DATASHEET

COMMERCIAL SENSORS / VISIBLE LIGHT SENSING

Ambient Light Sensor

visible light Silicon Phototransistor

LXD/GB3-A1ELS

GENERAL DESCRIPTION

The LXD/GB3-A1ELS is consisting of a phototransistor in 3mm lamp.It is sensitive to visible light much like the human eye and has peak sensitivity at 550 nm.

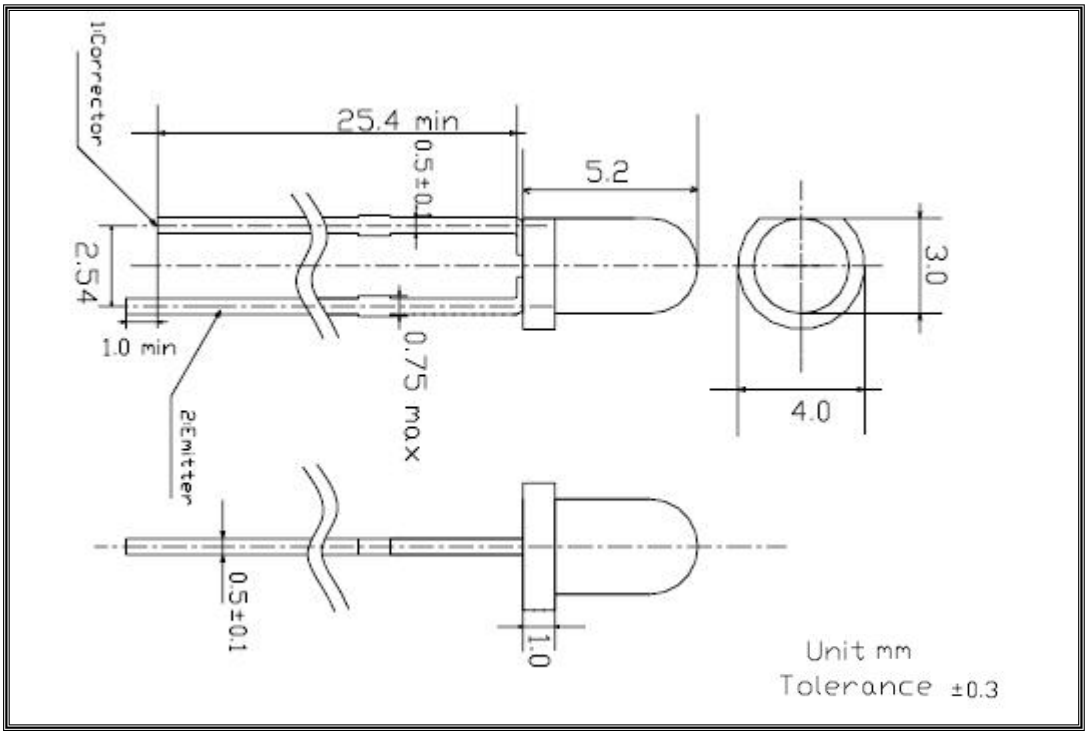
Features

- Package type: DIP Lamp
- Package form: 3MM ROUND
- Dimensions (L x W x H in mm): 3x5.2
- High photo sensitivity
- Adapted to human eye responsivity
- Supression filter for near infrared radiation
- Lead (Pb)-free reflow soldering

Applications

- Street light switching
- Interior and exterior light control (dusk/dawn switch)
- Automotive headlight dimmer
- Contrast control
- Colorimeters
- Oil burner flame monitoring

OUTLINE (TYP.)



