TOSHIBA BiCD Integrated Circuit Silicon Monolithic

TB62763FMG

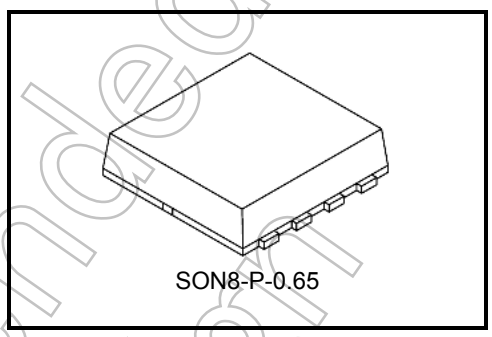
Step Up Type DC/DC Converter for White LED

The TB62763FMG is a high efficient Step-Up Type DC/DC Converter specially designed for constant current driving of White LED.

This IC can drive 2-6 Hi-current type white LEDs connected series using a Li-ion battery.

This IC contains N-ch MOS-FET Transistor for Coil-Switching, and LED current (IF) is set with an external resistor.

This IC is especially for driving back light white LEDs in LCD of PDA, Cellular Phone, or Handy Terminal Equipment.

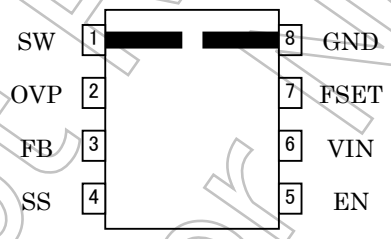


Weight : 0.017 g (Typ.)

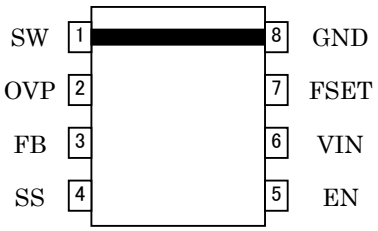
Features

- Variable LED current IF is set with a external resistor: 80mA (typ.)
- High current accuracy: +/- 1.5%
- High output power : 3W LED loading @(VOUT=20V, VIN=5V)
- High efficiency: 80% over (using recommended external parts and recommended circuit condition)
- Output over voltage shutdown function
  : Switching operation is shut downed when OVP terminal voltage is over 32.5 V (typ.).
- Soft start function included
- Adjustable switching frequency (200kHz-2MHz)
- Package : SON8-P-0.65

Pin Assignment (top view)



