Linear Charger for Low Voltage Battery

BD7090NUV

General Description

BD7090NUV is a linear charger for low charge voltage battery. The battery charge voltage, charge current, and termination current are set using external resisters.

Features

- Adjustable Termination Current: 50 µA to 10 mA
- Low Quiescent Battery Current: I_{BATT} = 0 µA (typ)
- NTC Thermistor Input for Temperature Qualified Charging
- Open-drain Charge Indicator LED Output
- 12 hour Charge Timer
- Thermal Shutdown
- Under Voltage Lockout Protection
- Battery Over Voltage Protection

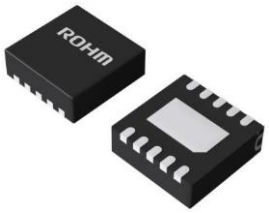
Applications

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

Key Specifications

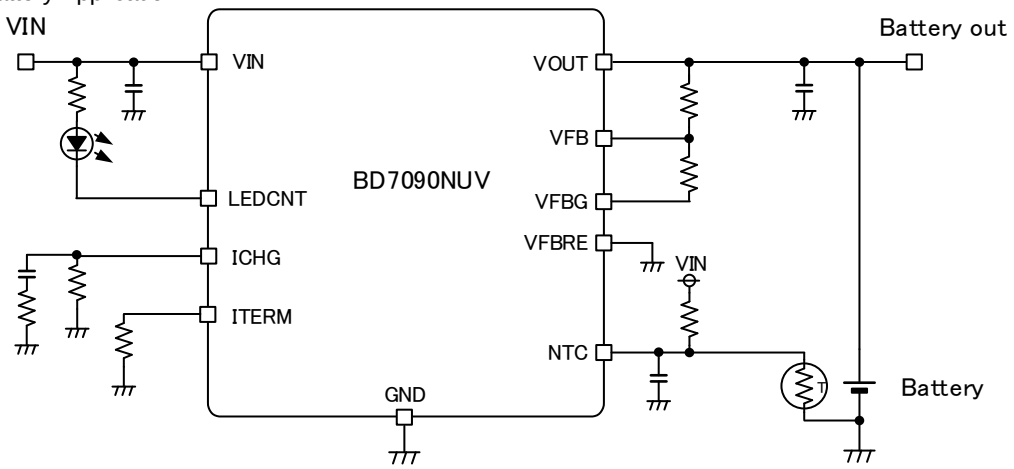
- Input Voltage Range: 2.9 V to 5.5 V
- Adjustable Battery Voltage: 1.2 V to 4.7 V
- Adjustable Recharge Voltage Threshold: Disenable or 1.0 V to 4.7 V
- Adjustable Charge Current: Up to 100 mA (VIN ≥ 4 V) Up to 30 mA (2.9 V ≤ VIN ≤ 4 V)
- Adjustable Termination Current: 50 µA to 10 mA
- Low Quiescent Battery Current: I_{BATT} = 0 µA (typ)
- Operating Temperature: -30 °C to +105 °C

Package	W (Typ) x D (Typ) x H (Max)
VSON010V3030	3.0 mm x 3.0 mm x 1.0 mm

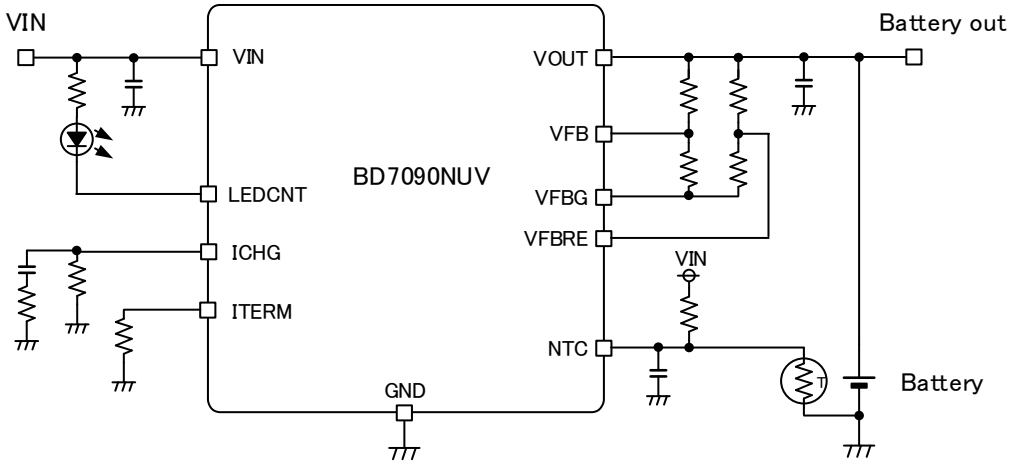


Typical Application Circuit

□Low Voltage Battery Application



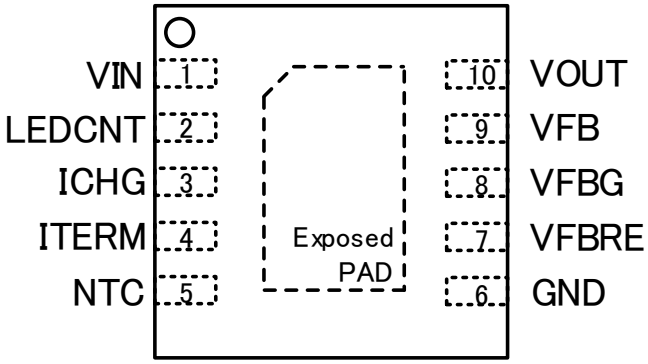
□Li-ion Battery Application



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

Contents

Pin Configuration

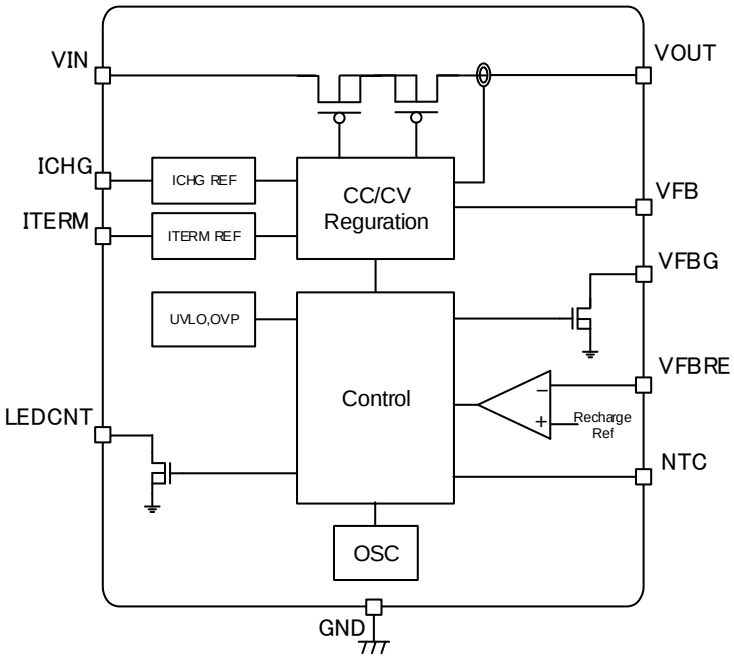


(TOP VIEW)

