CUSTOMER : LG Display .

DATE : 2009. 07. 13 .

SPECIFICATIONS FOR APPROVAL

PRODUCT NAME : White Top View SMD LED

MODEL NAME : LEWWS41R26EZ00

CUSTOMER P/N :

APPROVAL	REMARK

APPENDIX
- LP156WH2-TLAA **- LP156WH2-TLBA** **- LP156WH2-TLEA** **- LP156WH2-TLFA** **- LP156WH2-TLNA** **- LP156WH2-TLPA** **- LP156WH2-TLRA**

Designed	Checked	Approved	LG Innotek Co., Ltd.	
			DOCUMENT No.	CLD-1069
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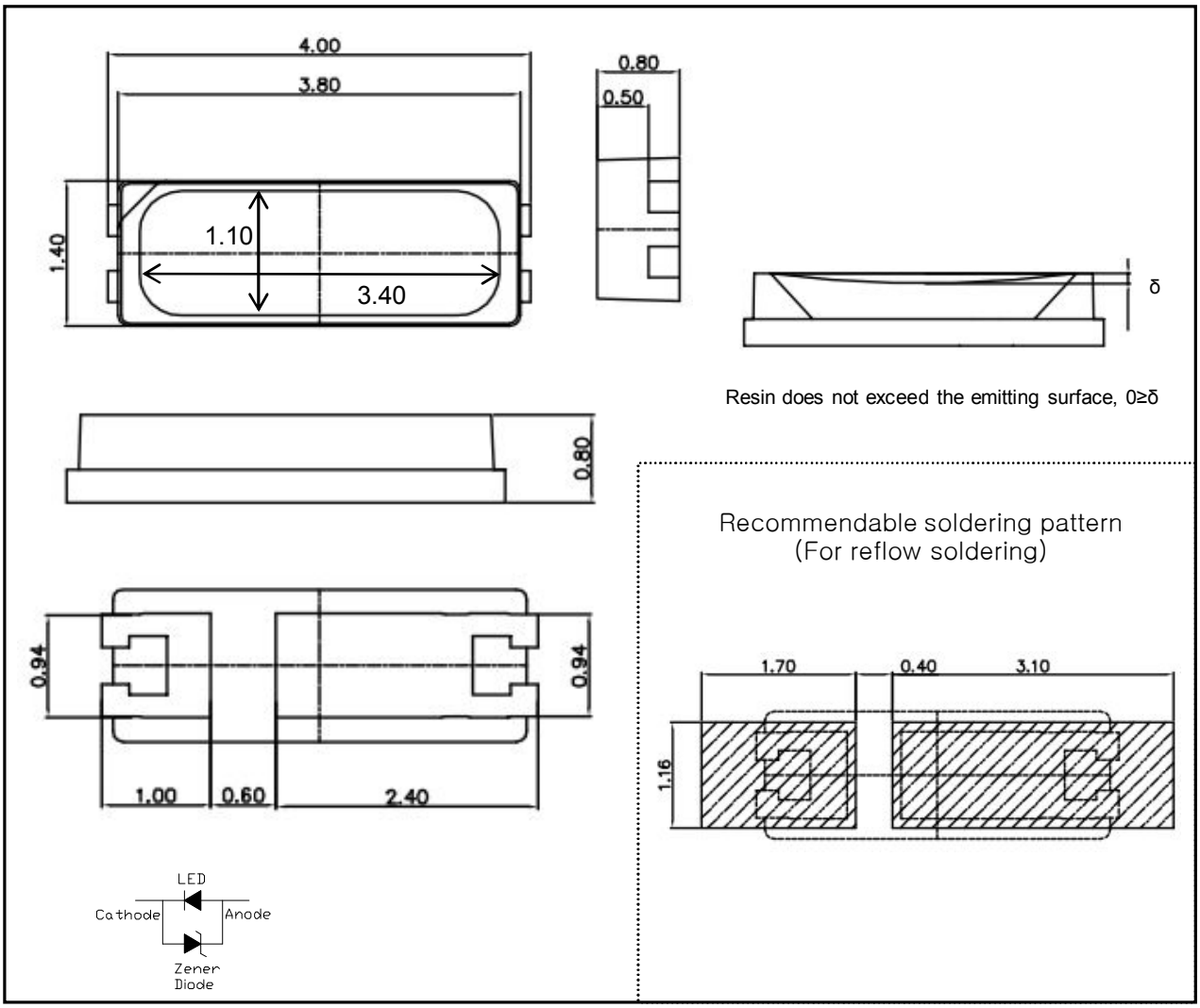
1. Features

- Lighting Color : White
- Small size surface mount type : 4.0×1.4×0.8 mm (L×W×H)
- Viewing angle : extremely wide(typically 120˚)
- Soldering methods : IR reflow soldering
- Taping : 12 mm conductive black carrier tape & antistatic clear cover tape. 3500pcs/reel, Φ178 mm wheel

Item	Lead Frame	Chip	Wire	Resin	Phosphor
Material	PPA	InGaN	Au	Silicone	Silicate
Company	J社	L社	C社	D社	F社

2. Outline Dimensions



3. Applications

- Indicating & NBPC LCD Backlighting

4. Absolute Maximum Ratings

(Ta=25℃)

Items	Symbols	Ratings	Unit
Forward Current	IF	35	(㎃)
Pulse Forward Current *1)	IFp	100	(㎃)
Power Dissipation	Pd	125	(㎽)
Reverse Current	IR	25	(㎃)
Operating Temperature	Topr	-30 ~ +85	(℃)
Storage Temperature	Tstg	-40 ~ +100	(℃)

*1) Pulse Width = 10 ms, Duty ≤ 10%

5. Electro - Optical Characteristics

(Ta=25℃)

Items	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V_F	I_F=20 [㎃]	2.9	3.2	3.4	V
Reverse voltage (Zener)	V_R	I_R=5[㎃]	0.6	0.8	1.2	V
Luminous Intensity Rank*2)	I_V	I_F=20 [㎃]	1800	-	-	mcd
CIE *3)	Cx / Cy	I_F=20 [㎃]	Rank Table is applied			-
Viewing Angle X-X Y-Y	2Θ1/2	I_F=20 [㎃]	-	120 120	-	deg
Life time *4)	-	Ta = 60℃ Tj ≤ 80℃	15000	-	-	hrs

*2),*3) Refer to the Rank Sorting Method (See 5 ~ 6 page)

※ These values measured by Optical Spectrum Analyzer of LG Innotek Co., LTD and tolerances are followings as below

- Luminous Intensity(Iv) : ±7%, Forward Voltage(V_F) : ±0.1, CIE Value : ±0.005

*4) It is based on LG INNOTEK internal test results and Initial Value S × 0.5 (50%degradation time) based using LG INNOTEK PCB board.