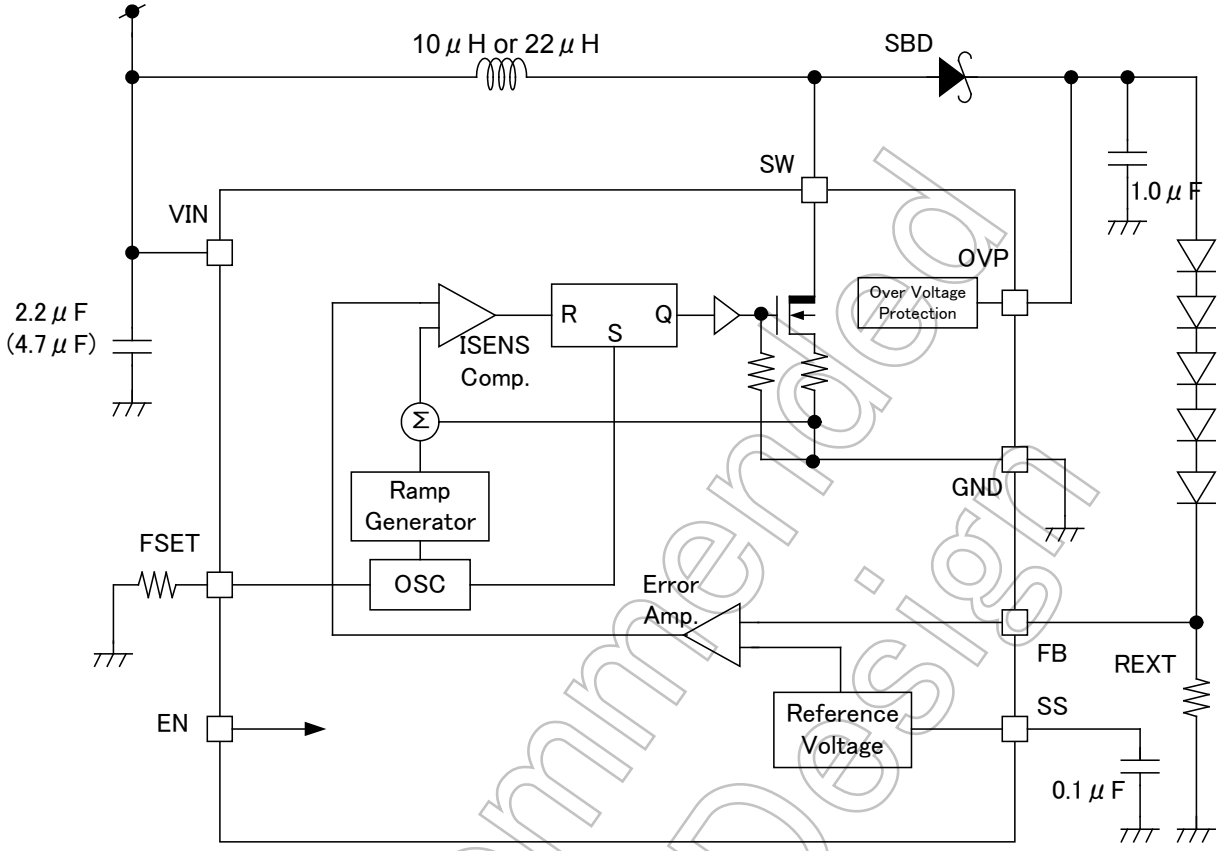
Week 1 to 26



Week 27 to 53

Note: This IC could be destroyed in some case if amounted in 180° inverse direction.
Please be careful about IC direction in mounting.

Block Diagram

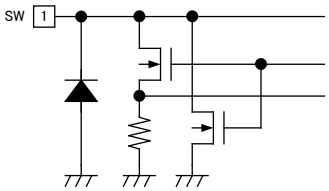


Pin Function

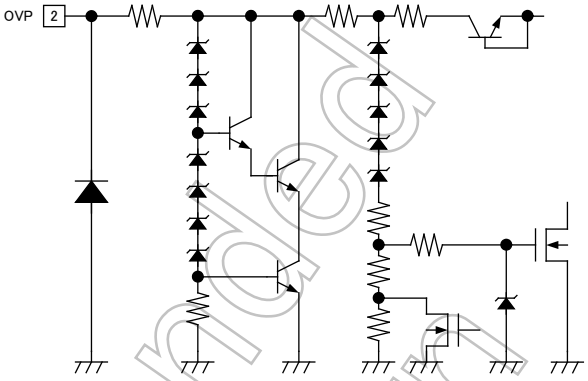
Pin No.	Symbol	Function Description
1	SW	Switch terminal for DC/DC converter. Nch MOSFET built-In.
2	OVP	Over voltage protection terminal. IC switching operation is disabled when OVP terminal voltage is over 32.5 V (TYP.). If the voltage returns to 31.5V (TYP) or less, operation is enabled again.
3	FB	LED IF setting resistor connecting terminal.
4	SS	This is a terminal to connect capacitance for soft-start function. If capacitance is no connecting in this terminal, IC operates without soft-start function.
5	EN	Voltage-input terminal for IC-enable. High: Operation mode Low: Shutdown mode If EN input is open, IC operation becomes unsettled. EN input must be fixed to High or Low.
6	VIN	Supply voltage input terminal. (2.8 V to 5.5 V)
7	FSET	Connect to resistance for internal frequency setup. (0.2 to 2MHz)
8	GND	Ground terminal.