Pin Descriptions

Pin No.	Pin Name	Function
1	VIN	Power supply input
2	LEDCNT	Charging indicator output
3	ICHG	Charge current setting pin
4	ITERM	Termination current setting pin
5	NTC	Thermistor sense input
6	GND	Ground
7	VFBRE	Feedback for recharge voltage
8	VFBG	Ground
9	VFB	Feedback for full charge voltage
10	VOUT	CC/CV output
-	Exposed PAD	Exposed PAD on the back side. Please connect PCB GND

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_{FB}, V_{FBG}, V_{FBRE} V_{NTC}	-0.3 to +7.0	V
Maximum Junction Temperature	Tjmax	+150	°C
Storage Temperature Range	Tstg	-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)*	
VSON010V3030				
Junction to Ambient	θ_{JA}	223.3	41.5	°C/W
Junction to Top Characterization Parameter*(Note 2)*	Ψ_{JT}	56	6	°C/W

*(Note 1)*Based on JESD51-2A(Still-Air)
*(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 µm

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	Φ0.30 mm

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

(Note 5) This thermal via connect with the copper pattern of layers 1,2, and 4. The placement and dimensions obey a land pattern.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
VIN 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_{FB}	-	-	5	mA
VIN Capacitor *(Note 6)*	C_{VIN}	1.0	-	4.7	µF
VOUT Capacitor without Battery	C_{VOUTNB}	10	-	-	µF
VOUT Capacitor with Battery	C_{VOUTB}	0.1	-	-	µF
VFB Total Resistance	R_{VFBR}	100	-	1000	kΩ
VFBRE Total Resistance	R_{VFBRER}	100	-	5000	kΩ
Operating Temperature	Topr	-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 = 1.8 V)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
<VIN Voltage>						
VIN UVLO Detect Voltage	V_{INUV}	2.3	2.4	2.5	V	VIN falls 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}	1.2	-	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 rises detect
Pre-charge Voltage Hysteresis	V_{PREHYS}	50	100	150	mV	-
Battery Recharging Voltage Range	V_{RCHG_R}	1.0	-	4.7	V	-
Recharge Disenable Threshold	V_{RECHG_DIS}	-	0.20	0.35	V	VFBRE input
Battery OVP Threshold	V_{BOVP}	VCHG x 1.01	VCHG x 1.05	VCHG x 1.10	V	VFB monitor
<Charge Current>						
Charge Current Setting Range 1	I_{CHG_R1}	1	-	100	mA	VIN ≥ 4 V
Charge Current Setting Range 2	I_{CHG_R2}	1	-	30	mA	VIN < 4 V
Charge Current Accuracy 1	-	-35	-	+35	%	30 mA < ICHG ≤ 100 mA
Charge Current Accuracy 2	-	-25	-	+25	%	12 mA < ICHG ≤ 30 mA
Charge Current Accuracy 3	-	-15	-	+15	%	3 mA ≤ ICHG ≤ 12 mA
Charge Current Accuracy 4		-20	-	+20	%	1 mA ≤ ICHG < 3 mA
Pre-charge Current Accuracy	-	-50	-	+50	%	IPRE = ICHG x 0.5
Termination Current Setting Range	I_{TERM_R}	0.05	-	10.00	mA	-
Termination Current Accuracy1	-	-35	-	+35	%	3 mA < I_{TERM} ≤ 10 mA
Termination Current Accuracy2	-	-25	-	+25	%	1.2 mA < I_{TERM} ≤ 3 mA
Termination Current Accuracy3	-	-15	-	+15	%	300 µA ≤ I_{TERM} ≤ 1.2 mA
Termination Current Accuracy4	-	-20	-	+20	%	125 µA ≤ I_{TERM} < 300 µA
Termination Current Accuracy5	-	-25	-	+25	µA	I_{TERM} < 125 µA
<Thermal Control>						
NTC Threshold Voltage HOT1	$V_{NTCHOT1}$	VIN x 0.328	VIN x 0.344	VIN x 0.360	V	-
NTC Threshold Voltage HOT2	$V_{NTCHOT2}$	VIN x 0.293	VIN x 0.307	VIN x 0.322	V	-
NTC Threshold Voltage COLD1	$V_{NTCCOLD1}$	VIN x 0.702	VIN x 0.721	VIN x 0.739	V	-
NTC Threshold Voltage COLD2	$V_{NTCCOLD2}$	VIN x 0.655	VIN x 0.675	VIN x 0.694	V	-
NTC Disenable Threshold Voltage	V_{NTCDIS}	-	VIN x 0.035	VIN x 0.050	V	-
<Timer>						
Charging Time	t_{CHGTM}	11.4	12.0	12.6	hour	-
Charging Termination Delay Time	t_{TERM}	17	18	19	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

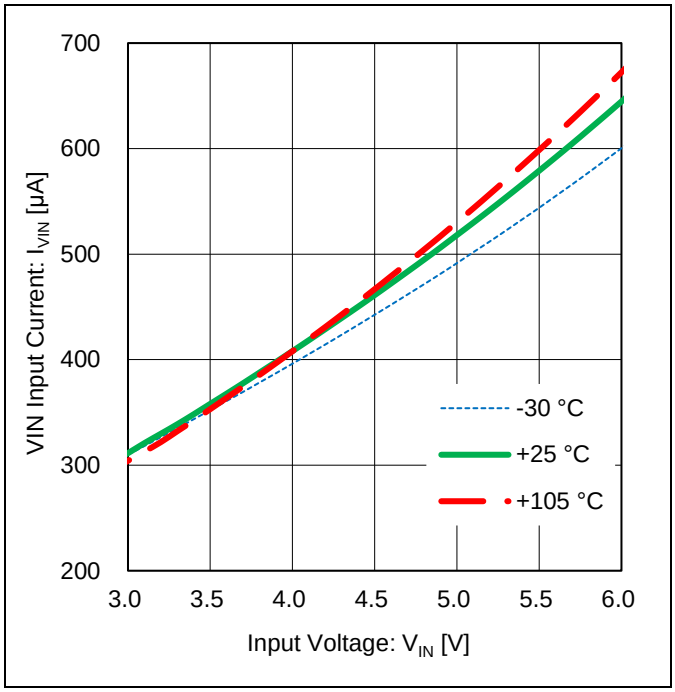


Figure 1. VIN Input Current vs Input Voltage
(CHG = Disenable)

