TOSHIBA BiCD Digital INTEGRATED CIRCIUTS SILICON MONOLITHIC
TB62730WLG

Step-up type DC/DC Converter for White LED

Development specification

TOSHIBA MICROELECTRONICS CORP.
APPLICATION ENGINEERING GROUP 3

Data Sheet Version No.	Data	Note	Charge	
0.10	2007-4-26	same as Japanese version 0.4	Kobayashi	
0.11	2007-6-13	add the Package Dimension	Kobayashi	

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TOSHIBA BiCD Digital Integrated Circuit Silicon Monolithic

TB62730WLG

Step Up Type DC-DC Converter for White LED

TB62730WLG is the high efficient STEP-UP type DC/DC converter by which the optimal design was carried out at constant current driver of white LED.
It is possible to drive white LEDs whose constant output current is 800mA by the lithium ion battery.
This IC contains the Nch-MOS transistor required for switching of external inductor.
The forward current of LED is set up by the external resistor.
This IC is the most suitable as a driver of camera flashes and strobes in the cellular phone, the PDA, the DSC, and other mobiles.
This device is Pb-free product.

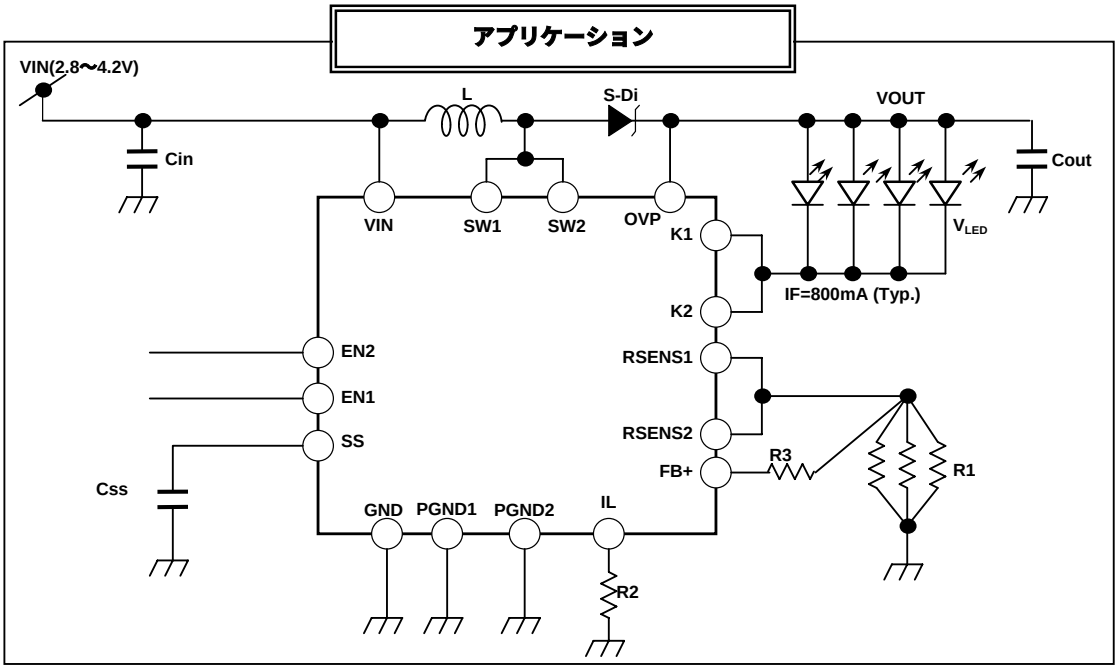
WLCSP

質量: TBD g (標準)

■ Features

- Package : WLCSP
- Maximum output voltage : 10V(I_F=400mA)
- Operating frequency : 2MHz(TYP.)
- Four operating modes
  - Light mode : ILED=350mA(Typ.)
    (VLED＝4.5V,R1＝0.375Ω,R2=47kΩ,R3＝8.2kΩ)
  - Flash mode : ILED=800mA(Typ.)
    (VLED＝4.5V,R1＝0.375Ω)
  - Shutdown mode : I_{IN}=0.01μA(Typ.)
- High efficiency : Maximum efficiency : 80%（In the flash mode）
- Integrated Over Voltage protection : 10V(MIN.)

