

Linear Charger for Low Voltage Battery

BD71631QWZ

General Description

BD71631QWZ is a linear charger for low charge voltage battery. The battery charge voltage, charge current, termination current are set using external resistors.

Features

- Adjustable Termination Current: 50 μ A to 10 mA
- Low Quiescent Battery Current: $I_{BATT} = 0 \mu$ A (typ)
- NTC Thermistor Input for Temperature Qualified Charging
- Open-Drain Charge indicator LED Output
- Fixed 10 hour Safety Timer
- Thermal Shutdown
- Under Voltage Lockout Protection
- Battery Over Voltage Protection

Applications

- Low Voltage Battery Products
- Li-ion 1Cell Battery Products

Key Specifications

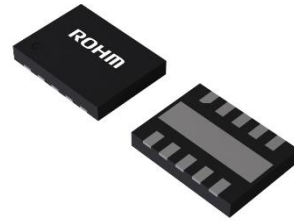
- Input Voltage Range: 2.9 V to 5.5 V
- Adjustable Battery Voltage: 2.0 V to 4.7 V
- Adjustable Recharge Voltage Threshold: Disable or 1.8 V to 4.7 V
- Adjustable Charge Current: Up to 300 mA ($V_{IN} \geq 4$ V, $V_{IN}-V_{OUT} \geq 1$ V)
Up to 100 mA ($V_{IN} \geq 4$ V)
Up to 30 mA (2.9 V $\leq V_{IN} \leq 5.5$ V)
- Adjustable Termination Current: 50 μ A to 10 mA
- Low Quiescent Battery Current: $I_{BATT} = 0 \mu$ A (typ)
- Operating Temperature: -30 $^{\circ}$ C to +105 $^{\circ}$ C

Package

UMMP10LZ1824

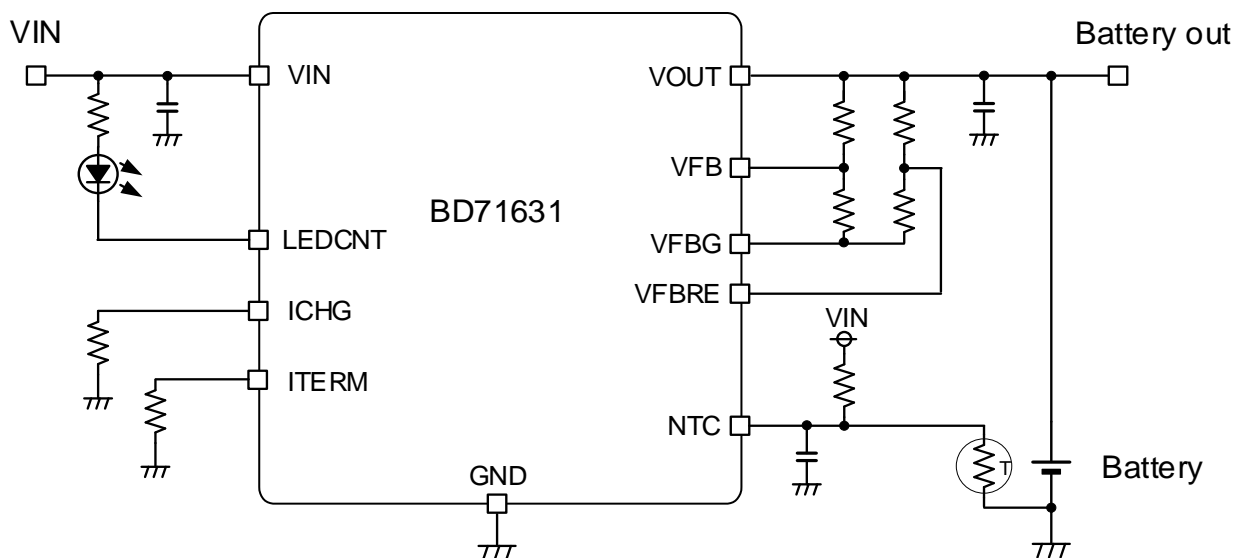
W (Typ) x D (Typ) x H (Max)

1.8 mm x 2.4 mm x 0.4 mm



Typical Application Circuit

Low Voltage Battery Application

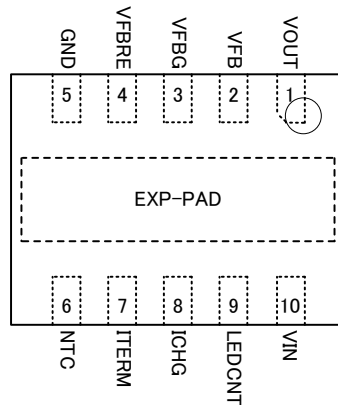


○Product structure : Silicon integrated circuit ○This product has no designed protection against radioactive rays.

Contents

General Description	1
Features.....	1
Applications	1
Key Specifications	1
Package.....	1
Typical Application Circuit	1
Contents	2
Pin Configuration	3
Pin Descriptions.....	3
Block Diagram	3
Absolute Maximum Ratings	4
Thermal Resistance.....	4
Recommended Operating Conditions.....	4
Electrical Characteristics.....	5
Typical Performance Curves.....	6
Figure 1. VIN Input Current vs Input Voltage.....	6
Figure 2. VOUT Input Current vs VOUT Voltage.....	6
Figure 3. Charge Current vs VOUT Voltage	6
Figure 4. Charge Current vs VOUT Voltage	6
Figure 5. Charging Voltage vs Input Voltage	7
Figure 6. Charging Voltage vs Input Voltage	7
Figure 7. VFBG ON Resistance vs Input Voltage.....	7
Figure 8. VFB Leak Current vs VFB Voltage.....	8
Figure 9. VFBRE Leak Current vs VFBRE Voltage	8
Figure 10. VFBG Leak Current vs VFBG Voltage	8
Battery Output Control.....	9
Charge Current vs Battery Temperature	9
Peripheral Components Setting	10
Charging State Control	11
Charging Timing Chart.....	12
I/O Equivalence Circuit	13
Operational Notes.....	14
1. Reverse Connection of Power Supply	14
2. Power Supply Lines.....	14
3. Ground Voltage.....	14
4. Ground Wiring Pattern.....	14
5. Recommended Operating Conditions.....	14
6. Inrush Current.....	14
7. Testing on Application Boards	14
8. Inter-pin Short and Mounting Errors	14
9. Unused Input Pins	14
10. Regarding the Input Pin of the IC	15
11. Ceramic Capacitor.....	15
12. Thermal Shutdown Circuit (TSD).....	15
Ordering Information.....	16
Marking Diagram	16
Physical Dimension and Packing Information	17
Revision History.....	18