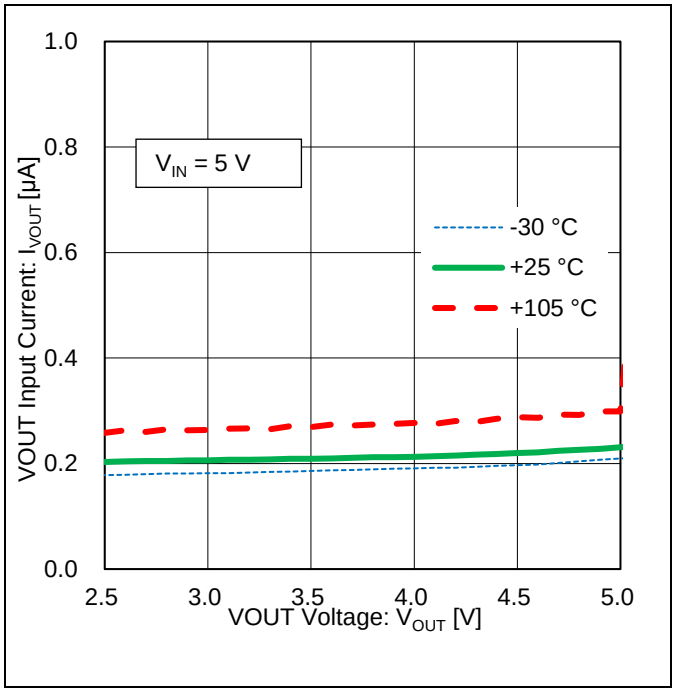


Figure 2. VOUT Input Current vs VOUT Voltage

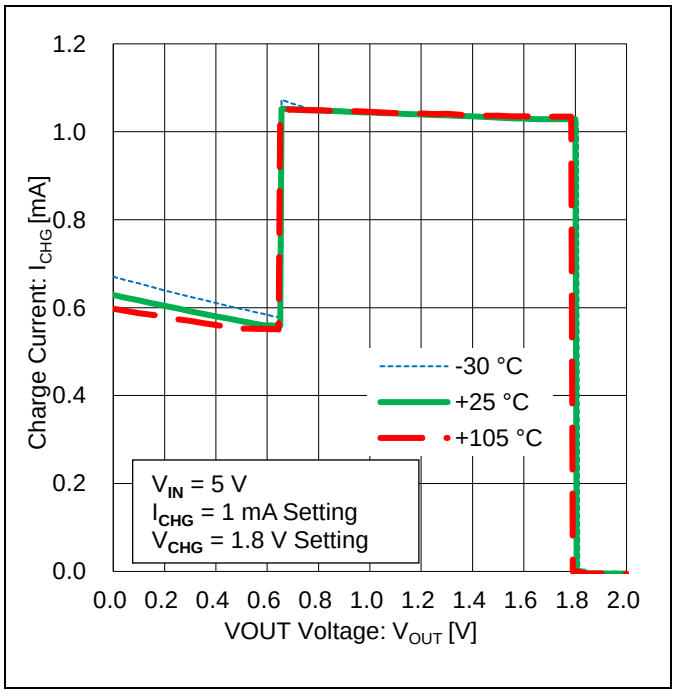


Figure 3. Charge Current vs VOUT Voltage

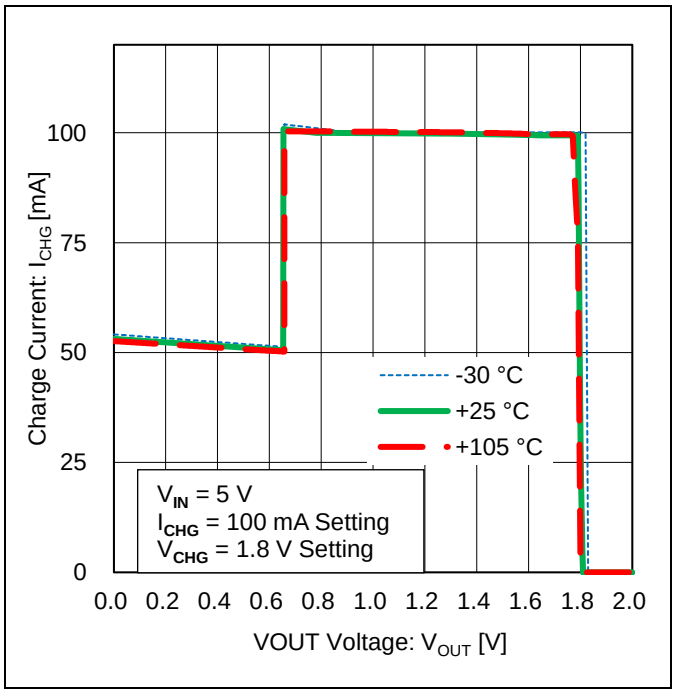


Figure 4. Charge Current vs VOUT Voltage

Typical Performance Curves - continued

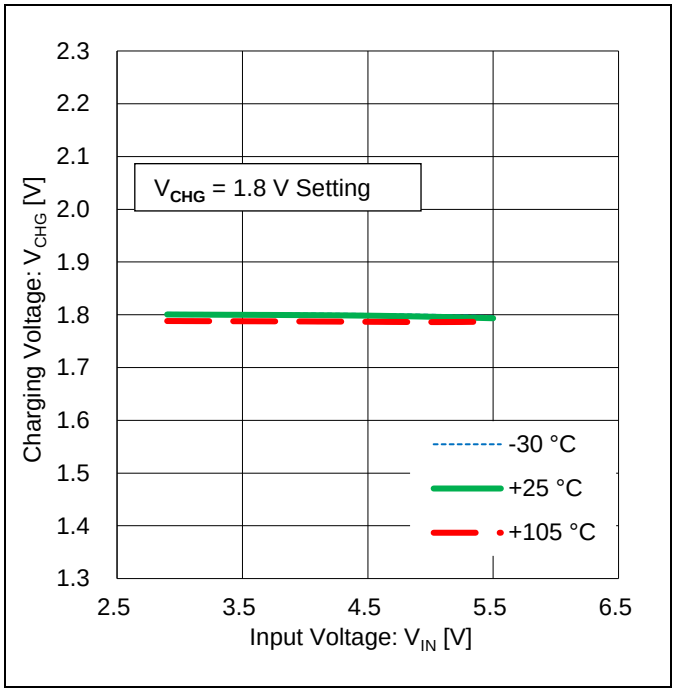


Figure 5. Charging Voltage vs Input Voltage

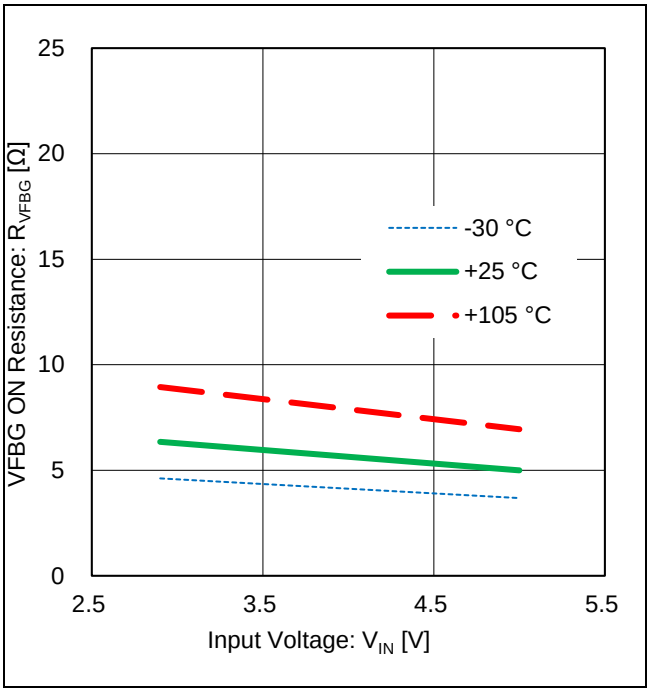


Figure 6. VFBG ON Resistance vs Input Voltage

Typical Performance Curves - continued