I/O Equivalent Pin Circuits

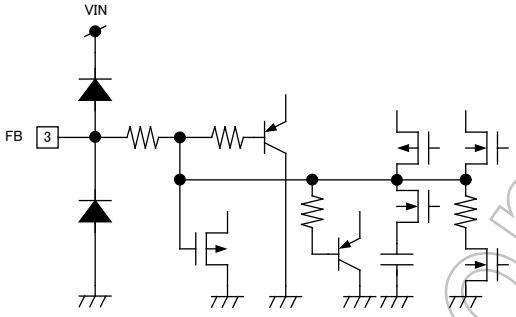
1. SW



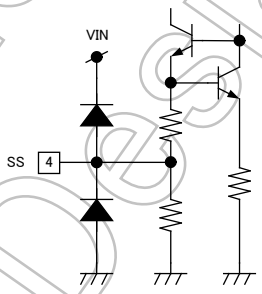
2. OVP



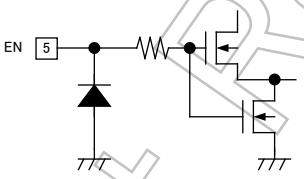
3. FB



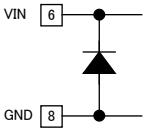
4. SS



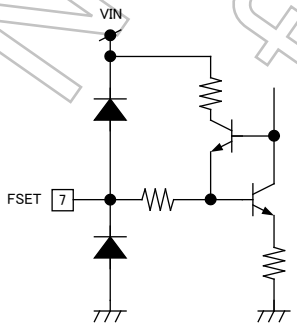
5. EN



6. VIN, GND



7. FSET



Absolute Maximum Ratings (Ta = 25°C if without notice)

Characteristics	Symbol	Rating	Unit
Power supply voltage	VIN	-0.3 to +6.0	V
Input voltage	VIN(EN)	-0.3 to +VIN + 0.3 (Note 1)	V
Switching terminal voltage	V_O (SW)	-0.3 to + 48	V
Power dissipation	P_D	0.36 (device)	W
		0.64 (on PCB) (Note 2)	
Thermal resistance	$R_{th\ (j-a)}$	340 (device)	°C/W
		193 (on PCB) (Note 3)	
Operation temperature range	T_{opr}	-40 to + 85	°C
Storage temperature range	T_{stg}	-55 to + 150	°C
Maximum junction temperature	T_j	150	°C

Note 1: Ensure that the supply voltage never exceeds 6.0 V.

Note 2: The power dissipation decreases the reciprocal of the saturated thermal resistance (1/ Rth(j-a)) for each degree (1°C) that the ambient temperature is exceeded (Ta = 25°C).

Note 3: PCB condition 40mm x 40mm x 1.6 mm, Cu 40%,FR-4

Operating Condition (Ta = -40 to 85°C if without notice)

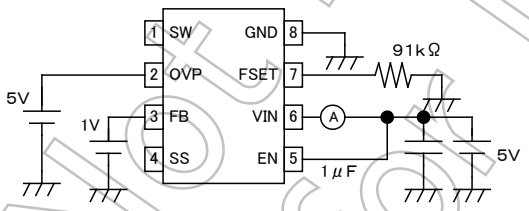
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	VIN	—		2.8	—	5.5	V
LED current	IF	—	VIN = 5.0 V, RSENS = 6.26Ω 6 white LEDs, Ta = 25°C	—	80	—	mA

Electrical Characteristics (Ta = 25°C, VIN = 4.5 to 5.5 V if without notice)

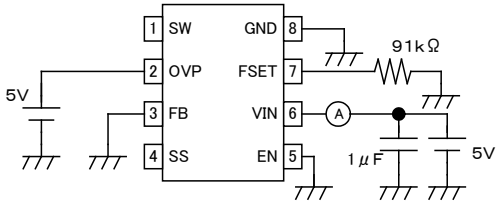
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	VIN	-	-	2.8	-	5.5	V
Operating consumption current	$I_{IN\ (ON)}$	1	V_{EN}= VIN, VFB=1V	-	0.6	0.9	mA
Quiescent consumption current	$I_{IN\ (OFF)}$	2	V_{EN}= 0 V	-	0.5	1.0	μA
EN terminal "H" level input voltage	V_{ENH}	3	-	1.3	-	VIN	V
EN terminal "L" level input voltage	V_{ENL}	3	-	0	-	0.4	V
EN terminal current	I_{EN}	4	V_{EN}=5.0 V or 0 V	-	0	1.0	μA
Integrated MOS-T_r switching frequency	f_{OSC}	5	RFSET=47kΩ	1.69	1.84	1.99	MHz
			RFSET=91kΩ	0.92	1.00	1.08	MHz
			RFSET=470kΩ	199	217	235	kHz
FSET terminal voltage	V_{FSET}	6	-	-	1.2V	-	V
FSET terminal current	I_{FSET}	7	-	11.8	13.2	14.6	μA
SS terminal voltage	V_{SS}	8	-	880	960	1060	mV
SS terminal current	I_{SS}	9	-	-	18	-	μA
SW terminal leakage current	I_{oz} (SW)	10	-	-	0.5	1	μA
Feedback voltage (FB terminal)	V_{FB}	11	RSENS = 6.26Ω	492.5	500.0	507.5	mV
		11	RSENS = 62.6Ω	492.5	500.0	507.5	mV
Feedback voltage line regulation (FB terminal)	ΔV_{FB}	11	VIN = 3.6V standard VIN = 3.0 to 5.0V	-2	-	2	%
FB terminal current	I_{FB}	12	V_{EN}= 5.0V, VFB = 500mV	-	0.02	-	μA
OVP terminal protection voltage	V_{OVP}	13	-	30.0	32.5	35.0	V
OVP terminal recover voltage	V_{REC}	13	-	29.0	31.5	34.0	V
OVP terminal hysteresis voltage	V_{OVPHYS}	13	V_{OVPHYS}= V_{OVP}-V_{REC}	0.5	1.0	2.0	V
OVP terminal leakage current	I_{OVP}	14	V_{OVP} = 28V	-	0.5	1	μA

