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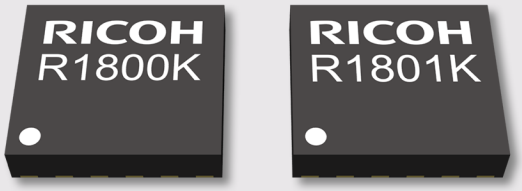
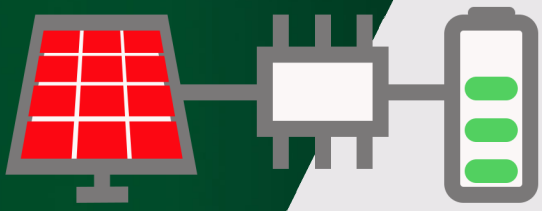
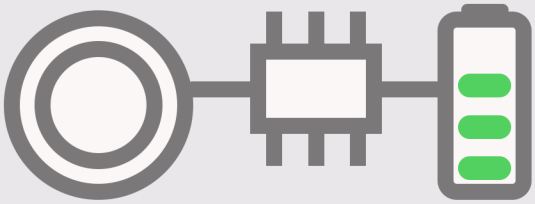
# Energy Harvesting ICs


## PhotoVoltaic & PiezoElectric Energy Harvester Environment Sensor Board

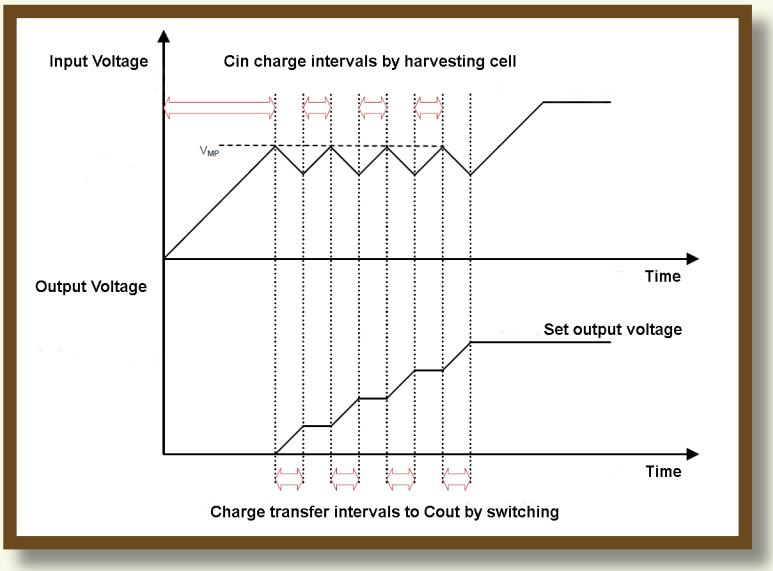




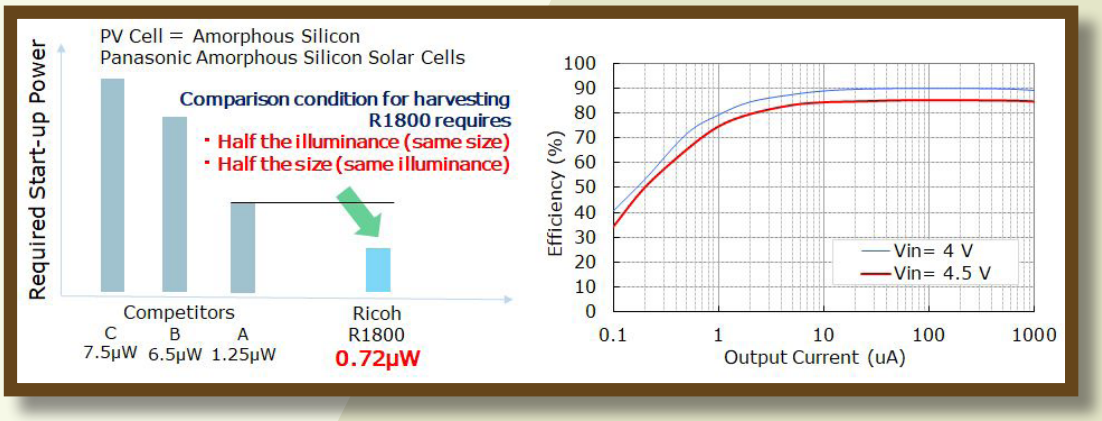
www.n-redc.co.jp/en/

## *Energy Harvesting DC/DC Converter ICs*

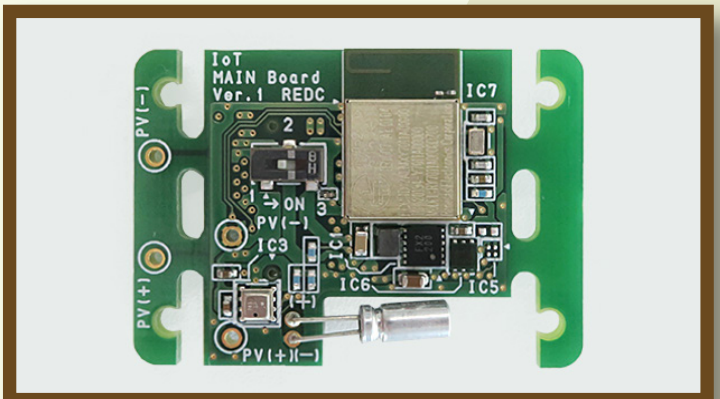
The R1800 Buck DC/DC Converter collects energy generated from a PhotoVoltaic or PiezoElectric energy harvester cell. An ultra-low quiescent current of 144 nA even allows to use the harvester circuit in a low illuminated environment and when the generated level of energy is moderate. The R1800 enables the development of applications without traditional batteries, saving the maintenance cost of battery replacement or the need for powering from mains.




When there is sufficient energy available on the input and reaches the maximum power point voltage level (Vmp), the buck DC/DC Converter will be enabled to transfer energy from input to output. During this phase the transferred energy is stored in a super capacitor or battery on the output until the energy left on the input drops below a threshold. The DC/DC Converter is disabled until sufficient energy is collected on the input again. This process repeats and increases the energy level in the capacitor or battery until the required output voltage is reached. A reverse current protection circuit keeps the electric charge in the energy storage device preventing a current flow occurring from output to input when the energy-harvesting cell does not provide sufficient energy, this circuit is triggered when the input voltage drops below the output voltage. Note that the R1800 has a much better start-up condition for the harvesting process, compared to our competition it needs around half the illuminance or half the size of the PhotoVoltaic cell. Furthermore it requires only 144nA current consumption and has an efficiency level of 90% at 10µA.




The similar but more advanced R1801 has a few additional features like an adjustable maximum power point control and adjustable output voltage. These levels are controlled stepwise by the binary settings of three inputs in a range of ±300mV. Furthermore a Power Good output was added to provide a logic signal as soon the output voltage reached a specific level and can be used to enable additional circuits for operation.



