

## Biomonitoring Sensor with Red & IR & Two Green LEDs

### FEATURES

- Peak wavelength:  $\lambda_p$  525nm (Green), 660nm (Red), 940nm (Infrared),
- Miniature, thin package: 3.2 X 5.0 X 0.65mm
- Pb free solder re-flowing permitted: 260°C, 2 times
- Pb free, Halogen free
- Conformity to RoHS directive

### APPLICATION

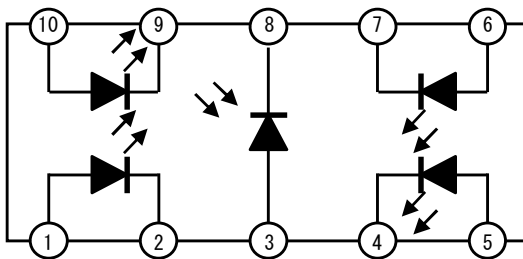
- Bio monitor as pulse rate, SpO<sub>2</sub> of Wearable Devices (Smart watch, Fitness Tracker etc.)
- Mobile Devices

### GENERAL DESCRIPTION

NJL5513R is the compact surface mount type photo sensor, which is built in high brightness Red LED, Infrared LED, two Green LEDs and a high sensitive photo diode.

NJL5513R is a sensor for pulse rate (heart rate) ,SpO<sub>2</sub> measurement which shows one of fitness application that targeted the fitness tracker like Smart watch/Band/Bracelet.

### EQUIVALENT CIRCUIT - BLOCK DIAGRAM

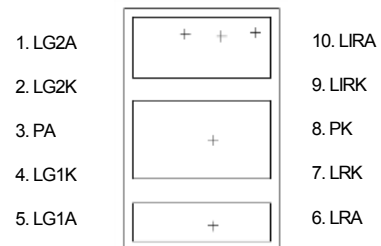


- |         |          |
|---------|----------|
| 1. LG2A | 6. LRA   |
| 2. LG2K | 7. LRK   |
| 3. PA   | 8. PK    |
| 4. LG1K | 9. LIRK  |
| 5. LG1A | 10. LIRA |

### PIN CONFIGURATION

| PIN NO. | SYMBOL | DESCRIPTION            |
|---------|--------|------------------------|
| 1       | LG2A   | Anode for GREEN LED2   |
| 2       | LG2K   | Cathode for GREEN LED2 |
| 3       | PA     | Anode for PD           |
| 4       | LG1K   | Cathode for GREEN LED1 |
| 5       | LG1A   | Anode for GREEN LED1   |
| 6       | LRA    | Anode for RED LED      |
| 7       | LRK    | Cathode for RED LED    |
| 8       | PK     | Cathode for PD         |
| 9       | LIRK   | Cathode for IR LED     |
| 10      | LIRA   | Anode for IR LED       |

(Top View)



### ORDERING INFORMATION

| PART NUMBER | PACKAGE OUTLINE | RoHS | HALOGEN-FREE | TERMINAL FINISH | MARKING    | WEIGHT (mg) | MOQ(pcs) |
|-------------|-----------------|------|--------------|-----------------|------------|-------------|----------|
| NJL5513R    | COBP            | ✓    | ✓            | Au              | No marking | 17          | 3,000    |

## ■ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                  | SYMBOL           | RATINGS    | UNIT |
|--|------------------|------------|------|
| Emitter                                    |                  |            |      |
| Forward Current (Continuous) <sup>*2</sup> | IF RED           | 50         | mA   |
|  | IF IR            | 50         | mA   |
|  | IF GREEN         | 15         | mA   |
| Reverse Voltage (Continuous)               | VR RED           | 5          | V    |
|  | VR IR            | 5          | V    |
|  | VR GREEN         | 5          | V    |
| Power Dissipation <sup>*1</sup>            | PD               | 65         | mW   |
| Detector                                   |                  |            |      |
| Reverse Voltage                            | VR               | 35         | V    |
| Power Dissipation                          | PD               | 20         | mW   |
| Coupled                                    |                  |            |      |
| Total Power Dissipation                    | P <sub>tot</sub> | 85         | mW   |
| Operating Temperature Range                | T <sub>opr</sub> | -20 to +70 | °C   |
| Storage Temperature Range                  | T <sub>stg</sub> | -30 to +85 | °C   |
| Reflow Soldering Temperature               | T <sub>sol</sub> | 260 peak   | °C   |

\*1 Please do not be turned on the LEDs of different wavelength at the same time.

\*2 This is current value of each 1pcs LED.

## ■ELECTRO-OPTICAL CHARACTERISTICS (Ta=25 °C)

| PARAMETER                 | SYMBOL                                | TEST CONDITION   | MIN. | TYP. | MAX. | UNIT |
|---------------------------|---------------------------------------|--|------|------|------|------|
| <b>Emitter</b>            |                                       |  |      |      |      |      |
| DC Forward Voltage        | V <sub>F</sub> RED                    | I <sub>F</sub> =10mA   | —    | 2    | 2.2  | V    |
|                           | V <sub>F</sub> IR                     | I <sub>F</sub> =10mA   | —    | 1.3  | 1.7  | V    |
|                           | V <sub>F</sub> GREEN                  | I <sub>F</sub> =10mA   | —    | 3    | 3.5  | V    |
| Pulse Forward Voltage     | V <sub>FP</sub> RED                   | I <sub>FP</sub> =100mA   | —    | 3.2  | —    | V    |
|                           | V <sub>FP</sub> IR                    | I <sub>FP</sub> =100mA   | —    | 2.2  | —    | V    |
|                           | V <sub>FP</sub> GREEN                 | I <sub>FP</sub> =100mA   | —    | 4    | —    | V    |
| Reverse Current           | I <sub>R</sub> RED                    | V <sub>R</sub> =5V   | —    | —    | 10   | μA   |
|                           | I <sub>R</sub> IR                     | V <sub>R</sub> =5V   | —    | —    | 10   | μA   |
|                           | I <sub>R</sub> GREEN                  | V <sub>R</sub> =5V   | —    | —    | 10   | μA   |
| Peak Wavelength           | λ <sub>P</sub> RED                    | I <sub>F</sub> =10mA   | —    | 660  | —    | nm   |
|                           | λ <sub>P</sub> IR                     | I <sub>F</sub> =10mA   | —    | 940  | —    | nm   |
|                           | λ <sub>P</sub> GREEN                  | I <sub>F</sub> =10mA   | —    | 525  | —    | nm   |
| <b>Detector</b>           |                                       |  |      |      |      |      |
| Dark Current              | I <sub>D</sub>                        | V <sub>R</sub> =10V  | —    | 0.1  | 2    | nA   |
| Forward Voltage           | V <sub>F</sub>                        | I <sub>F</sub> =1mA  | —    | —    | 1.2  | V    |
| Terminal Capacitance      | C <sub>t</sub>                        | V <sub>R</sub> =0V, f=1MHz   | —    | 25   | —    | pF   |
|                           |                                       | V <sub>R</sub> =2.5V, f=1MHz   | —    | 12   | —    | pF   |
| Peak Wavelength           | λ <sub>P</sub>                        | —  | —    | 800  | —    | nm   |
| <b>Coupled</b>            |                                       |  |      |      |      |      |
| Output Current *2         | I <sub>O</sub> RED                    | I <sub>F</sub> =4mA, V <sub>R</sub> =2.5V, d=1.85mm <sup>(5)</sup>                     | 8    | —    | 22   | μA   |
|                           | I <sub>O</sub> IR                     | I <sub>F</sub> =4mA, V <sub>R</sub> =2.5V, d=1.85mm <sup>(5)</sup>                     | 2    | —    | 12   | μA   |
|                           | I <sub>O</sub> GREEN                  | I <sub>F</sub> =4mA <sup>(4)</sup> , V <sub>R</sub> =2.5V, d=1.85mm <sup>(5)</sup>     | 2    | —    | 10   | μA   |
| Operating Dark Current *3 | I <sub>LD</sub> RED                   | I <sub>F</sub> =4mA, V <sub>R</sub> =2.5V,<br>Without reflective plate                 | —    | 30   | 100  | nA   |
|                           | I <sub>LD</sub> IR                    | I <sub>F</sub> =4mA, V <sub>R</sub> =2.5V,<br>Without reflective plate                 | —    | 30   | 100  | nA   |
|                           | I <sub>LD</sub> GREEN                 | I <sub>F</sub> =4mA <sup>(4)</sup> , V <sub>R</sub> =2.5V,<br>Without reflective plate | —    | 10   | 200  | nA   |
| Response Time(Rise/Fall)  | t <sub>r</sub> , t <sub>f</sub> RED   | V <sub>R</sub> =0V, R <sub>L</sub> =1kΩ  | —    | 400  | —    | ns   |
|                           |                                       | V <sub>R</sub> =2.5V, R <sub>L</sub> =1kΩ  | —    | 250  | —    | ns   |
|                           | t <sub>r</sub> , t <sub>f</sub> IR    | V <sub>R</sub> =0V, R <sub>L</sub> =1kΩ  | —    | 550  | —    | ns   |
|                           |                                       | V <sub>R</sub> =2.5V, R <sub>L</sub> =1kΩ  | —    | 300  | —    | ns   |
|                           | t <sub>r</sub> , t <sub>f</sub> GREEN | V <sub>R</sub> =0V, R <sub>L</sub> =1kΩ  | —    | 400  | —    | ns   |
|                           |                                       | V <sub>R</sub> =2.5V, R <sub>L</sub> =1kΩ  | —    | 250  | —    | ns   |

\*1 Pulse duty 10% (Pulse width 200us, Period 20ms)

\*2 Please refer to "Output Current Test Condition".

