



# AK7864

3 channel LED driver with Charge Pump

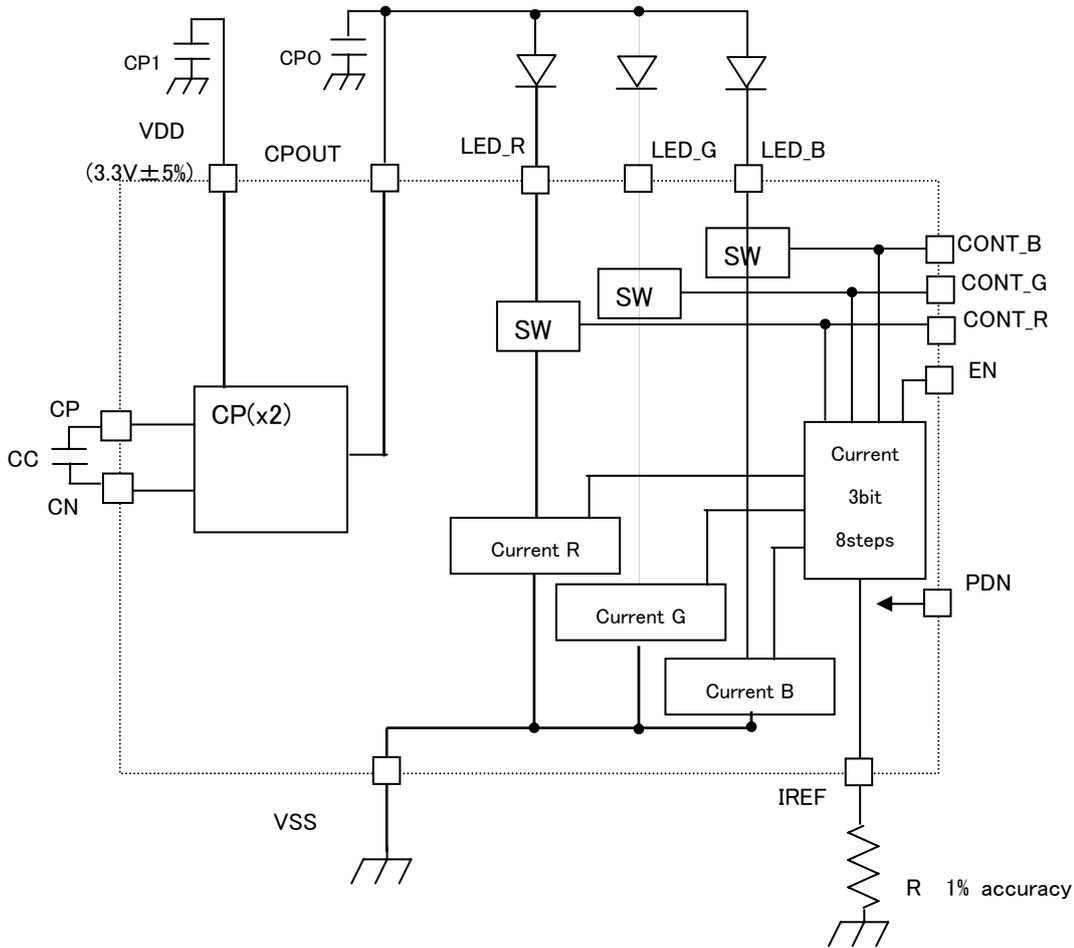
## Device Outline

This product includes the charge pump power supply and includes the 3 channel LED driver which drives the LED of the anode common in the constant current. The current to pass for each channel can be adjusted by the external resistance and the register setting. Also, it has the control pins which turn on or off the current. It is the best for the LED drive for the CIS sensor.