Test Circuits

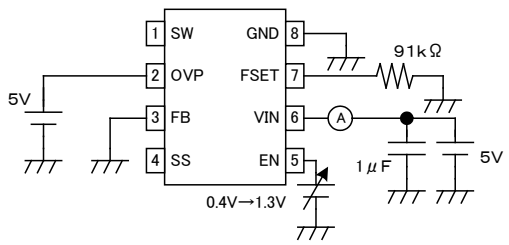
1. Operating consumption current



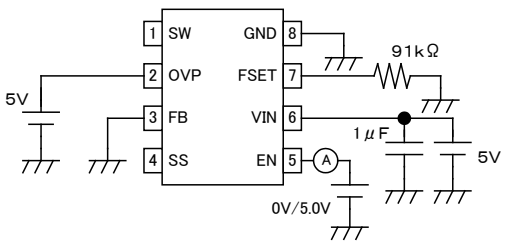
2. Quiescent consumption current



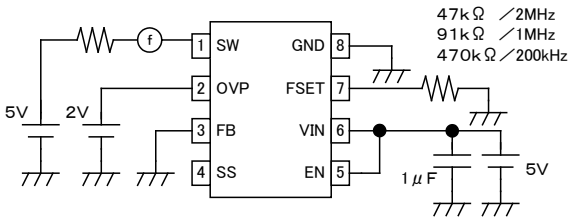
3. EN terminal "H" level and "L" level input voltage



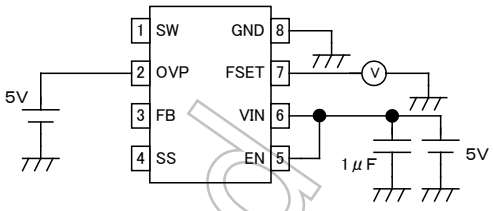
4. EN terminal current



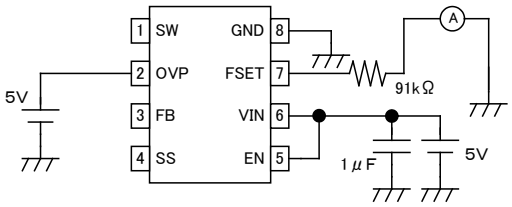
5. Integrated MOS-T_r switching frequency



