TOSHIBA BiCD Digital Integrated Circuit Silicon Monolithic

TB62737FPG

-TENTATIVE-

Step Up Type DC/DC Converter for White LED

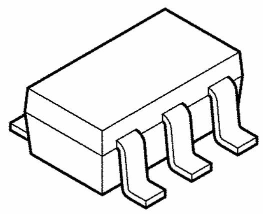
The TB62737FPG is a high efficient step-up type DC/DC converter specially designed for constant current driving of White LED.

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

This IC contains N-ch MOS-FET Transistor for Coil-Switching, and LED Current (I_F) 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.



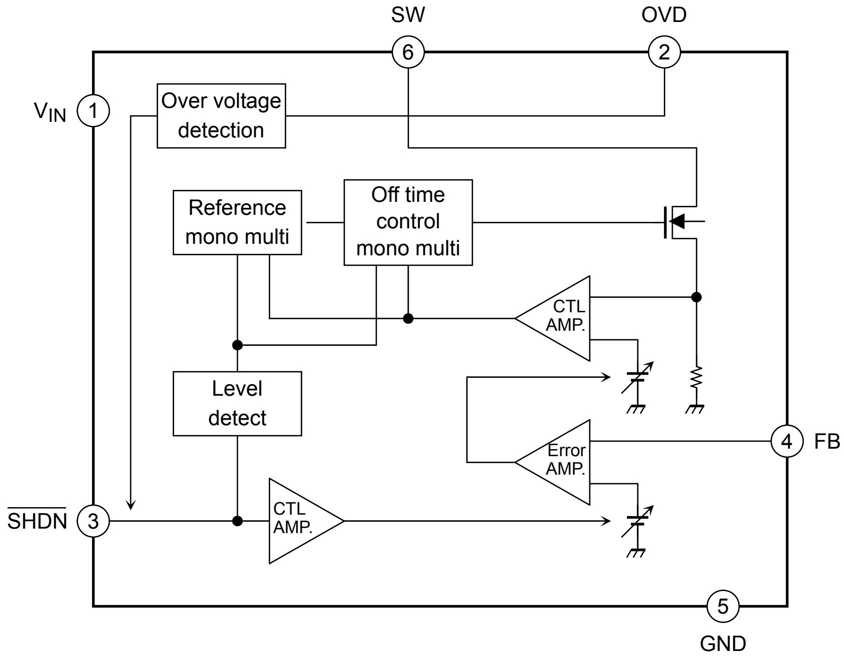
SSOP6-P-0.95B

Weight: 0.016 g (typ.)

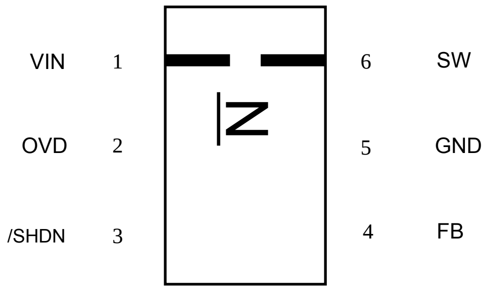
Features

- Brightness control function with changing drive current:
  LED current $I_F = 25\%$ to 100% (analog input)
  For the control in range of 25% or less, refer 6-page.
- Can drive 2-6 white LEDs connected series
- Built-in over voltage detection circuit:
  Protection Voltage: OVD pin =22V (TYP.)
- Variable LED current I_F is set with a external resistor:
  20 mA (typ.) @$R_{SENS} = 16\ \Omega$
- Output power: Available for 400 mW LED loading
- High efficiency: 87% @maximum (using recommended external parts)
- IC package: PLP-6
- Switching frequency: 1.1 MHz (typ.)

Block Diagram



Pin Assignment (top view)



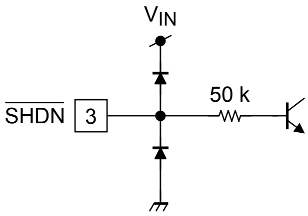
Note: This IC could be destroyed in some case if amounted in 180° inverse direction.
Please be careful about IC direction in mounting.

Pin Function

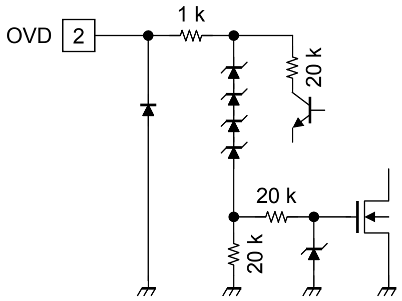
Pin No.	Symbol	Function Description
1	V_{IN}	Supply voltage input terminal. (2.8 V to 5.5 V)
2	OVD	Over voltage detection terminal. IC switching operation is disabled with detection over voltage. If the voltage returns to detection level or less, operation is enabled again.
3	/SHDN	Voltage-input terminal for IC-enable/setting LED-I_F. 0 V to 0.5 V: Shutdown (PS) mode, IC operation is disabled. 1.0 V to 2.5 V: I_F = 25% to 100% Over 2.5 V: I_F = 100% I_F adjustment with PWM input signal is also available.
4	FB	LED I_F setting resistor connecting terminal.
5	GND	Ground terminal.
6	SW	Switch terminal for DC/DC converter. Nch MOSFET built-in.

I/O Equivalent Pin Circuits

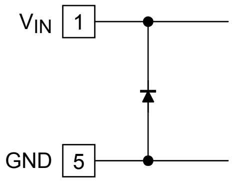
1. $\overline{\text{SHDN}}$ Terminal



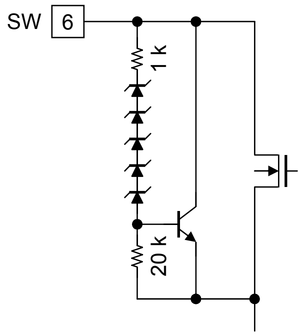
2. OVD Terminal



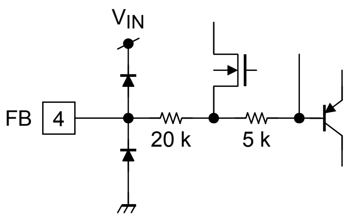
3. V_{IN} Terminal to GND Terminal



4. SW Terminal



5. FB Terminal



Setting of External Capacitor

In case not using PWM signal to $\overline{SHDN}$ terminal for brightness control, recommended values are C_1 = Over 2.2 (μF), C_2 = Over 1.0 (μF)

In case with PWM signal to $\overline{SHDN}$ terminal for brightness control, recommended values are C_1 = Over 4.7 (μF), C_2 = Under 0.1 (μF).

The recommended capacitor values depend on the Brightness Control Method.

<Please refer the next page or later>

The capacitor value must be considered for gain enough accuracy of brightness with reduction of noise from Input current changing.

Setting of External Inductor Size

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

Recommendation

LEDs	Indictor Size	Note
2	4.7 μH	LED current I_F = 20 mA
3		
4	6.8 μH	
5	8.1 μH	
6	10 μH	

LED Current IF Setting

The resistance between the FB pin and GND, RSENS (Ω) is the resistance for the setting the output current.
Depending on the resistance value, it is possible to set the average output current Io (mA).
The average output current Io (mA) can be approximated with the following equation:

$$I_F = (325\ [mV]/RSENS\ [\Omega])$$

The current value error is ± 5%.

