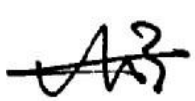
SPECIFICATION

ITEM	WARM WHITE TOP VIEW LED
MODEL	PCL-C4W(W)CZ22SA
CUSTOMER	
ISSUED DATE	

C U S T O M E R		
Approved by	Approved by	Approved by
/	/	/

S U P P L I E R		
Drawn by	Checked by	Approved by
		
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C O N T E N T S

1. Revision history

Title	Specification for approval
Doc. No.	KQSP-LL-2107

Rev. No.	Date	Summary for revision	Remarks
00	2008.11.	New establishment	
01	2009.07.	Chromaticity Coordinates	
02	2010.01	Revised All Sheets Precaution for Use	
03	2010.06	Recommended soldering pattern	

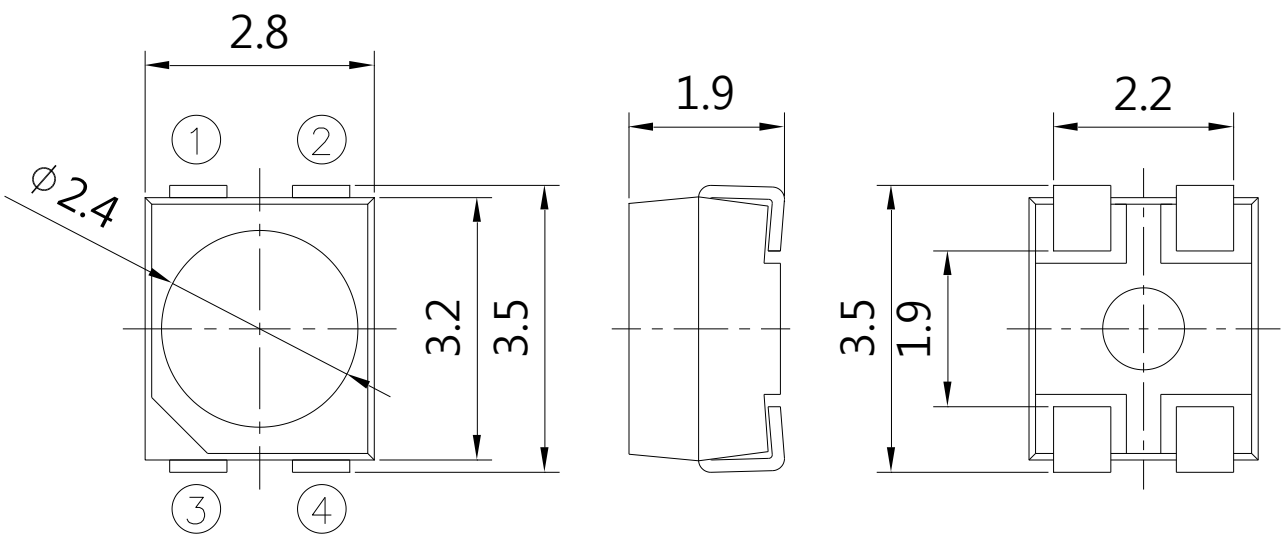
2. General description

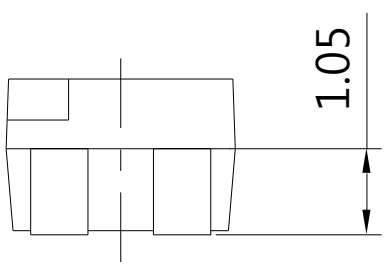
(1) Features

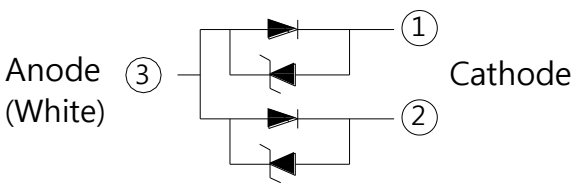
- Package Size : 3.5 × 2.8 × 1.9mm
- SMD (Top View) type
- Very wide viewing angle
- Chip material based on InGaN
- High luminous intensity
- ESD protection (Class 2 under 2KV)

(2) Outline Dimensions

UNIT : mm







Diode (LED chip)

Zener Diode (ESD protection)

3. Electro-Optical characteristics

(1) Absolute Maximum Rating

(Ta=25℃) ◆1

Parameter	Symbol	Value	Unit
Forward Current◆2	I_F	60	mA
Peak Forward Current ◆3	I_{FP}	200	mA
Reverse Voltage	V_R	5	V
Power Dissipation	P_D	216	mW
Operating Temperature ◆4	Toper	-40 to +80	℃
Storage Temperature ◆5	Tstg	-40 to +100	℃
Soldering temperature	Tsol	Reflow soldering : 260℃, 10 sec Hand soldering : 300℃, 3 sec	

◆1 Ta : Ambient Temp

◆2 For Forward Current, please refer to Forward Current Derating Curve of this manual.

◆3 This is max. current under the condition if Duty Ratio (on / off time ratio) ≤ 1/10, Pulse Width ≤ 10 msec.

◆4 Refer to Forward Current Derating Curve of this manual.

◆5 This indicates Maximum storage temperature condition and for the actual storage, please follow the storage condition of user's notices of this manual.

(2) Electrical / Optical Characteristics

(Ta=25℃)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	V_F	I_F=40mA	-	3.2	3.6	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Luminous Intensity ■	I_V	I_F=40mA	2,000	3,000	-	mcd
Viewing Angle ★	$2\theta_{1/2}$	I_F=40mA	100	120	140	deg.
Chromaticity coordinates	-	I_F=40mA	-	X : 0.43 Y : 0.42		-

■ Luminous intensity is measured with a light sensor and filter combination that approximates the CIE eye-response curve. Please refer to rank table.

★ θ1/2 is the off-axis angle at which the luminous intensity is half the axial luminous intensity.

4. Ranks

(1) Luminous Intensity Ranks

(Ta=25℃)

Iv Rank	Condition	Min	Typ	Max	Unit
A	I_F=40㎃	2,000	-	2,500	mcd
B		2,500	-	3,000	
E		3,000	-	3,500	
F		3,500	-	4,000	

※ Measurement Uncertainty of the Luminous Intensity : ± 10%

(2) Forward Voltage Ranks

(Ta=25℃)

V_F Rank	Condition	Min	Max	Unit
A	I_F=40㎃	2.8	3.0	V
B		3.0	3.2	
C		3.2	3.4	
D		3.4	3.6	

※ Measurement Uncertainty of the Forward Voltage : ± 0.07V

(3) Chromaticity Coordinates ranks

- Normal white chromaticity coordinates ranks

*** Cool White ~ Pure White**

(Ta=25℃)

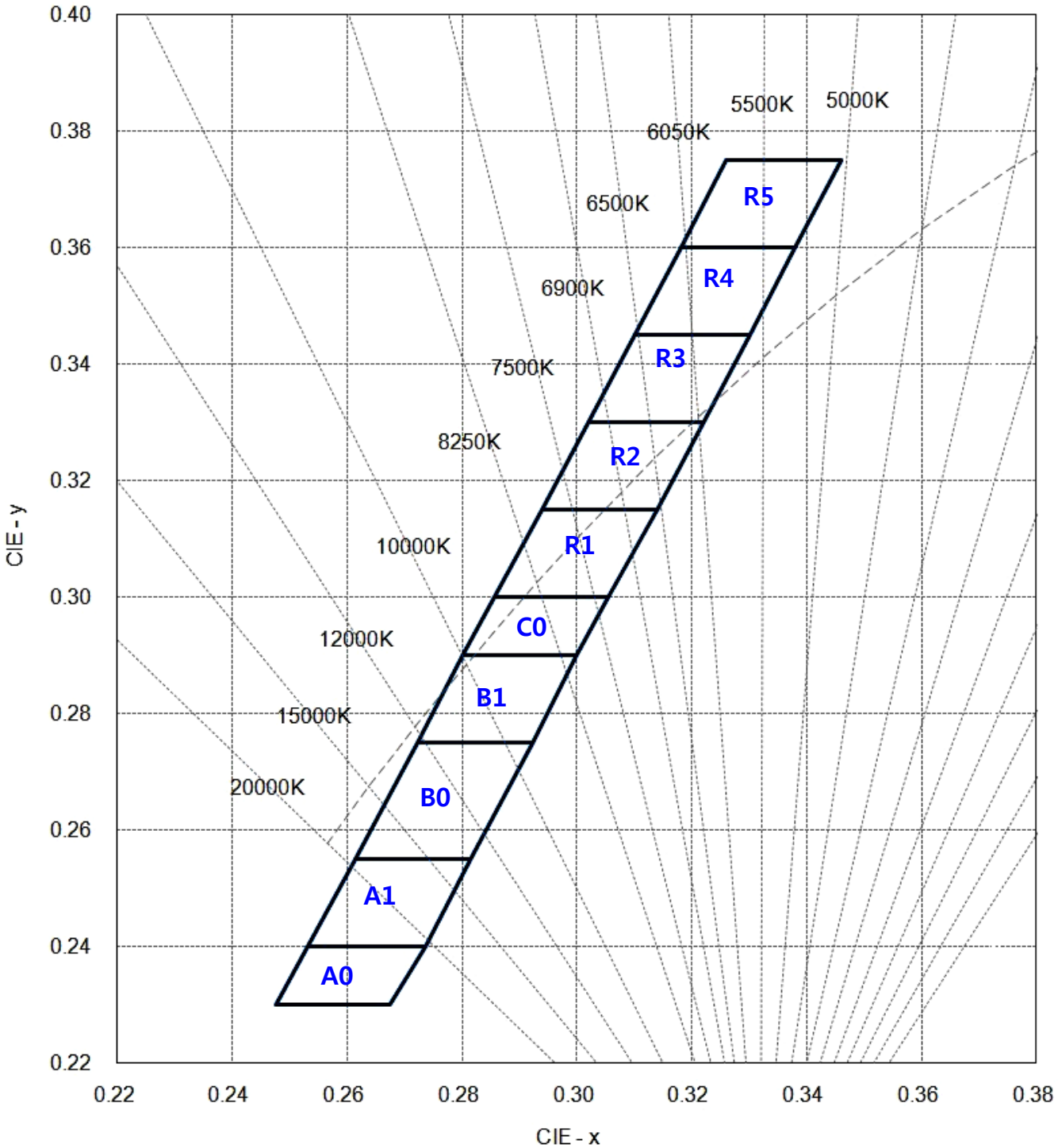
Rank	X	Y	Rank	X	Y
A0	0.2475	0.2300	R1	0.2855	0.3000
	0.2675	0.2300		0.3055	0.3000
	0.2735	0.2400		0.3140	0.3150
	0.2530	0.2400		0.2940	0.3150
A1	0.2530	0.2400	R2	0.2940	0.3150
	0.2735	0.2400		0.3140	0.3150
	0.2815	0.2550		0.3220	0.3300
	0.2615	0.2550		0.3020	0.3300
B0	0.2615	0.2550	R3	0.3020	0.3300
	0.2815	0.2550		0.3220	0.3300
	0.2922	0.2750		0.3300	0.3450
	0.2722	0.2750		0.3100	0.3450
B1	0.2722	0.2750	R4	0.3100	0.3450
	0.2922	0.2750		0.3300	0.3450
	0.3000	0.2900		0.3380	0.3600
	0.2800	0.2900		0.3180	0.3600
C0	0.2800	0.2900	R5	0.3180	0.3600
	0.3000	0.2900		0.3380	0.3600
	0.3055	0.3000		0.3460	0.3750
	0.2855	0.3000		0.3260	0.3750