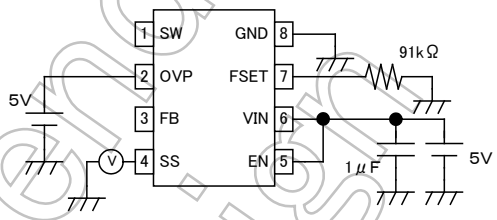
6. FSET terminal voltage



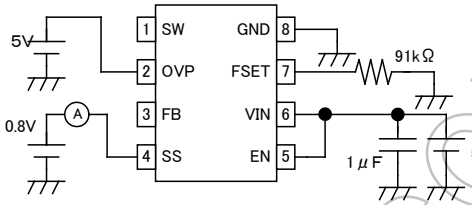
7. FSET terminal current



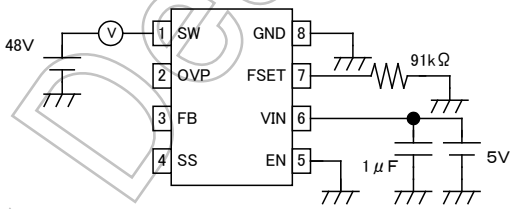
8. SS terminal voltage



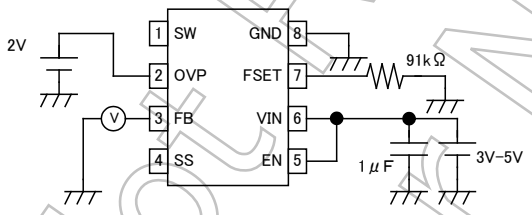
9. SS terminal current



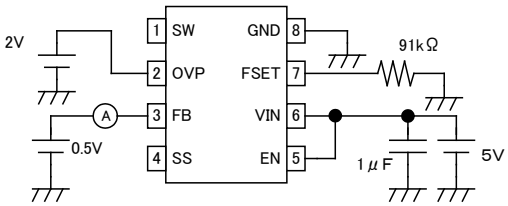
10. SW terminal leakage current



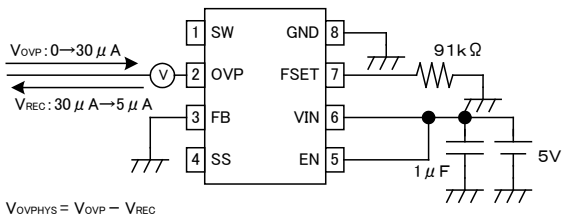
11. FB terminal feedback voltage and FB terminal line regulation



12. FB terminal current

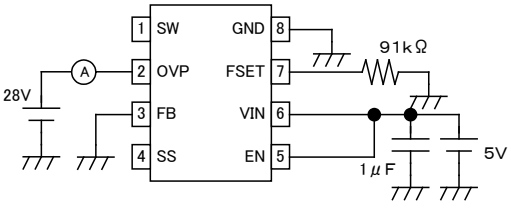


13. OVP terminal protection voltage, OVP terminal recover voltage
OVP terminal hysteresis voltage



$V_{OVPHYS} = V_{OVP} - V_{REC}$

14. OVP terminal leakage current

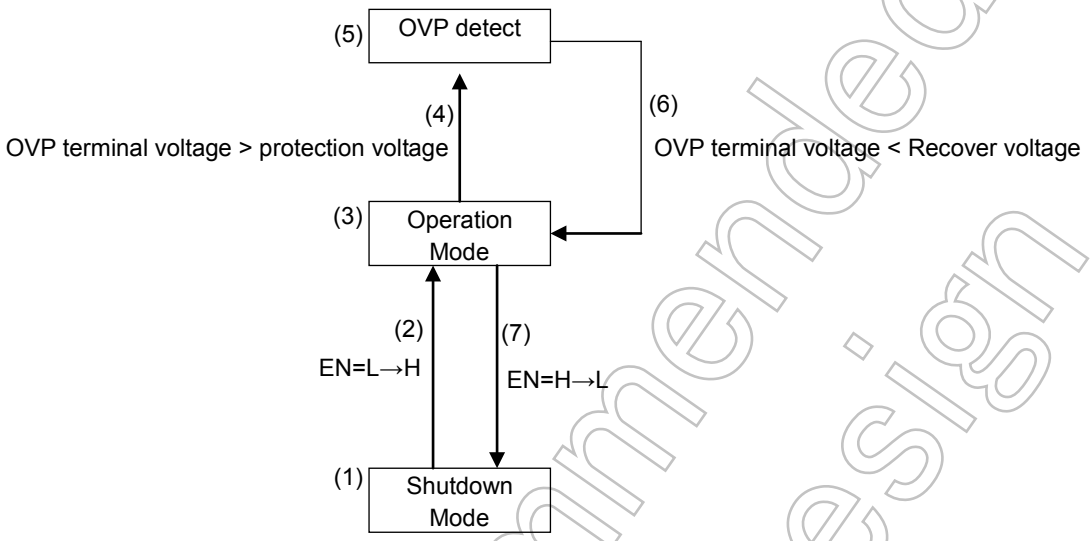


Function diagram

The mode selecting shown below with logic input EN terminal.

EN	MODE
H	Operation mode
L	Shutdown mode

State Transition Diagram



	State	boost circuit	OVP circuit	OSC circuit	Internal reference circuit	Soft start circuit
(1)	Shutdown	Stop	Stop	Stop	Stop	Stop
(2)	EN: L to H	—	—	—	—	—
(3)	Operation	Operate	Operate	Operate	Operate	Operate
(4)	OVP detect	—	—	—	—	—
(5)	OVP operation	Stop	Operate	Stop	Operate	Operate
(6)	OVP release	—	—	—	—	—
(7)	EN: H toL	—	—	—	—	—

Usage Precautions

Protection in LED Opened Condition

The operation with OVP terminal is available for the protection in case LED circuit opened.

