chanhvinh.com

Datasheet

40 V 600 mA 1ch Constant Current Driver for Automotive LED Lamps

BD18326NUF-M

General Description

The BD18326NUF-M is a constant current driver IC for driving automotive LED lamp, that can withstand up to 40 V. Small-size package is suitable for use in socket LED driver applications.
The BD18326NUF-M offers high reliability with built-in functions for the thermal de-rating function, the LED open detection, the output short circuit protection, the SET pin short circuit protection, the over-voltage mute function, the current bypass function at reduced-voltage, the output for fault flag function and the input for output current OFF control signal.

Key Specifications

- Input Voltage Range: 5.5 V to 20 V
- Output Current Accuracy: ±5 %
- Maximum Output Current: 400 mA (DC)
  600 mA (ON Duty: 50 %)
- Operating Temperature Tj: -40 °C to +150 °C

Package	W (Typ) x D (Typ) x H (Max)
VSON10FV3030	3.0 mm x 3.0 mm x 1.0 mm



Features

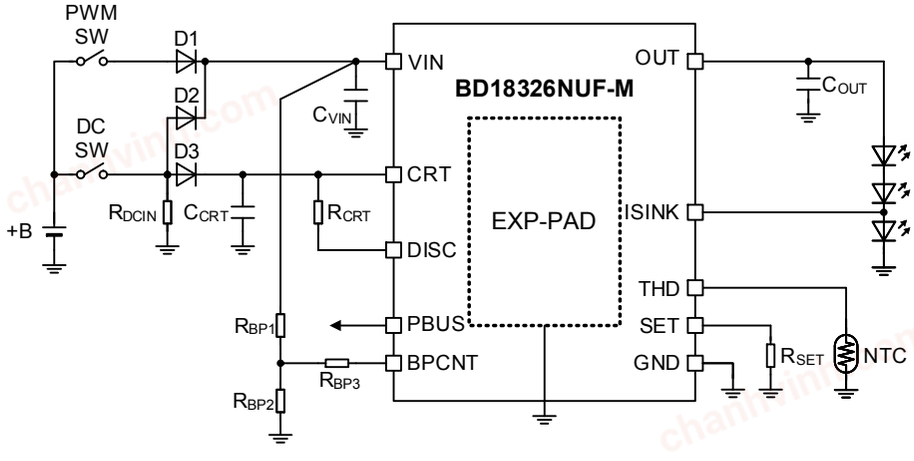
- AEC-Q100 Qualified(Note 1)
- Functional Safety Supportive Automotive Products
- CR Timer for PWM Dimming
- Thermal De-rating Function (THD)
- LED Open Detection
- Output Short Circuit Protection (OUT SCP)
- SET Pin Short Circuit Protection (SET SCP)
- Over Voltage Mute Function (OVM)
- Current Bypass Function at Reduced-Voltage
- Disable LED Open Detection Function at Reduced-Voltage (OPM)
- Output for Fault Flag / Input for Output Current OFF Control Signal (PBUS)

(Note 1) Grade1

Applications

- Automotive LED Exterior Lamps
  (Rear Lamp, Turn Lamp, DRL/Position Lamp, Fog Lamp)
- Automotive Interior Lamps
  (Air Conditioner Lamp, Interior Light, Cluster Light etc.)

Typical Application Circuit

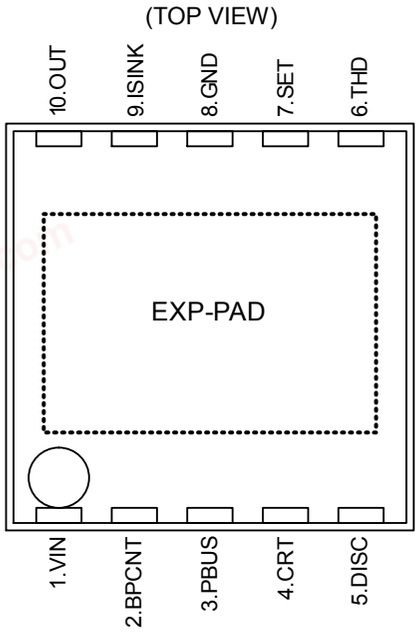


○Product structure: Silicon integrated circuit ○This product has no designed protection against radioactive rays.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Pin Configuration



Pin Descriptions

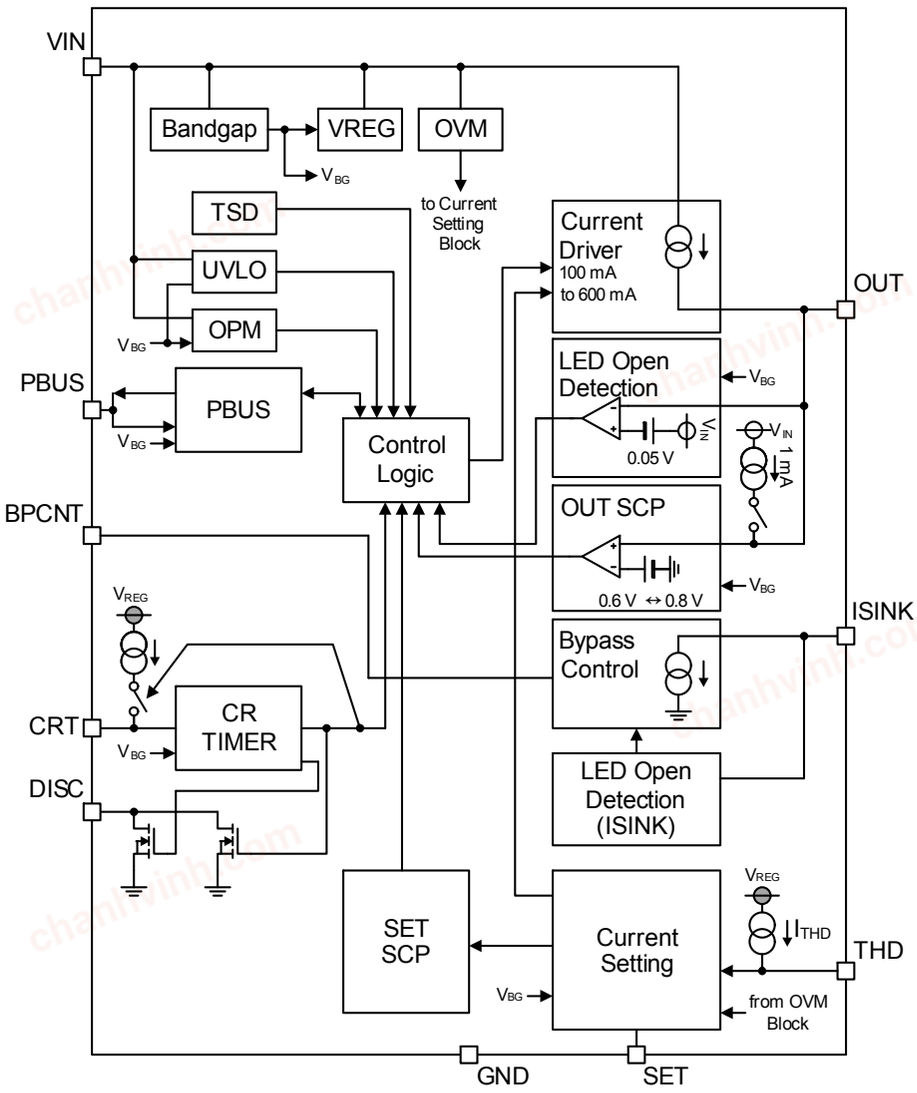
Pin No.	Pin Name	Function
1	VIN	Power supply input
2	BPCNT	Current bypass function at reduced-voltage setting*(Note 1)*
3	PBUS	Output for fault flag / Input for output current OFF control signal*(Note 2)*
4	CRT	CR timer setting 1*(Note 3)*
5	DISC	CR timer setting 2*(Note 3)*
6	THD	Thermal de-rating setting*(Note 4)*
7	SET	Output current setting*(Note 1)*
8	GND	GND
9	ISINK	Current sink pin for current bypass function at reduced-voltage
10	OUT	Current output
-	EXP-PAD	Heat radiation pad. The EXP-PAD is connected to GND.

(Note 1) Do not connect external capacitor.
(Note 2) Open the PBUS pin when not in use output for fault flag / input for output current OFF control signal.
(Note 3) Short the CRT pin to the VIN pin and open the DISC pin or connect it to GND when in use at DC mode only.
(Note 4) Open the THD pin when not in use thermal de-rating function.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Block Diagram



© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

1. Table of Operations

The BD18326NUF-M has a built-in CR timer for PWM dimming and it is possible to change between PWM dimming mode and DC mode. Once the VIN pin voltage V_{IN} is 17.4 V (Typ) or more, the output current I_{OUT} is limited to suppress the heat generation from the IC.
It is possible to detect the LED open state or short circuit state by monitoring the OUT pin voltage. In case of the LED abnormality detection, it can notify the abnormality to the outside by changing the PBUS pin voltage to low.
The output current is also turned OFF when the Low signal is input to the PBUS pin.
In addition, under voltage lock out (UVLO) and thermal shutdown circuit (TSD) are built-in, which further increase system reliability.
The correspondence table is given below. For details, refer to functional description of each block.

Operation Mode	CRT Pin	Detecting Condition		Output Current (I_{OUT})	PBUS Pin
		[Detect]	[Release]		
DC	V_{CRT} ≥ 2.0 V (Typ)	-	-	100 mA to 400 mA	-
PWM Dimming	Refer to Description of Blocks 4	-	-	Refer to Description of Blocks 4	-
Thermal De-rating (THD)	-	V_{THD} ≤ 0.8 V (Typ)	V_{THD} > 0.8 V (Typ)	Refer to Description of Blocks 9	-
Over Voltage Mute (OVM)	-	V_{IN} ≥ 17.4 V (Typ)	V_{IN} < 17.4 V (Typ)	Refer to Description of Blocks 10	-
LED Open Detection (OUT Pin)	-	V_{OUT} ≥ V_{IN} - 0.050 V (Typ) and VIN ≥ 11.0 V (Typ)	V_{OUT} < V_{IN} - 0.050 V (Typ) or VIN < 11.0 V (Typ)	OFF	Low
LED Open Detection (ISINK Pin)	-	V_{ISINK} ≥ 5.80 V (Typ)	V_{ISINK} < 4.60 V (Typ)	-	-
Output Short Circuit Protection (OUT SCP)	-	V_{OUT} ≤ 0.6 V (Typ)	V_{OUT} ≥ 0.8 V (Typ)	OFF	Low
SET Pin Short Circuit Protection (SET SCP)		I_{SET} ≤ 0.5 mA (Typ)	I_{SET} > 0.5 mA (Typ)	OFF	Low
Input for Output Current OFF Control Signal (PBUS)	-	V_{PBUS} ≤ 0.6 V (Typ)	V_{PBUS} ≥ 2.4 V (Typ)	OFF	V_{PBUS} ≤ 0.6 V (Typ) input
Under Voltage Lock Out (UVLO)	-	V_{IN} ≤ 4.50 V (Typ)	V_{IN} ≥ 6.05 V (Typ)	OFF	High
Thermal Shutdown Circuit (TSD)	-	Tj ≥ 175 °C (Typ)	Tj ≤ 150 °C (Typ)	OFF	Low

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

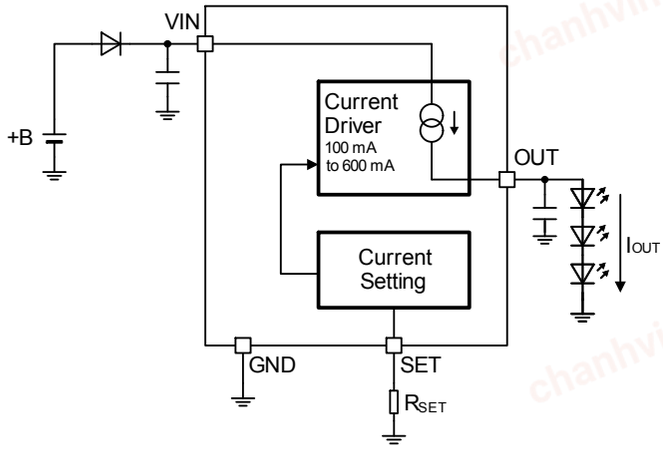
2. Output Current I_{OUT} Setting

The output current I_{OUT} can be set by the value of the output current setting resistor R_{SET}.

$$I_{OUT} = \frac{K_{SET}}{R_{SET}} \quad [\text{mA}]$$

where:

K_{SET} is the output current setting coefficient, 2400 (Typ).
R_{SET} is the output current setting resistor. [kΩ]



Output Current Setting

2.1 Relationship between VIN Pin Voltage V_{IN} and Output Current I_{OUT}

Set the VIN pin voltage V_{IN} and output current I_{OUT} to satisfy the following relationship.

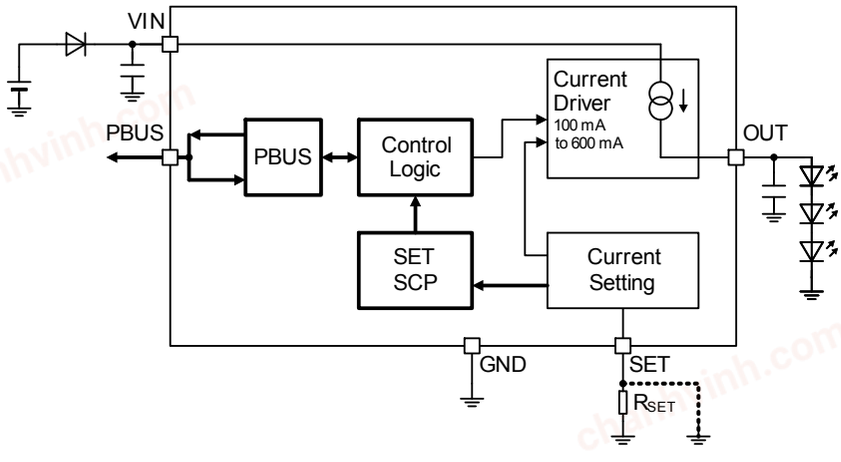
$$V_{IN} \geq V_{f_LED} \times N + V_{DR} \quad [\text{V}]$$

Where:

V_{IN} is the VIN pin voltage.
V_{f_LED} is the forward voltage of LED.
N is the number of LED.
V_{DR} is the drop voltage between the VIN pin and the OUT pin.

3. SET Pin Short Circuit Protection (SET SCP)

Once the current which flows through the SET pin is more than or equal to the SET pin short circuit protection threshold current I_{SET_SH} (0.50 mA (Typ)), the output current I_{OUT} is turned off to prevent thermal damage of the IC, and it can notify the abnormality to the outside by changing the PBUS pin output to low.



