	–	A compact board that adds power backup function by SLB to 3.3V constant voltage output regulator. Supports 3V to 6V input, no SLB soldering required.	
4	CC/CV charger compatible with 20C charging (1)	EVSLB-CGAD01	SLB charger board for CC/CV charging that can accommodate a wide range current by changing resistors. Variety of functions including; Available the USB charging, float charge prevention and recharge circuitry etc.	
5	CC/CV charger compatible with 20C charging (2)	EVSLB-CGAD02	CC/CV charging evaluation board that expanded compatible output voltage range of EVSLB-CGAD01. By changing the resistors, it is also possible to charge the series-tied-SLB connected to the output terminal.	
6	Cell balancer for two SLBs tied in series	–	Simple connection board that allows you to connect two SLB08115L140/SLB12400L151 in series. Built-in cell balancer. No need to solder the SLB. Can be use inserting into a breadboard, etc.	
7	Voltage manager for SLBs connected in series (1)	EVSLB-SCAB01	Evaluation kit for connecting up to 6 SLB12400L151s in either series or parallel configuration. Per-cell voltage monitor and cell balancer are implemented. Low power consumption.	Supports daughter connection to EVSLB-BUTI03/BUAD04
8	Voltage manager for SLBs connected in series (2)	EVSLB-SCTR02	Evaluation kit for connecting up to 6 SLB12400L151s in either series or parallel configuration. Per-cell voltage monitor and cell balancer are implemented. Circuit operating voltage thresholds can be set freely.	Supports daughter connection to EVSLB-BUTI03/BUAD04
9	SLB backup power supply (1)	EVSLB-BUTI01	Evaluation board that can configure a 3-5V system power supply with emergency power backup from the SLB. Key parameters can be easily changed by replacing jumper chips.	
10	SLB backup power supply (2)	EVSLB-BUAD02	Evaluation board that can add a power backup function using SLB to circuits that operate at 1.8V to 5V. Various thresholds can be changed by changing resistors. A built-in balancer allows the use of two SLBs in series.	
11	SLB backup power supply (3)	EVSLB-BUTI03	Evaluation board that can add a backup function using SLB to a system power supply up to 12V. The SLB charger supports CC/CV charging and can customize a wide range of functions.	Available to using in combination with EVSLB-SCAB01/SCTR02
12	SLB backup power supply (4)	EVSLB-BUAD04	Evaluation board that can add a backup function using SLB to a system power supply up to 15V. The SLB charger supports CC/CV charging and can customize a wide range of functions.	Available to using in combination with EVSLB-SCAB01/SCTR02

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Target Market

■ Target product of SLB

IoT device

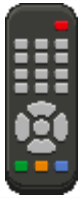
Asset tracker

Smart meter

Smart lock

Electronic pen

Automotive auxiliary power supply



Remote controller

Electric tool

Handy measuring device

Wearable device

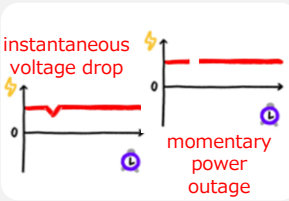
Smart glasses

Environmental sensor

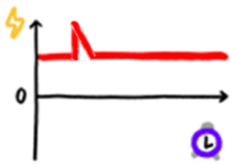
Rechargeable toys

Assist power suit

Emergency call device



Backup system



Peak assist

Use in cold regions

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Application case (Stylus pen)

Galaxy series S pen

Galaxy

Samsung Electronics Co., Ltd.

Galaxy S24 Ultra(NEW)

Galaxy S23 Ultra

Galaxy S22 Ultra

Galaxy Note 20| 20 Ultra

Galaxy Note 10| 10+

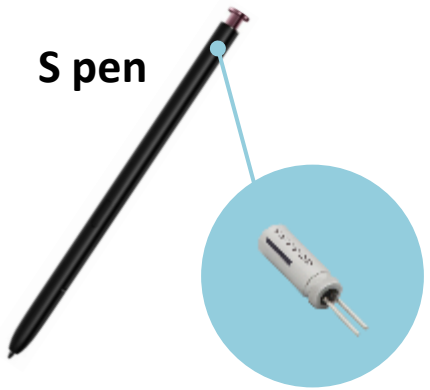
S Pen size (5.8 x 4.35 x 105.08 mm) S Pen board (from Web disassembly site)

SP912
6-axis sensor

Dialog DA14585
Bluetooth 5 SoC

nichicon SLB
φ3×7L 0.35mAh

IFIXIT HP（https://www.ifixit.com/Teardown/Samsung+Galaxy+Note10++5G+Teardown/125590）



SLB03070LR35

Background of adoption

Note9 is equipped with an electric double-layer capacitor from another company.

⇒ Replaced by our lithium-ion battery

The key factor for adoption was to cope with increased power consumption due to new functions.

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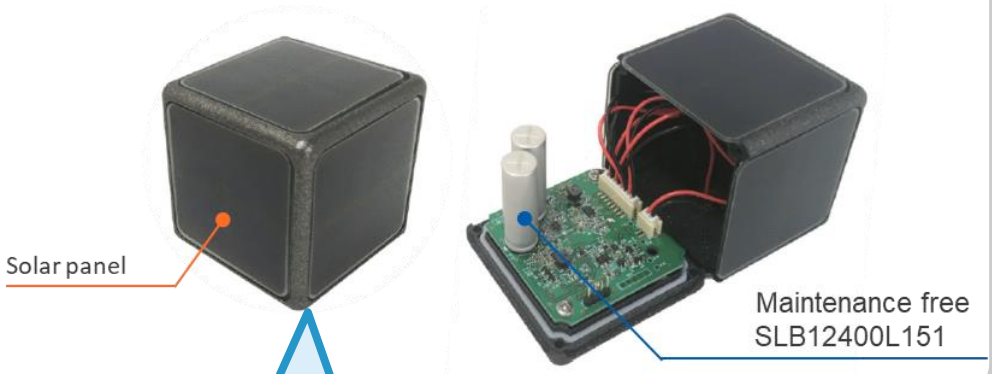
Application case (Compact solar independent power supply)

Compact solar independent power supply「CUBE66」

L-kougen

L-Kougen Co.Ltd

CUBE66



The best in the industry
Compact size

W66xH66xD66mm
※Excluding the protruding parts

- Power supply for sensors
- Power supply for communication modules
- IoT devices (replacement of primary power supply)

Model trend	The battery needs	Special Features of SLB High adaptability
Automatic operation for long periods of time	maintenance-free	Long life
Small size power supply	Small size and large current discharge	Rapid (charging) discharge possible
Environmental power generation (other than solar)	Low charging current	Can be charged with very low current
Installation in cold regions	Stable operation at low temperatures	Good low-temper-ature performance
Can be placed in the wild	Eliminate the risk of ignition	High safety

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Application case (Flood monitoring system)

Flood monitoring system

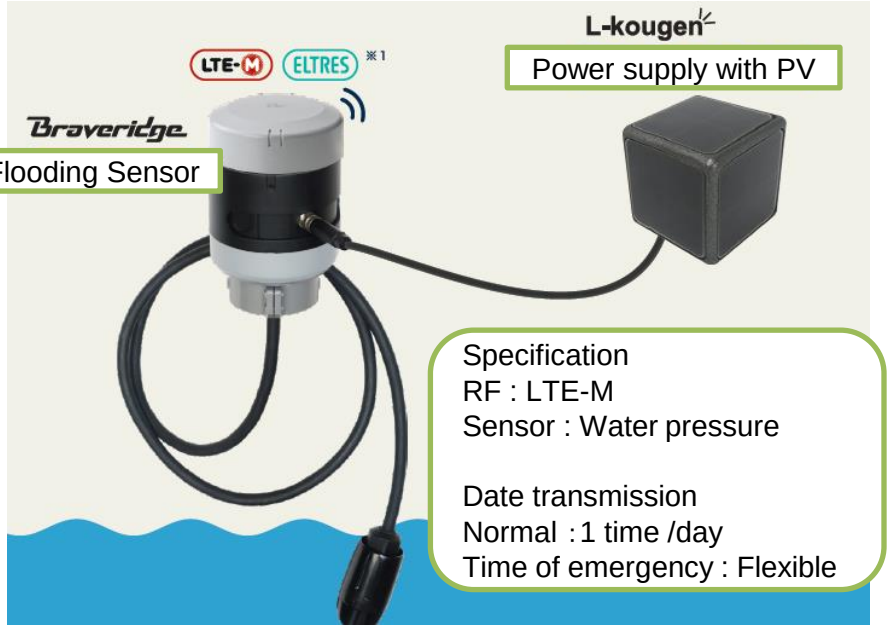
A maintenance-free disaster prevention system for monitoring water levels in dams and rivers.
SLB series applications in flood control monitoring power packs.

Braveridge

Braveridge Co., Ltd.

WEB app

Flood monitoring system



Compact solar-powered , no battery replacement required

Real-time monitoring of water levels even after flooding

Low price, easy to install in small rivers and irrigation canals

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Application case (Maintenance free sensor network)

RICOH EH environmental sensor D201 / D202

The SLB series is used for the environmental sensing device RICOH EH Environmental Sensor D201/D202. Monitoring of refrigerated, high temperature and high humidity environments with wiring-free and maintenance-free.

Ricoh Company, Ltd.

With solid-state dye-sensitized solar cell

RICOH EH environmental sensor D201 / D202

※ D202 is waterproof model

Product features

- Can be used in dark places
- Suitable for use in refrigeration facilities over a wide temperature range
- Ultra-small size and easy to install
- 5 sensors to measure different environments
- Easy linkage monitoring
- Added water and dust proof model

SLB08115L140

- Long-life cycle batteries for maintenance-free operation !
- Rapid discharge (20C) for wireless (e.g. BLE) possible !
- Low current charging (0.01 C) with environmental power generation !
- Can be charged and discharged at low temperatures (-30℃) !

