RTK-G015-EPRSinkCharger-140W board USB-Type-C® Battery system reference

This is a single port of reference design what it can implement battery systems with 2 to 7 cells connected in series supporting USB-PD extended power range (EPR). This reference design supports a mode where power is only supplied from the USB Type-C® port and a mode that enables a power bank in combination with a lithium-ion battery with BMS.

Introduction

The RTK-G015-EPRSinkCharger-140W is an evaluation board for Universal Serial Bus Power Delivery (USB PD). The RTK-G015-EPRSinkCharger-140W supports up to 28V/140W USB Type-C® EPR input. The RTK-G015-EPRSinkCharger-140W is designed with 48V USB-C Port Controller (SPR/EPR TCPC) RAA489400, USB-C Port Manager (TCPM) R9A02G0151, and 28V On-Board Charger RAA489118. The RTK-G015-EPRSinkCharger-140W supports USB PD 2.0, USB PD 3.1, USB Type-C®- Specification. The RTK-G015-EPRSinkCharger-140W works as

USB Type-C® EPR power sink charger or power bank. The Battery module requires Renesas' Battery Management System to avoid over discharging, especially when the RTK-G015-EPRSinkCharger-140W is used in the power bank mode. The configuration switches enable the selection of the number of battery cells, the maximum charge current, operating mode. When RTK-G015-EPRSinkCharger-140W may be combined with an Evaluation Module of the Battery Fuel Gauging IC(FGIC).

Part Number

- RTK-251-G015-EPRSinkCharger-140W: RTKA489EPRDE0010BU
- 48V USB-C Port Controller (SPR/EPR TCPC): RAA489400
- USB-C Port Management (TCPM): R9A02G0151
- 28V On-Board Charger: RAA489118

Evaluation board and Block Diagram
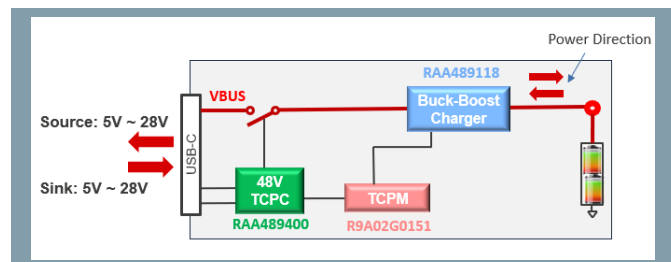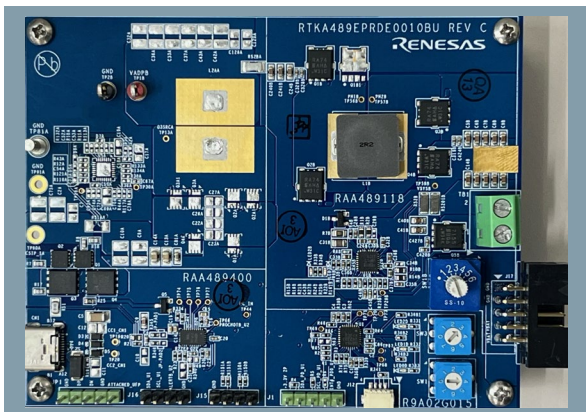
Features

- USB PD Spec Rev 2.0 and 3.1
- USB Type-C® Cable Spec Rev 2.2.
- Sink Only or Dual Role Power (DRP)
- Under Sink Only SPR Mode 5, 9, 15, or 20V input from USB Type-C® and EPR mode up to 28V input from USB Type-C® power sourcing device.
- PDP rating of 15W, 27W, 45W, 60W, 100W, or 140W in sourcing mode.
- Power Supply Indicator (2 LEDs, green)
- Error Indicators from R9A02G0151 (3 LEDs, red)
- Battery Configuration control for RAA489118
- Charging Current limits and operation mode control to R9A02G0151.
- Renesas on-chip debugging emulator interface for firmware programming and debugging for R9A02G0151.

- BMS Evaluation board interface to communicate with Battery w/FGIC.
- Standalone battery charging for power tools, portable vacuums, battery-powered lawn mowers, drones.
- Rotary DIP Switch to select number cells from 2 to 7 cells, PD Capabilities, and charging current from 2A to 12A.
- The input voltage of the battery charger is from Type-C® sourcing device negotiated with the R9A02G0151.

Related Document

Use this document in combination with the following documents.

The related documents mentioned in this publication may include preliminary versions. However, preliminary versions are not marked as such.

- RAA489400 Data Sheet: R16DS0292EU
- R9A02G0151 Data Sheet: R19DS0101EJ
- E1 Emulator E20 Emulator User's Manual: R20UT0398EJ
- E2 Emulator Lite User's Manual: R20UT3240EJ
- E1/E20 Emulator, E2 Emulator Lite Additional Document for User's Manual (Notes on Connection of RL78): R20UT1994EJ
- Renesas Flash Programmer V3.13 Flash memory programming software User's Manual: R20UT5312EJ
- RAA489118 Short-Form Data Sheet: R16DO0024EU

About Switch Setting

RTK-G015-EPRSinkCharger-140W has three rotary switches to control numbers of battery cells, battery charging current limit, and operating mode selection.

- SW1B: The battery voltage ranges from 5.632 to 28.336V.

- SW1: Used to set Charging Current Limits and Operating mode. there are three operating modes "Board", "BMS", and "Manual". The default firmware uses "Board" mode, in which the switches on the board configure the EVB parameters from 2A to 12A. "BMS" sets EVB parameters by battery status information from BMS. "Manual" can set EVB parameters directly.

- SW3: There are two valid operating mode selection to set up Power Role (DRP or Sink).

In addition, the board can be supported battery charging current by changing the firmware generated by VIDWriter tool.

Table 2-1 Rotary switch setting value for Battery Configuration

SW position	Battery Configuration (SW1B)
1	2 Cells in series
2	3 Cells in series
3	4 Cells in series
4	5 Cells in series
5	6 Cells in series
6	7 Cells in series

Table 2-2 Battery Configuration vs MaxSysVol/MinSysVol for $LiCoO_2$ and $LiMn_2O_4$ battery in Standard FW

Battery Configuration	MaxSysVol (mV)	MinSysVol (mV)
2 Cells in series	8096	5632
3 Cells in series	12144	8448
4 Cells in series	16192	11264
5 Cells in series	20240	14080
6 Cells in series	24288	16896
7 Cells in series	28336	19712

Table 2-5 Rotary switch setting value for Charging Current Limits

SW position	Charging Current Limits (SW1)	Operating mode
0	The specific values (MaxSysVol, MinSysVol, and Charging Current limit) can be set in FW	Manual
1	2A	Board (Default)
2	4A	Board (Default)
3	6A	Board (Default)
4	8A	Board (Default)
5	10A	Board (Default)
6	12A	Board (Default)
7	The values (MaxSysVol, Charging Current limit and so on) are retrieved via BMS interface	BMS

Table 2-7 Rotary switch setting value for Operating Mode Selection

SW position	Operating Mode Selection (SW3)
0	28V/140W EPR DRP mode 28V Sink and 28V Source
1	Prohibited
2	Prohibited
3	28V/140W EPR Sink Only mode
4	Prohibited
5	Prohibited
6	Prohibited
7	Prohibited