About the current of the external resistor that generated by the FB terminal and FBRE terminal

Nch FET is built in between the VFBG terminal and the GND terminal.
When the VIN terminal is connected, the Nch FET turns on and current flows from the battery to the external resistor.
When the VIN terminal is disconnected, the Nch FET turns off and no current flows from the battery to the external resistor.
If the VFBRE terminal is connected to GND and recharging is disabled , the internal Nch FET will be turned off when charging is completed even if VIN is connected.

2. Charge current, Termination current setting

The charging current ICHG can be set by the following formula using the external resistor RICHG1.

$$I_{CHG} = (500000 / \mathrm{RICHG1}\ [\Omega])[\mathrm{mA}]$$

The charging current can be set up to 300 mA (VIN ≥ 4 V, VIN-VOUT ≥ 1 V), 100 mA (VIN ≥ 4 V, VIN-VOUT ≥ 0.3 V), and 30 mA (2.9 V ≤ VIN ≤ 5.5 V, VIN-VOUT ≥ 0.3V). There is a limit to the voltage between VIN and VOUT in the usage range of the charging current.

The termination current ITERM can be set by the following equation using the external resistor RITERM.
The termination current can be set from 50 μA to 10 mA.

$$I_{TERM} = (50000 / \mathrm{RITERM}\ [\Omega])[\mathrm{mA}]$$

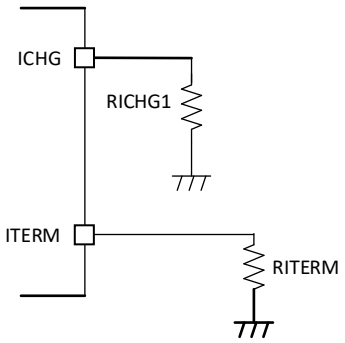


Figure 6. Resistor setting of ICHG and ITERM

3. Charge Current vs Battery Temperature

It is possible to monitor the temperature of the battery using NTC thermistor.
The charging current is controlled by the battery temperature, as shown in the temperature profile in Figure 7.
It is set by the NTC thermistor and pull-up resistor in Figure 8.
The component constants can be set according to the voltage of the NTC terminal at each temperature.

© 2021 ROHM Co., Ltd.

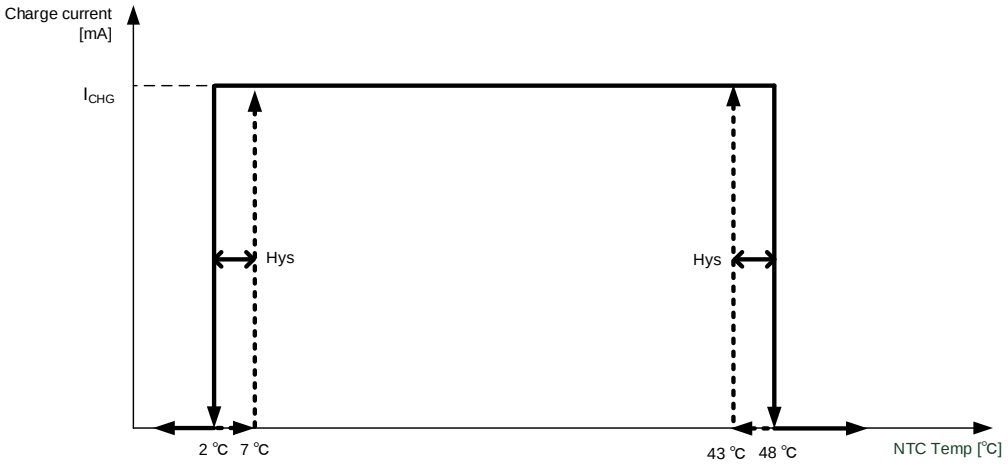
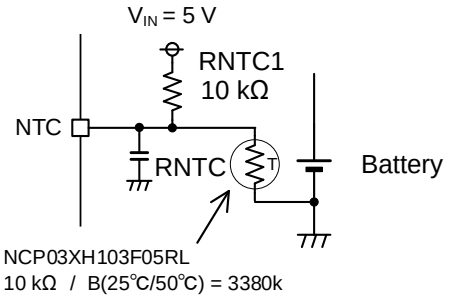