Pin Configuration

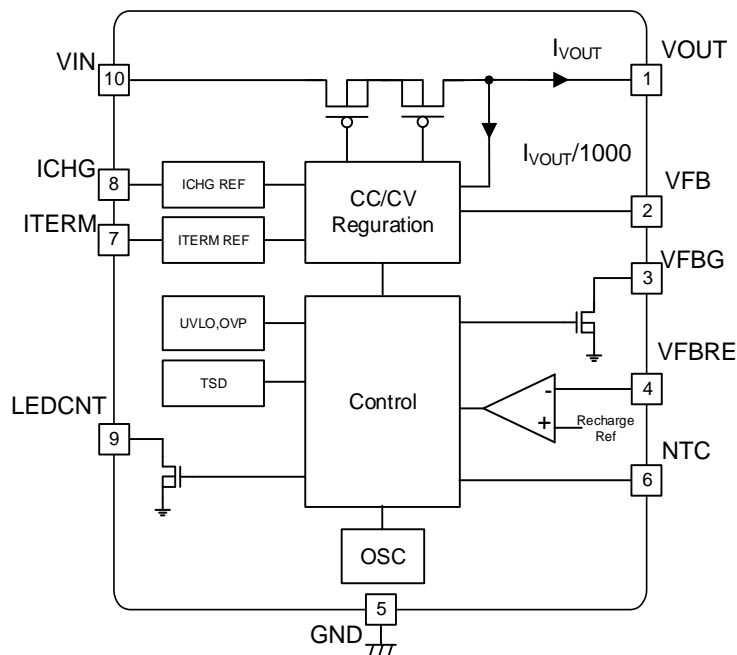


(TOP VIEW)

Pin Descriptions

Pin No.	Pin Name	Function
1	VOUT	CCCV output
2	VFB	Feedback for full charge voltage
3	VFBG	Ground by internal switch in charging Unused on the VFBG pin open
4	VFBRE	Feedback for recharge voltage. This pin should not be left floating Tie the VFBRE pin to GND to disable recharge function
5	GND	Ground
6	NTC	Thermistor sense input. This pin should not be left floating Tie the NTC pin to GND to disable thermistor sense function
7	ITERM	Termination current setting pin
8	ICHG	Charge current setting pin This pin should not be connected a capacitor
9	LEDCNT	Charging indicator output Unused on the LEDCNT pin open
10	VIN	Power supply input
-	EXP-PAD	The EXP-PAD is connected to the GND Pin.

Block Diagram



Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Rating	Unit
Voltage Range (with respect to GND)	V _{IN} , V _{OUT} , V _{ICHG} , V _{ITERM} , V _{LEDCNT} , V _{F_B} , V _{F_B} , V _{F_B} V _{N_T}	-0.3 to +7.0	V
Maximum Junction Temperature	T _{jmax}	+150	°C
Storage Temperature Range	T _{stg}	-55 to +150	°C

Caution 1: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Caution 2: Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.

Thermal Resistance (Note 1)

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s ^(Note 3)	2s2p ^(Note 4)	
UMMP10LZ1824				
Junction to Ambient	θ_{JA}	172.24	54.00	°C/W
Junction to Top Characterization Parameter ^(Note 2)	Ψ_{JT}	14.87	6.97	°C/W

(Note 1) Based on JESD51-2A (Still-Air), using a BD71631QWZ Chip.

(Note 2) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.

(Note 3) Using a PCB board based on JESD51-3.

(Note 4) Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70 μ m

Layer Number of Measurement Board	Material	Board Size	Thermal Via ^(Note 5)	
			Pitch	Diameter
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt	1.20 mm	Φ 0.30 mm

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 μ m	74.2 mm x 74.2 mm	35 μ m	74.2 mm x 74.2 mm	70 μ m

(Note 5) This thermal via connects with the copper pattern of all layers.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
V _{IN} Voltage	V _{IN}	2.9	5.0	5.5	V
Minimum I/O Voltage Difference	V _{DIF}	0.3	-	-	V
Battery Voltage	V _{BAT}	0	-	4.7	V
LEDCNT Current	I _{LED}	-	-	20	mA
VFBG Current	I _{F_B}	-	-	5	mA
V _{IN} Capacitor ^(Note 6)	C _{VIN}	1.0	-	4.7	μ F
V _{OUT} Capacitor without Battery	V _{OUTNB}	10	-	-	μ F
V _{OUT} Capacitor with Battery	V _{OUTB}	0.1	-	-	μ F
VFB Total Resistance	V _{F_B}	100	-	1000	k Ω
VFBRE Total Resistance	V _{F_B}	100	-	5000	k Ω
Operating Temperature	T _{opr}	-30	-	+105	°C

(Note 6) The Max value is for using USB output as the power supply.

Electrical Characteristics (Unless otherwise specified VIN = 5 V, Ta = 25 °C, VOUT = 2.5 V)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
<VIN Voltage>						
VIN UVLO Detect Voltage	V _{INUV}	2.3	2.4	2.5	V	VIN fall detect
VIN UVLO Detect Hysteresis	V _{INUVHYS}	50	100	150	mV	-
<Charge Voltage>						
VFB Threshold Voltage	V _{FBTH}	0.588	0.600	0.612	V	-
Battery Charging Voltage Range	V _{CHG_R}	2.0	-	4.7	V	-
VFBRE Threshold Voltage	V _{FBRCHTH}	0.588	0.600	0.612	V	-
Pre-charge Voltage Threshold	V _{PRETH}	0.6	0.7	0.8	V	Battery rise detect
Pre-charge Voltage Hysteresis	V _{PREHYS}	50	100	150	mV	-
Battery Recharging Voltage Range	V _{RCHG_R}	1.8	-	4.7	V	-
Recharge Disenable Threshold	V _{RECHG_DIS}	-	0.20	0.35	V	VFBRE input
Battery OVP Threshold	V _{BOVP}	V _{CHG} ×1.01	V _{CHG} ×1.05	V _{CHG} ×1.10	V	VFB monitor
<Charge Current>						
Charge Current Setting Range 1	I _{CHG_R1}	1	-	300	mA	VIN ≥ 4 V, VIN-VOUT ≥ 1 V
Charge Current Setting Range 2	I _{CHG_R2}	1	-	100	mA	VIN ≥ 4 V
Charge Current Setting Range 3	I _{CHG_R3}	1	-	30	mA	2.9 V ≤ VIN ≤ 5.5 V
Charge Current Accuracy 1	-	-10	-	+10	%	ICHG ≥ 100 mA
Charge Current Accuracy 2	-	-25	-	+25	%	10 mA ≤ ICHG < 100 mA
Charge Current Accuracy 3	-	-50	-	+50	%	ICHG < 10 mA
Pre-charge Current Accuracy	-	-50	-	+50	%	-
Termination Current Setting Range	I _{TERM_R}	0.05	-	10.00	mA	-
Termination Current Accuracy1	-	-10	-	+10	%	300 μA ≤ ITERM ≤ 800 μA
Termination Current Accuracy2	-	-25	-	+25	%	800 μA < ITERM ≤ 3 mA ITERM < 300 μA
Termination Current Accuracy3	-	-50	-	+50	%	3 mA < ITERM ≤ 10 mA
Termination Current Accuracy4	-	-25	-	+25	μA	ITERM < 100 μA
<Thermal Control>						
NTC Threshold Voltage HOT1	V _{NTCHOT1}	VIN× 0.328	VIN× 0.344	VIN× 0.360	V	-
NTC Threshold Voltage HOT2	V _{NTCHOT2}	VIN× 0.293	VIN× 0.307	VIN× 0.322	V	-
NTC Threshold Voltage COLD1	V _{NTCCOLD1}	VIN× 0.702	VIN× 0.721	VIN× 0.739	V	-
NTC Threshold Voltage COLD2	V _{NTCCOLD2}	VIN× 0.655	VIN× 0.675	VIN× 0.694	V	-
NTC Disenable Threshold Voltage	V _{NTCDIS}	-	VIN× 0.035	VIN× 0.050	V	-
<Timer>						
10 hour Safety Timer	t _{CHGTM}	9.5	10.0	10.5	hour	-
Charging Termination Delay Time	t _{TERM}	13	15	17	s	From ITERM detect
<LEDCNT>						
LEDCNT Output Low Voltage	V _{LED_L}	-	-	0.4	V	I _{LEDCNT} = 5 mA
<VFBG>						
VFBG ON Resistance	R _{VFBG}	-	-	100	Ω	-
<Power Consumption>						
Battery Standby Current	I _{BATT}	-	0	1	μA	VIN = 0 V
LEDCNT Leak Current	I _{LEDCNT_LEAK}	-	0	1	μA	LEDCNT = 5 V
VFBG Leak Current	I _{VFBG}	-	0	1	μA	VFBG = 5 V, VIN = 0 V
VFB Leak Current	I _{VFB}	-	0	1	μA	VFB = 5 V
VFBRE Leak Current	I _{VFBRE}	-	0	1	μA	VFBRE = 5 V
NTC Leak Current	I _{NTC}	-	0	1	μA	NTC = 5 V