Advantages of adopting SLB

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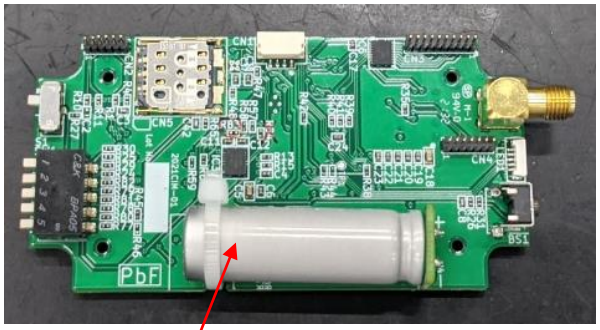
Application case (communication module)

LTE Cat. M1 communication module (integrated in the device)

An IoT system that focuses on small volumes of data such as sensor data and suppresses communication costs. The SLB is used as a power supply in the circuit board of this system.

- Rechargeable batteries enable communication even when mains power is cut
- Available in Japan, USA and Europe for €12 for 10 years or approx. 10 ¢/month. (1NCE with eSIM)
- Secure communication with AWS-IoT is possible, or 1NCE Cloud and AWS can be OpenVPN connection between 1NCE Cloud and AWS as a pseudo-closed network to enhance data security.
- Cat.M1 communication reduces price and current consumption
- High safety, high power and over 25,000 charge/discharge cycles.



SLB12400L151（150mAh）

1NCE with eSIM　　Cat.M1 Modem IC

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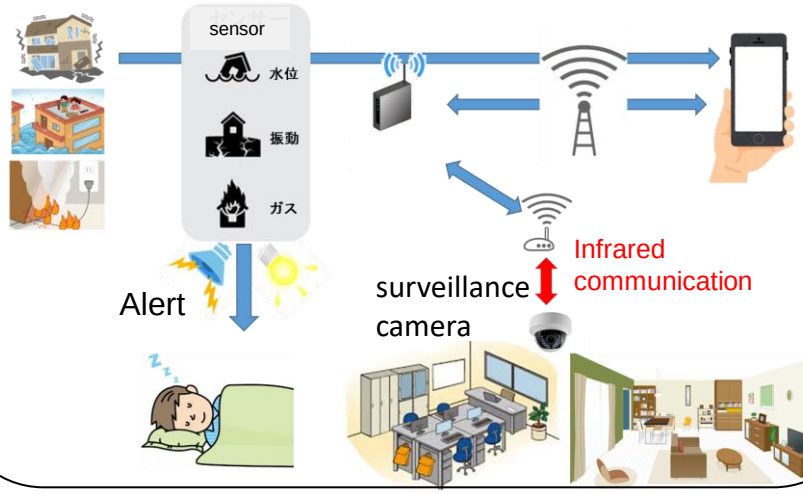
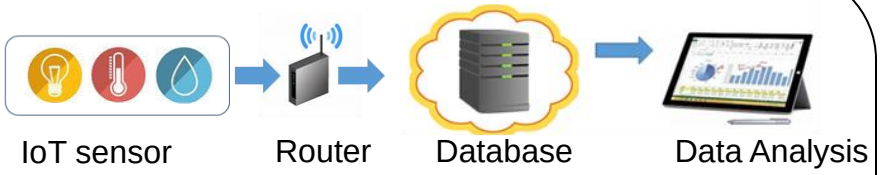
IoT Solutions: The Potential of Sensing Technology

(1) Smart Home

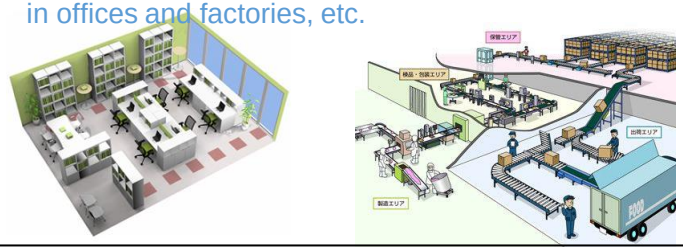
(2) Disaster Prevention Solutions



(3) Smart Architecture



Optimization of lighting and air conditioning installation in offices and factories, etc.



(4) Smart Agriculture

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Utilizing Big Data through IoT

Utilization of big data and sensing with wireless edge devices

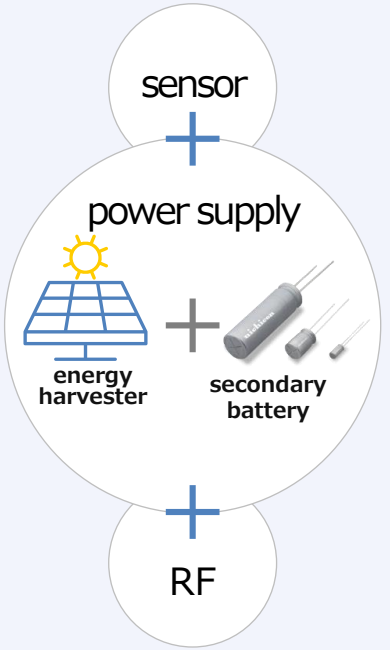
Data analysis
AI

Data accumulation
cloud server

Data collection
wireless edge device

Utilization of big data

Components of a wireless edge device



Utilizing energy harvesting to achieve maintenance-free operation

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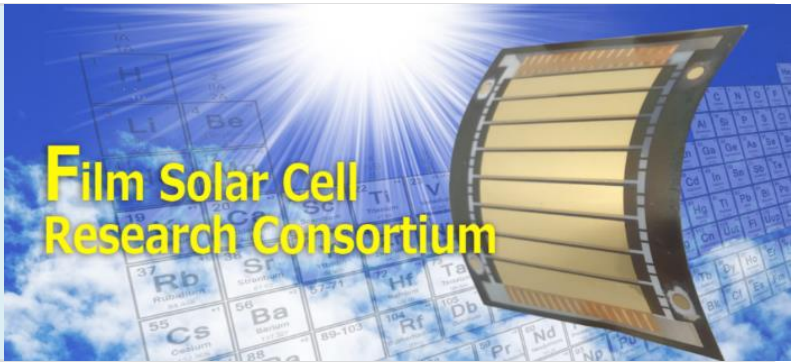
Trends of energy harvesting

Perovskite solar cells

It is a low-cost, light and flexible film-type solar cell that is expected to be used in a variety of applications.



Usage

Clock/wearable
Smart street light
Disaster relief tent
Rooftop power generation
Car boat

ZEH/ZEB
solar powered car
Universe development
Solar plane/drone

IoT Market

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Trends of energy harvesting

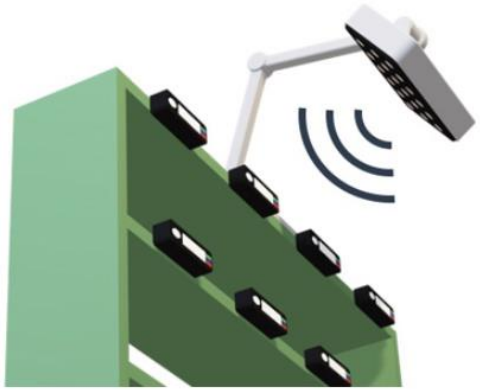
Wireless Power Transfer (WPT)

Spatial power is possible when and where it is needed.
It is a radio wave emitting wireless power supply system that can supply power from a distance of 10 meters or more, and is expected to be used in a variety of applications.

Usage

Digital picking system

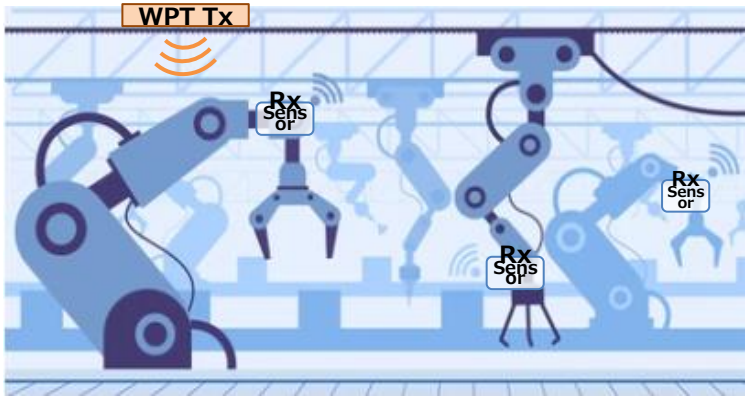
Reducing replacement man-hours by charging the display with WPT



Free the devices from wires

Next-generation robot hand sensor

There is a risk of disconnection in the wiring of moving parts, so charge with WPT.



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Case 1 : Maintenance-free Electronic Shelf Label

Maintenance-free ESL

Nisshinbo Micro Devices Inc.

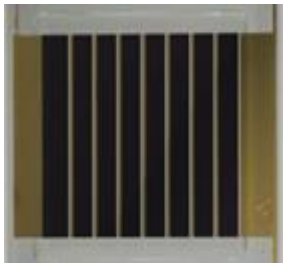
Three features of maintenance-free electronic shelf labels

1. PV cells free you from the restrictions of rewriting
2. No need to replace batteries thanks to power-saving circuitry and secondary batteries
3. BLE and NFC communication allows for shelf tag management and promotion

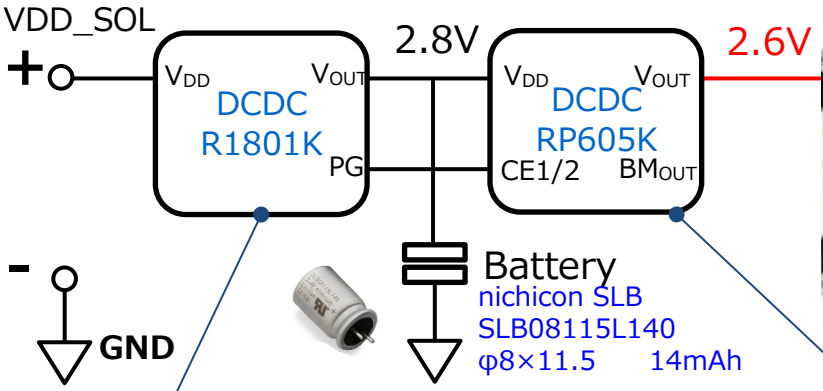
Manage and update the display information of electronic shelf labels using the app

Multiple electronic shelf labels can be managed together

◆Circuit diagram



PV cells



IC : R1801 （Nisshinbo Micro Devices ）

・Start-up power 1μW Ultra-low current consumption 200nA High efficiency (80% @ 10μA)
・Monitors output voltage, outputs PG signal
・Controls output voltage and maximum power point