## Features

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ <b>Operation Voltage</b></li> <li>■ <b>Operating Temperature Range</b></li> <li>■ <b>LED driver current</b></li> </ul>                                      | <p>3.3V±5%</p> <p>0 ~ 70°C</p> <p>RED: 66mA (Adjustment external resistor: 22 ~ 66mA)</p> <p>GREEN: 66mA (Same as above, each channel is spec in absolute value.)</p> <p>BLUE: 66mA (Same as above, each channel is spec in absolute value.)</p> <p>Usable Vf MAX range of the LED is 4.8V. The resistance for the current regulation is usable in 1/16W -type.</p> <ul style="list-style-type: none"> <li>▪ 50% setting is an upper bound when 3ch becoming turning on at the same time.</li> <li>▪ 3ch independent ON/OFF.</li> <li>▪ Current setting in eight steps</li> </ul> |
| <ul style="list-style-type: none"> <li>■ <b>Current Accuracy</b></li> <li>■ <b>LED Current rise / fall time</b></li> <li>■ <b>Charge Pump processor circuit</b></li> <li>■ <b>Package</b></li> </ul> | <p>When the external resistance value becomes the assumption outside, it has the protection circuit which doesn't make the electric current which flows through the LED equal to or more than 150mA (-30% ~ +45%)</p> <p>±9.1% (by ideal resistance)</p> <p>10µs (typ.) (10% ~ 90%)</p> <p>Generate the necessary voltage for the LED (Vf max 4.8V)</p> <p>16pinQFN 3mm, 0.75mm thickness with radiation TAB in Solderside</p>  |
| <ul style="list-style-type: none"> <li>■ <b>Power</b></li> <li>■ <b>Application</b></li> </ul>   | <p>VDD 3.135 ~ 3.465V</p> <p>A light source driver for CIS module of MFP</p>  |

**Block Diagram**



**Circuit Block Description**

□ **Charge Pump Circuit**

A necessary voltage for LED ( $V_f$  4.8V or less) lighting is generated from the voltage supplied to VDD pin. Please supply the generated power supply from CPOUT pin to external LED.

□ **LED Driver Part**

This product generates has 3 channel LED driver to drive RGB constant current. Use the ON/ OFF digital terminal to control the constant current.

The current setting can be set to 8 level with CONT\_R/G/B and EN combination.

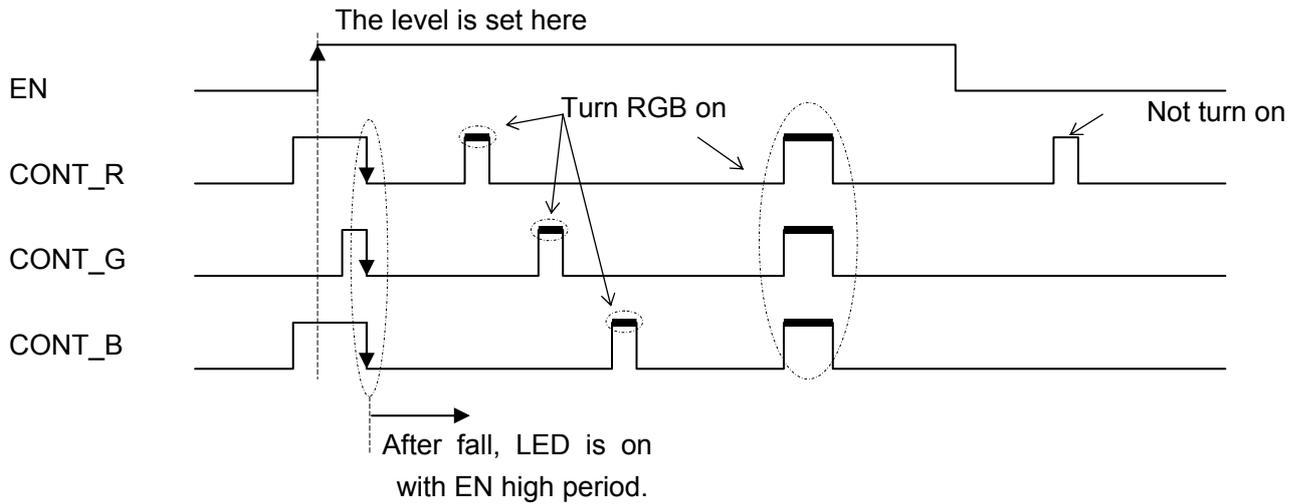
It is possible to light 1ch LED or 3ch simultaneously. Please set the current less than 50% by 3ch simultaneously.

- Current setting of 3 channels is same. 3ch ON/OFF independent or at the same time.
- Current setting can be set to 8 level with CONT\_R/G/B and EN combination.  
(100%/87.5%/75%/62.5%/50%/37.5%/25%/12.5%)
- When 100%=60mA, 87.5%=52.5mA, 75%=45mA, . . .
- When 100%=66mA, 87.5%=57.75mA, 75%=49.5mA, . . .