Typical Performance Curves

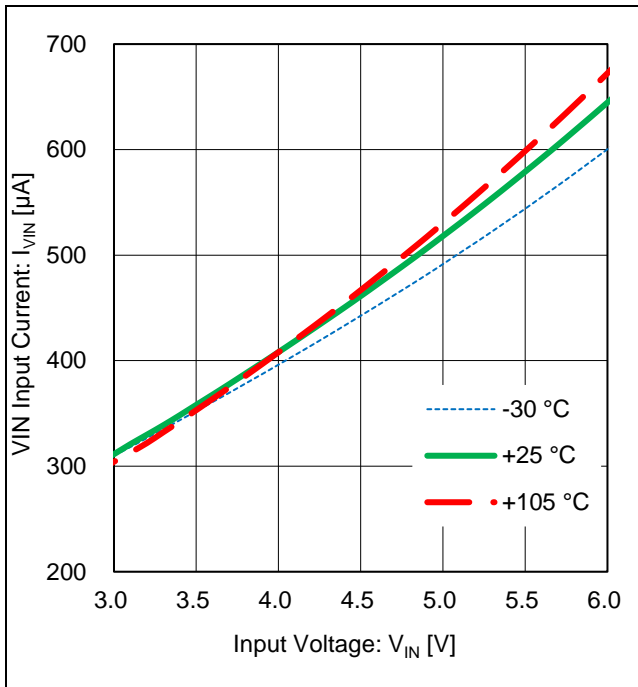


Figure 1. VIN Input Current vs Input Voltage (CHG = Disenable)