IC : RP605 （Nisshinbo Micro Devices ）

・Step-up/down DC/DC converter (ultra-low current consumption 300nA)
・Wide input voltage (1.8 to 5.5V)
・High-precision battery voltage monitoring using a microcontroller AD converter

Case 2 : Bridge Monitoring System

Infrastructure Monitoring System Using Vibration Power Generation

金沢大学 KANAZAWA UNIVERSITY

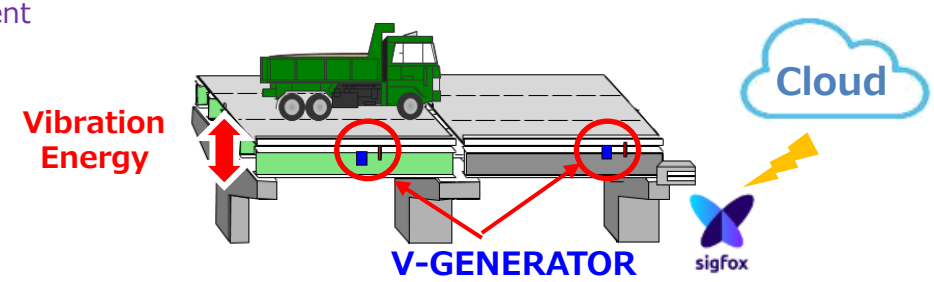
1. Simple and easy to manufacture, high durability
2. High power and high sensitivity
3. Excellent power supply characteristics (low output resistance)
4. High degree of freedom in size and shape
5. low cost

◆Circuit configuration example

Vibration Power Generation

Storing weak current

It is possible to collect information via cloud network, monitor infrastructure status, and collect big data.



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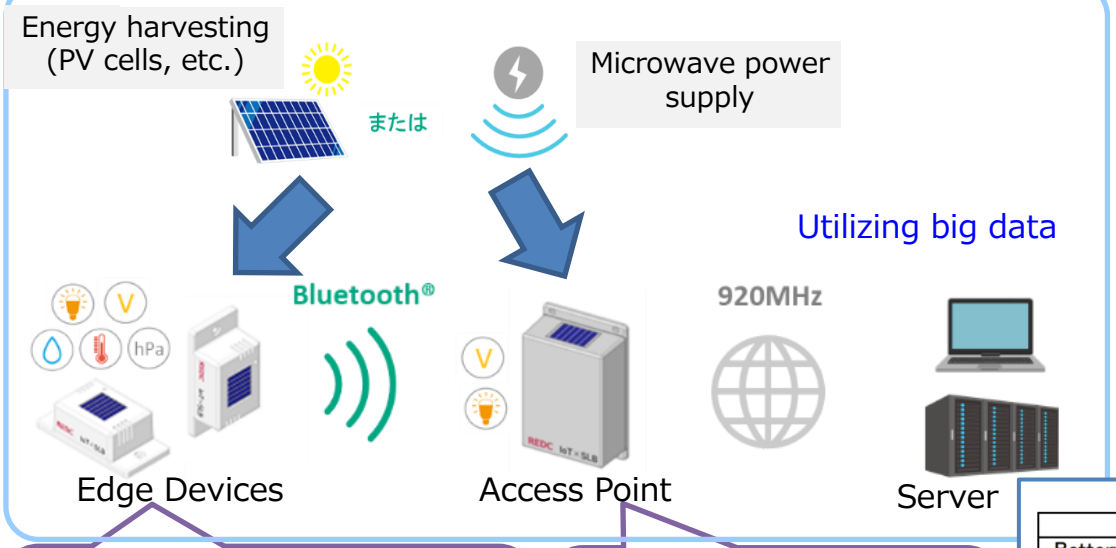
Case 3 : IoT Access Point & Edge Terminal

IoT Access Point & Edge Terminal

Easy asset management for infrastructure, production equipment and more.
Wireless, maintenance-free IoT access point and edge terminal systems.

IoT Access Point & Edge Terminal System



Sensor information is updated every 10 seconds.
Transmits information on temperature, humidity, air pressure, illuminance, motion, GAS (Indoor Air Quality), and battery voltage.

nichicon SLB
SLB08115L140
φ8×11.5　14mAh

920MHz band wireless communication equipment enables line-of-sight communication between Edge Devices and servers up to 200m

nichicon SLB
SLB12400L151
φ12.5×40　150mAh

Nisshinbo Micro Devices Inc.

Using IoT to remotely monitor environmental information such as temperature, humidity, and air pressure

- Predictive maintenance of infrastructure and production facilities
- Temperature and humidity control in office spaces
- Agricultural greenhouse environment monitoring
- Environmental monitoring for warehouses and stores

Monitoring Data Information

IoT Monitor Sensor Status

Sensor	No.1	No.2	No.3	Gateway
Battery [V]	2.294	2.542	2.533	2.642
Illuminance [Lux]	112.0	104.4	104.0	207.4
Pressure [hPa]	1004.9	1004.9	1004.7	
Temperature [℃]	27.8	27.0	23.0	
Humidity [%RH]	52.2	55.1	55.1	
Cube face				
Air Quality				
IAQ Index	25			
Accuracy	0			
Resistance [Ω]	140496.0			

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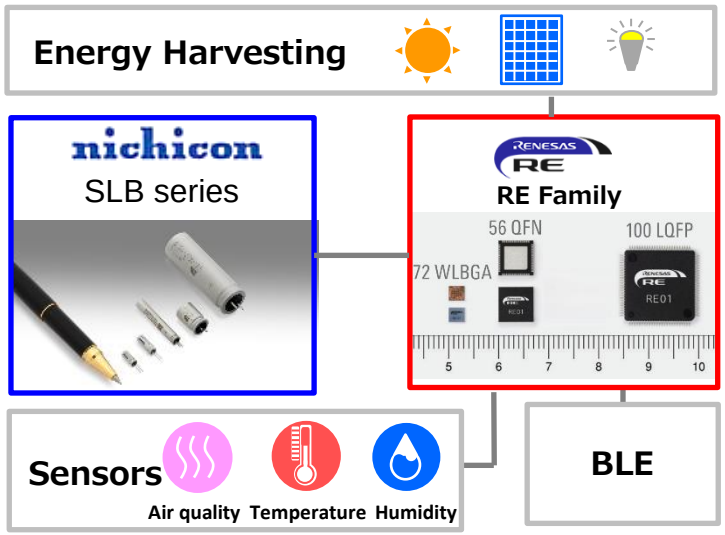
Case 4 : Maintenance-free Smart Remote

Maintenance-free Smart Remote

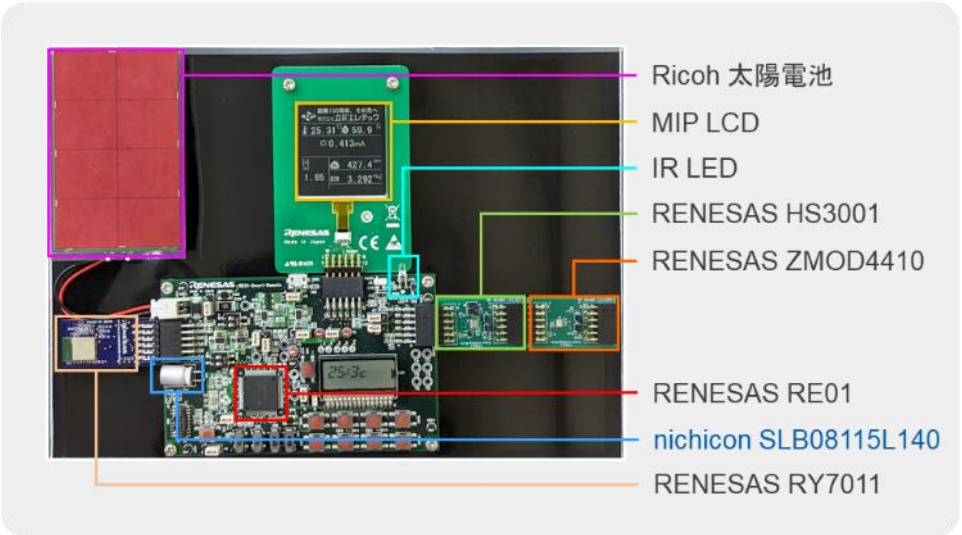
Maintenance-free IoT devices achieve energy harvesting by utilising SOTB technology and embedded controllers of the SLB series. Other devices can be controlled by an intelligent remote control function linked to the data acquired by the sensors.

TACHIBANA ELETECH 株式会社 立花エレテック

RE Family "Maintenance-Free Smart Remote"



◇Board Configuration



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Case 5 : Zero Carbon LoRa Evaluation Board

Maintenance-free Asset Management system

Location and sensor information can be acquired by energy harvesting operations and sent to the cloud via Zero Carbon LoRa.

TACHIBANA ELECTRONIC SOLUTIONS CO., LTD.
株式会社立花電子ソリューションズ

Features of the Zero Carbon LoRa® Evaluation Board

nichicon

・Energy harvesting charging using natural energy

RENESAS

RENESAS RE

・World's smallest class low current consumption
Low voltage, high speed operation possible

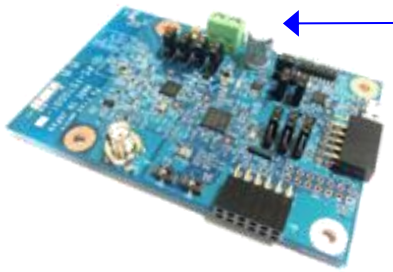
SEMTECH

LoRa®

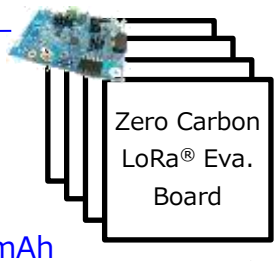
・Low-power LoRa® communication and unique indoor/outdoor tracking function (WiFi & GNSS hybrid positioning)

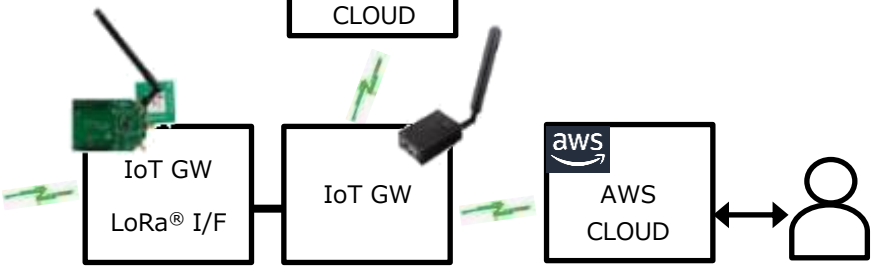
Example of using the Zero Carbon LoRa® Evaluation Board

・Luggage and cart management in airports, tracking of lost children
・Cart management and tracking of lost children in shopping malls
・Equipment management in hospitals and factories, etc.