※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Normal white chromaticity coordinates ranks

* Cool White ~ Pure White

(Ta=25℃)



※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Pure white ~ Warm white chromaticity coordinates ranks

(Ta=25℃)

Rank name		Rank table				
D rank (5,950K ~ 7,500K)	1	X	0.2923	0.2963	0.3047	0.3017
		Y	0.3420	0.3263	0.3346	0.3510
	2	X	0.2963	0.3004	0.3077	0.3047
		Y	0.3263	0.3103	0.3179	0.3346
	3	X	0.3004	0.3045	0.3108	0.3077
		Y	0.3103	0.2942	0.3010	0.3179
	4	X	0.3017	0.3047	0.3131	0.3110
		Y	0.3510	0.3346	0.3425	0.3595
	5	X	0.3047	0.3077	0.3151	0.3131
		Y	0.3346	0.3179	0.3252	0.3425
	6	X	0.3077	0.3108	0.3173	0.3151
		Y	0.3179	0.3010	0.3077	0.3252
	7	X	0.3110	0.3131	0.3220	0.3209
		Y	0.3595	0.3425	0.3505	0.3680
	8	X	0.3131	0.3151	0.3231	0.3220
		Y	0.3425	0.3252	0.3327	0.3505
	9	X	0.3151	0.3173	0.3242	0.3231
		Y	0.3252	0.3077	0.3145	0.3327
E rank (4,900K ~ 5,950K)	1	X	0.3209	0.3220	0.3312	0.3312
		Y	0.3680	0.3505	0.3584	0.3763
	2	X	0.3220	0.3231	0.3313	0.3312
		Y	0.3505	0.3327	0.3401	0.3584
	3	X	0.3231	0.3242	0.3314	0.3313
		Y	0.3327	0.3145	0.3213	0.3401
	4	X	0.3312	0.3312	0.3406	0.3415
		Y	0.3763	0.3584	0.3659	0.3841
	5	X	0.3312	0.3313	0.3397	0.3406
		Y	0.3584	0.3401	0.3473	0.3659
	6	X	0.3313	0.3314	0.3388	0.3397
		Y	0.3401	0.3213	0.3280	0.3473
	7	X	0.3415	0.3406	0.3498	0.3515
		Y	0.3841	0.3659	0.3729	0.3912
	8	X	0.3406	0.3397	0.3480	0.3498
		Y	0.3659	0.3473	0.3539	0.3729
	9	X	0.3397	0.3388	0.3461	0.3480
		Y	0.3473	0.3280	0.3343	0.3539

※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Pure white ~ Warm white chromaticity coordinates ranks

(Ta=25℃)

Rank name		Rank table				
F rank (4,100K ~ 4,900K)	1	X	0.3515	0.3498	0.3594	0.3620
		Y	0.3912	0.3729	0.3797	0.3982
	2	X	0.3498	0.3480	0.3567	0.3594
		Y	0.3729	0.3539	0.3606	0.3797
	3	X	0.3480	0.3461	0.3539	0.3567
		Y	0.3539	0.3343	0.3407	0.3606
	4	X	0.3620	0.3594	0.3699	0.3734
		Y	0.3982	0.3797	0.3866	0.4052
	5	X	0.3594	0.3567	0.3662	0.3699
		Y	0.3797	0.3606	0.3674	0.3866
	6	X	0.3567	0.3539	0.3625	0.3662
		Y	0.3606	0.3407	0.3474	0.3674
	7	X	0.3734	0.3699	0.3807	0.3850
		Y	0.4052	0.3866	0.3932	0.4117
	8	X	0.3699	0.3662	0.3761	0.3807
		Y	0.3866	0.3674	0.3740	0.3932
	9	X	0.3662	0.3625	0.3714	0.3761
		Y	0.3674	0.3474	0.3540	0.3740
G rank (3,420K ~ 4,100)	1	X	0.3850	0.3807	0.3927	0.3979
		Y	0.4117	0.3932	0.4000	0.4183
	2	X	0.3807	0.3761	0.3873	0.3927
		Y	0.3932	0.3740	0.3809	0.4000
	3	X	0.3761	0.3714	0.3816	0.3873
		Y	0.3740	0.3540	0.3609	0.3809
	4	X	0.3979	0.3927	0.4045	0.4104
		Y	0.4183	0.4000	0.4059	0.4239
	5	X	0.3927	0.3873	0.3983	0.4045
		Y	0.4000	0.3809	0.3871	0.4059
	6	X	0.3873	0.3816	0.3917	0.3983
		Y	0.3809	0.3609	0.3673	0.3871
	7	X	0.4104	0.4045	0.4168	0.4234
		Y	0.4239	0.4059	0.4114	0.4290
	8	X	0.4045	0.3983	0.4096	0.4168
		Y	0.4059	0.3871	0.3928	0.4114
	9	X	0.3983	0.3917	0.4025	0.4096
		Y	0.3871	0.3673	0.3735	0.3928

※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Pure white ~ Warm white chromaticity coordinates ranks

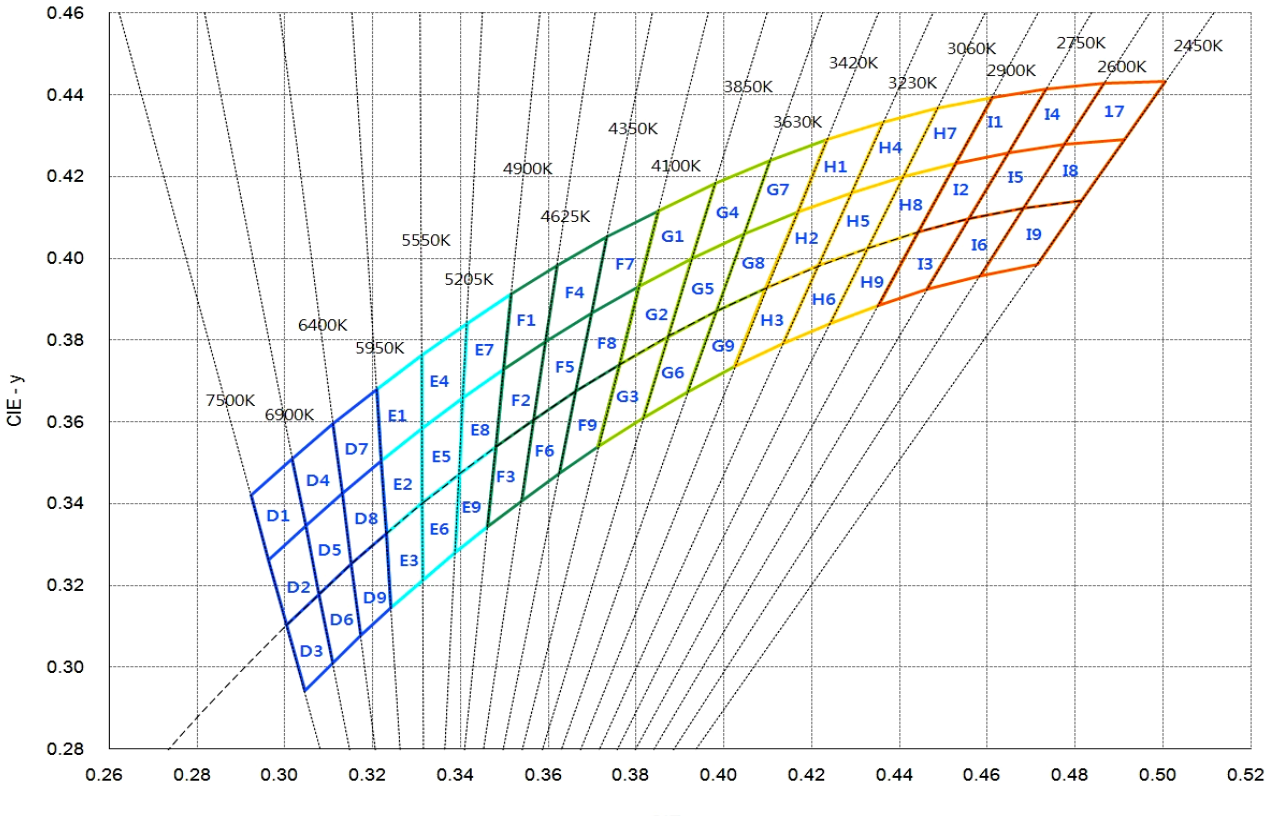
(Ta=25℃)