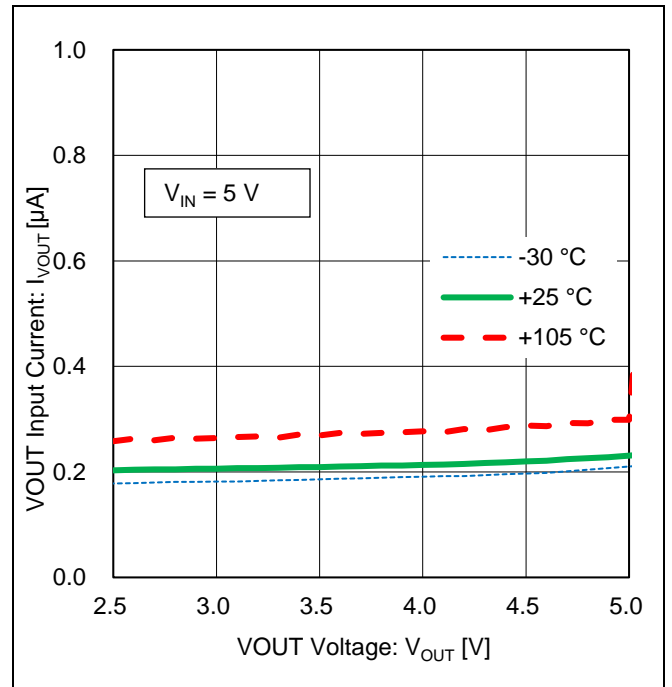


Figure 2. VOUT Input Current vs VOUT Voltage

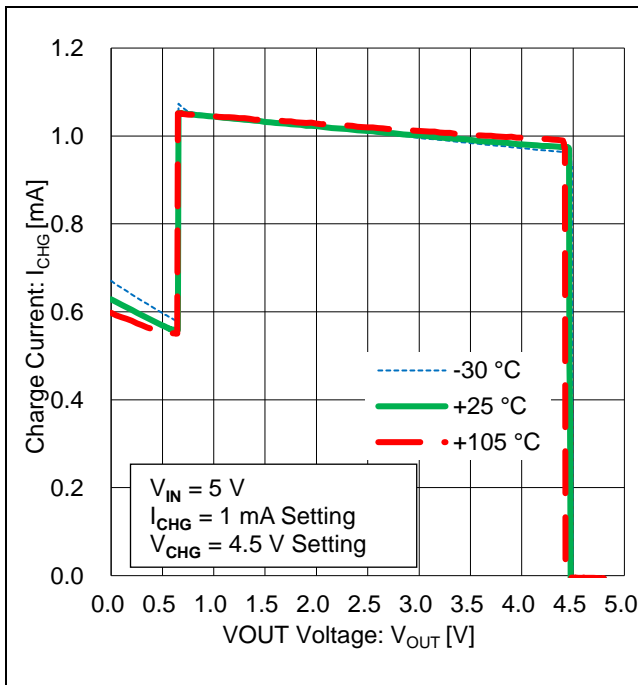


Figure 3. Charge Current vs VOUT Voltage

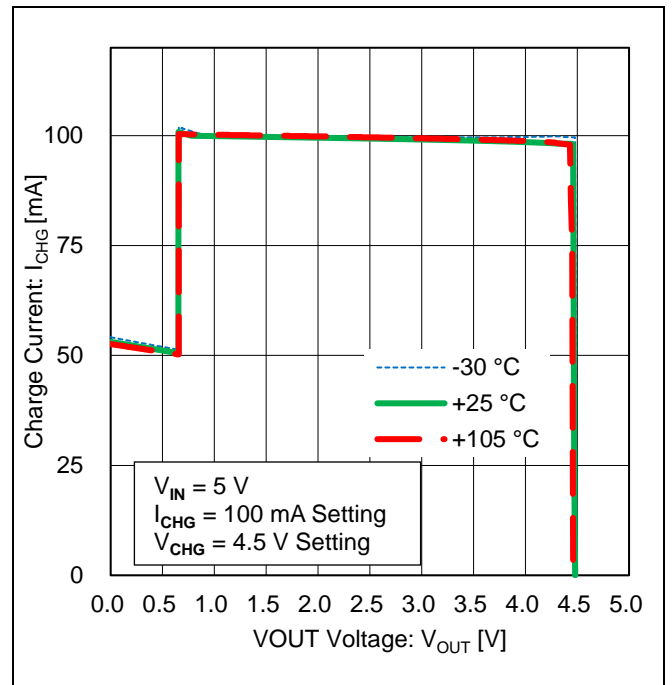


Figure 4. Charge Current vs VOUT Voltage

Typical Performance Curves - continued

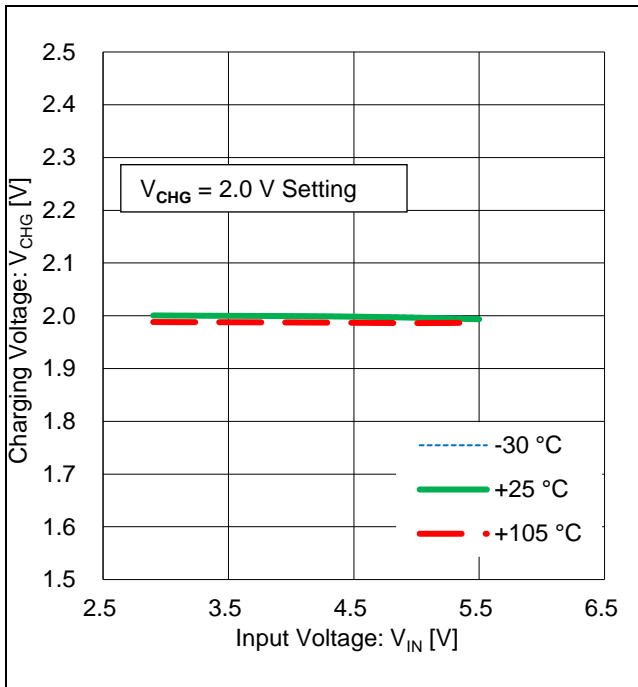


Figure 5. Charging Voltage vs Input Voltage

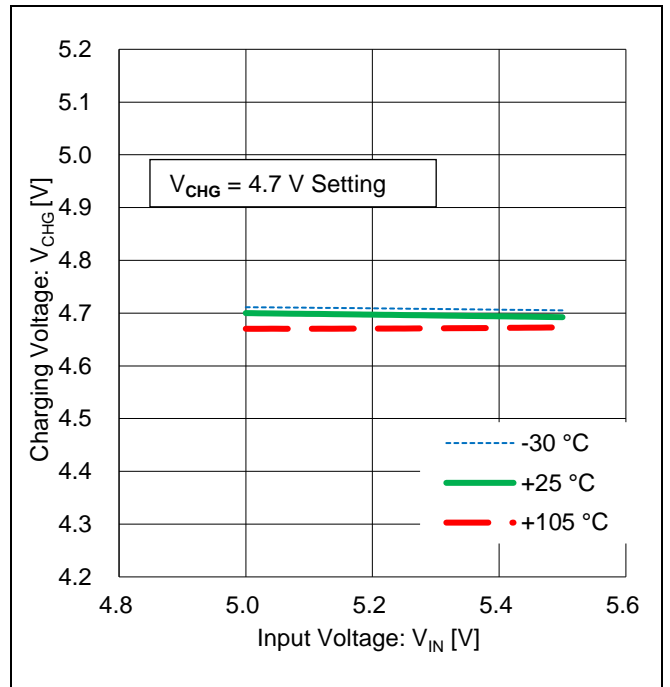


Figure 6. Charging Voltage vs Input Voltage

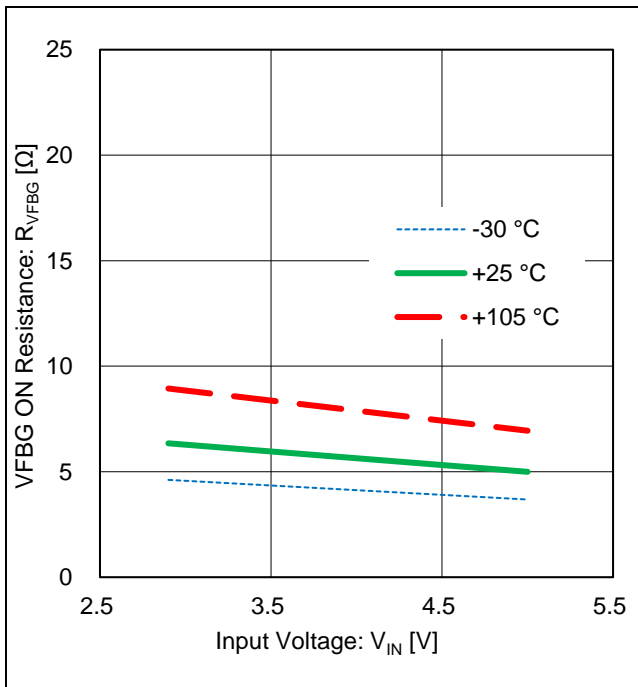


Figure 7. VFBG ON Resistance vs Input Voltage

Typical Performance Curves - continued

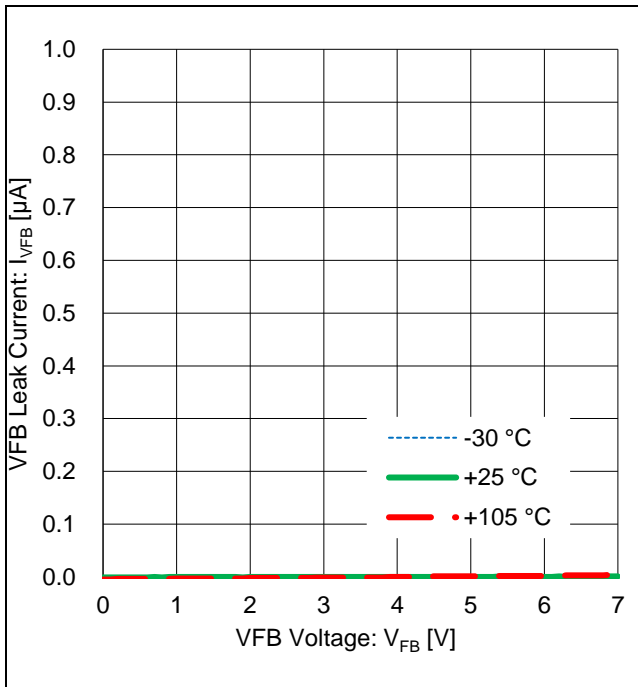


Figure 8. VFB Leak Current vs VFB Voltage

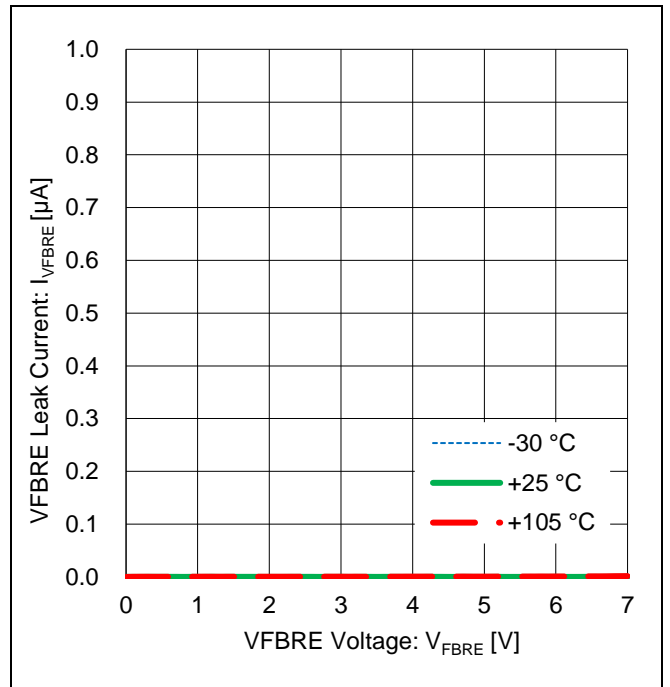


Figure 9. VFBRE Leak Current vs VFBRE Voltage