Absolute Maximum Ratings :

Parameter	Symbol	Rating	Unit
Collector-Emitter Voltage	VCEO	12	V
Emitter-Collector Voltage	VECO	5	V
Collerctor Power Dissipation	PC	100	mW
Operating Temperature	Topr.	-25~+65	°C
Storage Temperature	Tstg.	-40~+65	°C
Soldering temperature *1	Tsol.	260	°C

Note : *1. For MAX.5 seconds at the position of 2mm from the package

Recommended Operating Conditions:

Operating Temperature	Symbol	Min.	Max.	Unit
Operating Temperature	Ta	-10	+65	°C
Supply Voltage	Vce	1.8	5.0	V

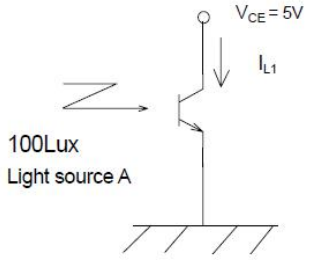
Electrical and Optical Characteristics (Ta=25℃)

Parameter		Symbol	MIN	TYP	MAX.	Unit	Test Condition
Collerct Dark Current		I_{CEO}	/	/	100	nA	VCE=20V H=0mw/cm2
Photo Current		$I_{PCE-01\ (IL1)}$	2	/	8	uA	Vce=5V Ev=10Lux [Note1]
		$I_{PCE-01\ (IL2)}$	7.5		80		Vce=5V Ev=100Lux [Note1]
		$I_{PCE-02\ (IL3)}$	15	/	73		Vce=5V Ev=200Lux [Note2]
Spectral sensitivity		λ	350	/	1100	/	/
Wavelength of peak sensitivity		λp	/	550	/	/	/
Collector-emitter saturation Voltage		Vce(s)	/	/	0.2	V	Ic=2mA IB=100uA
Switching Time	Rise time	tr	/	15	/	uS	Vce=5V IC=10mA
	Fall time	tf	/	15	/		RL=1000Ω
Angle of half Sensitivity		Δθ	/	20°	/	Deg	/
Current gain		$V_{CE(SAT)}$	200	/	/	/	V_{CE}=5V I_C=10mA

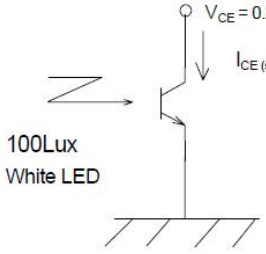
[Note1]Illuminance by CIE standard illuminant-A / 2856K, incandescent lamp.
[Note2]White Fluorescent light (Color Temperature = 6500K) is used as light source. However, White LED is substituted in mass production.

TEST CIRCUIT

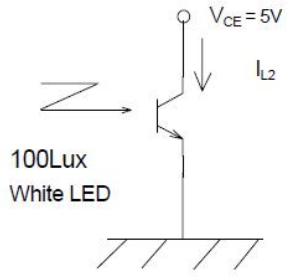
Photocurrent 1 I_{L1}



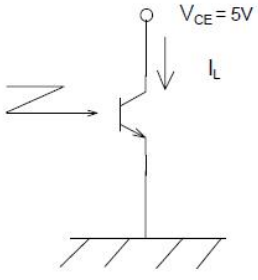
Collector - Emitter Saturation Current $I_{CE(sat)}$



