

TOSHIBA BiCD Digital Integrated Circuit Silicon Monolithic

TB62752BFUG

Step Up Type DC/DC Converter for White LED

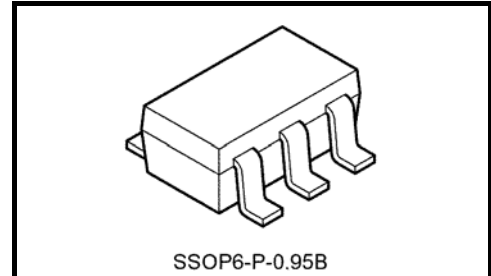
The TB62752BFUG is a high efficient Step-Up Type DC/DC Converter specially designed for constant current driving of White LED.

This IC can drive 2-7 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.

This device is Pb-free product.

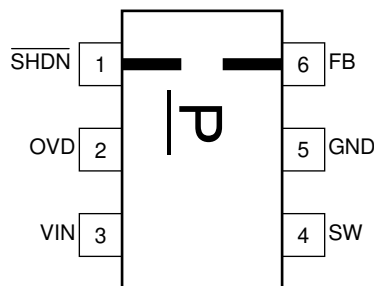


Weight: 0.016 g (typ.)

Features

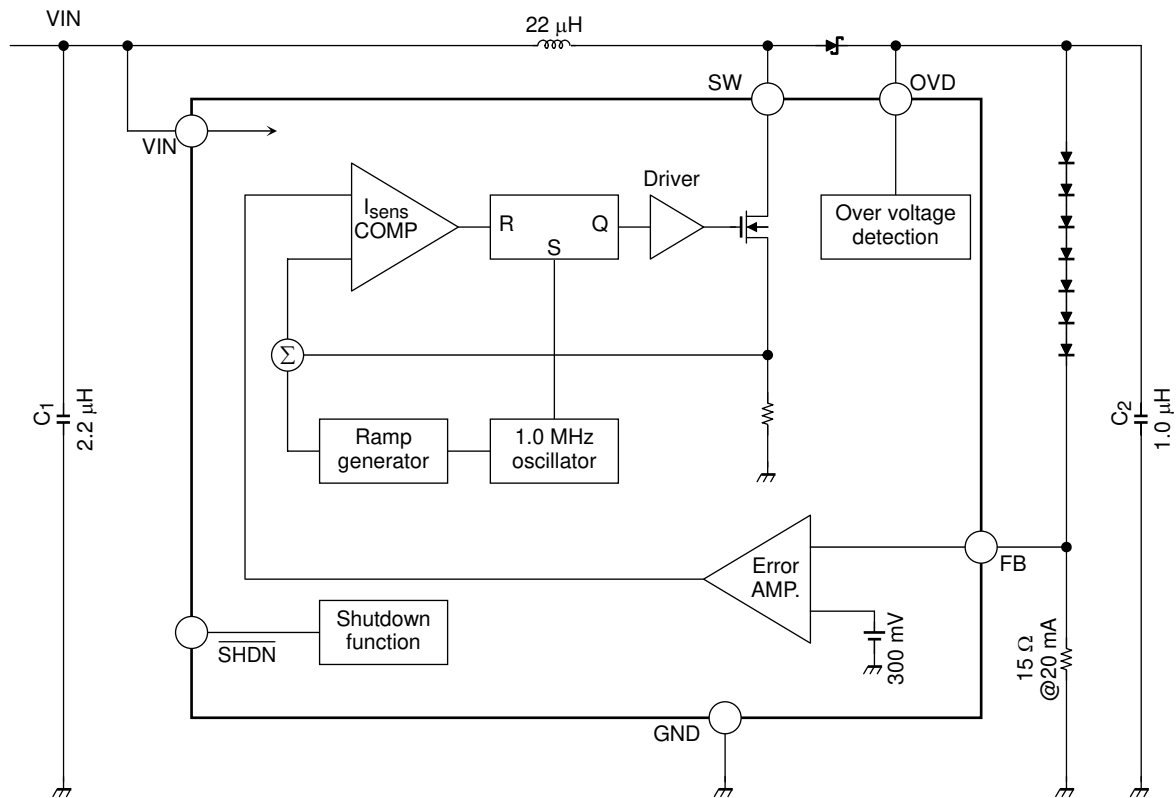
- 2-7 white LEDs connected series.
- Variable LED current IF is set with a external resistor: 20 mA (typ.) @RSENS = 15 Ω
- Output power: Available for 800 mW LED loading (7LEDs, IF = Over 25 mA)
- High efficiency: 80% over (using recommended external parts)
- Output over voltage shutdown function
: Switching operation is shut downed when OVD terminal voltage is over 37 V (typ.).
- IC package: SSOP6-P-0.95B
- Switching frequency: 1.0 MHz (typ.)