6. Rank Sorting Method

■ Luminous intensity ranks

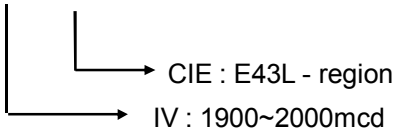
IV Rank	IV (mcd)			Flux (Lm)
	Min	Typ	Max	Typ
R2	1800	-	1900	4.2
R3	1900	-	2000	4.4
S1	2000	-	2100	4.6
S2	2100	-	2200	4.9
S3	2200	-	2300	5.1
T1	2300	-	2400	5.3

• Luminous Intensity (Iv) : ±7%, Luminous Flux Measurement Allowance is ±5% @ 20mA

• Luminous Flux is typically measured with LGIT Measurement System

■ Method of Rank No indication(Rank label)

R3 – E43L



* Measurement system of IV & Color rank

- Auto sorting in Manufacturing = Teknolog LX4560, QA out going inspection = Instrument CAS140B
- CIE 127 : 2007 , 6.2.2.1 Total luminous flux measurement 기준

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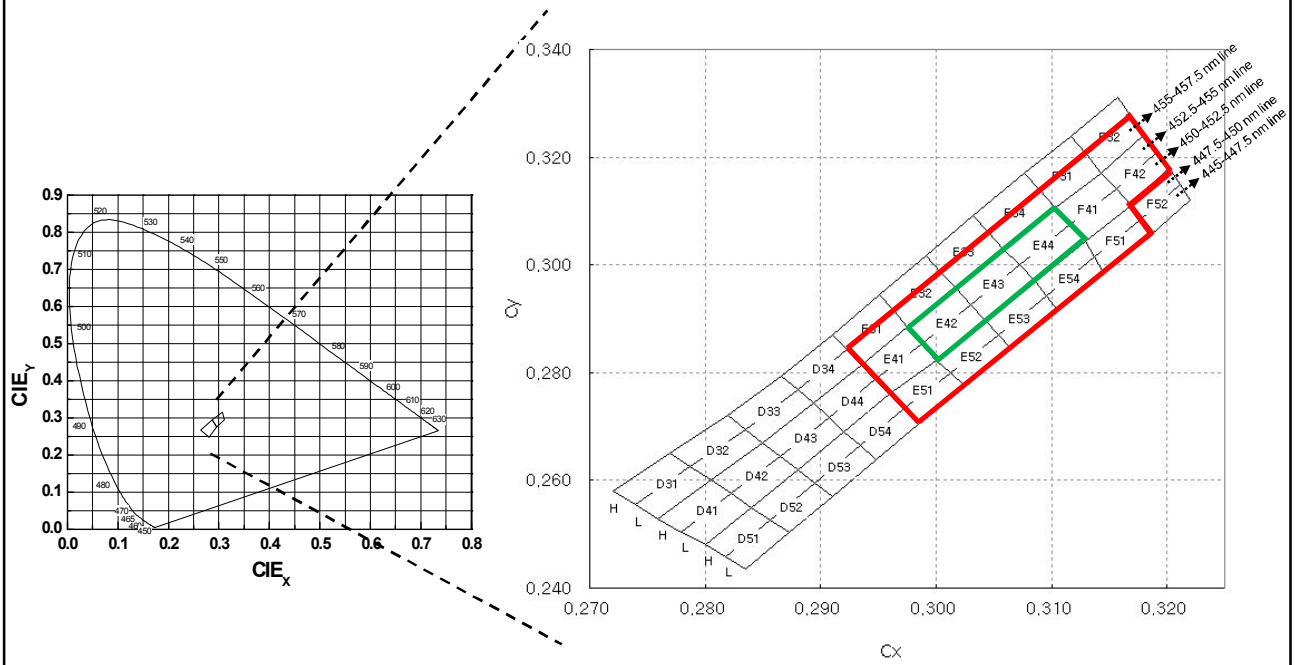
■ **Color Ranks,** CIE Value @20㎃