Figure 7. Charge Current vs Battery Temperature



NTC terminal voltage(V_{NTC_Cold}、V_{NTC_Hot})

2 °C: 3.605 V
7 °C: 3.375 V
43 °C: 1.720 V
48 °C: 1.535 V

Figure 8. Resistor setting of NTC terminal

How to find the external resistance of the NTC terminal and the NCT constant is as follows.
When calculating RNTC and RNTCR1, firstly calculate the resistance voltage dividers V_{Hot} and V_{Cold} when charging stops with the NTC thermistor temperature profile in Figure 7. The error of the %V_{Cold} and %V_{Hot} thresholds will depend on temperature coefficient B of the chosen NTC thermistor resistor.
By simulated calculation, the resistance value is calculated so that the error of the NTC terminal voltage at each temperature becomes small.

$$V_{Cold} = \left(\frac{RNTC_cold}{RNTC1 + RNTC_cold}\right) \times VIN\ [V]$$

$$V_{Hot} = \left(\frac{RNTC_Hot}{RNTC1 + RNTC_Hot}\right) \times VIN\ [V]$$

$$\%V_{Cold} = \frac{V_{Cold}}{V_{NTC_Cold}}$$

$$\%V_{Hot} = \frac{V_{Hot}}{V_{NTC_Hot}}$$

© 2021 ROHM Co., Ltd.

Where the NTC thermistor resistance at the T_{Cold} and T_{Hot} temperatures must be resolved as follows:

$$R_{NTC_Cold} = Ro \times e^{B\left(1/T_Cold - 1/To\right)}$$

$$R_{NTC_Hot} = Ro \times e^{B\left(1/T_Hot - 1/To\right)}$$

V_{Cold}: The value of the voltage divided by the resistance at low temperature
V_{Hot}: The value of the voltage divided by the resistance at hot temperature
V_{NTC_Cold}: Detection voltage of NTC terminal at low temperature . 3.605 V at Ta=2 °C
V_{NTC_Hot}: Detection voltage of NTC terminal at high temperature. 1.535 V at Ta=48 °C
R_{NTC_Cold}: NTC thermistor resistance at cold temperature
R_{NTC_Hot}: NTC thermistor resistance at hot temperature
Ro: NTC thermistor resistance at Ta 25°C
B: B constant of NTC thermistor
T_{Cold}: Low temperature
T_{Hot}: High temperature
To: 25°C

© 2021 ROHM Co., Ltd.

Parts list

Table 5. Parts list

Count	Parts No.	Type	Value	Description	Manufacturer Part Number	Manufacturer	Size [Unit: mm(inch)]
IC							
1	U1	Charger	-	Linear Charger	BD71631QWZ-E2	ROHM	1.8 x 2.4 (0.071x0.094)
Capacitor							
1	CVIN1	MLCC	4.7µF	16V, X5R, ±10%	GRM188R61C475KAAJD	MURATA	1608(0603)
1	CVOUT1	MLCC	1µF	25V, X5R, ±10%	GRM155R61E105KA12D	MURATA	1005(0402)
1	CNTC	MLCC	0.01µF	16V, B, ±10 %	GRM155B11C103KA01	MURATA	1005(0402)
2	CVIN2, CVOUT2	MLCC	OPEN	-	-	-	-
Resistor							
3	RLED, RNTC1, RNTC2	Resistor	10kΩ	1/10W, 50V, ±0.5%	MCR03EZPD1002	ROHM	1608(0603)
1	RICHG1	Resistor	5.1kΩ	1/10W, 50V, ±0.5%	MCR03EZPD5101	ROHM	1608(0603)
1	RITERM	Resistor	51kΩ	1/10W, 50V, ±0.5%	MCR03EZPD5102	ROHM	1608(0603)
1	RVFB1	Resistor	180kΩ	1/10W, 50V, ±0.5%	MCR03EZPD1803	ROHM	1608(0603)
1	RVFBRE1	Resistor	120kΩ	1/10W, 50V, ±0.5%	MCR03EZPD1203	ROHM	1608(0603)
2	RVFB2, RVFBRE2	Resistor	30kΩ	1/10W, 50V, ±0.5%	MCR03EZPD3002	ROHM	1608(0603)
1	RNTC3	-	SHORT	-	-	-	-
LED							
1	LED	-	LED	White, Clear	SML312WBCW1	ROHM	1608(0603)
Connector							
1	J1	-	OPEN	-	-	-	-
1	CN1	Connector	4terminals	3.81mm pitch	MKDS 1/ 4-3,81	Phoenix contact	15.23x 7.3 (0.6x0.29)
Optional parts (Boost converter)							
1	U2	-	OPEN	-	-	-	-
1	L3	-	OPEN	-	-	-	-
2	CDCDCIN1, CDCDCIN2	-	OPEN	-	-	-	-
2	CDCDCOUT1, CDCDCOUT2	-	OPEN	-	-	-	-
3	REN, RVSEL_H, RVSEL_L	-	OPEN	-	-	-	-