Nichicon SLB
SLB08115L140
φ8×11.5　　14mAh





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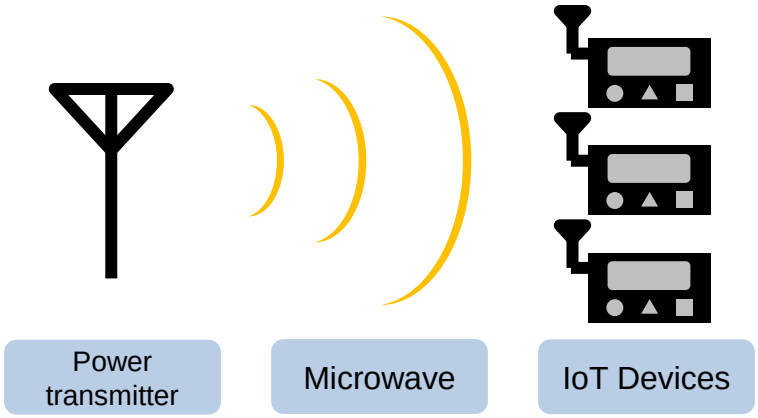
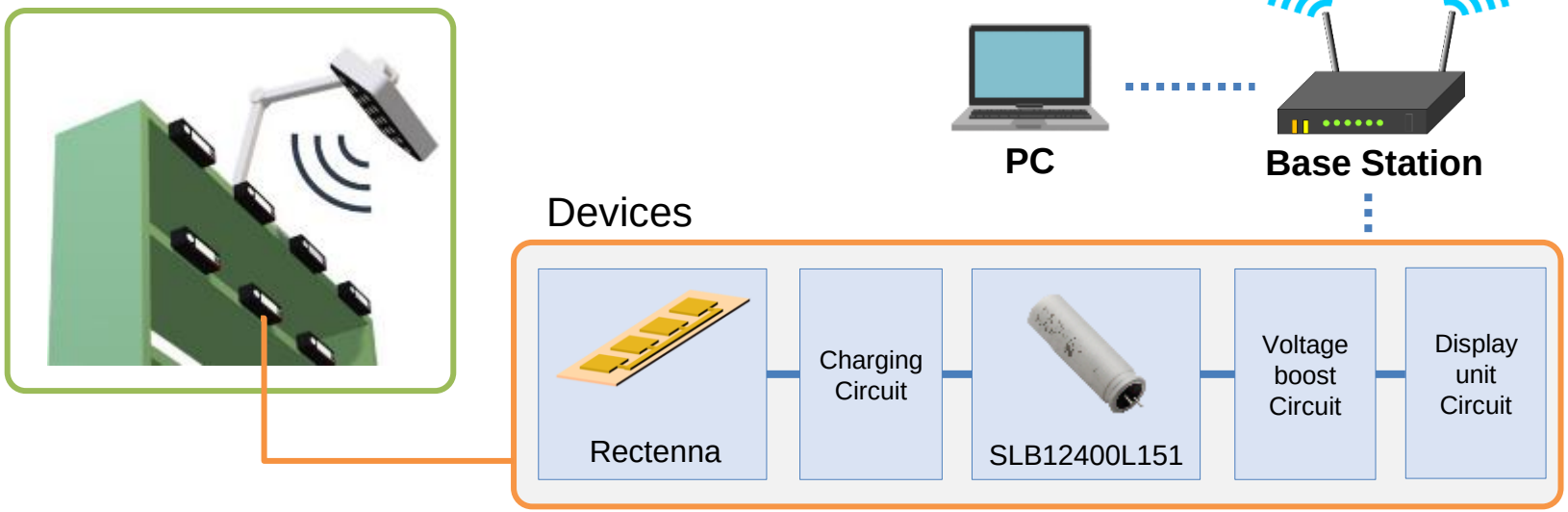
Case 6 : Wireless Power Transfer Solutions

Digital Picking Indicator Using Microwave Power Supply

B-STORM



1. No wiring required! Wireless power supply
2. Free from the constraints of battery capacity
3. Maintenance free



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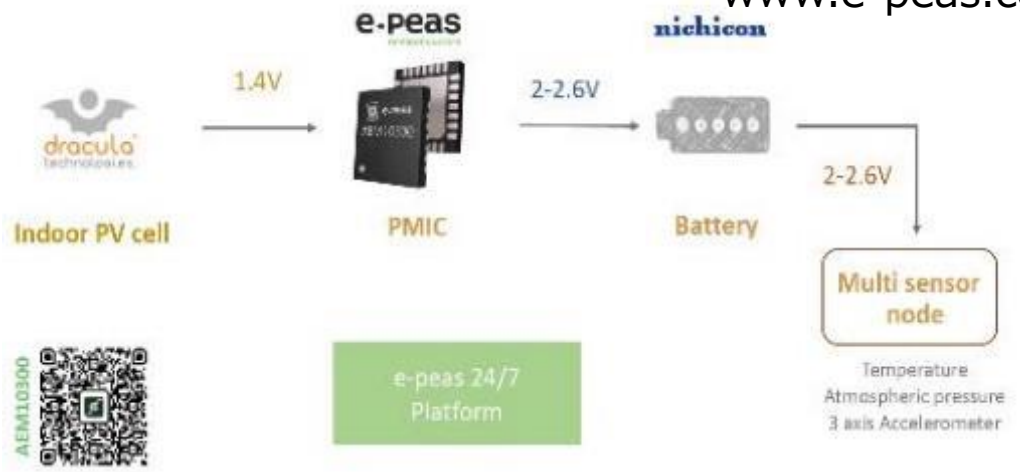
Case 7 : 24/7 Environmental Sensor Platform

PV-based edge sensor node capability reaching 1+ months of autonomy in complete darkness, while sensing and connectivity is maintained.

