R9A02G011

RTK-251-BuckBoostConverter2 Instruction Manual

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Rev.1.0
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

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)

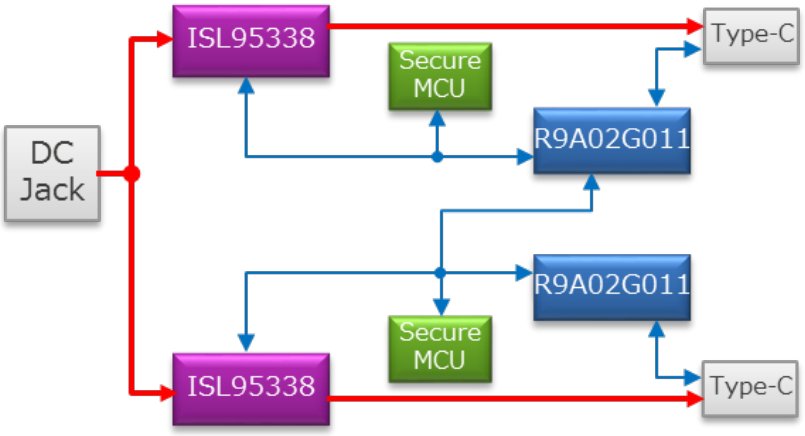


Figure 1-1 RTK-251-BuckBoostConverter2 Block Diagrams

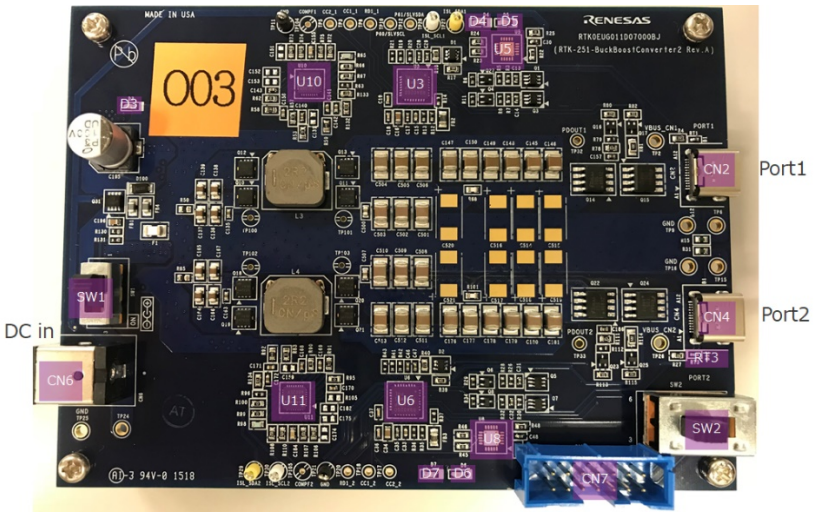


Figure 1-2 RTK-251-BuckBoostConverter2 board photo (Top side)

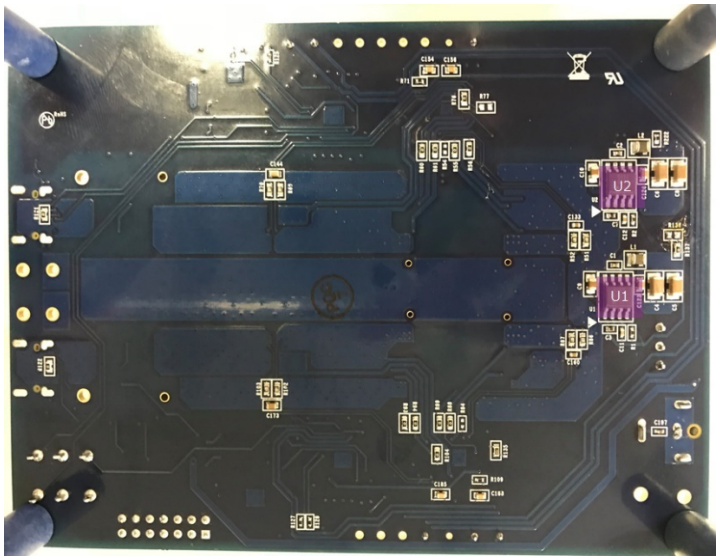


Figure 1-3 RTK-251-BuckBoostConverter2 board photo (Bottom side)

