Technical Data Sheet

Acrich

SEOUL SEMICONDUCTOR

Application Note:

Circuit Design for SAW8KG0B

SAW8KG0B

Description

This surface-mount LED comes in standard package dimension. It has a substrate made up of a molded plastic reflector sitting on top of a bent lead frame. The die is attached within the reflector Cavity and the cavity is encapsulated by silicone.

The package design coupled with careful selection of component materials allow these products to perform with high reliability.

Features

- White colored SMT package.
- Pb-free ReflоW Soldering
- Suitable for all SMT
- Lead Free and RoHS compliant

Applications

- Interior lighting
- General lighting
- Indoor and out door displays
- Architectural / Decorative lighting

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Contents

1. SAW8KG0B Information

1.1 Description

The SAW8KG0B emitter is designed to operate of rectified high voltage AC. The SAW8KG0B contains a high brightness, high voltage LED chip array and connects the LED chip to the anode and cathode of the package. Each SAW8KG0B emitter contains a zener diode to provide ESD protection.

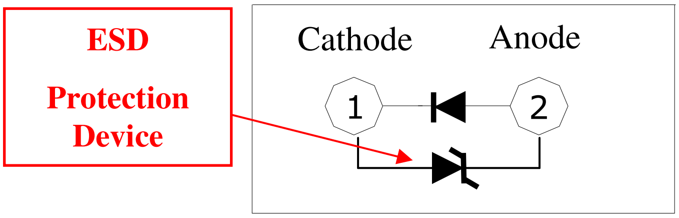
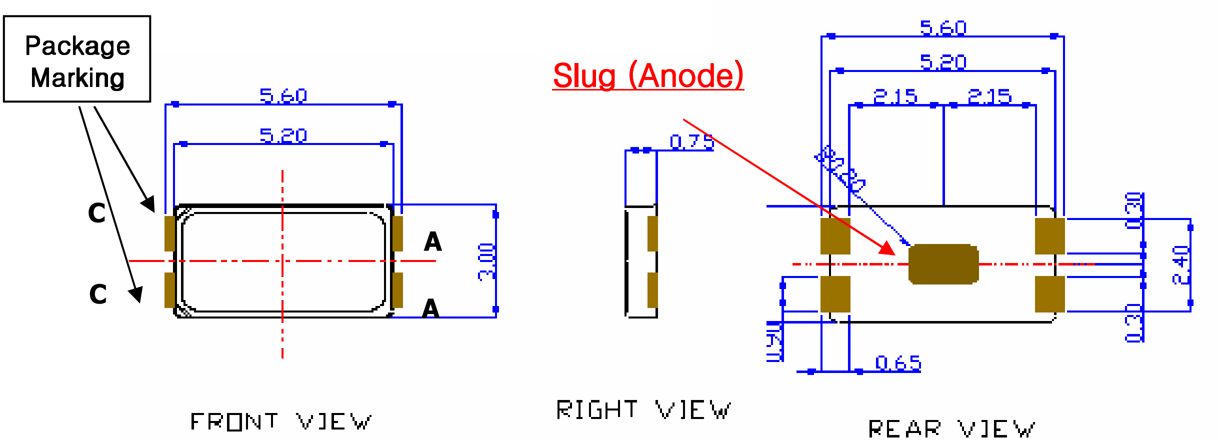


Figure 1. SAW8KG0B (left) and Circuit Diagram

1.2 Mechanical Dimensions



(Tolerance: ±0.1, Unit: mm)

Figure 2. SAW8KG0B mechanical dimensions(mm)