D33H		D34H		E31H		E32H		E33H		E34H		F31H		F32H	
0.2820	0.2720	0.2866	0.2794	0.2910	0.2870	0.2951	0.2944	0.2991	0.3016	0.3032	0.3091	0.3076	0.3170	0.3117	0.3239
0.2866	0.2794	0.2910	0.2870	0.2951	0.2944	0.2991	0.3016	0.3032	0.3091	0.3076	0.3170	0.3117	0.3239	0.3157	0.3310
0.2880	0.2769	0.2923	0.2843	0.2963	0.2915	0.3004	0.2987	0.3045	0.3061	0.3090	0.3139	0.3130	0.3205	0.3169	0.3275
0.2835	0.2695	0.2880	0.2769	0.2923	0.2843	0.2963	0.2915	0.3004	0.2987	0.3045	0.3061	0.3090	0.3139	0.3130	0.3205
D33L		D34L		E31L		E32L		E33L		E34L		F31L		F32L	
0.2835	0.2695	0.2880	0.2769	0.2923	0.2843	0.2963	0.2915	0.3004	0.2987	0.3045	0.3061	0.3090	0.3139	0.3130	0.3205
0.2880	0.2769	0.2923	0.2843	0.2963	0.2915	0.3004	0.2987	0.3045	0.3061	0.3090	0.3139	0.3130	0.3205	0.3169	0.3275
0.2894	0.2743	0.2935	0.2815	0.2975	0.2885	0.3017	0.2957	0.3058	0.3030	0.3103	0.3107	0.3143	0.3171	0.3180	0.3240
0.2850	0.2670	0.2894	0.2743	0.2935	0.2815	0.2975	0.2885	0.3017	0.2957	0.3058	0.3030	0.3103	0.3107	0.3143	0.3171
D43H		D44H		E41H		E42H		E43H		E44H		F41H		F42H	
0.2850	0.2670	0.2894	0.2743	0.2935	0.2815	0.2975	0.2885	0.3017	0.2957	0.3058	0.3030	0.3103	0.3107	0.3143	0.3171
0.2894	0.2743	0.2935	0.2815	0.2975	0.2885	0.3017	0.2957	0.3058	0.3030	0.3103	0.3107	0.3143	0.3171	0.3180	0.3240
0.2907	0.2717	0.2948	0.2788	0.2988	0.2854	0.3030	0.2927	0.3072	0.3000	0.3116	0.3076	0.3156	0.3141	0.3191	0.3210
0.2865	0.2645	0.2907	0.2717	0.2948	0.2788	0.2988	0.2854	0.3030	0.2927	0.3072	0.3000	0.3116	0.3076	0.3156	0.3141
D43L		D44L		E41L		E42L		E43L		E44L		F41L		F42L	
0.2865	0.2645	0.2907	0.2717	0.2948	0.2788	0.2988	0.2854	0.3030	0.2927	0.3072	0.3000	0.3116	0.3076	0.3156	0.3141
0.2907	0.2717	0.2948	0.2788	0.2988	0.2854	0.3030	0.2927	0.3072	0.3000	0.3116	0.3076	0.3156	0.3141	0.3191	0.3210
0.2920	0.2690	0.2960	0.2760	0.3000	0.2823	0.3043	0.2896	0.3086	0.2969	0.3129	0.3044	0.3169	0.3110	0.3202	0.3180
0.2880	0.2620	0.2920	0.2690	0.2960	0.2760	0.3000	0.2823	0.3043	0.2896	0.3086	0.2969	0.3129	0.3044	0.3169	0.3110
D53H		D54H		E51H		E52H		E53H		E54H		F51H		F52H	
0.2880	0.2620	0.2920	0.2690	0.2960	0.2760	0.3000	0.2823	0.3043	0.2896	0.3086	0.2969	0.3129	0.3044	0.3169	0.3110
0.2920	0.2690	0.2960	0.2760	0.3000	0.2823	0.3043	0.2896	0.3086	0.2969	0.3129	0.3044	0.3169	0.3110	0.3202	0.3180
0.2934	0.2664	0.2973	0.2733	0.3013	0.2799	0.3054	0.2871	0.3096	0.2942	0.3137	0.3015	0.3177	0.3083	0.3211	0.3150
0.2895	0.2595	0.2934	0.2664	0.2973	0.2733	0.3013	0.2799	0.3054	0.2871	0.3096	0.2942	0.3137	0.3015	0.3177	0.3083
D53L		D54L		E51L		E52L		E53L		E54L		F51L		F52L	
0.2895	0.2595	0.2934	0.2664	0.2973	0.2733	0.3013	0.2799	0.3054	0.2871	0.3096	0.2942	0.3137	0.3015	0.3177	0.3083
0.2934	0.2664	0.2973	0.2733	0.3013	0.2799	0.3054	0.2871	0.3096	0.2942	0.3137	0.3015	0.3177	0.3083	0.3211	0.3150
0.2948	0.2638	0.2985	0.2705	0.3025	0.2775	0.3065	0.2845	0.3105	0.2915	0.3145	0.2985	0.3185	0.3055	0.3220	0.3120
0.2910	0.2570	0.2948	0.2638	0.2985	0.2705	0.3025	0.2775	0.3065	0.2845	0.3105	0.2915	0.3145	0.2985	0.3185	0.3055

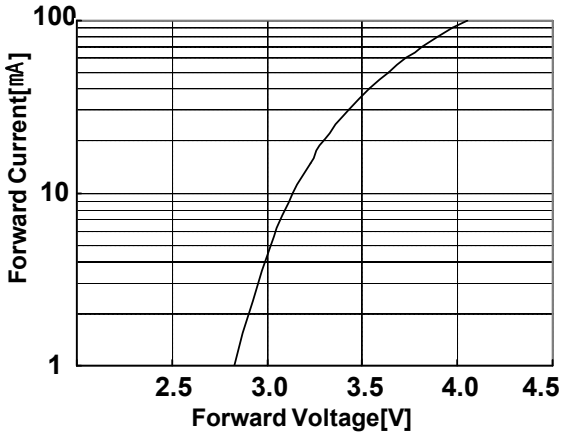
* The quantity-ratio of CIE ranks is decided by LGIT
* Color Coordinate is based on the CIE 1931 Chromaticity Diagram



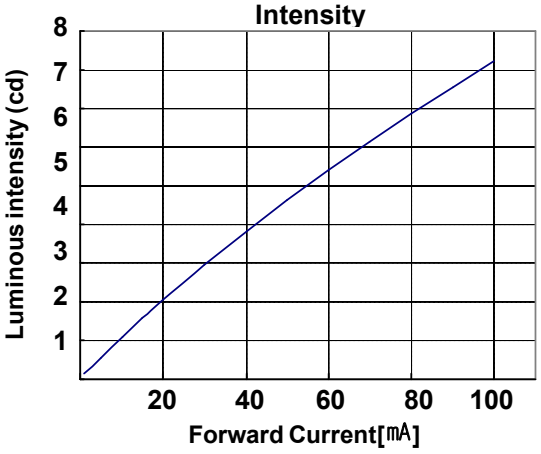
* The Range of Blue Chip Wavelength (Wd) is above line based ; 445 – 460nm
  But, Each line does not exactly belongs with 2.5nm range.
* Inner Range is Spec of Single Bins

7. Typical Characteristic Curves

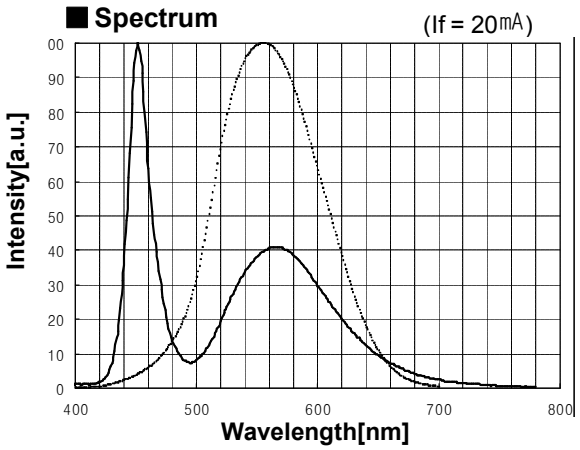
■ Forward Voltage vs. Forward Current



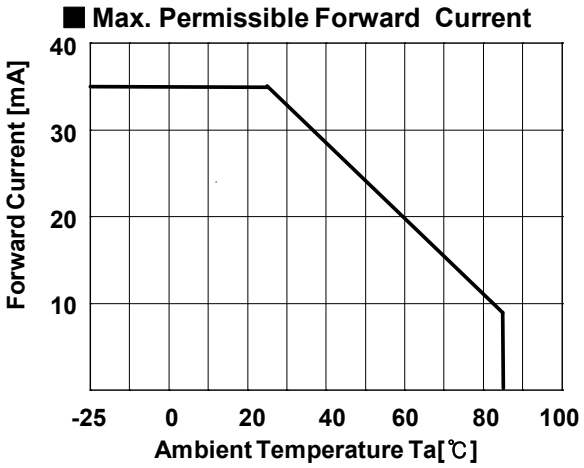
■ Forward Current vs. Relative luminous Intensity