SET Pin Short Circuit Protection

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

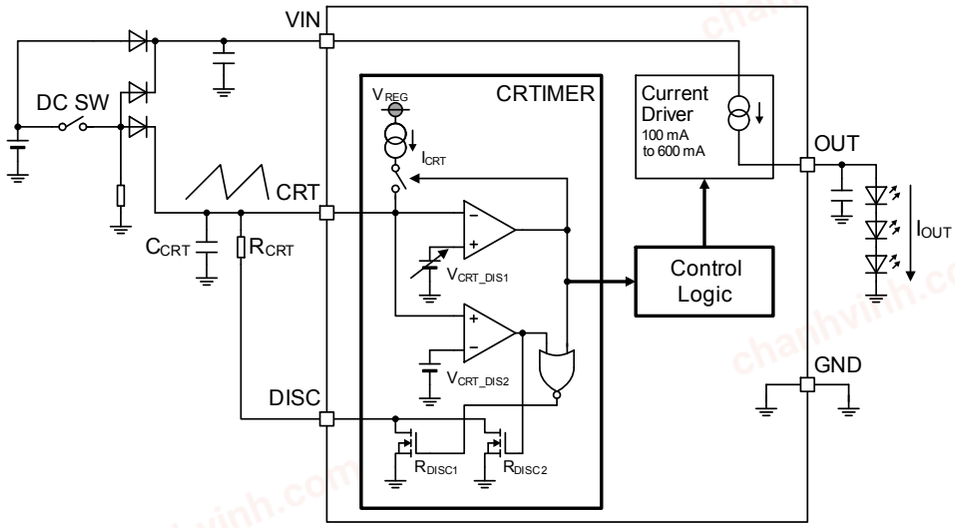
(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

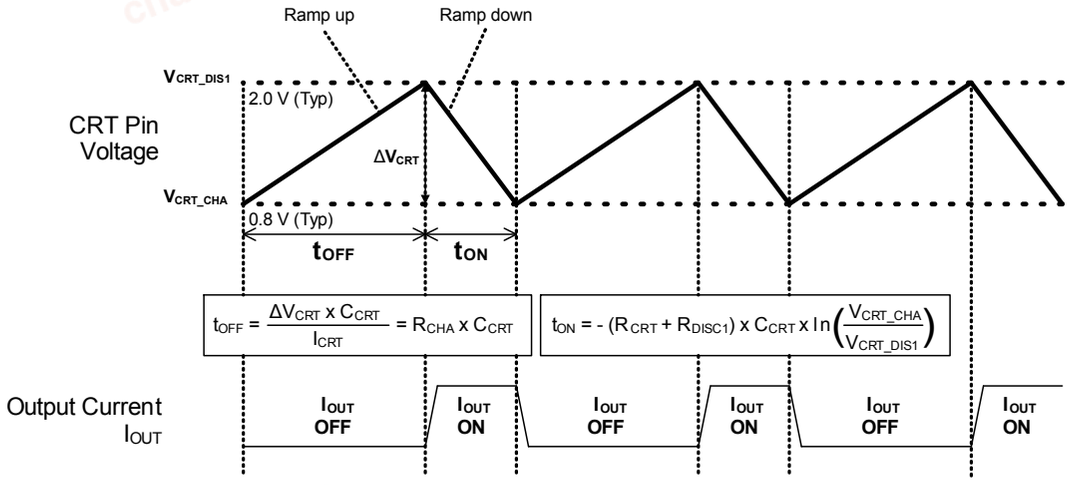
4. PWM Dimming Operation

PWM dimming is performed by connecting external parts to the CRT pin and the DISC pin as shown below. PWM dimming frequency and ON duty width can be set by the values of the external resistor R_{CRT} and the external capacitor C_{CRT}. When use the DC mode only, connect the CRT pin to the VIN pin and open the DISC pin.

A triangular waveform is generated when the DC SW is open as shown below. Output current I_{OUT} is turned OFF while the CRT pin voltage ramps up and I_{OUT} is turned ON while the CRT pin voltage is ramp down.

Once the CRT pin voltage is V_{CRT_DIS1} (2.0 V (Typ)) or more, it turns to DC mode. And once the CRT pin voltage is more than V_{CRT_DIS2} (2.4 V (Typ)), the DISC pin ON resistance changes from R_{DISC1} (50 Ω (Typ)) to R_{DISC2} (5 kΩ (Typ)) and the power consumption of the IC is reduced by reducing the inflow current of the DISC pin.





PWM Dimming Operation

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

4. PWM Dimming Operation – continued

4.1 CRT Pin Voltage Ramp Up Time t_{OFF} and Ramp Down Time t_{ON}

CRT pin voltage ramp up time t_{OFF} and ramp down time t_{ON} can be set by the following equations. Make sure that t_{ON} is set PWM minimum pulse width t_{MIN} to 50 µs or more.

$$t_{OFF} = \frac{\Delta V_{CRT} \times C_{CRT}}{I_{CRT}} = R_{CHA} \times C_{CRT} \quad [ms]$$

$$t_{ON} = -(R_{CRT} + R_{DISC1}) \times C_{CRT} \times In\left(\frac{V_{CRT_CHA}}{V_{CRT_DIS1}}\right) \quad [ms]$$

where:

V_{CRT_CHA}	is the CRT pin charge voltage,	0.8 V (Typ).
V_{CRT_DIS1}	is the CRT pin discharge voltage 1,	2.0 V (Typ).
I_{CRT}	is the CRT pin charge current,	40 µA (Typ).
C_{CRT}	is the capacitor for setting CR timer,	[µF].
R_{CRT}	is the resistor for setting CR timer,	[kΩ].
R_{CHA}	is the CRT pin charge resistor,	30 kΩ (Typ).
R_{DISC1}	is the DISC pin ON resistor 1,	25 Ω (Typ).

4.2 PWM Dimming Frequency f_{PWM}

PWM frequency is defined by t_{ON} and t_{OFF}.

$$f_{PWM} = \frac{1}{t_{ON} + t_{OFF}} \quad [Hz]$$

4.3 ON Duty (D_{ON})

PWM ON duty is defined by t_{ON} and t_{OFF}.

$$D_{ON} = \frac{t_{ON}}{t_{ON} + t_{OFF}} \times 100 \quad [\%]$$

(Example) In case of R_{CRT} = 3.6 kΩ (Typ), C_{CRT} = 0.1 µF (Typ)

$$t_{OFF} = R_{CHA} \times C_{CRT} = 30 \times 0.1 = 3.0 \quad [ms]$$

$$t_{ON} = -\left(R_{CRT} + \frac{R_{DISC1}}{1000}\right) \times C_{CRT} \times In\left(\frac{V_{CRT_CHA}}{V_{CRT_DIS1}}\right)$$

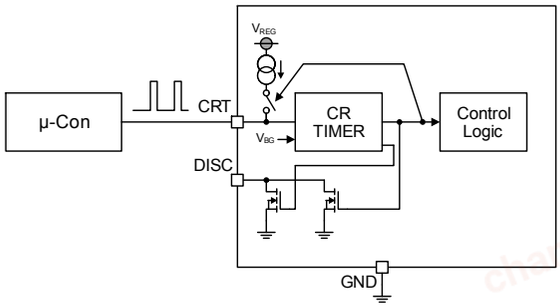
$$= -\left(3.6 + \frac{25}{1000}\right) \times 0.1 \times In\left(\frac{0.8}{2.0}\right) = 0.332 \quad [ms]$$

$$f_{PWM} = \frac{1}{t_{ON} + t_{OFF}} = \frac{1}{3.0 + 0.332} = 300 \quad [Hz]$$

$$D_{ON} = \frac{t_{ON}}{t_{ON} + t_{OFF}} \times 100 = \frac{0.332}{3.0 + 0.332} \times 100 = 10.0 \quad [\%]$$

4.4 PWM Dimming Operation Using External Signal

If input the external pulse signal to the CRT pin as shown below, make sure that input pulse signal high voltage ≥ 2.2 V and pulse signal low voltage ≤ 0.72 V. Also, open the DISC pin.



In Case External Pulse Signal Input to the CRT Pin

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

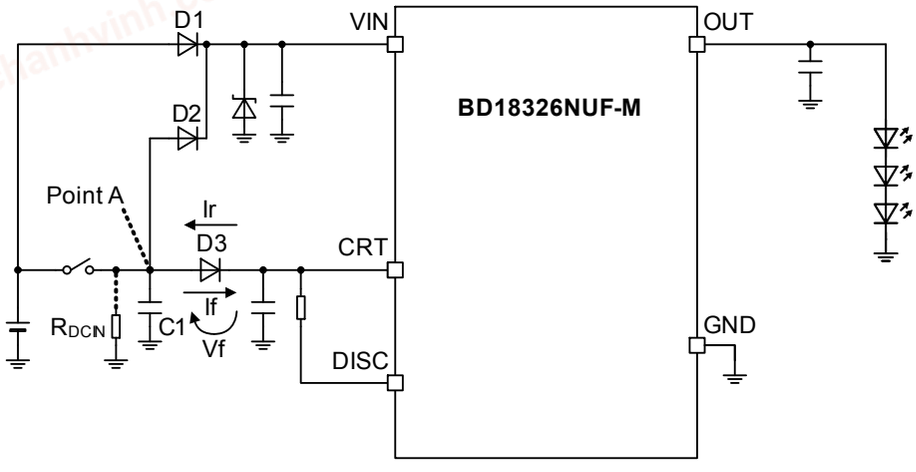
4. PWM Dimming Operation – continued

4.5 About the Deviation of the CRT Pin Voltage Ramp Up/Down Time Due to Reverse Current Characteristics of Reverse Connection Protection Diodes

If this IC is used to drive LED as shown below, there is a possibility of the deviation of the CRT pin voltage ramp up/down time from the settings depends on reverse current characteristics of connected reverse current protection diodes (D2, D3).
Consider a diode which is recommended by ROHM or a diode which is 1 μA (Max) or less of reverse current characteristics because reverse current Ir of a diode especially increases at high temperature.
Since reverse current flows even with the recommended diodes, connect a resistor of R_{DCIN} of 10 kΩ or less between Point A and GND so that the voltage at point A does not rise.

●Mechanism of the deviation of the CRT pin voltage ramp up/down time from the settings.

A) During the PWM dimming mode, Point A on the below figure is in the high impedance (Hi-Z) state.
↓
B) Reverse current Ir of D2 and D3 flow to Point A.
(Power supply voltage is being input into the cathode of D2, so mainly reverse current of D2 flows to C1.)
→Reverse current Ir of D3 is added to the CRT pin charge current and discharge current, so the CRT pin voltage ramp up/down time deviates from the settings.
↓
C) C1 gets charged, voltage at Point A rises.
↓
D) Point A voltage is the CRT pin voltage of each IC or more.
↓
E) Forward voltage Vf is generated to the diode D3.
↓
F) D3 flows forward current If.
→Forward current If of D3 is added to the CRT pin charge current and discharge current, so the CRT pin voltage ramp up/down time deviates from the settings.
↓
Repetition of B) to F).



Mechanism of the Deviation of the CRT Pin Voltage Ramp Up/Down Time due to Reverse Connection Protection Diodes

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

5. LED Open Detection

• In case any of Point A to Point C is in the open state
Once the OUT pin voltage V_{OUT} becomes more than or equal to LED open detection voltage V_{OPD} (V_{IN} - 0.050 V (Typ)), it can notify the abnormality to the outside by changing the PBUS pin output to low.

• In case any of Point D or Point E is in the open state
Once the ISINK pin voltage becomes 5.80 V (Typ) or more, the ISINK pin current I_{ISINK} is turned OFF*(Note 1)*. After that, once the OUT pin voltage V_{OUT} becomes more than or equal to LED open detection voltage V_{OPD} (V_{IN} - 0.050 V (Typ)), it can notify the abnormality to the outside by changing the PBUS pin output to low.

(Note 1) While output current bypass function at reduced-voltage (Refer to Description of Function 13) is activated, the LED is lighted because the output current flows to the two upper side LEDs.

6. Disable LED Open Detection Function at Reduced-Voltage (OPM)

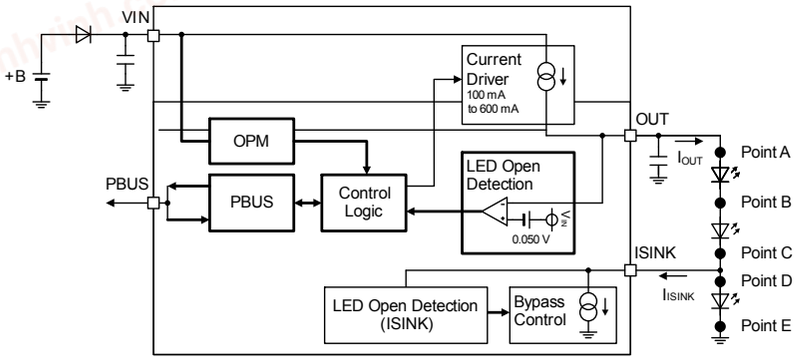
The disable LED open detection function serves to prevent LED open erroneous detection at the reduced-voltage during the ramp up/down of the VIN pin voltage. Even if the LED is in the open state, LED open is not detected until the VIN pin voltage becomes more than disable LED open detection voltage at reduced-voltage V_{IN_OPM} (11.0 V (Typ)). Set V_{IN_OPM} to satisfy the following formula.

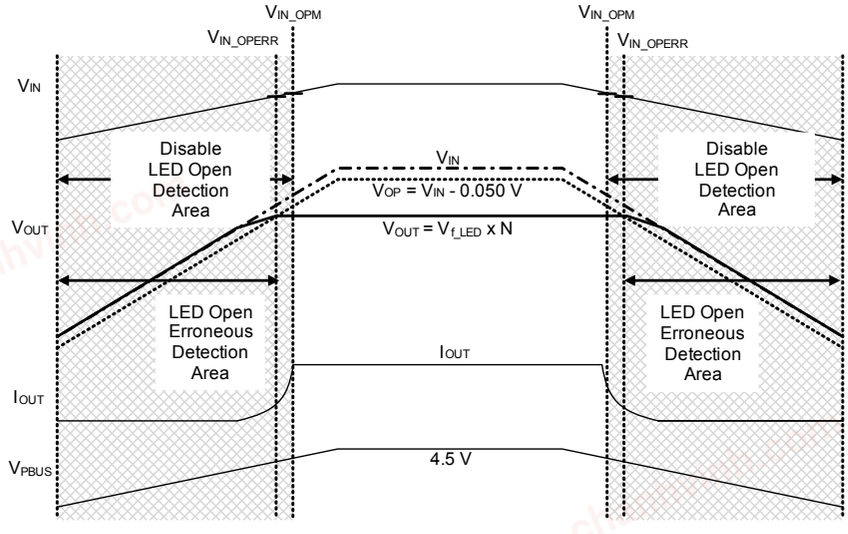
$$V_{IN_OPM} > V_{IN_OPERR}$$

$$V_{IN_OPERR} = V_{f_LED_OPD} \times N + (V_{IN} - V_{OPD}) \quad [V]$$

where:

V_{IN_OPM} is the VIN pin disable LED open detection voltage at reduced-voltage.
V_{IN_OPERR} is the VIN pin LED open erroneous detection voltage at reduced-voltage.
$V_{f_LED_OPD}$ is the LED Vf at LED open release.
N is the number of LED.
V_{OPD} is the LED open detection voltage.