**Current setting method**

The method of setting the LED current is as follows.

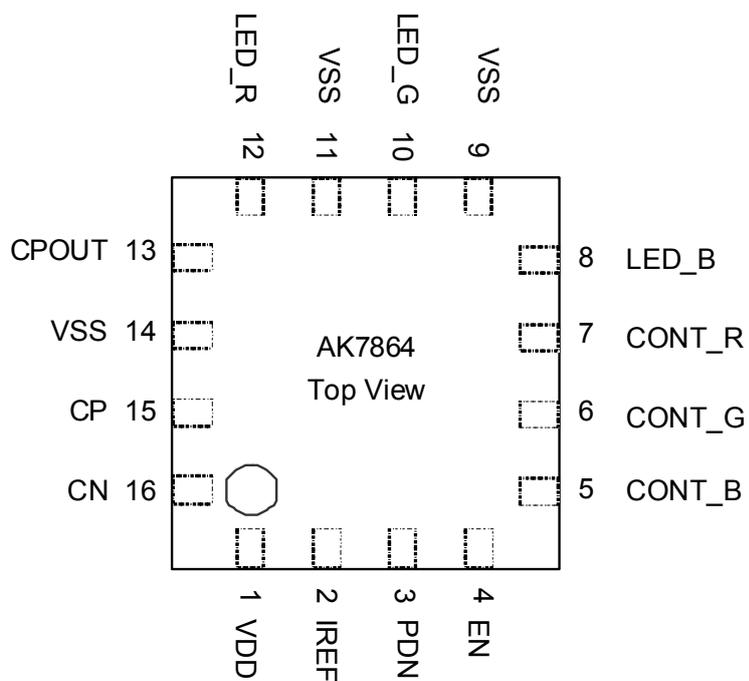
Latch the pattern of CONT\_R, CONT\_G, CONT\_B at the time of following EN rise to decide the current value. After the CONT\_R, CONT\_G, CONT\_B signal fall once, the current interlocks with CONT\_R, CONT\_G, CONT\_B's on or off.



The relation between the pattern and the current setting value of CONT\_R, CONT\_G, CONT\_B at the time of the EN rise as follows.

CONT_R	CONT_G	CONT_B	Current setting
0	0	0	100%
0	0	1	87.5%
0	1	0	75%
0	1	1	62.5%
1	0	0	50%
1	0	1	37.5%
1	1	0	25%
1	1	1	12.5%

Pin Allocation



<b>Pin Functions</b>
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No.	Name	IO	Description
1	VDD	P	power supply
2	IREF	O	LED current setting external resistor pin (Use the external resistance Pull Down by power down)
3	PDN	I	Power down mode terminal Hi: power up, Lo: power down
4	EN	I	LED current enable terminal Hi:enable, Lo:disable
5	CONT_ B	I	LED control input B
6	CONT_ G	I	LED control input G
7	CONT_ R	I	LED control input R
8	LED_B	O	LED output pin B (Hi-z@PD)
9	VSS	P	GND
10	LED_G	O	LED output pin G (Hi-z@PD)
11	VSS	P	GND
12	LED_R	O	LED output pin R (Hi-z@PD)
13	CPOUT	O	Charge pump power supply output pin (Use the internal resistance Pull Down by power down)
14	VSS	P	GND
15	CP	I	Charge pump connect with cap positive terminal (Use the internal resistance Pull Down by power down)
16	CN	I	Charge pump connect with cap negative terminal (Use the internal resistance Pull Down by power down.)
radiation pad			Connect it with GND.

### Absolute Maximum Ratings

Voltages are referenced to corresponding ground level. VSS=0V

Item	Symbol	Min.	Max.	Unit	Remarks
Power supply	VDD	-0.3	4.0	V	
Input Voltage	VINA	-0.3	VDD+0.3	V	
Storage temperature	Tstg	-65	150	°C	

Operation under a condition exceeding above limits may cause permanent damage to the device. Normal operation is not guaranteed under the above extreme conditions.

### Recommended Operating Conditions

Voltages are referenced to corresponding ground level. VSS=0V

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power supply	VDD	3.135	3.3	3.465	V	
Storage temperature	Ta	0		70	°C	

When powered-up, Please set PDN to Lo, then set PDN to Hi. Release from reset + PD.