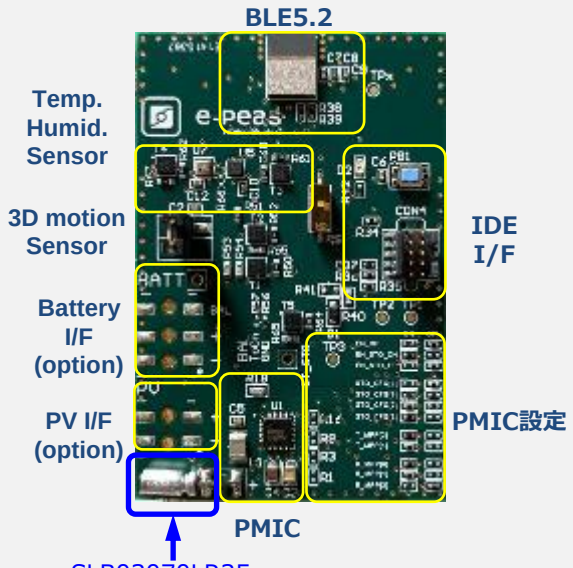
e-peas semiconductors

www.e-peas.com

Asset Tracking | Smart Buildings | Smart Home

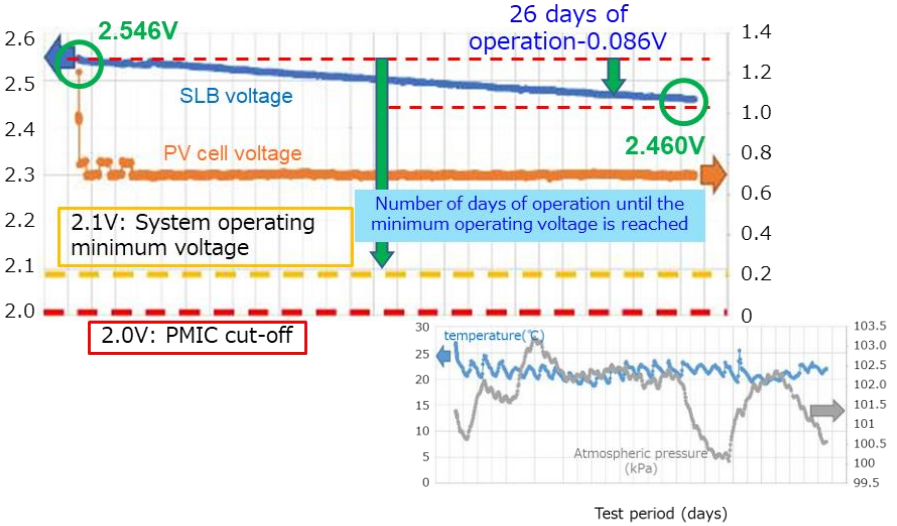


Board Configuration



Mobile App

26 days of operation data in darkness



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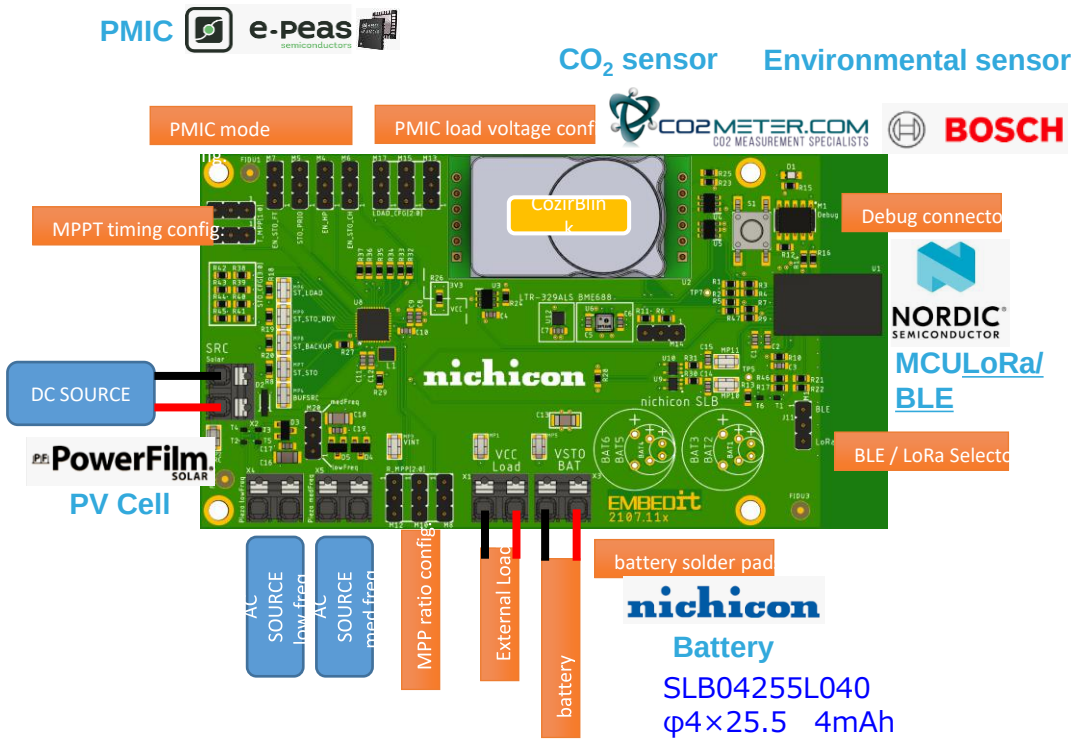
Case 8 : CO2 Sensor Platform with Energy Harvester

Harvesting with NICHICON – SLB LTO battery

CO2 & Environmental Demonstration Board (Android OS / Chrome)

IoT energy harvesting evaluation board with E-Peas AEM10330 (Solar) and AEM30330 (Piezo)



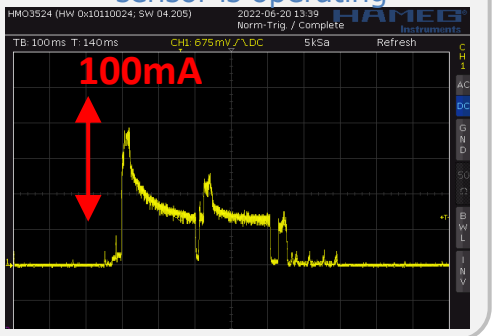
Key Features

- Equipped with temperature, humidity, air pressure, illuminance and CO2 sensors
- Evaluation mode for IoT application development
- Variants available for PV power generation and vibration power generation
- Fully configurable PMIC functions
- All sizes of the SLB series can be evaluated
- Battery Voltage Monitoring
- Low power consumption

Standby current <80μA, Operating current <380μA

Peak current: ~100mA

Current waveform when CO2 sensor is operating



The SLB series, which excels at high-rate discharge, can handle it!

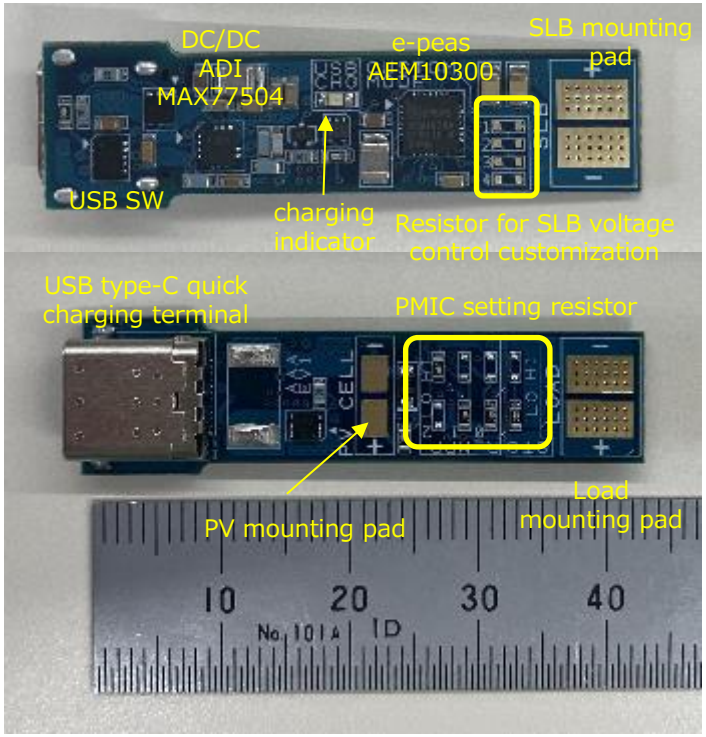
Case 9 : ESL with wireless power supply system

ESL equipped with a wireless power supply system using Ossia's Cota technology
Using the SLB series is expected to contribute to weak charging and long-life operation
(SLB support is being considered for the next model)

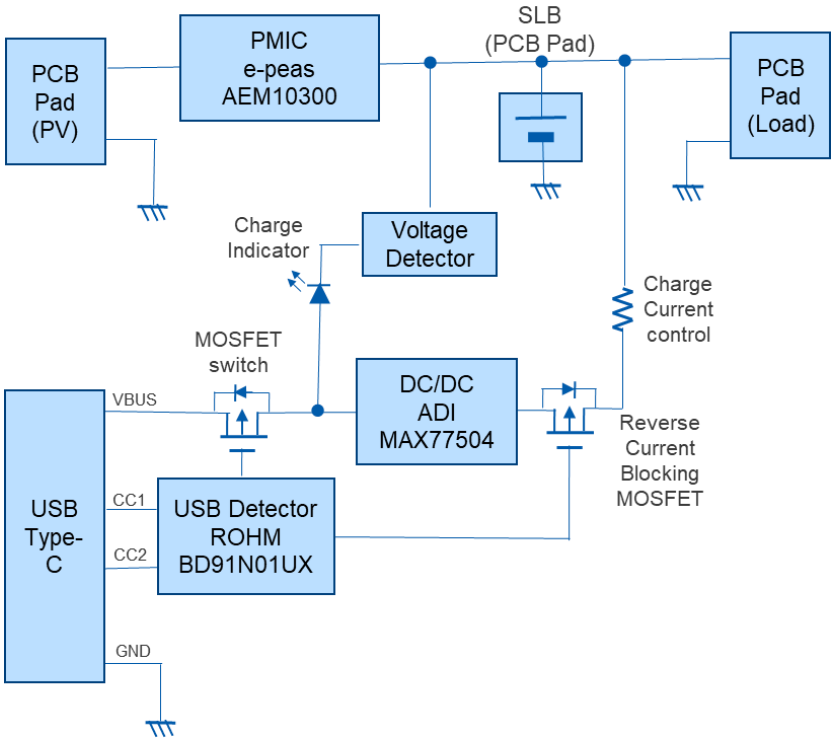
Ossia Inc.

Case 10：Maintenance-free power supply system using SLB+PV

Equipped with PV energy harvesting and SLB control functions on a AAA battery-sized board
Also equipped with a USB type-C quick charging port, which can be used to replace primary batteries.



Example of installing SLB φ8mm

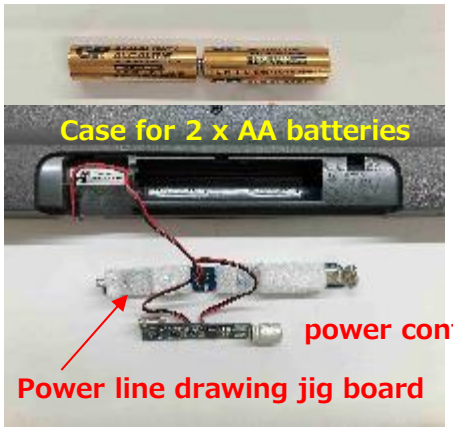


Case 10：Maintenance-free power supply system using SLB+PV

Equipped with PV energy harvesting and SLB control functions on a AAA battery-sized board
Also equipped with a USB type-C quick charging port, which can be used to replace primary batteries.

We prototyped a proposed POC to replace 2 AA batteries.

SLB08115L140
+
power control board



PV panel
Powerfilm
INP3.6 12x310

・With this keyboard, you can use up to 2 hours in a row per day.
Key typing requires no power supply maintenance (14 hours @ 1,000 Lux/day indoor light charging condition)

・Continuous operation time without PV power assist
SLB08115L140: Approximately 6 hours
SLB12400L151: Approximately 56 hours

・USB-C quick charge
Approximately 1 hour of continuous operation after 1 minute of charging
(from energy depletion state)

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Power IC for SLB (Recommended List)

No.	Maker	Product No.	overview	Battery size				
				φ3x7 0.35mAh	φ3.3x9 0.8mAh	φ4x25.5 4mAh	φ8x11.5 14mAh	φ12.5x40 150mAh
1	Analog Devices	LTC4079	Linear Charger	—	—	○	○	△
2	Analog Devices	LTM4661	µModule Regulator	—	—	○	○	○
3a	Analog Devices	MAX17220/17222 /17224	Boost DC/DC converter with ETP function	○	○	○	○	△
3b	Analog Devices	MAX17221/17223 /17225	Boost DC/DC converter	○	○	○	○	△
4	Analog Devices	MAX77827	Boost DC/DC converter	○	○	○	○	○
5	Analog Devices	LT8350	Buck-Boost DC/DC Converter compatible with CC/CV regulation	○	○	○	○	○
6	Analog Devices	ADP5090 ADP5091/5092	Boost DC/DC converter with MPPT and battery management function	○	○	○	○	△
7	Renesas Electronics	RE01	MCU with battery management function	○	○	○	○	○
8	Nisshinbo Micro Devices Inc.	R1800 R1801	Buck DC/DC Converter	○	○	○	○	△
9	Nisshinbo Micro Devices Inc.	RP604 RP605	Buck-Boost DC/DC Converter	○	○	○	○	△

The ICs listed are not guaranteed to work by us, so be sure to check them on your own when considering them.
For detailed control IC specifications, please check the IC manufacturer's datasheet.