Pin Assignment (top view)



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

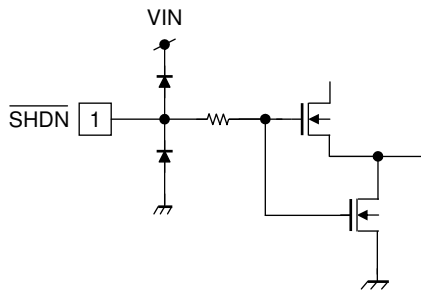


Pin Function

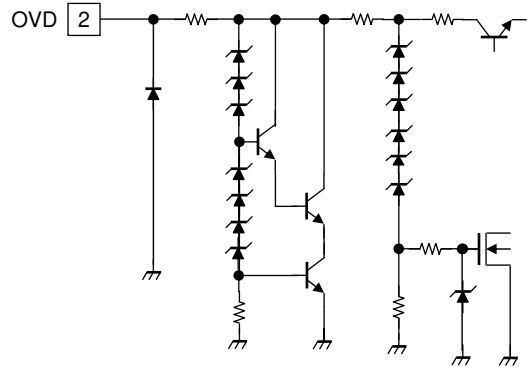
Pin No.	Symbol	Function Description
1	$\overline{\text{SHDN}}$	Voltage-input terminal for IC-enable/disable LED- I_F . A high input on this pin enables the IC to operate while a low input causes it to shut down. The behavior of the IC is unpredictable if the input on the pin is undefined. Ensure that the pin is tied to either a high or low level.
2	OVD	Over voltage detection terminal. IC switching operation is disabled with detection over voltage. If the voltage returns to detection level or less, operation is enabled again.
3	VIN	Supply voltage input terminal. (2.8 V to 5.5 V)
4	SW	Switch terminal for DC/DC converter. Nch MOSFET built-in.
5	GND	Ground terminal.
6	FB	LED I_F setting resistor connecting terminal.