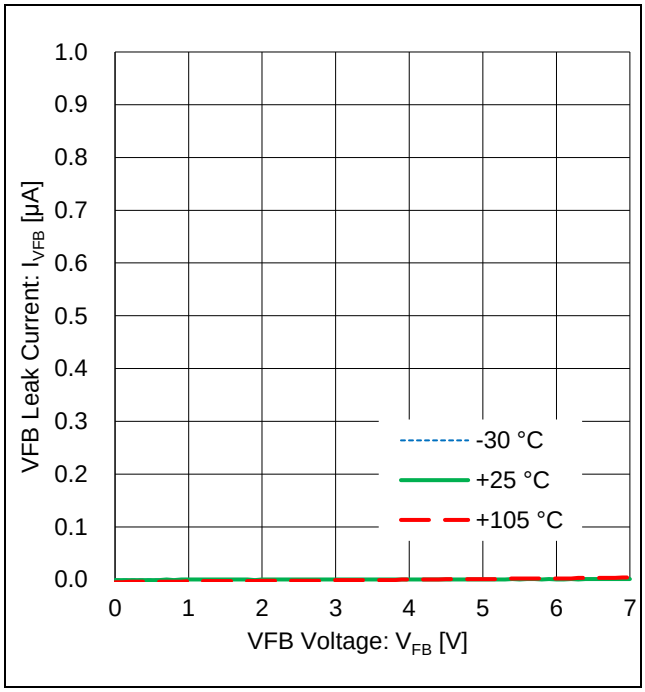


Figure 7. VFB Leak Current vs VFB Voltage

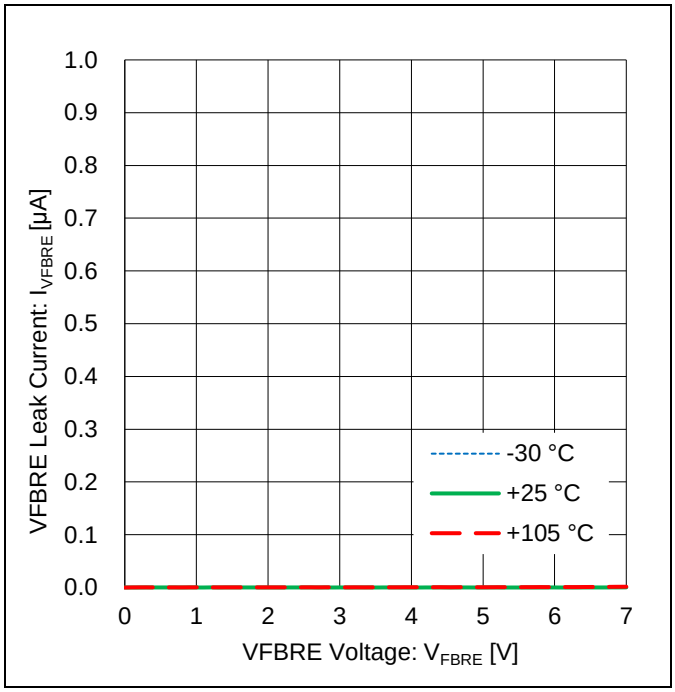


Figure 8. VFBRE Leak Current vs VFBRE Voltage

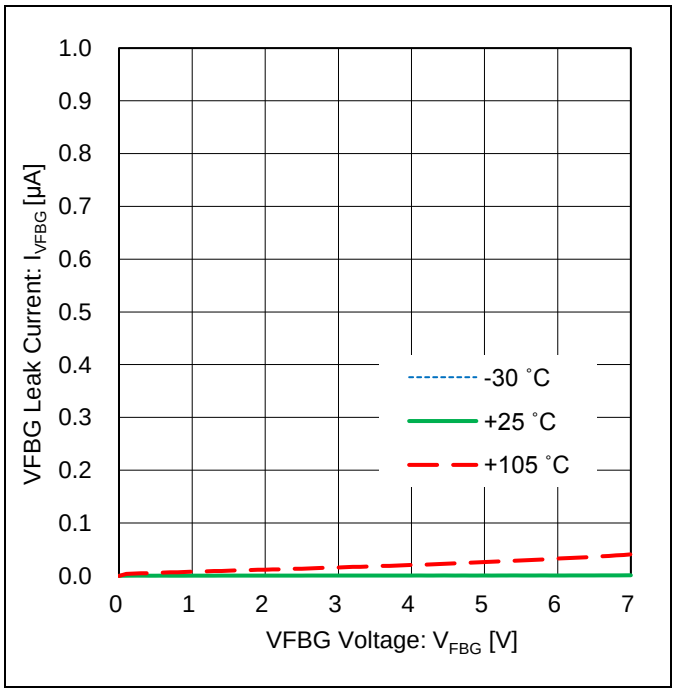
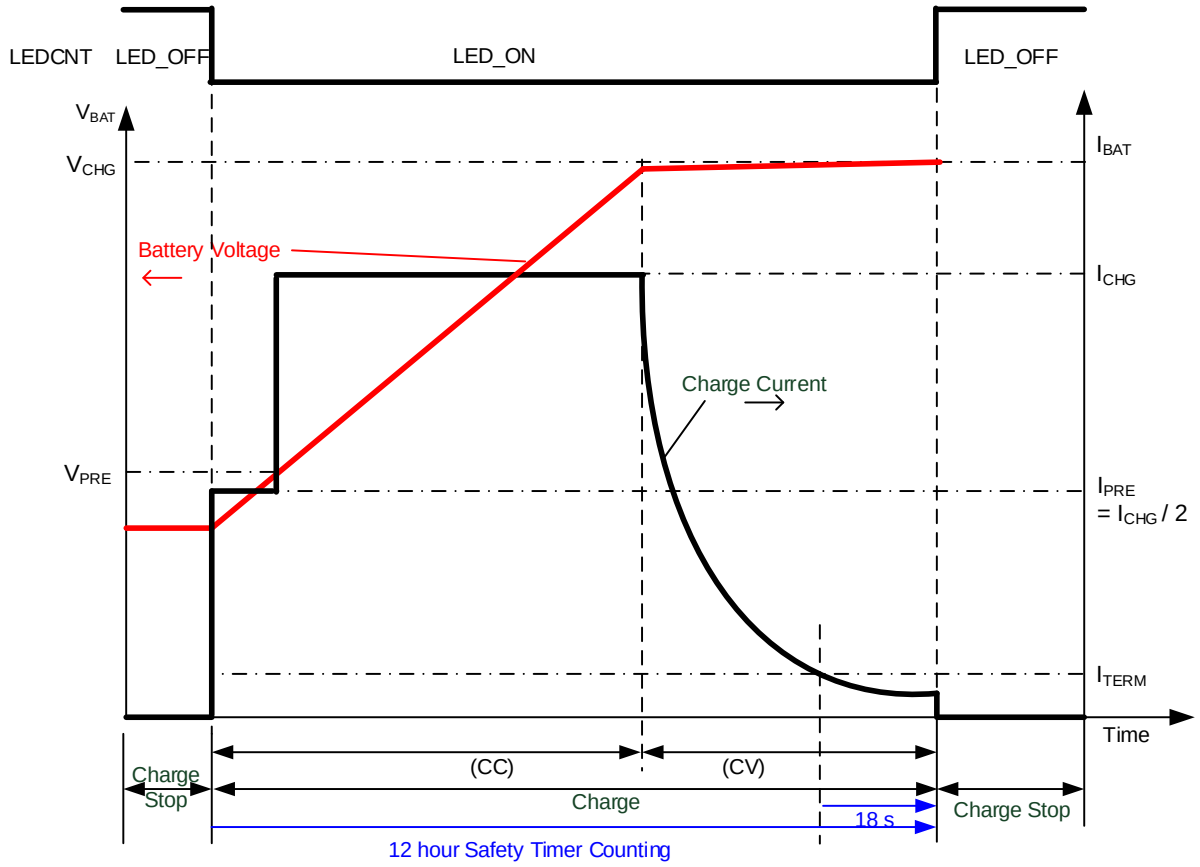
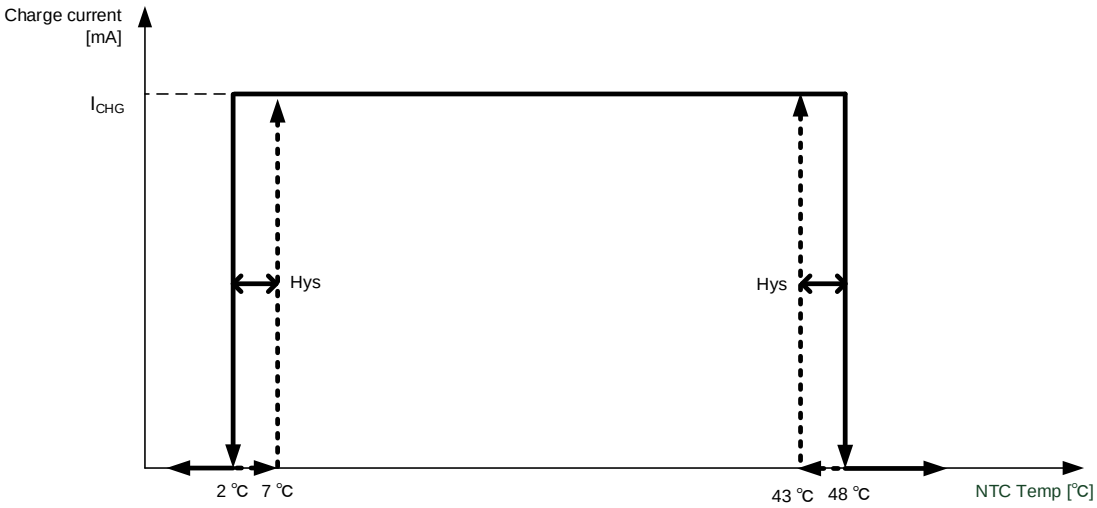


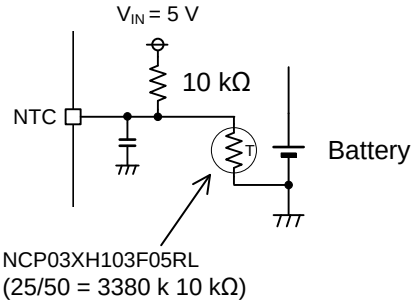
Figure 9. VFBG Leak Current vs VFBG Voltage

Battery Output Control



Charge Current vs Battery Temperature





NCP03XH103F05RL
(25/50 = 3380 k 10 kΩ)

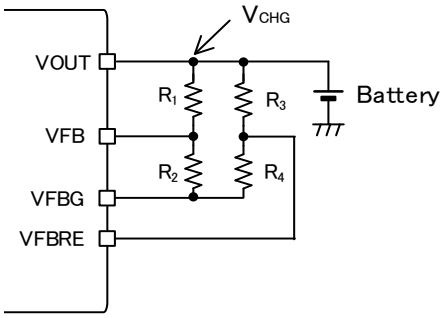
NTC pin voltage

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

Connect the NTC pin to GND to disenable thermal control.

Peripheral Components Setting

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



The battery charge voltage is determined as follows :

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

The battery re-charge voltage is determined as follows :

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

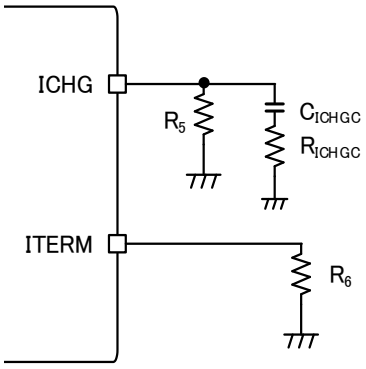
About total feedback resistance, follow the Recommended Operating Conditions.