アプリケーション



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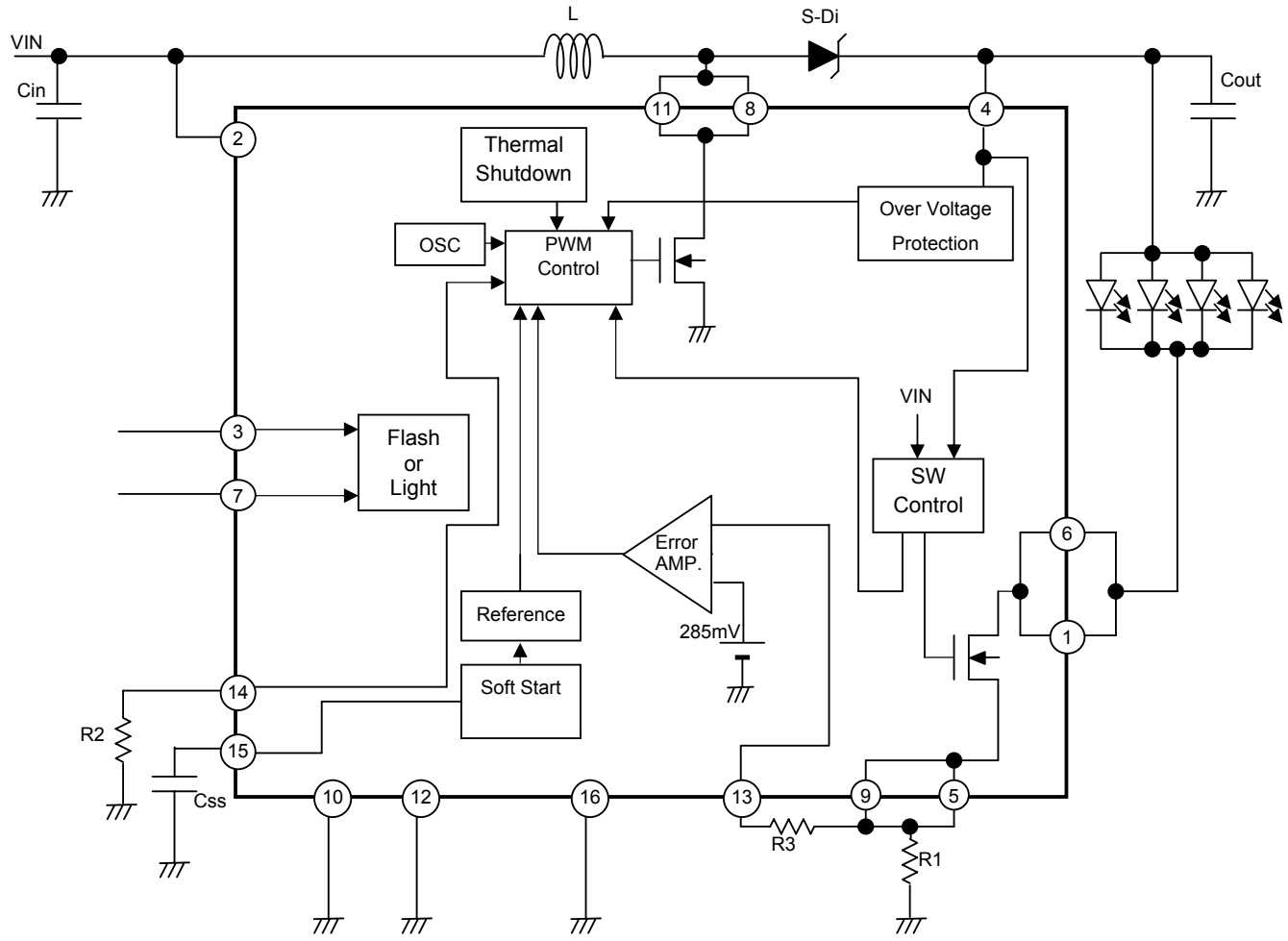
■ Block Diagram