I/O Equivalent Pin Circuits

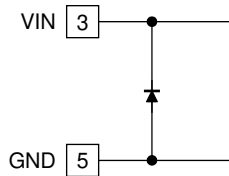
1. SHDN Terminal



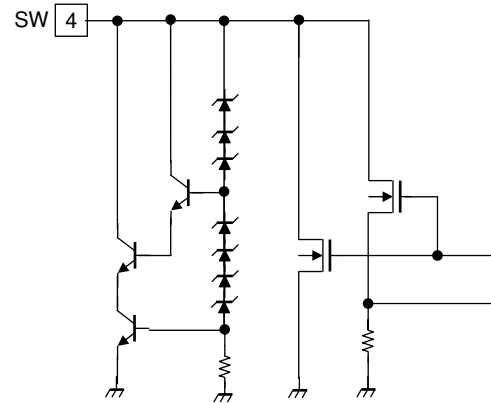
2. OVD Terminal



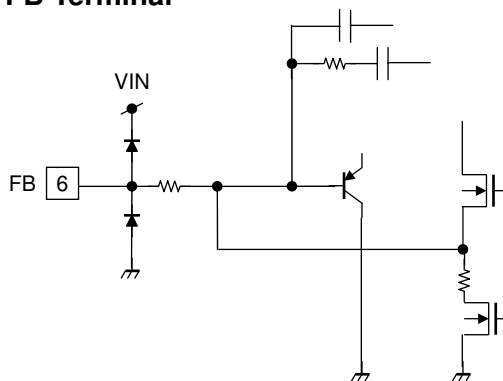
3. VIN Terminal to GND Terminal



4. SW Terminal



5. FB Terminal



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 ($\overline{\text{SHDN}}$)	-0.3 to +VIN + 0.3 (Note 1)	V
Switching terminal voltage	VO (SW)	-0.3 to +40	V
Switching terminal current	IO (SW)	1500	mA
Power dissipation	PD	0.41 (device)	W
		0.47 (on PCB) (Note 2)	
Thermal resistance	Rth (j-a)	300 (device)	°C/W
		260 (on PCB)	
Operation temperature range	Topr	-40 to +85	°C
Storage temperature range	Tstg	-55 to +150	°C
Maximum junction temperature	Tj	150	°C

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

Note 2: Power dissipation must be calculated with subtraction of 3.8 mW/°C from maximum rating with every 1°C if Topr is upper 25°C. (on PCB)

Recommended 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 = 3.6 V, RSENS = 15 Ω 6 white LEDs, Ta = 25°C	—	20	—	mA

Electrical Characteristics (Ta = 25°C, VIN = 2.8 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	IIN (ON)	1	VIN = 3.6 V, RSENS = 15 Ω	—	0.6	0.9	mA
Quiescent consumption current	IIN (OFF)	2	VIN = 3.6 V, $\overline{\text{SHDN}} = 0$ V	—	0.5	1.0	μA
$\overline{\text{SHDN}}$ terminal "H" level input voltage	V $\overline{\text{SHDNH}}$	3	—	1.3	—	VIN	V
$\overline{\text{SHDN}}$ terminal "L" level input voltage	V $\overline{\text{SHDNL}}$	3	—	0	—	0.4	V
$\overline{\text{SHDN}}$ terminal current	I $\overline{\text{SHDN}}$	4	VIN = 3.6 V, $\overline{\text{SHDN}} = 3.6$ V or 0 V	—	0	1.0	μA
Integrated MOS-Tr switching frequency	fOSC	5	VIN = 3.6 V, $\overline{\text{SHDN}} = 3.6$ V	0.77	1.0	1.43	MHz
Switching terminal leak current	IOz (SW)	6	—	—	0.5	1	μA
FB terminal feedback voltage	VFB	7	VIN = 3.6 V, RSENS = 15 Ω Ta = 25°C, L = 22 μH	285	300	315	mV
		7	VIN = 4.2 V, RSENS = 150 Ω Ta = 25°C, L = 22 μH	285	300	315	mV
FB terminal line regulation	ΔVFB	7	VIN = 3.6 V (typ.) VIN = 3.0 to 5.0 V	-5	—	5	%
FB terminal current	IFB	8	VIN = 3.6 V, $\overline{\text{SHDN}} = 3.6$ V, VFB = 300 mV	—	0.02	—	μA
OVD terminal detect voltage	VOVD	9	—	29	31.5	34	V
OVD terminal leakage current	IOVD	10	VOVD = 30 V	—	0.5	1	μA

Usage Precautions

Protection in LED Opened Condition

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

When the voltage of OVD terminal is over 37 V (typ.), Nch MOS switching operation is disabled in the IC. When the voltage of OVD terminal drops below 37 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 External Capacitor

Terminal for brightness control, recommended values are

$$C_1 = \text{Over } 2.2 \text{ } (\mu\text{F}), C_2 = \text{Over } 1.0 \text{ } (\mu\text{F})$$

The recommended values of the capacitors depend on the control of brightness. For details, please see the item "Control of brightness" from the next page.

These recommended values reduce fluctuation of input current to up accuracy of brightness.