VIN Pin Disable LED Open Detection Voltage at Reduced-Voltage
and LED Open Erroneous Detection Voltage at Reduced-Voltage

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

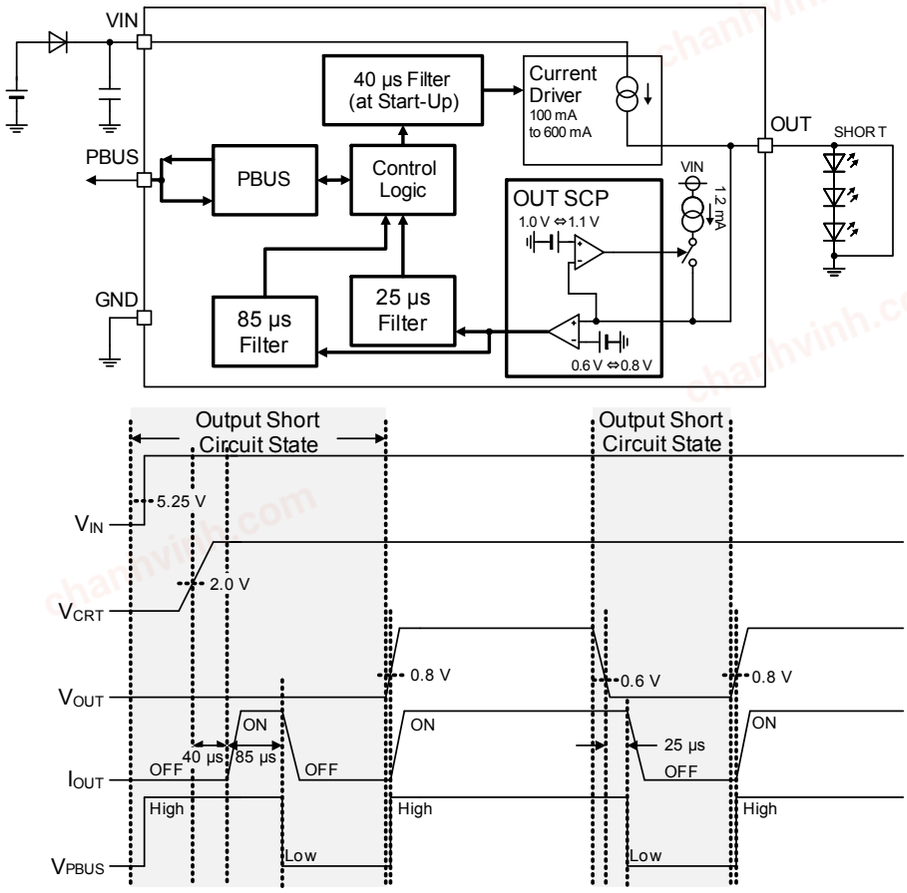
(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

7. Output Short Circuit Protection (OUT SCP)

Once the OUT pin voltage is less than or equal to the OUT pin short circuit protection voltage V_{SCP} (0.6 V (Typ)), then the short circuit protection is activated when SCP delay time t_{SCP1} (25 µs (Typ)) passes. At that time output current I_{OUT} is turned off to prevent the thermal damage of the IC and it can notify the abnormality to the outside by changing the PBUS pin output to low.

In order to avoid the malfunction when the power is turned on, the short circuit protection is not activated until the CRT pin voltage is more than 2.0 V (Typ) after UVLO is released.

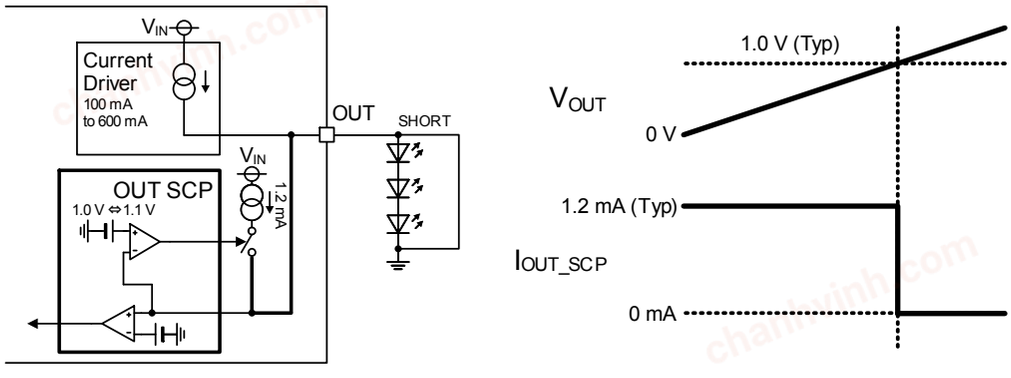
In addition, in case it is in the output short circuit state (V_{OUT} < 0.6 V (Typ)) since the power is turned on, the output short circuit protection is activated when V_{CRT} > 2.0 V (Typ) condition is reached and t_{IOUT_ON} (40 µs (Typ)) and t_{SCP2} (85 µs (Typ)) pass, after UVLO is released.



Output Short Circuit Protection (OUT SCP)

7.1 Current at OUT Pin Short Circuit

The OUT pin sources the OUT pin short circuit current I_{OUT_SCP} (1.2 mA (Typ)) once its voltage is less than 1.0 V (Typ) in order to prevent the malfunction of the short circuit protection.



Current at OUT Pin Short Circuit

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

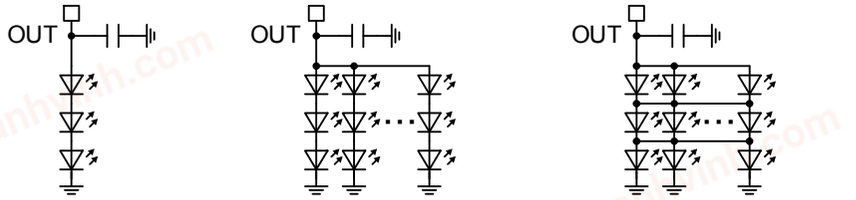
Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

8. Caution of Using LED Open Detection and Output Short Circuit Protection

8.1 Connection Method of LEDs to the OUT Pin

Protection functions could be enabled or disabled based on how LEDs are connected to the OUT pin.



Connection Method of LEDs

Connection Method	Output Short Circuit Protection	LED Open Detection
1 string in series	Detectable	Detectable
2 or more strings in parallel	Detectable	Not detectable *(Note 1)*
2 or more strings in parallel (Matrix connection)	Detectable	Not detectable *(Note 2)*

(Note 1) Detectable only when 1 or more LEDs are open in all strings.
(Note 2) Detectable only when all LEDs from any string are open.

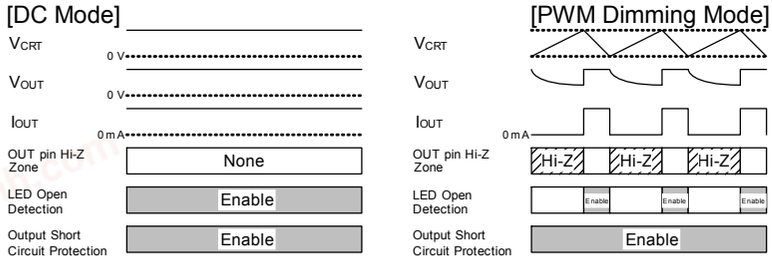
8.2 The Enable Zone of LED Open Detection and Output Short Circuit Protection, and Hi-Z Zone of the OUT Pin

The enable zone of LED open detection and output short circuit protection is different between DC mode and PWM dimming mode.

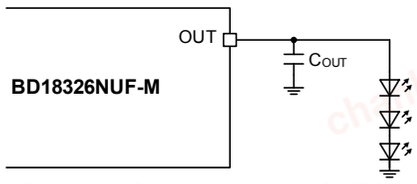
DC mode : LED open detection and output short circuit protection are enable in all zone.
PWM dimming mode : LED open detection is enable in only CRT ramp down zone.
Output short circuit protection is enable in all zone.

There is a zone which the OUT pin becomes Hi-Z at PWM dimming mode. During this time noise *(Note 3)* may affect the decrease of the OUT pin voltage and cause malfunction of output short circuit protection. To prevent this, consider measurements such as connecting a capacitor C_{OUT} *(Note4)* between the OUT pin and GND nearby IC. (Recommended value by ROHM: C_{OUT} = 0.1 µF GCM188L81H104KA42 murata)

(Note 3) Conducted noise, Radiated noise, Crosstalk of wiring and connecter etc.
(Note 4) In case connecting a capacitor with 0.1 µF or more, do evaluation of a delay time from the power-on of V_{IN} until output current I_{OUT} flows and pulse width of output current I_{OUT} at PWM dimming mode. (Refer to example of evaluation: Description of Blocks 8.3)



The Enable Zone of LED Open Detection, Output Short Circuit Protection, and Hi-Z Zone of the OUT Pin



Capacitor Connected to the OUT Pin

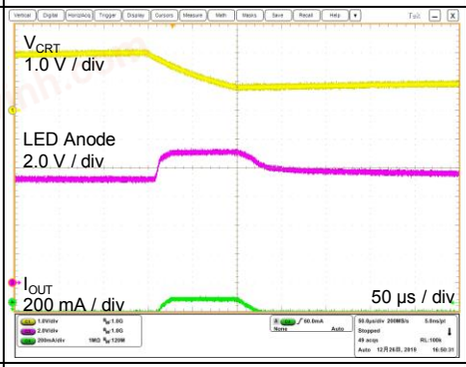
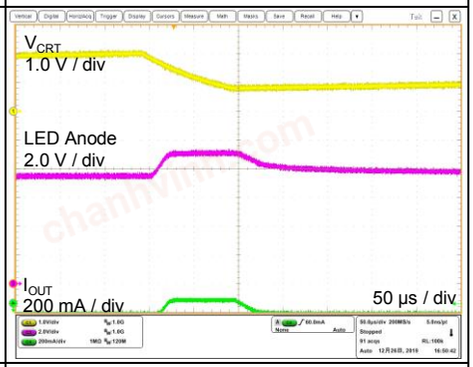
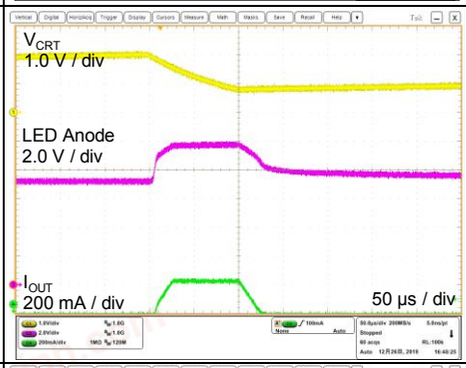
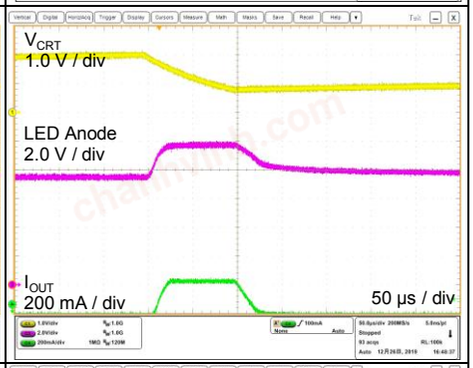
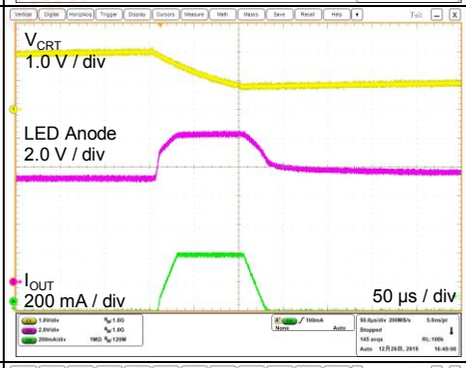
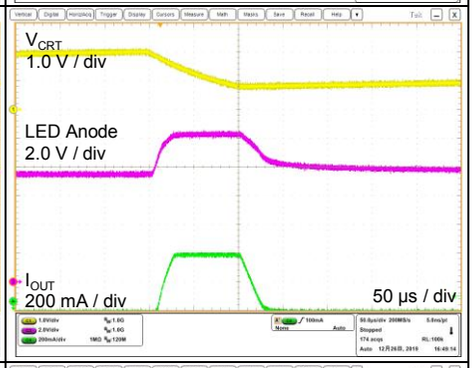
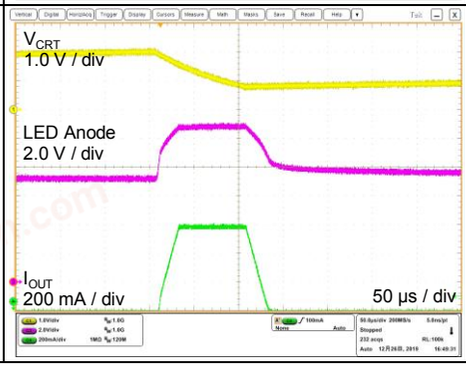
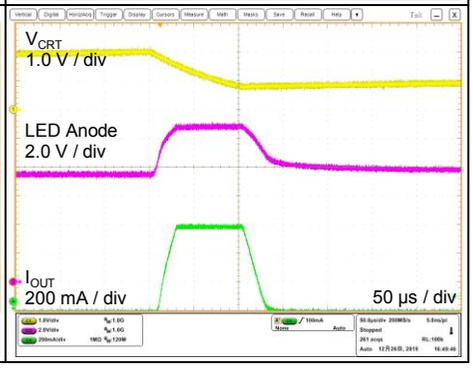
© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

8. Caution of Using LED Open Detection and Output Short Circuit Protection – continued

8.3 Evaluation Example of PWM Dimming I_{OUT} Pulse Width

Evaluation condition: V_{IN} = 13 V, Tj = 25 °C, 3 White LEDs in series, PWM ON Duty = 3.2 %, Pulse width = 0.105 ms, PWM Frequency = 300 Hz

	C_{OUT} = 0.10 µF	C_{OUT} = 0.47 µF
I_{OUT} = 100 mA		
I_{OUT} = 240 mA		
I_{OUT} = 400 mA		
I_{OUT} = 600 mA		

© 2020 ROHM Co., Ltd. All rights reserved.