\*3 I<sub>LD</sub> may increase according to the periphery situation of the surface mounted condition.

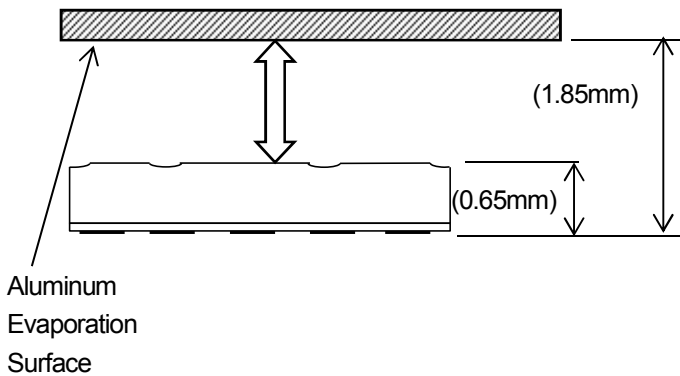
\*4 Total current of each LED (I<sub>F</sub>=2mA/pcs).

\*5 Distance from the package undersurface to the aluminum evaporation surface.

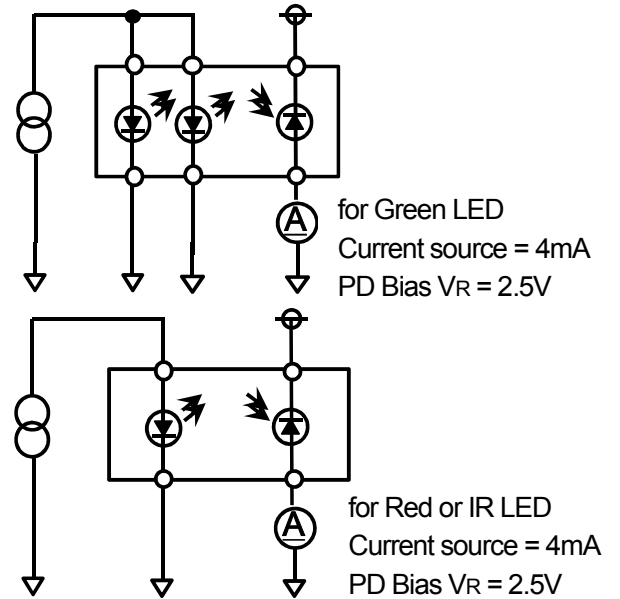
※In the Electro-Optical characteristics table, items that are showed only the typical value are not tested in manufacturing process.

## ■ OUTPUT CURRENT TEST CONDITION

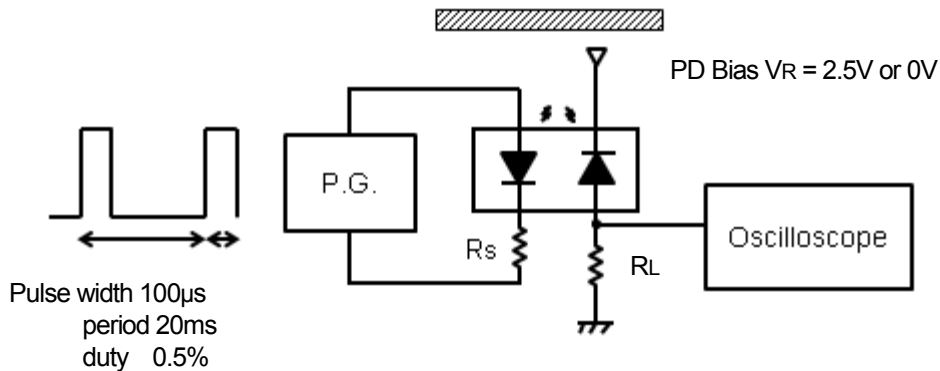
The signal from LED is reflected at the aluminum surface.



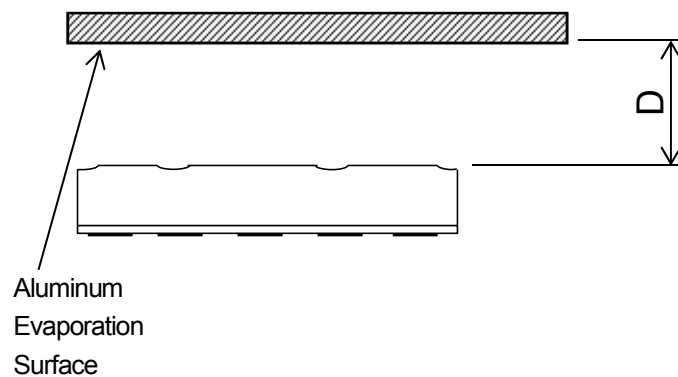
## ■ DARK CURRENT TEST CONDITION



## ■ RESPONSE TEST CONDITION

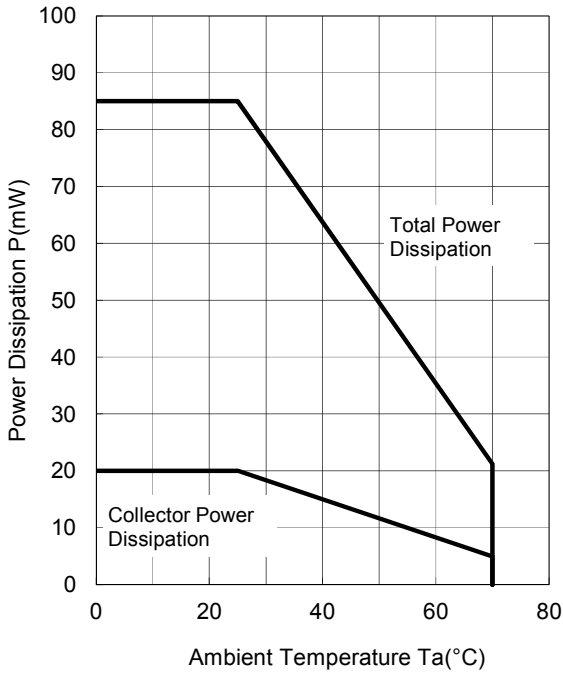


## ■ OUTPUT CURRENT vs. DISTANCE TIME TEST CONDITION

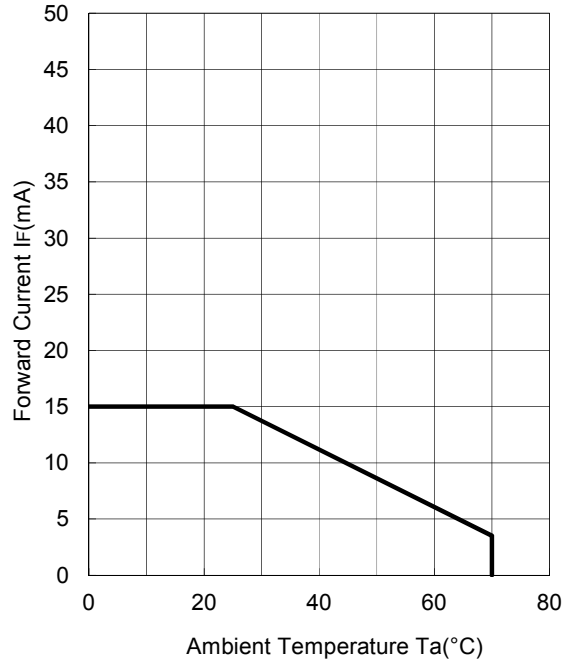


## POWER DISSIPATION vs. AMBIENT TEMPERATURE

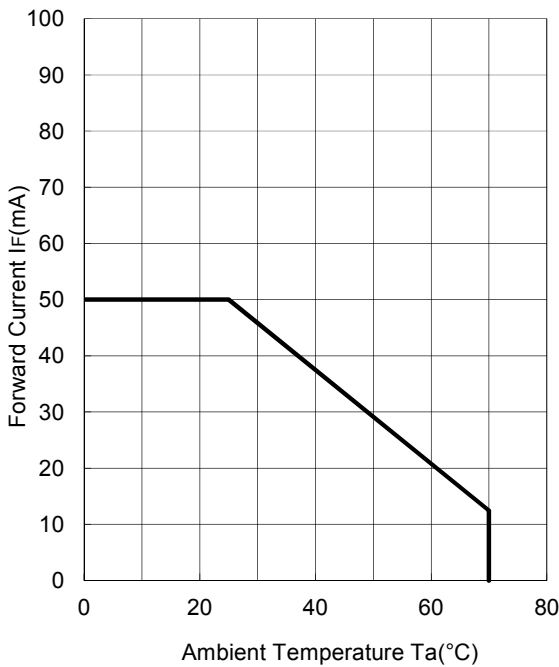
Power Dissipation vs. Temperature



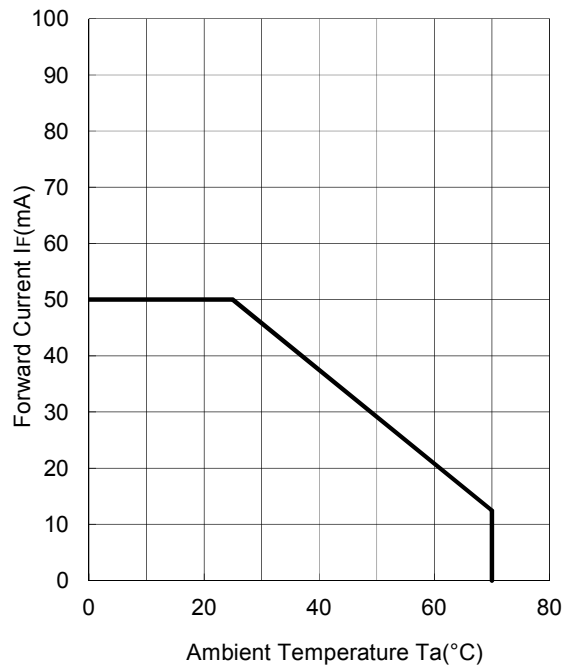
Forward Current vs. Temperature  
GREEN LED