Setting of I_F

Resistance connects between RSENS pin and GND.

The average current is set by this RSENS value and average current are obtained by the following equation.

$$I_F \text{ (mA)} = \frac{300 \text{ [mV]}}{\text{RSENS } [\Omega]}$$

Current value error is within $\pm 5\%$.

Setting of External Inductor Size

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

[Recommended inductor values]

LEDs	Indictor Size	Note
2 to 5	10 μH	LED current $I_F = 20 \text{ mA}$
Over 6	22 μH	

Current Dimming Control

Recommended brightness control circuits are 4 types.

- (1) Input PWM signal to $\overline{\text{SHDN}}$ terminal
 I_F can be adjusted with PWM signal by inputting it to $\overline{\text{SHDN}}$ terminal.

<<PWM signal frequency>>

- The recommended PWM signal frequency is from 100 Hz to 10 kHz. There is a possibility to arise the audible frequency in mounting to the board because it is within the auditory area.

<<Constant number of external condenser>>

- To reduce the fluctuation of input current and increase the accuracy of brightness, the values that $C_1 = 4.7 \text{ } (\mu\text{F})$ or more, $C_2 = 0.1 \text{ } (\mu\text{F})$ or less are recommended.
- When the PWM signal is off, the time to drain C_2 of charge depends on the constant number. And so, the actual value is little different from the theoretical value.

<<PWM input signal>>

- Set the amplitude of PWM signal within the range of $\overline{\text{SHDN}}$ terminal specification.

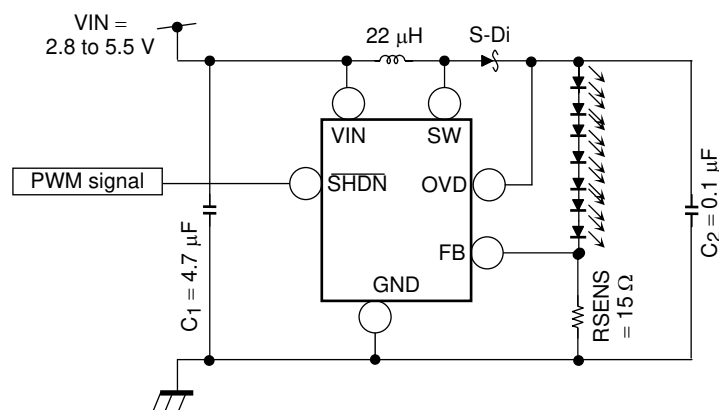
<<Rush current in inputting>>

- In case dimming by inputting the PWM signal to the $\overline{\text{SHDN}}$ terminal, this IC turns on and off repeatedly.
 And the rush current, which provides the charge to C_2 , arises in turning on. Take care in selecting the condenser.

<<Current value in control with PWM: Ideal equation>>

$$I_F \text{ [mA]} = \frac{300 \text{ [mV]} \times \text{ON Duty [\%]}}{R_{\text{SENS}} \text{ } [\Omega]}$$

<<Recommended application>>



(2) Input analog voltage to FB terminal

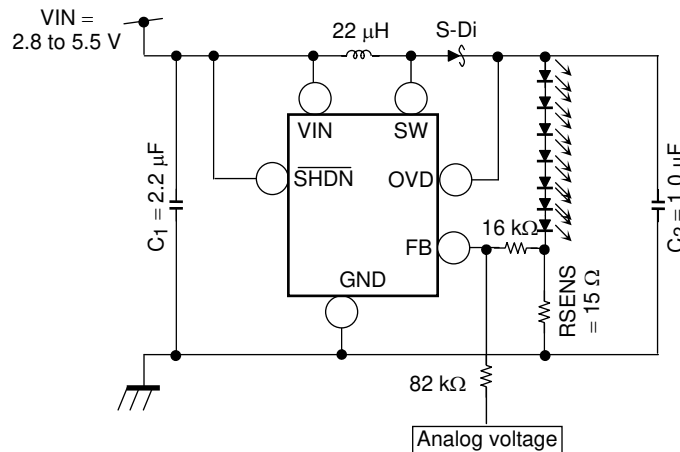
I_F can be adjusted with analog voltage input to FB terminal.