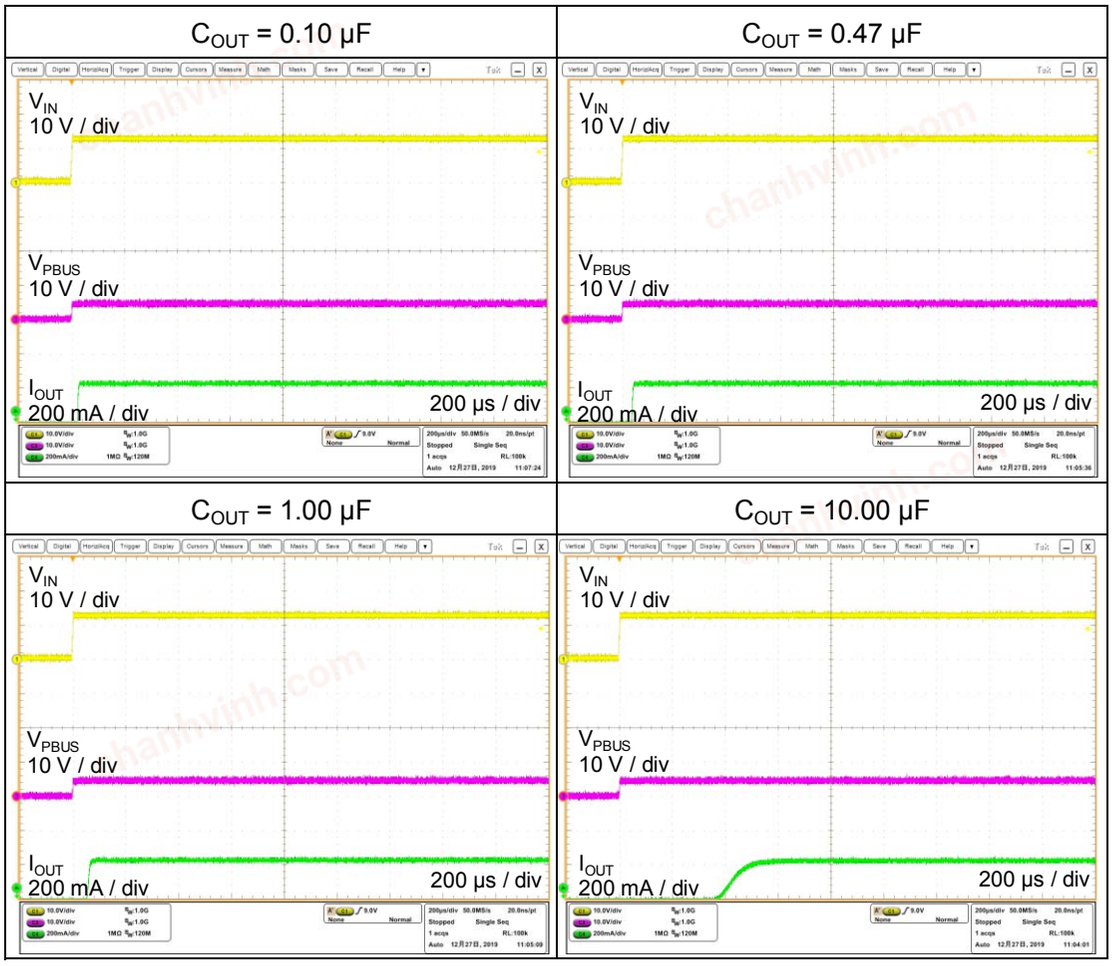
chanhvinh.com

8. Caution of Using LED Open Detection and Output Short Circuit Protection – continued

8.4 Maximum Capacitance Value Connected to the OUT Pin (C_{OUT})

When the capacitance connected to the OUT pin is above the recommended range (1.0 µF or more), the delay time of output rise time could be in around hundreds of microseconds. Below are examples of evaluation data for reference.

Measurement conditions: V_{IN} = 13 V, Tj = 25 °C, DC mode, 3 LEDs in series



Capacitor Connected to the OUT Pin

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

9. Thermal De-rating Function (THD)

It is possible to reduce the output current I_{OUT} at high temperature and suppress the degradation of the LED by connecting a thermistor to the THD pin. Once the THD pin voltage is less than or equal to thermal de-rating start voltage V_{THDS} (0.8 V (Typ)), the output current I_{OUT} is reduced according to the THD pin voltage.

Open the THD pin when not using thermal de-rating function.

In case variation of the THD pin voltage is steep, take measures such as connecting a capacitor to the THD pin to prevent the output current chattering. In addition, evaluate I_{OUT} waveform on actual board because the output amplifier may not follow the steep variation.

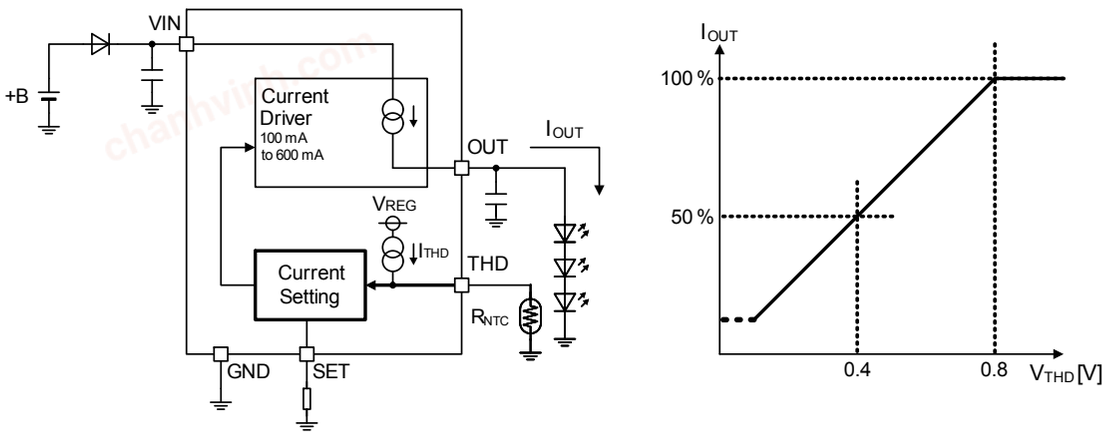
The thermal de-rating function can be set by the following formula.

$$V_{THD} = I_{THD} \times R_{NTC} \quad [V]$$

$$I_{OUT} \ (V_{THD} \leq 0.8 \ V) = \frac{K_{SET}}{R_{SET}} \times \frac{V_{THD}}{V_{SET}}$$

Where:

I_{THD}	is the THD pin source current, 200 µA (Typ).
R_{NTC}	is the resistance of NTC thermistor.
I_{OUT}	is the output current.
V_{THD}	is the THD pin voltage.
V_{SET}	is the SET pin voltage, 0.8 V (Typ).



Thermal De-rating Function

© 2020 ROHM Co., Ltd. All rights reserved.

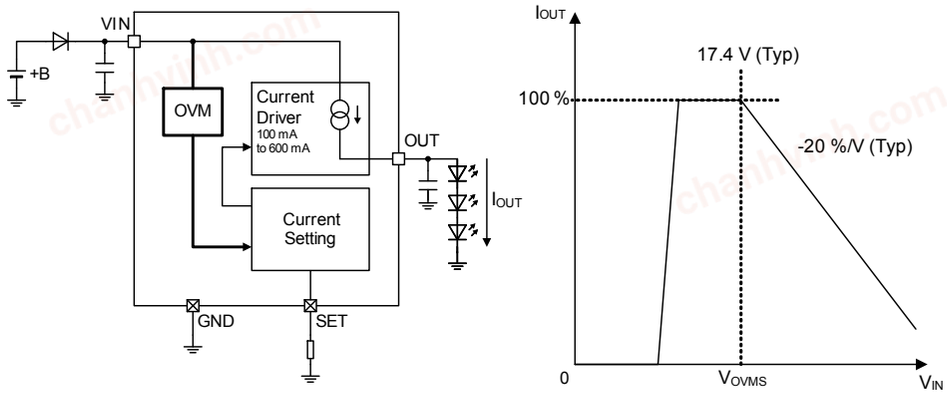
chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

10. Over Voltage Mute Function (OVM)

Once the VIN pin voltage V_{IN} is over voltage mute start voltage V_{OVMS} 17.4 V (Typ) or more, the over voltage mute function is activated to decrease the output current I_{OUT} in order to suppress the heat generation from the IC.
The output current I_{OUT} will decay at -20 %/V (Typ).



Over Voltage Mute Function (OVM)

11. Under Voltage Lock Out (UVLO)

UVLO is a protection circuit to prevent malfunction of the IC when the power is turned on or when the power is suddenly shut off. When the VIN pin voltage V_{IN} is 4.50 V (Typ) or less, the output current I_{OUT} is turned OFF, and when the VIN pin voltage V_{IN} increases to 6.05 V (Typ) or more, normal operation starts.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

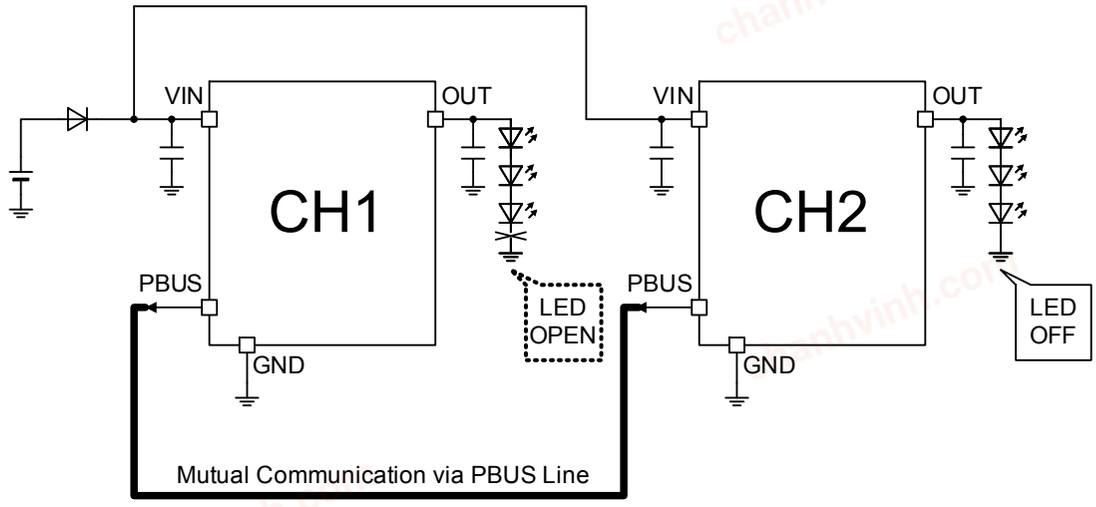
(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

12. Output for Fault Flag / Input for Output Current OFF Control Signal (PBUS)

When abnormality such as LED open or output short circuit occurs, it can notify the abnormality to the outside by changing the PBUS pin output from high to low. In addition, by externally controlling the PBUS pin from high to low, the output current I_{OUT} is turned off. When using multiple ICs to drive multiple LED strings, it is possible to turn off all LED strings at once by connecting the PBUS pins of each CH as shown in the figure below, even if LED open or output short circuit occurs.

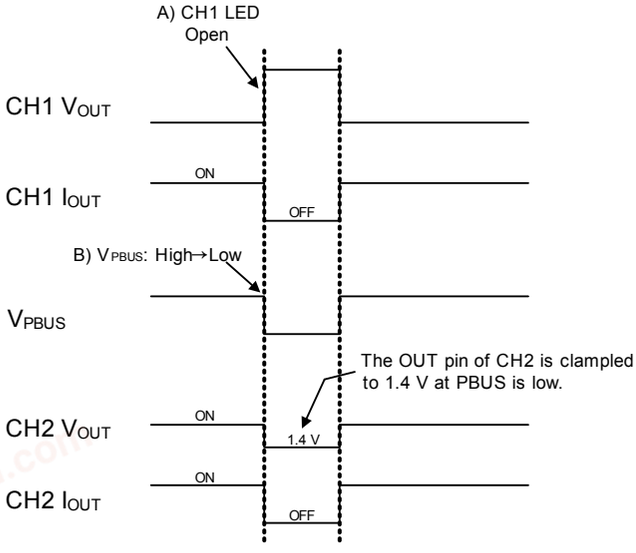
Caution of Using the PBUS Pin

Do not connect to the PBUS pins other than below list items due to the difference of ratings, internal threshold voltages, and so on.
(BD18340FV-M, BD18341FV-M, BD18342FV-M, BD18343FV-M, BD18345EFV-M, BD18337EFV-M, BD18347EFV-M)



PBUS Function

12.1 Example of Protective Operation Due to LED Open



Example of Protective Operation

When CH1 is the LED open state, the PBUS pin of CH1 is changed from High to Low output. As the PBUS pin becomes Low, LED driver of CH2 turns OFF its output current. The OUT pin voltage is clamped to 1.4 V (Typ) during the OFF period, in order to prevent malfunction of output short circuit.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

13. Current Bypass Function at Reduced-Voltage

The BD18326NUF-M is built-in current bypass function at reduced-voltage.
When the V_{IN_DIV} which is the resistor divider of the VIN pin voltage V_{IN} is more than the BPCNT reference voltage V_{BP} (2.0 V (Typ)), the ISINK pin sink current I_{ISINK} decreases. The output current I_{OUT} changes linearly.

The ISINK pin sink current I_{ISINK} can be set by the following formula.

