

Environment Sensing Board

NO.EEV-576-200108

1. Overview

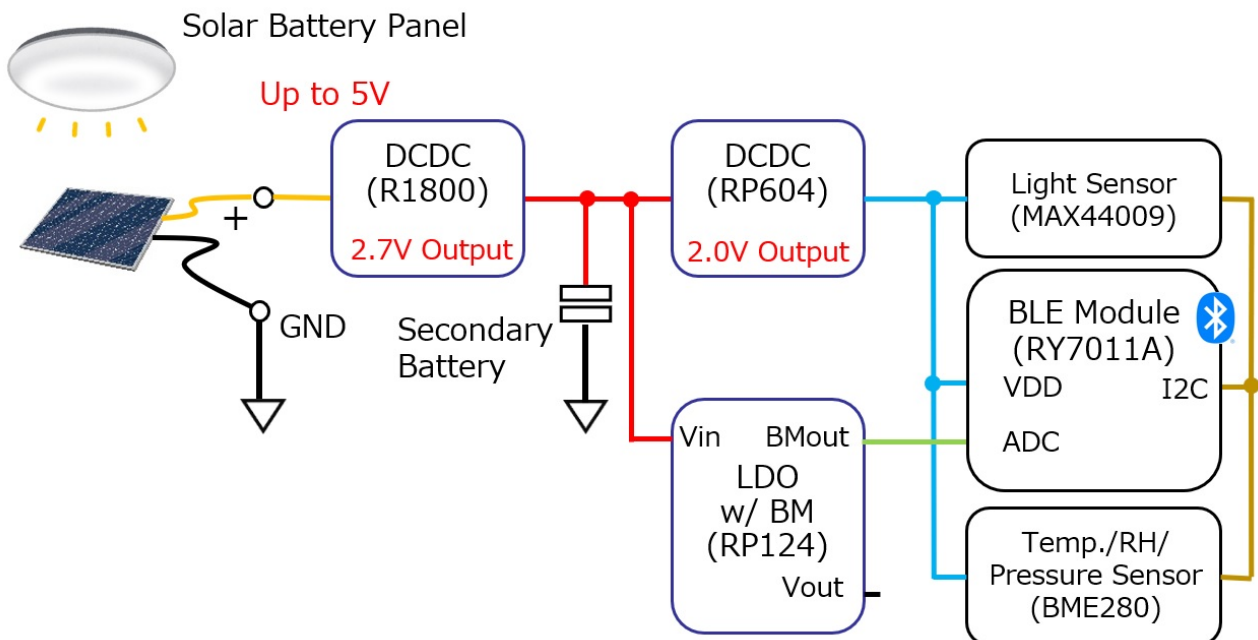
The RIOT-001, an environment sensing board, transmits data obtained from a temperature/humidity and pressure sensor (BME280) and an ambient light sensor (MAX44009) to tablets or other smart devices by using Bluetooth Low Energy (BLE). It can operate with a solar battery panel for indoor light*1.

The electric power a solar battery panel generates is harvested efficiently by the R1800, a buck DC/DC converter for energy harvest, and stored in a small Li-ion secondary battery. The stored power is supplied to a BLE module with an MCU and sensors by the RP604, an ultra-low supply current buck-boost DC/DC converter.

The board also includes the RP124, a voltage regulator with a battery monitor, to monitor the secondary battery voltage. By transmitting battery information to tablets or other smart devices via an AD converter inside the BLE module, it is possible to check the state of the secondary battery voltage.

2. Board Specifications

2-1. Block Diagram



*1 Solar battery panels are not provided with the board.

2-2. Ratings

Symbol	Parameter	Condition	Min.	Typ.	Max.
V _{in}	Input Voltage		2.0 V	-	5.5 V
V _{mp}	Max. Power Voltage			4.4 V	
V _{out}	Output Voltage		1.79 V	2.0 V	2.03 V
V _{lib}	Secondary Battery Charging Voltage		2.62 V	2.7 V	2.78 V
I _{cc}	Avg. Operating Current			16.4 uA *2	
T _a	Operating Temperature	No condensation	0°C		50°C

*2 The value refers to an average supply current when the board is used with firmware that intermittently operates once per 5 seconds.

2-3. BLE Transmission

The board contains an integrated sensor (BME280) measuring temperature, humidity and pressure, an ambient light sensor (MAX44009), and a voltage regulator with a battery monitor (RP124) for measurement of the secondary battery voltage. It calculates the measured values at BLE transmission and transmits them as BLE advertising data.