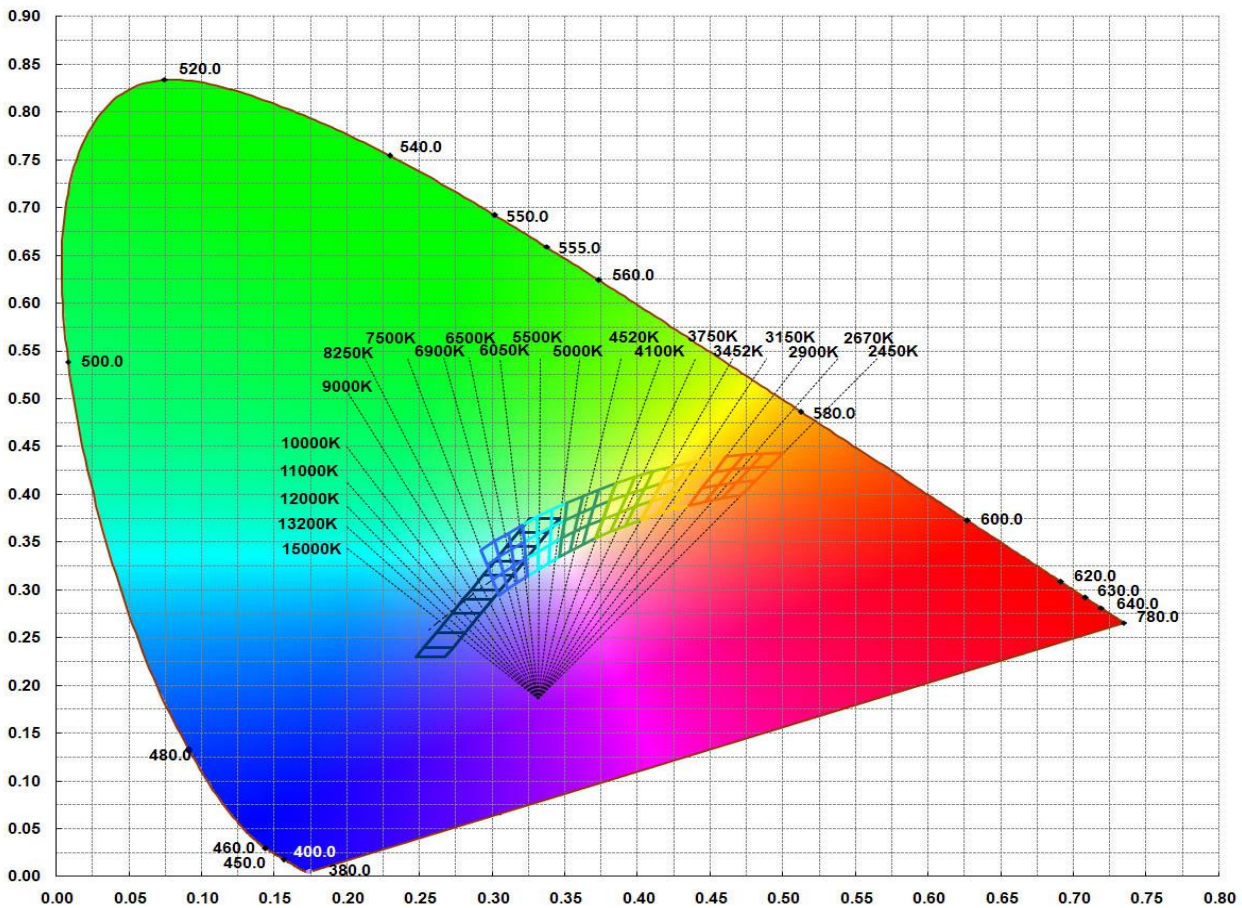
Rank name		Rank table				
H rank (2,900K ~ 3,420K)	1	X	0.4234	0.4168	0.4290	0.4362
		Y	0.4290	0.4114	0.4161	0.4333
	2	X	0.4168	0.4096	0.4214	0.4290
		Y	0.4114	0.3928	0.3982	0.4161
	3	X	0.4096	0.4025	0.4134	0.4214
		Y	0.3928	0.3735	0.3791	0.3982
	4	X	0.4362	0.4290	0.4408	0.4486
		Y	0.4333	0.4161	0.4200	0.4367
	5	X	0.4290	0.4214	0.4327	0.4408
		Y	0.4161	0.3982	0.4026	0.4200
	6	X	0.4214	0.4134	0.4241	0.4327
		Y	0.3982	0.3791	0.3841	0.4026
	7	X	0.4486	0.4408	0.4528	0.4610
		Y	0.4367	0.4200	0.4233	0.4394
	8	X	0.4408	0.4327	0.4442	0.4528
		Y	0.4200	0.4026	0.4065	0.4233
	9	X	0.4327	0.4241	0.4351	0.4442
		Y	0.4026	0.3841	0.3885	0.4065
I rank (2,450K ~ 2,900K)	1	X	0.4610	0.4528	0.4648	0.4734
		Y	0.4394	0.4233	0.4259	0.4414
	2	X	0.4528	0.4442	0.4558	0.4648
		Y	0.4233	0.4065	0.4097	0.4259
	3	X	0.4442	0.4351	0.4463	0.4558
		Y	0.4065	0.3885	0.3924	0.4097
	4	X	0.4734	0.4648	0.4776	0.4866
		Y	0.4414	0.4259	0.4279	0.4428
	5	X	0.4648	0.4558	0.4682	0.4776
		Y	0.4259	0.4097	0.4123	0.4279
	6	X	0.4558	0.4463	0.4583	0.4682
		Y	0.4097	0.3924	0.3958	0.4123
	7	X	0.4866	0.4776	0.4912	0.5005
		Y	0.4428	0.4279	0.4290	0.4432
	8	X	0.4776	0.4682	0.4815	0.4912
		Y	0.4279	0.4123	0.4142	0.4290
	9	X	0.4682	0.4583	0.4713	0.4815
		Y	0.4123	0.3958	0.3986	0.4142

※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Pure white ~ Warm white chromaticity coordinates ranks

(Ta=25℃)





- Pure white ~ Warm white chromaticity coordinates ranks for ANSI C78.377A

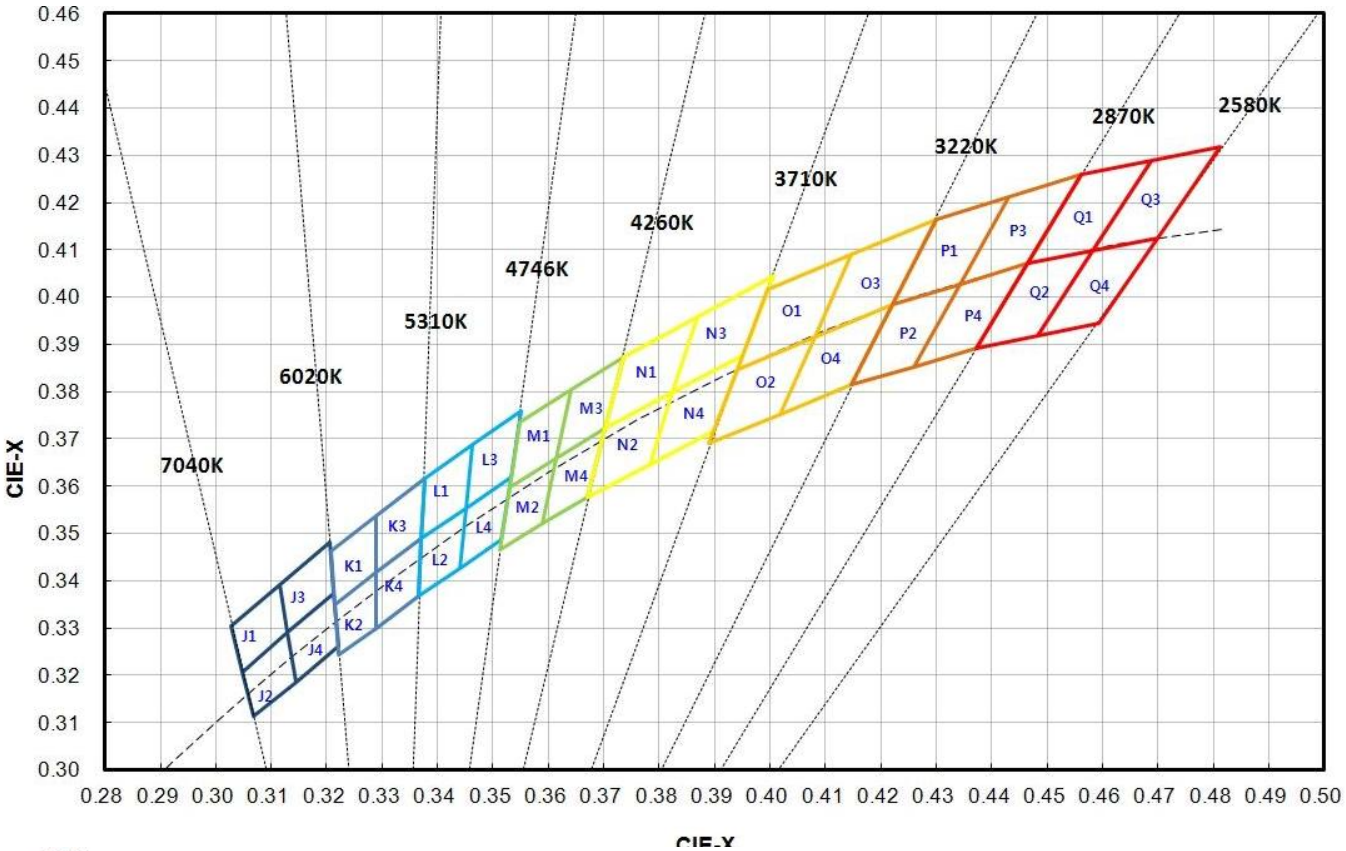
(Ta=25℃)