Power IC for SLB (Recommended List)

No.	Maker	Product No.	overview	Battery size				
				φ3x7 0.35mAh	φ3.3x9 0.8mAh	φ4x25.5 4mAh	φ8x11.5 14mAh	φ12.5x40 150mAh
10	ROHM	BD99954GW/MWV	Battery Manager	—	—	—	—	△
11	ROHM	BD71631QWZ	Linear Charger	○	○	○	○	△
12	ROHM	BD5320NVX-2C	Reset IC	○	○	○	○	○
13	TOREX SEMICONDUCTOR	XC8109	High Function Power Switch	—	—	○	○	○
14	TOREX SEMICONDUCTOR	XC6504	Linear Regulator (LDO)	○	○	○	○	△
15	TOREX SEMICONDUCTOR	XC6240	Linear Regulator (LDO)	○	○	○	○	△
16	TOREX SEMICONDUCTOR	XC6215	Linear Regulator (LDO)	○	○	○	○	△
17	TOREX SEMICONDUCTOR	XC6140	Reset IC	○	○	○	○	○
18	TOREX SEMICONDUCTOR	XCL103	Boost DC/DC Converter	○	○	○	○	○
19	TOREX SEMICONDUCTOR	XC6132	Reset IC with sense pin isolation and HYS external adjustment	○	○	○	○	○
20	TOREX SEMICONDUCTOR	XC6135	Reset IC with sense pin isoration	○	○	○	○	○

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Power IC for SLB (Recommended List)

No.	Maker	Product No.	overview	Battery size				
				φ3x7 0.35mAh	φ3.3x9 0.8mAh	φ4x25.5 4mAh	φ8x11.5 14mAh	φ12.5x40 150mAh
21a	e-peas	AEM10330	Power manager with regulated output and storage charger for solar energy harvesting	○	○	○	○	△
21b	e-peas	AEM30330	Power manager with regulated output and storage charger for vibration/RF energy harvesting	○	○	○	○	△
21c	e-peas	AEM00330	Power manager with regulated output and storage charger for ambient energy harvesting	○	○	○	○	△
22a	e-peas	AEM10300	Buck-boost storage charger for solar energy harvesting	○	○	○	○	△
22b	e-peas	AEM30300	Buck-boost storage charger for vibration/RF energy harvesting	○	○	○	○	△
22c	e-peas	AEM00300	Buck-boost storage charger for ambient energy harvesting	○	○	○	○	△
23	e-peas	AEM10941	Power manager with LDO output and boost storage charger for solar energy harvesting	○	○	○	○	△
24	e-peas	AEM20940	Power manager with LDO output and storage charger for ambient thermal energy harvesting	○	○	○	○	△

The ICs listed are not guaranteed to work by us, so be sure to check them on your own when considering them.
For detailed control IC specifications, please check the IC manufacturer's datasheet.

Power IC for SLB (Recommended List)

No.	Maker	Product No.	overview	Battery size				
				φ3x7 0.35mAh	φ3.3x9 0.8mAh	φ4x25.5 4mAh	φ8x11.5 14mAh	φ12.5x40 150mAh
25	ABLIC Inc.	S-19190	Over voltage detector with cell balancing function	○	○	○	○	○
26	ABLIC Inc.	S-19192	Voltage manager for multi battery cell in series (3 to 6 in series)	○	○	○	○	○
27	ABLIC Inc.	S-8269B	Charging/discharging current supervisor	○	○	○	○	○
28	ABLIC Inc.	S-8215C	Voltage manager for multi battery cell in series (3 to 5 in series)	○	○	○	○	○
29	ABLIC Inc.	S-8265C	Voltage manager with cell balancing function for multi battery cell in series (3 to 5 in series)	○	○	○	○	○
30	ABLIC Inc.	S-1740 S-1741	Linear Regulator (LDO) with divided voltage output	○	○	○	○	—
31	ABLIC Inc.	S-8354 S-8356	Boost DC/DC converter	○	○	○	○	△
32	ABLIC Inc.	S-85S1A	Buck DC/DC Converter	○	○	○	○	△
33	ABLIC Inc.	S-13R1	Linear Regulator (LDO) with reverse current protection	○	○	○	○	△
34	ABLIC Inc.	S-1313	Linear Regulator (LDO)	○	○	○	○	△

The ICs listed are not guaranteed to work by us, so be sure to check them on your own when considering them.
For detailed control IC specifications, please check the IC manufacturer's datasheet.

Power IC for SLB (Recommended List)

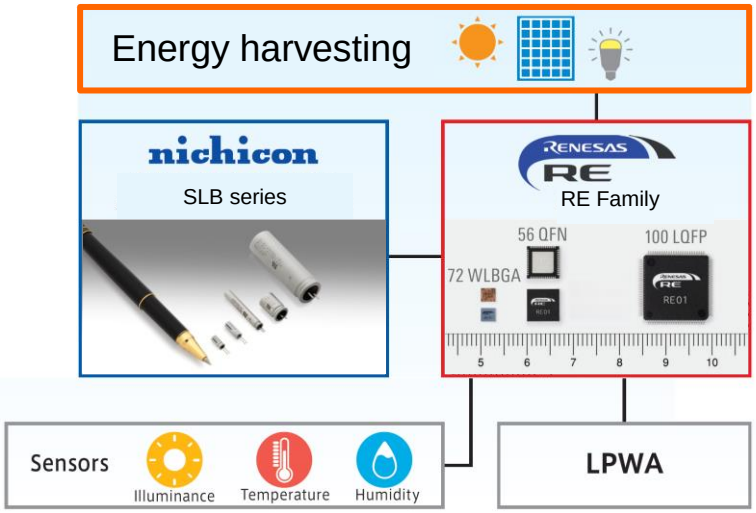
No.	Maker	Product No.	overview	Battery size				
				φ3x7 0.35mAh	φ3.3x9 0.8mAh	φ4x25.5 4mAh	φ8x11.5 14mAh	φ12.5x40 150mAh
35	MATRIX	Prometheus series	Thermoelectric power generator	○	○	○	○	○
36	Powercast	PCC110/PCC210	Chipset consisting of RF energy harvester and boost DC/DC converter	○	○	○	○	○
37	Atmosic	ATM33e	Ultra low power consumption SoC with RF harvesting charger compatible with BLE	○	○	○	○	○
38	Atmosic	ATM34e	Ultra low power consumption SoC with RF harvesting charger compatible with BLE and PAN (802.15.4)	○	○	○	○	○
39	Nexperia	NEH2000BY	Boost charger for photovoltaic energy harvesting	○	○	○	○	○
40	Texas Instruments	TPS552872 TPS552892	Buck-Boost DC/DC Converter compatible with CC/CV regulation	△	△	○	○	○
41	Texas Instruments	TPS552882	Buck-Boost DC/DC Converter compatible with CC/CV regulation	△	△	○	○	○

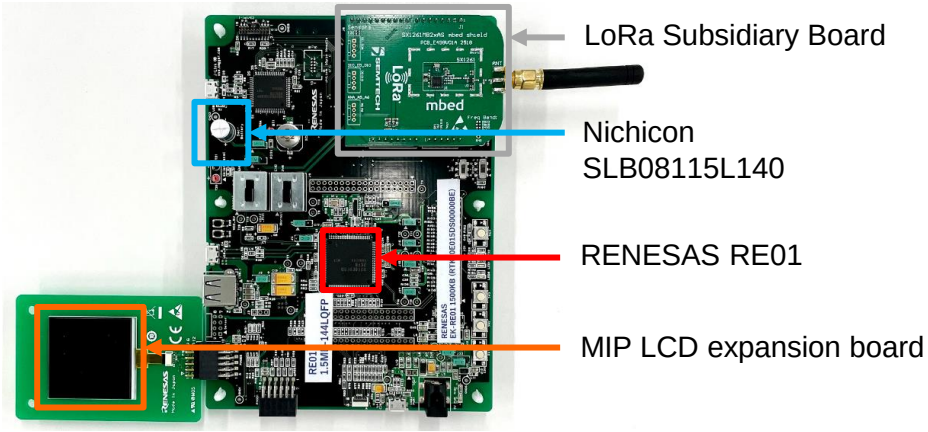
Power IC for SLB

RE Family “LoRa Solution without Battery Replacement”

Realization of energy-harvesting IoT devices by using embedded controllers with SOTB technology and SLB series

Renesas Electronics Corporation





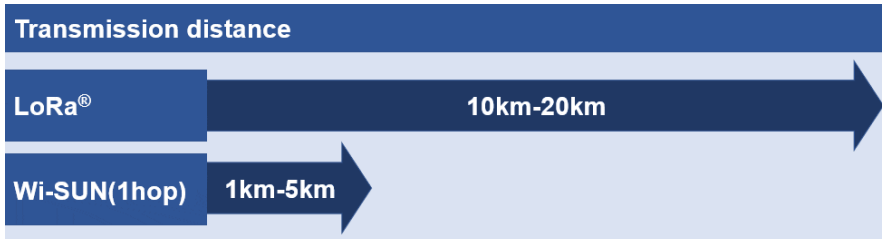
LoRa Case of Solution Applications

- Gas meter
- Water flow meter
- Vending machine data collection

- Structural anomaly notification
- Building/Parking Lot Management
- Warehouse Inventory Management

- Agriculture / Livestock Management
- Livestock Feed Management
- Livestock location detection

- Healthcare Data Management and Transfer
- Tracking of people



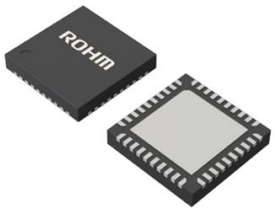
nichicon

Power IC for SLB

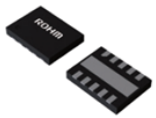
Ultra-rapid Charging IC

It provides ultra-fast charging that enables 80% charge in 2 minutes

ROHM CO., LTD.