Forward Current vs. Temperature  
RED LED

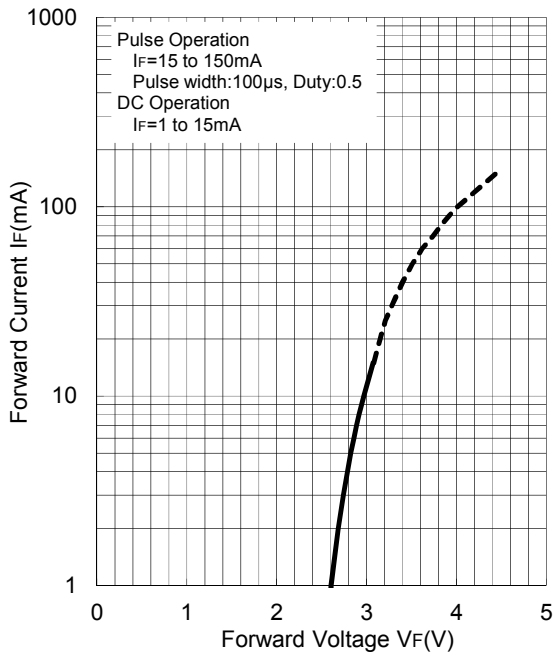


Forward Current vs. Temperature  
IR LED

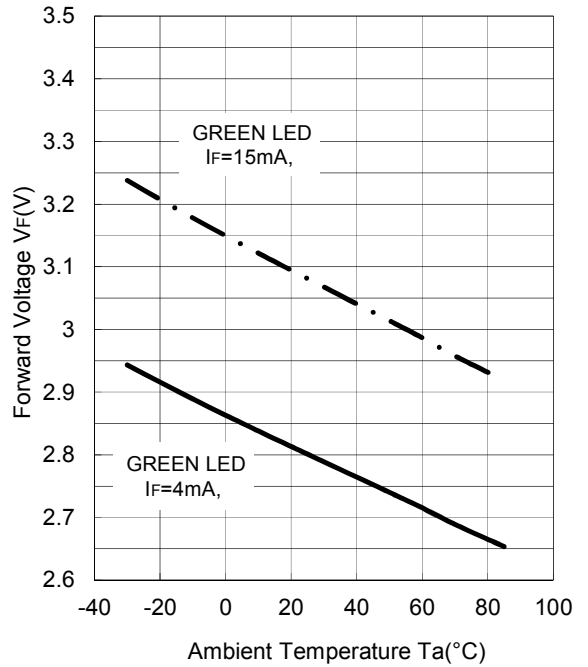


## ■ TYPICAL CHARACTERISTICS RELATED GREEN EMITTER

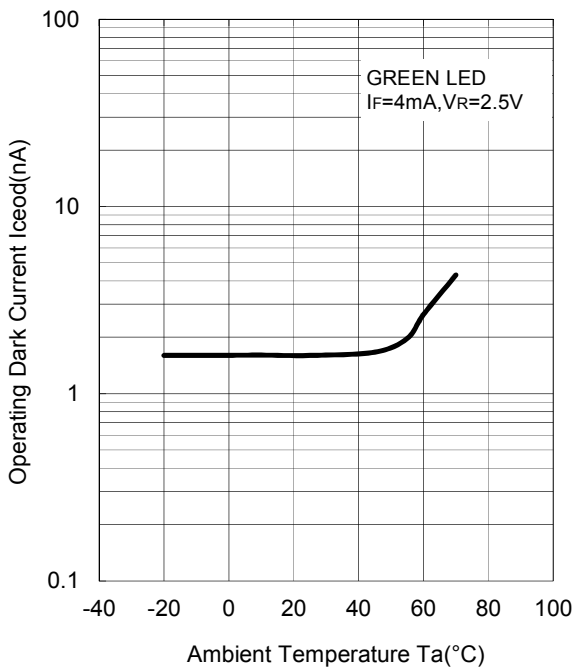
**Forward Voltage vs. Forward Current  
GREEN LED**



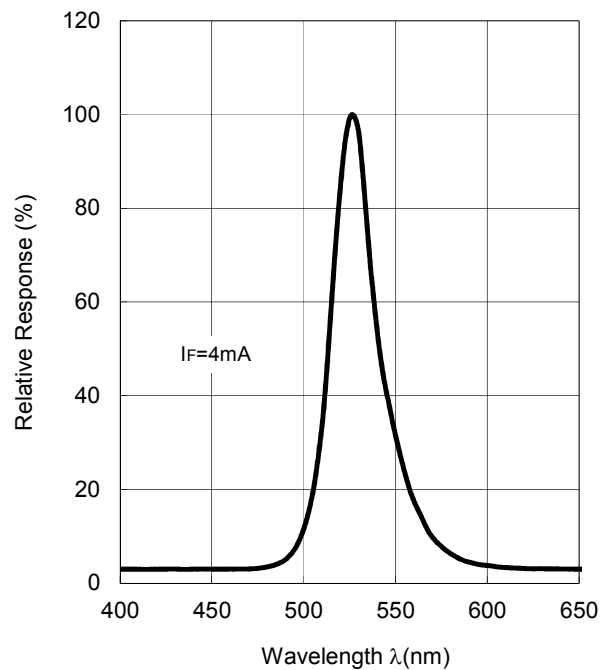
**Forward Voltage vs. Temperature  
GREEN LED**



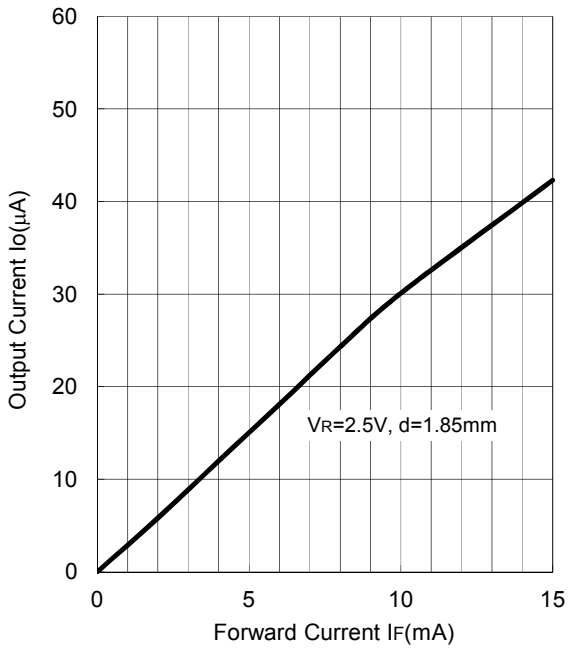
**Operating Dark Current vs. Temperature  
GREEN LED**



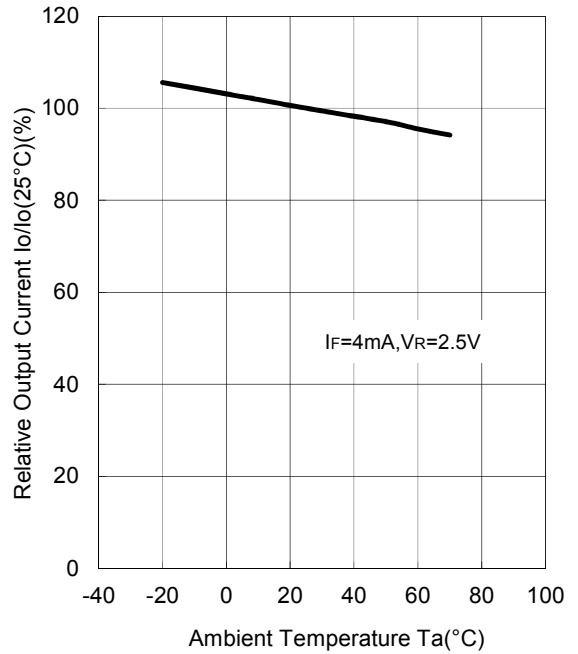
**Spectral Response ( $T_a = 25^\circ\text{C}$ )  
Emitter Green LED**



