

## R9A02G011

R19AN0055EJ0100

Rev.1.0

### RTK-251-BuckBoostConverter2 Instruction Manual

Nov 9, 2018

#### Introduction

The RTK-251-BuckBoostConverter2 is DC-DC module for a part of a Universal USB Power Delivery (PD) AC adapter utilizing the USB PD 3.0 controller R9A02G011 and Bi-directional Buck-Boost Voltage Regulator ISL95338. This document is an instruction manual for RTK-251-BuckBoostConverter2.

The RTK-251-BuckBoostConverter2 accepts 19V with 4.73A DC input power and produces USB PD-compatible VBUS output power. It supports Programable Power Supply (PPS) - USB PD 3.0 ver.1.1 compliant function - and has two USB Type-C™ receptacles for VBUS power output.

The RTK-251-BuckBoostConoverter2 was developed to facilitate evaluation of the USB PD 3.0 Controller R9A02G011 and Bi-directional Buck-Boost Voltage Regulator ISL95338.

The RTK-251-BuckBoostConverter2 is USB-IF PD3.0 certified and the functions and capabilities are fixed in the setting at that time.

#### Target Device

USB Power Delivery Controller: R9A02G011

Bi-directional Buck-Boost Voltage Regulator: ISL95338

---

**Contents**

<b>1. Features .....</b>	<b>3</b>
1.1 USB-IF PD3.0 certified configurations .....	5
<b>2. Functions .....</b>	<b>6</b>
2.1 Programable Power Supply (PPS) function .....	6
2.2 LED indicators .....	7
2.3 Protections .....	8
<b>3. Board setup and how to use.....</b>	<b>9</b>
<b>4. Optional functions.....</b>	<b>10</b>

## 1. Features

RTK-251-BuckBoostConverter2 supports the following features.

- USB Power Delivery and USB Type-C
  - Two USB Type-C ports
  - Power Role: Source Only
    - Power Source voltage: 5, 9, 12, 15, 20V
  - Supports Programmable Power Supply (PPS) function
    - 20V Prog supported (3.3V to 21V VBUS power supply)
- LED indicators
  - System power indicator (1 LED)
  - USB Type-C port power supply status indicator (1 LED/port)
- Protections
  - Over Temperature Protection on the USB Type-C Receptacles
  - Over Current Protection (VBUS current)

