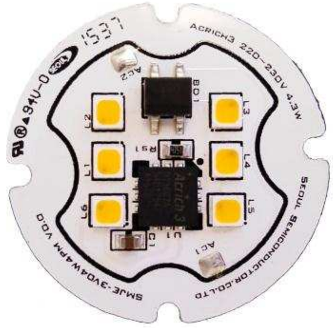
SEOUL SEMICONDUCTOR

Product Data Sheet

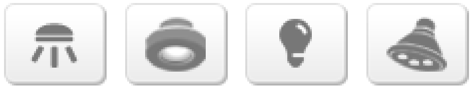
SMJE-XV04W4P# - Acrich3 4.5W



Integrated AC LED Solution

Acrich3 – 4.5W

SMJE-3V04W4P#
SMJE-2V04W4P#



RoHS

Product Brief

Description

- The Acrich3 series of products are designed to be driven directly off of AC line voltage, therefore they do not need the standard converter essential for conventional general lighting products.
- The converter or driver found in most general lighting products can limit the overall life of the product, but with the Acrich3 series of products the life of the product can more closely be estimated from the LED itself. This will also allow for a much smaller form factor from an overall fixture design allowing for higher creativity in the fixture.
- The modules have a high power factor which can contribute to a higher energy savings in the end application.

Features and Benefits

- Connects directly to AC line voltage though Acrich2 SPC (SMJC-SPCR5WV4)
- High Power Efficiency & Factor
- Low THD
- Long Life Time
- Simple BOM
- Miniaturization
- Lead Free Product
- RoHS Compliant

Key Applications

- PAR16 light
- Candle light
- Bulb light

Table 1-1. Product Selection (Flux)

Part No.	Bin	Flux [lm]		Vin [Vac]	P [W]
		Min.	Typ.		
SMJE-2V04W4PD SMJE-2V04W4PE	A38	290	380	120	4.5
	A29	220	290		
SMJE-3V04W4PM SMJE-3V04W4PN	A38	290	380	230	
	A29	220	290		

Table 1-2. Product Selection (CCT)

Part No.	Bin	Rank	CCT [K]	CRI
				Min.
SMJE-2V04W4PD SMJE-2V04W4PE	X03, X04, X0A	H ~ B	2700~5600	80
				90
SMJE-3V04W4PM SMJE-3V04W4PN	X03, X04, X0A	H ~ B	2700~5600	80
				90

Note : G03 = G rank 3-step / G04 = G rank 4-step / G0A = G rank All

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Performance Characteristics

Table 2. Electro Optical Characteristics, T_a = 25ºC

Parameter	Symbol	Value			Unit	Mark
		Min.	Typ.	Max.		
Luminous Flux	Φ_V [2]	220	290		lm	A29
		290	380			A38
Correlated Color Temperature [3]	CCT	5300	5600	6000	K	B
		4700	5000	5300		C
		3700	4000	4200		E
		2900	3000	3200		G
		2600	2700	2900		H
CRI	Ra	80	-	-	-	
		90	-	-	-	
Input Voltage [4]	V_{in}		230		Vac	3V
			120		Vac	2V
Power Consumption	P	4.1	4.5	4.9	W	04W
Operating Frequency	f		50 / 60		Hz	
Power Factor	PF		Over 0.97		-	
Viewing Angle	$2\Theta_{1/2}$		120		deg.	

Notes :

(1) At 230Vac, At 120Vac, T_a = 25ºC

(2) Φ_V is the total luminous flux output measured with an integrated sphere.

(3) Correlated Color Temperature is derived from the CIE 1931 Chromaticity diagram.

(4) Operating Voltage doesn't indicate the maximum voltage which customers use but means tolerable voltage according to each country’s voltage variation rate. It is recommended that the solder pad temperature should be below 70℃.

Absolute Maximum Ratings

Table 3. Absolute Maximum Ratings, T_a = 25ºC

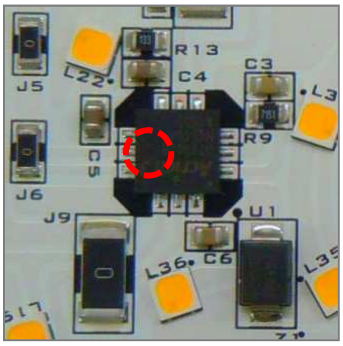
Parameter	Symbol	Unit	Value
Maximum Input Voltage	V_{in}	Vac	230
Power Consumption	P	W	5.7
Operating Temperature	T_{opr}	ºC	-30 ~ 85
Storage Temperature	T_{stg}	ºC	-40 ~ 100
ESD Sensitivity	-	-	±4,000V HBM