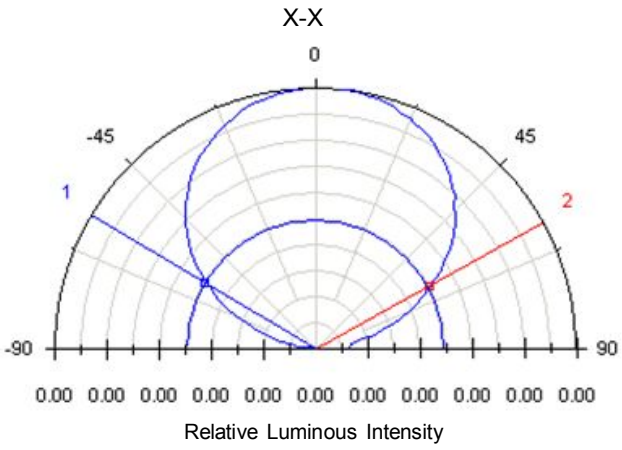
■ Spectrum (If = 20mA)

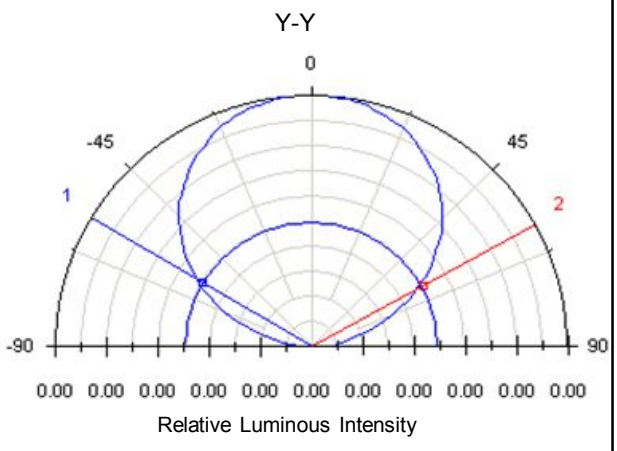


■ Max. Permissible Forward Current

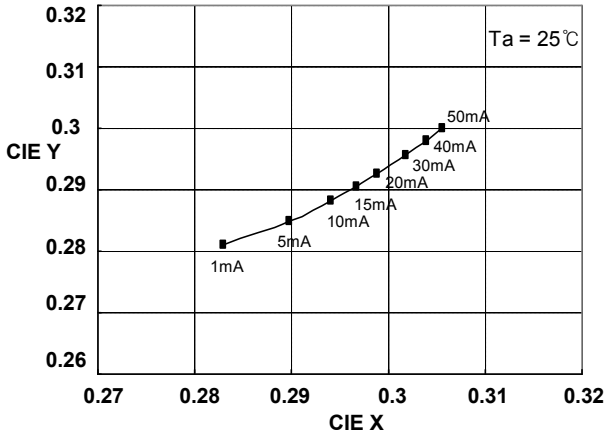


■ Radiation Characteristics

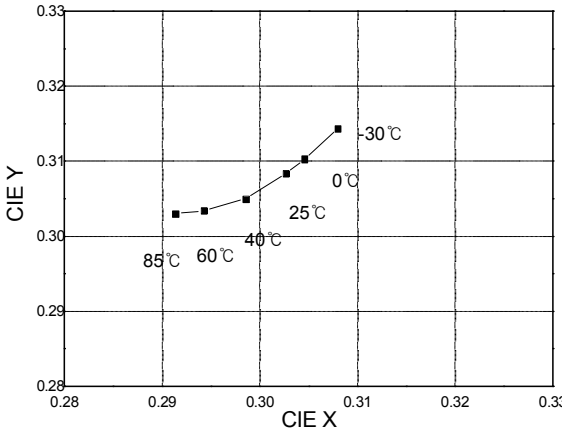




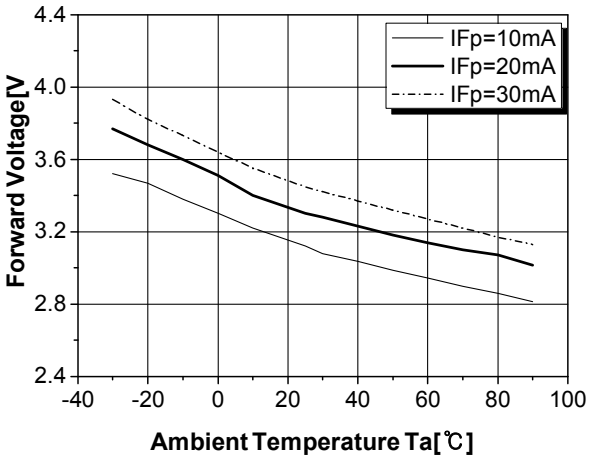
■ Forward current vs chromaticity coordinate



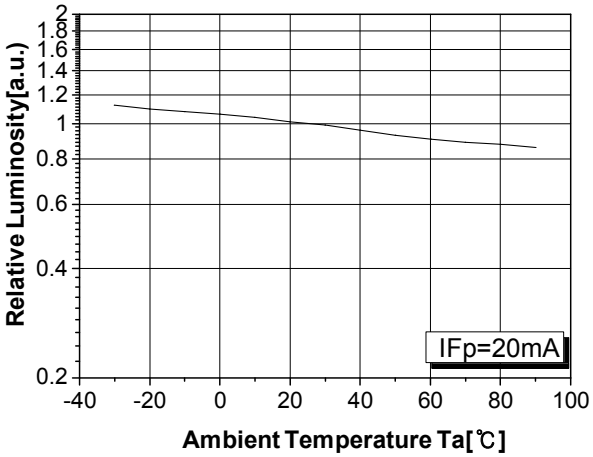
■ Ambient Temp [℃] vs. chromaticity coordinate



■ Ambient Temp [℃] vs Forward Voltage



■ Ambient Temp [℃] vs Relative Luminosity



8. Reliability Test Items and Conditions

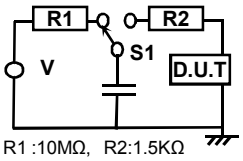
8-1. The Reliability criteria of SMD LED

Item	Symbol	Test Condition	Limit	
			Min.	Max.
Forward Voltage	V_F	I_F = 20㎃	—	U.S.L.× 1.1
Reverse Current	I_R	V_R = 5V	—	U.S.L.× 2.0
Luminous intensity (mcd)	mcd	I_F = 20㎃	S× 0.7	—

*U.S.L : Upper Spec Limit, *L.S.L : Lower Spec Limit *S : Initial Value

※ The Reliability criteria of ESD Test is judged by VF shift (±0.2V@2mA) or impedance(Ω) check data.