1. SAW8KG0B Information

1.3 Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage*	V_F	I_F=20mA	20.7	22	23	V
Reverse Voltage	V_R	I_R=10mA	0.7	-	-	V
Luminous Intensity*[1] (3700~7000K)	I_v	I_F=20mA	-	13.8 (42.8)	-	cd (lm)
Luminous Intensity*[1] (2600~3700K)	I_v	I_F=20mA	10.9	12.2 (37.8)	-	cd (lm)
Color Correlated Temperature	CCT	I_F=20mA	2,600	-	7,000	K
Viewing Angle [2]	$2\Theta_{1/2}$	I_F=20mA	-	115	-	deg.
Color Rendering Index*	Ra	I_F=20mA	80	82	90	-
ESD (HBM)		1.5kΩ;100 pF	5	-	-	KV
Thermal resistance [3]	$R_{th}JS$	I_F=20mA	-	27	-	K/W

[1] The luminous intensity IV was measured at the peak of the spatial pattern which may not be aligned with the mechanical axis of the LED package.
[2] $2\Theta_{1/2}$ is the off-axis where the luminous intensity is 1/2 of the peak intensity.
[3] Thermal resistance: RthJS (Junction / solder)
* Tolerance : V_F :± 0.4V, I_V :± 7%, Ra :± 2, x,y :± 0.01

[Note] All measurements were made under the standardized environment of SSC.

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Power Dissipation *[1]	P_d	0.58	W
Forward Current	I_F	25	mA
Operating Temperature	T_{opr}	-30~+85	℃
Storage Temperature	T_{stg}	-40~+100	℃
Junction Temperature	T_j	125	℃

[1] Care is to be taken that power dissipation does not exceed the absolute maximum rating of the product.
* LED's properties might be different from suggested values like above and below tables if operation condition will be exceeded our parameter range.

2. Driver Configurations

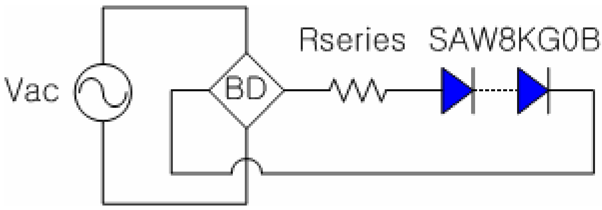
2.1 Description

The SAW8KG0B emitter is designed to operate directly off of AC line power(e.g 120Vac, 230Vac) with a rectifier, linear circuits or capacitive circuits or switching circuits.

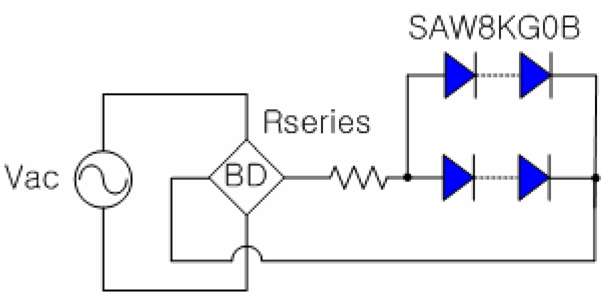
2.2 Linear Circuit

A) Resistor Driving Circuit

It is better to use higher than rated power resistors for reliability. The rated power of the resistor should be chosen based on the equation Irms(A)*Irms(A)*Resistor value(ohms). The normal power rating of a 3216 size resistor is 0.25W. If the power consumption in one resistor exceeds the rated power of the resistor it is suggested to use multiple resistors in parallel.



(a) Series configuration



(b) Parallel configuration

Figure 3. Resistor driving circuit for 100~120Vac

Table 1. Resistor values in Figure 3-(a)

Input Voltage	Power dissipation	LED#	Target Drive Current	VF bins		
				A	B	C
100 Vac	2 W	5ea	20 mA,rms	630 Ω	480 Ω	330 Ω
110 Vac	2 W	5ea	20 mA,rms	1060 Ω	910 Ω	760 Ω
120 Vac	2 W	5ea	20 mA,rms	1510 Ω	1360 Ω	1210 Ω

Table 2. Resistor values in Figure 3-(b)