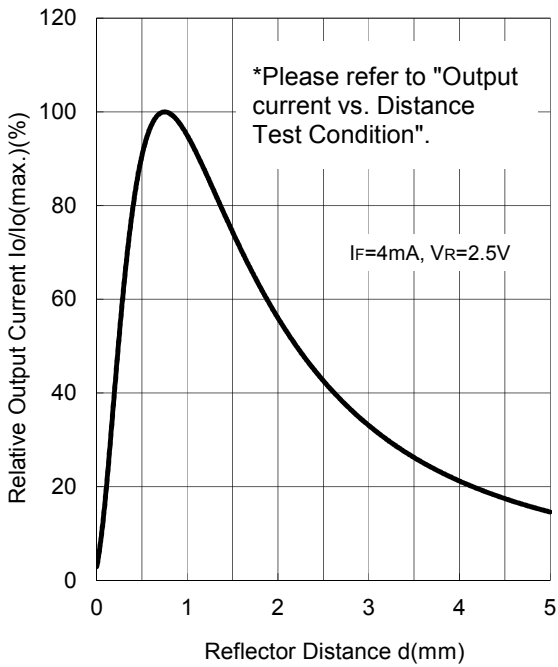
**Output Current vs. Forward Current  
Green LED (Ta=25°C)**



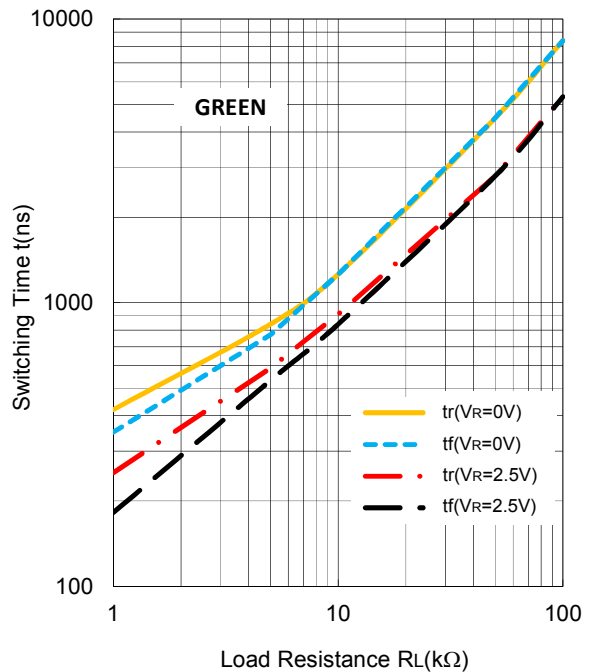
**Output Current vs. Temperature  
Green LED**



**Output Current vs. Distance  
GREEN LED (Ta=25°C)**

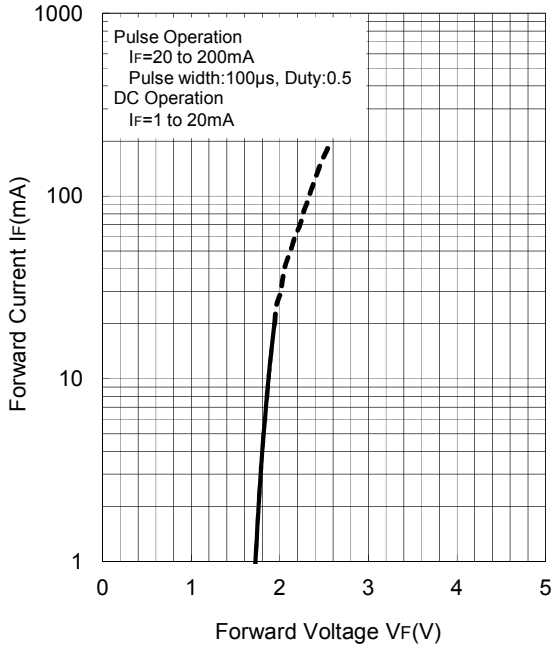


**Switching Time vs. Load Resistance  
(Ta=25°C)**

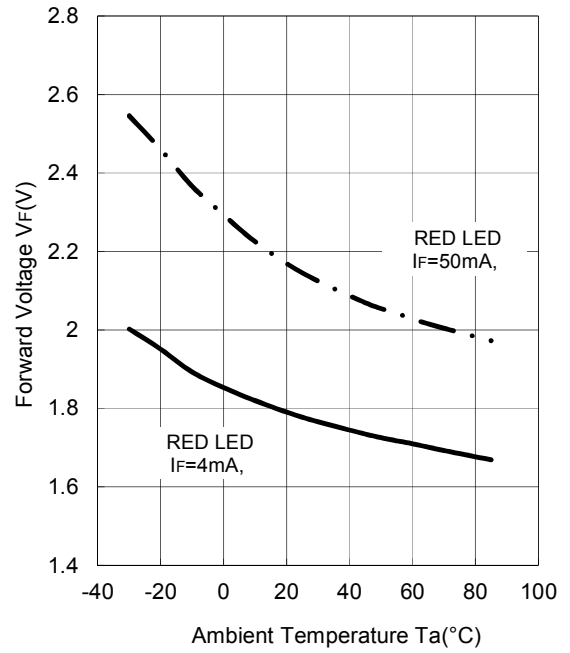


## ■ TYPICAL CHARACTERISTICS RELATED RED EMITTER

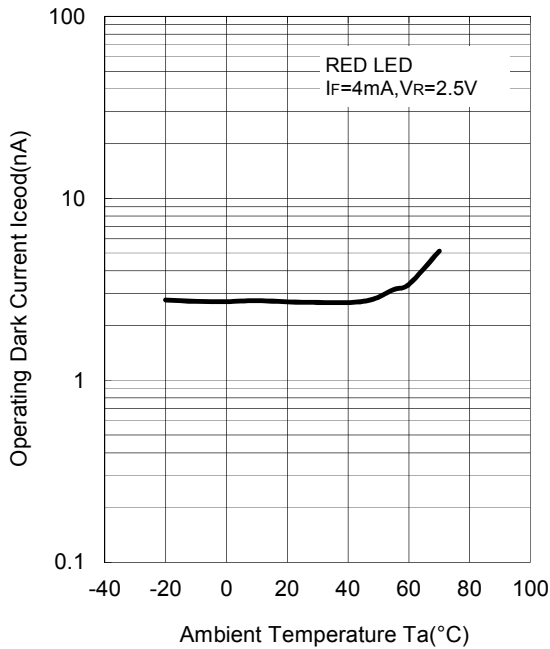
**Forward Voltage vs. Forward Current  
RED LED**



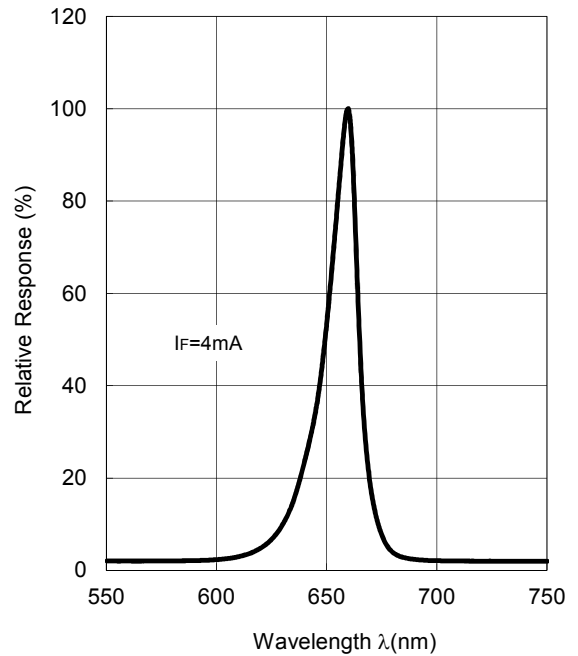
**Forward Voltage vs. Temperature  
RED LED**