8-2. Results of Reliability Test

NO	Item	Test Condition	Test Hours/Cycles	Sample NO	Ac/Re
1	DC Operating Life-A	I_F : 20㎃	1000 HRS	11 PCS	0/1
2	DC Operating Life-B	I_F : 35㎃	1000 HRS	11 PCS	0/1
3	High Temperature Operating Life	Temp : 85℃ (IF= 8.5㎃)	1000 HRS	11 PCS	0/1
4	Low Temperature Operating Life	Temp : -30℃ (IF=20㎃)	1000 HRS	11 PCS	0/1
5	High Temperature / Humidity Life	60℃ / 90% RH (IF=20㎃)	1000 HRS	11 PCS	0/1
6	Temperature Cycle	H : +100℃30min ∫ 5 min L : -40℃ 30min	100 CYCLES	11 PCS	0/1
7	Thermal shock	H : +100℃ 5min ∫ L : 0℃ 5min	20 CYCLES	11 PCS	0/1
8	High Tempe. Storage	100℃	1000 HRS	11 PCS	0/1
9	Tempe/Humidity Storage	60℃ / 90% RH	1000 HRS	11 PCS	0/1
10	Low Tempe. Storage	-40℃	1000 HRS	11 PCS	0/1
11	Solderability (IR Reflow)	Tsld=215 +/-5℃, 3sec	1time	11 PCS	0/1
12	Resistance to Soldering (IR Reflow)	Tsld=260℃, 10sec Pretreatment 30℃, 70%RH, 168hrs	2times	11 PCS	0/1
13	ESD (HBM) Min –1kV	 R1 :10MΩ, R2:1.5KΩ C:100pF	3times	22 PCS	0/1
14	Vibration Test	10~2000~10Hz Sweep 4min. 200m/s^2 ,3direction, 4cycles	48min	11 PCS	0/1
15	Substrate Bending	3mm, 5±1sec	1time	11 PCS	0/1
16	Peel strength (Stick)	5N, 10±1sec	1time	11 PCS	0/1
17	Moisture Resistance Cycle	25℃~65℃~-10℃ (90%RH,24hr./1cycle)	10 Cycles	11 PCS	0/1

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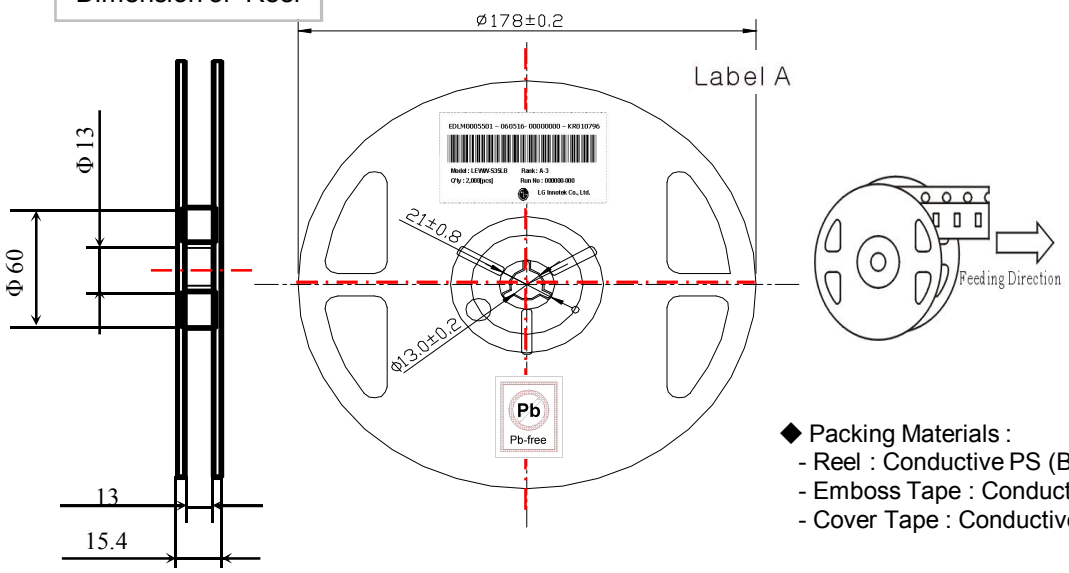
9. Package and Marking of Products

9-1. Taping Outline Dimension

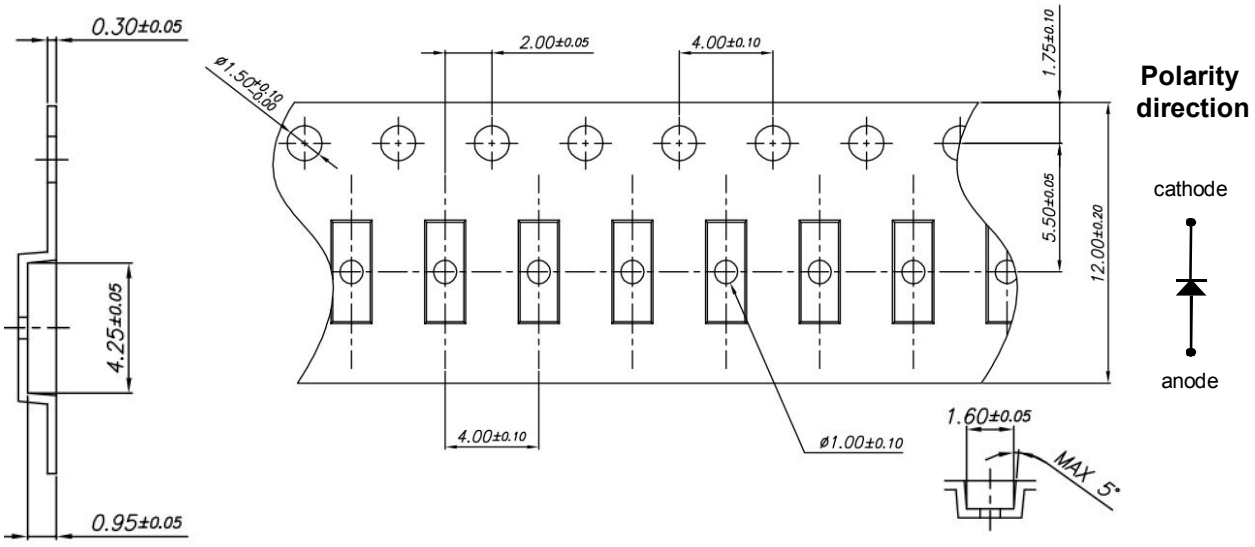
Dimension of Reel

(Unit : mm)