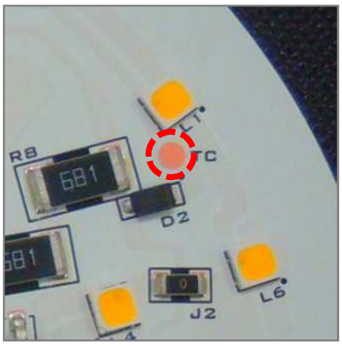
Thermal Resistance

Table 5. Thermal information, Ta = 25ºC

Part	Maximum Junction Temperature [℃]	$R\theta_{j\text{-}s}$ [℃/W]
SAW8CF2A SAW8C72A SAW9CF2A SAW9C72A(B)	125	10
Acrich3 IC	150	11.25

Notes :





The Acrich3 module is recommended to keep the junction temperature under maximum junction temperature spec. (Table 5)

LED lead temperature and IC top case temperature are measured with thermocupler. (Fig1)

LED & IC junction temperatures can be calculated using the formulas below.

$$T_{s\_max} = T_{j\_max} - (R\theta_{j\text{-}s} * P_d)$$

< Example >

If LED lead temperature and IC top temerature are 110℃

1) LED juntion temperature

$T_J = T_S + (R\theta_{j\text{-}s} * P_d)$

= 100℃ + (10 ℃/W * 1.5W) = 115 ℃

2) IC junction temperature

$T_J = T_S + (R\theta_{j\text{-}s} * P_d)$ (1)

= 110℃ + (11.25 ℃/W * 2.8W) = 141.5℃

* (1) : In the example, P_d value is the power consumption of IC when the rated voltage.

Relative Spectral Distribution

Fig 1. Relative Spectral Distribution vs. Wavelength Characteristic – G, H

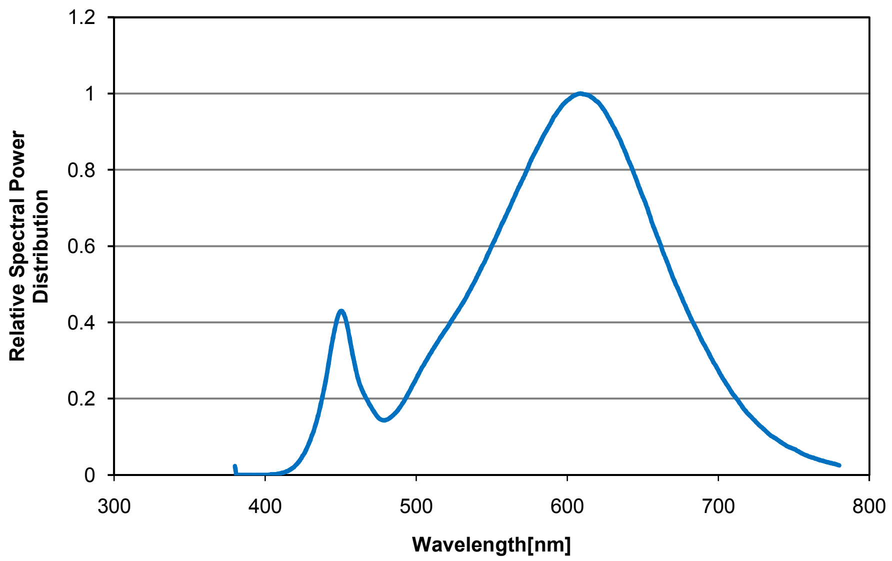
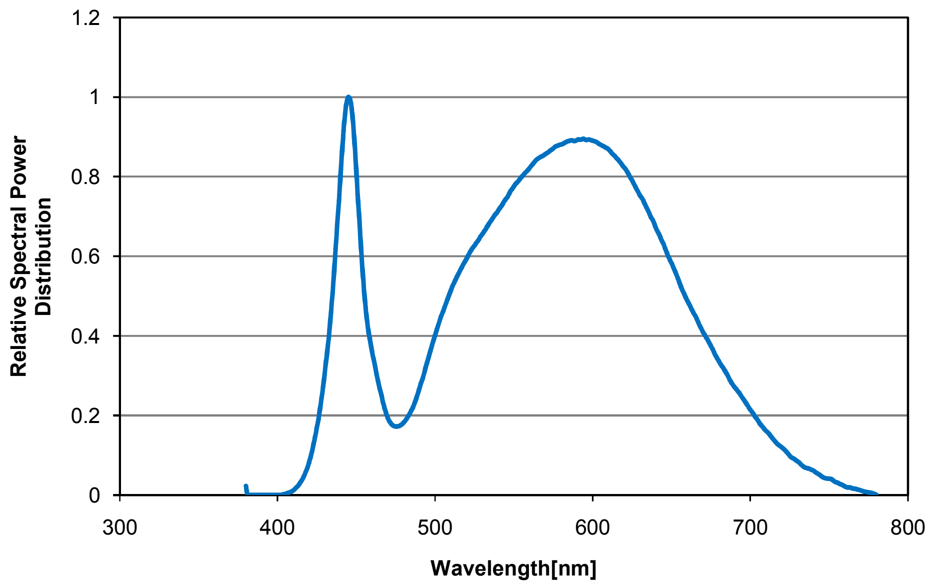
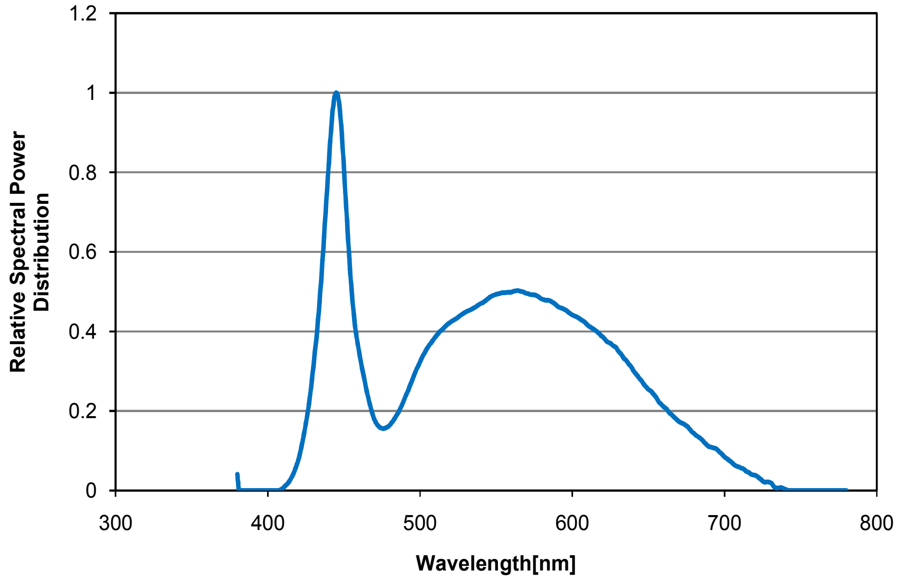