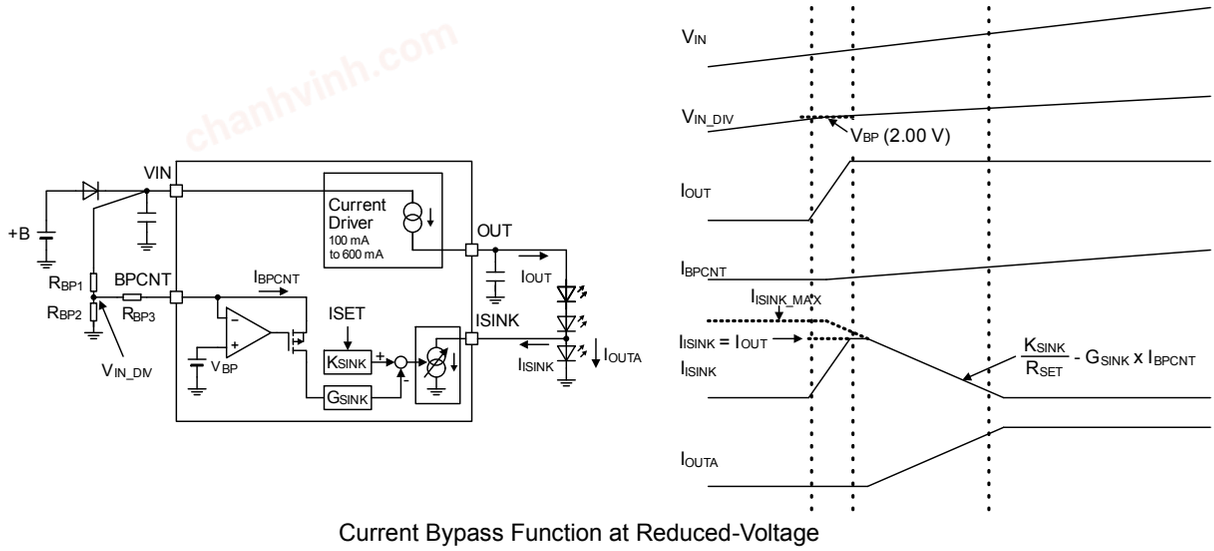
$$I_{ISINK} = \frac{K_{SINK}}{R_{SET}} + G_{SINK} \times I_{BPCNT} \div 10^3 \quad [\text{mA}]$$

$$I_{BPCNT} = \frac{1}{R_{BP3}} \left\{ \frac{R_{BP2} \times (R_{BP1} \times V_{BP} + R_{BP3} \times V_{IN})}{R_{BP1} \times R_{BP2} + R_{BP3} \times (R_{BP1} + R_{BP2})} - V_{BP} \right\} \times 10^3 \geq 0 \quad [\mu\text{A}]$$

$$I_{ISINK_MAX} = \frac{K_{SINK}}{R_{SET}} \quad [\text{mA}]$$

Where:

K_{SINK}	is the ISINK current setting coefficient,	3000 (Typ).
R_{SET}	is the output current setting resistor,	[kΩ]
G_{SINK}	is the ISINK current gain,	-7300 (Typ).
I_{BPCNT}	is the BPCNT pin input current,	[μA]
R_{BP1}	is the resistor for setting current bypass 1,	[kΩ]
R_{BP2}	is the resistor for setting current bypass 2,	[kΩ]
R_{BP3}	is the resistor for setting current bypass 3,	[kΩ]
V_{BP}	is the BPCNT reference voltage,	2.00 V (Typ)
I_{ISINK_MAX}	is the ISINK pin maximum sink current,	[mA]



Current Bypass Function at Reduced-Voltage

When not using the current bypass function at reduced-voltage, the ISINK pin is connected to the GND and the BPCNT pin is connected with pull-down resistor or to the GND.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

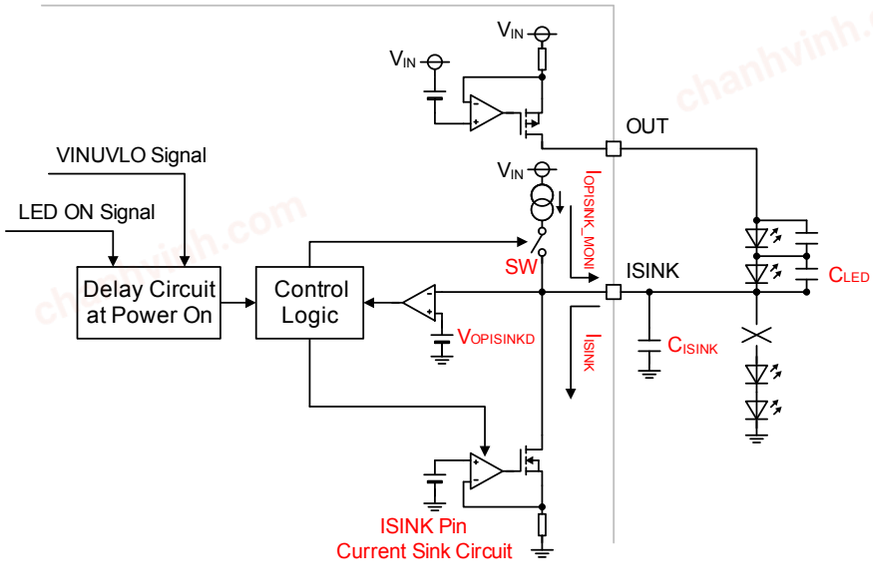
14. ISINK Pin Sink Current On Delay Time at Power On

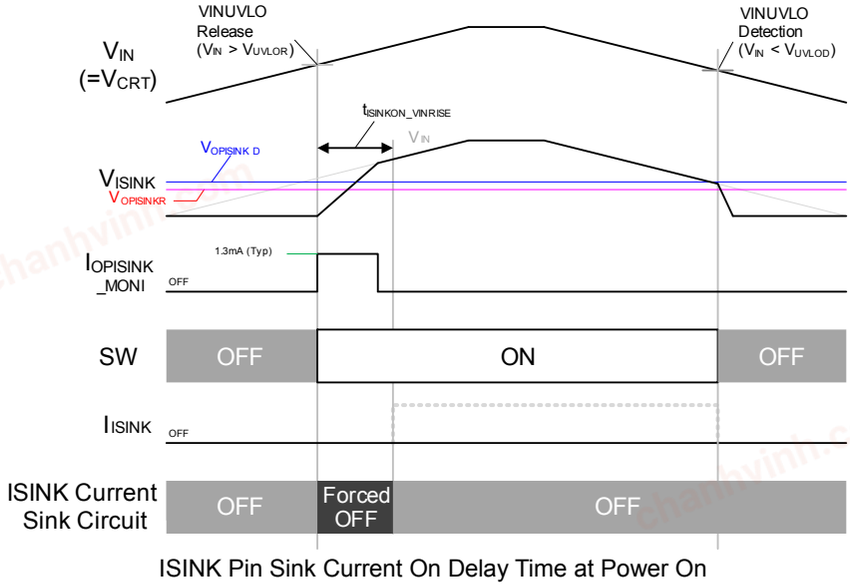
Once UVLO is released and the CRT pin voltage is V_{CRT_DIS1} (2.0 V (Typ)) or more, the ISINK pin sink current is OFF until the ISINK Pin Sink Current On Delay Time at Power On $t_{ISINKON_VINRISE}$ (40 µs (Typ)) elapses. At this time, the ISINK Pin LED Open Monitor Current $I_{OPISINK_MONI}$ is sourced from the ISINK pin to monitor the status of the ISINK pin. If the LED connected between the ISINK pin and GND is open, it is detected that the ISINK pin voltage V_{ISINK} is exceeded the ISINK Pin LED Open Detection Voltage $V_{OPISINKD}$ (5.80 V (Typ)), and the ISINK pin sink current continues to be OFF.

Set the external parts connected to the ISINK pin to satisfy the following formula.

$$V_{OPISINKD} < \frac{I_{OPSINK_MONI} + t_{ISINKON_VINRISE}}{C_{LED} + C_{ISINK}} \quad [V]$$

$V_{OPISINKD}$	is the ISINK pin LED open detection voltage,	5.80 V (Typ)
$I_{OPISINK_MONI}$	is the ISINK pin LED open monitor current,	1.3 mA (Typ)
$t_{ISINKON_VINRISE}$	is the ISINK pin sink current on delay time at power on,	40 µs (Typ)
C_{LED}	is the LED parasitic capacitance,	[nF]
C_{ISINK}	the capacitor connecting the ISINK pin,	[nF]





ISINK Pin Sink Current On Delay Time at Power On

© 2020 ROHM Co., Ltd. All rights reserved.

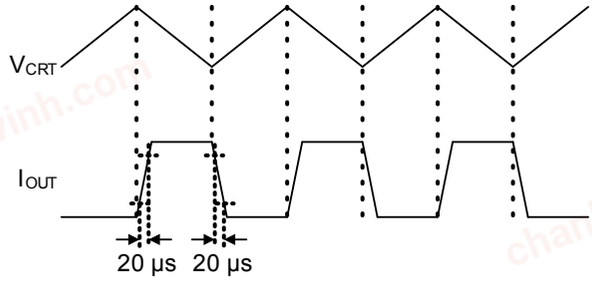
chanhvinh.com

Description of Blocks – continued

(Unless otherwise specified, Tj = 25 °C, V_{IN} = 13 V)

15. Output Current Rise/Fall Time Fixed Function

The BD18326NUF-M has built-in output current rise/fall time fixed function.
It can suppress the noise generated to the power supply line by fixing the output current rise/fall time to 20 µs (Typ).



Output Current Rise/Fall Time Fixed Function

chanhvinh.com

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Absolute Maximum Ratings (Ta = 25 °C)

No.	Parameter	Symbol	Rating	Unit
A-1	VIN Pin Voltage	V_{IN}	-0.3 to +42.0	V
A-2	CRT, DISC Pin Voltage	V_{CRT}, V_{DISC}	-0.3 to +42.0	V
A-3	OUT Pin Voltage	V_{OUT}	-0.3 to V_{IN}+0.3 < +42.0	V
A-4	PBUS, BPCNT, ISINK Pin Voltage	V_{PBUS}, V_{BPCNT}, V_{ISINK}	-0.3 to +20.0	V
A-5	SET, THD Pin Voltage	V_{SET}, V_{THD}	-0.3 to +7.0	V
A-6	Storage Temperature Range	Tstg	-55 to +150	°C
A-7	Maximum Junction Temperature	Tjmax	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)*	
VSON10FV3030				
Junction to Ambient	θ_{JA}	158.00	46.00	°C/W
Junction to Top Characterization Parameter*(Note 2)*	Ψ_{JT}	23.00	12.00	°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 connects with the copper pattern of all layers.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Recommended Operating Conditions

No.	Parameter	Symbol	Min	Typ	Max	Unit
O-1	Supply Voltage *(Note 1) (Note 2)*	V_{IN}	5.5	13.0	20.0	V
O-2	OUT Pin Maximum Output Current (DC)	$I_{OUT(DC)}$	-	-	400	mA
O-3	OUT Pin Maximum Output Current (ON Duty: 50 %)	$I_{OUT(50\%DUTY)}$	-	-	600	mA
O-4	PWM Dimming Frequency	f_{PWM}	200	-	750	Hz
O-5	PWM Minimum Pulse Width *(Note 3)*	t_{MIN}	50	-	-	µs
O-6	Operating Temperature	Topr	-40	-	+150	°C

(Note 1) ASO should not be exceeded.
(Note 2) At start up, apply 6.5 V or more once. The value is the voltage range after applying 6.5 V or more once.
(Note 3) It is the same as when the pulse input to the CRT pin.

External Parts Setting Range

No.	Parameter	Symbol	Min	Typ	Max	Unit
P-1	Capacitor Connecting The VIN Pin at Operating DC Mode Only *(Note 3)*	C_{VIN_DC}	0.47	-	-	µF
P-2	Capacitor Connecting The VIN Pin at Operating PWM Mode *(Note 3)*	C_{VIN_PWM}	1.0	-	-	µF
P-3	Capacitor Connecting The OUT Pin *(Note 4)* (I_{LED} < 400 mA)	$C_{OUT\ U400}$	-	-	1.0	µF
P-4	Capacitor Connecting The OUT Pin *(Note 4)* (I_{LED} ≥ 400 mA)	$C_{OUT\ O400}$	0.1	-	1.0	µF
P-5	Capacitor Connecting The ISINK Pin	C_{ISINK}	-	-	1.0	nF
P-6	Capacitor for Setting CR Timer	C_{CRT}	0.047	0.100	0.220	µF
P-7	Resistor for Setting CR Timer	R_{CRT}	0.1	-	50.0	kΩ
P-8	Resistor for Setting Output Current	R_{SET}	4.0	-	24.0	kΩ
P-9	Resistor for DCIN Pull-down	R_{DCIN}	-	-	10	kΩ
P-10	Resistor for Setting BPCNT 1	R_{BP1}	10.5	-	100.0	kΩ
P-11	Resistor for Setting BPCNT 2	R_{BP2}	3.3	-	30.0	kΩ
P-12	Resistor for Setting BPCNT 3	R_{BP3}	0.24	-	96.50	kΩ

(Note 3) Connect C_{VIN_DC} or C_{VIN_PWM} within 10 mm from the IC. If they are connected more than 10 mm from the IC, there is a possibility of unstable operation such as oscillation of output current I_{OUT} etc. So consider with enough evaluation on actual board
(Note 4) If a long wire connects from the OUT pin to the LED anode, there is a possibility of output current I_{OUT} oscillation.
After consideration with enough evaluation, connect a capacitor connecting to the OUT pin C_{OUT} between the OUT pin and GND to prevent oscillation.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Electrical Characteristics

(Unless otherwise specified Tj = -40 °C to +150 °C, V_{IN} = 13 V)

No.	Parameter	Symbol	Limit			Unit	Conditions
			Min	Typ	Max		
	Circuit Current						
E-1	VIN Pin Circuit Current at Normal Mode	I_{VIN1}	-	2.6	5.0	mA	R_{SET} = 24 kΩ
E-2	VIN Pin Circuit Current at LED Open Detection	I_{VIN2}	-	2.4	5.0	mA	V_{OUT} = Open R_{SET} = 24 kΩ
E-3	VIN Pin Circuit Current at PBUS = Low	I_{VIN3}	-	2.7	5.0	mA	V_{PBUS} = 0 V R_{SET} = 24 kΩ
	Output Current						
E-4	OUT OFF Current	I_{OUT_OFF}	-	-	1.0	μA	V_{OUT} = 2.0 V V_{CRT} = 0 V, Tj = 25 °C
E-5	Drop Voltage Between VIN Pin and OUT Pin 1	V_{DR1}	-	-	0.92	V	Tj = -40 °C I_{OUT} = 600 mA
E-6	Drop Voltage Between VIN Pin and OUT Pin 2	V_{DR2}	-	-	1.03	V	Tj = +25 °C I_{OUT} = 600 mA
E-7	Drop Voltage Between VIN Pin and OUT Pin 3	V_{DR3}	-	-	1.25	V	Tj = +150 °C I_{OUT} = 600 mA
E-8	Output Current Rise Time	I_{OUT_RISE}	10	20	30	μs	I_{OUT} = 20 %→80 % R_{SET} = 10 kΩ
E-9	Output Current Fall Time	I_{OUT_FALL}	10	20	30	μs	I_{OUT} = 80 %→20 % R_{SET} = 10 kΩ
E-10	The Difference Between Output Current Rise Time and Fall Time	$\Delta I_{RISEFALL}$	-5	0	5	μs	R_{SET} = 10 kΩ
	LED Open Detection						
E-11	OUT Pin LED Open Detection Voltage	V_{OPD}	V_{IN} - 0.080	V_{IN} - 0.050	V_{IN} - 0.020	V	
E-12	ISINK Pin LED Open Release Voltage	$V_{OPISINKR}$	4.35	4.60	4.85	V	V_{ISINK}: Sweep down
E-13	ISINK Pin LED Open Detection Voltage	$V_{OPISINKD}$	5.50	5.80	6.10	V	V_{ISINK}: Sweep up
E-14	ISINK Pin LED Open Monitor Current	$I_{OPISINK_MONI}$	0.65	1.50	2.50	mA	V_{IN} = 6.5V, V_{ISINK} = 6.2V
E-15	Release Voltage for Function to Disable LED Open Detection	V_{IN_OPM}	10.5	11.0	11.5	V	V_{IN}
	Output Short Circuit Protection (OUT SCP)						
E-16	Current at OUT Pin Short Circuit	I_{OUT_SCP}	0.2	1.2	2.0	mA	
E-17	OUT Pin Short Circuit Protection Voltage	V_{SCP}	0.5	0.6	0.7	V	
E-18	OUT Pin Short Circuit Protection Release Voltage	V_{SCPR}	0.7	0.8	0.9	V	
E-19	Current ON Voltage at OUT Pin Short Circuit	V_{ISCPON}	0.9	1.0	1.2	V	
E-20	SCP Delay Time	t_{SCP1}	10	25	50	μs	
E-21	SCP Disable Time at Power On	t_{SCP2}	-	85	-	μs	