BD99954MWV
UQFN040V5050W



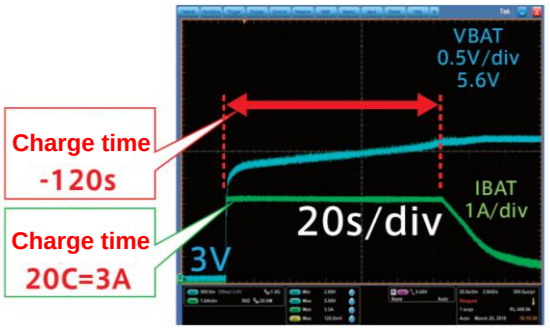
☆BD71631QWZ
UMMP10LZ1824

Ultra-rapid Charging（20C）

80% charge Achieved in 2 minutes

Small lithium-ion rechargeable battery “SLB Series”

Charge waveform at BD99954MWV



φ12.5 × 40L / 150mAh
2 connection

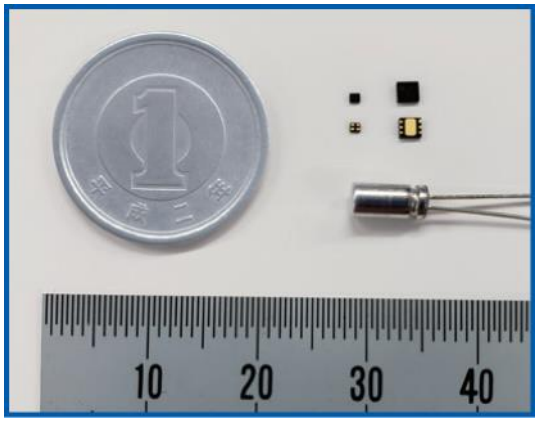
20C=3A charging setting
(Full charge setting: 5.6V)

Power IC for SLB

Ultra-compact charging solution IC

TOREX
SEMICONDUCTOR LTD.

LDO sealed in an ultra-compact package.
By using a line switch, it is possible to The use of LDO and line switches in an ultra-compact package enables space-saving CCCV charging of the SLB series of ϕ3 × 7L

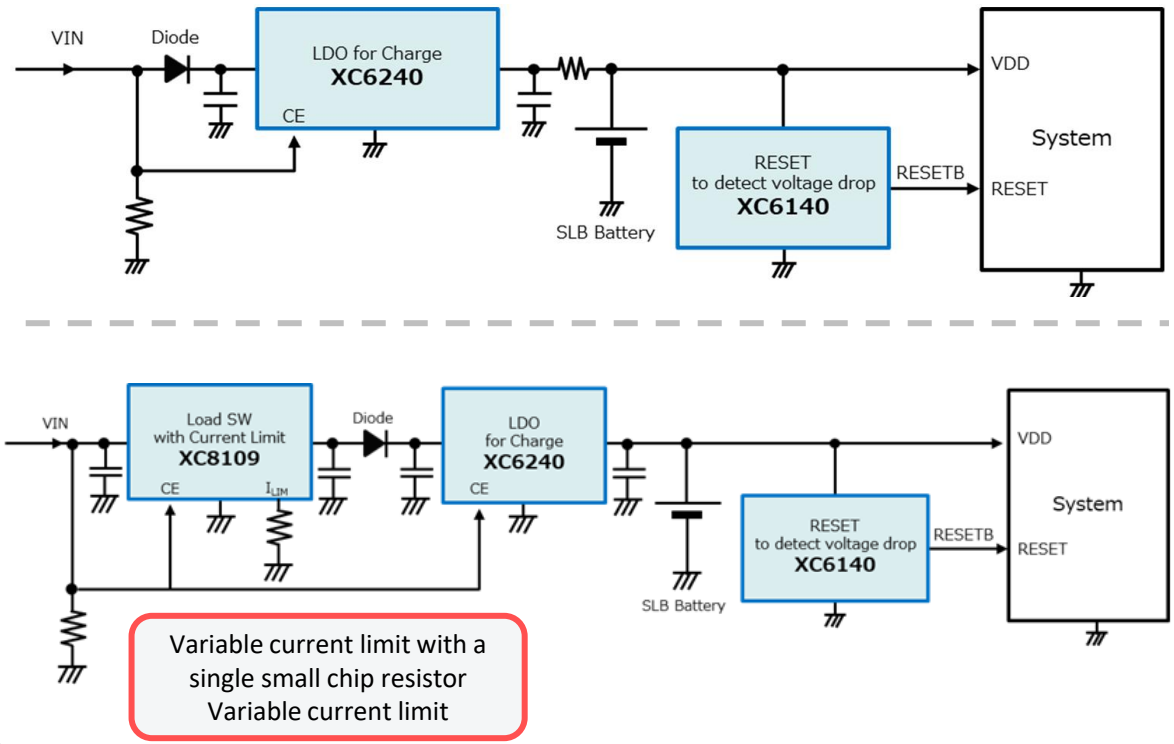


0.8μA Ultra Low Supply Regulator
XC6240 Series

Battery Voltage Monitoring IC
XC6140 Series

85mΩ High Performance Load Switch **XC8109 Series**

Circuit Diagram



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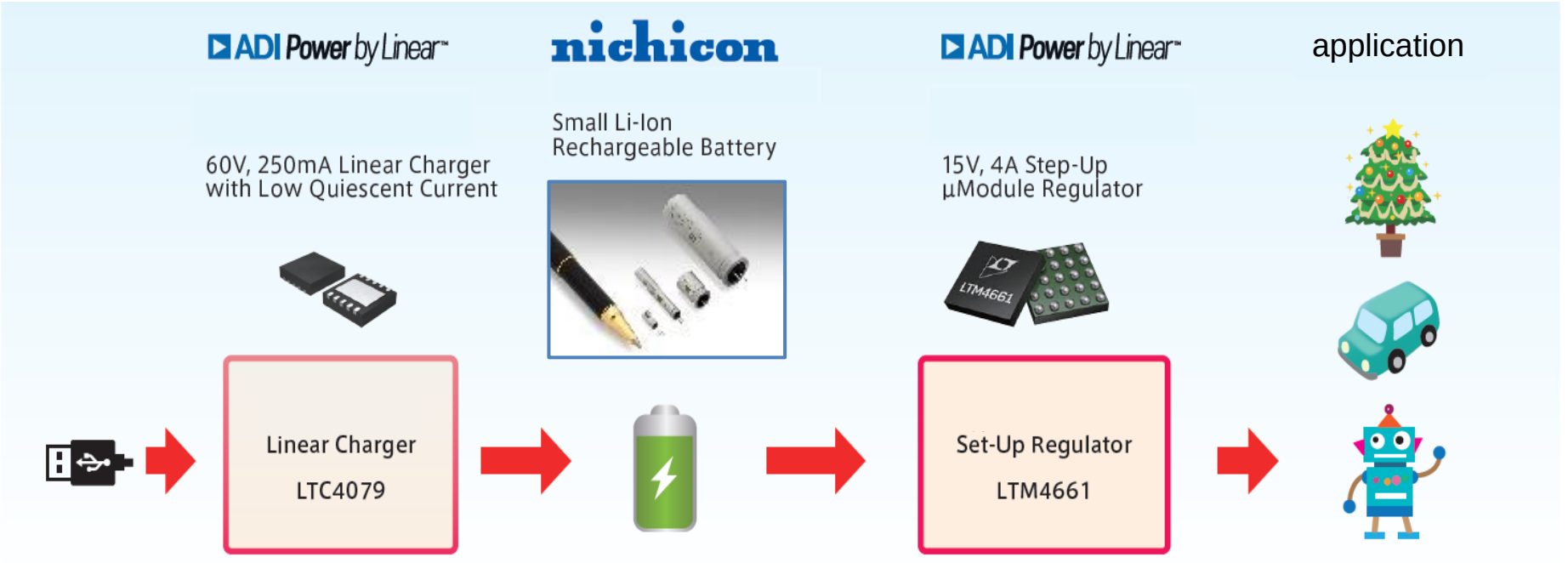
Power IC for SLB

Linear Charger and Set-Up Regulator

ADI Power by Linear™

Analog Devices, Inc.

The SLB series can be used with linear chargers and set-up/set-down regulators to power a variety of devices according to specifications.
The SLB series can be used to run a variety of devices according to your specifications.



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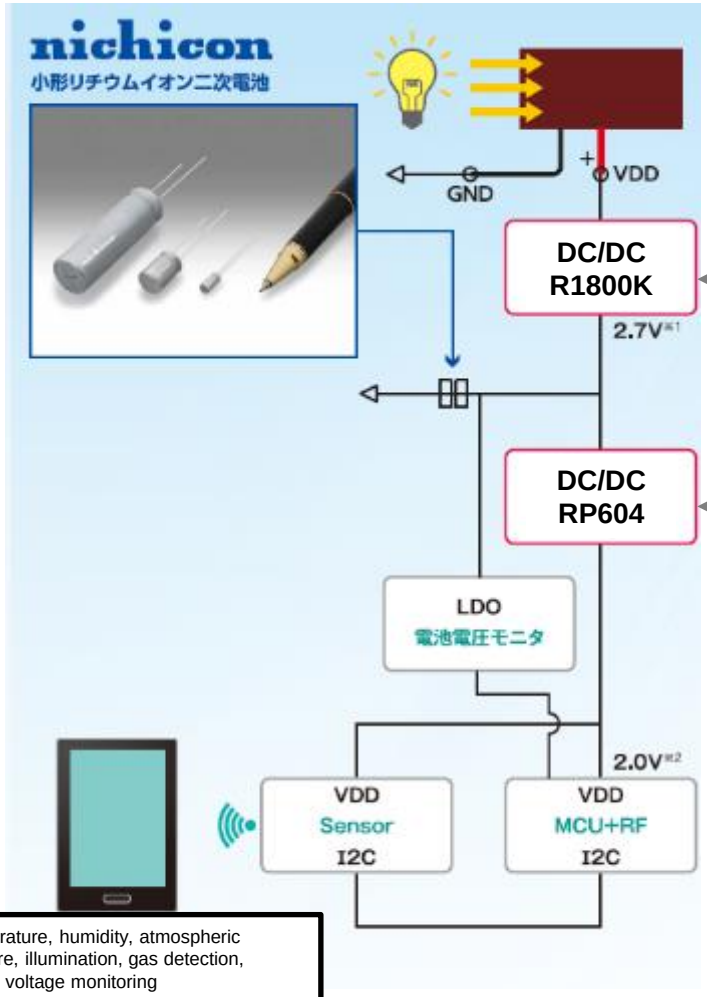
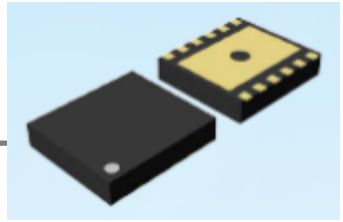
Power IC for SLB

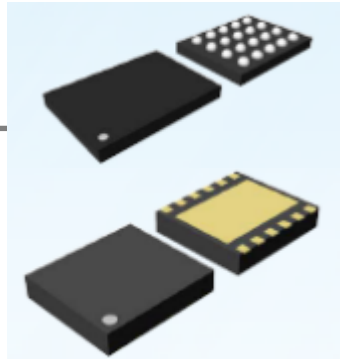
Ultra Low Power IC

Nisshinbo Micro Devices Inc.