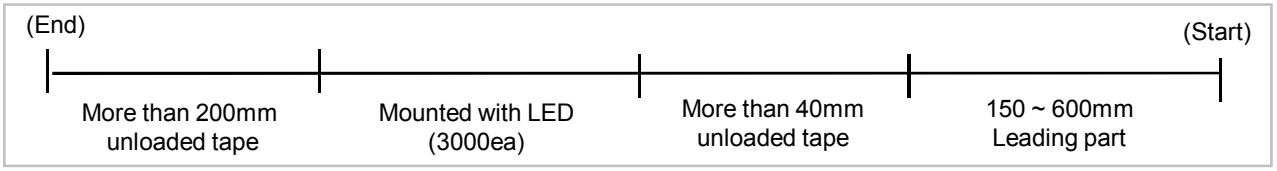


◆ Packing Materials :
- Reel : Conductive PS (Black)
- Emboss Tape : Conductive PS (Black)
- Cover Tape : Conductive PET Base

Dimension of Tape

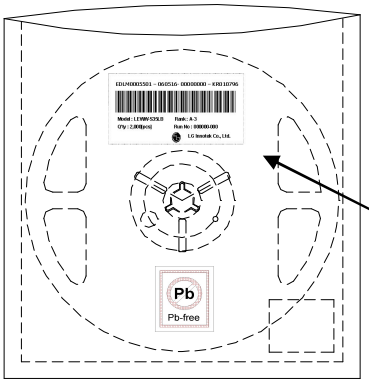


Arrangement of Tape



9-2. Package

Products are packed in one bag of 3,500 pcs (above 1000 pcs) and a label is affixed on each bag specifying Model , Rank, Quantity and Run number.

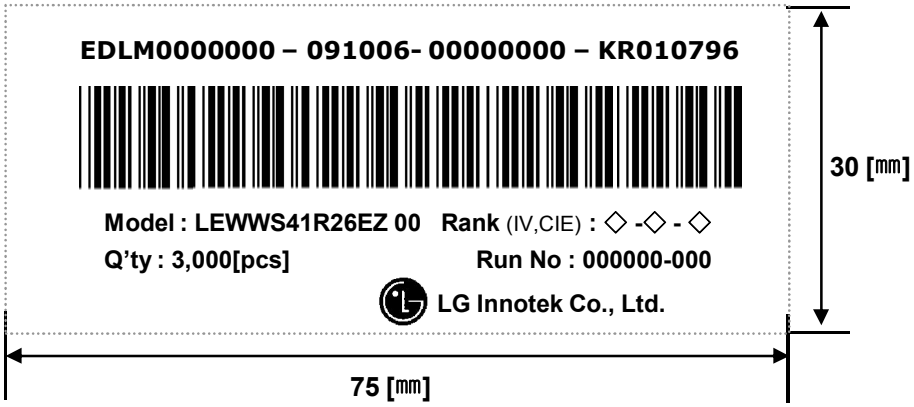


Label A (Model , Rank, Quantity , Run number)

- Package : damp-proof package made of aluminum

※. Label A

Specifying Model , Rank, Quantity and Run number

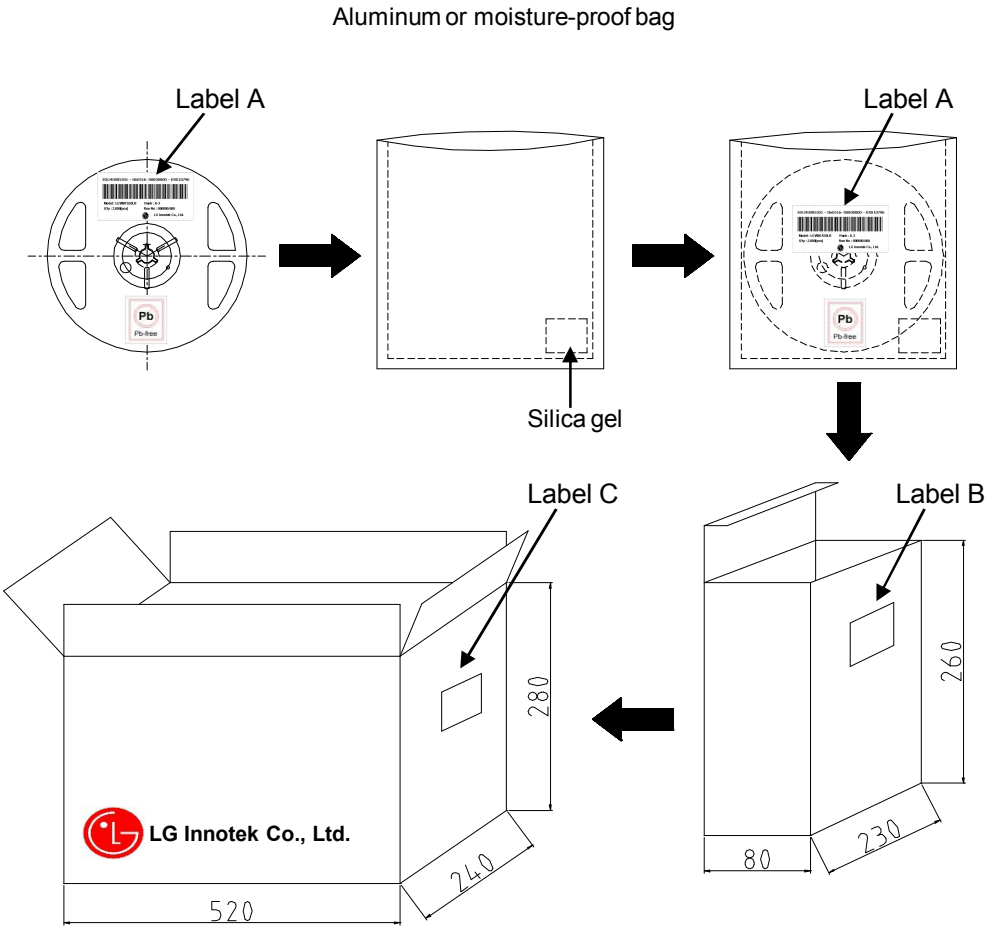


◆ Run No indication

1	2	3	4	5	6	—	7	8	9
LG Innotek's Own Characters		Manufacture Year(Last number)	Manufacture month	Manufacture date			Serial no		
" "	" "	" 9 "	" x "	" 06 "			" 001 "		