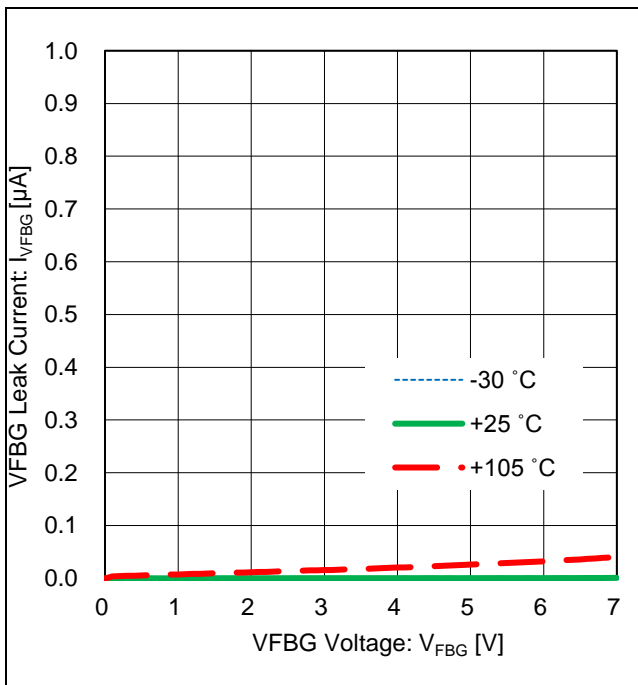
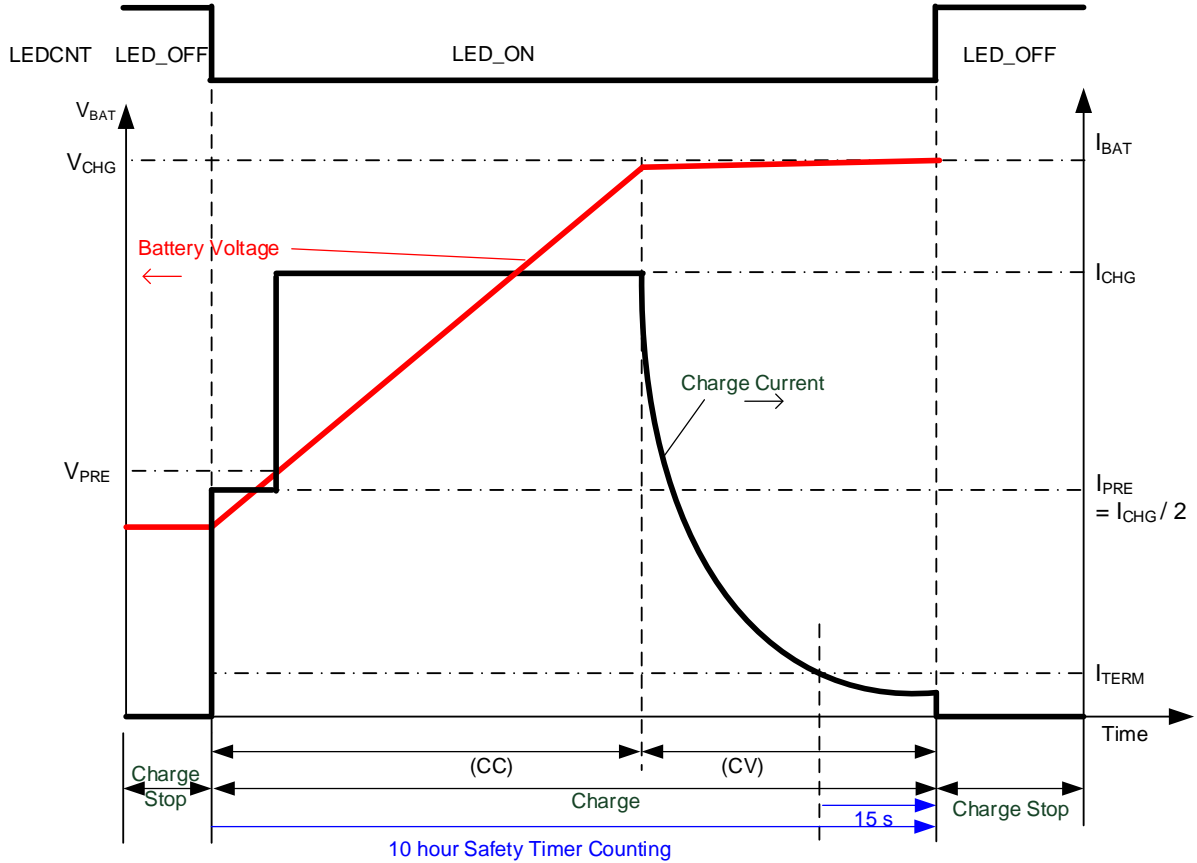
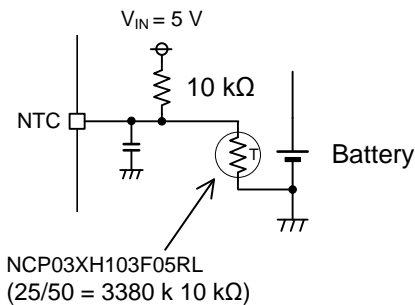


Figure 10. VFBG Leak Current vs VFBG Voltage

Battery Output Control



Charge Current vs Battery Temperature

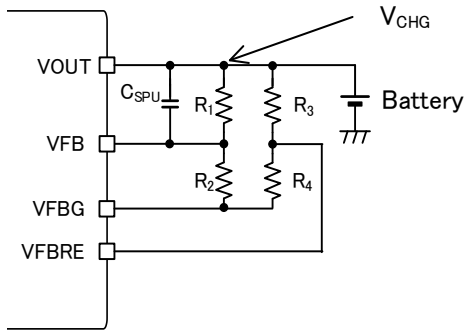


NTC pin voltage

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

Peripheral Components Setting

1. Charging voltage (V_{CHG}), Recharge voltage (V_{RECHG}) setting



The battery charge voltage is determined as follows :

$$V_{CHG} = (R_1 + R_2)/R_2 \times 0.6 [V]$$

The battery re-charge voltage is determined as follows :

$$V_{RECHG} = (R_3 + R_4)/R_4 \times 0.6 [V]$$

About total feedback resistance, follow the Recommended Operating Conditions.