### Electrical Characteristics

#### 1. Digital input DC characteristics

(VDD=3.135~3.465V, Ta=0~70°C unless otherwise specified)

Item	Symbol	Pin	Min.	Typ.	Max.	Unit.	Remarks
H level input voltage	VIH	Note 1	0.7× VDD			V	
L level input voltage	VIL	Note 1			0.3× VDD	V	
Input leakage current	IL	Note 1	-2		2	μA	

(Note 1) PDN, EN, CONT\_R,G,B

#### 2. CP block, Analog characteristics

(VDD=3.135~3.465V, Ta=0~70°C unless otherwise specified)

Item	Min.	Typ.	Max.	Unit	Remarks
CPOUT Voltage	6.27	6.6	6.93	V	@LED current disable
CPOUT Rise time			1	msec	
CPOUT Fall time			20	msec	
Current Consumption		4.0		mA	

## 3. LEDD block, Analog characteristics

(VDD=3.135~3.465V , Ta=0~70°C unless otherwise specified)

Item	Min.	Typ.	Max.	Unit	Remarks
LED drive current range	22		66	mA	(note 1)
The LED protection circuit activation current	105	150	217.5	mA	
LED current (R/G/B)	60	66	72	mA	IREF resister =4.7 kΩ ±1% LED pin voltage =(2*VDD - 3.1)V
LED current accuracy (R/G/B)		100		%	LED pin voltage =(2*VDD - 3.1)V
	86.0	87.5	89.0	%	000
	73.5	75	76.5	%	001
	60.5	62.5	64.5	%	010
	48	50	52	%	011
	35.5	37.5	39.5	%	100
	23	25	27	%	101
	10.5	12.5	14.5	%	110
LED current LED pin voltage dependence	-2.5		2.5	%	LED pin voltage =(2*VDD - 3.1)V reference
LED Vf	1.1		4.8	V	(note 2)
Current Consumption		1.1		mA	Except LED drive current

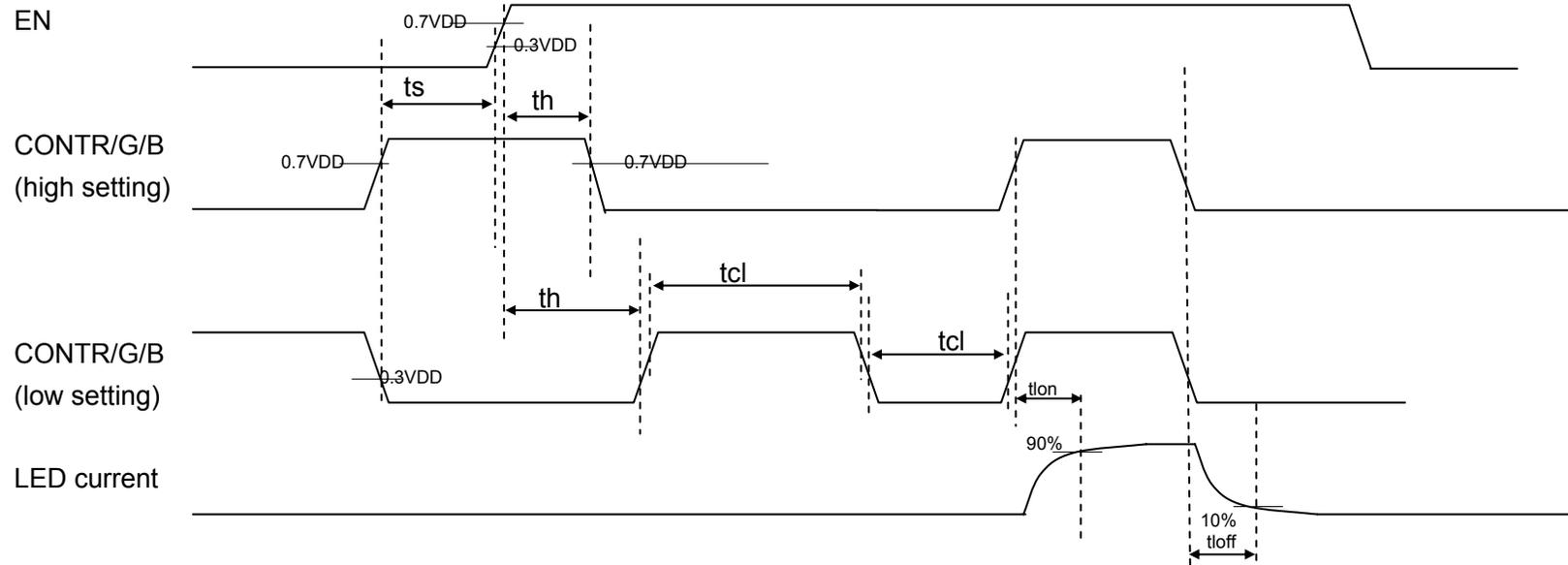
(note 1) IREF resistance value(kΩ) =  $66 \div [\text{LED set value (mA)}] \times 4.7(\text{k}\Omega)$  , also [LED set value] is possible to set with 22mA ~ 66mA.