Protection in LED Opened Condition

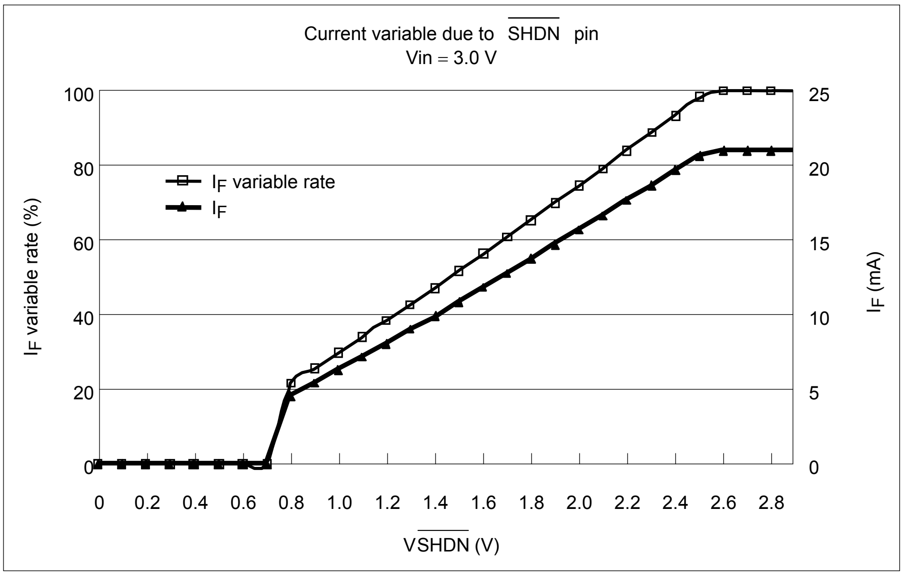
The operation with OVD terminal is available for the protection in case LED Circuit opened.
Please see the example of application circuit.
If load of LED is detached, Nch MOS switching operation is disabled with detection of boost circuit voltage.

Current Dimming Control

Recommended Brightness Control Circuits are 5 types.

1) Input analog voltage to $\overline{SHDN}$ terminal
   I_F can be adjusted in range of 25% to 100% after set with external resistor connected RSENS terminal.
   Linearity error in V-A Conversion is within +/−10%.

$\overline{SHDN}$ Voltage	$V\overline{SHDN}$ = 0 V to 0.5 V	$V\overline{SHDN}$ = 1 V to 2.5 V	$V\overline{SHDN}$ > 2.5 V	Note
I_F Valuable Rate	0	25 to 100	100	Unit: %



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

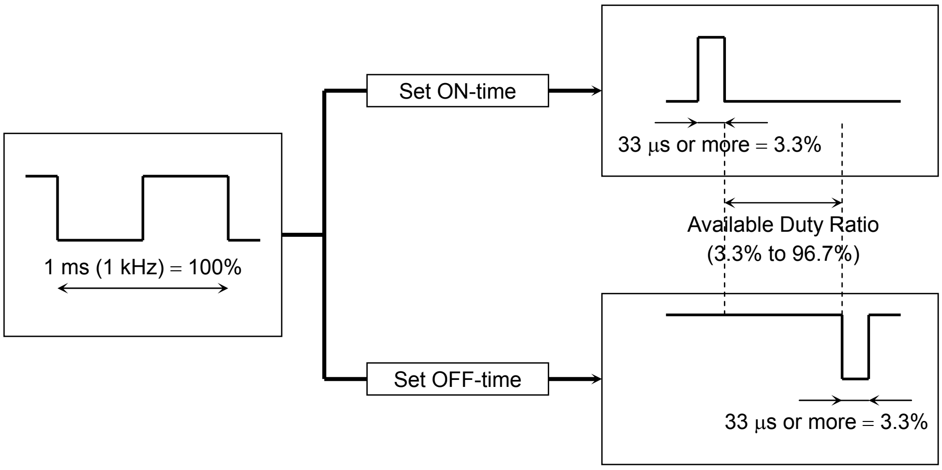
[Notice]

<<Minimum ON-time of PWM signal input>>

- Set the minimum ON-time or OFF-time 33 μs or more in inputting the PWM signal.
- Set the Duty ratio satisfying the condition above.

Ex) In case PWM Frequency is 1 kHz,
1 kHz is 1 ms (PWM width = 100%) and it takes 10 μs per 1%.
To set the pulse width 33 μs or more, necessary ON-or-OFF-time is calculated below.
33 μs ÷ 10 μs = 3.3% (Under the condition that 10 μs equals 1%.)

Finally, the Duty Ratio can be set in range of 3.3% to 96.7%.



<<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 (μF) or more , C_2 = 0.1 (μF) 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 $\overline{SHDN}$ terminal specification.

<<Rush current in inputting>>

- In case dimming by inputting the PWM signal to the $\overline{SHDN}$ 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.

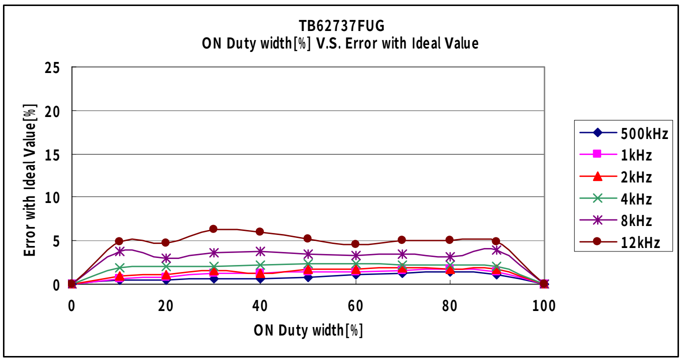
<<Current value in Control with PWM: Ideal Equation>>

$$I_F\,[\mathrm{mA}] = \frac{325\,[\mathrm{mV}] \times \mathrm{ON\ Duty}\,[\%]}{\mathrm{RSENS}\,[\Omega]}$$