Resister reference value

Resistor	V_{CHG} = 1.8 V V_{RECHG} = Disenable	V_{CHG} = 4.2 V V_{RECHG} = 3.9 V
	Resister value [Ω]	
R_1	200 k	600 k
R_2	100 k	100 k
R_3	-*	1.1 M
R_4	-*	200 k

*VFBRE pin connect to GND

2. Charge current (I_{CHG}), Termination current (I_{TERM}) setting

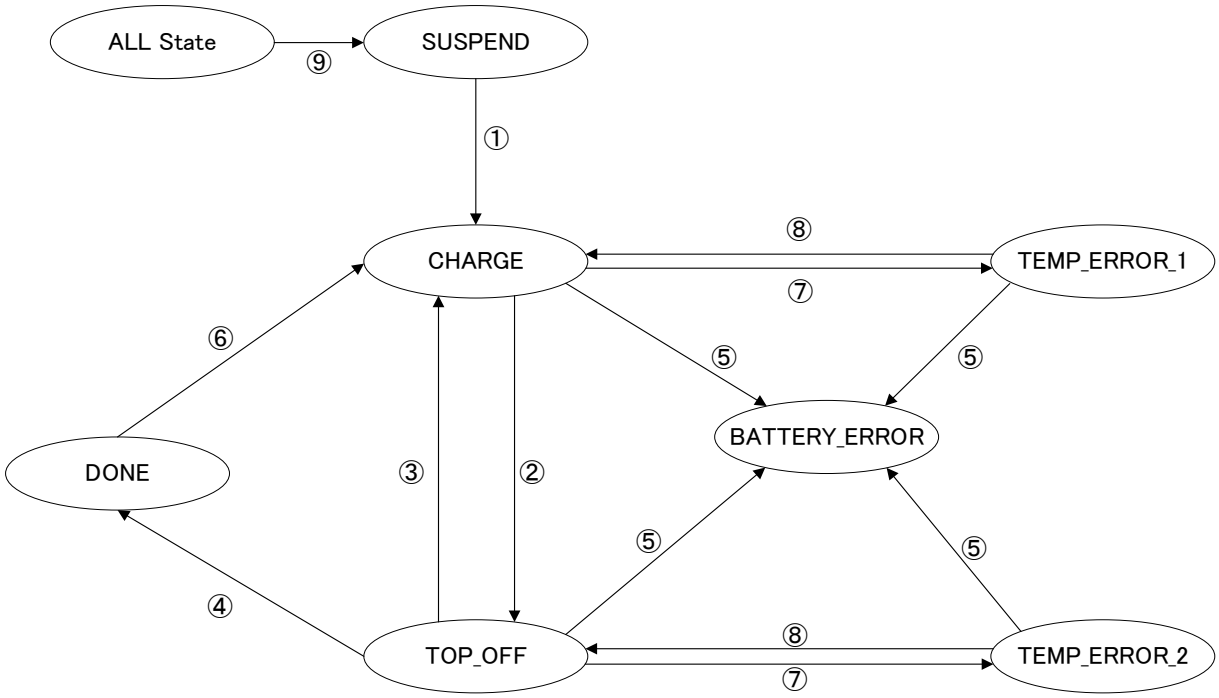


$$\boldsymbol{I_{CHG} = 500000/R_5} \quad [\mathrm{mA}]$$
$$\boldsymbol{I_{TERM} = 50000/R_6} \quad [\mathrm{mA}]$$

Please connect C_{ICHGC}, R_{ICHGC} for feedback stability. This value is the set value for PSB401010H. Adjustment may be necessary depending on the batteries used.

C_{ICHGC} = 0.01 [μF]
R_{ICHGC} = 15 [kΩ]

Charging State Control



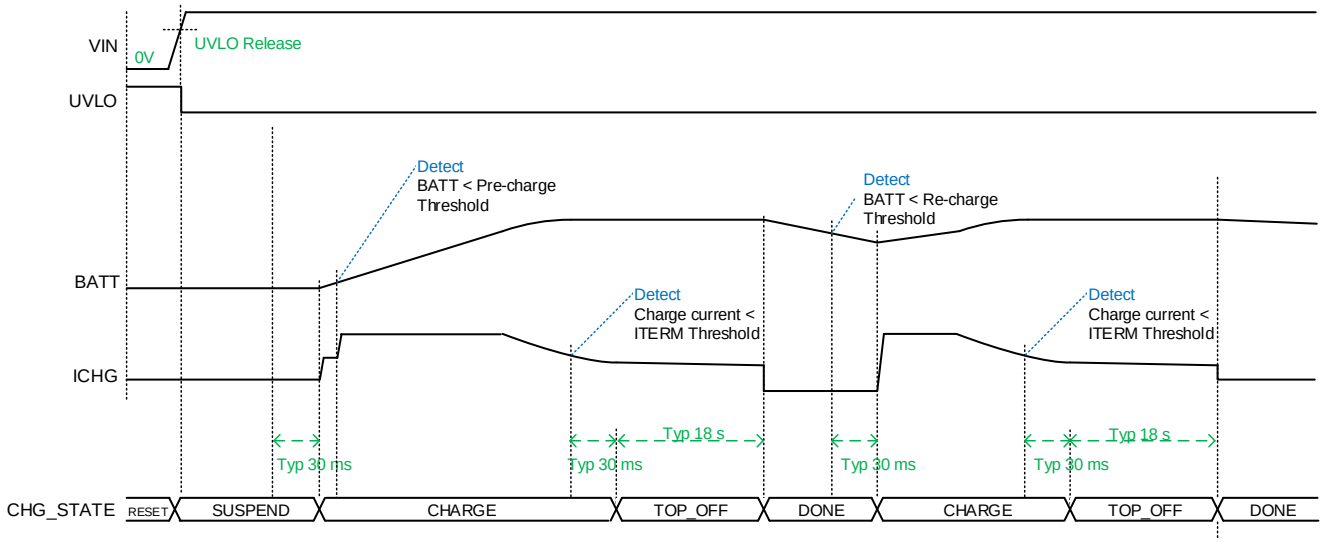
Normal operation

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 30 ms
②	CHARGE -> TOP_OFF	Charge current < ITERM Continue to satisfy the condition for 30 ms
③	TOP_OFF -> CHARGE	Charge current > ITERM Continue to satisfy the condition for 30 ms
④	TOP_OFF -> DONE	Continue to satisfy the condition for 18 s
⑤	CHARGE or TOP_OFF or TEMP_ERROR_1 or TEMP_ERROR_2 -> BATTERY_ERROR	BATT OVP detect or 12 hour counter ended counting
⑥	DONE -> CHARGE	BATT < Re-charge voltage Continue to satisfy the condition for 30 ms
⑦	CHARGE -> TEMP_ERROR_1 or TOP_OFF -> TEMP_ERROR_2	Temp Error detect Continue to satisfy the condition for 30 ms
⑧	TEMP_ERROR_1 -> CHARGE or TEMP_ERROR_2 -> TOP_OFF	Temp Error not detect Continue to satisfy the condition for 30 ms
⑨	ALL State -> SUSPEND	UVLO, TSD detect or VIN < BATT + 0.3 V