Input Voltage	Power dissipation	LED#	Target Drive Current	VF bins		
				A	B	C
100 Vac	4 W	10ea	40 mA,rms	315 Ω	240 Ω	165 Ω
110 Vac	4 W	10ea	40 mA,rms	530 Ω	455 Ω	380 Ω
120 Vac	4 W	10ea	40 mA,rms	755 Ω	680 Ω	605 Ω

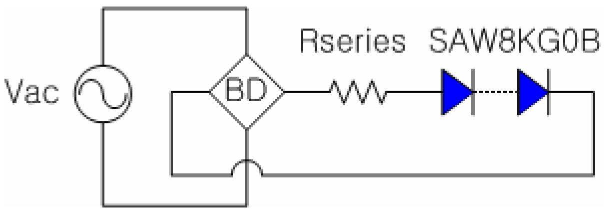


Figure 4. Resistor driving circuit for 220Vac

Table 3. Resistor values in Figure 4.

Input Voltage	Power dissipation	LED#	Target Drive Current	VF bins		
				A	B	C
220 Vac	4 W	10ea	20 mA,rms	2200 Ω	1900 Ω	1600 Ω
230 Vac	4 W	10ea	20 mA,rms	2640 Ω	2340 Ω	2040 Ω
240 Vac	4 W	10ea	20 mA,rms	3080 Ω	2780 Ω	2480 Ω

2.3 Capacitive Circuit

SAW8KG0B can be operated in three additional optional configurations if higher efficiency or less flicker is needed. These capacitive configurations can lower power factor as seen in Table 4. The three different capacitive configurations consist of a bridge diode, resistor, and capacitor(s).

Optional Configuration #1 : output resistor + output capacitor(parallel)
Optional Configuration #2 : Input capacitor(series) + output resistor
Optional Configuration #3 : Input capacitor(series) + output capacitor(parallel) + output resistor

Table 4 shows detail circuit characteristic of four configurations that are operated in 230Vac/50Hz.

	Standard AC Drive	Optional Configuration #1	Optional Configuration #2	Optional Configuration #3
LED #	10 ea	10 ea	10 ea	10 ea
LED VF rank	C	C	C	C
Vin	230 Vac	230 Vac	230 Vac	230 Vac
Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Rout	2040 Ω	4750 Ω	100 Ω	390 Ω
Cin	N/A	N/A	550 nF	1130 nF
Cout	N/A	47 uF	N/A	47 uF
LED current	20 mA,rms	20 mA,rms	20 mA,rms	20 mA,rms
Input current	20 mA,rms	100 mA,rms	20 mA,rms	40 mA,rms
P_{in}	4.16 W	6.52 W	3.23 W	4.71 W
P_{led}	3.33 W	4.54 W	3.17 W	4.53 W
Effciency(P_{led}/P_{in})	80.15%	69.56%	98.19%	96.23%
Noticeable flicker	100Hz	no	100Hz	no
PF	0.90	0.28	0.70	0.51