The following list shows format specifications of the BLE advertising data.

Types	Data
Flags	02 01 04
Local Name	06 09 ① ① ① ① ①
Manufacture Data	0F FF 5B 08 00 05 ② ② ③ ③ ④ ④ ⑤ ⑤ ⑥ ⑥

①

Stores a 5-byte-long device name.

②

Temperature (°C). Stores a 2-byte signed datum (hexadecimal representation) determined by calculating a value to the first decimal place and multiplying it by 10.

③

Humidity (%RH). Stores a 2-byte unsigned datum (hexadecimal representation) determined by

calculating a value to the first decimal place and multiplying it by 10.

④

Air pressure (hPa). Stores a 2-byte unsigned datum (hexadecimal representation) determined by calculating a value to the first decimal place and multiplying it by 10.

⑤

Illuminance (Lux). Stores a 2-byte unsigned datum (hexadecimal representation) determined by dividing a calculated integral number by 4 (fractions smaller than 4 omitted).

⑥

Battery voltage (V). Stores a 2-byte unsigned datum (hexadecimal representation) determined by calculating a value to the third decimal place and multiplying it by 1000.

The 2-byte data mentioned above are stored in a little-endian format.

An example of BLE advertising data is shown below: R0001, the device name; temperature at 25.2°C; humidity at 40.8%; pressure at 1012.4 hPa; illuminance at 680 Lux; battery voltage at 2.62 V.

Types	Data
Flags	02 01 04
Local Name	06 09 52 30 30 30 31
Manufacture Data	0F FF 5B 08 00 05 FC 00 98 01 8C 27 AA 00 3C 0A

BLE advertising data are broadcast once per 5 seconds*3. The transmitted information is readable with RIOT Monitor, our application for Android devices (Ver.7.0 or above).

(*3) A default value. The operation interval may vary by the firmware used with this board.

2-4. Main Parts

Part No.	Product Name	Product No.	Vendor	Notes
IC1	Buck DC/DC Converter for Energy Harvest	R1800K022A	Ricoh Electronic Devices	For power control from a solar battery panel
IC2	Buck-boost DC/DC Converter	RP604K201B	Ricoh Electronic Devices	A power supply for the BLE module, etc.
IC3	Temperature, Humidity and Pressure Sensor	BME280	BOSCH	
IC4	LDO + Battery Monitor	RP124L123B	Ricoh Electronic Devices	A battery monitor for secondary battery voltage
IC6	Ambient Light Sensor	MAX44009	MAXIM	For illuminance measurement
IC7	BLE Module	RY7011A	Renesas Electronics	A BLE module including an MCU
B1	Secondary Battery	SLB series φ 3 x 7 L (mm)	Nichicon	

Links to datasheets of each component are below. (*4)

R1800K022A

<https://www.e-devices.ricoh.co.jp/en/products/power/dcdc/r1800/r1800-ea.pdf>

RP604K201B

<https://www.e-devices.ricoh.co.jp/en/products/power/dcdc/rp604/rp604-ea.pdf>

RP124L123B

https://www.e-devices.ricoh.co.jp/en/products/power/vr_ldo/rp124/rp124-ea.pdf

BME280

https://www.bosch-sensortec.com/bst/products/all_products/bme280

MAX44009

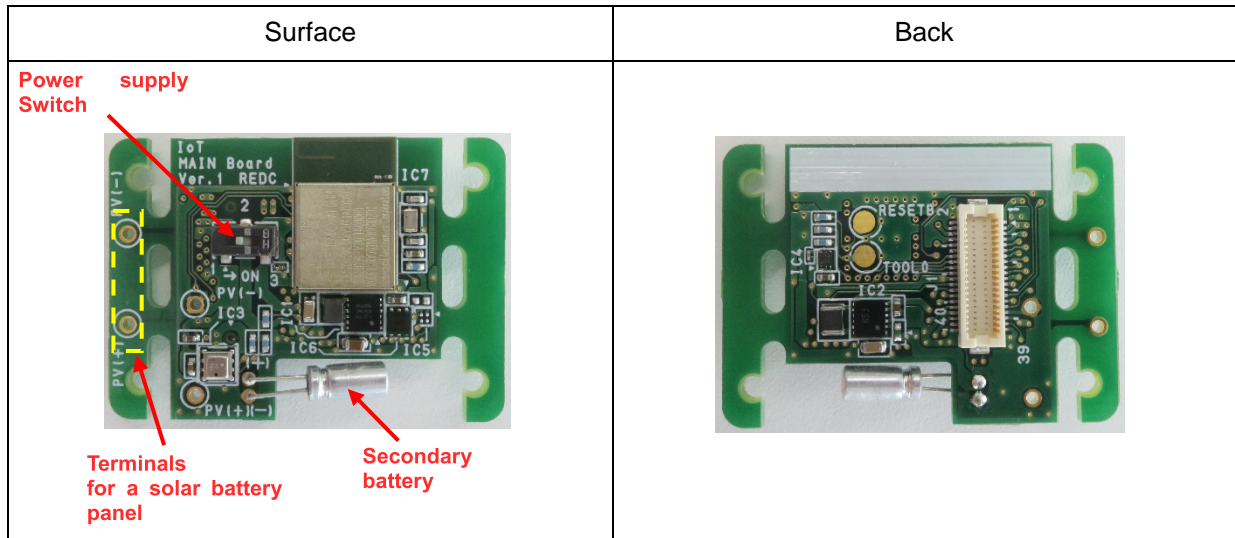
<https://www.maximintegrated.com/en/products/interface/sensor-interface/MAX44009.html>

