

1. General

1.1. Scope

This specification is the battery module ### (hereafter called "module").

1.2. Definition of Terms and Abbreviations

Terms and Abbreviations	Description
Cell	23Ah-lithium-ion rechargeable cell
2P12S	2 parallel 12 series 12 series connected cells connected in 2 parallel connection system
Battery module (MDL)	The battery module consists of 24 cells (2P12S) and the CMU Board.
CMU Board	The board is equipped with a CPU and a cell monitor IC and is incorporated in the battery module.
Battery unit	The name of a battery sub-system containing one or more battery modules and the battery system components, including a BMU. Up to 16 battery units can be arranged in parallel.
BMU	Battery Management Unit The device which controls the battery unit consisting of multiple battery modules. It controls the safety of the battery unit and provides notification of any abnormality and fault detection, and provides information such as battery capacity, etc.
CMU	Cell Monitoring Unit This device carries out instructions from the BMU and measures cell voltage and temperature in the module.
CAN	Controller Area Network The communication standard used in data transfer between devices.
UART	Universal Asynchronous Receiver Transmitter Start-stop asynchronous communication I/F (serial- parallel conversion I/F)
SOC	State Of Charge The charge state of a battery ranges from 0 to100%; 0% is completely discharged; 100% is fully charged.
Cell balance	The process to equalize cell voltage in a battery module when a cell voltage difference occurs between the cells.

1.3. Environment

Item	Specifications
Installation location	General industry-level room with air conditioner. (ex. indoor electric room) When installed outdoors, please store modules in outdoor cubicles prepared by system integrator. When you consider any applications other than the above, please contact us.
Operating ambient temperature	-30 ~ +45°C* ¹
Storage ambient temperature	-30 ~ +55°C (+35°C or lower recommended)
Humidity	85% or lower * ² (No condensation)
Limitation of altitude	2000m or lower* ³
Restriction on use environment	Avoid using or storing in the following environment. (1) A place with low/high temperature outside the environment conditions (2) A place with high humidity outside the environment conditions (3) A place with sudden temperature changes causing condensation (4) A place with a risk of splashes or submersion in water (5) A place with strong vibrations or shock (6) A place with a lot of dust (7) A place with corrosive gases (SO ₂ , H ₂ S), flammable gases, salt mist, iron mist, oil mist, etc. (8) A place near a device generating heat or with direct sunlight (9) A place near a device generating strong radio waves or magnetic field

* 1. At 0 ° C or less, the usable capacity of the battery and the time to stabilize the open circuit voltage change compared with normal temperature, so please contact us.

* 2. The module may be damaged and become unusable due to condensation.

* 3. The cooling performance and strength voltage performance of the battery module will decrease as the altitude used increases.

(1) Cooling performance

Please take into account that the cell temperature does not exceed 55 degrees.

(2) Strength voltage performance

The limit of the altitude, 2000m or lower, assumed that the module connect in 37 series.

2000m or more altitude may be available if less than 37 series connection. .

1.4. Shipping form

Packing form of this product is the following two types

(1) UN-packaging for sea shipment

(2) UN-packaging for air shipment

2.3. CMU Electromagnetic compatibility (EMC)

Item	Specification	Supplements & standards
Electrostatic discharge immunity	Contact discharge : $\pm 8\text{kV}$ Air discharge : $\pm 15\text{kV}$	JIS C 61000-4-2 :2012 (IEC 61000-4-2:2008) Electromagnetic compatibility (EMC)-Part 4-2: Testing and measurement techniques- Electrostatic discharge immunity test Test Level 4
Radiated, radio-frequency, electromagnetic field immunity test	Field strength $\leq 20\text{V/m}$	JIS C 61000-4-3 :2012 (IEC 61000-4-3:2010) Electromagnetic compatibility (EMC)-Part 4-3: Testing and measurement techniques- Radiated, radio-frequency, electromagnetic field immunity test Test Level 3
		IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility –Part 3-2: Rolling stock – Apparatus Table 9.1
	Test levels related to the protection against RF emissions from digital radio telephones $\leq 30\text{V/m}$	JIS C 61000-4-3 :2012 (IEC 61000-4-3:2010) Electromagnetic compatibility (EMC)-Part 4-3: Testing and measurement techniques-Radiated, radio-frequency, electromagnetic field immunity test Test Level 4
		IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility –Part 3-2: Rolling stock – Apparatus Table 9.2
Electrical fast transient/burst immunity test	Power Supply Port Peak: $\pm 2\text{kV}/100\text{Hz}$ I/O, Signal, Data & Control Lines Peak: $\pm 1\text{kV}/100\text{Hz}$	JIS C 61000-4-4 :2015 (IEC 61000-4-4:2012) Electromagnetic compatibility (EMC)-Part 4-4: Testing and measurement techniques-Electrical fast transient/burst immunity test Test Level 3
		IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility –Part 3-2: Rolling stock – Apparatus Table 7.2
Surge immunity	1.2.50 μs Open circuit test voltage, line to ground: $\pm 2\text{kV}$ Open circuit test voltage, line to line: $\pm 1\text{kV}$	JIS C 61000-4-5 :2018 (IEC 61000-4-5:2014) Electromagnetic compatibility (EMC)-Part 4-5: Testing and measurement techniques-Surge immunity test Test Level 3
		IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility –Part 3-2: Rolling stock – Apparatus Table 7.3
Immunity to conducted disturbances, induced by radio-frequency fields	Voltage level: 10V	JIS C 61000-4-6 :2017 (IEC 61000-4-6:2013) Electromagnetic compatibility(EMC)-Part 4-6:Testing and measurement techniques-Immunity to conducted disturbances, induced by radio-frequency fields Test Level 3
		IEC 62236-3-2:2008 Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus Table 7.1
Conducted and radiated emission	Class A , Group 1	CISPR11 2010-Ed. 5.1

4. CMU specification

This section describes the rating and function of the CMU, which is built into the battery module.