Fig 2. Relative Spectral Distribution vs. Wavelength Characteristic – E



Relative Spectral Distribution

Fig 3. Relative Spectral Distribution vs. Wavelength Characteristic – B, C



Relative Power Distribution

Fig 2-1. Relative Power Distribution vs. Voltage at T_a =25℃, 230V

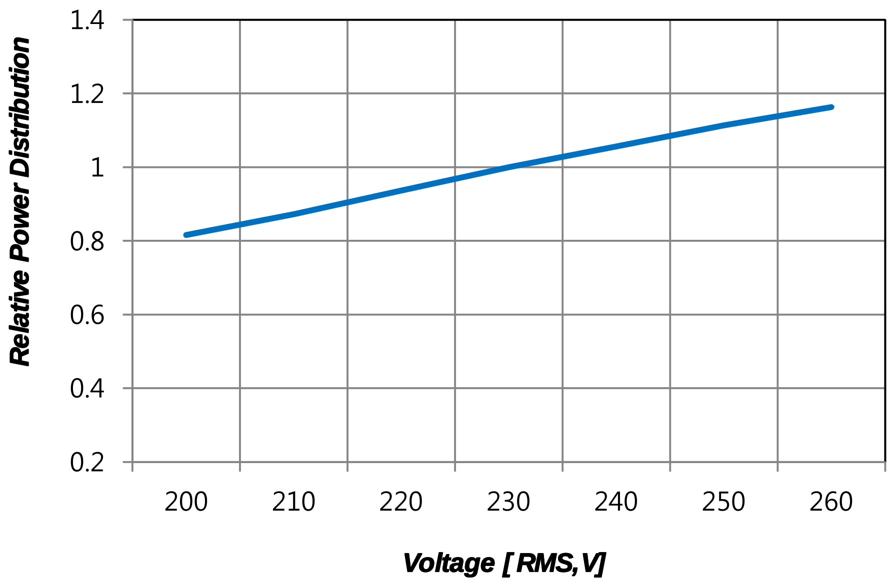
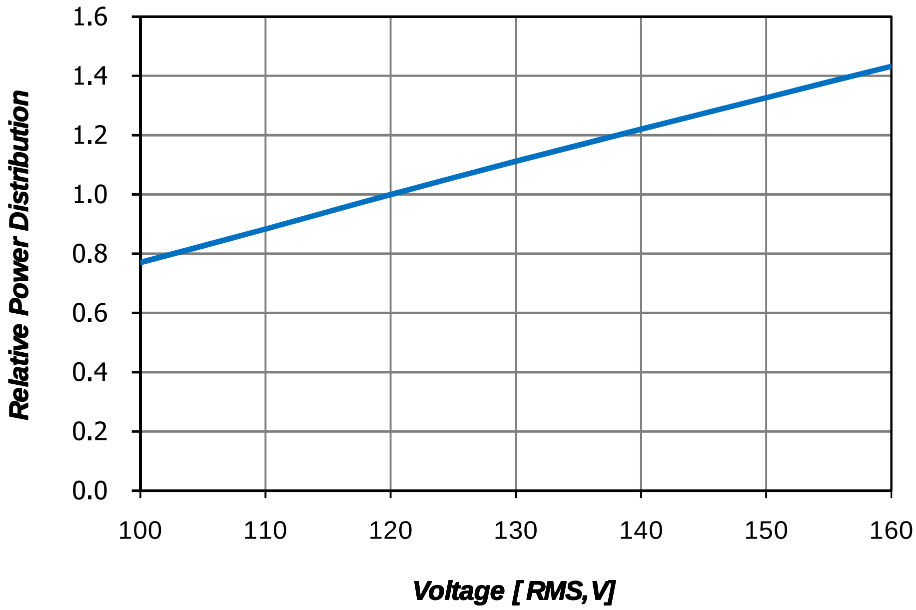


