Industrial Lithium-ion Battery \textit{SCiB$^{\text{TM}}$} SIP series

New Battery Solution for Automated Guided Vehicle etc.
It takes 8 to 10 hours to charge a battery. Two sets of battery for charging and discharging have to be prepared for continuous operation.

Battery needs to be replaced every one to three years... Frequent replacement increases the maintenance cost...

Replacement of large and heavy battery is quite taxing... Space for charging battery is also a waste.

The place for charging battery is limited due to safety reasons. Unmanned charging could result in serious incident by possible hydrogen gas generation.

1-hour quick charging improves the operation rate! 20-minute charging is even possible!* With 1 hour lunch break, one set of battery is just enough for 24/7 operation.

10 years long life reduces the total cost! 10 years long life contributes to total cost reduction. Moreover, this is a maintenance-free battery!

Compact and light battery can be replaced easily and smoothly. Battery weights reduced to one-quarter of lead acid battery for same operation time.

This battery has no risk of fuming or ignition. This battery does not produce hydrogen gas. Users can charge the battery anytime and anywhere!

Lead-acid batteries can be replaced easily with “SIP series” which has unique features.

Note: The values do not guarantee the product performance.

Let the SCiB™ “SIP series” solve all the inconveniences caused by lead-acid batteries.
The reasons why “SCiB™” is chosen rather than lead-acid batteries or other lithium-ion batteries

**Safety**

- No emission of hydrogen gas
- No need to have dedicated charging room

**Long life**

**Continuous 20,000 cycles or more**

The capacity remains at 70% or more even after 20,000 times of charging/discharging. SCiB™ also has small degree of deterioration even with float charging, making it usable for applications that keep constant voltage such as backup power supply.

**Quick charging/discharging current**

Charging completes within 1 hour

It takes 8 hours to charge a lead acid battery. On the other hand, SCiB™ reduces charging time significantly. With customized charger, 20 minutes charging becomes available.

**Resistance to low temperature**

SCiB™ outputs 70% or higher capacity even when the surrounding temperature is at -30°C

SCiB™ exhibits low degradation even when it is charged and discharged at -30°C

**Using 100% of discharging depth (DOD)**

100% of DOD* is available

A lead-acid battery is ordinary used at approx. 50% of DOD in order to prevent degradation. However, SCiB™ is available at 100% of DOD.

**Compliance with safety standards**

<table>
<thead>
<tr>
<th>Organization</th>
<th>23Ah cell</th>
<th>SIP series</th>
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</thead>
<tbody>
<tr>
<td>UL1942</td>
<td>UL45513</td>
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<tr>
<td>CAN/CSA-E62133</td>
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<td>JIS C 8715-2</td>
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**Protection function**

The SIP series is equipped with BMU* which monitors voltage, current, temperature and others to protect the battery from abnormalities.

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BMU: Battery Management Unit
DOD: Depth of Discharge

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* BMU: Battery Management Unit

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Case Study: Automated Guided Vehicle (AGV) powered by SCiB™

In case of two 8-hours shifts operation

<table>
<thead>
<tr>
<th>Production Line Layout</th>
<th>Operational Image</th>
<th>Quantity</th>
<th>Weight</th>
<th>Workload for Charging</th>
<th>Life</th>
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<tbody>
<tr>
<td>Lead-acid battery</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>8-hours operation</td>
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<tr>
<td>Dedicated charging room</td>
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<td>Charging in 1-hour break</td>
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<tr>
<td>Production line</td>
<td></td>
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<tr>
<td>Charging Room</td>
<td></td>
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<tr>
<td>Set A</td>
<td>8-hours operation</td>
<td>19kg</td>
<td>24V-50Ah</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-hour break</td>
<td>19kg</td>
<td>12V-50Ah</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8-hours operation</td>
<td>19kg</td>
<td>24V-50Ah</td>
<td></td>
<td></td>
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<tr>
<td>Set B</td>
<td>8-hours operation</td>
<td>19kg</td>
<td>24V-50Ah</td>
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</tbody>
</table>

SCiB™ can be charged on board (the AGV) during 1-hour break.

Two batteries can be reduced to one if charging is done during 1-hour break.