The product and manufacturer names listed in the parts list are current at the time this user's guide was prepared, and some parts may not be available. Please select the equivalent product based on the characteristics listed in the table. Select a ceramic capacitor with the same actual capacitance in consideration of the DC bias characteristics.

© 2021 ROHM Co., Ltd.

Board Layout

EVK PCB information

Number of Layers	Material	Board Size	Copper Thickness
4	FR-4	46mm x 36mm x 1.6mm	1oz (35µm)

The layout of BD71631QWZ-EVK-001 is shown below.

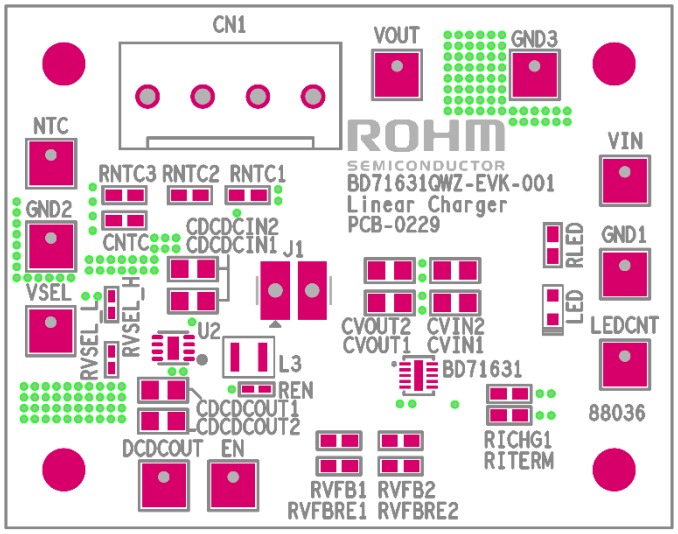


Figure 9. Top Silkscreen Layout
(Top View)

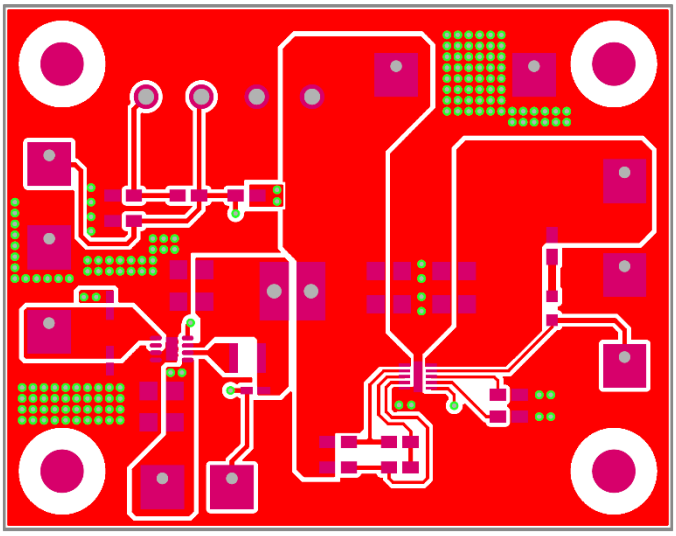


Figure 10. Top Layer Layout
(Top View)