**Operating Dark Current vs. Temperature  
RED LED**

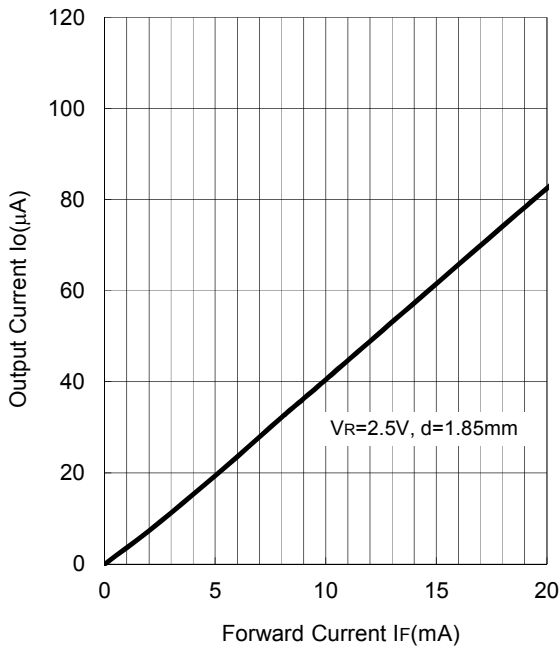


**Spectral Response ( $T_a = 25^\circ\text{C}$ )  
Emitter RED LED**

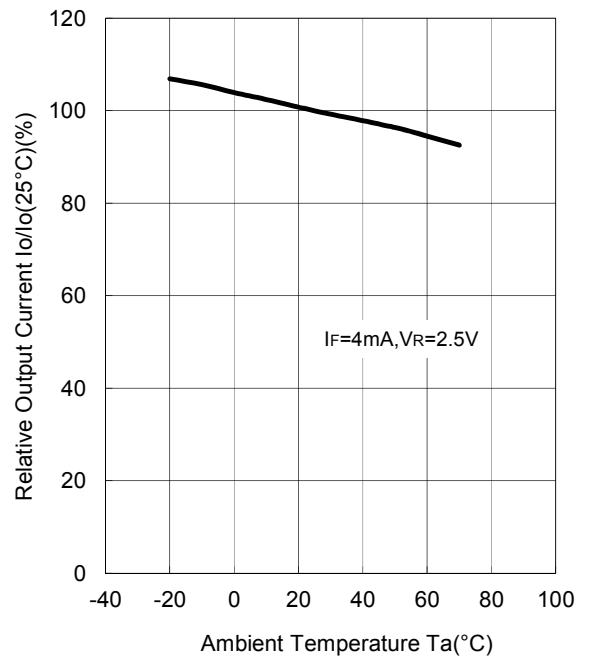




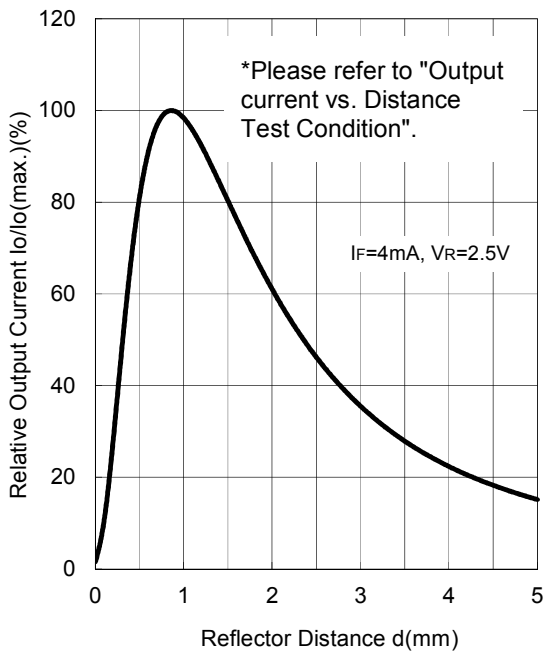
**Output Current vs. Forward Current  
RED LED (Ta=25°C)**



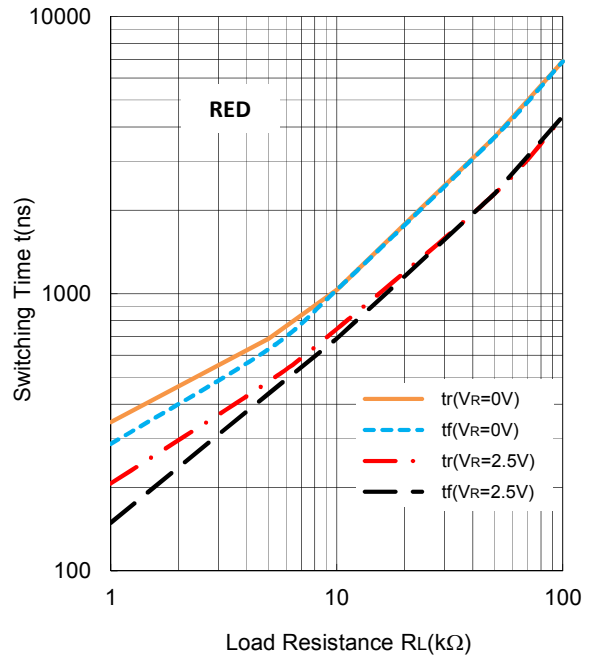
**Output Current vs. Temperature  
RED LED**



**Output Current vs. Distance  
RED LED (Ta=25°C)**

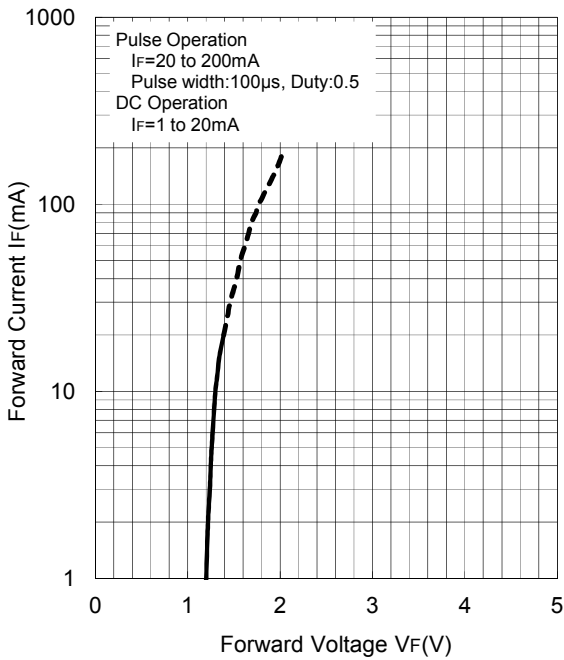


**Switching Time vs. Load Resistance  
(Ta=25°C)**

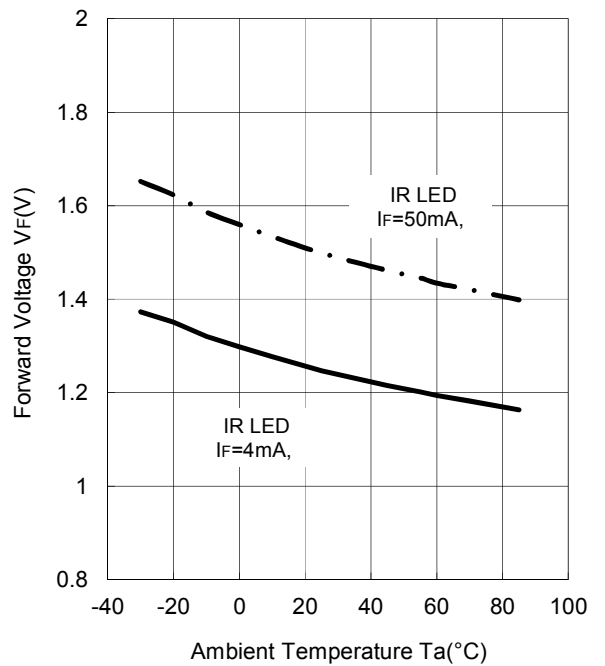


## ■ TYPICAL CHARACTERISTICS RELATED INFRARED EMITTER

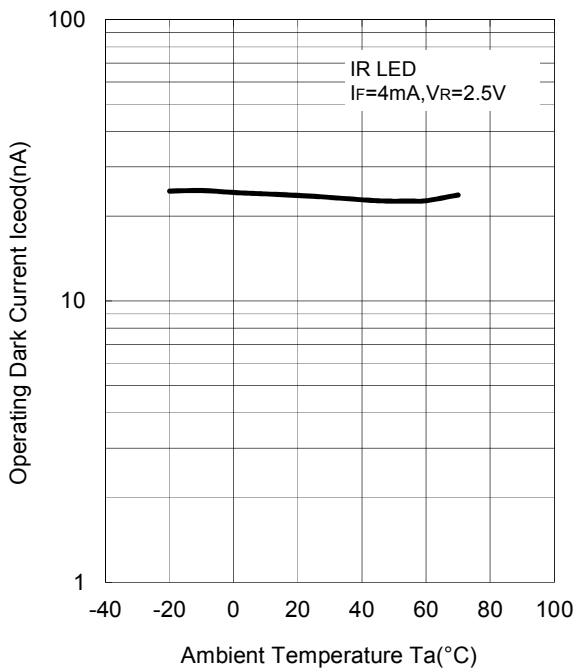
**Forward Voltage vs. Forward Current  
IR LED**



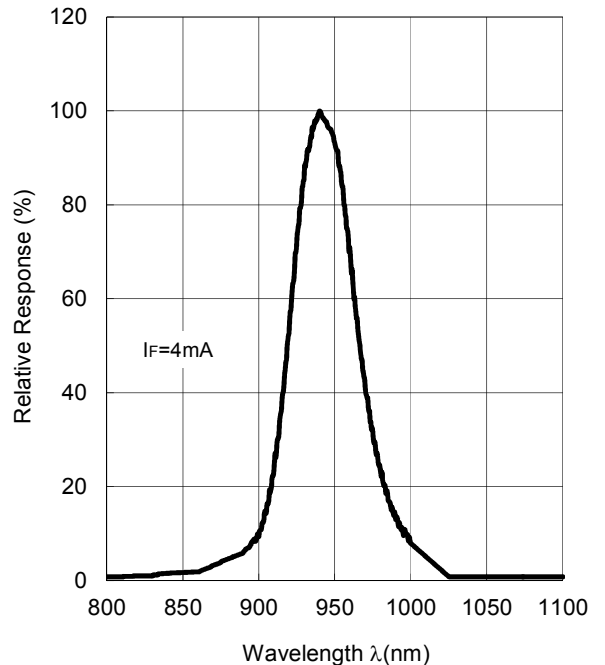
**Forward Voltage vs. Temperature  
IR LED**