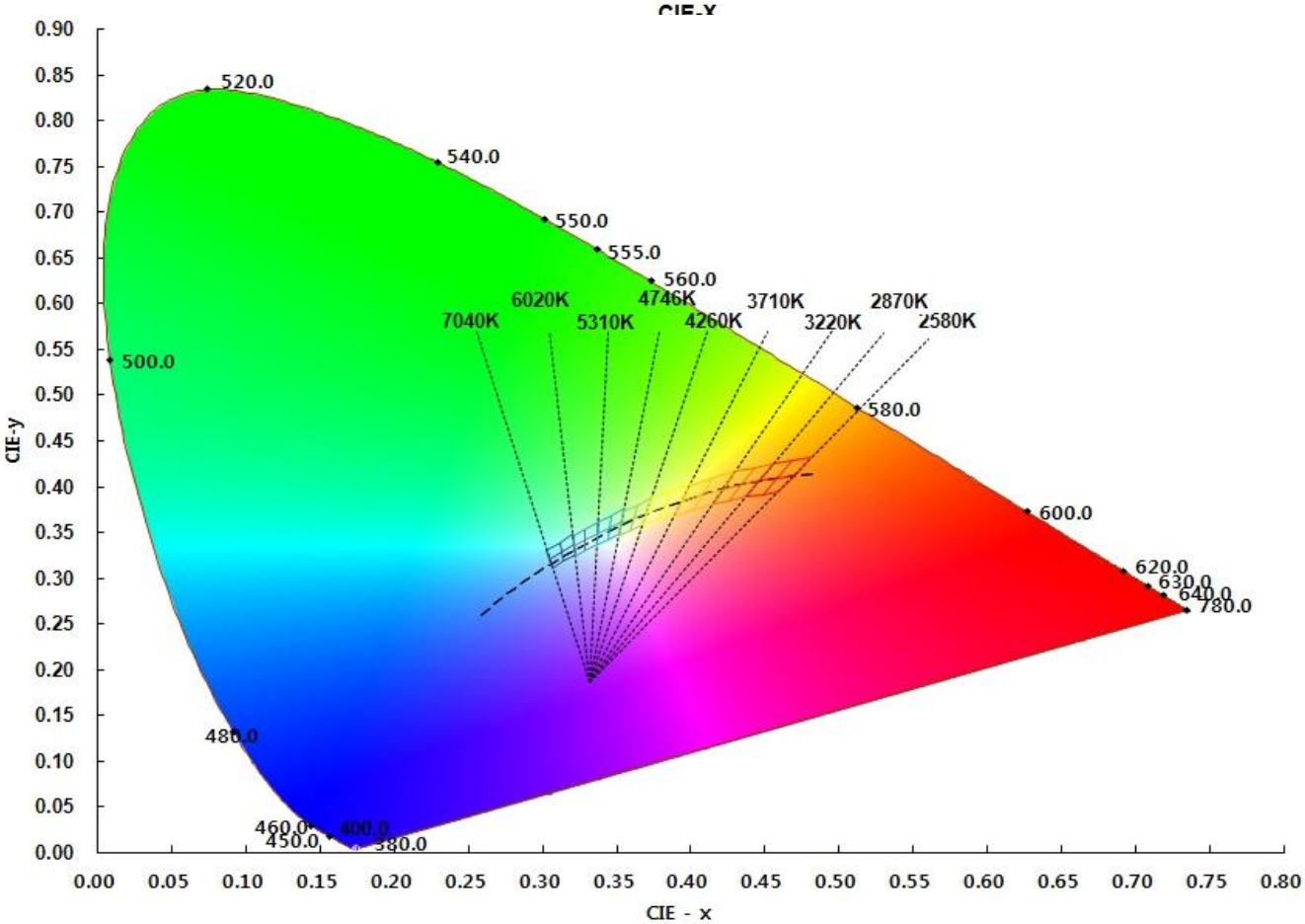
Division	1		2		3		4	
	x	y	x	y	x	y	x	y
J RANK	0.3028	0.3304	0.3048	0.3207	0.3115	0.3391	0.3130	0.3290
	0.3115	0.3391	0.3130	0.3290	0.3205	0.3481	0.3213	0.3373
	0.3130	0.3290	0.3144	0.3186	0.3213	0.3373	0.3221	0.3261
	0.3048	0.3207	0.3068	0.3113	0.3130	0.3290	0.3144	0.3186
K RANK	0.3207	0.3462	0.3215	0.3350	0.3290	0.3538	0.3290	0.3417
	0.3290	0.3538	0.3290	0.3417	0.3376	0.3616	0.3371	0.3490
	0.3290	0.3417	0.3290	0.3300	0.3371	0.3490	0.3366	0.3369
	0.3215	0.3350	0.3222	0.3243	0.3290	0.3417	0.3290	0.3300
L RANK	0.3376	0.3616	0.3371	0.3490	0.3463	0.3687	0.3451	0.3554
	0.3463	0.3687	0.3451	0.3554	0.3551	0.3760	0.3533	0.3620
	0.3451	0.3554	0.3440	0.3427	0.3533	0.3620	0.3515	0.3487
	0.3371	0.3490	0.3366	0.3369	0.3451	0.3554	0.3440	0.3427
M RANK	0.3548	0.3736	0.3530	0.3597	0.3641	0.3804	0.3615	0.3659
	0.3641	0.3804	0.3615	0.3659	0.3736	0.3874	0.3702	0.3722
	0.3615	0.3659	0.3590	0.3521	0.3702	0.3722	0.3670	0.3578
	0.3530	0.3597	0.3512	0.3465	0.3615	0.3659	0.3590	0.3521
N RANK	0.3702	0.3722	0.3670	0.3578	0.3825	0.3798	0.3783	0.3646
	0.3736	0.3874	0.3702	0.3722	0.3869	0.3958	0.3825	0.3798
	0.3869	0.3958	0.3825	0.3798	0.4006	0.4044	0.3950	0.3875
	0.3825	0.3798	0.3783	0.3646	0.3950	0.3875	0.3898	0.3716
O RANK	0.3941	0.3848	0.3889	0.3690	0.4080	0.3916	0.4017	0.3751
	0.3996	0.4015	0.3941	0.3848	0.4146	0.4089	0.4080	0.3916
	0.4146	0.4089	0.4080	0.3916	0.4299	0.4165	0.4221	0.3984
	0.4080	0.3916	0.4017	0.3751	0.4221	0.3984	0.4147	0.3814
P RANK	0.4221	0.3984	0.4147	0.3814	0.4342	0.4028	0.4259	0.3853
	0.4299	0.4165	0.4221	0.3984	0.4430	0.4212	0.4342	0.4028
	0.4430	0.4212	0.4342	0.4028	0.4562	0.4260	0.4465	0.4071
	0.4342	0.4028	0.4259	0.3853	0.4465	0.4071	0.4373	0.3893
Q RANK	0.4465	0.4071	0.4373	0.3893	0.4582	0.4099	0.4483	0.3919
	0.4562	0.4260	0.4465	0.4071	0.4687	0.4289	0.4582	0.4099
	0.4687	0.4289	0.4582	0.4099	0.4813	0.4319	0.4700	0.4126
	0.4582	0.4099	0.4483	0.3919	0.4700	0.4126	0.4593	0.3944

※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- Pure white ~ Warm white chromaticity coordinates ranks for ANSI C78.377A

(Ta=25℃)





- **White chromaticity coordinates ranks for obtaining certification of KS or High Performance Equipment**

(Ta=25℃)

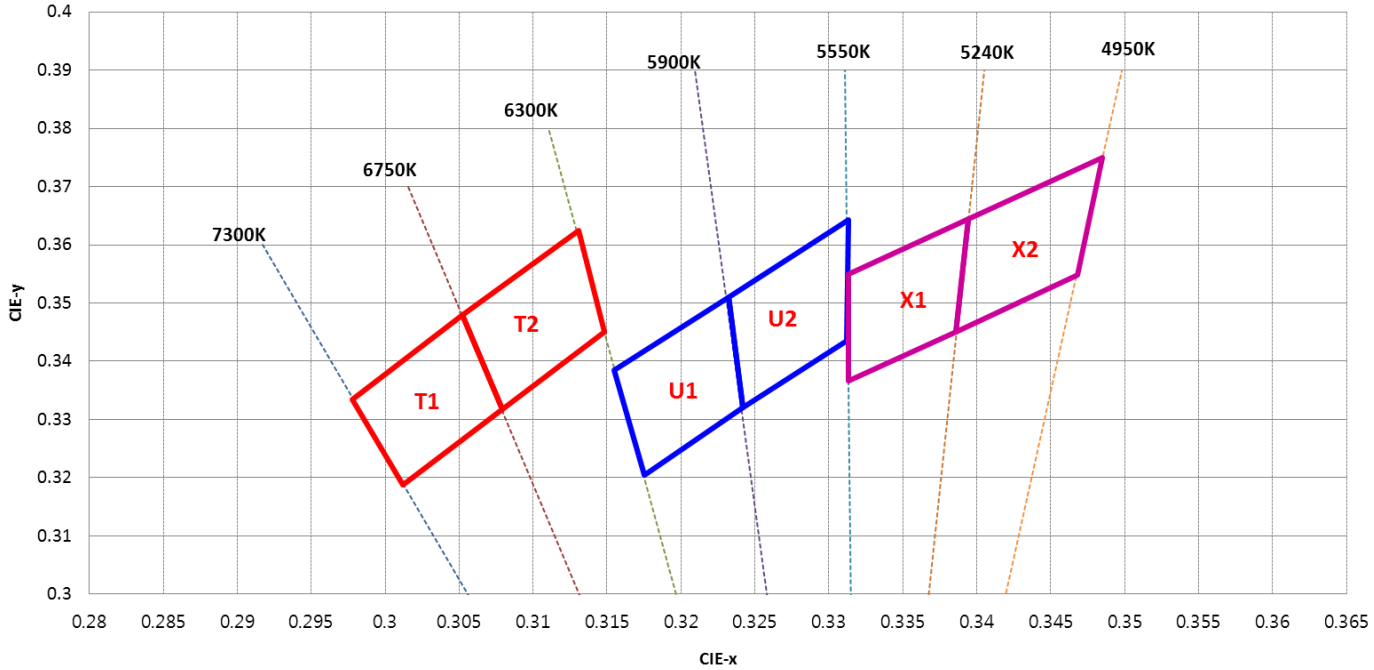
Division	1		2	
	x	y	x	y
T rank	0.2978	0.3335	0.3052	0.3480
	0.3012	0.3188	0.3079	0.3318
	0.3079	0.3318	0.3148	0.3450
	0.3052	0.3480	0.3131	0.3625
U RANK	0.3155	0.3385	0.3232	0.3510
	0.3175	0.3205	0.3242	0.3320
	0.3242	0.3320	0.3312	0.3435
	0.3232	0.3510	0.3313	0.3643
X RANK	0.3313	0.3550	0.3394	0.3645
	0.3313	0.3367	0.3386	0.3450
	0.3386	0.3450	0.3468	0.3548
	0.3394	0.3645	0.3485	0.3750

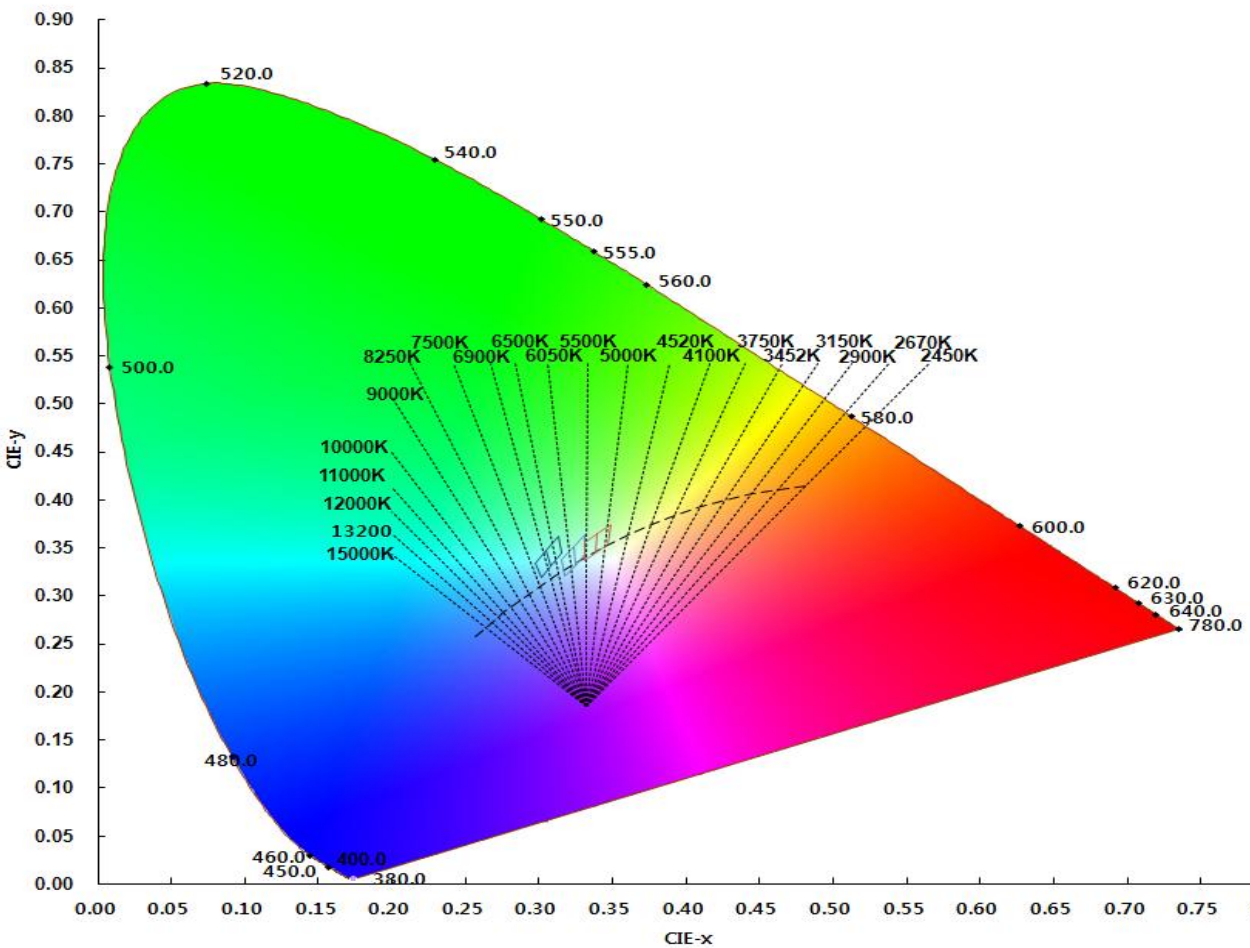
※ Measurement Uncertainty of the Color Coordinates : ± 0.01