<Reference Data>

Condition: V_{IN} = 3.6 V, L = 6.8 μH, 4LEDs, RSENS = 16 mΩ @Io = 20 mA

(1) C_1 = 4.7 μF, C_2 = 0.1 μF

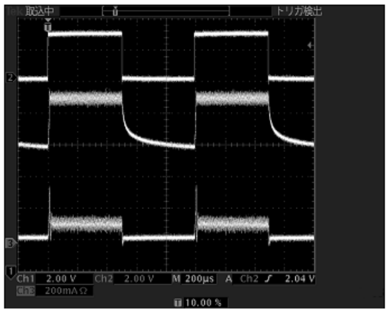


Wave Form

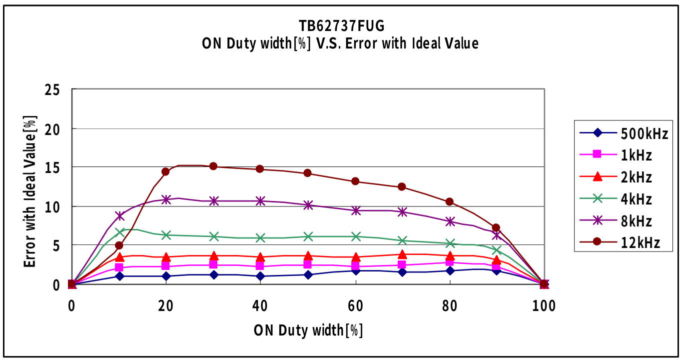
SHDN

VOUT

I_{IN}



(2) C_1 = 4.7 μF, C_2 = 0.47 μF

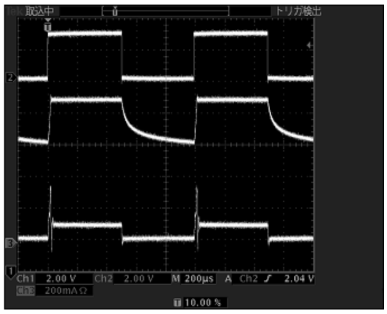


Wave Form

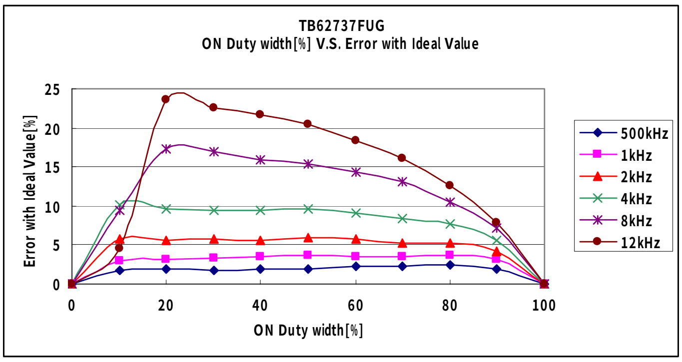
SHDN

VOUT

I_{IN}



(3) C_1 = 4.7 μF, C_2 = 1.0 μF

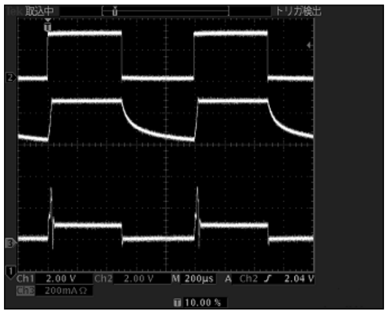


Wave Form

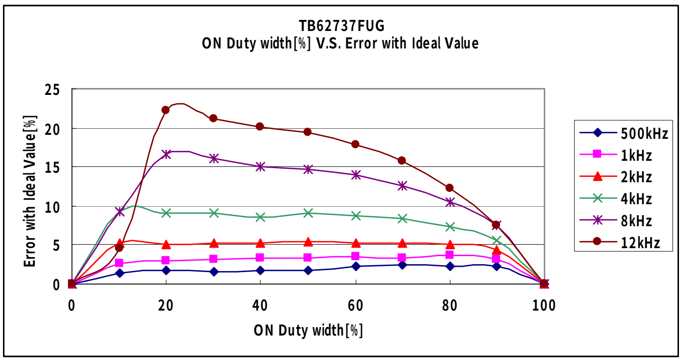
SHDN

VOUT

I_{IN}



(4) C_1 = 2.2 μF, C_2 = 1.0 μF

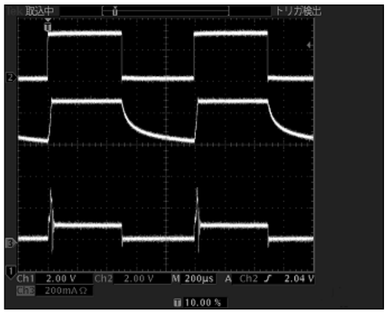


Wave Form

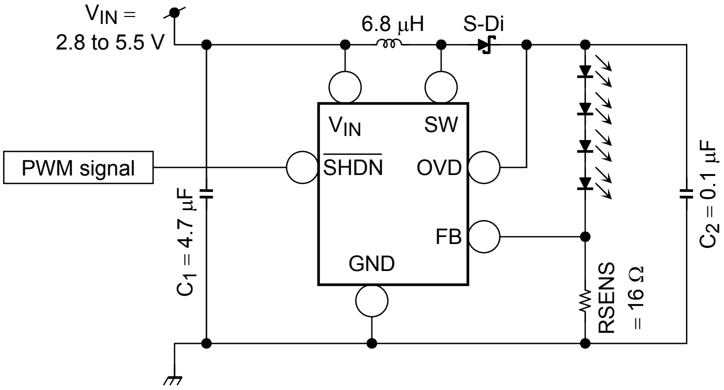
SHDN

VOUT

I_{IN}



<Recommended application>



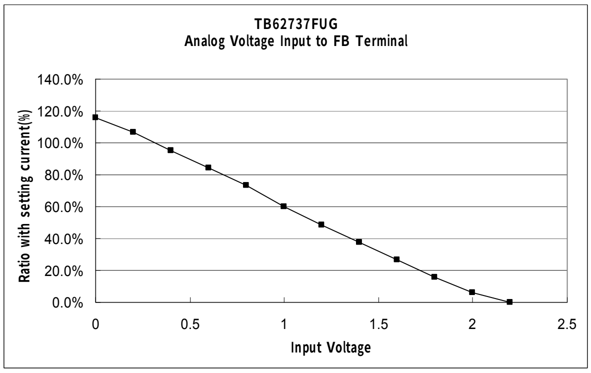
3) Input analog voltage to FB terminal
I_F can be adjusted with Analog voltage input to FB terminal.
This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

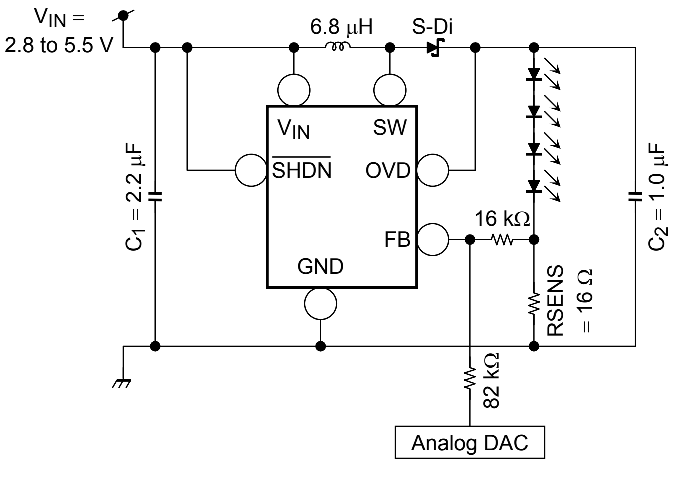
- LED current value goes over 100% of the current set with RSENS, if the input analog voltage is between 0 V to 325 mV (typ.).

(Reference data) Analog voltage = 0 to 2.2 V
About external parts value, please see recommended circuit.

Supply Voltage (V)	Ratio with Setting Current
No connect (OFF)	100%
0	116.0%
0.2	106.5%
0.4	95.4%
0.6	84.5%
0.8	73.6%
1	59.9%
1.2	48.4%
1.4	37.4%
1.6	26.6%
1.8	15.9%
2	5.8%
2.2	0.0%



<Recommended application>



4) 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.

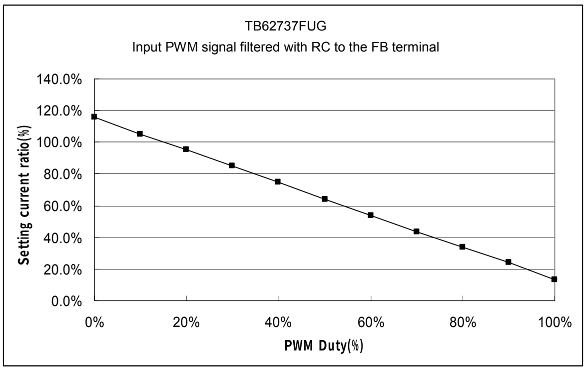
This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

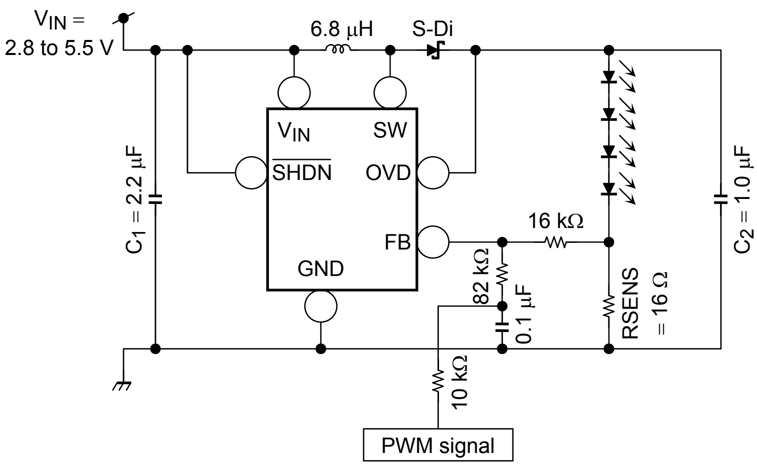
- LED current value goes over 100% of the current set with RSENS, if the input voltage after filtering is between 0 V to 325 mV (typ.).