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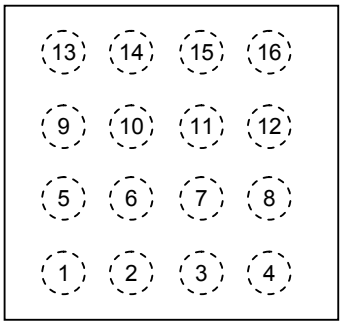
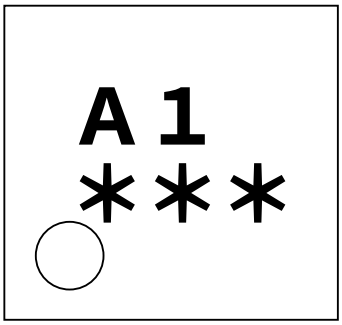
■ Explanation of the Terminal

No.	Symbol	Function
1	K2	Connected to the LED cathode.
2	VIN	Inputting the power supply voltage to the IC. The operating voltage is 2.8 to 5.5V.
3	EN1	Inputting the logic signals which set the modes. "ON" : DC-DC operation "OFF" : Stop
4	OVP	Detecting the over-voltage.
5	RSENS2	Connected to the current-setting resistor: R1 for the flash.
6	K1	Connected to the LED cathode.
7	EN2	Inputting the logic signals which set the modes. "ON" : Flash mode "OFF" : Lighting mode
8	SW1	Switching the DC-DC converter. Nch MOSFET is built-in.
9	RSENS1	Connected to the current-setting resistor: R1 for the flash.
10	AGND	Ground terminal for analog.
11	SW2	Switching the DC-DC converter. Nch MOSFET is built-in.
12	PGND1	Ground terminal for the power device.
13	FB+	Detecting the voltage of the current-setting resistor: R1 for the flash. It can change
14	IL	Connected to the ILED setting resistor: R2 in the light mode. The light-mode-current is changed depending on the setting ratio of R2 and R3.
15	SS	Setting the constant to limit the current when DC-DC operation starts. The rising time is changed depending on the constant of the condenser.
16	PGND2	Ground terminal for the power device.

■Pin Assignment (top view)



TOP VIEW



TOP VIEW

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■ Absolute Maximum Ratings (T_{opr} = 25°C if not specified)

Characteristics	Symbol	Ratings	Unit
Power supply voltage	VIN	- 0.3 ～ 6.0	V
Input voltage	VIN(LOGIC)	- 0.3 ～ VIN + 0.3	V
Switching terminal voltage	Vo(SW)	- 0.3 ～ 15	V
Output current	IF	1000	mA
Operating temperature range	Topr	- 40 ～ 85	°C
Storage temperature	Tstg	- 55 ～ 150	°C

■ Recommended Operating Condition (T_{opr} = –40 to 85°C if not specified)

Characteristics		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Power supply voltage		VIN	-	2.8	-	5.5	V
Logic Input Voltage	HIGH	VIH	EN1,EN2,EN3	1.3	–	VIN	V
	LOW	VIL		0	–	0.4	
Constant-current output		IF	VOUT=5V	-	800	-	mA
ISET Resistor	Flash mode	R1	-	-	0.375	-	Ω
	Light mode	R2	-	33	47	62	kΩ
		R3	-	-	8.2	-	kΩ
Input condenser		Cin	-	-	20	-	μF
Output condenser		Cout	-	-	10	-	μF
Condenser for soft start		Css	-	2200	3300	10000	pF
External inductor		L	-	-	3.9	-	μH
Flash mode lighting time		t FLASH	-	–	100	300	ms

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■ Electrical Characteristics

Characteristics of DC-DC regulator. (Ta = 25°C, if not specified.)