- **White chromaticity coordinates ranks for obtaining certification of KS or High Performance Equipment**

(Ta=25℃)

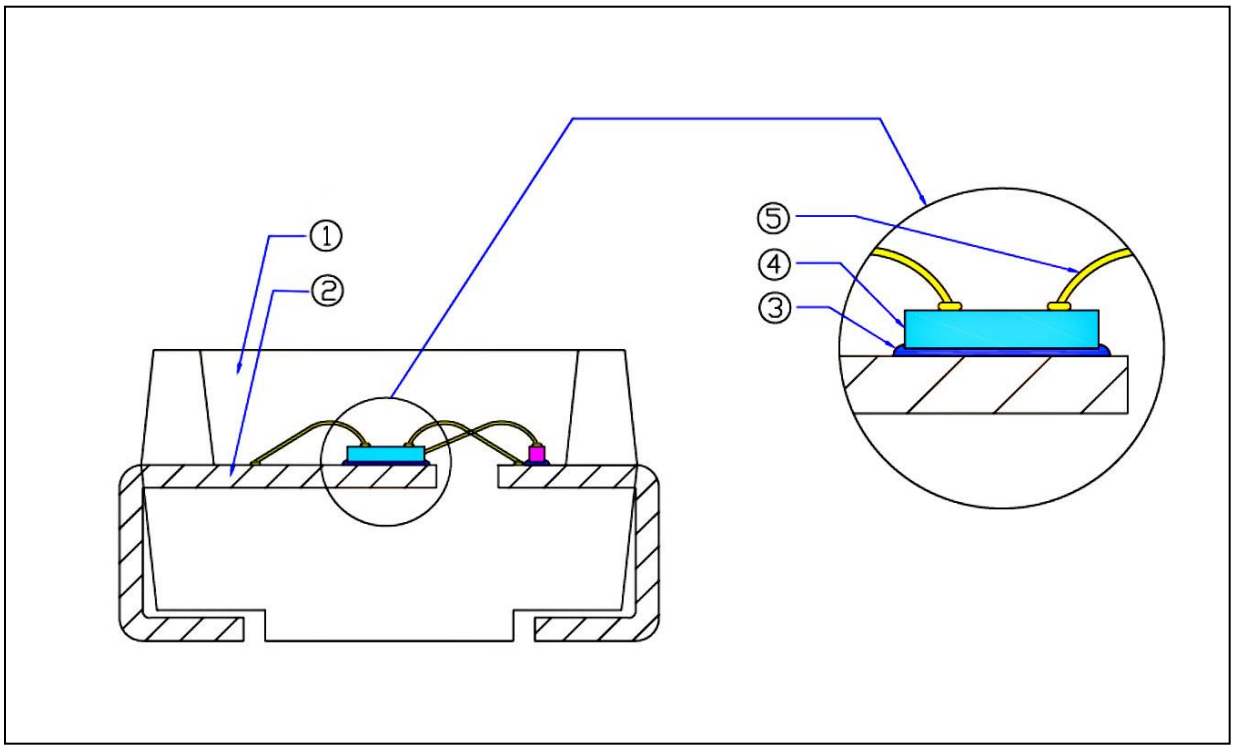
chromaticity coordinates ranks





5. Composition of package

(1) Composition of package



(2) Component material

Number	Item	Material
1	Encapsulant	Silicone
2	Electrodes	Ag Plating Cu Alloy
3	Die adhesive	Epoxy or Silicone
4	LED Chip	InGaN
5	Au Wire	0.9~1.2mil

6. Environmental pollution free

(1) Testing institute

SGS Testing Korea CO.,Ltd.

(2) Test material

LED Package ▶ ① Resin, ② Metal

① Resin Test

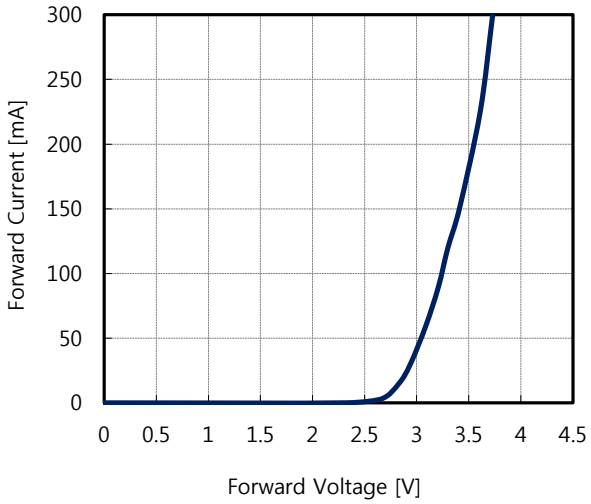
Test item	Unit	Result	Test method
Pb	mg/kg	No detection	ICP 62321:2008 ICP UV-VIS GC/MS
Cd	mg/kg	No detection	
Hg	mg/kg	No detection	
Cr^{+6}	mg/kg	No detection	
PBBs/PBDEs	mg/kg	No detection	

② Metal Test

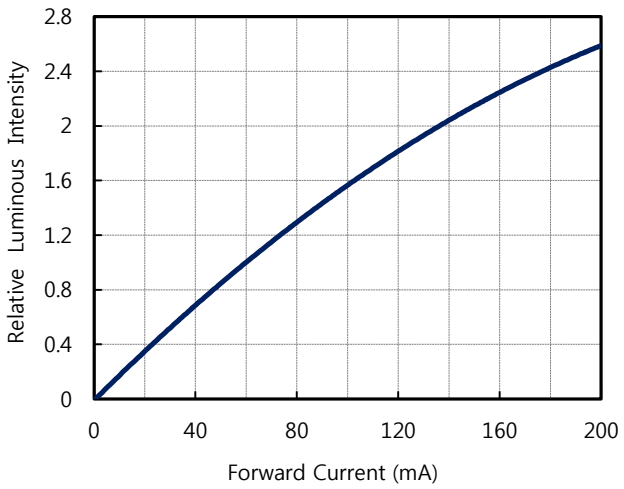
Test item	Unit	Result	Test method
Pb	mg/kg	No detection	US EPA 3052(1996) US EPA 6010B(1996) ICP US EPA 3060A(1996) US EPA 7196A UV US EPA 3540C GC/MS
Cd	mg/kg	No detection	
Hg	mg/kg	No detection	
Cr^{+6}	mg/kg	No detection	
PBBs/PBDEs	mg/kg	No detection	

7. Typical electrical / Optical characteristics curves

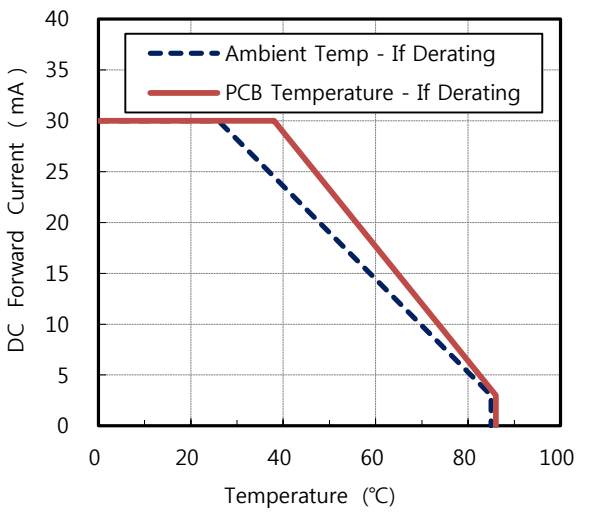
■ Forward Voltage Vs. Forward Current



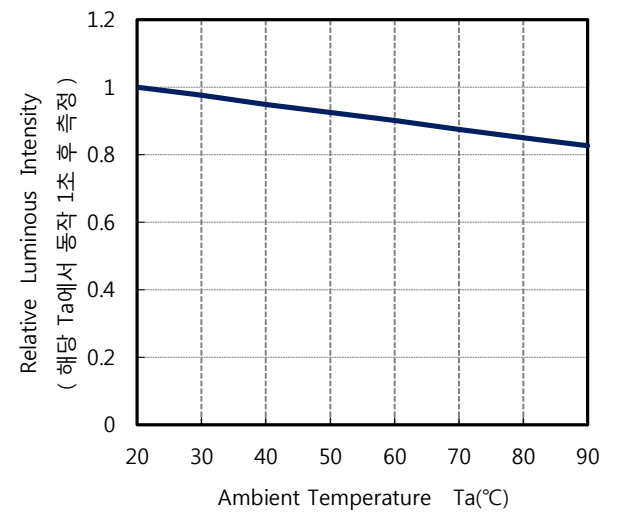
■ Forward Current Vs. Relative Luminosity



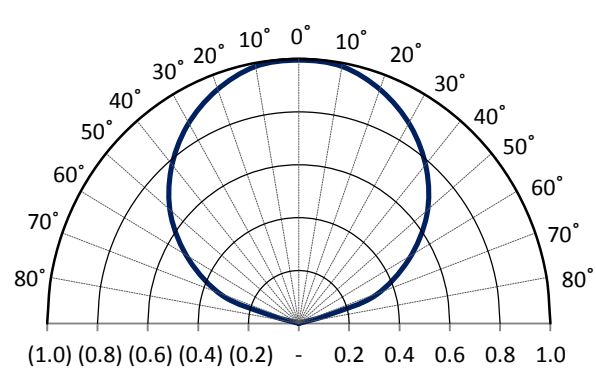
■ Forward Current Derating Curve (per 1 chip)