(note 2) Set a lower limit value 1.1V to be only 1ch in 3ch, and use the other 2ch by 2.0V or more with LED\_Vf.

(note 3) External load: The total line resistance value of CPOUT pin ~ LED anode and LED cathode ~ LED\_X pin within 2Ω.

(note 4) 50% setting is an upper bound when 3ch becoming turning on at the same time.

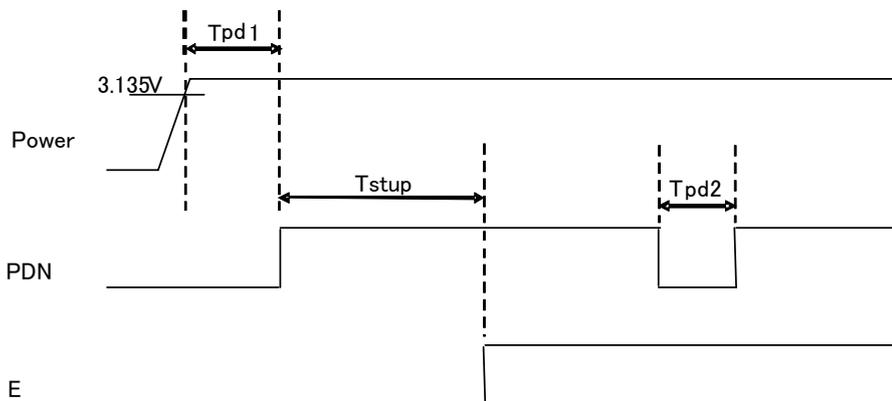
4. LEDD block, Switching characteristics



(VDD=3.135~3.465V , Ta=0~70°C, unless otherwise specified)

No.	Item	min.	typ.	max.	Unit	Conditions
t <sub>lon</sub>	LED current rise time		10		μsec	
t <sub>loff</sub>	LED current fall time		10		μsec	
t <sub>s</sub>	Reset valid setup time LEDB_EN(0.7AVDD):base position	1			μsec	CONTR/G/B to EN(0.7VDD)
t <sub>h</sub>	Count up setup time LEDB_EN(0.3AVDD):base position	1			μsec	EN(0.3VDD) to CONTR/G/B
t <sub>cl</sub>	Current set clearing CONT_x:0.7VDD: base position	1			μsec	

## 5. PDN Switching characteristics



(VDD=3.135~3.465V, Ta=0~70°C, unless otherwise specified)

Item	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
Power down period 1	Tpd1	PDN	150			ns	
Power down period 2	Tpd2	PDN	150			ns	
Start up time	Tstup	EN			1	ms	

( note 1) Please make PDN and EN Lo when you turn on the power supply.

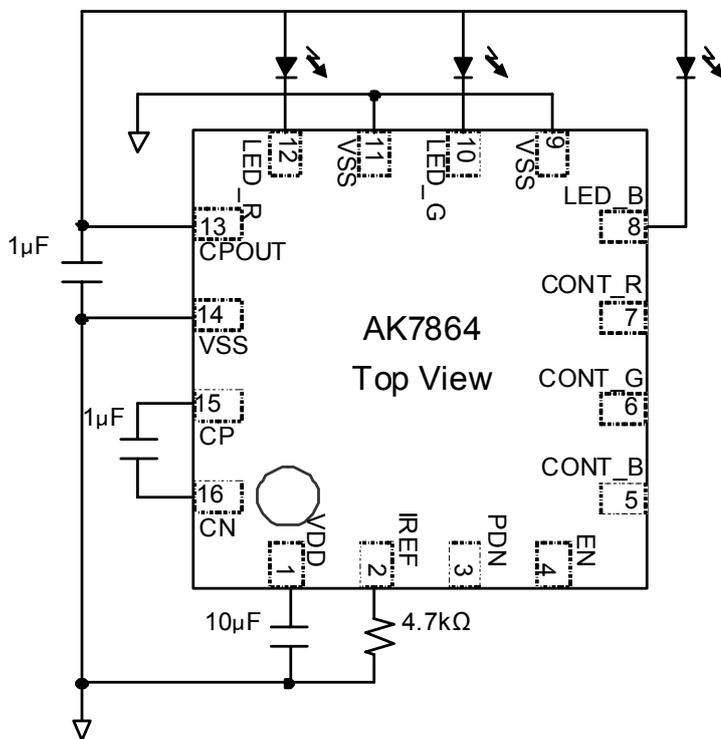
( note 2) LED's lighting after max.1msec after standing up of PDN.