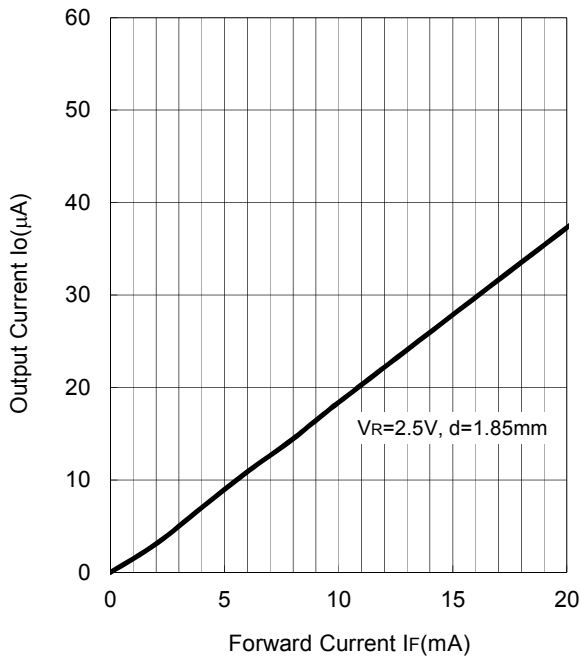
**Operating Dark Current vs. Temperature  
IR LED**



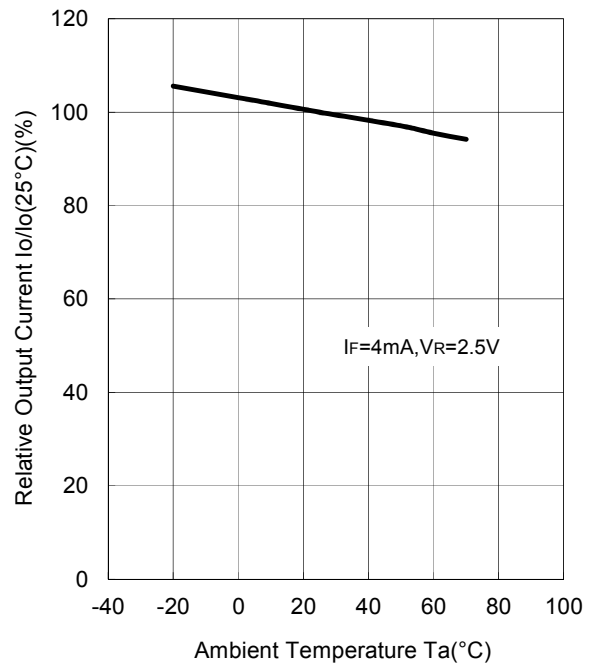
**Spectral Response ( $T_a = 25^\circ\text{C}$ )  
Emitter IR LED**



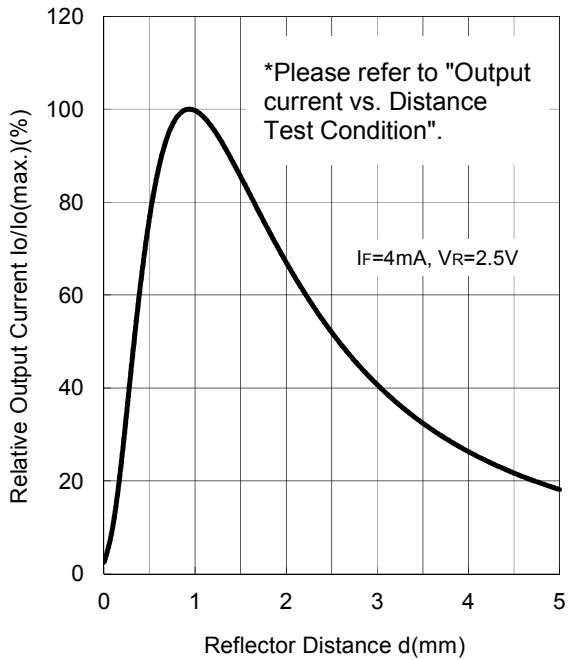
**Output Current vs. Forward Current**  
IR LED (Ta=25°C)



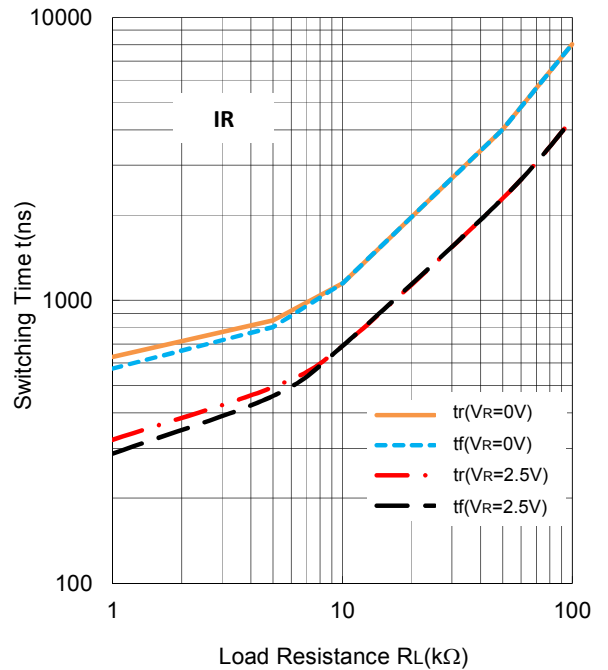
**Output Current vs. Temperature**  
IR LED



**Output Current vs. Distance**  
IR LED (Ta=25°C)

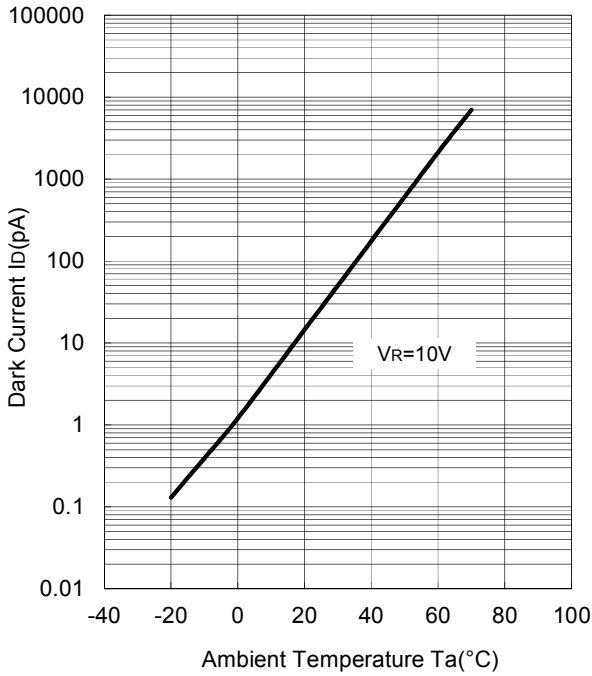


**Switching Time vs. Load Resistance**  
(Ta=25°C)

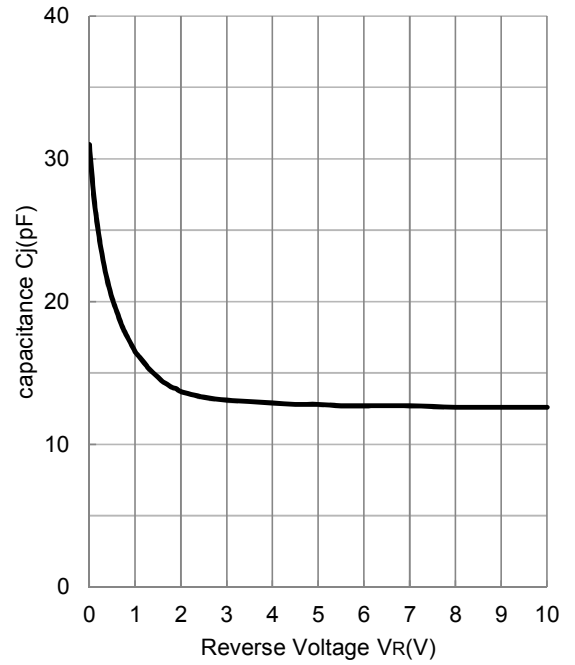


## ■ TYPICAL CHARACTERISTICS RELATED DETECTOR

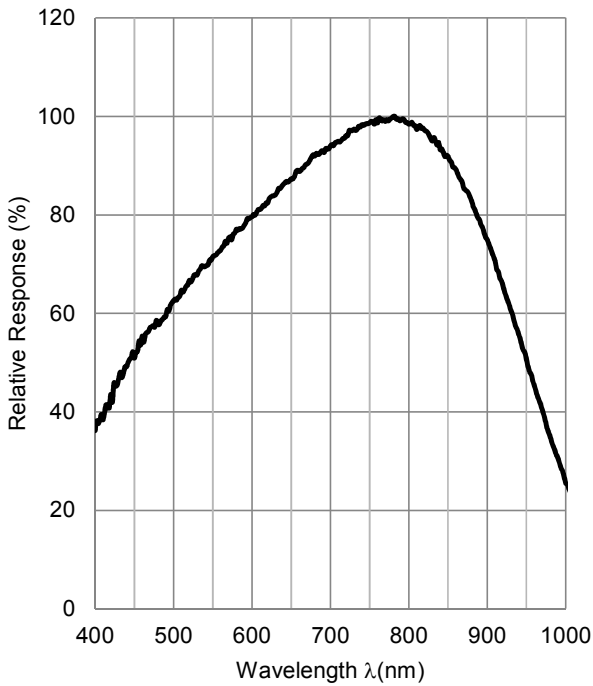
Dark Current vs. Temperature



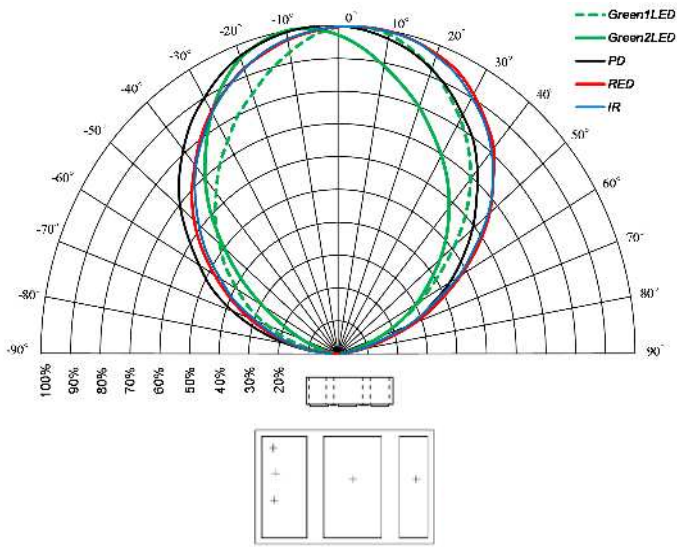
capacitance vs. Reverse Voltage  
( $T_a=25^\circ\text{C}$ )