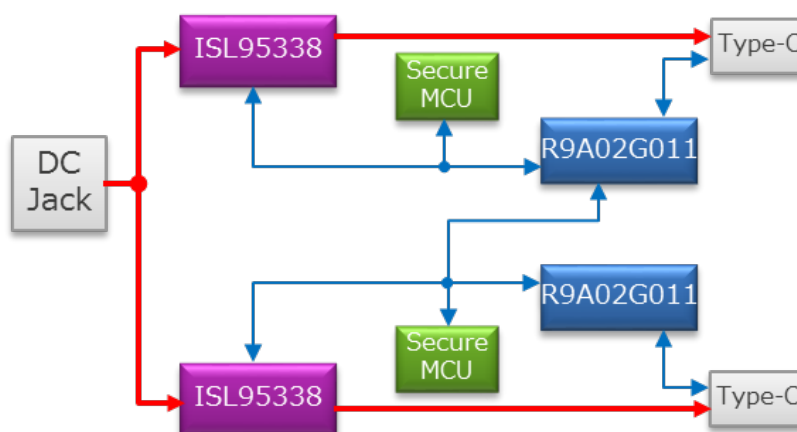


Figure 1-1 RTK-251-BuckBoostConverter2 Block Diagrams



D5, D7: Port Power Supply indicator Port1, Port2

## 1.1 USB-IF PD3.0 certified configurations

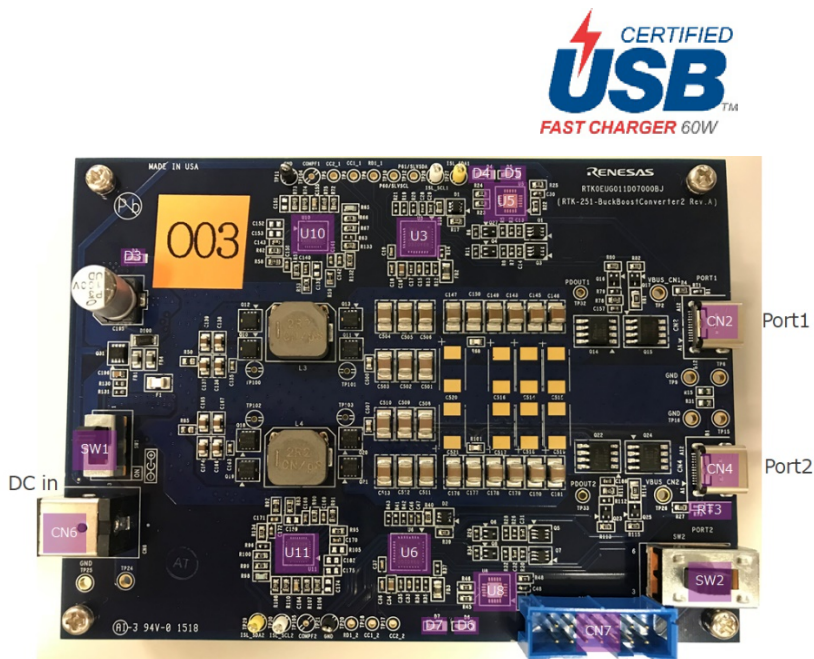
The RTK-251-BuckBoostConverter2 board is USB-IF PD3.0 certified under the following configuration.

Category: Power Brick (with PPS)

Product Name: RTK-251-BuckBoostConverter2

TID: 1000181

- Power Role: Source only
  - Port 1: 60W Power Source (5, 9, 12, 15, 20V and 20V Prog)
  - Port 2: 15W Power Source (5V and 5V Prog)
- Supports BC1.2 DCP



## 2. Functions

The RTK-251-BuckBoostConverter2 functions are described in this section.

### 2.1 Programable Power Supply (PPS) function

Programable power supply (PPS) is a new feature of USB Power Delivery Rev 3.0 for battery charging. A sink device having a battery requests VBUS voltage and also current directly to charge the battery. This feature achieves the reduction of voltage transformation loss and heat for devices having a battery. In order to realize this feature, a USB PD source device should provide VBUS voltage and also current limit as fine steps. The VBUS voltage rises until either the target voltage is reached or the specified maximum VBUS current is reached.

## 2.2 LED indicators

RTK-251-BuckBoostConverter2 supports 5 LED indicators. Only three of them are enabled.

1. **Orange (D3):** System power indicator. LED lights when RTK-251-BuckBoostConverter2 is supplied power from AC adapter (CN6 jack).
2. **Blue (D5, D7):** VBUS power supply indicator. LED lights when VBUS power is supplied on the USB receptacle.