## 6. Power Down Characteristic

(VDD=3.135~3.465V, Ta=0~70°C, unless otherwise specified)

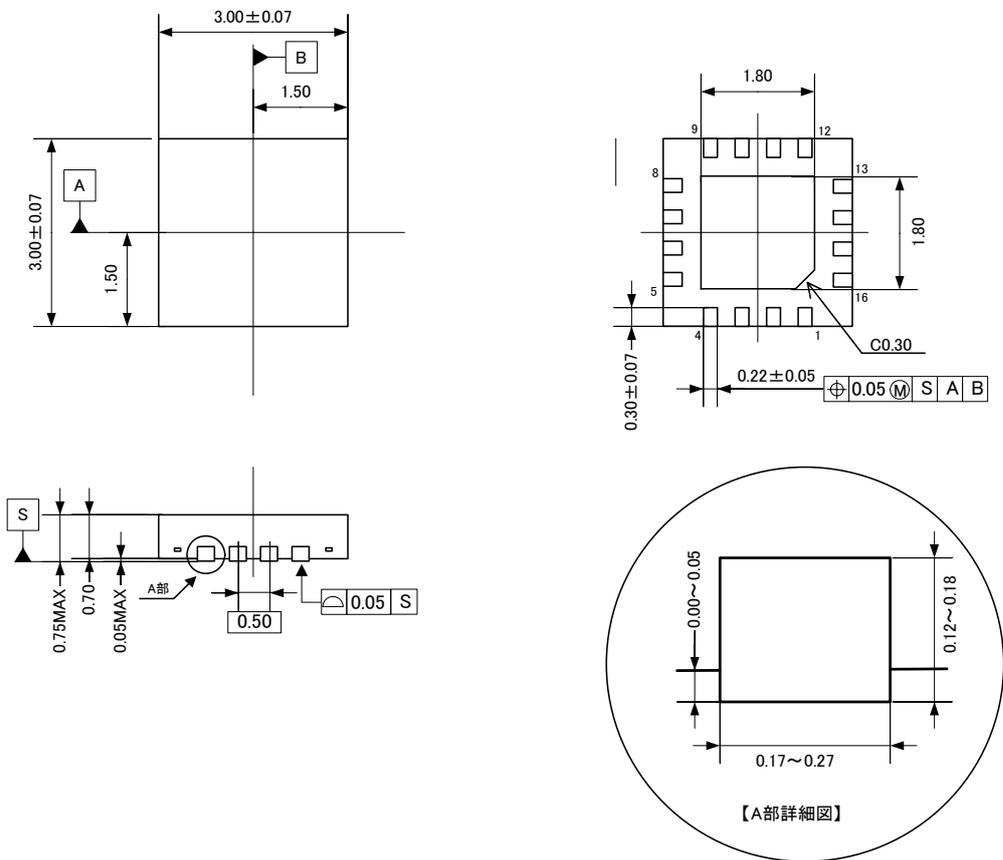
Item	Min.	Typ.	Max.	Unit.	Remarks
Power Down Current			20	μA	

External circuit example



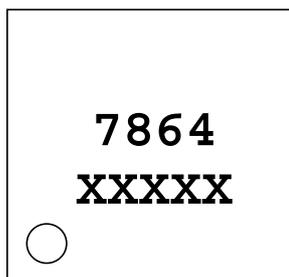
**Package**

**1 Package dimension unit [mm]**



**2 Marking**

- 1. Marketing code : 7864
- 2. Date code : XXXXX



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