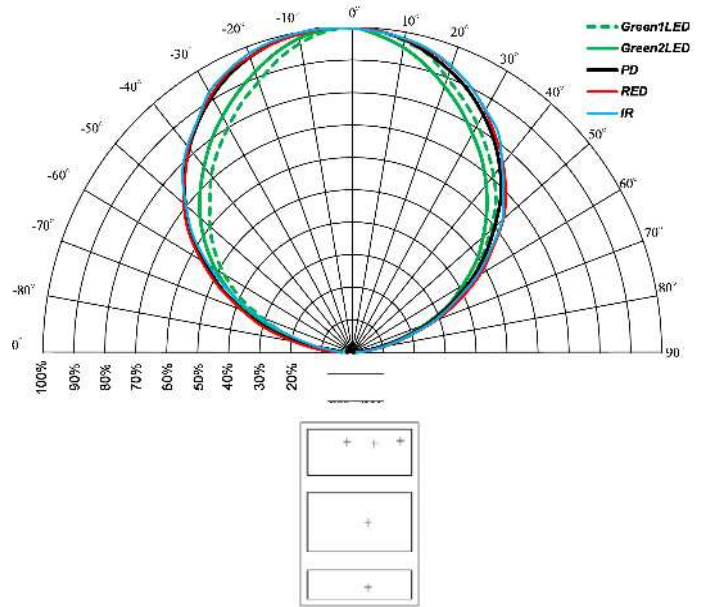
Spectral Response ( $T_a=25^\circ\text{C}$ )  
Detector



Directivity at Package direction X



Directivity at Package direction Y



**■APPLICATION NOTE**

## (1) Attention in handling

Treat not to touch the light receiving and light emitting part.

Avoid to adhering the dust and any other foreign materials on the light receiving and light emitting part when using.

When LED has operated by voltage, it should be connected the resistor of current adjustment. Avoid to applying direct voltage to LED, because there is possibility that LED is destroyed.

When mounting, special care has to be taken on the mounting position and tilting of the device because it is very important to place the device to the optimum position to the object.

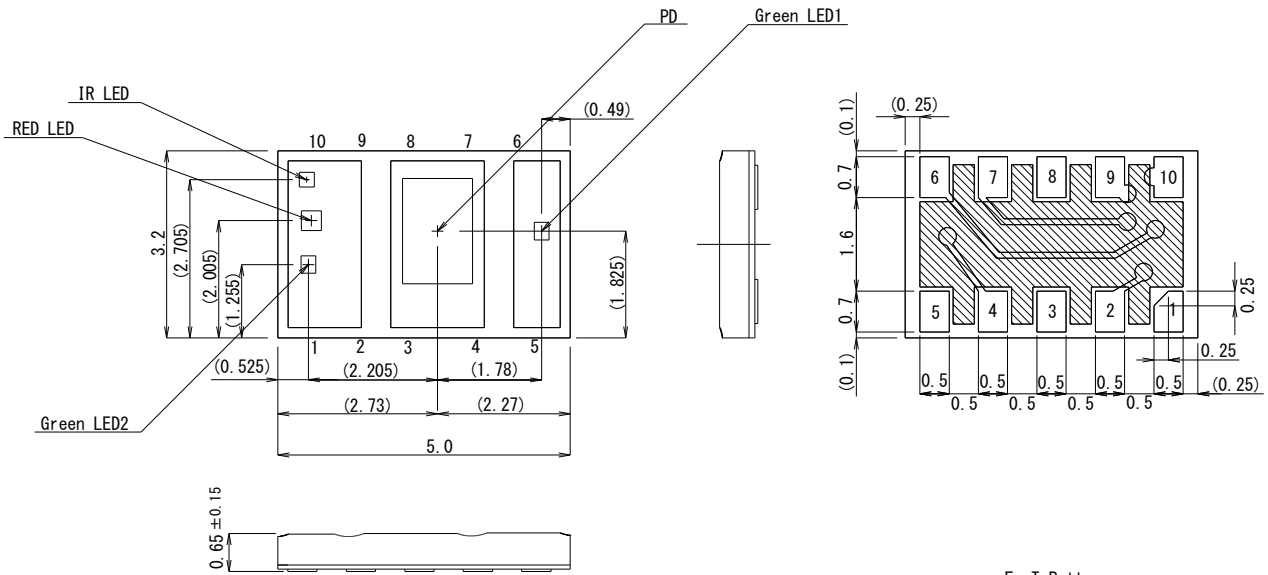
## (2) Attention in designing

Avoid the entering ambient light into light receiving part for avoid the malfunction by ambient light. Furthermore, there is possibility of malfunction when there are the other mounted parts by near this product peripheral.

There will be changing characteristics by detection object. Refer to this datasheet and evaluate by actual detection object.

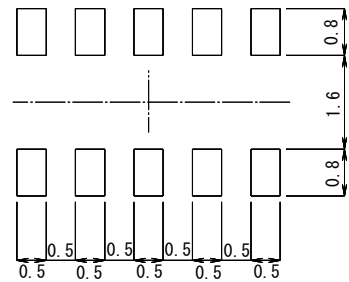
When LED has been applied continuous power on long period of time, the output current is dropped. If it uses by always applying power to LED, have to consider the circuit designing of including output current decrease.

## PACKAGE OUTLINE



- 1. LG2A
- 2. LG2K
- 3. PA
- 4. LG1K
- 5. LG1A
- 6. LRA
- 7. LRK
- 8. PK
- 9. LIRK
- 10. LIRA

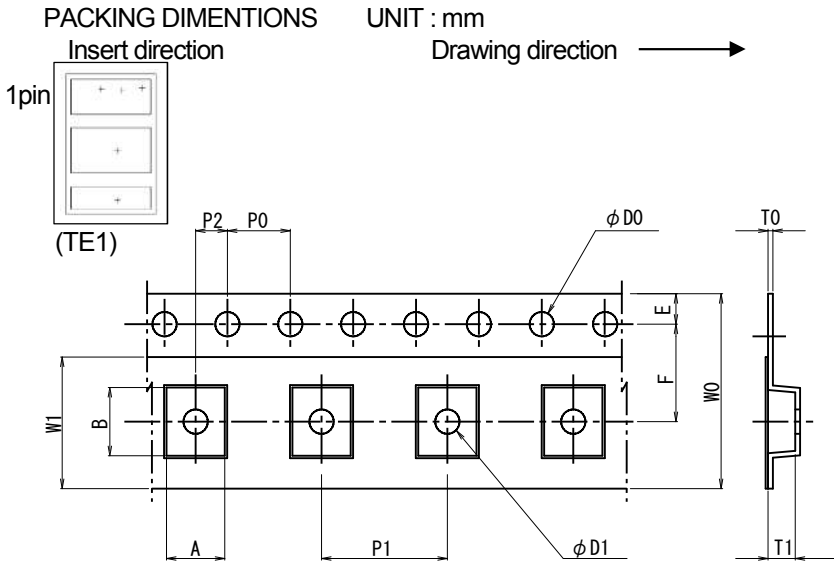
Foot Pattern



Unspecified tolerance :  $\pm 0.1\text{mm}$

Dimensions in parenthesis are shown for reference.