(Reference data) Voltage during PWM Signal-ON = 2 V
About external parts value, please see recommended circuit.

Supply Voltage (V)	Ratio with Setting Current
No connect (OFF)	100%
0	116.1%
10%	105.3%
20%	95.1%
30%	84.8%
40%	74.6%
50%	64.0%
60%	53.8%
70%	43.7%
80%	34.0%
90%	24.2%
100%	13.3%



<Recommended application>



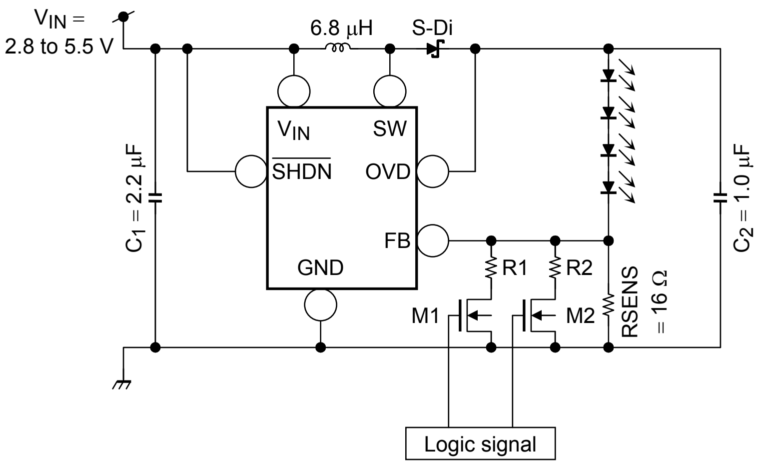
5) Input Logic signal

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 Io (mA) is next, approximately.

I_F = (325 [mV]/Sum of resistor value [Ω])

<Recommended application>



M1	M2	LED Current
OFF	OFF	$\frac{325\,[mV]}{RSENS\,[\Omega]}$
ON	OFF	$325\,[mV] \times \frac{RSENS\,[\Omega] \times R1\,[\Omega]}{RSENS\,[\Omega] + R1\,[\Omega]}$
OFF	ON	$325\,[mV] \times \frac{RSENS\,[\Omega] \times R2\,[\Omega]}{RSENS\,[\Omega] + R2\,[\Omega]}$
ON	ON	$325\,[mV] \times \frac{RSENS\,[\Omega] \times R1\,[\Omega] \times R2\,[\Omega]}{RSENS\,[\Omega] \times R1\,[\Omega] + RSENS\,[\Omega] \times R2\,[\Omega] + R1\,[\Omega] \times R2\,[\Omega]}$

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{IN}	−0.3 to +6.0	V
Input voltage	$V_{\overline{SHDN}}$	−0.3 to +V_{IN} + 0.3	V
Switching terminal voltage	V_o (SW)	−0.3 to 24	V
Power dissipation	P_D	TBD (device)	W
		TBD (on PCB) (Note)	
Thermal resistance	$R_{th\ (j\text{-}a)}$	TBD (device)	°C/W
		TBD (on PCB)	
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: Power Dissipation must be calculated with subtraction of 3.8 mW/°C from Maximum Rating with every 1°C if T_{opr} is upper 25°C. (on PCB)

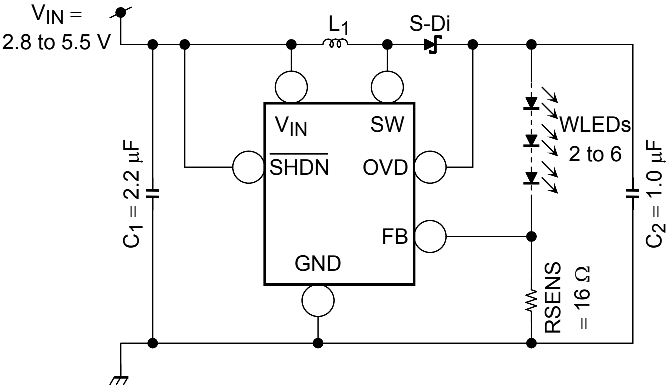
Recommended Operating Condition (Ta = −40°C to 85°C if without notice)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	V_{IN}	—	2.8	—	5.5	V
$\overline{SHDN}$ terminal “H” level input voltage	$V_{\overline{SHDN}H}$	—	2.7	—	V_{IN}	V
$\overline{SHDN}$ terminal “L” level input voltage	$V_{\overline{SHDN}L}$	—	0	—	0.5	V
$\overline{SHDN}$ terminal input pulse width	tpw	Both “H” and “L” pulse	33	—	—	μs
LED current (average value)	I_{F1}	V_{IN} = 3.6 V, R_{SENS} = 16 Ω 4 White LEDs, T_{opr} = 25°C	—	20	—	mA

Electrical Characteristics (Ta = 25°C, V_{IN} = 2.8 to 5.5V if without notice)

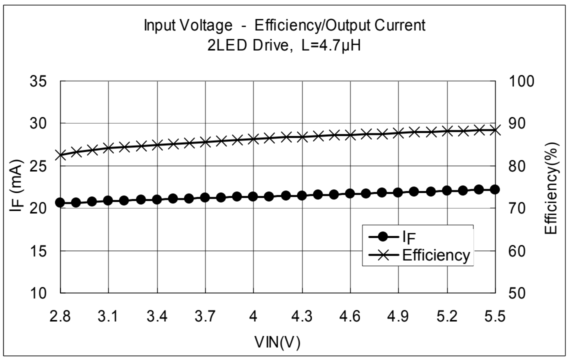
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	V_{IN}	—	2.8	—	5.5	V
Operating consumption current	I_{IN} (On)	V_{IN} = 3.6 V, RSENS = 16 Ω	—	0.9	1.5	mA
Quiescent consumption current	I_{IN} (Off)	V_{IN} = 3.6 V, $V\overline{SHDN}$ = 0 V	—	0.5	1.0	μA
$\overline{SHDN}$ terminal “H” level input voltage	$V_{\overline{SHDN}H}$	—	2.7	—	V_{IN}	V
$\overline{SHDN}$ terminal “L” level input voltage	$V_{\overline{SHDN}L}$	—	0	—	0.5	V
Integrated MOS-Tr switching frequency	f_{OSC}	V_{IN} = 3.6 V, $V\overline{SHDN}$ = 3.6 V	0.77	1.1	1.43	MHz
Switching terminal protection voltage	V_o (SW)	—	—	25	—	V
Switching terminal current	I_{oz} (SW)	—	—	400	—	mA
Switching terminal leakage current	I_{oz} (SW)	—	—	0.5	1	μA
FB terminal feedback voltage (VFB)	V_{FB}	V_{IN} = 3.6 V, RSENS = 16 Ω T_{opr} = 25°C, L = 6.8 μH	308	325	342	mV
FB terminal line regulation (VFB)	ΔV_{FB}	V_{IN} = 3.6 V (typ.) V_{IN} = 3.0 to 5.0 V	−5	—	5	%
OVD terminal voltage	V_{OVD}	—	19	22	23.5	V
OVD terminal leakage current	I_{OVD}	V_{OVD} = 16 V	—	0.5	1	μA