4.1. CMU Rating

Item		Specifications
Low-voltage systems	Rated supply voltage	12V
	Operating voltage range	10.2~13.2V
	Current consumption	30mA or less
High-voltage systems	Rated voltage	27.6V (2.3V/Cell)
	Operating voltage range	15.6V~36V (min. 1.3V/Cell, max. 3.0V/Cell)
	Current consumption	10mA or less
	Cell balance current	105mA (@25°C, 2.3V)
	Dark current	100μA or less

4.2. External interface (connector configuration)

Information on Model number and pin layout of CAN communication connector(CN1, CN2) is shown below

CAN Communication connector (RJ45 connector)

Item	Specifications
Model No.	TM11R-5M2-88 (8P8C ,Modular Connector ANSI/TIA-568-A)

CAN communication connector PIN layout

Number of PIN	CN1 : IN		CN2 : OUT	
	Terminal name	I/O	Terminal name	I/O
1	CANL	I/O	CANL	I/O
2	CANH	I/O	CANH	I/O
3	GND	GND	GND	GND
4	ANOI (Automatic numbering)	IN	ANOO (Automatic numbering)	OUT
5	GND	GND	GND	GND
6	RET	OUT	RET	OUT
7	IGCT	Power source	IGCT	Power source
8	IGCT	Power source	IGCT	Power source
Connector outline				

Measurement accuracy (cell voltage and module temperature)

Item	Measurement range	Transmission resolution ability	Detection accuracy
Cell voltage	0.000 ~5.000 V	1mV	0.000~3.000V: $\pm 10\text{mV}$
Temperature in the module (6 points)	-30~85°C	1°C	-30~ 2°C: $\pm 3^\circ\text{C}$
			0~40°C: $\pm 2^\circ\text{C}$
			40~85°C: $\pm 3^\circ\text{C}$
Temperature in the module (13points)	-30~85°C	0.1°C	-30~ 2°C: $\pm 3^\circ\text{C}$
			0~40°C: $\pm 2^\circ\text{C}$
			40~85°C: $\pm 3^\circ\text{C}$

Measurement of Cell voltage and temperature in the module

Item	Measured Targets	Measurement cycle
Measurement of voltage and temperature	Cell voltage	120ms
	Module voltage	120ms
	Temperature	240ms
Measured value transmission	The measured cell voltage, module temperature and the balancer drive status are sent via CAN communication.	

(2) Cell balance

CMU receives the balance signal "1:Enable" from the BMU and it starts the balance circuit. It starts the cell balance (discharge) control to a target voltage (typically: 10 mV).

During voltage measurement, the CMU stops balancer temporarily in order not to affect the measurements.

If the target voltage is higher than all of the cell voltages in the system at that time, or if there are cell voltages higher than 2.8V, or if there are cell voltages lower than 2.1V, then the balance feature does not work.

(3) CAN communication features

CAN communication I/F and BMU specifications are as follows. Data, such as control instructions from the BMU, temperature and voltage, and module status are transmitted via CAN communication. For structures of the data frame and definitions of the send/receive frame, please refer to "System Integration Guidelines for BMU (SPC-COM-E0166)".

Item	Contents
CAN protocol specification	ISO11898 CAN2.0B (standard format adopted)
Data format	Standard format (CAN ID:11 Bit)
Communication speed	500kbps (High Speed CAN)
Message management	Full-CAN mode
Sample points	70%
Communication form	Bus connections Dominant ECU: BMU x 1 Following Non dominant ECU: CMU x 28(max.)

(4) Module ID auto-numbering

Module need to be assigned ID's to identify each module to the BMU. BMU will send instructions for auto-numbering and numbering the module ID, in the order that the connections are made and notified to the BMU. Data becomes specific to each module. For structures of the data frame on the communications and setting protocol for the module ID definitions, please refer to "System Integration Guidelines for BMU (SPC-COM-E0166)".

However, in case of the module is set without auto-numbering from the BMU, it starts with the default ID.

Communication specification

Communication protocol	
I/F	ISO9141 equivalent
Communication systems	Start stop asynchronous, unilateral (in accordance with UART)
Communication speed	1200bps $\pm 1\%$
Start bit(ST)	1bit
Data bit	8bit
Parity bit(PT)	1bit even parity
Stop bit(SP)	1bit

Module ID

Default	0
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5. Reference documents

When you build a battery system, please refer to the following documents.

Document No.	Document title
SPC-COM-E0166	System Integration Guidelines for BMU
SPC-COM-E0113	Battery Module for ### Instruction Manual
SPC-COM-E0036	Battery System Components for Social Infrastructure Applications Standard Inspection
6F6V0043	Battery System Component Instruction Manual
SPC-COM-E0037	Battery System Component Cable Connection Diagrams
6F6V0056	System Integration Guidelines for Host System