This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

- LED current value goes over 100% of the current set with RSENS, if the input analog voltage is between 0 V to 300 mV (typ.).

<<Recommended application>>



(3) Input PWM signal with filtering to FB terminal

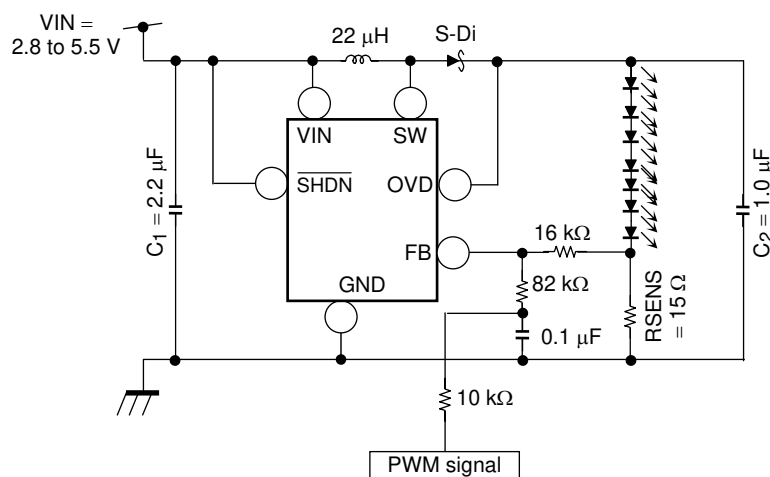
I_F can be adjusted with filtering PWM signal using RC filter indicated in recommended circuit, because the PWM signal can be regard as analog voltage after filtering.

This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

- LED current value goes over 100% of the current set with RSENS, if the input voltage after filtering is between 0 V to 300 mV (typ.).

<<Recommended application>>



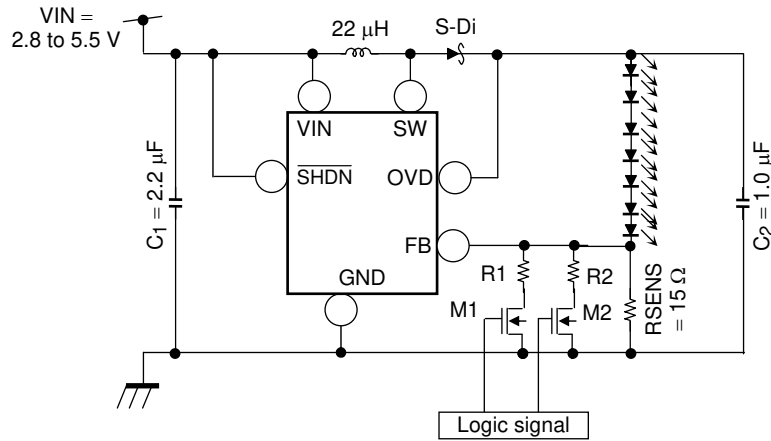
(4) Input logic signal

I_F can be adjusted with logic signal input as indicated in recommended circuit.
The resistor connected the ON-State Nch MOS drain and RSENS determines I_F.

Average of setting current I_O (mA) is next, approximately.

$$I_F \text{ [mA]} = \frac{300 \text{ [mV]}}{\text{Sum of resistor value } [\Omega]}$$