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Electrical Characteristics – continued

(Unless otherwise specified Tj = -40 °C to +150 °C, V_{IN} = 13 V)

No.	Parameter	Symbol	Limit			Unit	Conditions	
			Min	Typ	Max			
	Output Current Setting							
E-22	Output Current Setting Coefficient	K_{SET}	2280	2400	2520	-	R_{SET} = 4 kΩ to 10 kΩ	Tj = -40 °C to +150 °C
			2256	2400	2544		R_{SET} = 10 kΩ to 20 kΩ	Tj = 25 °C
			2232	2400	2568			Tj = 150 °C
			2160	2400	2640			Tj = -40 °C to +150 °C
			2160	2400	2640		R_{SET} = 20 kΩ to 24 kΩ	Tj = -40 °C to +150 °C
E-23	Reference Voltage for Output Current Setting	V_{SET_REF}	0.72	0.80	0.88	V	V_{SET}	
E-24	SET Pin Short Circuit Protection Threshold Current	I_{SET_SH}	0.24	0.50	1.20	mA		
E-25	Output Current On Delay Time at Power On	t_{IOUT_ON}	-	40	100	µs	VIN = 0 V→13 V t_{IOUT_ON} = t_{IOUT} (80 %) – t_{IOUT} (@V_{IN} = V_{UVLOR}) R_{SET} = 24 kΩ	
	Thermal De-Rating (THD)							
E-26	THD Pin Source Current	I_{THD}	193	203	213	µA		
E-27	Thermal De-Rating Start Voltage	V_{THDS}	0.76	0.80	0.84	V	V_{THD}	
E-28	Thermal De-Rating Gain	G_{THD}	-131.3	-125.0	-118.7	%/V	ΔI_{OUT} / ΔV_{THD} V_{THD}: 0.667 V→0.333 V V_{IN} = 13 V	
	CR Timer for PWM Dimming							
E-29	CRT Pin Charge Current	I_{CRT}	36	40	44	µA		
E-30	CRT Pin Charge Voltage	V_{CRT_CHA}	0.72	0.80	0.88	V		
E-31	CRT Pin Discharge Voltage 1	V_{CRT_DIS1}	1.80	2.00	2.20	V		
E-32	CRT Pin Discharge Voltage 2	V_{CRT_DIS2}	2.10	2.40	3.00	V	V_{CRT} > V_{CRT_DIS2} R_{D1}→R_{D2}	
E-33	CRT Pin Charge Resistance	R_{CHA}	28.5	30.0	31.5	kΩ		
E-34	CRT Discharge Constant	V_{CRT_CHA} / V_{CRT_DIS1}	0.38	0.40	0.42	V/V		
E-35	DISC Pin ON Resistance 1	R_{DISC1}	10	25	80	Ω	I_{DISC} = 10 mA	
E-36	DISC Pin ON Resistance 2	R_{DISC2}	2.5	5	10	kΩ	I_{DISC} = 100 µA	
E-37	CRT Pin Leakage Current	I_{CRT_LEAK}	-	-	10	µA	V_{CRT} = V_{IN}	
	Over Voltage Mute Function (OVM)							
E-38	Over Voltage Mute Start Voltage	V_{OVMS}	16.0	17.4	18.8	V	ΔI_{OUT} = -3 % ΔI_{OUT} = I_{OUT} (@V_{IN} = V_{OVM}) / I_{OUT} (@V_{IN} = 13 V) -1	
E-39	Over Voltage Mute Gain	G_{OVM}	-	-20	-	%/V	ΔI_{OUT} / ΔV_{IN} V_{THD} > 1.5 V	

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Electrical Characteristics – continued
(Unless otherwise specified Tj = -40 °C to +150 °C, V_{IN} = 13 V)

No.	Parameter	Symbol	Limit			Unit	Conditions
			Min	Typ	Max		
	Output for Fault Flag / Input for Output Current OFF Control Signal (PBUS)						
E-40	Input High Voltage	V_{PBUSH}	2.4	-	-	V	
E-41	Input Low Voltage	V_{PBUSL}	-	-	0.6	V	
E-42	PBUS Pin Source Current	I_{PBUS}	75	150	300	µA	V_{PBUS} = 0 V
E-43	PBUS Pin Output Low Voltage	V_{PBUS_OL}	-	-	0.6	V	I_{PBUS_EXT} = 3 mA
E-44	PBUS Pin Output High Voltage	V_{PBUS_OH}	3.5	4.5	5.5	V	I_{PBUS_EXT} = -10 µA
E-45	PBUS Pin Leakage Current	I_{PBUS_LEAK}	-	-	10	µA	V_{PBUS} = 5 V
	Under Voltage Lock Out (UVLO)						
E-46	UVLO VIN Detection Voltage	V_{UVLOD}	4.25	4.50	4.75	V	V_{IN}: Sweep down
E-47	UVLO VIN Release Voltage	V_{UVLOR}	5.75	6.05	6.35	V	V_{IN}: Sweep up
E-48	UVLO VIN Hysteresis Voltage	V_{HYS}	-	1.55	-	V	
	Current Bypass Function at Reduced-Voltage						
E-49	BPCNT Reference Voltage	V_{BP}	1.94	2.00	2.06	V	I_{BPCNT} = 10 µA
E-50	ISINK Current Setting Coefficient	K_{SINK}	2790	3000	3210	V	I_{BPCNT} = 0 µA K_{SINK} = I_{SINK} x R_{SET} R_{SET} = 24 kΩ
E-51	ISINK Current Gain	G_{SINK}	-7447	-7230	-7013	-	G_{SINK} = {I_{ISINK1} (@I_{BPCNT} = 5 µA) - I_{ISINK2} (@I_{BPCNT} = 10 µA)} / 5 µA R_{SET} = 24 kΩ
E-52	Voltage Between ISINK Pin and GND 1	V_{DRIS1}	-	-	0.88	V	Tj = -40 °C I_{ISINK} = 600 mA
E-53	Voltage Between ISINK Pin and GND 2	V_{DRIS2}	-	-	1.00	V	Tj = +25 °C I_{ISINK} = 600 mA
E-54	Voltage Between ISINK Pin and GND 3	V_{DRIS3}	-	-	1.25	V	Tj = +150 °C IISINK = 600 mA
E-55	ISINK Pin Sink Current On Delay Time at Power On	$t_{ISINKON_VINRISE}$	20	40	-	µs	V_{ISINK} = 2.0V, V_{IN} > $V_{INUVLOR}$, V_{CRT} > V_{CRT_DIS1} → I_{SINK}:ON

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Typical Performance Curves (Reference Data)

(Unless otherwise specified Tj = 25 °C, V_{IN} = 13 V)

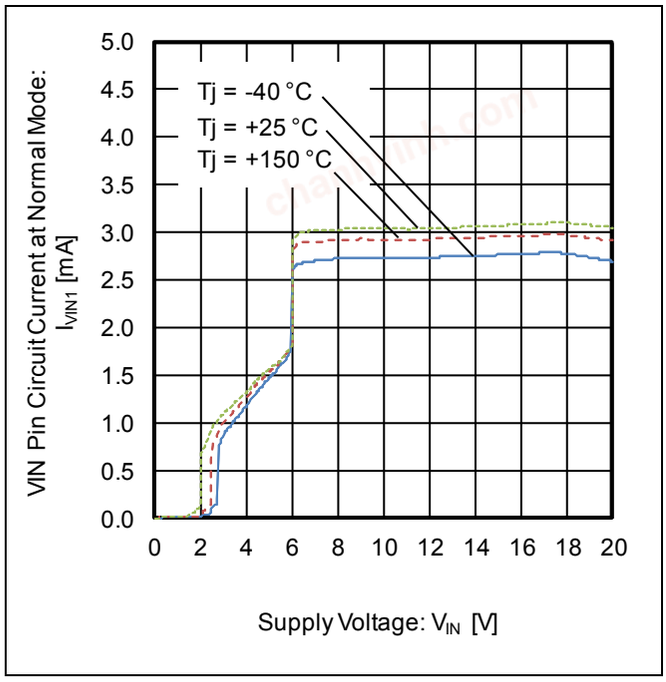


Figure 1. VIN Pin Circuit Current at Normal Mode vs Supply Voltage

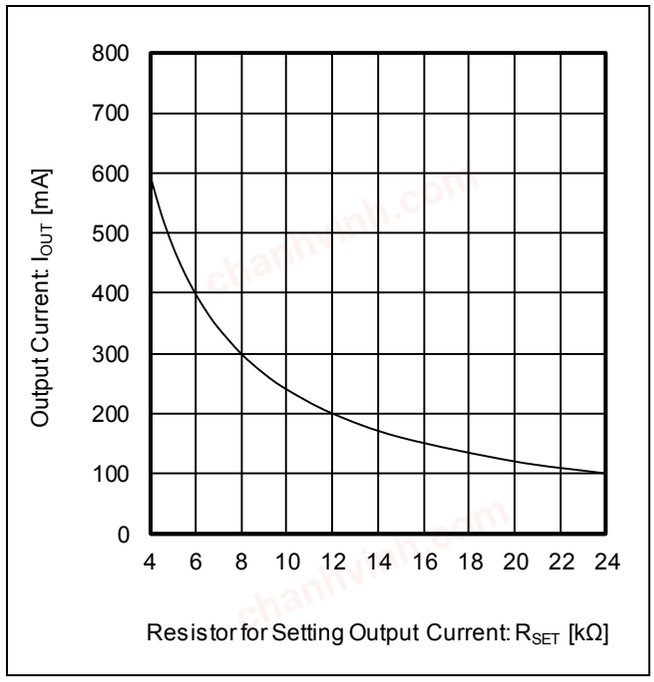


Figure 2. Output Current vs Resistor for Setting Output Current

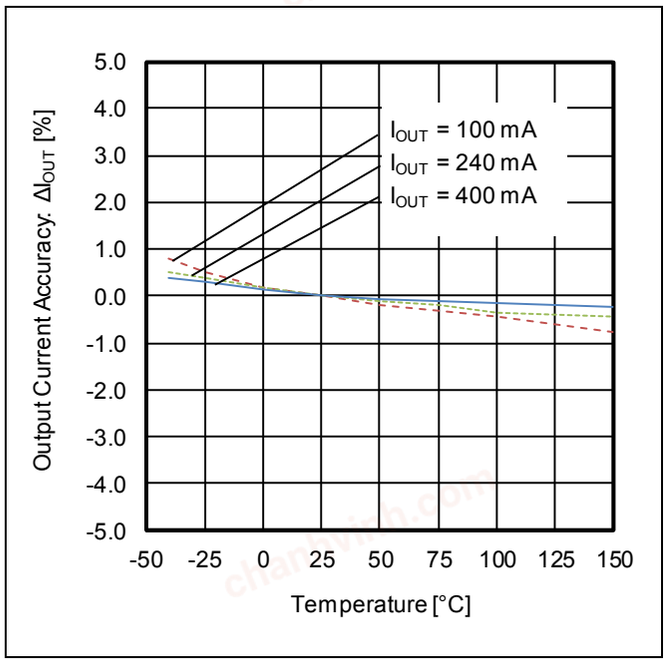


Figure 3. Output Current Accuracy vs Temperature

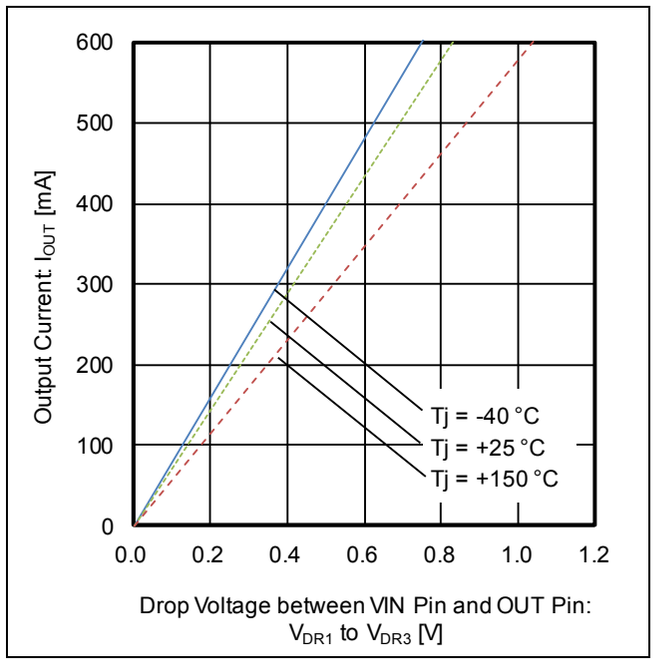


Figure 4. Output Current vs Drop Voltage between VIN Pin and OUT Pin

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Typical Performance Curves (Reference Data) – continued
(Unless otherwise specified Tj = 25 °C, V_{IN} = 13 V)