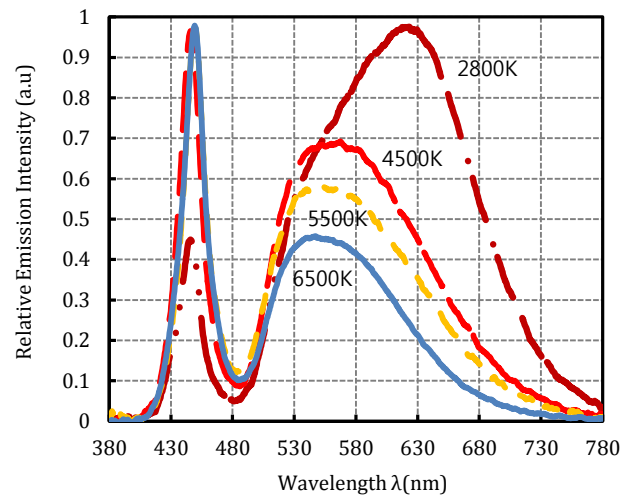
■ Relative Luminosity Vs. Ambient Temperature



■ Directivity



■ Relative Luminous intensity vs. Wavelength



※ 25℃ Ambient Temperature Unless Otherwise Noted

8. Classification by name

PART NO : PCL - □XX X□ □ □ □ □ □ □ □ □

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

(1) POWERLIGHTEC Lamp

(2) PACKAGE TYPE

Type		Model		Size [mm]	Pad
Top view	3020	**C5**	O	3.0*2.0*1.3	2
	3528	**C4**	P	3.5*2.8*1.9	2 / 4
		C41	O	3.5*2.8*1.2	4
		C42	O	3.2*2.8*1.4	6
	5450	**C6**	O	5.4*5.0*1.6	6
		C7	O	5.4*5.0*1.6	6
		C9	P	5.4*5.0*1.6	6
		D9	P	5.4*5.0*1.6	6
	5630	**B1**	O	5.6*3.0*0.9	4
	L2L	**A1**	N	15*3.8*1.15	2
BLU	5630	**B1**	O	5.6*3.0*0.9	4
Power	LEDGE Series	**L1** [0.4W]	P	6.0*5.0*1.3	2
		L2 [0.8W]	P	6.0*5.0*1.3	2
		L3 [1W]	P	6.0*5.0*1.3	2
		L4 [1.5W]	P	6.0*5.0*1.3	2

N : New Product P : Product D : Develop Product O : Old Product

(3) EMITION COLOR

B	C	SB	G	Y	O	A	R
Blue	Cyan	Sky Blue	Green	Yellow	Orange	Amber	Red
W	**WW**	**PW**	**YG**	**D**	**RGB**	**UV,R**	**WR**
White	Warm White	Pink White	Y-Green	Dual	R, G, B	Ultra Violet, Red	White , Red

(4) LENS COLOR

A	Colored Transparency	**C**	Colored Diffusion
B	Colorless Transparency	**D**	Milky Diffusion

(5) ESD PROTECTION (Zener Diode: Z / Varistor: V / No Protection: N)

(6) NUMBER OF UV CHIP (1Chip: 1 / 2Chip: 2 / 3Chip: 3)

(7) NUMBER OF RED CHIP (1Chip: 1 / 2Chip: 2 / 3Chip: 3)

(8) MOLD RESIN (Epoxy: E / Silicone: S)

(9) POLARITY MARK (Anode: A / Cathode: C)

(10) MATERIAL

9. Reliability

(1) Test items and results

Test Item	Standard Test Method	Test Conditions	Note	Number of Damaged
Resistance to Soldering Heat (Reflow Soldering)	JEITA ED-4701 300 301	Tsol=260℃, 10sec. (Pre treatment 30℃, 70%,168hrs.)	2 times	0/20
Solder ability (Reflow Soldering)	JEITA ED-4701 300 303	Tsol=215±5℃, 3sec.	1 time over 95%	0/20
Temperature Cycle	JEITA-ED-4701 100 105	-40℃ ~ 25℃ ~ 100℃ ~ 25℃ 30min. 5min. 30min. 5min.	200 cycles	0/20
Temperature Humidity Storage	JEITA ED-4701 100 103	Ta=60℃, RH=90%	1000 hrs.	0/20
Life Test Condition 1	Internal Standard	Ta=25℃, IF=60mA	1000 hrs.	0/20
Life Test Condition 2	Internal Standard	Ta=25℃, IF=90mA	500 hrs.	0/20
High Temperature Life Test	Internal Standard	Ta=85℃, IF=15mA	1000 hrs.	0/20
High Humidity Heat Life Test	Internal Standard	60℃, RH=90%, IF=45mA	500 hrs.	0/20
Electrostatic Discharges	MIL-STD-883 Method 3015	Class2 , 2kV ,1.5KΩ ;100pF	3 Time	0/20

(2) Criteria for judging the damage

Item	Symbol	Test Conditions	Criteria for Judgment	
			Min.	Max.
Forward Voltage	VF	IF=40mA	-	U.S.L.*) × 1.1
Reverse Current	IR	VR=5V	-	U.S.L.*) × 2.0
Luminous Intensity	IV	IF=40mA	L.S.L.**) × 0.7	-

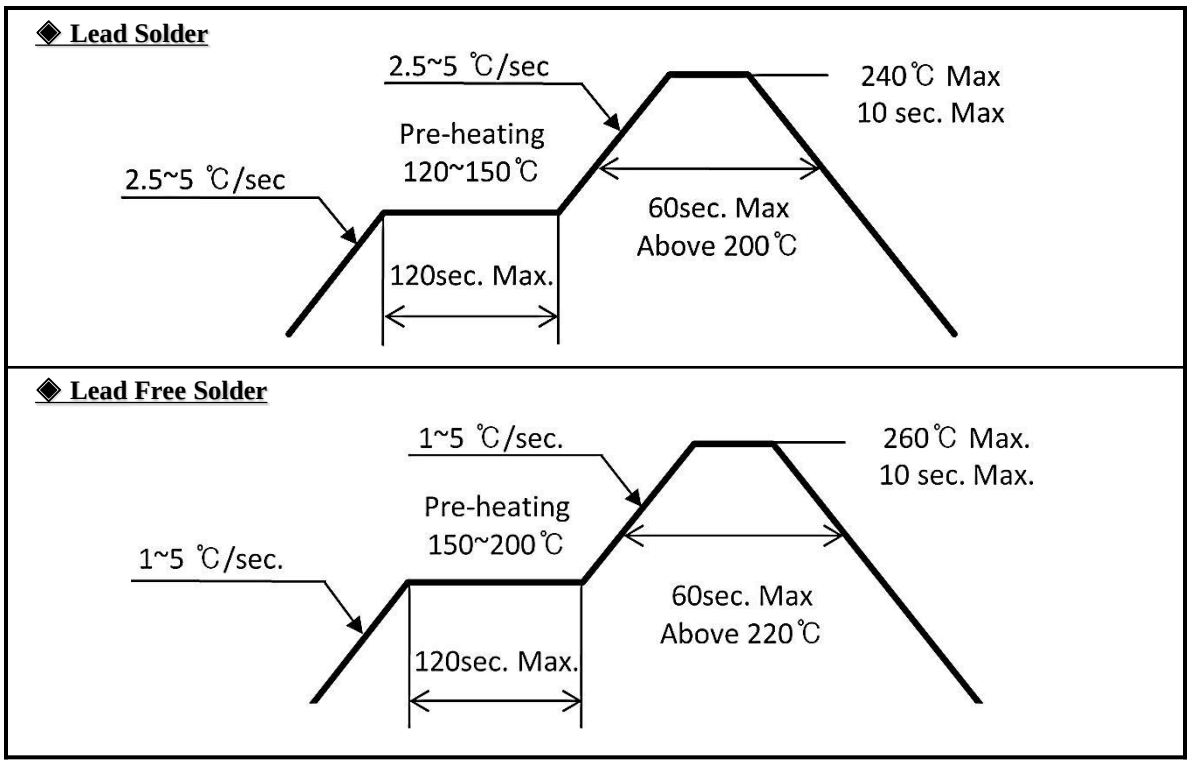
*) U.S.L. : Upper Standard Level **) L.S.L. : Lower Standard Level

10. Soldering condition

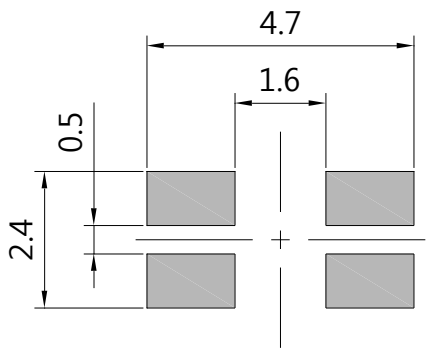
(1) Soldering condition

Reflow soldering			Hand soldering	
Step	Lead solder	Lead free Solder	Condition	Spec.
Pre heating	120~150 ℃	150~200 ℃	Soldering Temp.	Max 300℃
Pre heating time	Max 120 sec.	Max 120 sec.		
Peak temp.	Max 240 ℃	Max 260 ℃	Soldering Time	Max 3sec.
Soldering time	Max 10 sec.	Max 10 sec.		