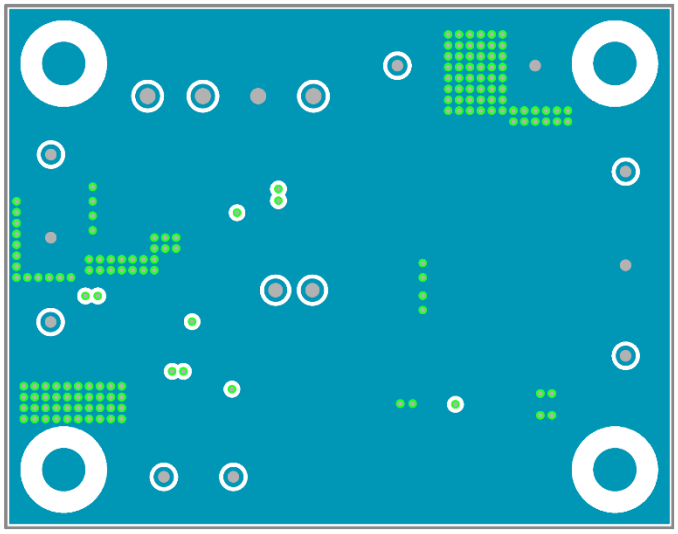


Figure 11. Middle1 Layer Layout
(Top View)

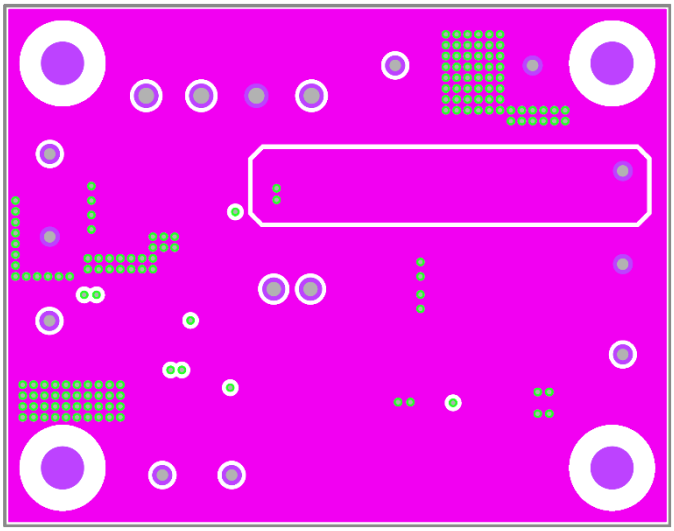


Figure 12. Middle2 Layer Layout
(Top View)

© 2021 ROHM Co., Ltd.

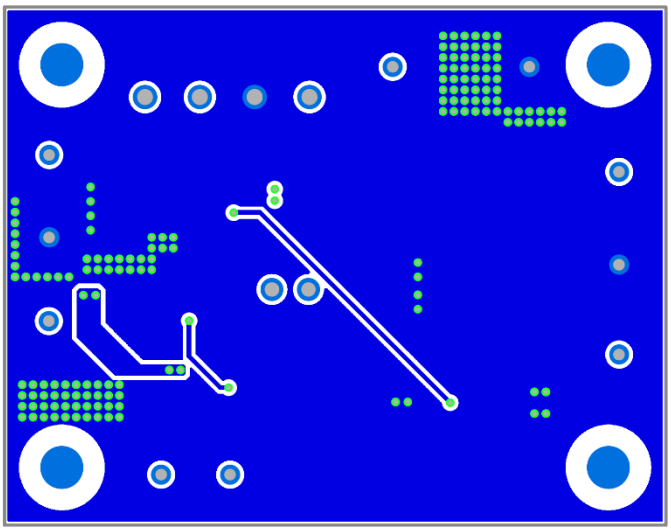


Figure 13. Bottom Layer Layout
(Top View)

© 2021 ROHM Co., Ltd.