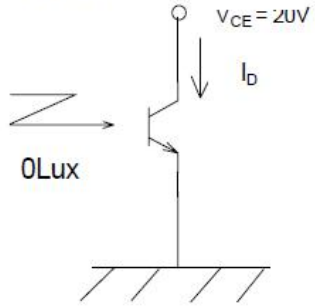
Photocurrent 2 I_{L2}



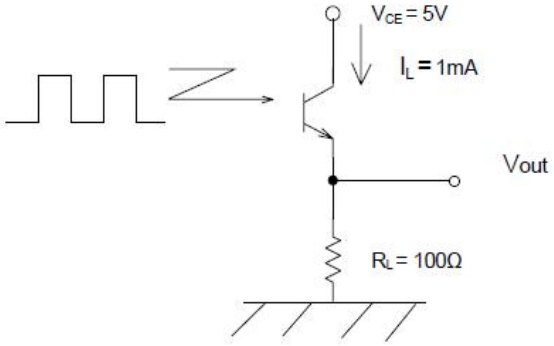
Half Angle $\Theta_{1/2}$



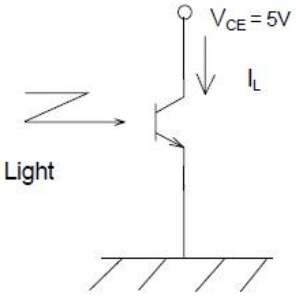
Dark Current I_{CEO}

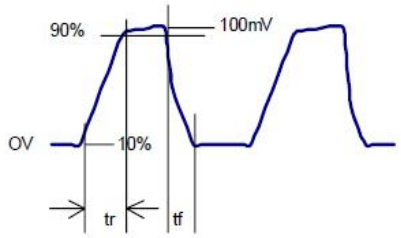


Rise Time tr
Fall Time tf

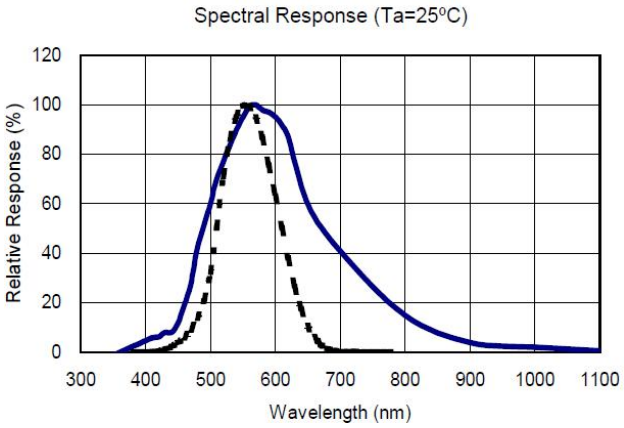


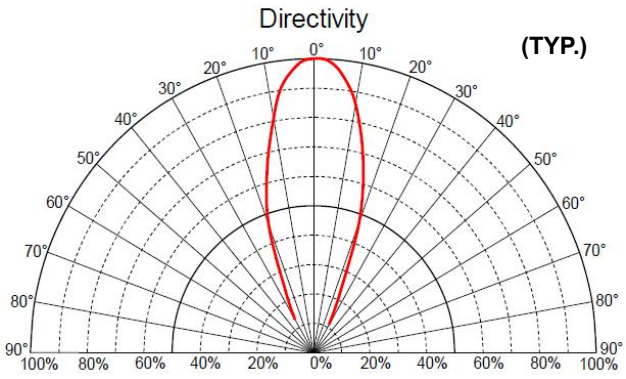
Peak Wavelength λP





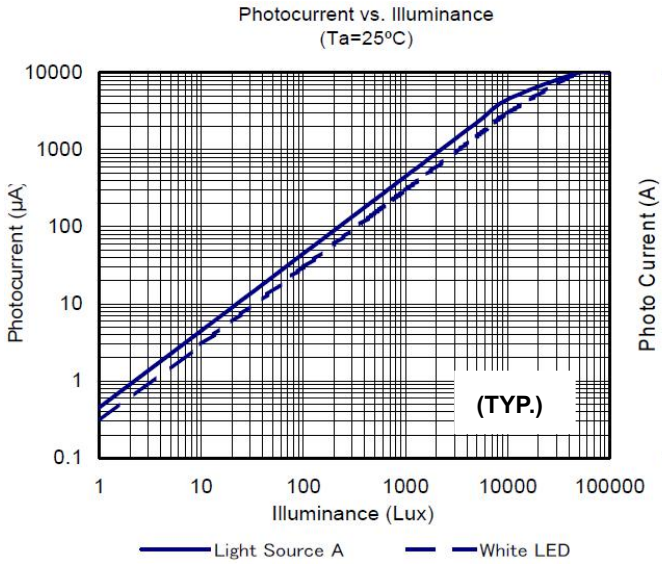
TYPICAL CHARACTERISTIC(TYP.)