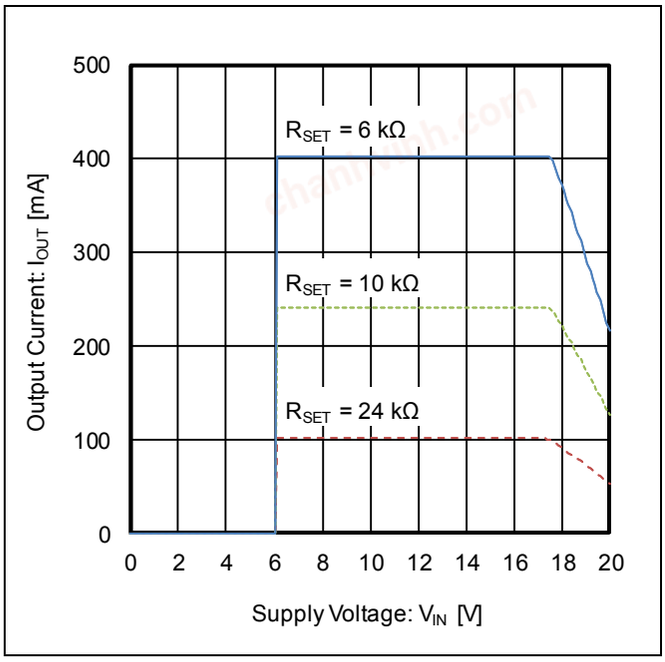


Figure 5. Output Current vs Supply Voltage

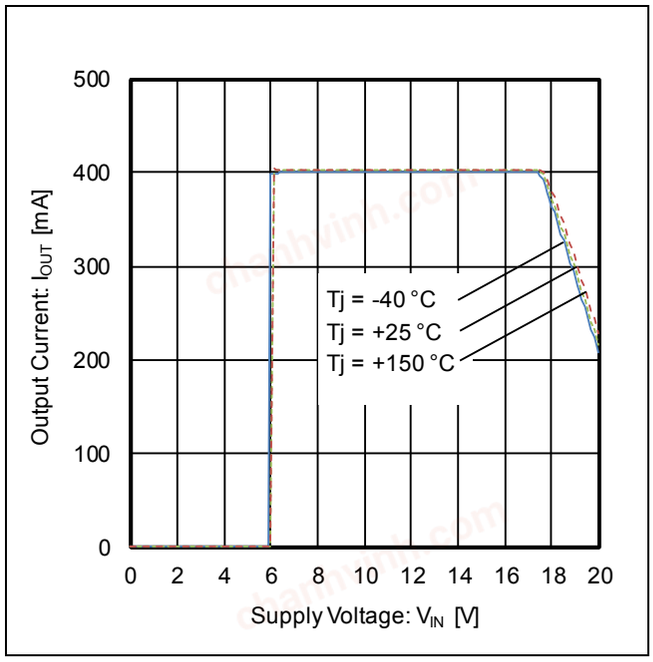


Figure 6. Output Current vs Supply Voltage

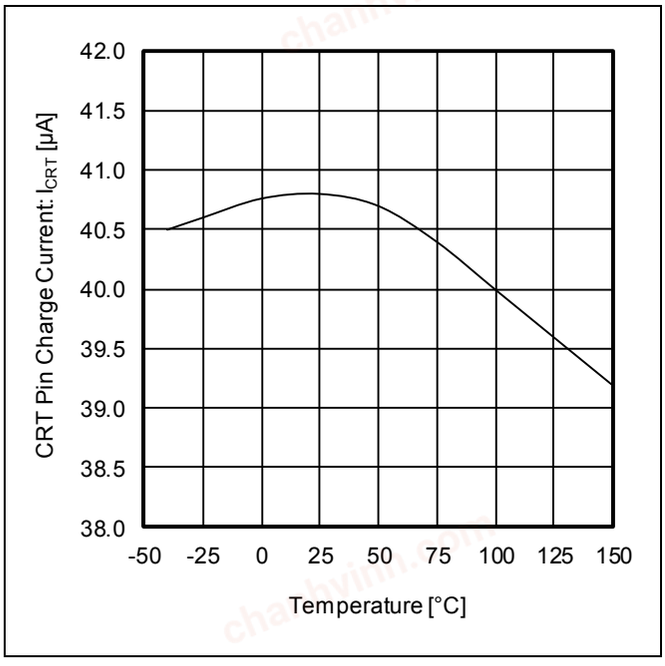


Figure 7. CRT Pin Charge Current vs Temperature

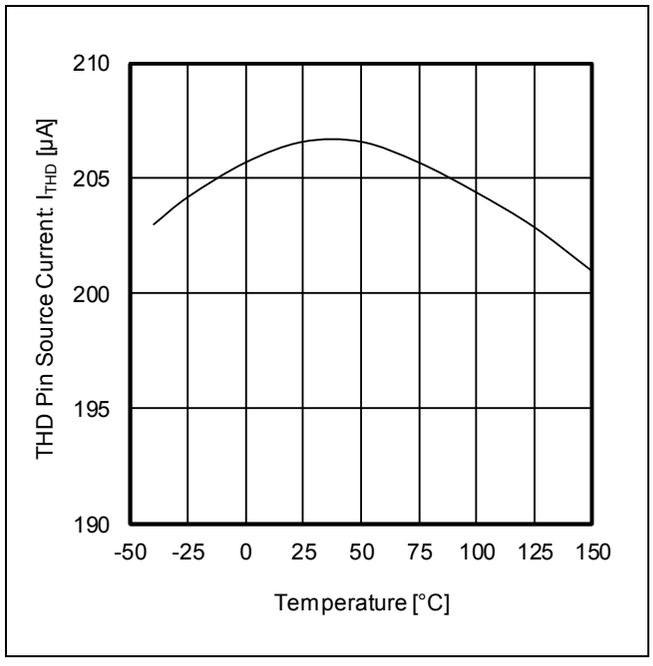


Figure 8. THD Pin Source Current vs Temperature

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Typical Performance Curves (Reference Data) – continued
(Unless otherwise specified Tj = 25 °C, V_{IN} = 13 V)

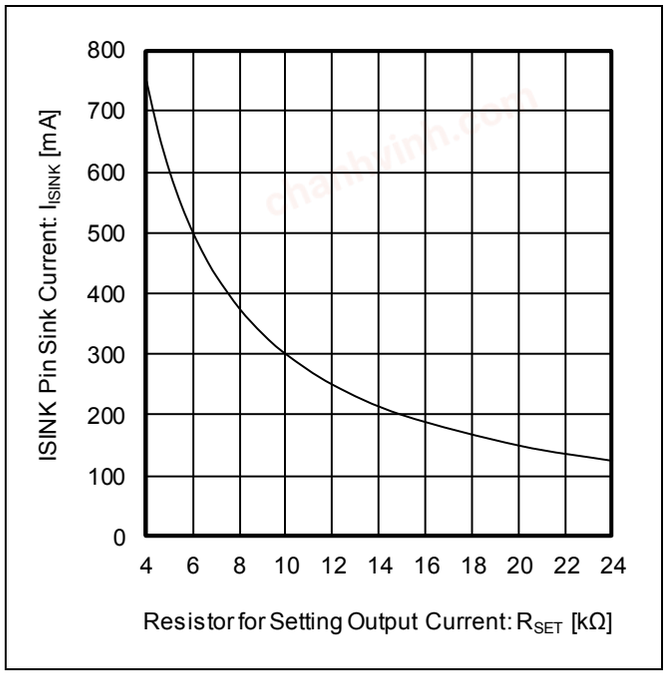


Figure 9. ISINK Pin Sink Current
vs Resistor for Setting Output Current

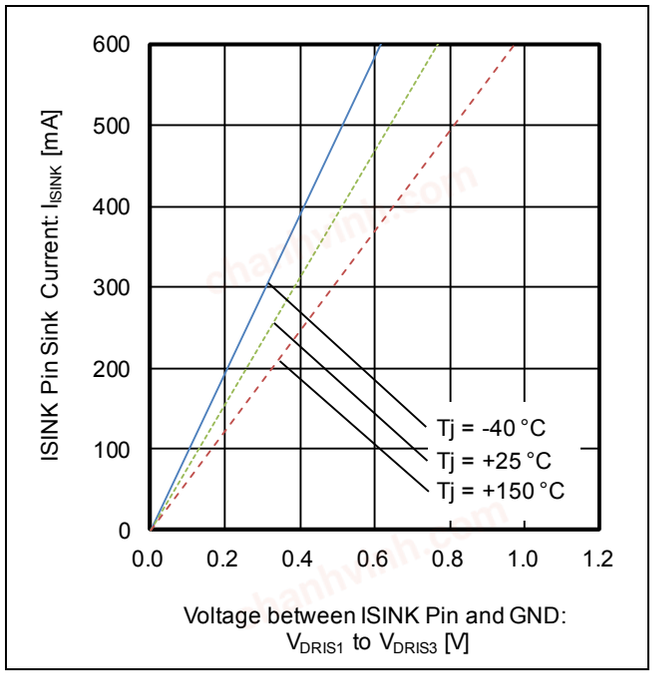


Figure 10. ISINK Pin Sink Current
vs Voltage between ISINK Pin and GND

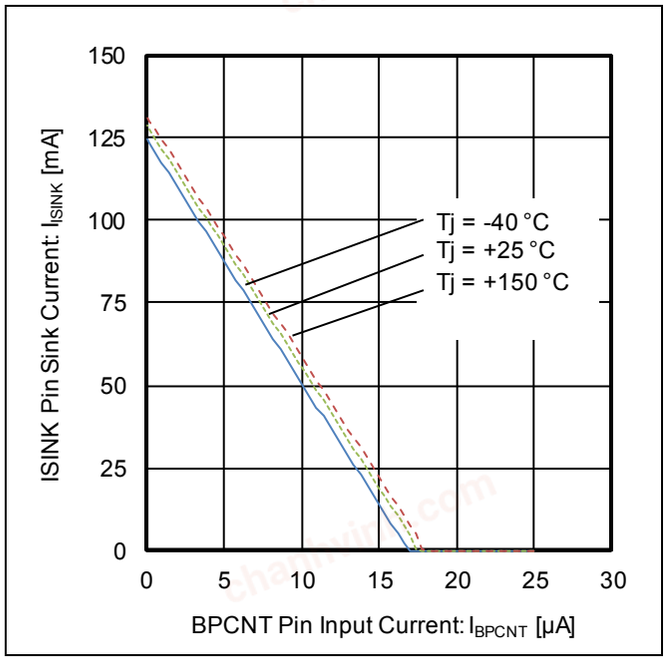
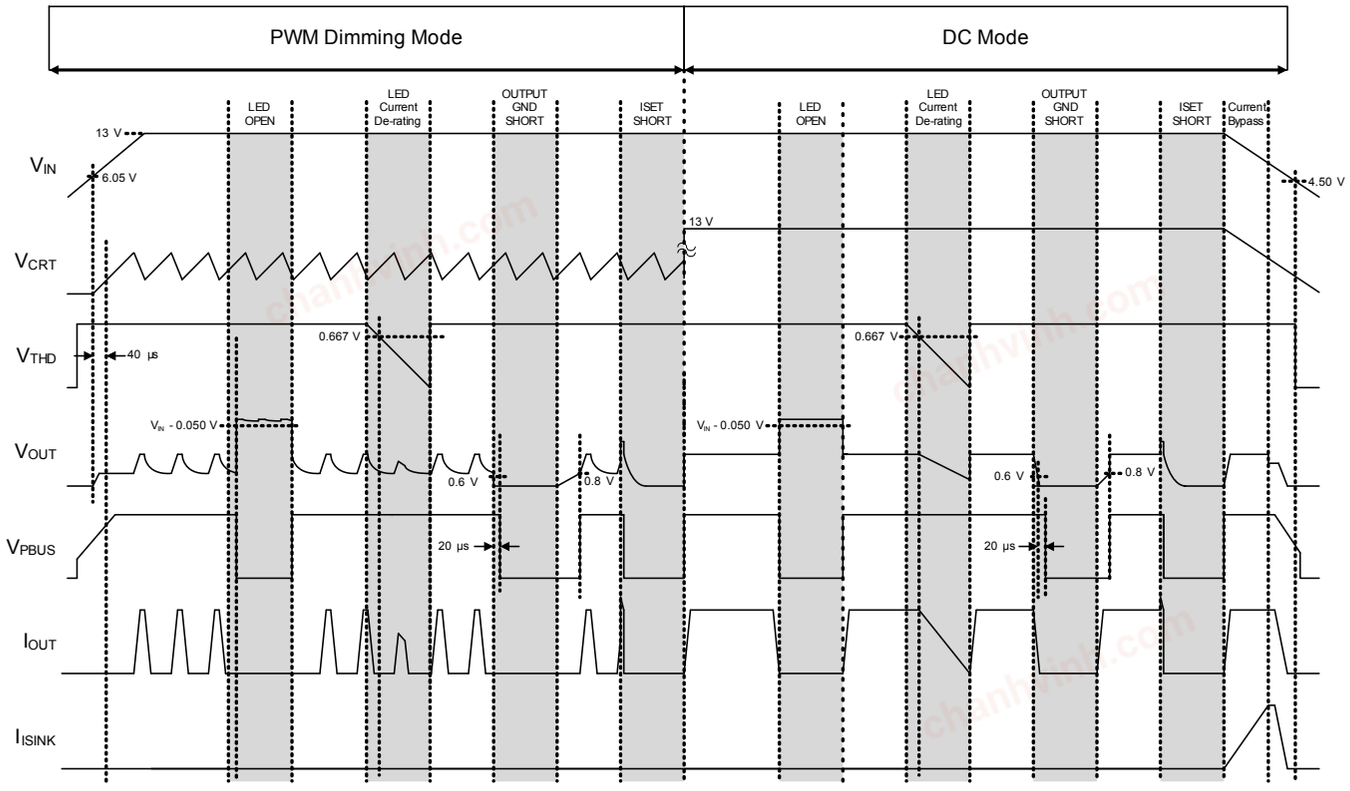


Figure 11. ISINK Pin Sink Current
vs BPCNT Pin Input Current

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Timing Chart

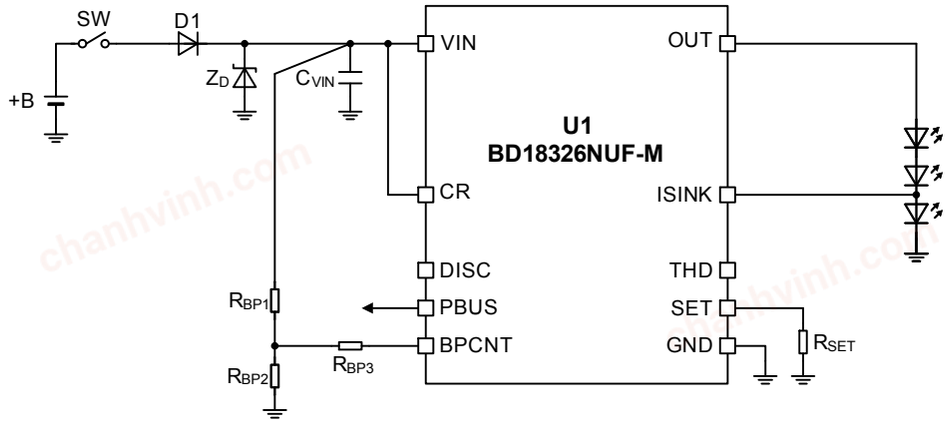


© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Application Examples

1. I_{OUT} = 200 mA, 3 White LEDs in Series, Unused Thermal De-rating Function

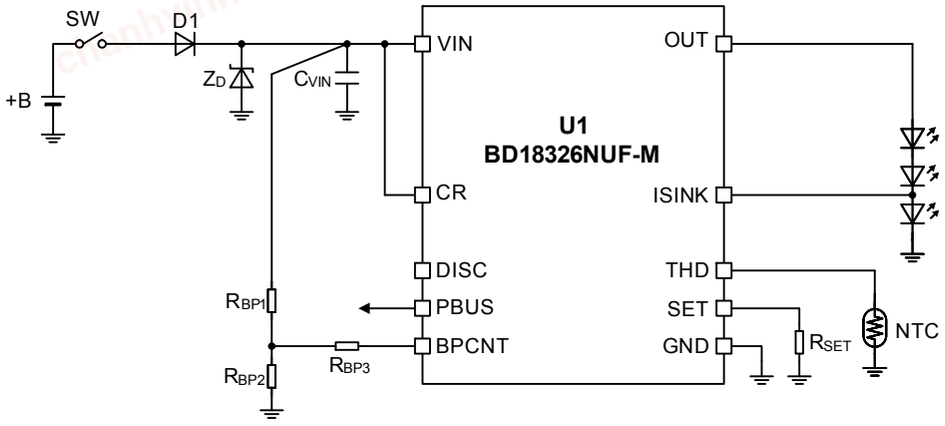


Recommended Parts List 1

Parts	No	Parts Name	Value	UNIT	Product Maker
IC	U1	BD18326NUF-M	-	-	ROHM
Diode	D1	RFN2LAM6STF	-	-	ROHM
	Z_D	TND12H-220KB00AAA0	-	-	NIPPON CHEMICON
Resistor	R_{SET}	MCR03EZPFX1202	12	kΩ	ROHM
Capacitor	C_{VIN}	GCM31CL81H105KA40	1.0	μF	murata

Caution: About Z_D, mount according to test standard of battery line.