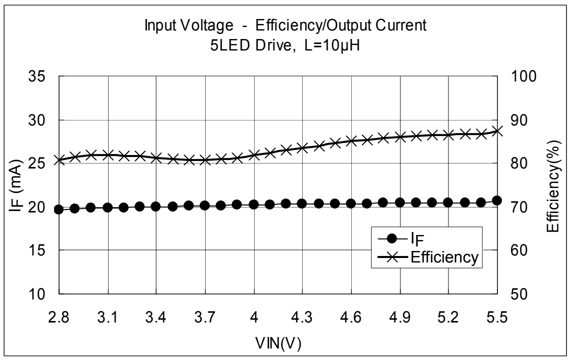
1. Application Circuit Example and Measurement Data (reference data)

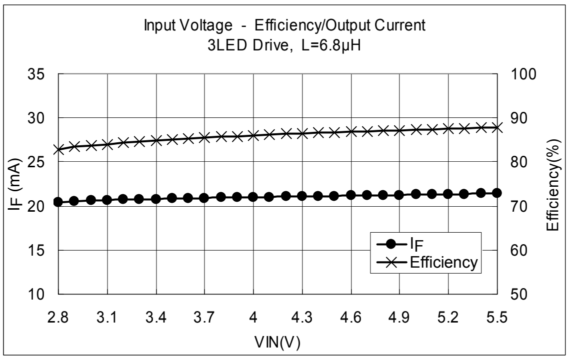


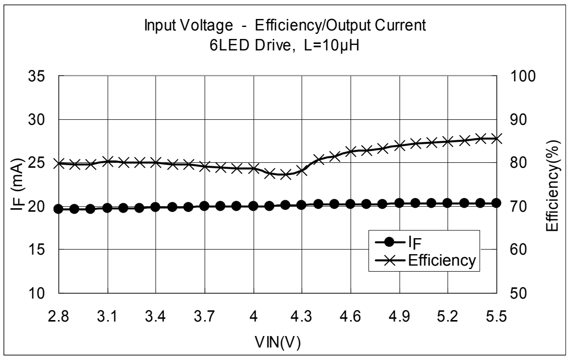
- Evaluation conditions (Ta = 25°C)

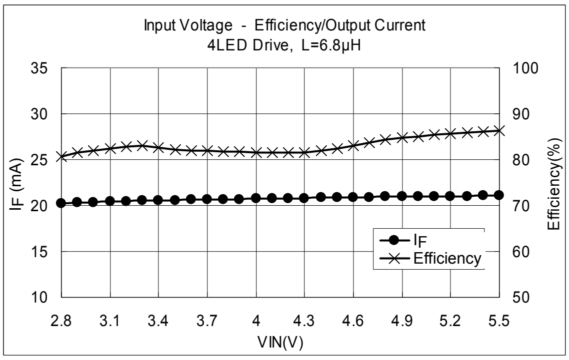
  L_1 : CXLD120 series (NEO MAX CO.,Ltd.)
  (Size: 2.5 mm × 3.0 mm × 1.2 mm)
  C_1 : C2012JB1E225K (TDK Corp.)
  C_2 : C2012JB1E105K (TDK Corp.)
  S-Di : CUS02 1 A/30 V (TOSHIBA Corp.)
  WLEDs: NSCW215T (NICHIA Corp.)
  RSENS: RK73B1ETBK (KOA Corp.)











<Measurement Data>

Efficiency in the range of V_{IN} = 2.8 to 5.5 V

	Efficiency (%)	Average Efficiency (%)
2 LEDs	82.60 to 88.46	86.29
3 LEDs	82.69 to 87.78	85.95
4 LEDs	80.73 to 86.22	83.05
5 LEDs	80.73 to 87.28	83.45
6 LEDs	79.78 to 85.55	81.15

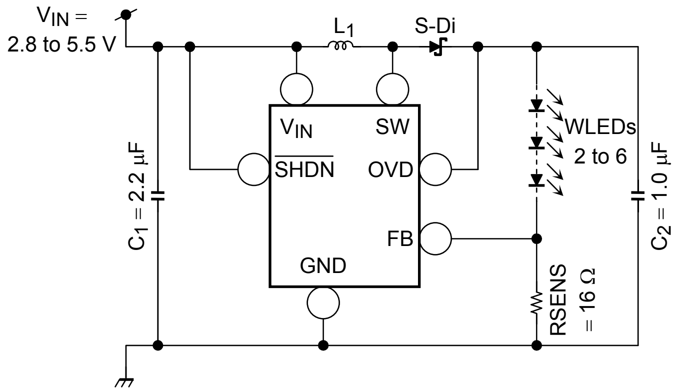
Output current in the range of V_{IN} = 3.0 to 5.0 V (V_{IN} = 3.6 V typ.)

	Output Current (mA) V_{IN} = 3.6 V	Tolerance (%)	
		Min	Max
2 LEDs	21.13	−3.50	1.77
3 LEDs	20.60	−1.95	1.38
4 LEDs	20.87	−1.75	1.11
5 LEDs	20.06	−1.81	1.15
6 LEDs	19.90	−1.95	1.28

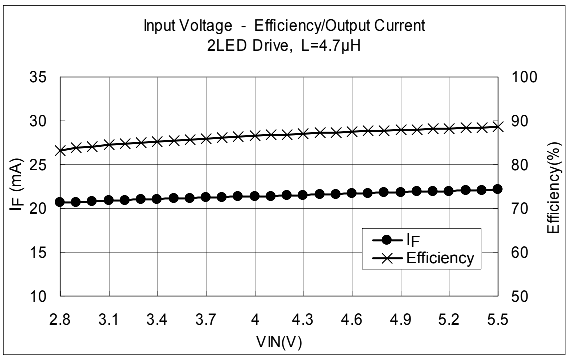
* V_{OUT} voltage in driving 5 or 6 LEDs must be lower than OVD detection level. (V_{OUT} < 19 V)

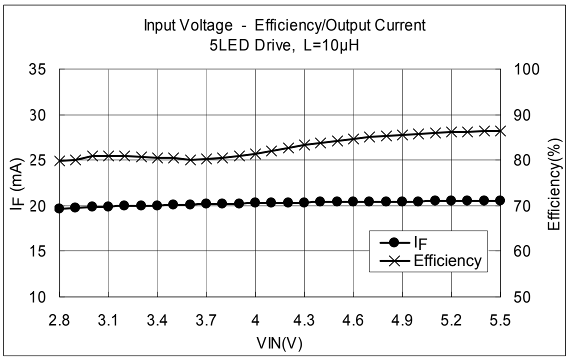
Note: These application examples are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

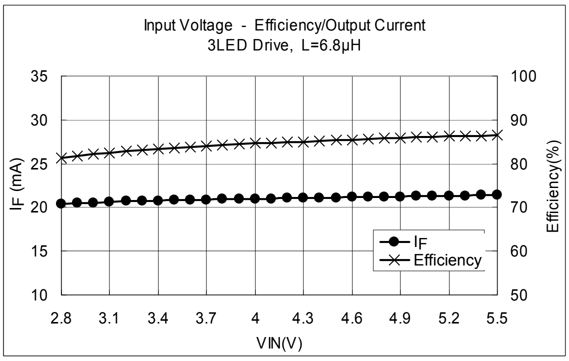
2. Application Circuit Example and Measurement Data (reference data)