LXD/GB3-A1ELS Human eye

FIGURE-1



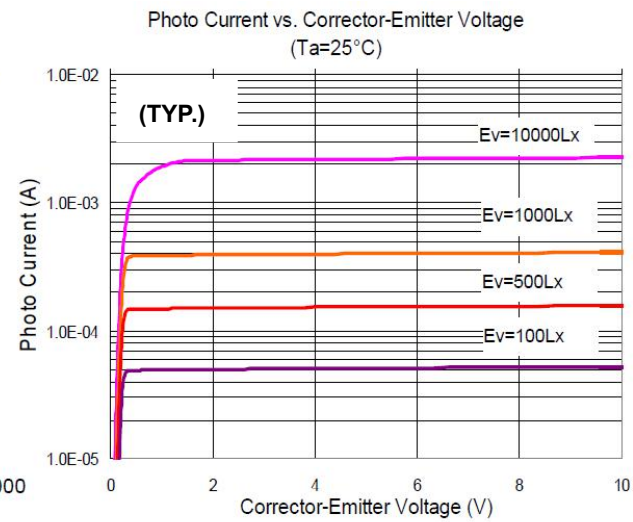
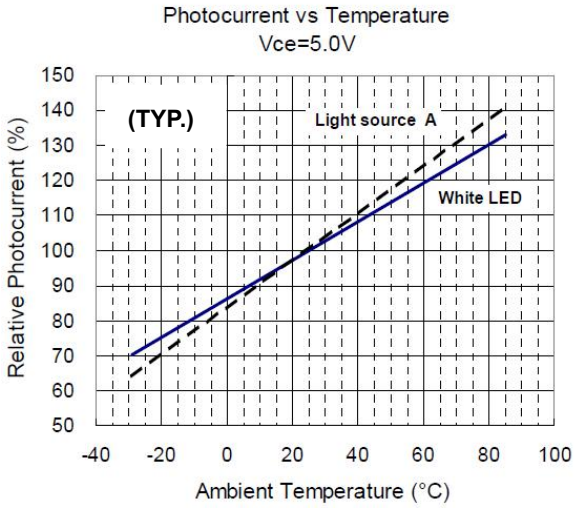
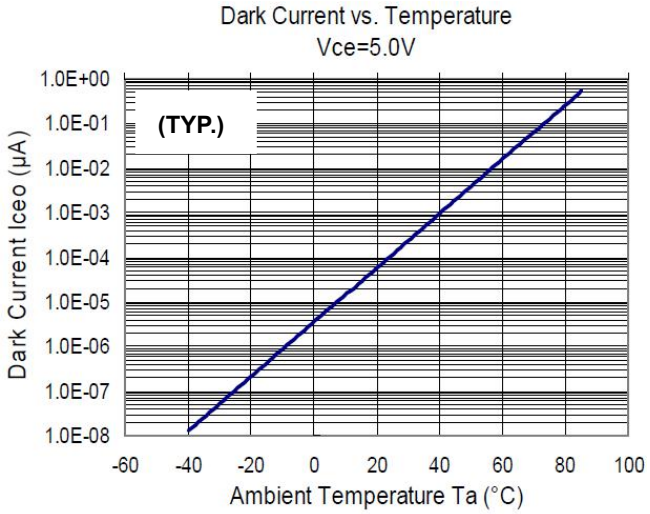


FIGURE-2





CHOOSING THE LOAD RESISTOR (TYP.)