Reference Application Data

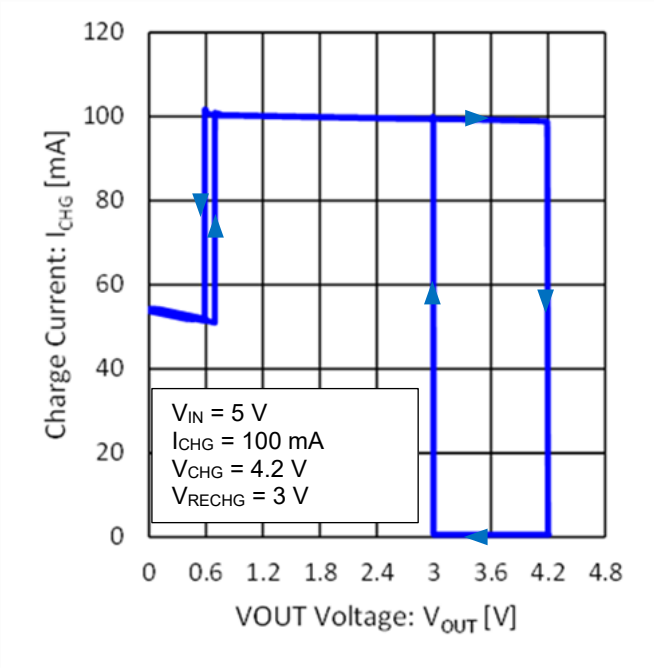


Figure 14. Charge Current vs VOUT Voltage

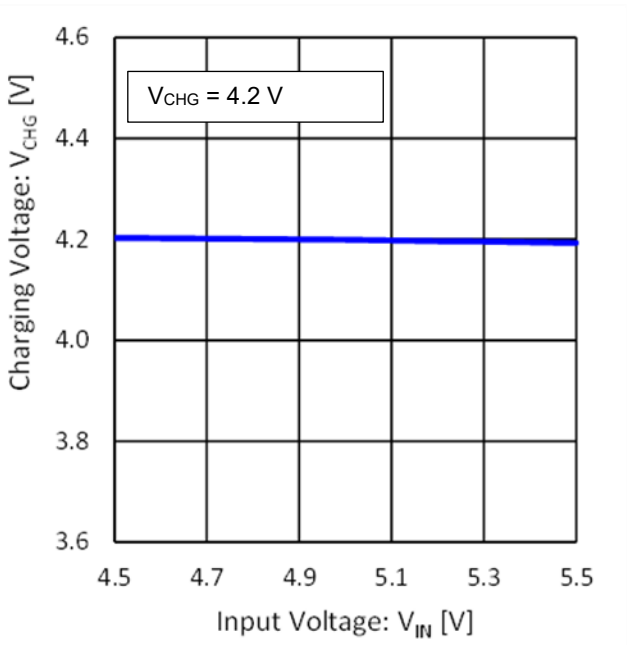


Figure 15. Charge Voltage vs Input Voltage

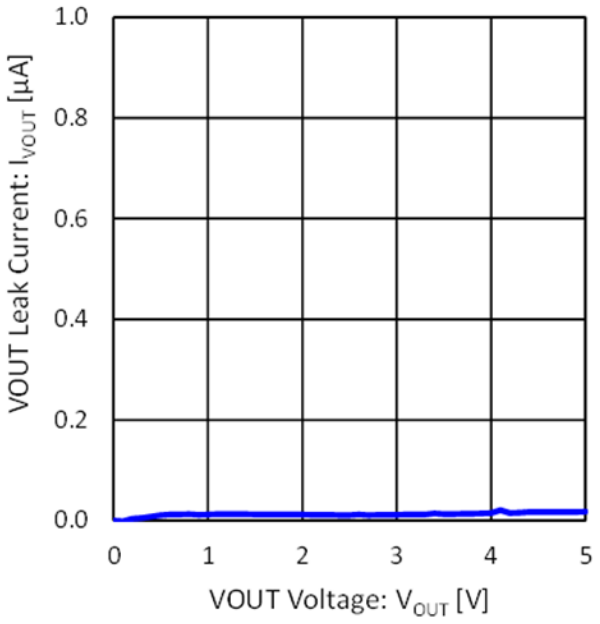


Figure 16. VOUT Leak Current vs VOUT Voltage
(VIN = Open)

Revision History

Date	Revision Number	Description
24. May. 2021	001	Initial release

© 2021 ROHM Co., Ltd.

Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products specified in this document are not designed to be radiation tolerant.

7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

10) ROHM has used reasonable care to ensure the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

11) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

12) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

13) This document, in part or in whole, may not be reprinted or reproduced without prior consent of ROHM.

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

https://www.rohm.com/contact/