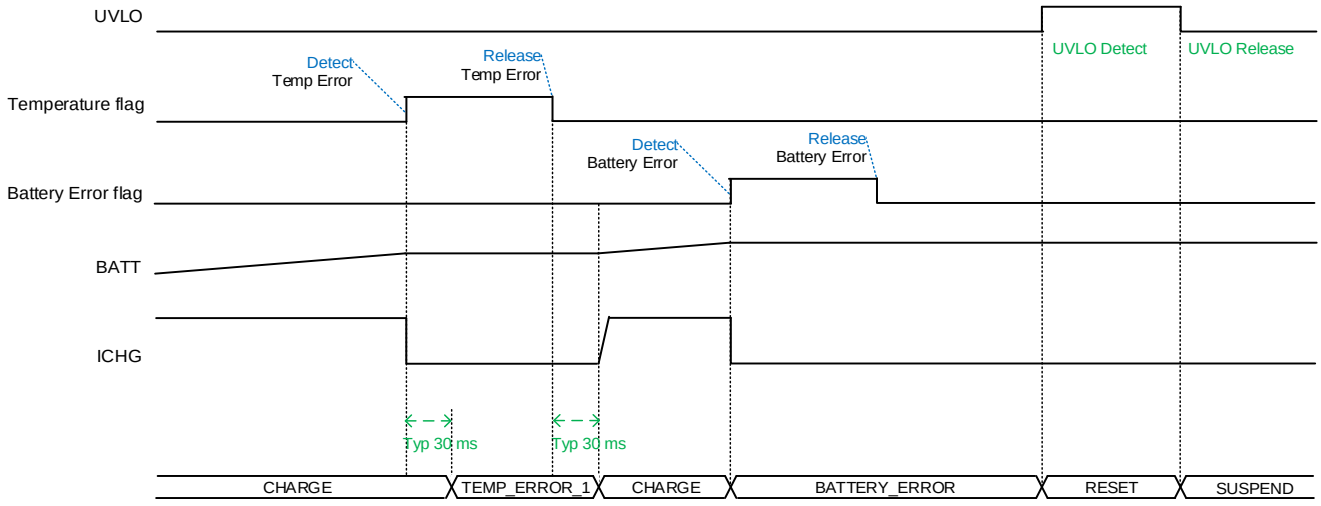
State	Battery charge	12 hour counter	LEDCNT
SUSPEND	Stop	Stop and reset	OFF
CHARGE	Charge	Count	ON
TOPOFF	Charge	Count	ON
DONE	Stop	Stop and reset	OFF
BATTERY_ERROR	Stop	Stop and reset	OFF
TEMP_ERROR_1	Stop	Count	OFF
TEMP_ERROR_2	Stop	Count	OFF

Charging Timing Chart

Normal operation

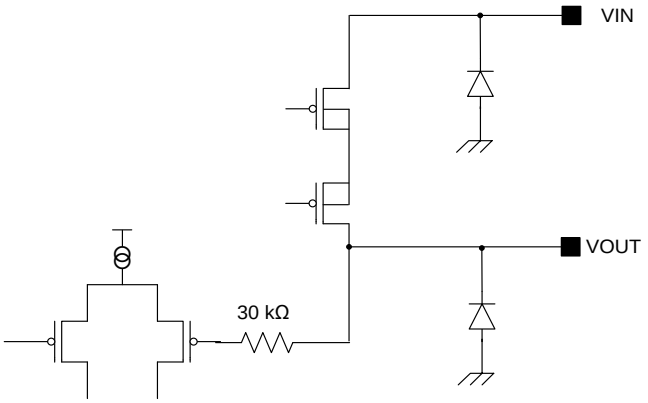


Error operation

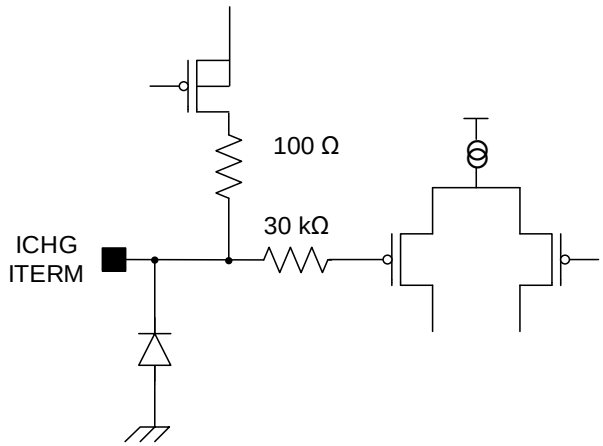


I/O Equivalence Circuit

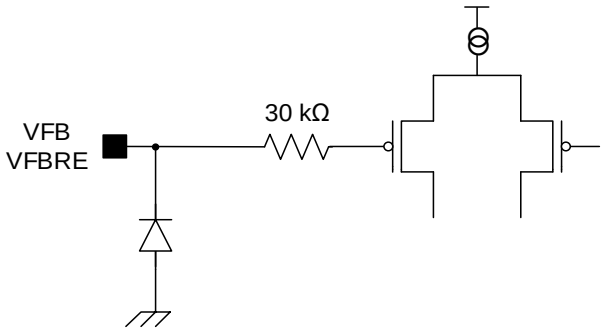
VIN, VOUT



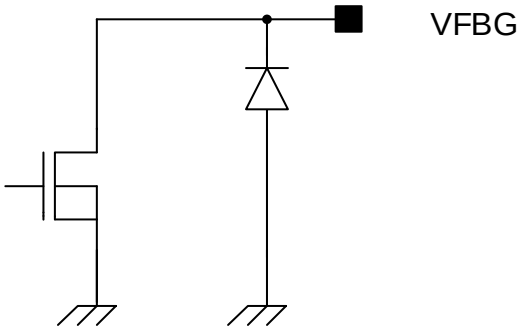
ICHG, ITERM



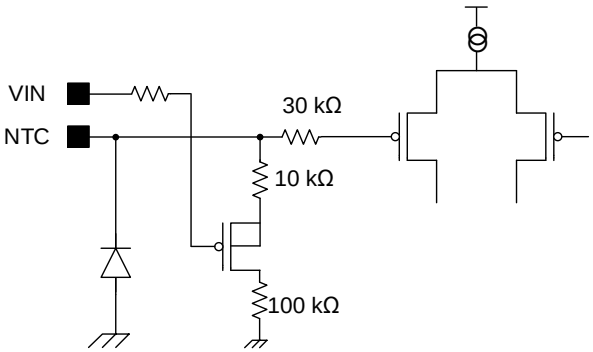
VFB, VFBRE



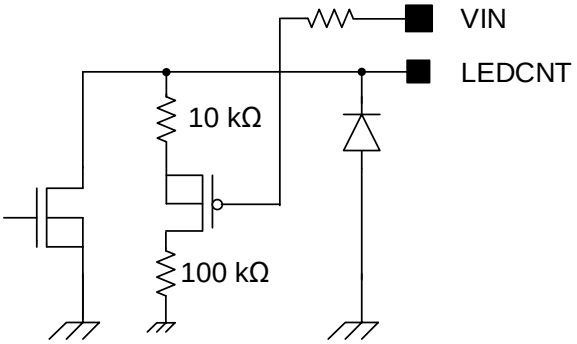
VFBG



NTC



LEDCNT



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.