2. I_{OUT} = 387 mA, 3 White LEDs in Series, Thermal De-rating Function



Recommended Parts List 2

Parts	No	Parts Name	Value	UNIT	Product Maker
IC	U1	BD18326NUF-M	-	-	ROHM
Diode	D1	RFN2LAM6STF	-	-	ROHM
	Z_D	TND12H-220KB00AAA0	-	-	NIPPON CHEMICON
Resistor	R_{SET}	MCR03EZPFX6201	6.2	kΩ	ROHM
Thermistor	NTC	NTCG104LH154JTDS	150	kΩ	TDK
Capacitor	C_{VIN}	GCM31CL81H105KA40	1.0	μF	murata

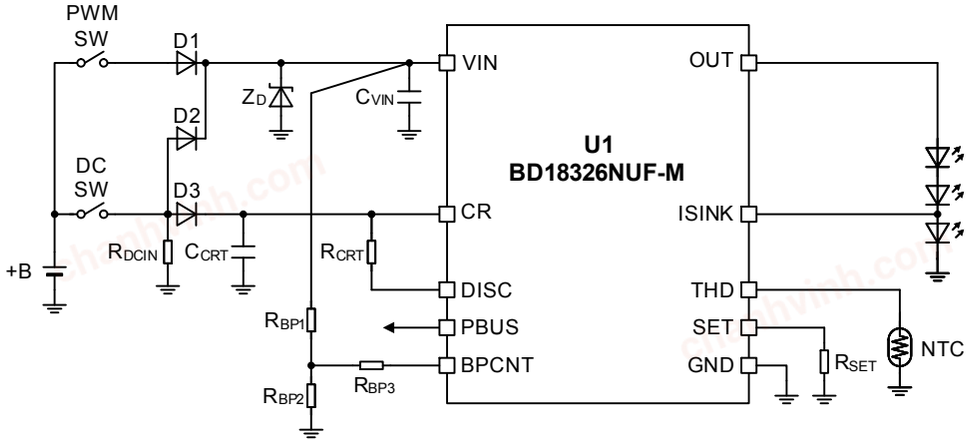
Caution: About Z_D, mount according to test standard of battery line.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Application Examples – continued

3. I_{OUT} = 387 mA, 3 White LEDs in Series, PWM ON Duty = 10 %, Pulse Width = 0.334 ms, PWM Frequency = 300 Hz



Recommended Parts List 3

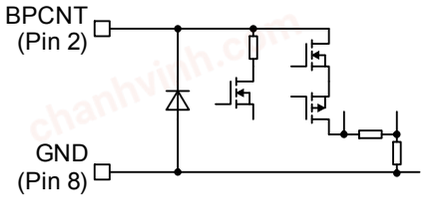
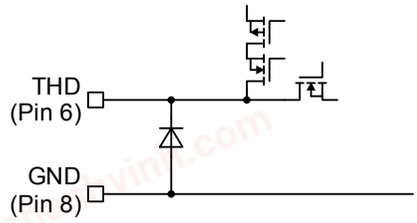
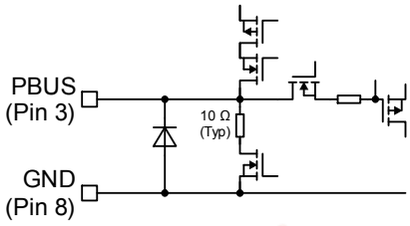
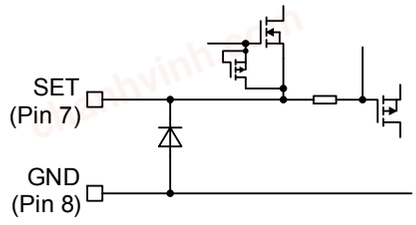
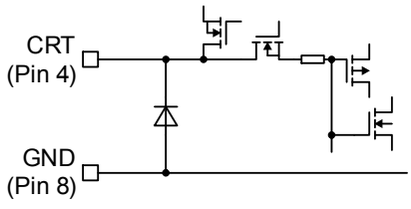
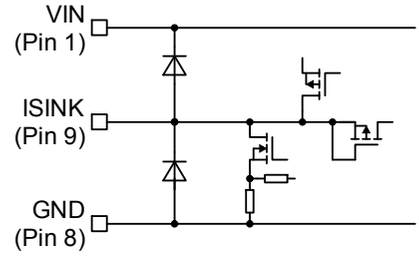
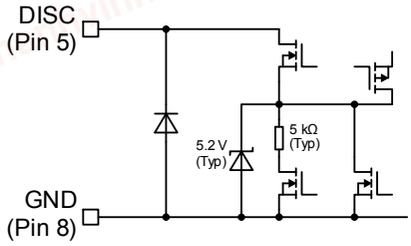
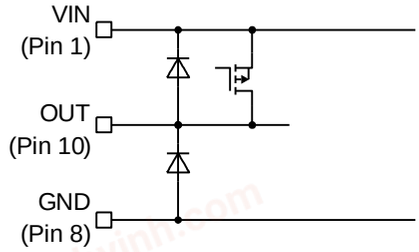
Parts	No	Parts Name	Value	UNIT	Product Maker
IC	U1	BD18326NUF-M	-	-	ROHM
Diode	D1	RFN2LAM6STF	-	-	ROHM
	D2	RFN2LAM6STF	-	-	ROHM
	D3	RFN2LAM6STF	-	-	ROHM
	Z_D	TND12H-220KB00AAA0	-	-	NIPPON CHEMICON
Resistor	R_{SET}	MCR03EZPFX6201	6.2	kΩ	ROHM
	R_{CRT}	MCR03EZPFX3601	3.6	kΩ	ROHM
	R_{DCIN}	MCR03EZPFX3902	39	kΩ	ROHM
Thermistor	NTC	NTCG104LH154JTDS	150	kΩ	TDK
Capacitor	C_{VIN}	GCM31CL81H105KA40	1.0	μF	murata
	C_{CRT}	GCM188L81H104KA42	0.1	μF	murata

Caution: About Z_D, mount according to test standard of battery line.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

I/O Equivalence Circuits

No.	Pin Name	Equivalence Circuit	No.	Pin Name	Equivalence Circuit
2	BPCNT		6	THD	
3	PBUS		7	SET	
4	CRT		9	ISINK	
5	DISC		10	OUT	

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

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.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

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.

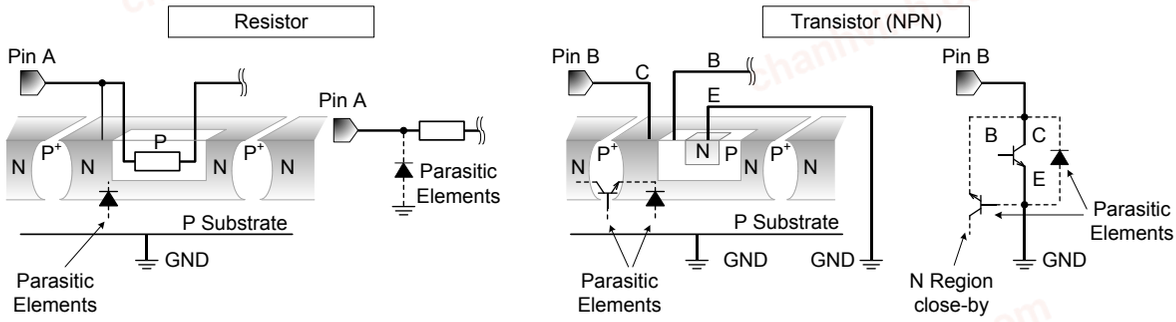


Figure 12. Example of Monolithic IC Structure

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.

13. Functional Safety

"ISO 26262 Process Compliant to Support ASIL-*"
A product that has been developed based on an ISO 26262 design process compliant to the ASIL level described in the datasheet.
"Safety Mechanism is Implemented to Support Functional Safety (ASIL-*)"
A product that has implemented safety mechanism to meet ASIL level requirements described in the datasheet.
"Functional Safety Supportive Automotive Products"
A product that has been developed for automotive use and is capable of supporting safety analysis with regard to the functional safety.
Note: "ASIL-*" is stands for the ratings of "ASIL-A", "-B", "-C" or "-D" specified by each product's datasheet.

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Ordering Information

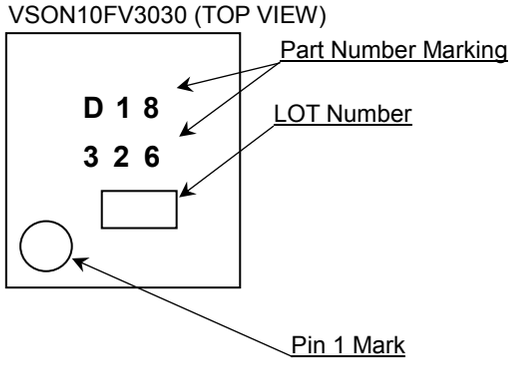
B	D	1	8	3	2	6	N	U	F	-	M	E	2

Package
NUF:
VSON10FV3030

Product Rank
M: for Automotive
Packaging Specification
E2: Embossed tape and reel

Marking Diagram

VSON10FV3030 (TOP VIEW)

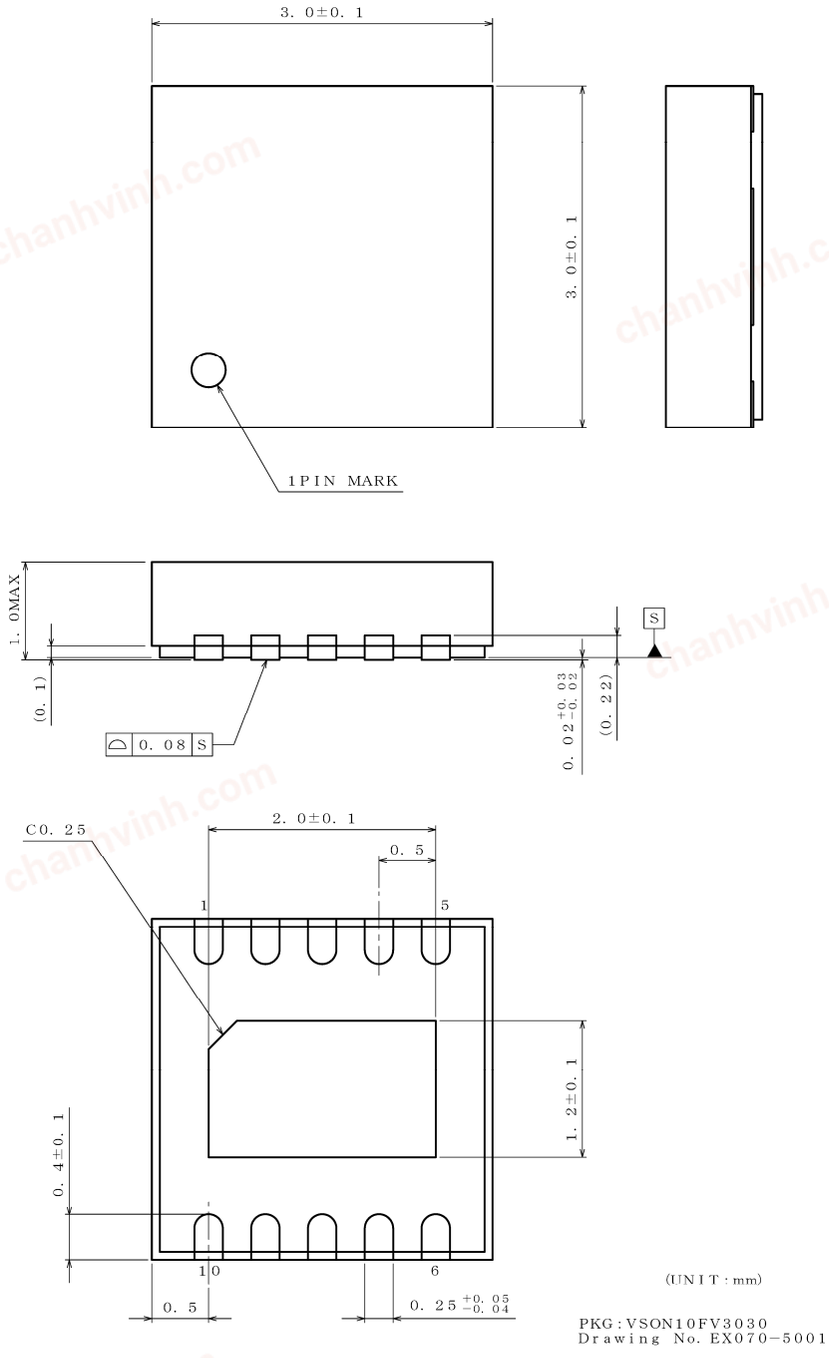


© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

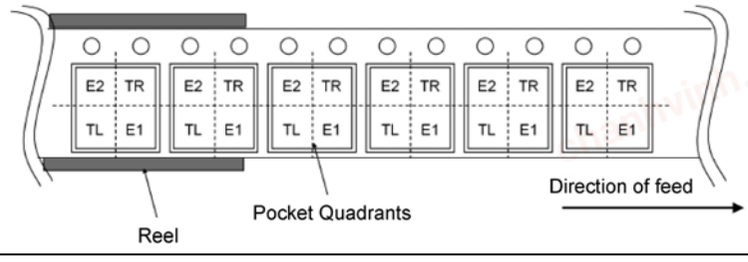
Physical Dimension and Packing Information

Package Name	VSON10FV3030



< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 The direction is the pin 1 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



© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Revision History

Date	Revision	Changes
28.Sep.2020	001	New Release

chanhvinh.com

© 2020 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, 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:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed 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:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [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

© 2015 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

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.

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.

© 2015 ROHM Co., Ltd. All rights reserved.

chanhvinh.com

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.

© 2015 ROHM Co., Ltd. All rights reserved.