## PACKING SPECIFICATION



| SYMBOL | DIMENSION                           | REMARKS          |
|--------|-------------------------------------|------------------|
| A      | 3.55 ±0.10                          | BOTTOM DIMENSION |
| B      | 5.35 ±0.10                          | BOTTOM DIMENSION |
| D0     | φ1.50 <sup>#0.1</sup> <sub>#0</sub> |                  |
| D1     | φ1.50 <sup>#0.2</sup> <sub>#0</sub> |                  |
| E      | 1.75 ±0.10                          |                  |
| F      | 5.50 ±0.05                          |                  |
| P0     | 4.00 ±0.10                          |                  |
| P1     | 8.00 ±0.10                          |                  |
| P2     | 2.00 ±0.05                          |                  |
| T0     | 0.25 ±0.05                          |                  |
| T1     | 1.28 ±0.10                          |                  |
| W0     | 12.00 ±0.10                         |                  |
| W1     | 9.3 ±0.10                           | THICKNESS 0.1MAX |

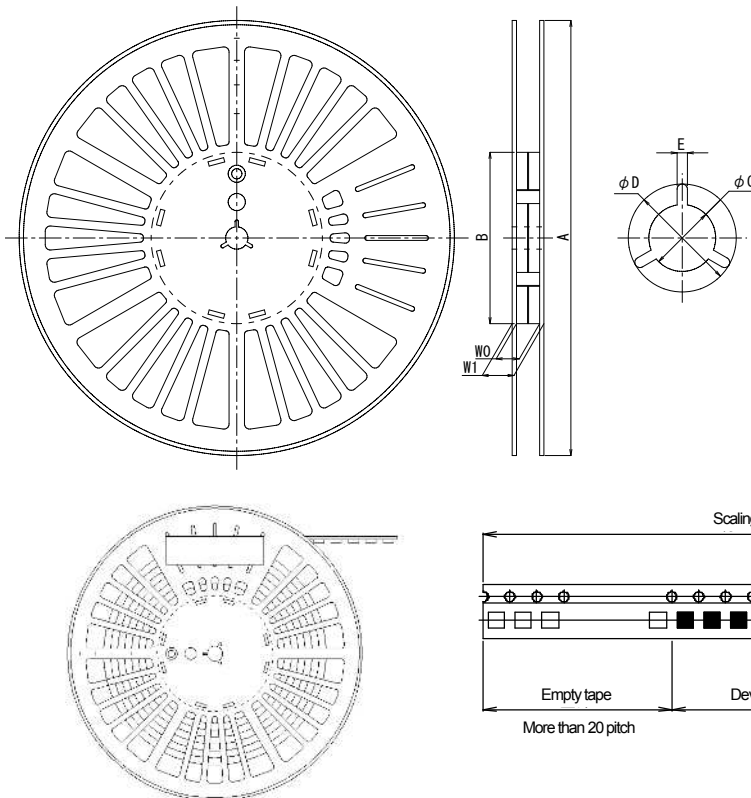
\* Carrier tape material : Polycarbonate(antistatic)  
Cover tape material : PP(antistatic)

## Taping Strength

There is a peel strength in the range of 0.2 to 0.7N when was peeled at a rate of 300mm per minute in opening angle 165 to 180° between the carrier tape and the cover tape.

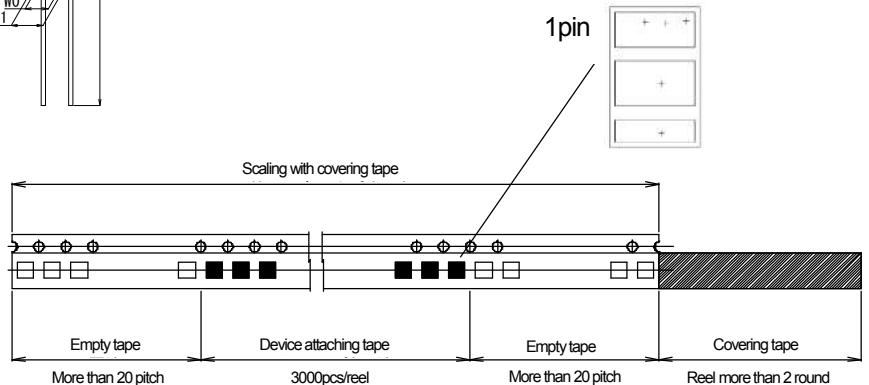
## Packaging

- 1) The taped products are to be rolled up on the taping reel as on the drawing.
- 2) Rolling up specification
  - 2-1) Start rolling : Carrier tape open space more than 20 Pieces.
  - 2-2) End of rolling : Carrier tape open space more than 20 Pieces, and 2 round of reel space at the cover tape only.
- 3) Taping quantity : 3,000 Pieces
- 4) Seal off after putting each reels in a damp proof bag with silica gel.



| SYMBOL | DIMENSION |
|--------|-----------|
| A      | φ254 ±1.0 |
| B      | φ100 ±1.0 |
| C      | φ13 ±0.2  |
| D      | φ21 ±0.8  |
| E      | 2.0 ±0.5  |
| W0     | 13.5 ±1.0 |
| W1     | 18.5 ±1.0 |

\* Reel material : PPE(antistatic)





## ■ RECOMMENDED MOUNTING METHOD

### NOTE

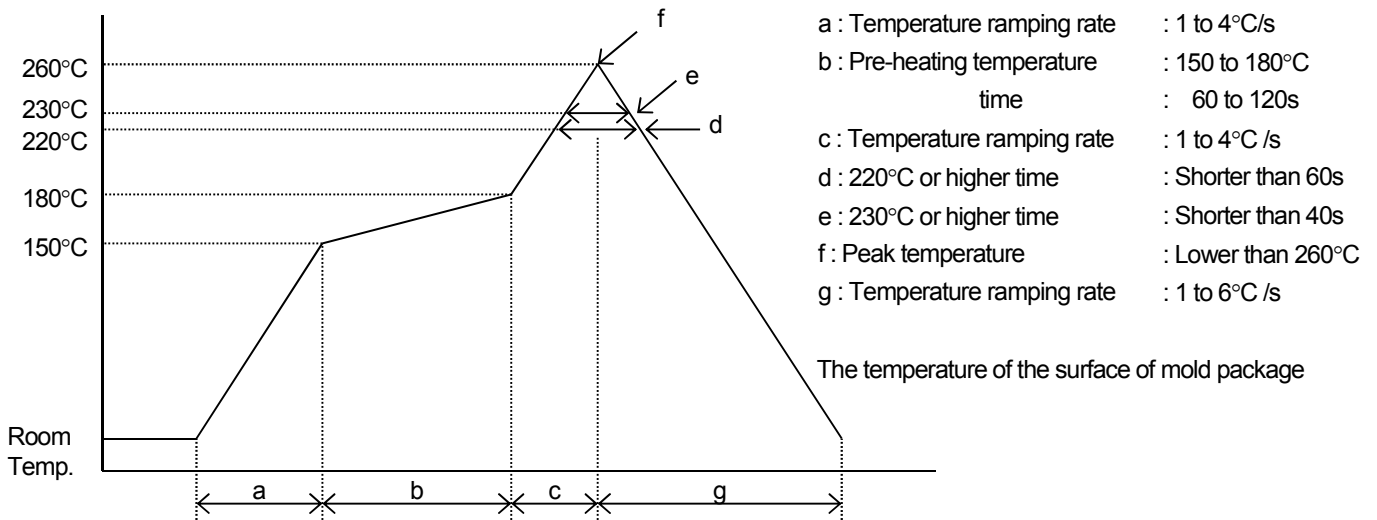
Mounting was evaluated with the following profiles in our company, so there was no problem.  
However, confirm mounting by the condition of your company beforehand.

The exposure of device under higher temperature many affect to the reliability of the products, it is recommended to complete soldering in the shortest time possible.

Mounting: Twice soldering is allowed.

## ■ INFRARED REFLOW SOLDERING METHOD

Recommended reflow soldering temperature profile is in the following.



(NOTE1) Using reflow furnace with short wave infrared radiation heater such as halogen lamp

Regarding temperature profile, please refer to those fo reflow furnace.

In this case the resin surface temperature may become higher than lead terminals due to endothermic ally of black colored mold resin. Therefore, please avoid from direct exposure to mold resin.

(NOTE2) Other method

Such other methods of soldering as dipping the device into melted solder and vapor phase method (VPS) are not appropriate because the body of device will be heated rapidly. Therefore, these are not recommended to apply.

(NOTE3) The resin gets softened right after soldering, so, the following care has to be taken

Not to contact the lens surface to anything.

Not to dip the device into water or any solvents.

## ■ FLOE SOLDERING METHOD

Flow soldering is not possible.

## ■ IRON SOLDERING METHOD

Iron soldering is not possible.

**■ CLEANING**

Avoid washing the device after soldering by reflow method.

**■ IC STORAGE CONDITIONS AND ITS DURATION****(1) Temperature and humidity ranges**

|              |              |              |
|--------------|--------------|--------------|
| Pack Sealing | Temperature: | 5 to 40 [°C] |
|              | Humidity:    | 40 to 80 [%] |
| Pack Opening | Temperature: | 5 to 30 [°C] |
|              | Humidity:    | 40 to 70 [%] |

After opening the bag, solder products within 48h.

Avoid a dry environment below 40% because the products are easily damageable by the electrical discharge.

Store the products in the place where it does not create dew with the products due to a sudden change in temperature.

(2) When baking, place the reel vertically to avoid load to the side.

(3) Do not store the devices in corrosive-gas atmosphere.

(4) Do not store the devices in a dusty place.

(5) Do not expose the devices to direct rays of the sun.

(6) Do not allow external forces or loads to be applied to IC's.

(7) Be careful because affixed label on the reel might be peeled off when baking.

(8) The product is recommended to do the baking before using for the stability of the quality.

**■ BAKING**

In case of keeping expect above condition be sure to apply baking.

Baking method: Ta=60°C, 48 to 72h, Three times baking is allowed

**■ STORAGE DURATION**

Within a year after delivering this device.

For the products stored longer than a year, confirm their terminals and solderability before they are used.

**■ MOISTURE SENSITIVITY LEVELS**

JEDEC : Level 5

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