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Operating consumption current	IIN(On1)	EN1="H", EN2="L",EN3=""L Vin=3.6V, VIN Current	-	4.3	7.5	mA
Operating consumption current (At Over voltage detect)	IIN(OVP)	EN1="H", EN2="L",EN3=""L Vin=4.2V, OVP=12V VIN Current	-	600	800	μA
Quiescent consumption current	IIN(Off)	EN1="L", EN2="L",EN3="L" Vin=3.6V, VIN Current	-	0.01	0.5	μA
Input current (Logic input terminal)	IIN(LOGIC)	Vin=4.2V	30	42	70	μA
Integrated MOS-Tr switching frequency	fosc	Vin=2.8 ~ 4.2V	1.67	2.00	2.50	MHz
Switching terminal peak current	Io(SW)	EN1="H", EN2="L",EN3="L" Vin=3.0 ~ 4.2V	2.0	-	-	A
Switching terminal leakage current	Ioz(SW)	EN1="L", EN2="L",EN3="L" V_{SW} = 4.2V	-	-	0.5	μA
RSENS terminal feedback voltage	VFB	EN1="H", EN2="L", V_{LED}=4.2V, VIN=3.6V, R1=0.375Ω、R2=47kΩ R3=8.2kΩ	111	125	138	mV
		EN1="H", EN2="H" VIN=3.6V, V_{LED}=4.5V R1=0.375Ω	271	285	299	mV
		EN1="H", EN2="H" VIN=3.6V, V_{LED}=9.5V R1=0.750Ω	271	285	299	mV
RSENS terminal line regulation	ΔVFB1	EN1="H", EN2="H" VIN=3.6V基準, VIN=3.0～4.2V VLED=4.5V	-2	-	2	%
		EN1="H", EN2="L" VIN=3.6V基準, VIN=3.0～4.2V VLED=4.5V	-10	-	10	%
Offset Voltage (between Constant current Mode and DC/DC mode)	ΔVFB2	EN1="H", EN2="H" VIN=3.0～4.2V, VLED=3.5V	5	15	25	mV
OVP voltage (OVP terminal)	V_{OVP}	-	10	11	-	V
TSD			120	150	180	℃

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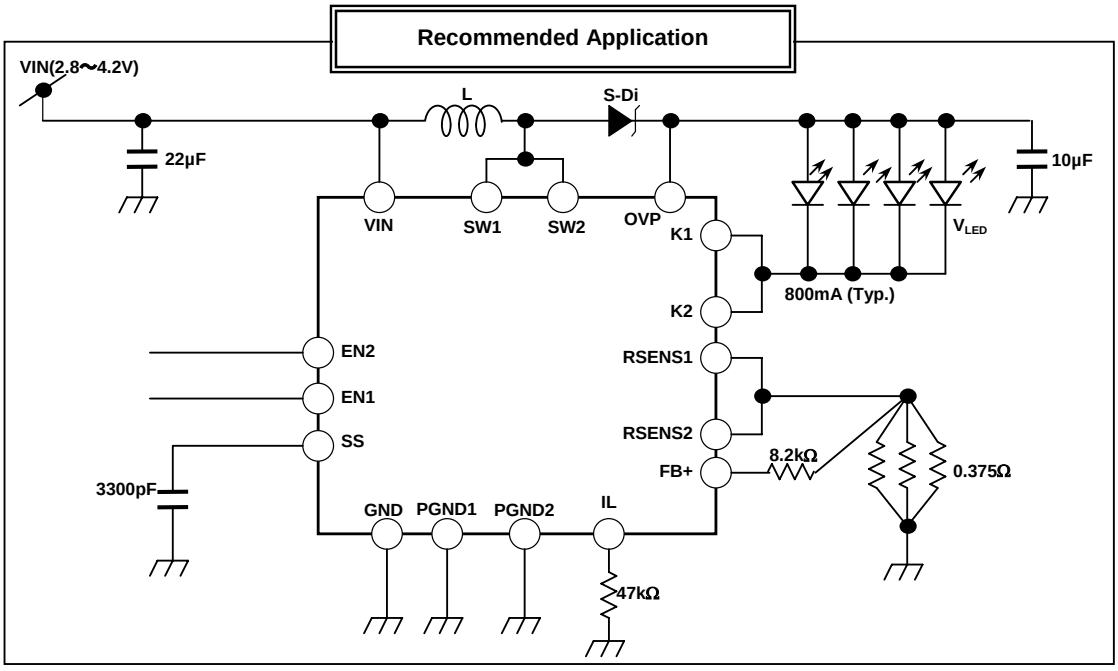
Characteristics of constant-current of SINK（Topr = 25°C, Vcc = 3.6V if not specified.）