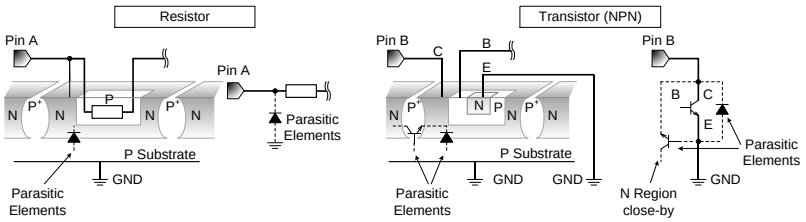


Figure 10. Example of Monolithic IC Structure

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 (Tj) will rise which will activate the TSD circuit that will turn OFF power output pins. When the Tj 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.

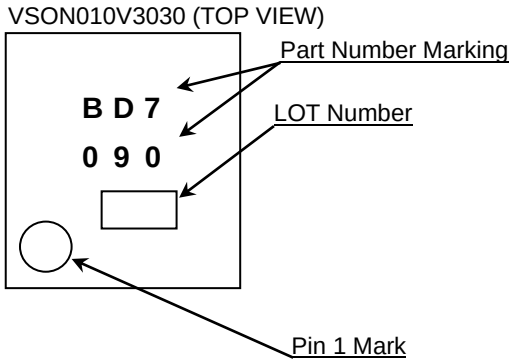
Ordering Information

B	D	7	0	9	0	N	U	V	-	E 2

Package
NUV: VSON010V3030

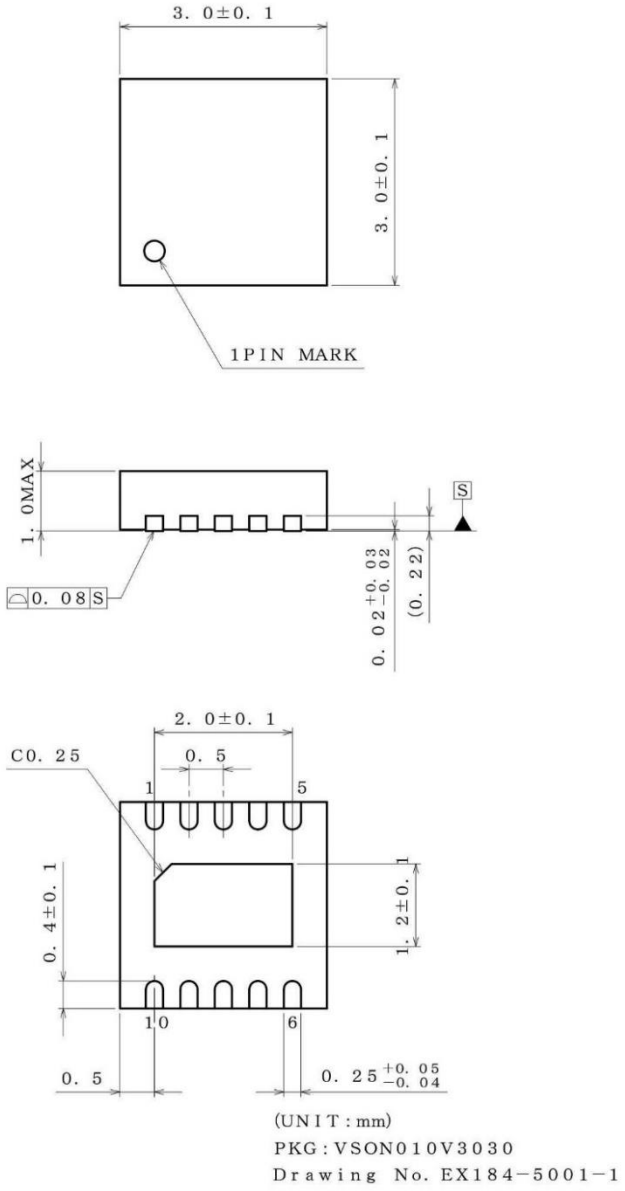
Packaging and forming specification
E2: Embossed tape and reel

Marking Diagram



Physical Dimension and Packing Information

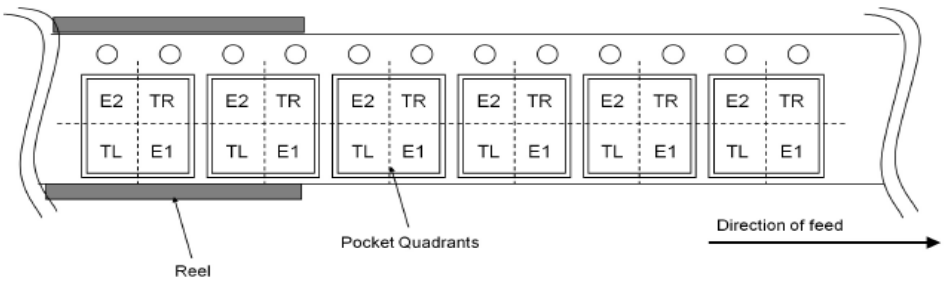
Package Name	VSON010V3030



(UNIT : mm)
PKG : VSON010V3030
Drawing No. EX184−5001−1

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



Revision History

Date	Revision	Changes
13 Jan.2023	001	New Release
26 Feb.2024	002	P.4 Delete the following items. ICHG Compensation Capacitor ICHG Compensation Resister P.5 Termination Current Accuracy5 unit is changed to “μA”. P.10 Changed C_{ICHGC}, R_{ICHGC} setting value and comments.
04 Dec.2024	003	P.1 Delete Custom mark. P.11 Delete the sentence “Charge current > ITERM” in the comment in case of TOP_OFF -> DONE. P.13 Change NTC and LEDCNT I/O Equivalence Circuit Modified

Notice

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1. 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
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. 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:
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   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

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   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] 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
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. 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.

7. 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.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. 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

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. 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 Cl_2, H_2S, NH_3, SO_2, and NO_2
   [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.

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