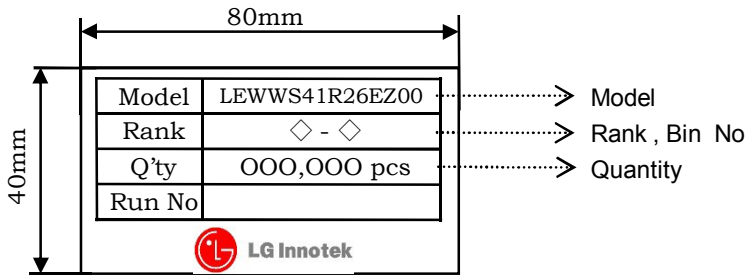
9-3. Packing Specifications

Reeled products (numbers of products are 3,500 pcs) packed in a seal off aluminum bag or moisture-proof bag along with desiccants (Silica gel).
Five aluminum bags (total maximum number of products are 17,500 pcs) packed in an inner box and Six inner boxes are put into an outer box.

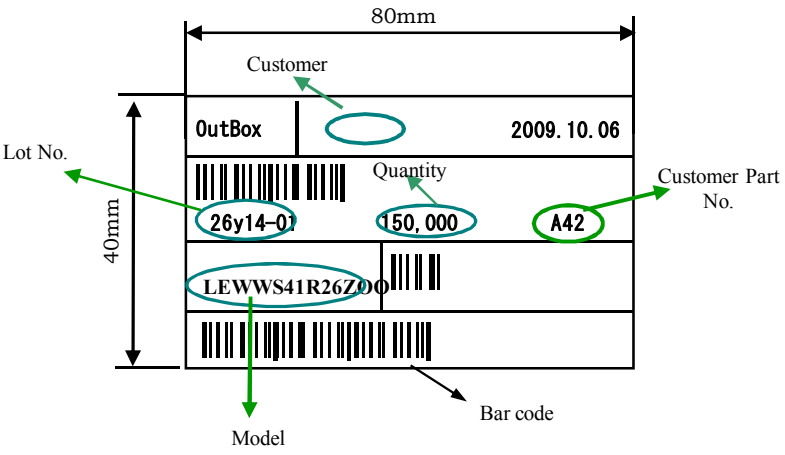


※ Label B

Specifying Customer, Model , Customer part no, Lot No, Quantity



※ Label C



◆ Lot No. indication

1	2	3	4 5	—	6 7
LG Innotek's Own Characters	QA Inspection Year (Last number)	QA Inspection month	QA Inspection date		Serial No
	" 9 "	" x "	" xx "		" 01 "
	(2009)	(1, 2, 3, 4, 5, 6 7, 8, 9, x, y, z)	(1 ~ 31)		(01 ~ 99)

10. Cautions on use

10-1.Circuit Layout

In general, the LEDs have a variation of forward voltage. Using LEDs with different forward voltages in a circuit with on resistor for the complete circuit causes different forward currents for each LED. This may lead to a variation in brightness. To avoid brightness variation of LEDs, the use of matrix circuit with one resistor for each LED is recommended.

10-2. Over-current-proof

Customer must apply resistors for protection, others slight voltage shift will cause big current change (Burn out will happen).

LG Innotek will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user's unit if use to exceed the absolute maximum ratings, or not keep the matters that demand special attention.

10-3. For the Storage

- Proper temperature and RH conditions for storage are : 5 ℃ ~35 ℃ , RH 60%.
- Do not open moisture-proof bag before the products are ready to use.
- Store products in a moisture-proof bag with a desiccant(Silica gel) after open.
- These products should be used within 168 hours after opening the bag based upon storage condition.
- These products must be baked to remove moisture before using them if the Silica gel loses its color. Conditions for baking are 60±5℃, 20% (RH) and 24 hours maximum. (For reeled status without bag)
- Considering the tape life, we suggest our customers to use our products within a year(from production date)

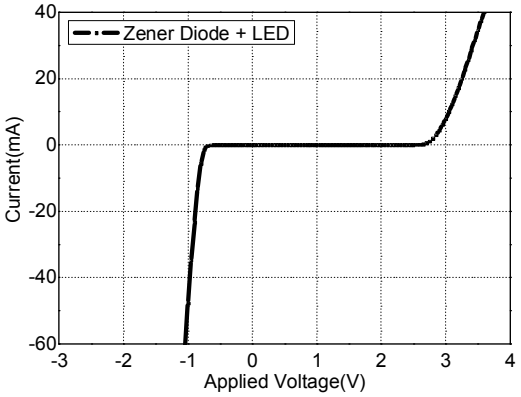
10-4. Cleaning

- Please avoid using a brush for cleaning and do not wash the product in organic solvents such as acetone, Organic solvent will damage the surface of LED. Please refer to following solvents and conditions.

  Solvent : alcohol, 25℃ max × 600sec max

10-5. Reverse voltage in Zener Diode embed LED

- If reverse voltage is applied to the LEDs, it will damage the Zener diode and LEDs and result in destruction.



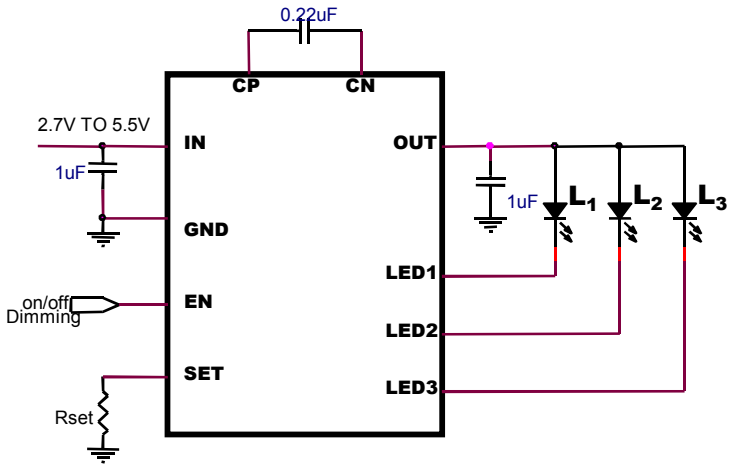
10-6. Static Electricity

- If over-voltage, which exceeds the absolute maximum rating, is applied to the LEDs, it will damage the LEDs and result in destruction. Since the LEDs are sensitive to the static electricity and surge, it is strongly recommended to use a wristband or anti-electrostatic glove when handling the LEDs and all devices, equipment and machinery must be properly grounded.
- Damaged LEDs will show some unusual characteristics such as the leak current remarkably increases, the turn-on voltage becomes lower, or the LEDs do not light at the low current.
- When examining the final product, it is recommended to check whether the assembled LEDs are damaged by static electricity or not. Static-damaged LEDs can easily be found by light-on test or the VF test at a low current.