Resistor reference value

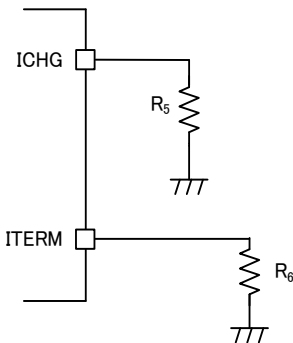
Resistor	V _{CHG} = 2.2 V V _{RECHG} = Disenable	V _{CHG} = 4.2 V V _{RECHG} = 3.9 V
	Resistor value [Ω]	
R ₁	200 k	600 k
R ₂	75 k	100 k
R ₃	-*	1.1 M
R ₄	-*	200 k

*VFBRE pin connect to GND

Connect C_{SPU} for feedback stability when Battery is no connected or the battery capacity is too small. The capacitance of C_{SPU} is determined as follows :

$$C_{SPU} = 1/(2\pi \times 300 \times R_1) [F]$$

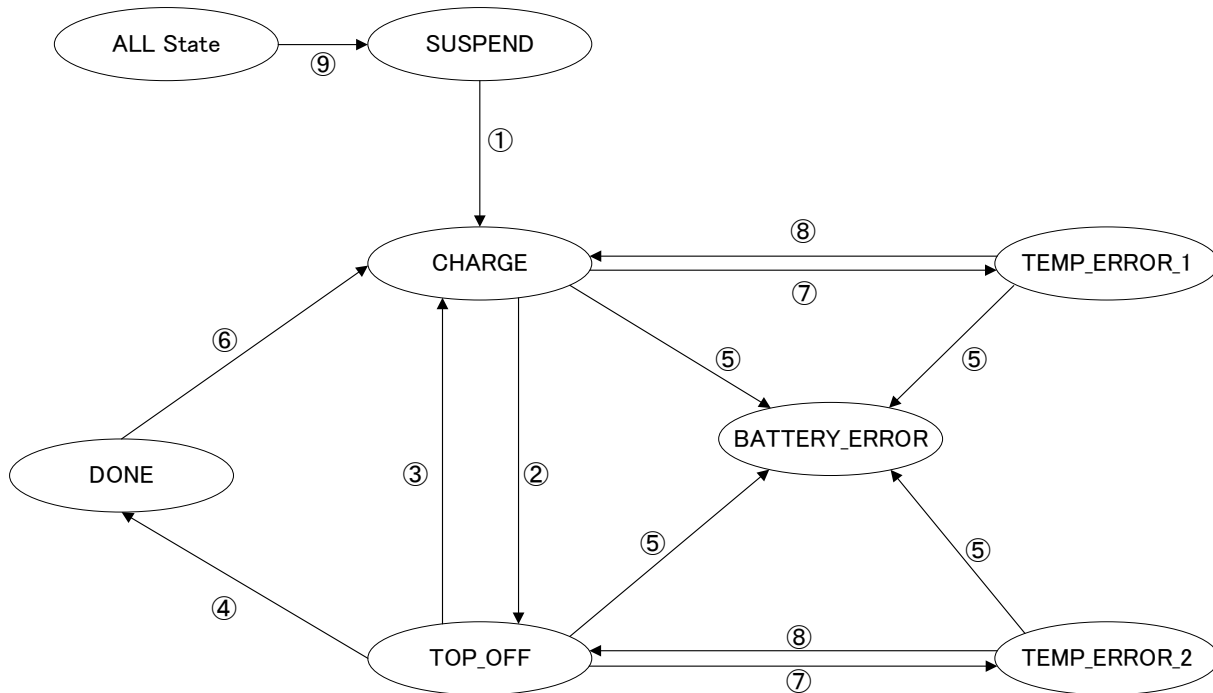
2. Charge current, Termination current setting



$$I_{CHG} = (500000 / R_5 [\Omega]) [mA]$$

$$I_{TERM} = (50000 / R_6 [\Omega]) [mA]$$

Charging State Control

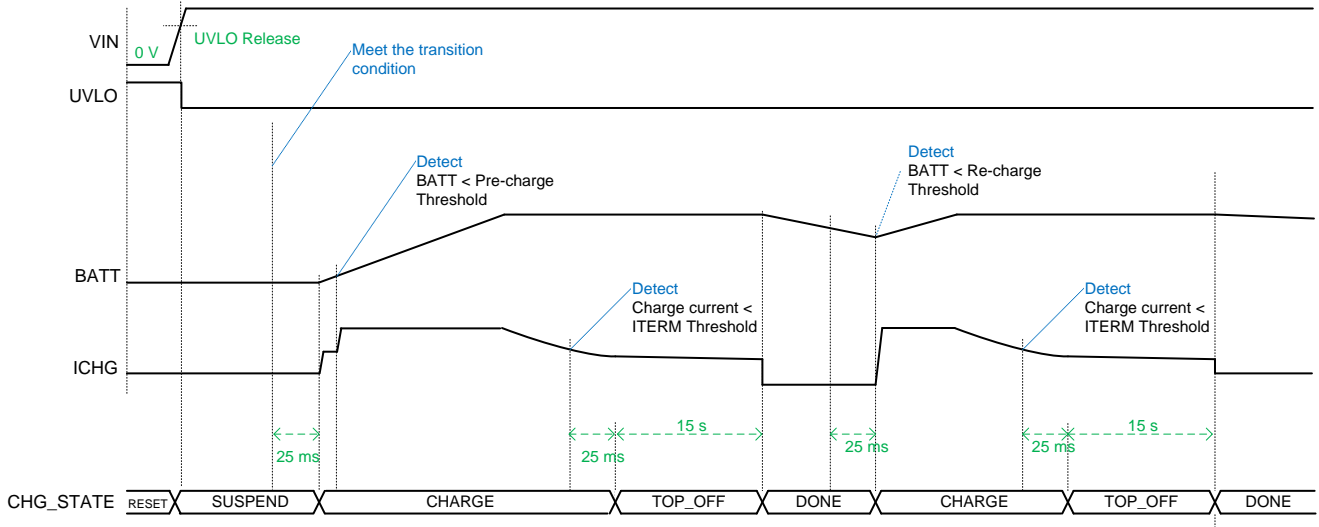


No.	State transition	Condition
①	SUSPEND -> CHARGE	UVLO, TSD not detect and VIN > BATT+0.3 V and BATT OVP not detect and Temp Error not detect Continue to satisfy the condition for 25 ms
②	CHARGE -> TOP_OFF	Charge current < ITERM Continue to satisfy the condition for 25 ms
③	TOP_OFF -> CHARGE	Charge current > ITERM Continue to satisfy the condition for 25 ms
④	TOP_OFF -> DONE	Continue to satisfy the condition for 15 s
⑤	CHARGE or TOP_OFF or TEMP_ERROR_1 or TEMP_ERROR_2 -> BATTERY_ERROR	BATT OVP detect or 10 hours safety timer expired
⑥	DONE -> CHARGE	BATT < Re-charge voltage Continue to satisfy the condition for 25 ms
⑦	CHARGE -> TEMP_ERROR_1 or TOP_OFF -> TEMP_ERROR_2	Temp Error detect Continue to satisfy the condition for 25 ms
⑧	TEMP_ERROR_1 -> CHARGE or TEMP_ERROR_2 -> TOP_OFF	Temp Error not detect Continue to satisfy the condition for 25 ms
⑨	ALL State -> SUSPEND	UVLO, TSD detect or VIN < BATT+0.3 V