Characteristics		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
ISET output current (Light mode)		I(LMODE)	EN1 = “H”, EN2 = “L” R2=47kΩ	18.5	19.5	20.5	μA
ISET output voltage (Light mode)		I(FB+)	EN1 = “H”, EN2 = “L” R2=47kΩ, R3=8.2kΩ	17.55	19.50	21.45	V
Lighting time in flash mode		V(LMODE)	EN1 = “H” EN2 = “L”	0.865	0.910	0.955	ms
Resistance between K1-3 and RSENS1-3			EN1=”H”, EN2=”H” VIN=3.0～4.2V VLED＝4.2V	-	0.25	-	Ω
Output Current of SS terminal		ISS	At start up VIN=3.6V	2.00	2.50	3.00	μA
Input Logic level	H level	VIH	EN1,EN2,EN3	1.3	-	VIN +0.15	V
	L level	VIL	EN1,EN2,EN3	-0.15	-	0.4	



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■ Explanation of operation

【Setting the operating mode】

1. Selecting the four modes shown below with logic input terminals: EN1 and EN2.

EN1	EN2	MODE
L	L	Shutdown mode
L	H	
H	L	Torch mode
H	H	Flash mode

• Flash mode

It can be driven with the constant-current at 800mA (max.).

In case of serial connect 2LEDs, It can be driven with the constant-current at 400mA (max.).

The maximum lightning time is 300ms.

Because it controls the FB+ at 285mV, the equation shown below is obtained.

$$Iout\ (mA) = 285\ (mV) \div R1\ (\Omega)$$

Pay attentions to the differences of the connected resistors and the power consumption.

The recommended resistor is as follows;

- Three or more resistors (1/4 W) in parallel.

• Torch mode

It can light continually by driving at constant-current (350mA in max.).

It sets the current of K1 to K3 based on the resistors: R1, R2, and R3.

$$Iout\ (mA) = \frac{0.285V - \left(0.91V\ (Vreference) \times \frac{R3}{R2}\right)}{R1}$$

The current value of IL is recommended at about 20μA.

Set R2 at 47kΩ

The range of setting resistance is from 33kΩ to 62kΩ.

When R3 is set at 0Ω, the same current is set in the flash mode and the light mode.

The operation might be unstable when the condition is in the light load (IF (mA) is 30mA or less). Pay attention in setting the current.

• Shutdown mode

It stops the operation.

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【Setting the external inductor】

Operating frequency : 2MHz

The circuit operation has the consecutive mode method. The ability of the output current is changed by the constant of the inductor.

【Soft start function】

Soft start function is built in to prevent the exceeding rush current and the decreasing of power voltage in switching from the shutdown mode (EN1＝"L") to the flash or write mode(EN1＝"H").
In applying the recommended application constant number, the rising time in the flash mode is about 300 μs.
The rising time depends on the LED set current and the power voltage. So, evaluate the IC enough to design for the mass production.

【OVP function】

OVP voltage： Detecting the over-load at 10V(MIN.).

When the loaded voltage of OVP rises because of the LED opening or something other,

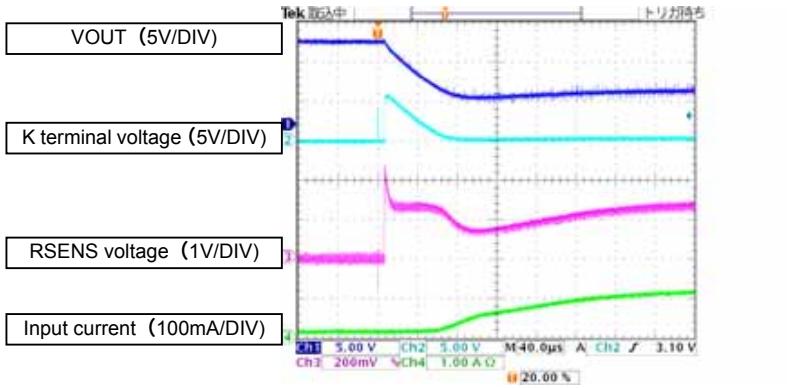
this function shutdowns the IC.

The operation recovers just after the voltage of OVP falls to 10V（MIN.) or less.

The rush current might generate in input current when the connecting chattering exists in recovering from the OVP operation to the normal operation.
The rush current depends on the usage conditions (the number of the LED lights, LED set current, and input voltage) and the chattering interval. So, evaluate the IC enough to design for the mass production.

※Example of rush current by chattering in LED reconnecting.