When the voltage of OVP terminal is over 32.5 V (typ.), Nch MOS switching operation is disabled in the IC. When the voltage of OVP terminal drops below 31.5 V (typ.), Nch MOS switching operation becomes available again.

If load of LED is detached, Nch MOS switching operation is disabled with detection of boost circuit voltage and the IC is protected from unexpected over voltage.

Setting of Capacitor

The recommended values are

C_1 = 2.2 (μF) or more, C_2 = 1.0 (μF) or more

The capacitor of ceramic condenser tends to decrease when voltage is applied.

So, please select the appropriate capacitor in consideration of IC characteristics of withstand voltage and size.

Setting of External Inductor Size

Please select the inductor size with referring this table corresponding to each number of switching frequency.

[Recommended inductor values]

Switching frequency	Indictor Value	Note
200 to 500kHz	22 μH	LED current IF = 80 mA
Up to 500kHz	10 μH	

Setting of IF

Resistance “REXT” which connects between FB pin and GND is for setting IF value.

The average current is set by this “REXT” value and average current are obtained by the following equation.

$$IF\ (mA) = \frac{500\ (mV)}{REXT\ (\Omega)}$$

Current value error is within ±1.5%. (The error of the REXT resistance is not included.)

Setting of Switching frequency

Resistance “RFSET” which connects between FSET pin and GND pin is for setting frequency.

Switching frequency “fosc” can be set by resistance value.

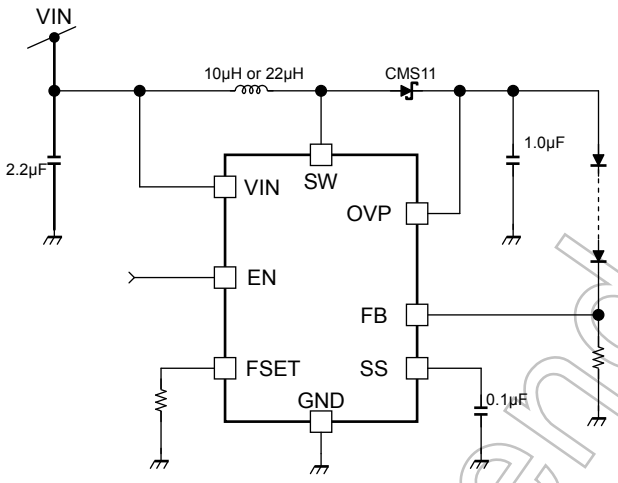
Switching frequency “fosc” are obtained by the following equation.

$$fosc(kHz) = 66231 \times RFSET\ (k\Omega)^{-0.9299}$$

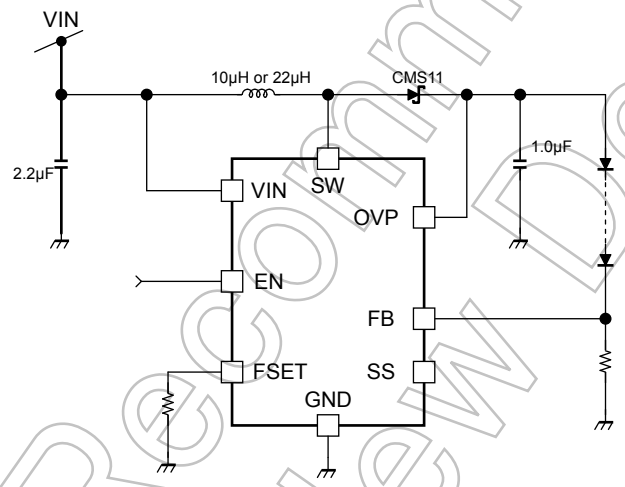
Setting error is within ±8%. (The error of the RFSET resistance is not included.)