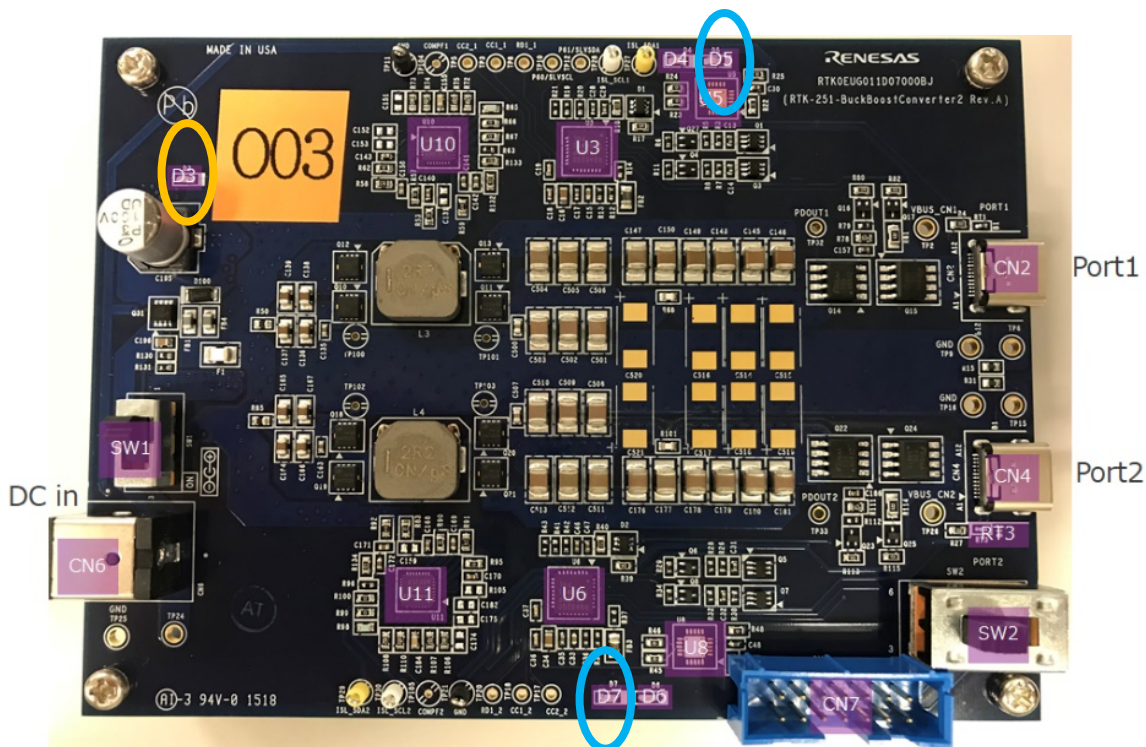


Figure 2-1 LEDs on the RTK-251-BuckBoostConverter2



## 2.3 Protections

This section describes the protection features that RTK-251-BuckBoostConverter2 supports.

OCP event on either the adapter side or the VBUS side is detected by ISL95338. Then ISL95338 stops output voltage. PDC detects VBUS drop as an OCP event. When PDC detects OCP event more than twice without cable detach, PDC stops VBUS output until PDC is reset by power off.

This behavior that stops VBUS output is based on the USB PD standards.

OTP event is detected when the temperature near the USB Type-C connector:

1. Exceeds 80 °C, immediately,
2. Exceeds 60 °C, for 1sec.

When the event happens, RTK-251-BuckBoostConverter2 disables the power circuitry to stop sourcing power on VBUS. When the temperature becomes lower than 40 °C, RTK-251-BuckBoostConverter2 enables the power circuitry again and starts the power negotiations. When RTK-251-BuckBoostConverter2 detects over temperature again, it does not supply power even if the temperature becomes lower than 40 °C. It is necessary to shut down RTK-251-BuckBoostConverter2 once to restart by detaching external power supply (AC adapter).



### 3. Board setup and how to use

The RTK-251-BuckBoostConverter2 has one DC jack for input power, and two USB Type-C Receptacles which provide VBUS power output and support USB PD 3.0. The following items need to be prepared to use this board.

- AC Adapter (mating plug is  $\Phi 5.5$  mm x 2.5 mm, center +. Depth is 8.85mm): 1 unit
- USB-Type-C Cable: 1 or 2 pcs

**Notes:**

Please use this board when you understand and agree that Renesas DOES NOT have any responsibility, indemnification, or liability for use of this board.

Renesas uses 90W (19V/4.73A) AC adapter for evaluation for this board.

## 4. Optional functions

The RTK-251-BuckBoostConverter2 board is not possible to change parameters by using the Renesas ROM Image Generator. The RTK-251-BuckBoostConverter2 supports any other optional functions as following. They are disabled in this kit. For changes in these functions, please contact Renesas local sales offices.

- Customize USB Type-C output power (Up to 60W PDP<sup>Note</sup>, supported optional capabilities such as 14.8V, supported PPS)
- Customize DC input power (Up to 19V, Up to 8A)
- Multi-port power control (for Shared Capacity Charger)
- USB Type-C<sup>TM</sup> Authentication (Initiator, Responder)

Note: Maximum PDP is depended on DC input power.

Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

Inquiries

<http://www.renesas.com/contact/>

All trademarks and registered trademarks are the property of their respective owners.

**Revision History**

Rev.	Date	Description	
		Page	Summary
1.0	Nov 6, 2018	—	Initial Release.

## General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

### 1. Handling of Unused Pins

Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

- The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

### 2. Processing at Power-on

The state of the product is undefined at the moment when power is supplied.

- The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.  
In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.  
In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

### 3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

### 4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

- When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

### 5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
  2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
  3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
  4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
  5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
  6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
  7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
  8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
  9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
  10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
  11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
  12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



### SALES OFFICES

### Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "http://www.renesas.com/" for the latest and detailed information.

**Renesas Electronics Corporation**  
TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

**Renesas Electronics America Inc.**  
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.  
Tel: +1-408-432-8888, Fax: +1-408-434-5351

**Renesas Electronics Canada Limited**  
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-651-700

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852 2886-9022

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics India Pvt. Ltd.**  
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

**Renesas Electronics Korea Co., Ltd.**  
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Renesas Electronics:](#)

[RTK0EUG011D07000BJ](#)