10-7. Application limits of LED Driver IC controller

- GaN based LED is relatively weak to electrical damage(such as static electricity and over current stress). Forward leakage of LED occurred by such damage in the forward low current region may result in turn-on-delay of LCD back light, which is dependent on a specific function of driver IC.
  For reasons mentioned above, minimum current level(source start-up current) of LED driver IC must be more than 0.3 mA. LGIT cannot make a guarantee on the LED using in Driver IC with start up current level of < 0.3 mA.
- When parallel circuit LED driver IC is applied in BLU, hot spot may occur in low current LCD operation region(dimming mode) by difference of LED voltage in low current region. So, driver IC with Individual LED controller is recommended.

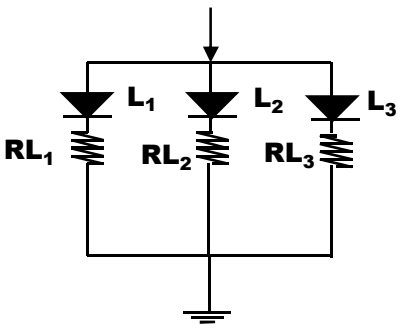
10-7. Recommended Circuit Conditions (schematic)



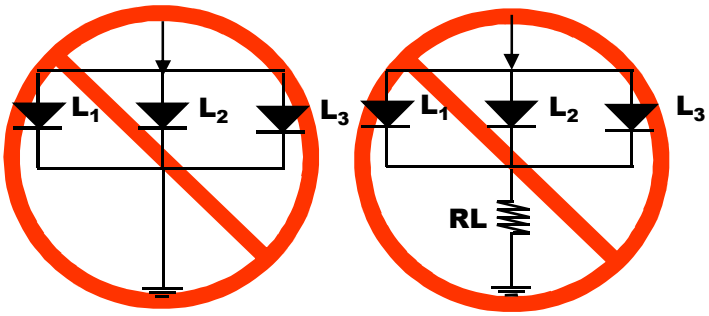
[Pic.1 Strongly Recommended Circuit]
(Driver IC with Individual LED controller is recommended)

▶ **Caution on designing in PCB & Parallel Circuit board**

Using more than 3 pcs of LED per a phone, It is strongly recommend to **use separate resistor per each LED.** (Pic. 2)
Please do notice that it is needed total 3 ea of separate resistor, if one resistor is connected to more than 2 pcs of LED (Pic.3), it can cause serious problem on brightness).



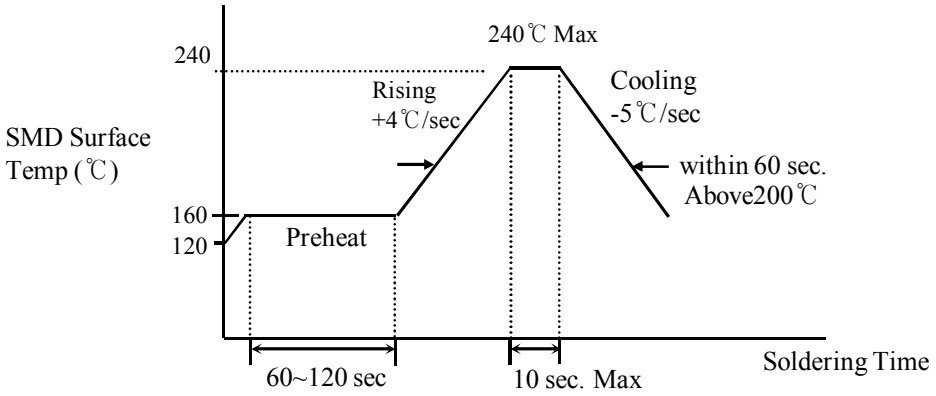
[Pic.2. Recommended Circuit in parallel mode]
: Separate resistor must use in each LED



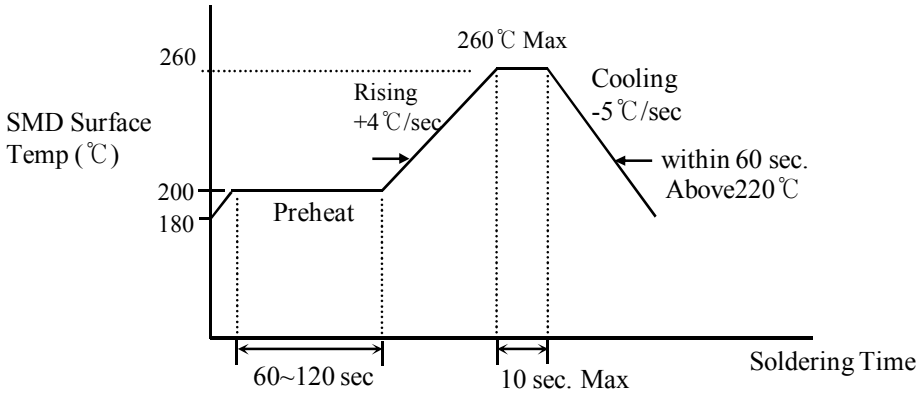
[Pic.3. Abnormal Circuit]
: hot spot may occur
especially in low current LCD operation region
(dimming mode) by difference of LED voltage.

11. Others

11-1. Lead Solder



11-2. Lead-free Solder



11-3. Soldering Iron

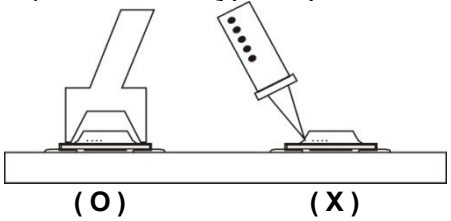
Basic spec is ≤5sec when 260℃. If temperature is higher, time shorter (+10℃ → -1sec). Power dissipation of Iron should be smaller than 15W, and temperature should be controllable. Surface temperature of the device should be under 230℃.

11-4. Rework

1) Customer must finish rework within 5sec under 245℃.

2) The head of Iron can not touch copper foil.

3) Twin-head type is preferred.



12. Change History of Revision

Revision	Date	Contents of Revision Change	Remark
0	09.07.13	New Established	