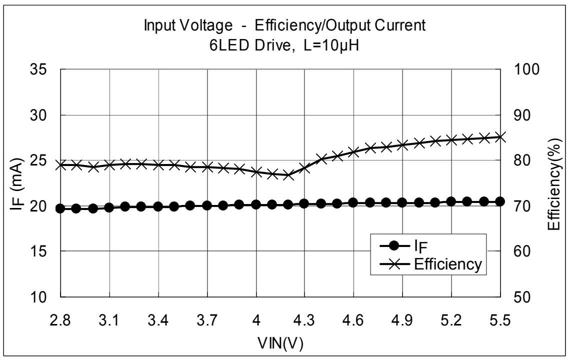


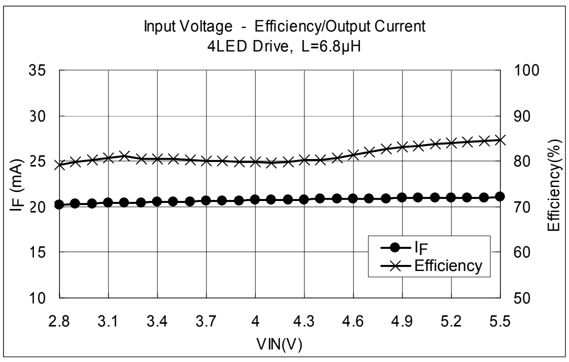
- Evaluation conditions (Ta = 25°C)
  - L_1 : 1001AS series (TOKO, INC) (Size: 3.6 mm × 3.6 mm × 1.2 mm)
  - C_1 : C2012JB1E225K (TDK Corp.)
  - C_2 : C2012JB1E105K (TDK Corp.)
  - S-Di : CUS02 1 A/30 V (TOSHIBA Corp.)
  - WLEDs: NSCW215T (NICHIA Corp.)
  - RSENS: RK73B1ETBK (KOA Corp.)











<Measurement Data>

Efficiency in the range of V_{IN} = 2.8 to 5.5 V

	Efficiency (%)	Average Efficiency (%)
2 LEDs	83.10 to 88.60	86.55
3 LEDs	81.32 to 86.47	84.54
4 LEDs	79.15 to 84.63	81.30
5 LEDs	79.72 to 86.39	82.87
6 LEDs	78.91 to 85.10	80.47

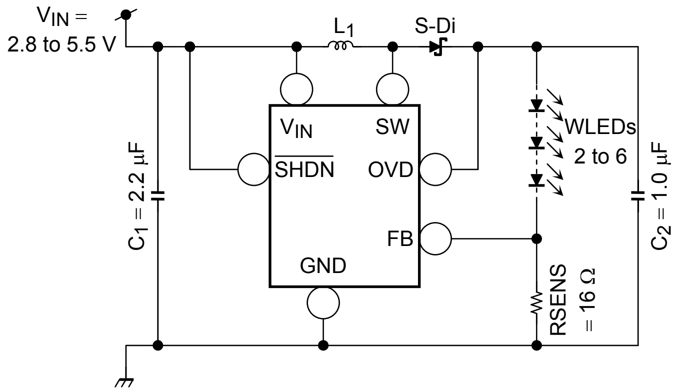
Output current in the range of V_{IN} = 3.0 to 5.0 V (V_{IN} = 3.6 V typ.)

	Output Current (mA) V_{IN} = 3.6 V	Tolerance (%)	
		Min	Max
2 LEDs	21.17	−3.32	1.73
3 LEDs	20.85	−1.95	1.38
4 LEDs	20.56	−1.79	1.15
5 LEDs	20.10	−1.82	1.22
6 LEDs	19.95	−1.94	1.26

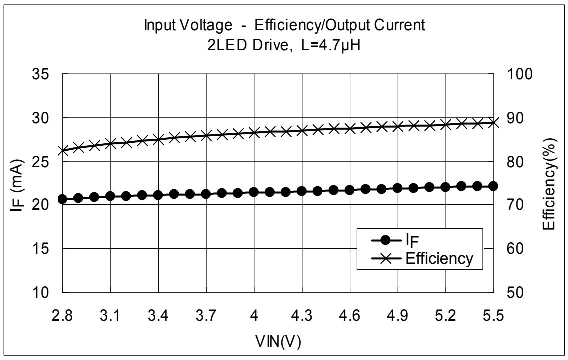
* V_{OUT} voltage in driving 5 or 6 LEDs must be lower than OVD detection level. (V_{OUT} < 19 V)

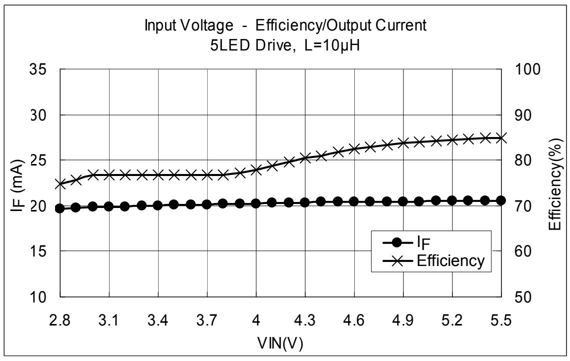
Note: These application examples are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

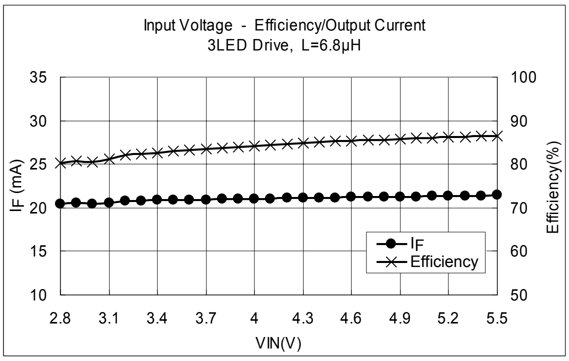
3. Application Circuit Example and Measurement Data (reference data)

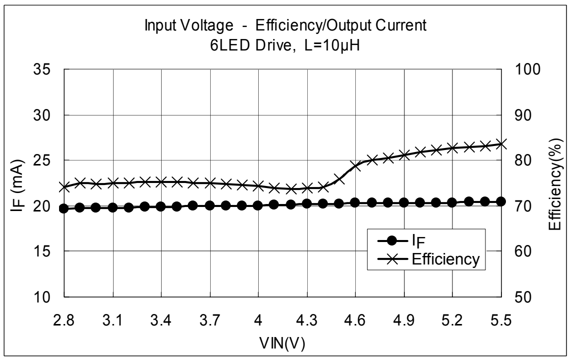


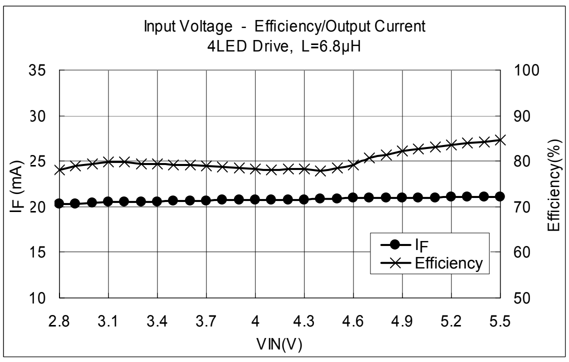
- Evaluation conditions (Ta = 25°C)
  - L_1 : LQH2M series (Murata Manufacturing Co.,Ltd.) (Size: 2.0 mm × 1.6 mm × 0.95 mm)
  - C_1 : C2012JB1E105K (TDK Corp.)
  - C_2 : C2012JB1E105K (TDK Corp.)
  - S-Di : CUS02 1 A/30 V (TOSHIBA Corp.)
  - WLEDs: NSCW215T (NICHIA Corp.)
  - RSENS: RK73B1ETBK (KOA Corp.)