Conditions）Power voltage: 3.6V, 1LED
RSENS＝0.375Ω(IF=800mA), flash lamp mode



$$※\ \text{Output current} = \frac{\text{RSENS terminal voltage}}{\text{RSENS resistance}}$$

【TSD function】

Internal shutdown circuit operates to turn off the output when IC temperature reaches the rating and TSD circuit drives.
Setting TSD operating temperature: 120℃ to180℃.

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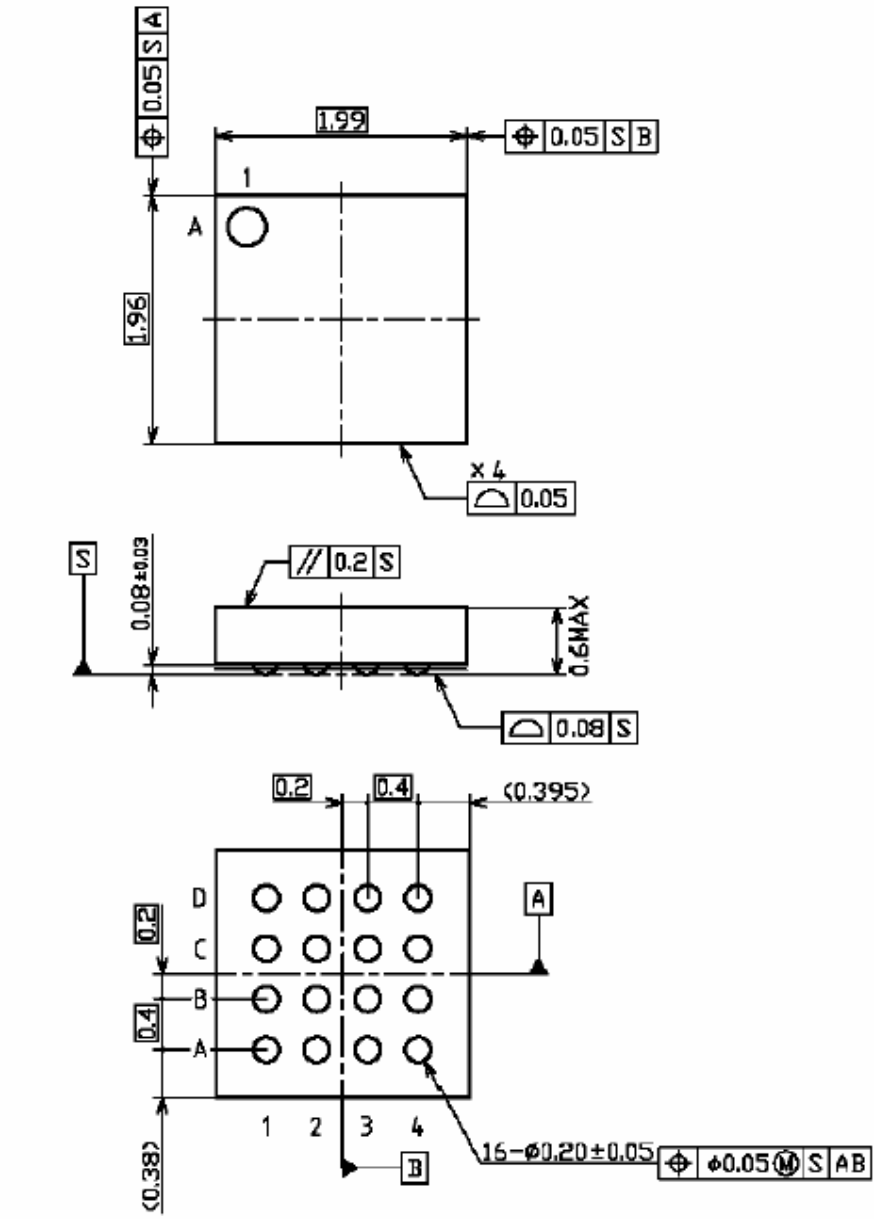
■Package Dimension



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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. 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.

4. 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.

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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 pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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The following conditions apply to solderability:

*Solderability

1. Use of Sn-37Pb solder bath
   *solder bath temperature = 230°C
   *dipping time = 5 seconds
   *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
   *number of times = once
   *use of R-type flux

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060116EBA

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