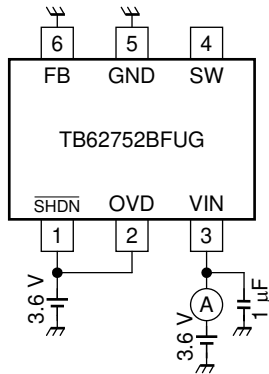
<<Recommended application>>



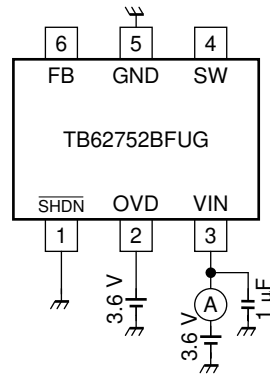
M1	M2	LED Current
OFF	OFF	$\frac{300 \text{ [mV]}}{R_{SENS} [\Omega]}$
ON	OFF	$300 \text{ [mV]} \times \frac{R_{SENS} [\Omega] + R1 [\Omega]}{R_{SENS} [\Omega] \times R1 [\Omega]}$
OFF	ON	$300 \text{ [mV]} \times \frac{R_{SENS} [\Omega] + R2 [\Omega]}{R_{SENS} [\Omega] \times R2 [\Omega]}$
ON	ON	$300 \text{ [mV]} \times \frac{R_{SENS} [\Omega] \times R1 [\Omega] + R_{SENS} [\Omega] \times R2 [\Omega] + R1 [\Omega] \times R2 [\Omega]}{R_{SENS} [\Omega] \times R1 [\Omega] \times R2 [\Omega]}$

TEST Circuit

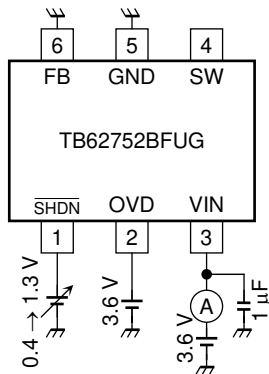
1. I_{IN} (ON)



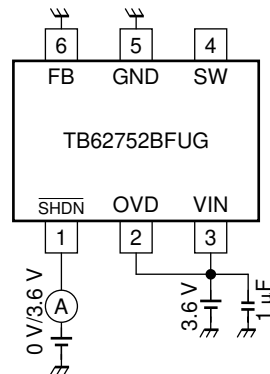
2. I_{IN} (OFF)



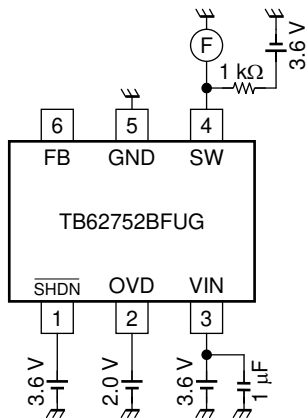
3. V_{SHDNH} , V_{SHDNL}



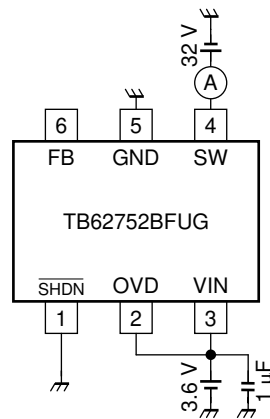
4. I_{SHDN}



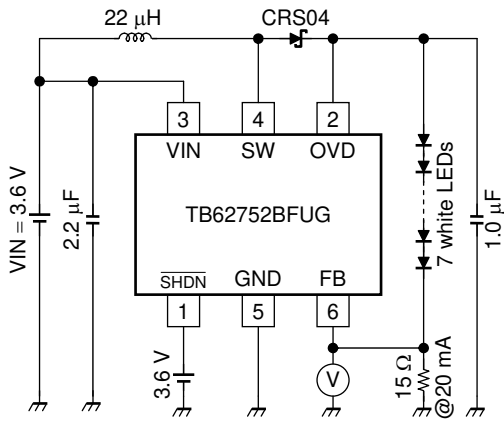
5. f_{osc}



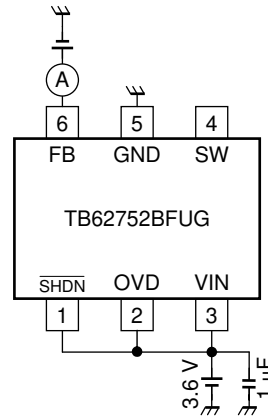
6. I_{oz} (SW)