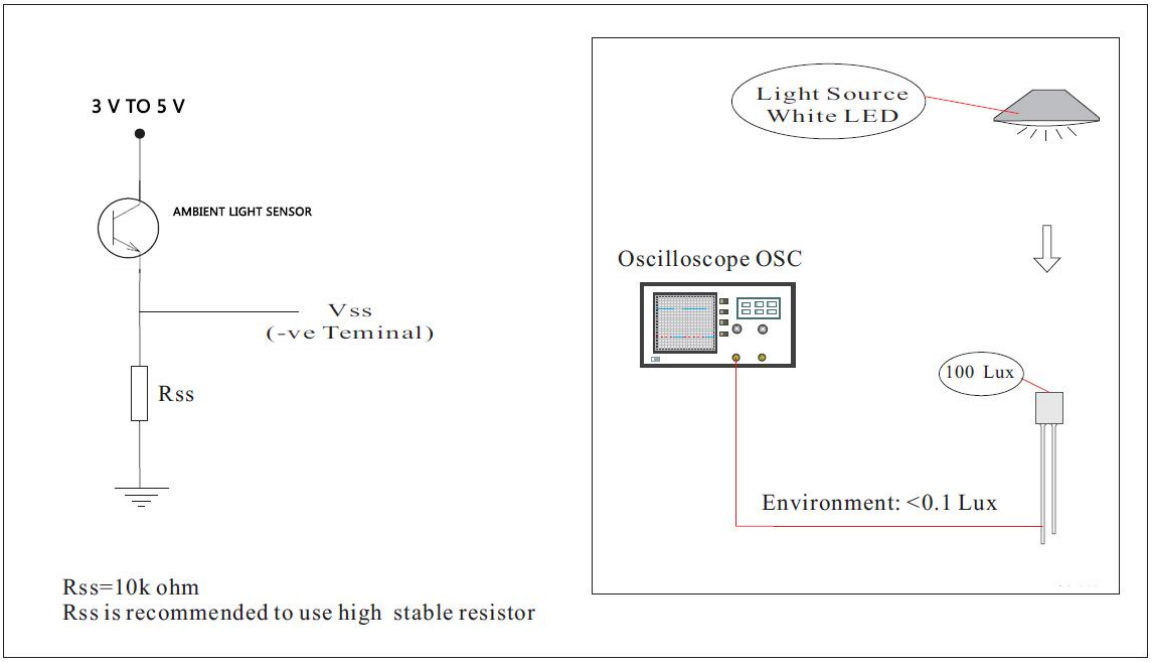
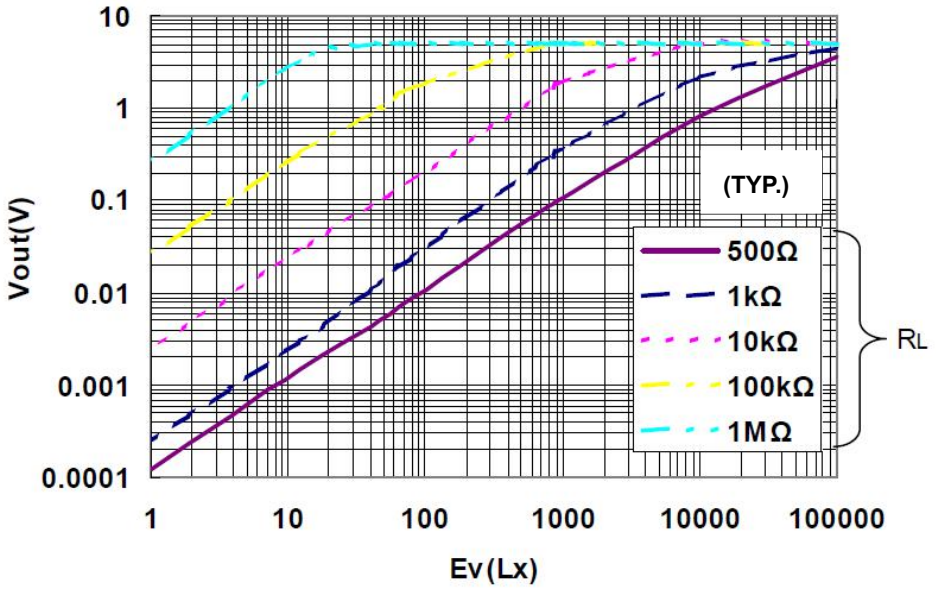
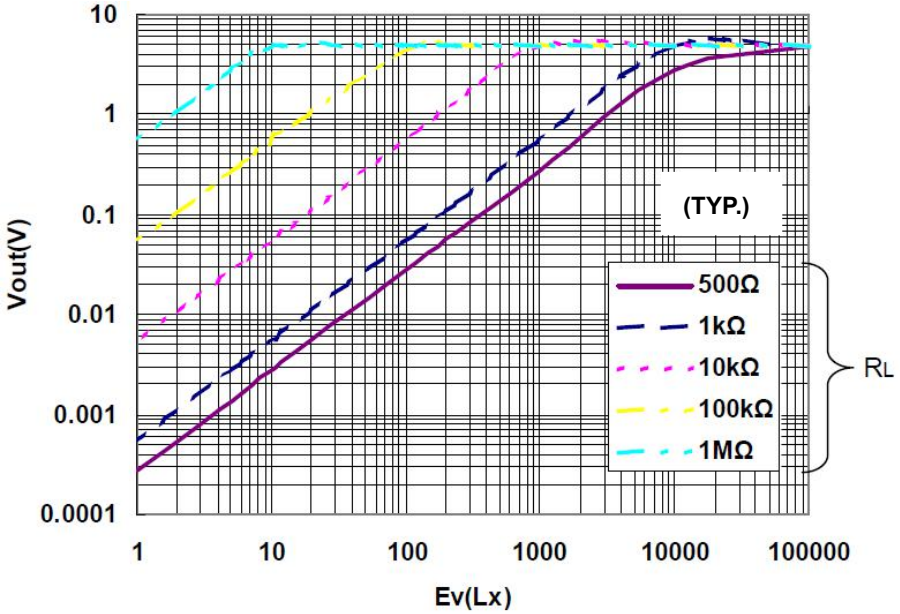