Application

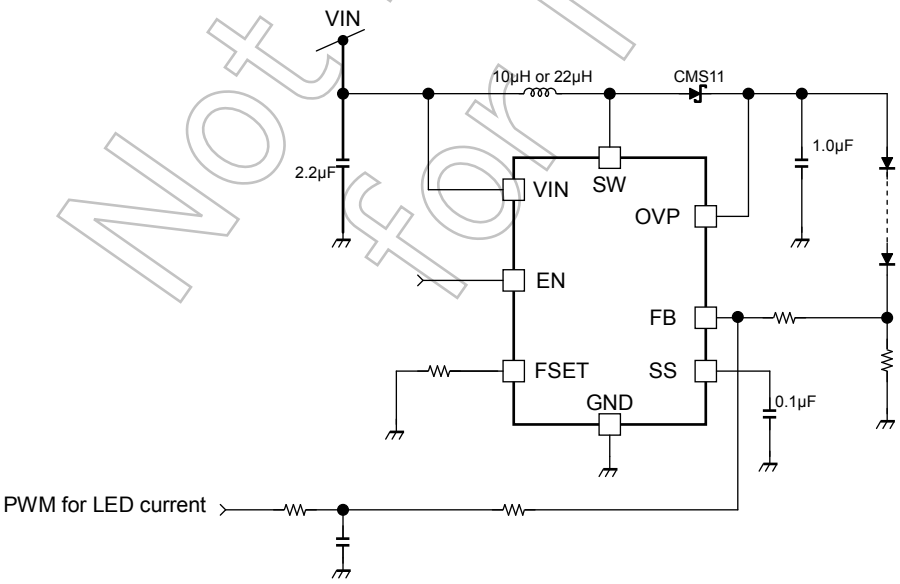
1. normal application



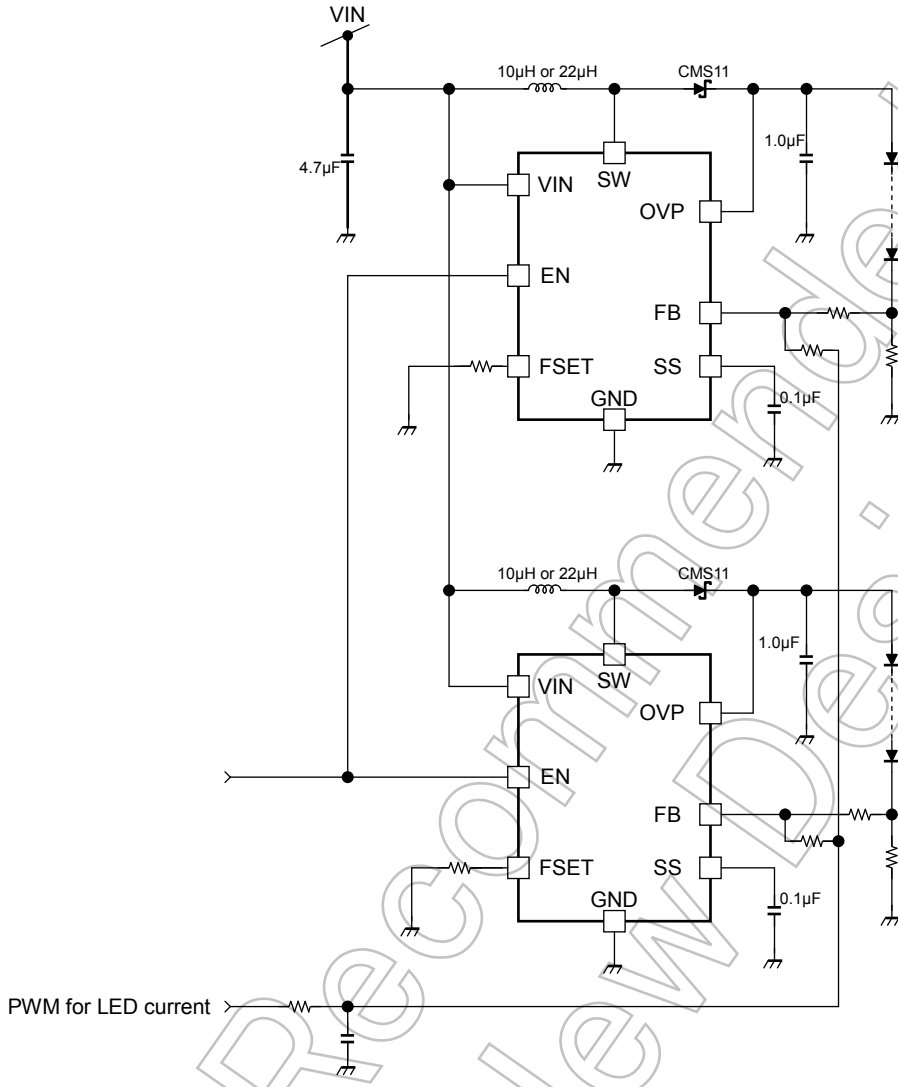
2. No use the soft –start function



3. Input the PWM signal to adjust the Switching frequency and LED current

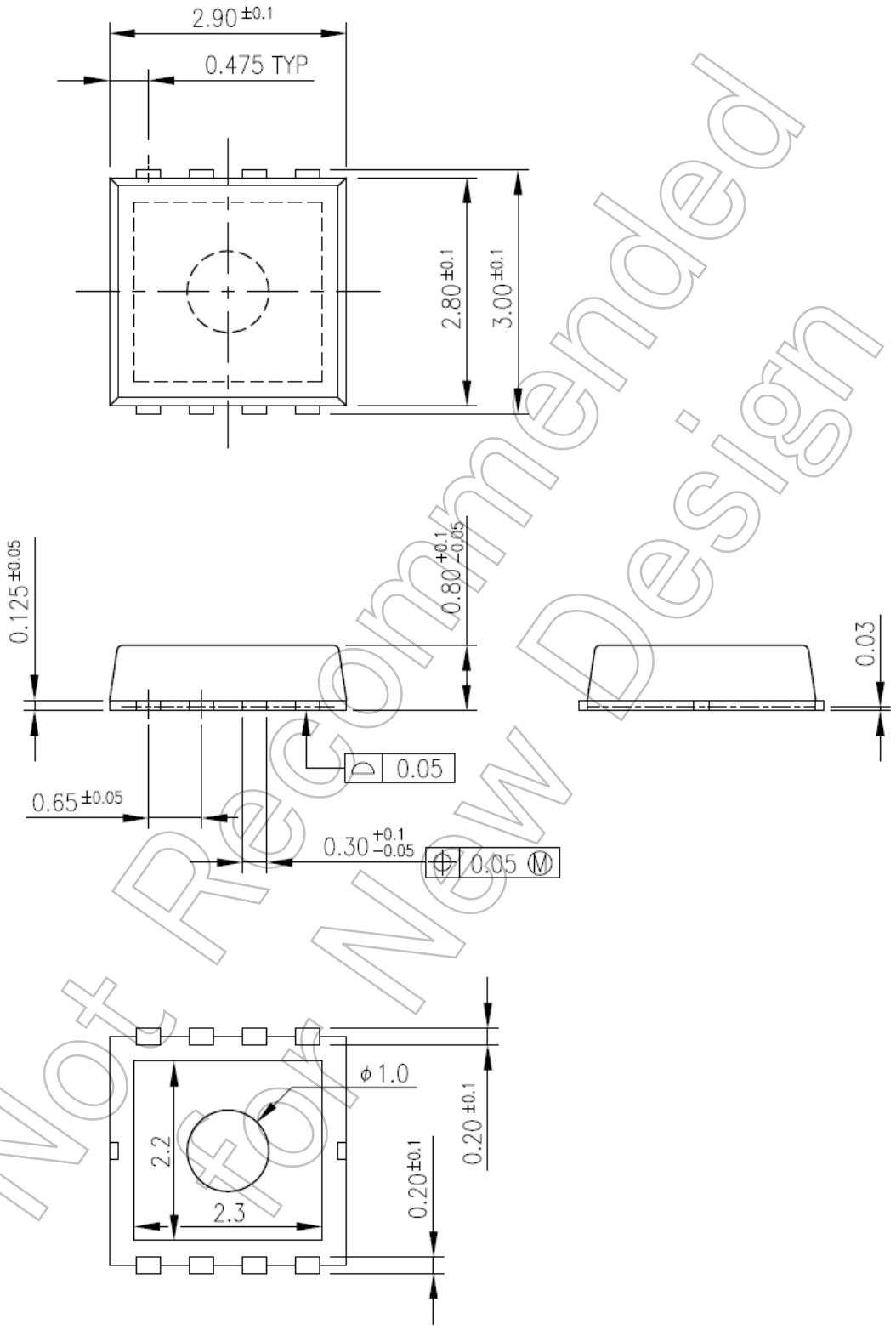


4. 2 lines control



Package Dimensions

SON8-P-0.65 Unit: mm



weight : 0.017 g (Typ.)

・Notes on Contents

1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits

Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

IC Usage Considerations

Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

[2] Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

[3] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[4] Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

[5] Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

(1) Heat Radiation Design

In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (T_J) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(2) Back-EMF

When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output terminals might be exposed to conditions beyond the absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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