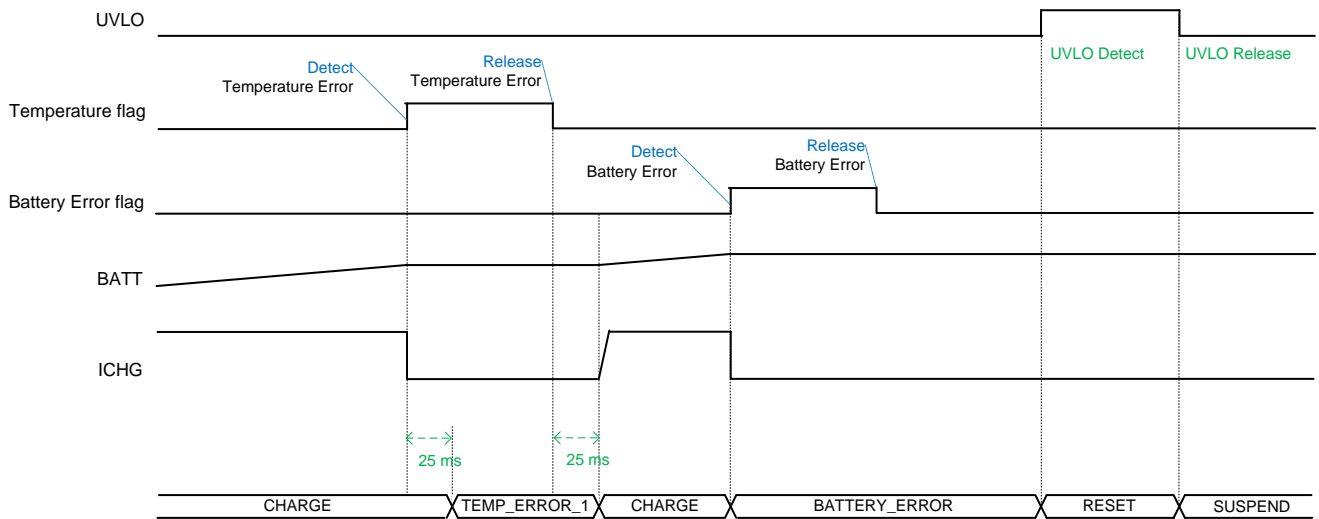
State	Battery charge	10 hours safety timer	LEDCNT
SUSPEND	Stop	Stop and reset	OFF
CHARGE	Charge	Count	ON
TOP_OFF	Charge	Count	ON
DONE	Stop	Stop and reset	OFF
BATTERY_ERROR	Stop	Stop and reset	OFF
TEMP_ERROR_1	Stop	Count	OFF
TEMP_ERROR_2	Stop	Count	OFF

Charging Timing Chart

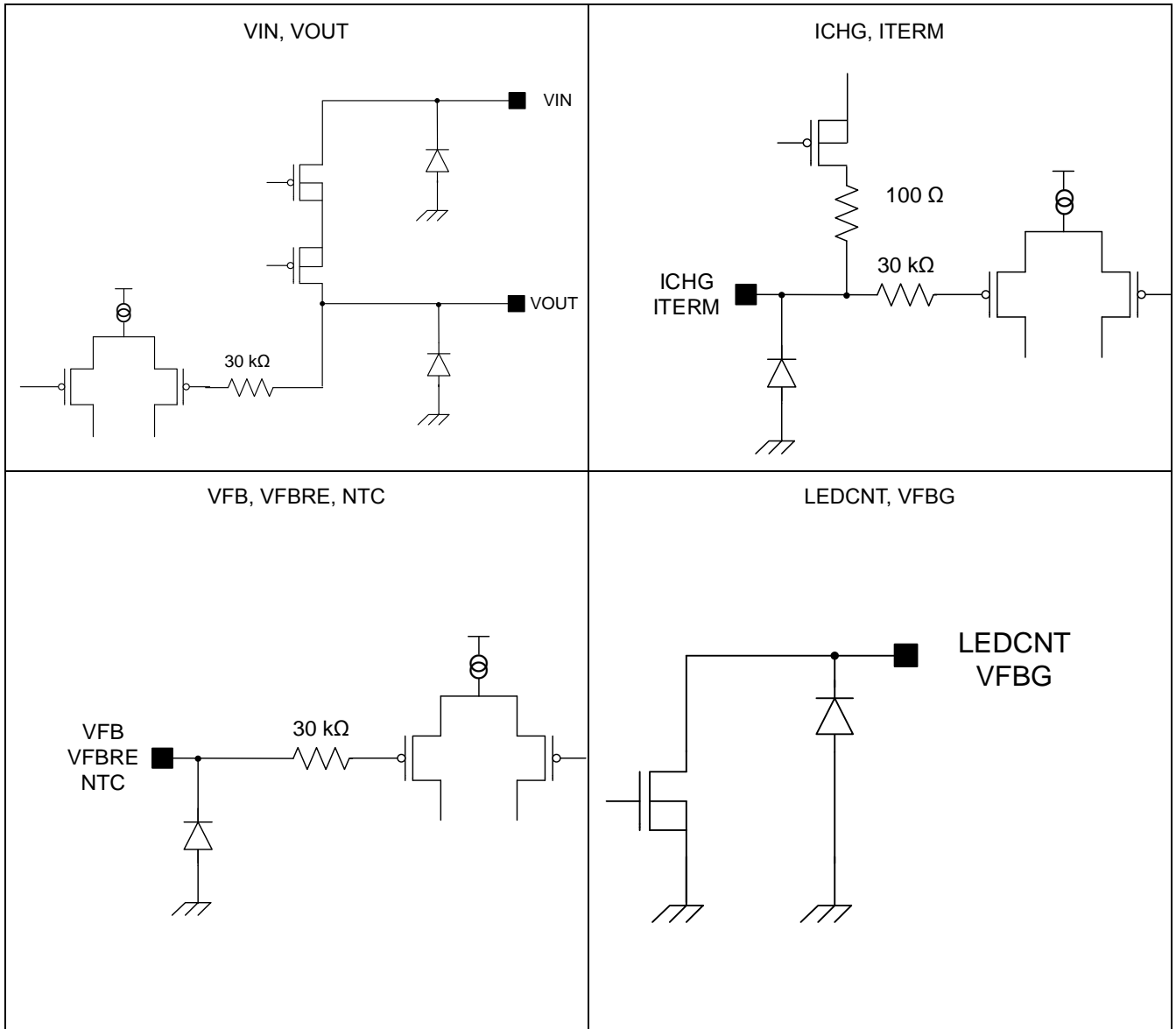
Normal operation



Error operation



I/O Equivalence Circuit



Operational Notes

1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. Ground Wiring Pattern

When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. Recommended Operating Conditions

The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

7. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

8. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

9. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

Operational Notes – continued

10. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When $GND > Pin A$ and $GND > Pin B$, the P-N junction operates as a parasitic diode.