FIGURE-3

LXD/GB3-A1ELS White LED Vce=5.0V



LXD/GB3-A1ELS Light Source A Vce=5.0V



OPERATING FROM 1 lux TO 100 000 lux(TYP.)

The sensitivity of LXD/GB3-A1ELS allows detection of ambient light from 1 lux to 100 000 lux. In many applications, the detection range of an ambient light sensor is from 1 lux to 1000 lux. The calculations for the loadresistor on the previous page were for this range.The maximum allowable current for the LXD/GB3-A1ELS is 20mA. Extrapolating the graph of the photo current versus illuminance a photo current of 18 mA is approximately equal to 100 000 lux. The relationship between photo current and ambient light is linear. Given the extremely low dark current for this part of 50 nA, and again extrapolating the graph, results in approximately 180 nA of photo current for 1 lux. The output current from 1 lux to 100 000 lux is 180 nA to 18 mA.

Depending on the sensitivity of the analog-to-digital converter, an operational amplifier could be placed at the output of the sensor as shown in figure 4. In this case, a load resistor of 10 kΩ results in an output voltage of 2 mV to 2.0 V for an ambient level of 1 lux to 1000 lux.

E_V = 1 lux to 1000 lux

I_{PCE} = 0.2 µA to 200 µA

R_L = 10 kΩ

V_{RL} = (0.2 µA x 10 kΩ) to (200 µA x 10 kΩ)

V_{RL} = 2 mV to 2 V

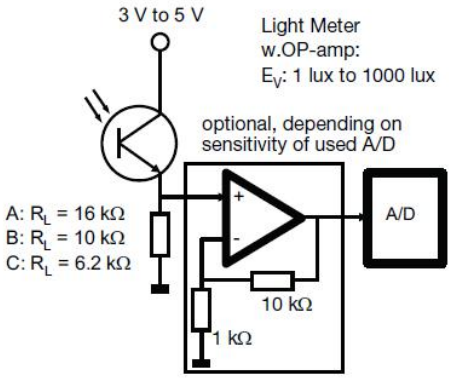


FIGURE-4

Operating over the full ambient range of 1 lux to 100 000 lux and using a 1 kΩ load resistor would result in an output voltage from 0.18 mV to 18 V. Given a typical operating voltage of 5 V or less, this circuit design is not adequate. The load resistor will need to switch based on the output of the operational amplifier (figure 5). Switching a low-ohm resistor that is in parallel to the divider resistor to ground when the operational amplifier is above a certain value, for example 3 V, allows full-range operation.