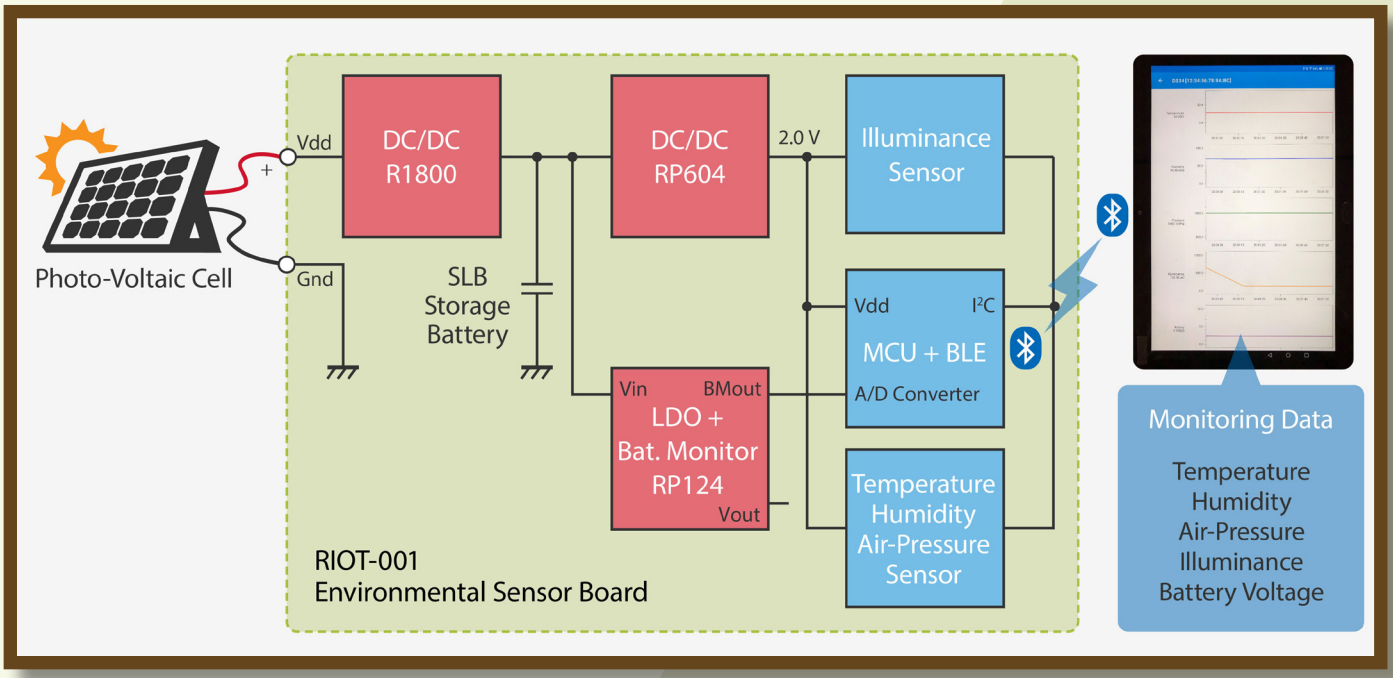

## *Environmental Sensor Board*

The RIOT-001 is an environmental sensor board that measures the ambient temperature, humidity, air-pressure, illuminance and energy storage level. The board also contains and MCU and Bluetooth (BLE) to process and transmit the measurement data to a smartphone or tablet with a dedicated application program.

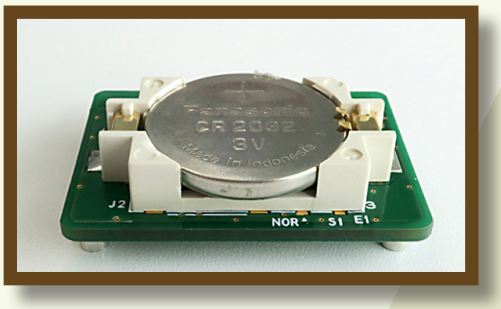
Ricoh developed this special circuit board because of the huge interest from the market for our recently launched power management ICs intended for IoT applications.

The RIOT-001 contains various power management ICs with an ultra-low supply current and low output noise level. IoT devices require specific functions such as maintenance free operation from an independent power supply, low energy consumption (extending the battery life), high accuracy sensors, wireless communication, small sized components, etc. This new sensor board makes it easier for designers to develop new IoT devices and contributes to shortening the time-to-market, see below block diagram for details.

The sensor board is powered by energy of a photovoltaic cell (not included), collected by the R1800 Buck DC/DC Converter for energy harvesting. The R1800 stores the collected energy in a unique Small Lithium-Ion secondary Battery (SLB) with a capacity of 0.35mAh. Theoretically, when fully charged, the SLB battery can provide power to the IoT board for approximately 20 hours. By using a photovoltaic cell according to the specifications of the RIOT-001 board makes battery-free operation possible, saving the costs for replacing the batteries regularly.




Another RP604 Buck-Boost DC/DC converter is present on the circuit board. With its wide operating voltage from 1.8 to 5.5 V, it regulates the fluctuating SLB battery voltage as it is charged and discharged during operation. The DC/DC Converter achieves a high level of efficiency in both standby and active modes. The SLB battery voltage is measured by a sophisticated battery monitor embedded in a RP124 LDO regulator.




An alternative power source is available if one prefers not to use a photovoltaic cell to supply power the RIOT-001 board. The RIOT-C01 (sold separately) is an add-on board with a CR2032 coin battery and can be attached onto the main board. A pair of connectors to connect the boards is already present for your convenience. Theoretically, this board can keep the RIOT-001 board operating for 1.5 years, depending on the sample rate of the measurements. Another second purpose for using the RIOT-C01 is to shorten the initial charging time of the SLB battery, since it takes a while for a photovoltaic cell to charge this battery. In this way, the RIOT-001 board is instantly ready for use.

For more information about our ICs for IoT and Energy Harvesting, please refer to our website:

https://www.n-redc.co.jp/en/applications/iot/iot_block.html