When $GND > Pin B$, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

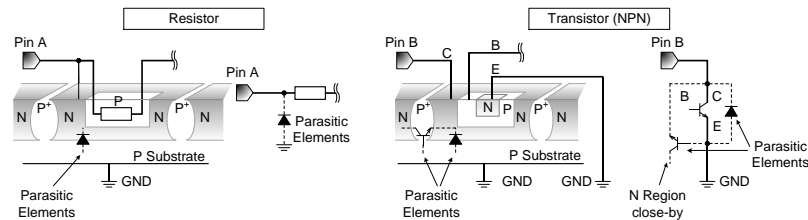


Figure 11. Example of Monolithic IC Structure

11. Ceramic Capacitor

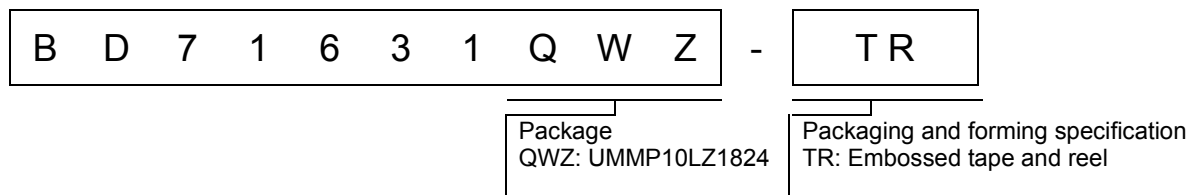
When using a ceramic capacitor, determine a capacitance value considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

12. Thermal Shutdown Circuit (TSD)

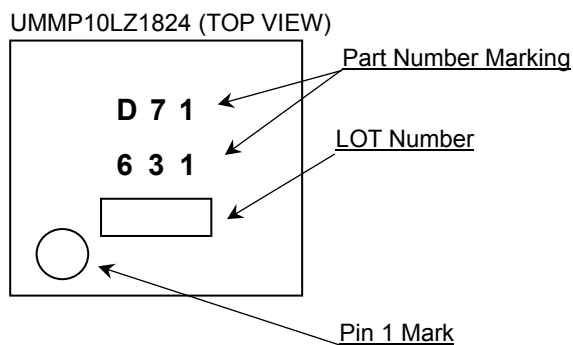
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's maximum junction temperature rating. If however the rating is exceeded for a continued period, the junction temperature (T_j) will rise which will activate the TSD circuit that will turn OFF power output pins. When the T_j falls below the TSD threshold, the circuits are automatically restored to normal operation.

Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

Ordering Information

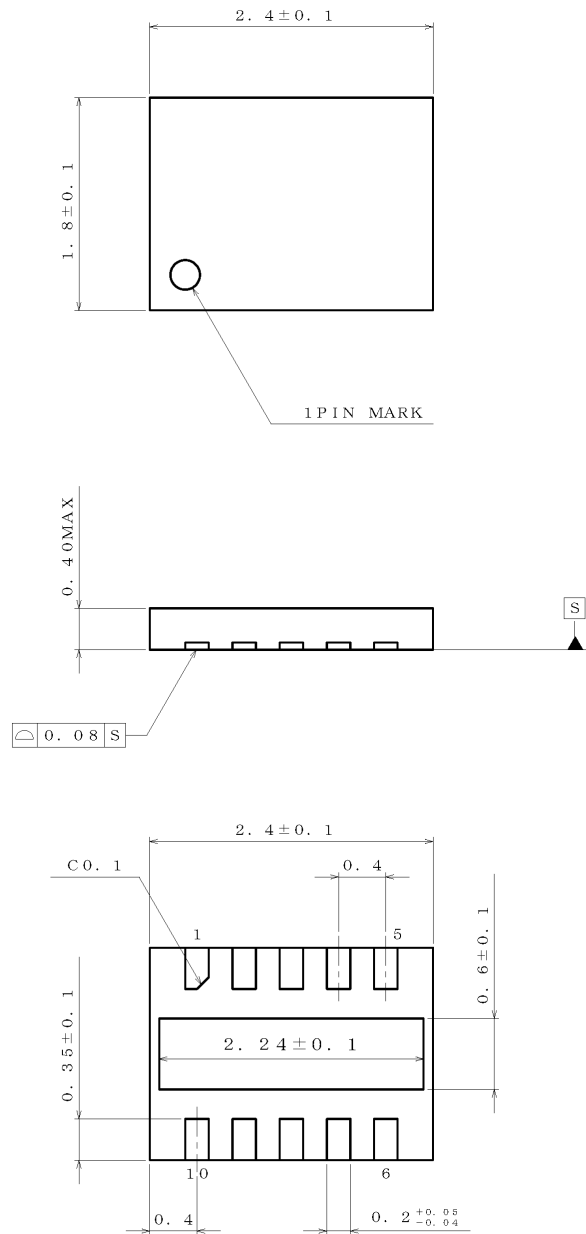


Marking Diagram



Physical Dimension and Packing Information

Package Name	UMMP10LZ1824
--------------	--------------



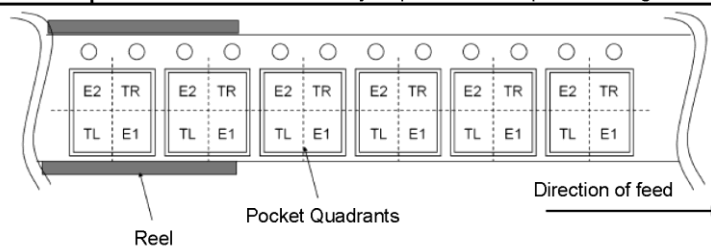
(UNIT : mm)

PKG : UMMP10LZ1824

Drawing No. EX769-5001-1

< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	TR The direction is the pin 1 of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand



Revision History

Date	Revision	Changes
24.Mar.2021	001	New Release

Notice

Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipment (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment ^(Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

- ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
 - Installation of protection circuits or other protective devices to improve system safety
 - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc. prior to use, must be necessary:
 - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
 - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
 - [a] the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] the temperature or humidity exceeds those recommended by ROHM
 - [c] the Products are exposed to direct sunshine or condensation
 - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.
2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).
3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.
2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.
3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.
4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.
2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.
3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.