<Measurement Data>

Efficiency in the range of V_{IN} = 2.8 to 5.5 V

	Efficiency (%)	Average Efficiency (%)
2 LEDs	82.37 to 88.70	86.38
3 LEDs	80.19 to 86.55	84.12
4 LEDs	78.11 to 84.54	80.16
5 LEDs	74.79 to 84.94	79.94
6 LEDs	74.14 to 83.47	77.17

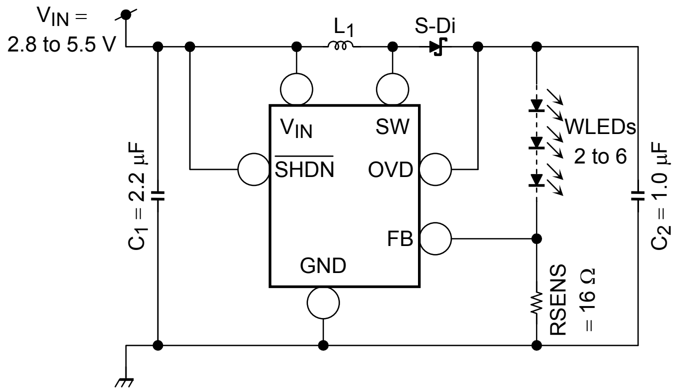
Output current in the range of V_{IN} = 3.0 to 5.0 V (V_{IN} = 3.6 V typ.)

	Output Current (mA) V_{IN} = 3.6 V	Tolerance (%)	
		Min	Max
2 LEDs	21.19	−3.26	1.69
3 LEDs	20.90	−1.87	2.17
4 LEDs	20.63	−1.78	1.01
5 LEDs	20.09	−1.88	1.25
6 LEDs	19.93	−1.99	1.07

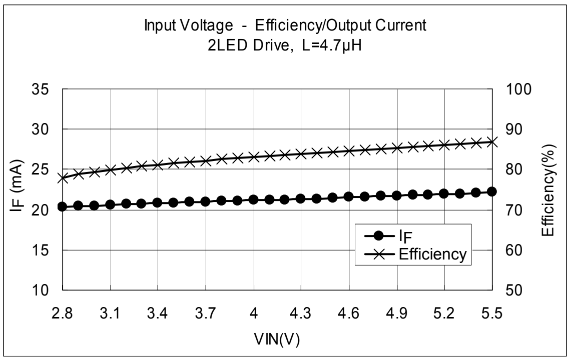
* V_{OUT} voltage in driving 5 or 6 LEDs must be lower than OVD detection level. (V_{OUT} < 19 V)

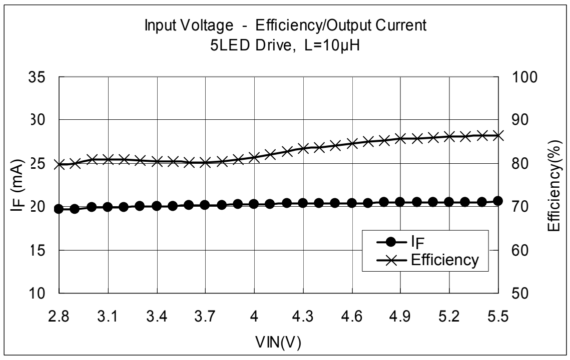
Note: These application examples are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

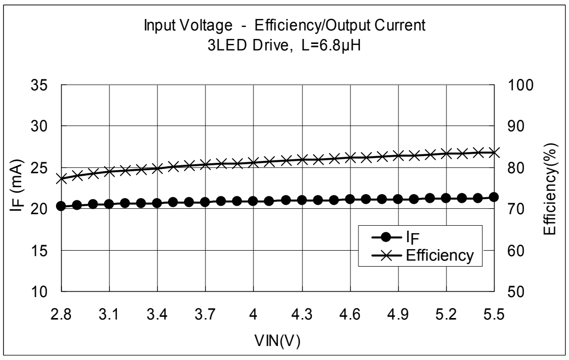
4. Application Circuit Example and Measurement Data (reference data)

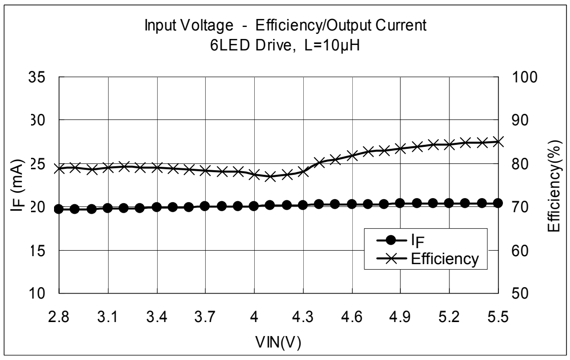


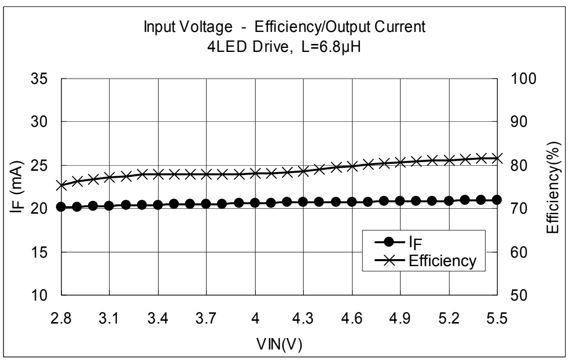
- Evaluation conditions (Ta = 25°C)
  - L_1 : VLF3010A series (TDK Corp.) (Size: 3.0 mm × 3.0 mm × 1.0 mm)
  - C_1 : C2012JB1E225K (TDK Corp.)
  - C_2 : C2012JB1E105K (TDK Corp.)
  - S-Di : CUS02 1 A/30 V (TOSHIBA Corp.)
  - WLEDs: NSCW215T (NICHIA Corp.)
  - RSENS: RK73B1ETBK (KOA Corp.)











<Measurement Data>

Efficiency in the range of V_{IN} = 2.8 to 5.5 V

	Efficiency (%)	Average Efficiency (%)
2 LEDs	79.85 to 86.97	84.02
3 LEDs	80.19 to 85.32	83.39
4 LEDs	78.77 to 83.60	80.69
5 LEDs	79.72 to 86.39	82.87
6 LEDs	78.91 to 85.10	80.49

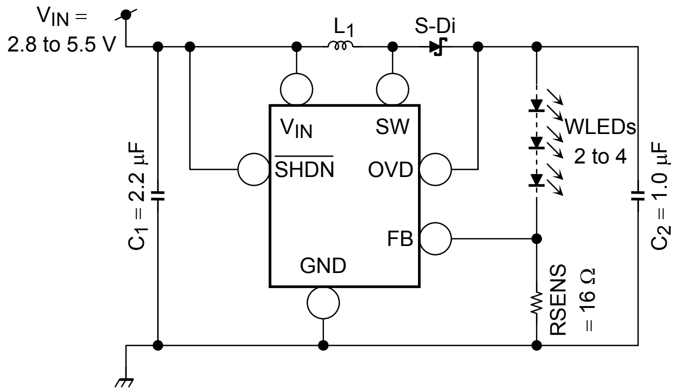
Output current in the range of V_{IN} = 3.0 to 5.0 V (V_{IN} = 3.6 V typ.)