Equivalent capacity

- Lead-acid batteries
- 50Ah
- SCiB™ 22Ah

Battery replacement is not required if batteries are charged on board during a break. Even if you remove batteries for charging, SIP series can be lifted easily thanks to small size and lightweight.

Unmanned charging is possible!

4 advantages to adopt SCiB™

- **Safety and environment**
  - No emission of hydrogen gas
  - Environment-friendly thanks to lower emission of hazardous materials

- **Operational rate of AGVs improves by rapid charging**
  - Operational rate of AGVs improves by rapid charging
  - Downtime of AGVs 8h → 1h → 5min

- **Reducing the workload**
  - The smaller size reduces the workload when replacing the battery
  - Since lead-acid batteries are large and heavy, charging and replacing is hard work.
  - However, the weight of SCiB™ is a quarter (8 kg) of a lead battery.

- **Reduction of TCO***
  - Total cost is lower because of long life
  - Although lead-acid battery is cheaper if only considering the initial cost, you can enjoy lower total cost of ownership by SIP series in the long run.

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*TCO: Total cost of ownership

Note: The values described on this page are the reference values based on the simulation performed by Toshiba under the conditions assuming the AGV application. The values do not guarantee the product performance.
You can easily replace lead-acid batteries with SIP series

SCiB™ SIP series equips BMU (battery management unit) which monitors cell voltage, current and temperature, detects errors, and protects by itself.
You can easily handle and use as replacement of lead-acid batteries.

Lithium-ion battery appropriate for frequent and repeated charging and discharging

Up to 125A (200 seconds) charge and discharge are available.
SIP series is appropriate for the motor drive or AGV, which repeat frequent charging and discharging.

Easy replacement from lead-acid batteries
SIP series is smaller and lighter than lead-acid batteries. They also can be handled more easily than other lithium-ion batteries. Therefore, you can replace your battery with the SIP series without difficulty.

Features

- Safety: Built-in BMU™ protects the battery from errors.
- Rapid charging: Thanks to shorter charging time, you can adopt automatic charging system.
- External interface: Warning, error message, and SOC*2 status are output by CAN communication.
- Weight reduction: The weight of SIP series is about a quarter*3 of lead-acid battery (approx. 8kg)

Product specifications

- **Product name**: SIP24-23(24V)/SIP48-23(48V)
- **Nominal voltage**: DC24V/DC48V
- **Voltage range**: DC18.9 to 29.7V
- **Maximum discharge current**: 125A (200 seconds) / 150A (200 seconds)
- **Charging method**: CCxCV constant current/constant voltage (0-8h)
- **Cooling method**: Air cooling
- **Weight**: Approx. 8kg
- **Operating temperature range**: 0°C to 50°C / 25°C to 55°C
- **Protection functions**: Over charge protection, over discharge protection, over current protection, high temperature protection, and low temperature protection

You can easily replace lead-acid batteries with SIP series.

External interface specifications

- **Shape**: Single configuration
- **Connector**: 2-pin parallel
- **Specifications**: DC0.5V power source (up to 25mA)
- **Remarks**: BMU: Battery Management Unit

System configuration

**Single configuration (With CAN communication)**

- **UPPER controller**
- **Terminal adapter**
- **SIP24**

**Single configuration (Without CAN communication)**

- **UPPER controller**
- **Terminal adapter**
- **SIP24**

**2-parallel/2-series configuration**

- **UPPER controller**
- **Terminal adapter**
- **SIP24/48**

- **Load (24V)**
- **Load (48V)**

- **2 parallel connection**
- **2 series connection**

* When you use CAN communication, prepare the terminating resistor on the upper controller side.

*1 Connectors on the device side shall be prepared by customer.
* For two series or parallel use, connect the GOUT harness on the master module to IN harness on the slave module, then connect the terminal adapter to OUT harness on the slave module.
* We recommend adding the circuit on system side to shut down the current when detecting SOH warning output.