By using Nisshinbo Microdevices' power supply IC and the SLB series the environmental sensor can be driven for a long period of time.







Low Quiescent Current
Buck DC/DC Converter for Energy Harvester

R1800K / R1801K series

*R1800K output can be changed to 2.8V.

Ultra-low supply current DC/DC converter and voltage regulator

RP604x/RP605x series

*RP604 can be driven from 1.8 V, so the SLB series can be used up to the lower limit voltage.

Temperature, humidity, atmospheric pressure, illumination, gas detection, current voltage monitoring

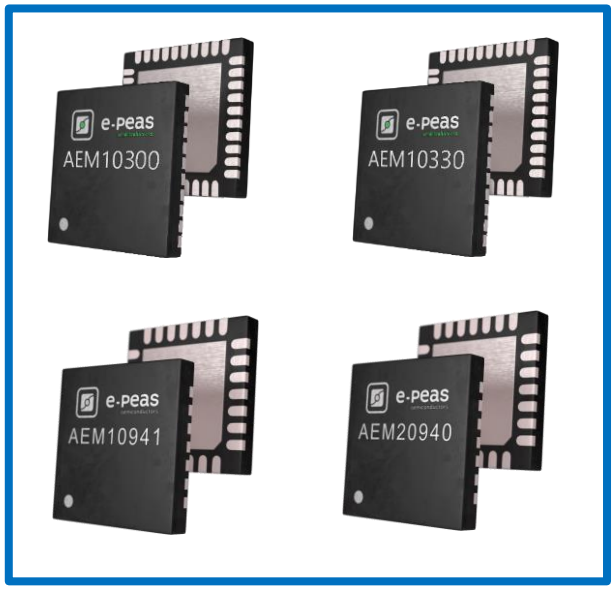
Power IC for SLB

Energy Harvesting Battery Charger

With e-peas energy harvesting ICs and Nichicon SLB series, it is possible to configure a stand-alone power supply that is ideal for IoT edge devices, harvesting various types of environmental energy with high efficiency and using it when needed.

e-peas S.A.

PMIC line-up for Energy Harvesting



AEMx0330 Series |	Ambient Energy Manager with Source Voltage Level Configuration Solar／Vibration／High Frequency／ Pulse Energy
AEMx0300 Series |	Ambient Energy Manager - Storage Charger only - Buck boost Solar／Vibration／ High Frequency ／Pulse Energy
AEM10941 |	Solar Energy Harvesting Charger with boost and LDO
AEM20940 |	Ambient Thermal energy harvesting Charger - Buck boost and LDO

Power IC for SLB

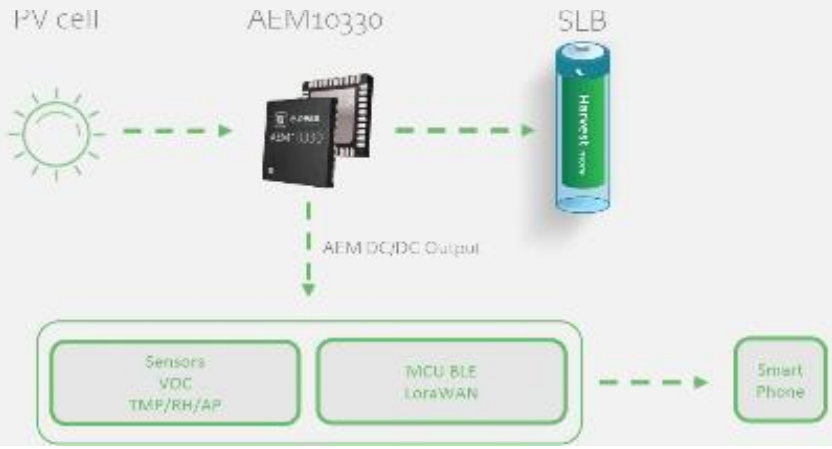
PMIC with MPPT function for solar power generation

e-peas S.A.

MPPT : Maximum Power Point Tracking

AEM10300 Features:

- Battery charger
- MPPT Tracking
- Vsource 100mV – 4.5V
- Battery management and protection
- Low cold start: 3uW@275mV
- Boost/Buck-Boost/Buck operation modes
- BOM: 3 components / QFN28 4x4mm
- Quiescent current: 5.9nA @ 3.7V



AEM10330 Features:

- Battery charger + application power supply
- MPPT Tracking
- Internal DC/DC output
  - 30mA low power mode
  - 60mA high power mode
  - Voltage range: 1.2V – 3.3V
- Vsource 100mV – 4.5V
- Battery management and protection
- Low cold start: 3uW@275mV
- Boost/Buck-Boost/Buck operation modes
- BOM: 4 components / QFN40 5x5mm
- Quiescent current: 875nA @ 3.7V

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Online contents

Dedicated HP for SLB

https://www.nichicon.co.jp/english/products/slb/

SLB Series TOP | About SLB | Products | Reference Note | Q&A | For Transport

- ・What's New
- ・Features
  ・introduction video
  ・Adoption case
  ・Pamphlet
- ・Dimensional drawing
  ・Characteristic diagram
  ・Specification table
  ・Data sheet
- ・ Circuit Design Support
- ·FAQ
  · Contact Us
- ·Precautions when transporting
  For Air Freight IATA
  For Ocean IMDG
- ·Safety data sheets
  SDS, UN38.3 summary

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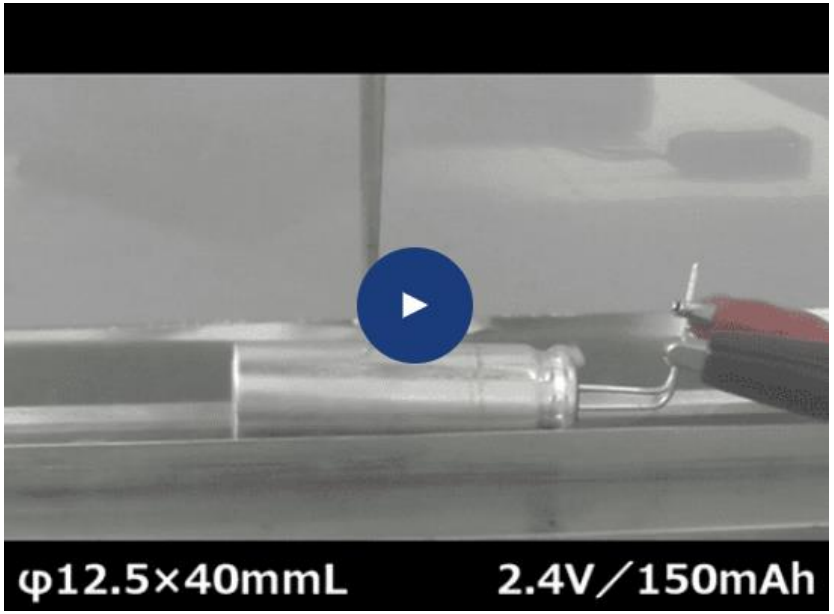
Online contents

Video contents

Introduction of SLB

Nail penetration test (safety confirmation test)



- **It is explained in an easy-to-understand manner using a video.**
- **Content will be added in the future.**

Online contents

Technical notes

https://www.nichicon.co.jp/_assets/pdf/products/slb/slb_technicalnote_all_E.pdf

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Described battery characteristics, usage, reliability, safety, etc.
A technical note was released in December 2020.

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Precautions for handling Small Li-Ion rechargeable batteries

- Hazardous
  - Since chemical components are sealed in a new electric storage device, the hazards are extremely low.
  - However, if you mistakenly use it, the new electric storage device may cause deformation, leakage, rupture, heat generation, or irritating gas or corrosive gas, so please be extremely careful in handling.

- Stability and reactivity
  - When two or more devices are randomly mixed without insulation treatment on the terminals, there is a possibility of bursting and rapid heat generation by short-circuiting.
  - When overcharged, heated, or dropped in a fire, electrolyte or other substances may burst out rapidly.
  - When disassembling the device, there is a possibility of rapid heat generation due to a short circuit.

Precautions for handling Small Li-Ion rechargeable batteries

- **Do not short circuit the battery**
  Overheating of the cell may cause leakage, overheating, or explosion.
- **Do not apply current via reversed polarity**
  An abnormal reaction may occur internally, causing leakage, overheating, or explosion.
- **Do not apply physical load.**
  If excessive force is applied, the parts will be damaged, causing electric shock, short circuit, or liquid leakage.
- **Do not conduct the tests listed below**
  Overcharge test, overdischarge test, nail penetration test, crushing test, drop test, chemical resistance test, high temperature exposure test.

Treatment when electrolyte leaks

The electrolyte is flammable and is a liquid with irritation to the eyes, skin and mucosa. If leakage occurs, please take below measures.

- **When adhering to the skin**
  Immediately wash the adhering part with water or tepid water by using soap. If there is a change in your skin or pain continues, please consult your doctor immediately.
- **When gets into eyes**
  Wash your eye with clean water for 15 minutes and submit to medical treatment.
- **Smoke or fire**
  Please extinguish with carbon dioxide, powder fire extinguisher, or a lot of water.

Storage of Small Li-Ion rechargeable batteries

○ Storage condition

・Please do not let the terminals contact with each other or contact with the conductors.

・Please avoid storage under the following circumstances.

(a) Being exposed to water, high temperature & high humidity atmosphere, or condensation of moisture.

(b) Being exposed to oil or an atmosphere that is filled with particles of oil.

(c) Being exposed to salty water or an atmosphere that is filled with particles of salt.

(d) In an atmosphere filled with toxic gasses (such as hydrogen sulfide, sulfurous acid, nitrous acid , chlorine, bromine, methyl bromide, ammonia, etc.)

(e) Being exposed to direct sunlight, ozone , ultraviolet ray, or radiation.

(f) Being exposed to acidic or alkaline solutions

・Long term storage performance is being confirmed.

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