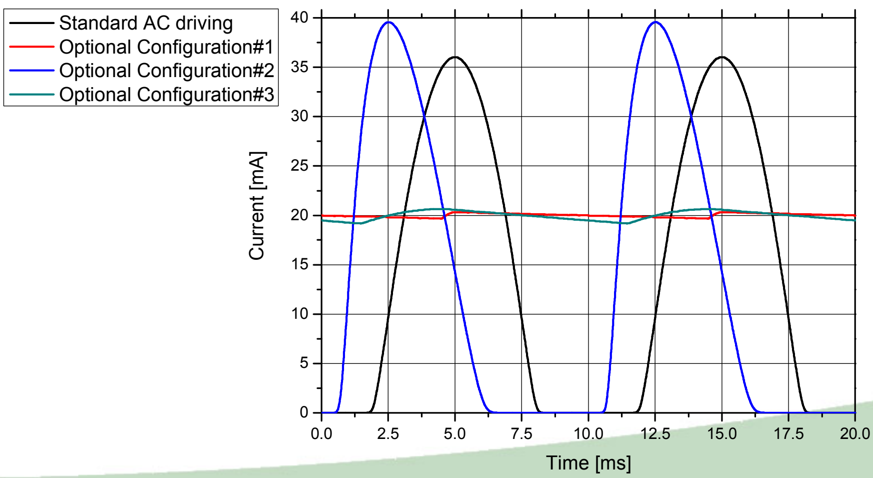


Figure 5. Current waveforms of different circuit configurations

Optional circuit configuration#1: This adds an output capacitor to the standard circuit. This configuration has no flicker. The current shape through the SAW8KG0B package is similar to DC Current, as seen in Figure 6. Input current and LED current are not the same value. The target Drive current indicates LED current through SAW8KG0B PKG. There is no difference in resistor values between 50Hz and 60Hz of frequency.

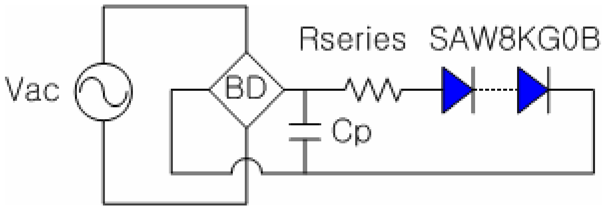


Figure 6. Optional capacitive drive circuit configuration#1

Table 5. Resistor and capacitor values in Figure 6

Input Voltage	Frequency	LED#	Target Drive Current (I_{LED}, not I_{in})	Cp	Rseries for VF bins		
					A	B	C
220 Vac	50Hz/60Hz	10 ea	20 mA,rms	47 uF	4650 Ω	4350 Ω	4050 Ω
230 Vac	50Hz/60Hz	10 ea	20 mA,rms	47 uF	5350 Ω	5050 Ω	4750 Ω
240 Vac	50Hz/60Hz	10 ea	20 mA,rms	47 uF	6050 Ω	5750 Ω	5450 Ω
100 Vac	50Hz/60Hz	5 ea	20 mA,rms	100 uF	1580 Ω	1430 Ω	1280 Ω
110 Vac	50Hz/60Hz	5 ea	20 mA,rms	100 uF	2290 Ω	2140 Ω	1990 Ω
120 Vac	50Hz/60Hz	5 ea	20 mA,rms	100 uF	2990 Ω	2840 Ω	2690 Ω

Optional circuit configuration#2: This adds an input capacitor to the standard circuit. This Configuration has the same current shape through the 5630 package as the standard AC drive (as seen in Figure 7), but since it can only drive one LED string it is very suitable for compact designs. Additionally the circuit efficiency is very high. You can also improve efficiency a little by eliminating the output resistor(Rout), but SSC recommends using Rout for surge immunity.

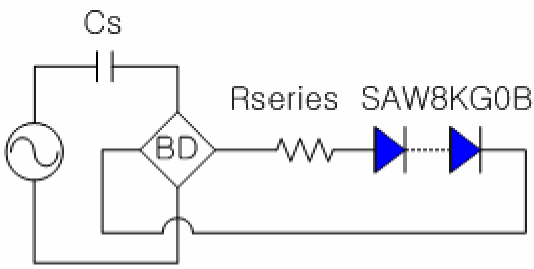


Figure 7. Optional capacitive drive circuit configuration#2

Table 6. Resistor and capacitor values in Figure 7 (220Vac)

Input Voltage	Frequency	LED#	Target Drive Current ($I_{LED} = I_{in}$)	Rs	Cs for VF bins		
					A	B	C
220 Vac	50 Hz	10 ea	20 mA,rms	100 Ω	560 nF	590 nF	640 nF
	60 Hz	10 ea	20 mA,rms	100 Ω	470 nF	490 nF	530 nF

Table 7. Resistor and capacitor values in Figure 7 (220Vac)