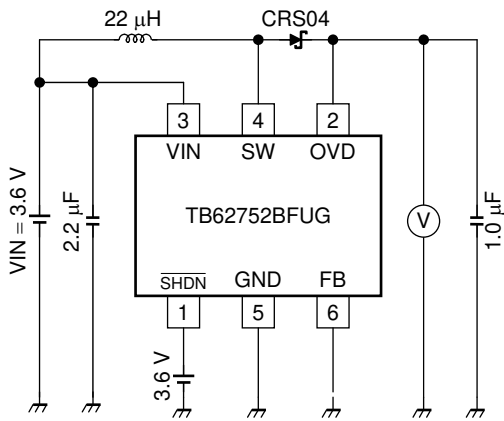
7. $V_{FB}, \Delta V_{FB}$ *1



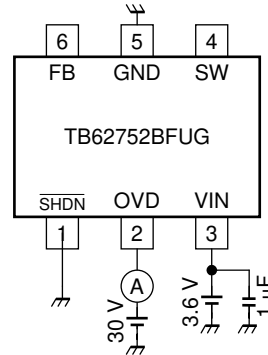
8. I_{FB}



9. V_{OVD} *1



10. I_{OVD}

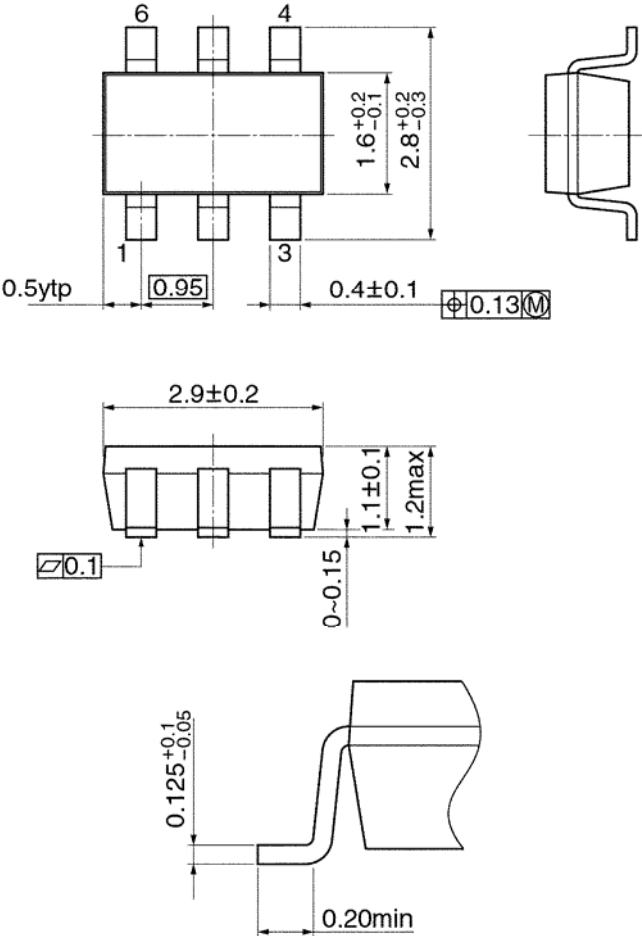


*1: The locations of the pins differ from the actual ones to simplify the diagram. See page 1 for the actual pin locations.

Package Dimensions

SSOP6-P-0.95B

Unit: mm



Weight: 0.016 g (typ.)

About solderability, following conditions were confirmed

- Solderability
 - (1) Use of Sn-63Pb solder Bath
 - solder bath temperature = 230°C
 - dipping time = 5 seconds
 - the number of times = once
 - use of R-type flux
 - (2) Use of Sn-3.0Ag-0.5Cu solder Bath
 - solder bath temperature = 245°C
 - dipping time = 5 seconds
 - the number of times = once
 - use of R-type flux

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