(2) Recommended reflow soldering profile



(3) Recommended soldering pattern



10. Soldering condition

(4) Notices in Soldering

- If the humidity is absorbed in the LED, it occurs the expansion and evaporation during soldering process. This phenomena may cause troubles in optical characteristics of LED and the delamination and crack in the encapsulant.
- To prevent the humidity, the package is made of aluminum moisture barrier bag in which the desiccant is included.
- Storage condition before unpacking :
  - Keep the temperature 5~30℃, humidity less RH65% and use it within 6 months.
  - When unpacking, check if there is a hole or any tear off in the sealed moisture barrier bag.
- LED needs to carry out Soldering/SMT within 3 hours after unpacking.
- If the unused LEDs remained after unpacking, keep them in moisture prevention packing (the sealed vessel including the desiccant) or put them in the existing given moisture barrier bag and seal them again and keep them in the condition listed below.
  - Keep the temperature 5~30℃, humidity lRH30% or less.
- Despite of the storage under the specified condition, a small amount of humidity penetration will keep in progressing. Thus, to remove the humidity penetrated into LED, please carry out the Baking as below.
- Baking (dryness) time and condition
  - Baking condition : temp. 65 ± 5℃ humidity less RH10% for more than 24 hours.
  - Baking time

    If 168 hours (7 days) have passed since stored in the condition and method specified above after unpacking,

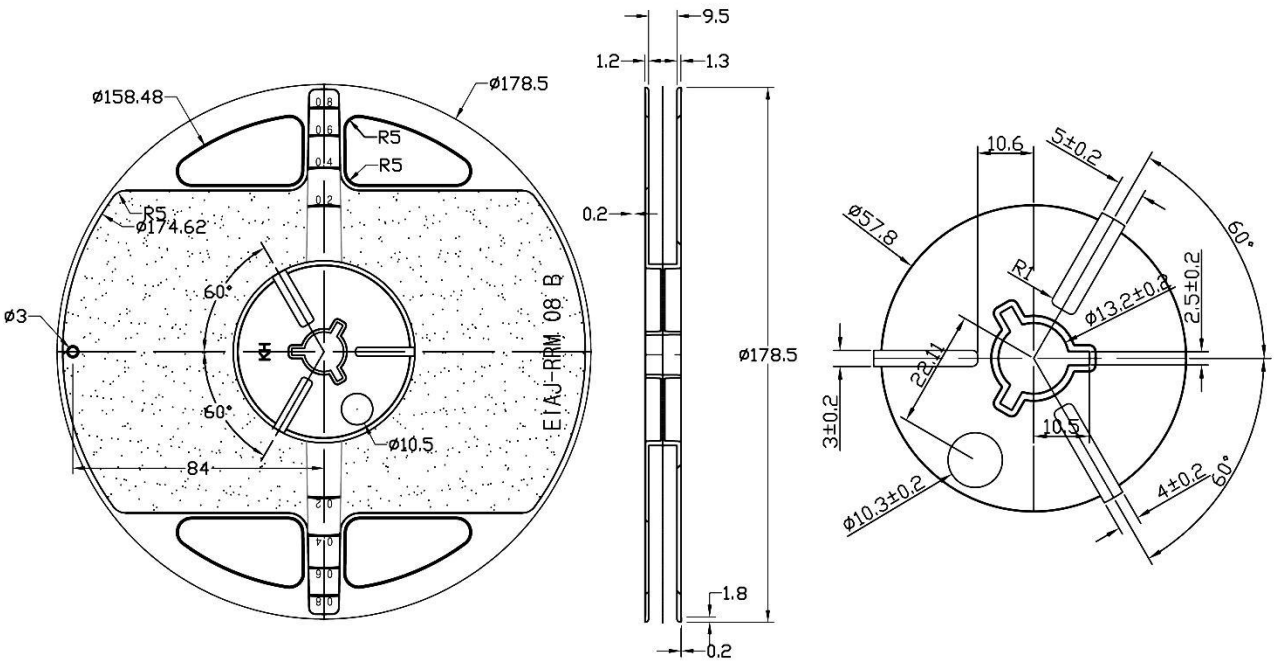
    If 3 hours have passed in the condition without moisture prevention storage after unpacking,.

    If 6 months have passed in the storage condition before unpacking
- LED encapsulant is very soft material. Thus, pay attention not to apply the strong force to LED encapsulant. Especially, if you use automatic mount device in SMT process, let Pick-up nozzle not to touch the encapsulant directly.
- During Reflow soldering, pay attention not to apply the impact, force or vibration to LED package.
- Avoid the process to lower the temperature sharply and cool it down.
- Do not repeat Reflow soldering twice and more.
- If the PCB temperature have not fallen down less than 80℃ just when Soldering is completed, do not laminate among PCBs. The high heat of PCB may damage LED package and cause the fatal fault.
- After Soldering completed, do not bend or distort the circuit boards.
- After LED의| Soldering / SMT completed, do not conduct the work to melt LED Solder and remove it again.
  - If it is needed to remove the LED, use Double- head solder tip and check whether the electrical characteristics of LED are changed and the change of appearance to make sure of the damage of LED

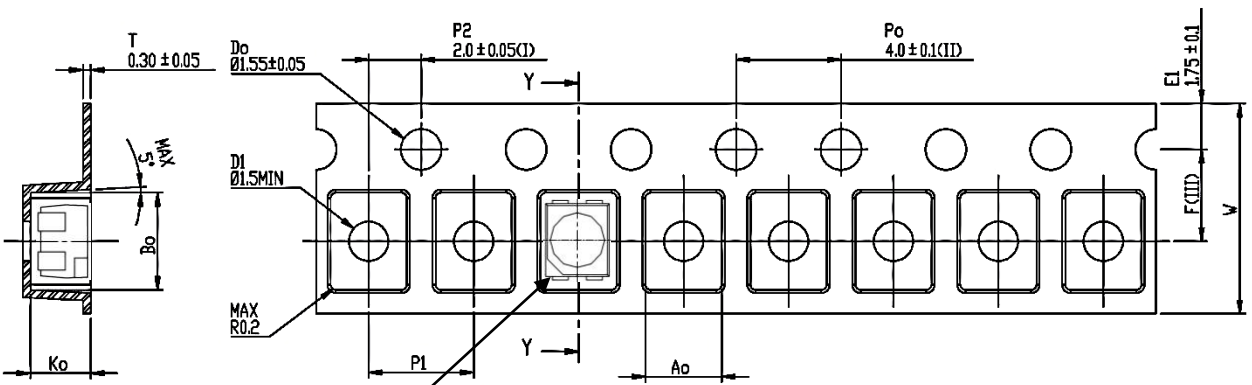
11. Packing & Packaging

(1) Reel & Carrier tape

Reel Part



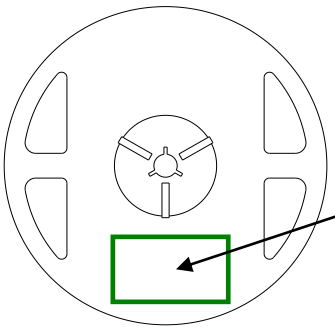
Carrier Tape Part



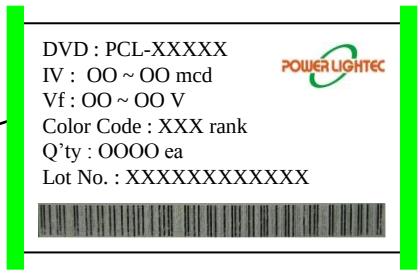
Ao	2.90	+/- 0.1
Bo	3.50	+/- 0.1
Ko	2.30	+/- 0.1
F	3.50	+/- 0.05
P 1	4.00	+/- 0.1
W	8.00	+/- 0.1

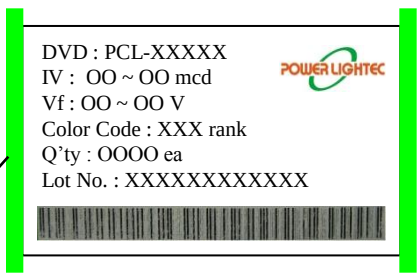
(2) Packing & Packaging

- **Reel**

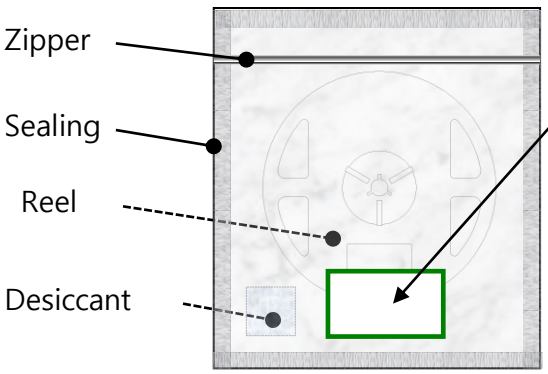


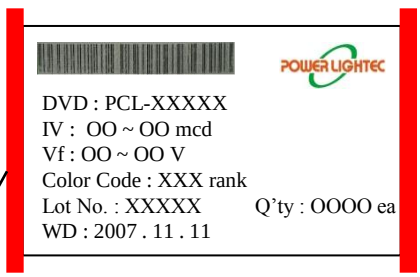
- **Label**



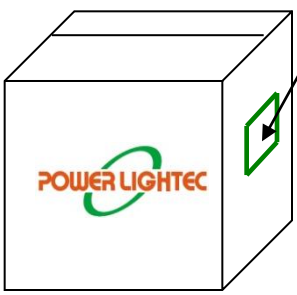


- **Aluminum bag (in a Reel)**

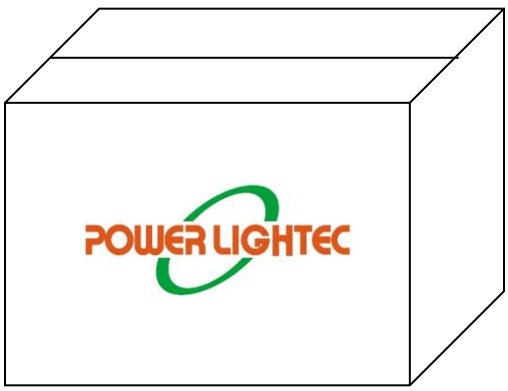




- **Inner Box**



- **Outer Box (in 8EA inner boxes)**



12. Precaution for use

(1) Humidity Penetration Prevention

- If the humidity is absorbed in the LED, it occurs the expansion and evaporation during soldering process. This phenomena may cause troubles in the optical characteristics of LED and the lamination and crack in the contact surface.
- To prevent the humidity penetration in LED, the package is made of aluminum moisture barrier bag in which the desiccant is included.

(2) Storage

- Storage condition before unpacking :
  - Keep the temperature 5~30℃, humidity less RH65% and use it within 6 months.
  - When unpacking, check if there is a hole or any tear off in the sealed moisture barrier bag.
- LED needs to carry out Soldering/SMT within 3 hours after unpacking.
- If the unused LEDs remained after unpacking, keep them in moisture prevention packing (the sealed vessel including the desiccant) or put them in the existing given moisture barrier bag and seal them again and keep them in the condition listed below.
  - Keep the temperature 5~30℃, humidity lRH30% or less.
- Despite of the storage under the specified condition, a small amount of humidity penetration will keep in progressing. Thus, to remove the humidity penetrated into LED, please carry out the Baking as below.
- Baking (dryness) time and condition
  - Baking condition : temp. 65 ± 5℃ humidity less RH10% for more than 24 hours.
  - Baking time

    If 168 hours (7 days) have passed since stored in the condition and method specified above after unpacking,

    If 3 hours have passed in the condition without moisture prevention storage after unpacking,.

    If 6 months have passed in the storage condition before unpacking
- Do not keep them in the environment where the temperature changes rapidly regularly or irregularly or humid place but follow the storage condition and baking condition on the above.
- Inside and outside of this product, there are some silver-plated parts. Silver-plated area is subject to decolorize due to the corrosive gas. If discoloration occurred, it may cause troubles in Soldering and the deterioration of optical characteristics. Thus, do not keep the LED in corrosive gas environment or let it alone..
- The cares should be taken to maintain the clean storage environment.