Input Voltage	Frequency	LED#	Target Drive Current ($I_{LED} = I_{in}$)	Rs	Cs for VF bins		
					A	B	C
230 Vac	50 Hz	10 ea	20 mA,rms	100 Ω	500 nF	520 nF	550 nF
	60 Hz	10 ea	20 mA,rms	100 Ω	420 nF	430 nF	460 nF

Table 8. Resistor and capacitor values in Figure 7 (100~120 Vac)

Input Voltage	Frequency	LED#	Target Drive Current ($I_{LED} = I_{in}$)	Rs	Cs for VF bins		
					A	B	C
100Vac	50 Hz	5 ea	20 mA,rms	100 Ω	1600 nF	1850 nF	2340 nF
	60 Hz	5 ea	20 mA,rms	100 Ω	1340 nF	1550 nF	1950 nF
110 Vac	50 Hz	5 ea	20 mA,rms	100 Ω	1150 nF	1230 nF	1330 nF
	60 H	5 ea	20 mA,rms	100 Ω	960 nF	1020 nF	1110 nF
120 Vac	50 Hz	5 ea	20 mA,rms	100 Ω	920 nF	950 nF	1000 nF
	60 Hz	5 ea	20 mA,rms	100 Ω	760 nF	800 nF	930 nF

Optional circuit configuration#3: This adds an input capacitor and output capacitor to the standard circuit. This configuration has no flicker and the current shape through the 5630 package is similar to DC current, as seen in Figure 8. This means we get a combination of configurations #1 & 2, higher efficiency and no flicker issues.

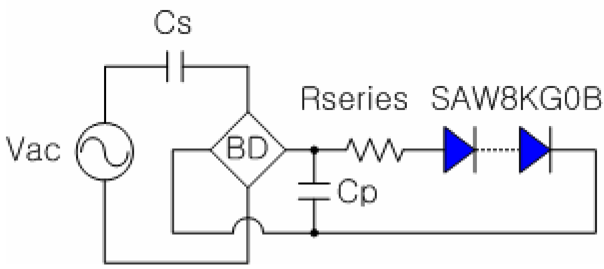


Figure 8. Optional capacitive drive circuit configuration#3

Table 9. Resistor and capacitor values in Figure 8 (220Vac)

Input Voltage	Frequency	LED#	Target Drive Current (I_{LED}, not I_{in})	Cp	Rs	Cs for VF bins		
						A	B	C
220 Vac	50 Hz	10 ea	20 mA,rms	47 uF	390 Ω	1160 nF	1250 nF	1350 nF
	60 Hz	10 ea	20 mA,rms	47 uF	390 Ω	960 nF	1040 nF	1120 nF

Table 10. Resistor and capacitor values in Figure 8 (230Vac)

Input Voltage	Frequency	LED#	Target Drive Current (I_{LED}, not I_{in})	Cp	Rs	Cs for VF bins		
						A	B	C
230 Vac	50 Hz	10 ea	20 mA,rms	47 uF	390 Ω	990 nF	1060 nF	1130 nF
	60 Hz	10 ea	20 mA,rms	47 uF	390 Ω	830 nF	880 nF	940 nF

Table 11. Resistor and capacitor values in Figure 8 (110~120Vac)

Input Voltage	Frequency	LED#	Target Drive Current (I_{LED}, not I_{in})	Cp	Rs	Cs for VF bins		
						A	B	C
110 Vac	50 Hz	5 ea	20 mA,rms	100 uF	200 Ω	2360 nF	2550 nF	2770 nF
	60 Hz	5 ea	20 mA,rms	100 uF	200 Ω	1970 nF	2120 nF	2300 nF
120 Vac	50 Hz	5 ea	20 mA,rms	100 uF	200 Ω	1780 nF	1890 nF	2010 nF
	60 Hz	5 ea	20 mA,rms	100 uF	200 Ω	1480 nF	1570 nF	1640 nF