1 lux to 1000 lux	**1 lux to 100 000 lux**
I_{PCE} = 180 nA to 180 µA	I_{PCE} = 180 µA to 18 mA
R_L = 100 Ω →	R_L = 100 Ω
V_{RL} = 18 µV to 18 mV	V_{RL} = 18 mV to 1.8 V
with va = 100	with va = 1
V_{ADC} = 1.8 mV to 1.8 V	V_{ADC} = 18 mV to 1.8 V

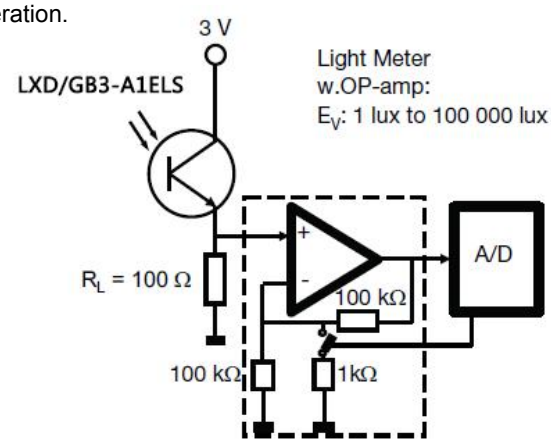


FIGURE-5

APPLICATION SCHEMATICS (TYP.)

Some simple application circuits for ambient light sensors with phototransistor output are shown below.

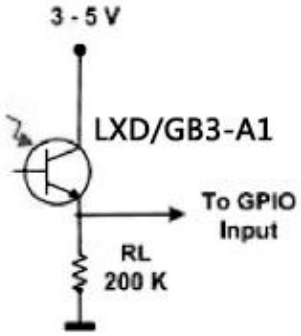


Fig. 6 - Switch, Output High at E_V > 25 lux, I_{PCE}: 10 µA, V_{OUT}: 2.0 V, Input Leakage Current: < 1 µA

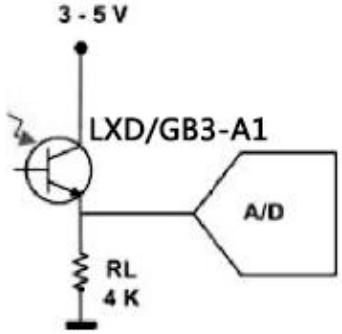


Fig. 7 -Light Meter, E_V: 10 lux to 1000 lux, I_{PCE}: 4 µA to 400 µA, V_{OUT}: 16 mV to 1.6 V

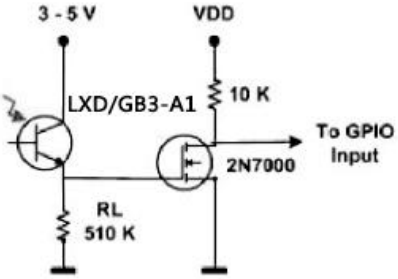


Fig. 8 - Switch, Output Low at E_V > 10 lux, I_{PCE}: 4 µA, Gate Threshold: 2.0 V, Input Leakage Current: < 1 µA

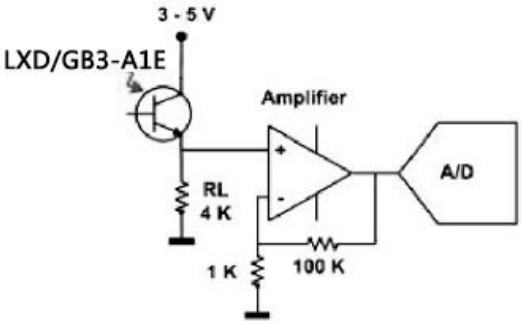


Fig. 9 - Low Illuminance Light Meter, E_V: 0.1 lux to 10 lux, I_{PCE}: 40 nA to 4 µA, V_{OUT}: 16 mV to 1.6 V

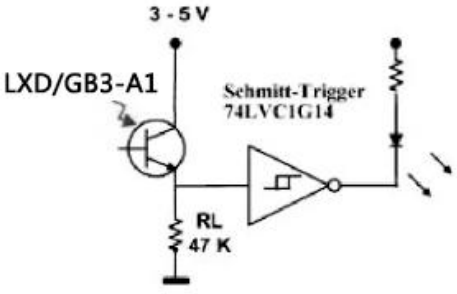


Fig. 10 - Light Switch, (Schmitt Trigger), Switch on at E_V < 100 lux, I_{PCE}: < 40 µA, Input Leakage Current: < 5 µA