RY7011A

<https://www.renesas.com/us/en/products/microcontrollers-microprocessors/r178/r178g1x/r178g1d/device/RY7011A0000DZ00.html>

(*4) Check the latest information on the vendors' web sites because the specifications and URLs may be updated.

2-5. Appearance



2-6. Recommended Solar Battery Panels

Amorphous silicon solar battery panels for indoor products suggested below are highly recommended.

Vendor: Panasonic Solar Amorton Co., Ltd.

Product name: AM-18xx series (open-circuit voltage: $V_{oc} = 5.0\text{ V}$)

Link to reference: <https://panasonic.co.jp/ls/psam/en/products/>

Other solar battery panels with V_{oc} from 4.0 V to 5.5 V are also available (optimal voltage: 5.0 V).

The terminals of the solar battery panel must be connected to the terminals of the board by such as soldering, etc.

2-7. Power Supply Switch

Slide the power supply switch to the ON printed on the board, and the board will start the operation as an environmental sensor by providing the BLE module and the sensors with electricity.



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15. Customers shall be strictly prohibited to use the products in equipment or systems that require extreme level of quality and reliability, and of which malfunction or failure may cause loss of human life and/or bodily injury, e.g., equipment used in aerospace industry, nuclear reactor control systems, traffic control systems, automotive and transportation equipment, combustion equipment, safety devices, life support systems.
16. Customer shall not use the products under any of the conditions mentioned below. This may cause malfunction or defect.
in water
in high humidity
under oily environment
in corrosive atmosphere
under environment with corrosive gas or inflammable gas
under an extremely high or low temperature environment
under conditions of violent vibration
in the place that generates electrostatic charges and electrifies
in a place that exposed to direct sunlight
in a dusty place
Anti-radiation design is not implemented in the products described in this document.
17. Improper or unintended use or misuse may lead to loss of human life and bodily injury, firing and smoking, failure of the products and connected components, and damage to property or loss of social profits.
18. Sharp edge of components such as short plug may unavoidably appear. Customer shall handle the products with the utmost care and attention to avoid injury from the sharp edge.
19. To avoid electrostatic discharge failure, Customer shall not touch the metal portion of the connector with bare hands or fingers.
Also, Customer shall remove static electricity of the human body before handling the products through touching something made of metal such as door handles.
20. Customer shall turn off immediately when firing, smoking or abnormal heating occur during operation.
21. When connecting the products to other products, Customer shall not give excessive stress on the products. Customer shall not warp boards nor push forcefully the mounted components.
22. Customer shall not apply the supply voltage to the product if the surface of the board is wet or the product touches any metals.
23. The X-ray exposure can influence functions and characteristics of the products.
24. Do not turn on this product at the place where using wireless devices is prohibited, such as in airplanes, hospitals, near an implantable cardiac pacemaker or medical electrical equipment, etc.
The radio wave generated from this product may interfere with those devices' operation.
25. This product may be affected by radio waves emitted from devices or equipment such as wireless LAN, BLE devices, digital cordless phones, microwave ovens, etc.
26. This product must not be incorporated nor used in a metallic cabinet. Also, do not use cabinets whose coating materials contain metal composition.
27. RICOH warrants the products with exceptions as indicated below, to the original purchaser to be free of defects for a period of three months from the date of arrival.
Within the warranty period, we will replace a defective product with a substitute. Ricoh assumes no liability for indirect, special or incidental damage or loss including loss of profits and consequential damage regardless of possibility of anticipation.

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