	Output Current (mA) V_{IN} = 3.6 V	Tolerance (%)	
		Min	Max
2 LEDs	21.19	−3.08	1.67
3 LEDs	20.89	−1.86	1.33
4 LEDs	20.64	−1.68	1.11
5 LEDs	20.10	−1.82	1.22
6 LEDs	19.95	−1.94	1.26

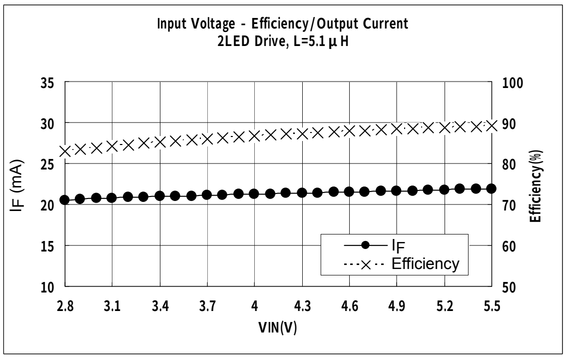
* V_{OUT} voltage in driving 5 or 6 LEDs must be lower than OVD detection level. (V_{OUT} < 19 V)

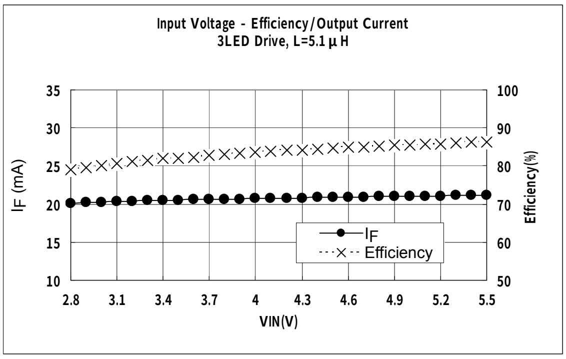
Note: These application examples are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

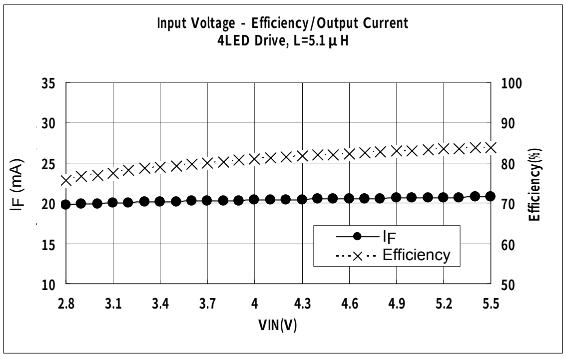
5. Application Circuit Example and Measurement Data (reference data)



- Evaluation conditions (Ta = 25°C)
  - L_1 : 32R51 (KOA Corp.) (Size: 3.2 mm × 2.5 mm × 0.6 mm)
  - C_1 : C2012JB1E225K (TDK Corp.)
  - C_2 : C2012JB1E105K (TDK Corp.)
  - S-Di : CUS02 1 A/30 V (TOSHIBA Corp.)
  - WLEDs: NSCW215T (NICHIA Corp.)
  - RSENS: RK73B1ETBK (KOA Corp.)







<Measurement Data>

Efficiency in the range of V_{IN} = 2.8 to 5.5 V

	Efficiency (%)	Average Efficiency (%)
2 LEDs	83.08 to 89.23	86.73
3 LEDs	79.02 to 86.30	83.52
4 LEDs	75.75 to 83.83	80.78

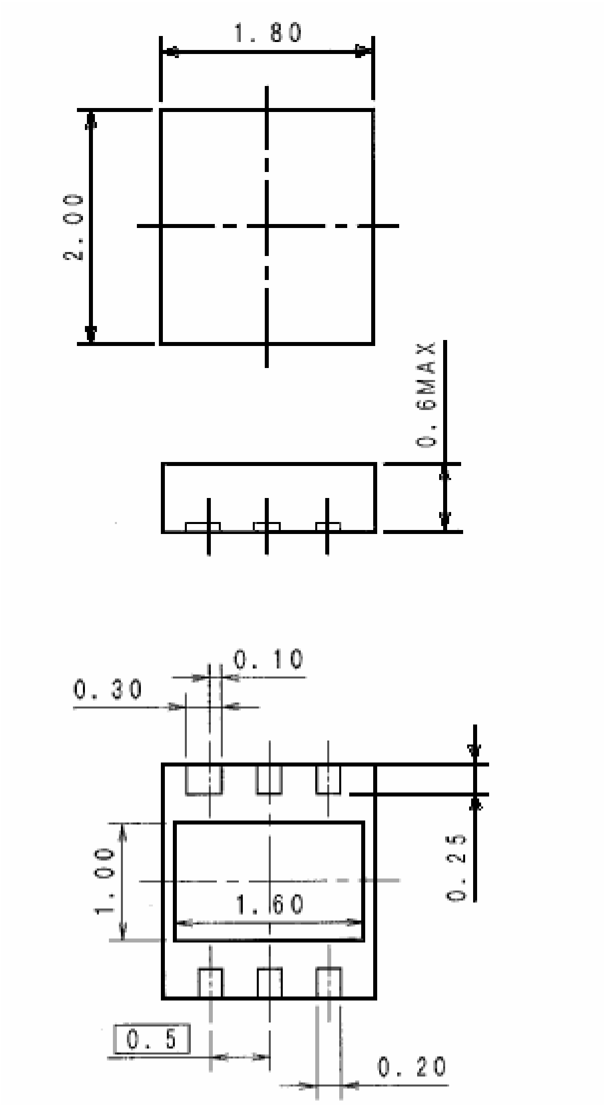
Output current in the range of V_{IN} = 3.0 to 5.0 V (V_{IN} = 3.6 V typ.)

	Output Current (mA) V_{IN} = 3.6 V	Tolerance (%)	
		Min	Max
2 LEDs	21.06	−2.46	4.02
3 LEDs	20.57	−2.39	2.94
4 LEDs	20.22	−2.28	2.65

Note: These application examples are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

Package Dimensions

Weight: TBD g (typ.)



Notes on Contents

1. Block Diagrams

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

2. Equivalent Circuitry

Some parts of the equivalent circuitry may have been omitted or simplified for explanatory purposes.

3. Maximum Ratings

The absolute maximum ratings of a semiconductor device are a set of specified parameter values that must not be exceeded during operation, even for an instant.

If any of these ratings are exceeded during operation, the electrical characteristics of the device may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.

Moreover, any exceeding of the ratings during operation may cause breakdown, damage and/or degradation in other equipment. Applications using the device should be designed so that no maximum rating will ever be exceeded under any operating conditions.

Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this document.

4. Application Examples

The application examples provided in this data sheet are provided for reference only. Thorough evaluation and testing should be implemented when designing your application's mass production design.

In providing these application examples, Toshiba does not grant the use of any industrial property rights.

5. Handling of the IC

- Ensure that the product is installed correctly to prevent breakdown, damage and/or degradation in the product or equipment.
- Short circuiting between output and line to ground faults may result in damage to the IC. Please exercise precaution in designing the output line, power line and GND line so as to prevent such damage.
- Be careful to insert the IC correctly. Inserting the IC the wrong way (e.g., wrong direction) may result in damage to the IC.
- Please exercise precaution in handling external components as shorting and opening such components may cause an overcurrent, which in turn may result in power overcurrent and/or in damage to the IC.

6. Overcurrent and Thermal Protection

- Toshiba does not guarantee that these protection functions will prevent damage to the product. These functions are only intended as a temporary means of preventing output short circuiting and other abnormal conditions.
- If the guaranteed operating ranges of this product are exceeded, these protection functions may not function as intended and this product might be damaged due to output short circuiting.
- The overcurrent protection function is intended to protect this product from temporary short circuiting only. Short circuiting that last for a long time may cause excessive stress and damage to this product.

About solderability, following conditions were confirmed

- Solderability

  (1) Use of Sn-37Pb 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