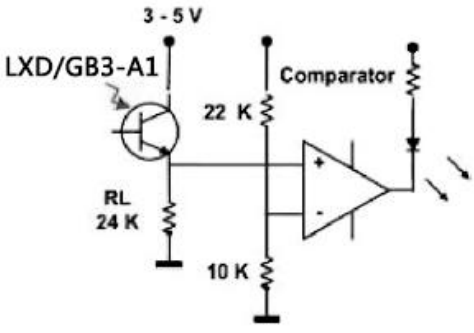
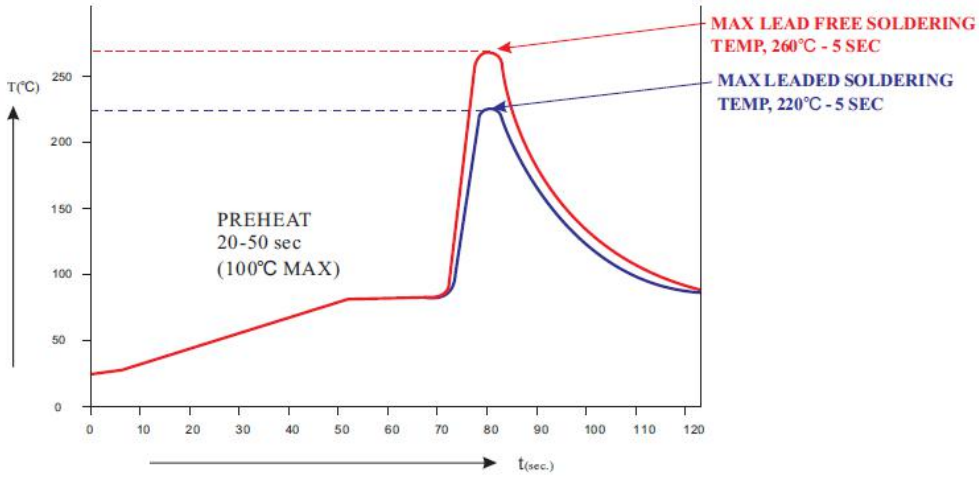


Fig. 12 - Light Switch, Switch On at E_V < 100 lux I_{PCE}: < 40 µA

Wave Solder Profile



Recommended Lead Free Wave Soldering Profile	
Preheat Temperature: 100℃ Max	Peak Temperature: 260℃ Max.
Preheat Time: 20~50 Seconds	Solder Time Above 217℃: 5 Seconds Max.
Note: Turn Off top heater at preheat to prevent the lamp body directly exposed to the heat source.	

CLEANING CONDITIONS

(1) Please refrain from cleaning of the device as much as possible.
A void the solvent or the vapor solvent from the resin of the device even during the mounting and using.
(2) This device can be cleaned if it is only a lead part when the cleaning of flux etc is indispensable.
How ever, clean the device by using the following

IC STORAGE CONDITION AND ITS DURATION

(1) Temperature and humidity ranges.
Temperature: 5 to 40 (°C)
Humidity : 30 to 75 (%)
Normally a package product does not have a quality problem such as package crack because of absorbing humidity. However, the above stated conditions are recommended for storage. Please note that
an electrostatic discharge is apt to destroy the product under the dried environment below 30%.
It is also recommended to store the products avoiding the place where it creates dew with the products due
to a sudden change in temperature.
(2) Please do not expose the products in the corrosive atmosphere.
(3) Please store the products in dust free place.
(4) Please do not expose the products to a direct sun light.
(5) Please store the IC without adding a load.
(6) No need to worry about baking under above storage terms.
(7) The leads are silver plated and they are discolored if the device is left open to the air for long after taken out
of the envelop. It causes deterioration of soldering characteristics. Mount the device as short as possible
after opening the envelope.

STORAGE DURATION

Please store the products less than one year after opening the envelop is made.
For the products which storage duration are longer than one year, please check the solderability and if the leads are rusty before they are used.

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Main Products
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Ambient light sensor
Visible light sensor IC (Photo IC)
Si photodiode

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