U1: 5.0V DC-DC

U2: 3.3V DC-DC

U3, U6: R9A02G011(PDC) Port1, Port2

U10, U11: BB-VR ISL95338 Port1, Port2

CN2, CN4: USB Type-C receptacle Port1, Port2

RT1, RT3: Thermistor Port1, Port2

SW1: Main power switch

CN6: DC Jack for power input from AC adapter

D3: System power indicator

D5, D7: Port Power Supply indicator Port1, Port2

1.1 USB-IF PD3.0 certified configurations

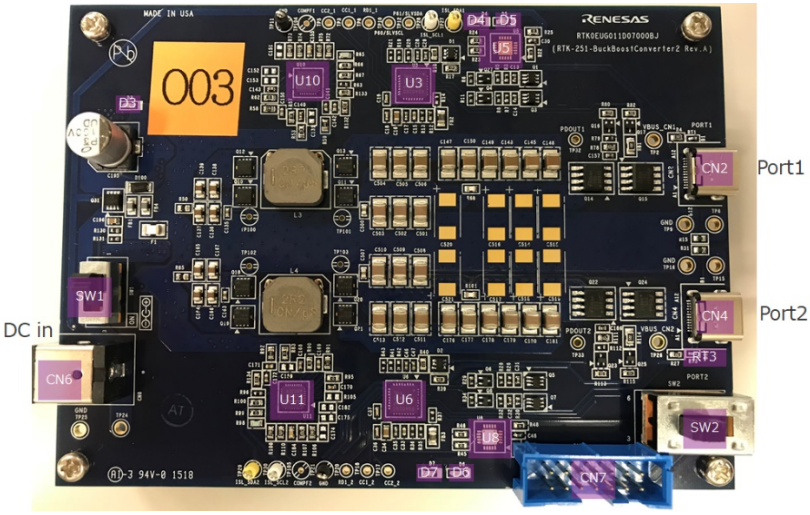
The RTK-251-BuckBoostConverter2 board is USB-IF PD3.0 certified under the following configuration.

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.

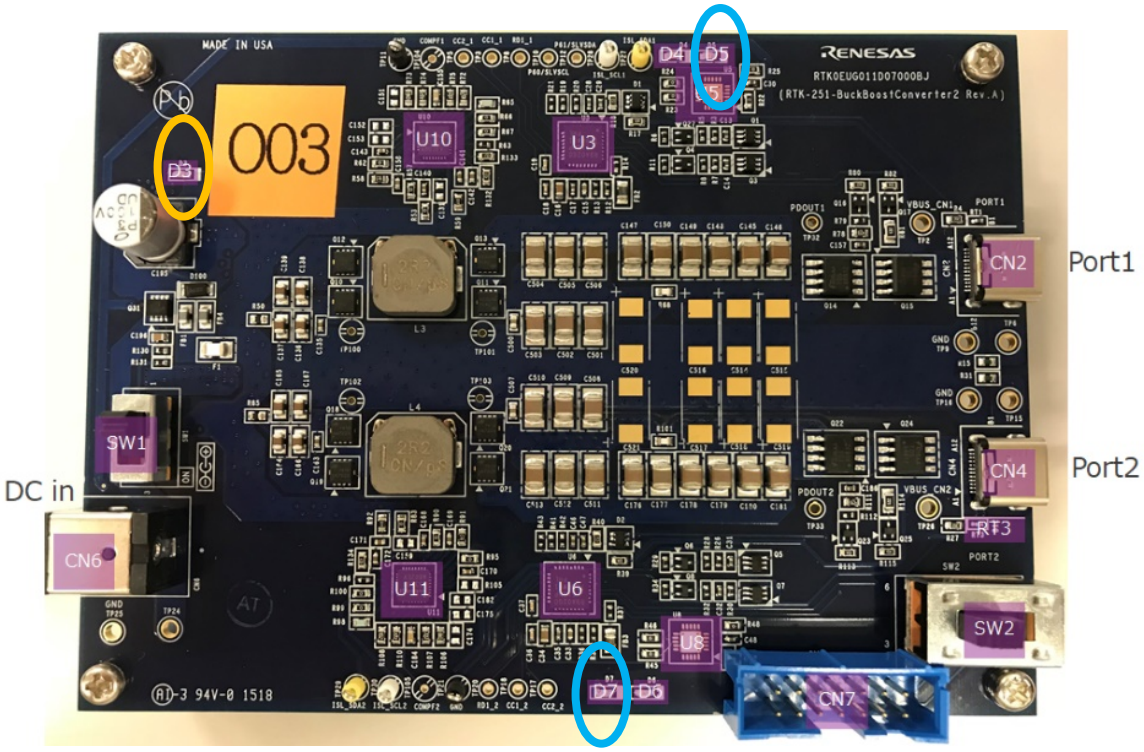


Figure 2-1 LEDs on the RTK-251-BuckBoostConverter2

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 Φ5.5 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[Note], 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™ Authentication (Initiator, Responder)

Note: Maximum PDP is depended on DC input power.

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Revision History

		Description	
Rev.	**Date**	**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.

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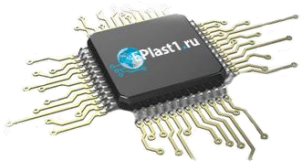

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