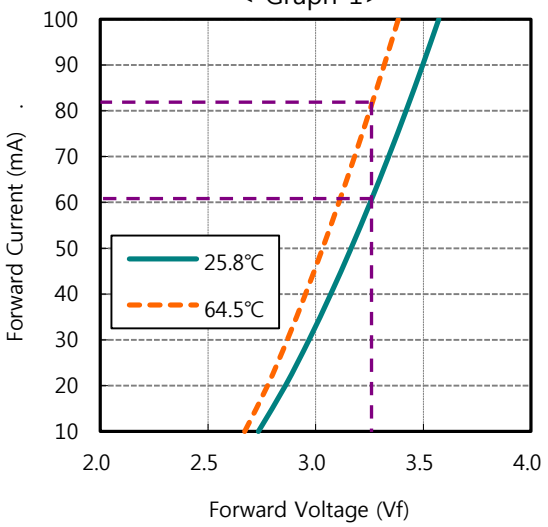
(3) Use and Operation Environment

- Regardless of LED action/inaction, avoid the place where the ambient temperature changes rapidly and the humid place.
- As this LED is not water-proof, install the protection device not to be affected by surrounding environment and avoid the direct exposure to water, humidity or spray.
- The use in the corrosive gas environment, may cause the discoloration of silver-plated area and the deterioration of optical characteristics.

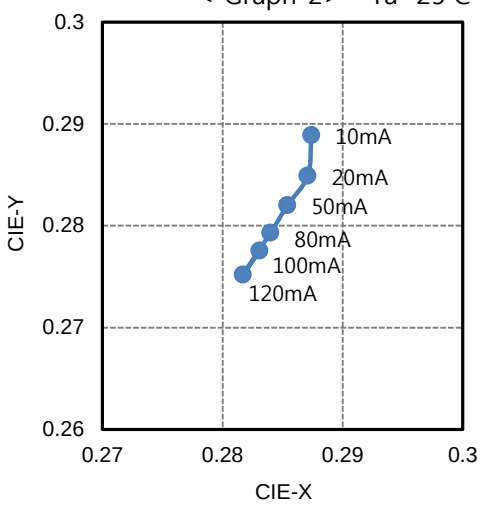
(4) Configuration of Recommended Circuit

- Apply the current that does not exceed max. rating to each LED and configure the circuit so that the current lower than rated current can flow, if possible.
- It is recommended to configure the circuit so that the static current can be supplied to the LED.
  - The heat emits due to the ambient temperature and the electric power to be supplied to LED Chip. The emitted heat raises the temperature of Chip Junction and LED Package and accordingly the LED characteristics and life span shall be changed.
  - If running the LED with static current, the change of Vf does not matter seriously. However, If running with static voltage or running with similar voltage, the current characteristics for Vf may be changed due to temperature rising and the current may increase.
  - As shown in <Graph-1>, if the static voltage 3.25V maintained for LED, the current of 60mA are applied at Ta 25.8℃ but 82mA at Ta 64.5℃, which shows the increase of 22mA.

< Graph-1>



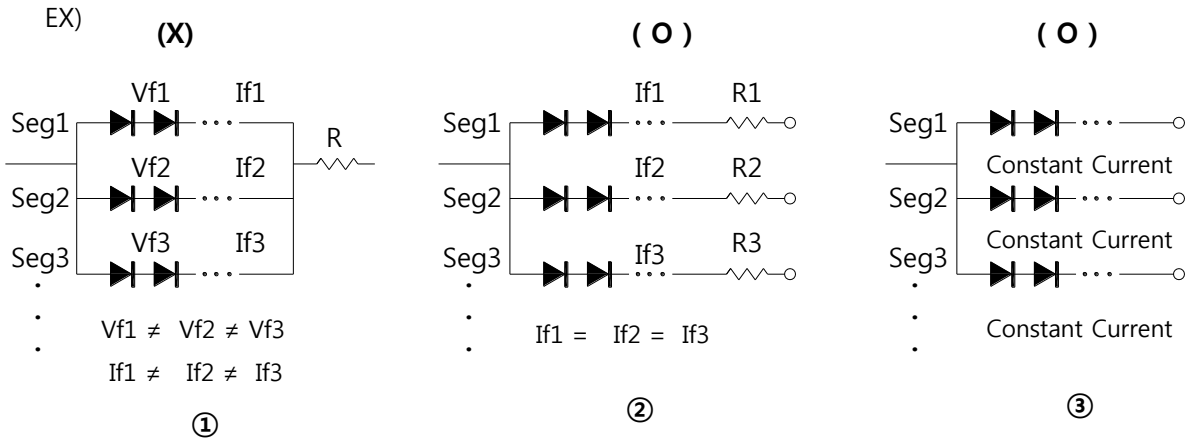
< Graph-2> Ta=25℃



※ The above graph is the data measured by our measuring environment and test equipments. Use them only for reference and when using a LED, it is required to reverify according to the usage environment

- If used the LED by mixing the parallel connection and serial connection, for the parallel connected area, the same current is not supplied to each parallel area due to the difference of forward voltage(Vf) of LED and the current exceeding the rating will flow which may cause the damage of LED. Take account of this when designing the circuit.

- This product operates by the forward current. If the reverse voltage is continuously applied, LED Chip may be damaged.
- LED's color coordinate shall be changed according to the size of operating current. Refer to <Graph-2>.
- It is recommended to use circuit ② , ③ which regulates the current flowing through each LED, In the meanwhile, when driving LEDs with a constant voltage in circuit ① , the current thorough the LEDs may vary due to the variation in forward voltage of the LEDs, In the worst case, some LED may be subjected to stresses in excess of the absolute maximum rating.



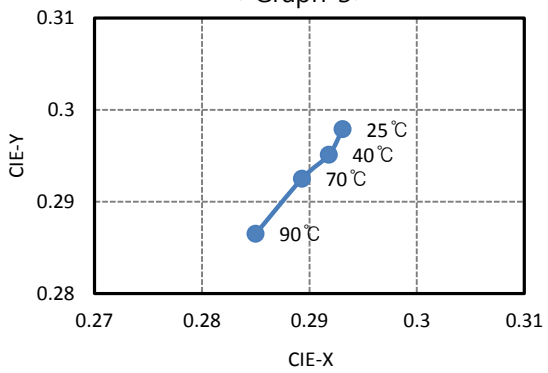
(5) Heat Generation

- LED emits the heat due to the ambient temperature and the electric power to be supplied to LED Chip. The emitted heat raises the temperature of Chip Junction (Junction of Pole P and Pole N) and LED Package and accordingly the LED characteristics and life shall be changed.
  - If the electric power to be supplied to LED Chip increases, the heat increases.
- As the heat emits when using a LED, the careful heat emission design is required for the apparatus to be combined additionally.
  - The temperature is subject to LED PKG and circuit board, the heat resistance of additional apparatus to be combined and the density of LED arrangement. At the same time, the careful circuit design and apparatus design are required to avoid the concentration of the emitting heat.
- LED's operating current should be determined after considering the temperature of surrounding environment and PCB (Printed Circuit Board) when running the LED.
  - Refer to '7. Electrical Optical Graph', **Forward Current Derating Curve** to determine the operating current.
  - Especially, in the place where receives directly the radiant such as sun light, as the tempera--ture of apparatus rises regardless of the ambient temperature, it is required to take account of this when designing.

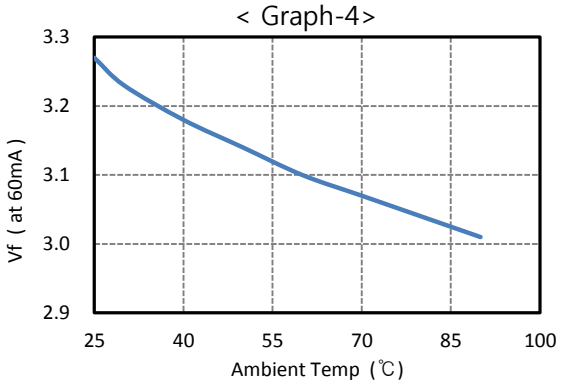
• LED changes the intensity of light and color coordinate according to the change of temperature.
  - Refer to **Relative Luminosity Vs. Ambient Temperature** of Electrical/Optical Characteristic Graph of this manual and <Graph-3>.

• LED drops forward voltage(Vf) according to the increase of temperature. Refer to <Graph-4>

< Graph-3>



< Graph-4>



※ The above graph is the data measured by our measuring environment and test equipments. Use them only for reference and when using a LED, it is required to reverify according to the usage environment

(6) Static Electricity

• Static Electricity and surge voltage may cause damage to LED.
• When handling LED, it is recommended to wear the anti-static wrist band or gloves.
• All facilities, devices and equipments should be grounded.
• In case of final inspection after LED SMT, check if LED is damaged by static electricity.
• The static electricity test allows us to check easily whether it is damaged or not through low current (less than 1mA) ON/OFF test.
  - The damaged LED shows the special characteristics that forward current value decreases or LED doesn't turn ON as the leakage current increases sharply.

(7) Cleaning

• To clean a LED, use the solvents like isopropyl alcohol. If you use different kinds of solvents, it may melt LED Package and encapsulant. Pay attention to this. In addition, do not use the ultrasonic cleaning to the LED.

(8) Notices in Handling

• LED encapsulant has soft silicon material. Thus, do not do any works that may affect pressure, impact, and scratch directly to encapsulant. The fatal fault may occur.
  - Do not press the encapsulant directly by hand.
  - Do not allow the sharp point of pincette or teaser to reach the encapsulant
  - While processing the manufacturing of apparatus using a LED, do not apply the pressure or impact to the encapsulant.
  - Do not allow Pick-up nozzle to contact directly to the encapsulant.
  - Never allow the SMT to laminate the completed PCB directly.

(9) Others

- The intensity of light of LED is strong enough to damage the eyes. Never look at the LED directly for a few seconds without wearing the protection equipments.
- These LEDs described in this brochure are intended to be used for ordinary electronic equipment (such as office equipment, communications equipment, measurement instruments and household appliance). Consult POWERLIGHTEC's sales staff in advance for information on the applications in which exceptional quality and reliability are required, particularly when the failure or malfunction of the LEDs may directly jeopardize life or health. (such as airplanes, aerospace, automobiles, traffic control equipment, life support systems and safety devices)
- User shall not reverse engineer by disassembling or analysis of the LEDs without having the prior written consent of POWERLIGHTEC. When defective LEDs are found, User shall inform to POWERLI -GHTEC directly before disassembling or analysis.
- The formal specification should be exchanged and authorized between both parties before starting a great deal of transactions.