**Safety**

1. BMU Battery Management Unit
2. SOC: State of Charge
3. *1 BMU: Battery Management Unit

**System configuration image**

- **Load (24V)**
- **Load (48V)**
- **SIP24/48 (Master)**
- **SIP24/48 (Slave)**
- **Auxiliary relay, indicators, etc.,**
- **Digital output (FET output: Up to 30 V, 20mA), power source**
- **1-point: DC 5V power source (up to 25 mA)**
- **3-point: Warning output*3 (low voltage, overvoltage, in four steps (2 bits).**
- **1-point: DC 5V power source (up to 25 mA)**
- **3-point: Starting signal, CAN address assignment, module number recognition**
- **1ch: CAN communication (CAN2.0B, 250 kbps)**
- **Output to the slave module**
- **3-point: Starting signal, CAN address assignment, module number recognition**
- **Output to the slave module**

**Connect the module configuration above when placing an order. SIP series is available only for the module configuration described above.**

**Warning, error message, and SOC*2 status are output by CAN communication.**

**Thanks to shorter charging time, you can adopt automatic charging system.**

**Built-in BMU™ protects the battery from errors.**

**SCiB™ SIP series equips BMU (battery management unit) which monitors cell voltage, current and temperature, detects errors, and protects by itself.**

**Easy replacement from lead-acid batteries**

SIP series is smaller and lighter than lead-acid batteries. They also can be handled more easily than other lithium-ion batteries. Therefore, you can replace your battery with the SIP series without difficulty.
Product outline and characteristics

Charging/discharging characteristics (SIP24-23)

Charging method and charging time

CCCV* charging, which is the normal method for lithium-ion batteries, is recommended for charging of the SIP series.

For SIP24-23: CV = 28.6 V
For SIP48-23: CV = 57.2 V

* CCCV: Constant Current Constant Voltage

Note: The graphs and data above do not guarantee the product performance. These are the reference data obtained under a certain condition.

Various applications and voice of customers

Applications suitable for SCiB™ SIP series

Motor drive
Service robot
Automated Guided Vehicle (AGV)
Aerial work platforms
Traction vehicle
Wind turbine
Electri/fied monorail system
PV power system
U P S
Motor drive

Voice of customers

Automated guided vehicle manufacturer A
We proposed the quick charge with automatic charging systems to an automobile manufacturer and our proposal was adopted.

Automobile manufacturer D
It was a harsh task to remove and install heavy lead-acid battery. However, SIP series made our work much easier.

Leasing company B
Cost-effectiveness of a long-life (15,000 times) and maintenance-free battery was a determining factor.

Electronic device manufacturer C
We couldn’t find a battery appropriate to the inductive/wireless charging, and we were at a loss. However, we finally encountered the SIP series.

Automated guided vehicle manufacturer A
We proposed the quick charge with automatic charging systems to an automobile manufacturer and our proposal was adopted.
From Inquiry to Delivery

Inquiry > Meeting > Quotation and proposal > Order > Delivery

The SIP series is available in the wider application range including automated guided vehicles (AGV), carrying robot, traction vehicle, electrified monorail system, power source solutions and others. If you have any problems with lead acid batteries, please feel free to contact us.

Manufacturing and R&D center: Toshiba Kashiwazaki Operations

Kashiwazaki Operations consistently undertakes the development, manufacturing, and quality control of SCiB™. It has a flexible production system that allows it to respond to demand changes. This environment-friendly factory also flexibly controls the clean and dry areas, and minimizes energy consumption required for sustainability. Moreover, the factory is equipped with a production quality system that meets TS16949, enabling it to supply high-quality and stable products.

Safety precautions

- Do not use this product for facilities in which there is a risk to human life or a disruption to public functionality if the product fails or malfunctions (nuclear power generator controls, aerospace applications, traffic equipment, life support equipment, safety equipment, and others).
- The product is produced under strict quality controls, however it may malfunction depending on the operating environment and conditions. Please consider countermeasure design (redundancies, fail-safe measures, etc.) if using this product in facilities in which failure of the product would be expected to cause a great loss or accident.
- The operating environment must be within the range of specifications noted in the catalog and instruction manuals. Using the product outside the specified range may cause injury, fire, or some other accident.
- Be sure to carefully read the instruction manuals before using this product so that you can use it correctly.
- Toshiba is not responsible for any losses related to malfunctions or abnormalities in equipment or devices connected to the product when the product fails or malfunctions, including losses from other secondary repercussions.
- The technical information in this document is for the purpose of explaining the typical operations and applications of the product, but not for granting any license or guarantee in regard to intellectual property rights, or any other rights, belonging to third parties or Toshiba.

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The description in this catalog is as of August 2019.