Fig 2-2. Relative Power Distribution vs. Voltage at T_a =25℃, 120V



Relative Luminous Distribution

Fig 3-1. Relative Luminous Flux vs. Voltage at T_a =25℃, 230V

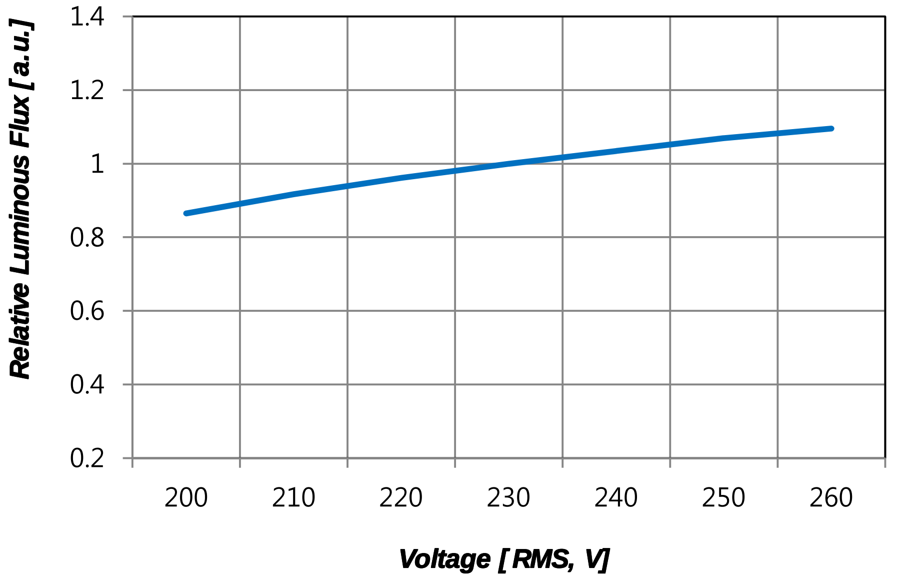
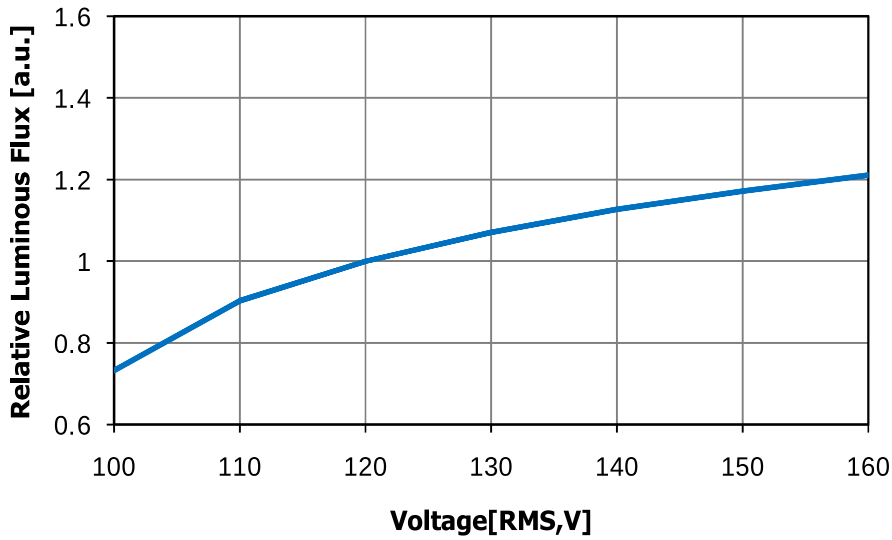
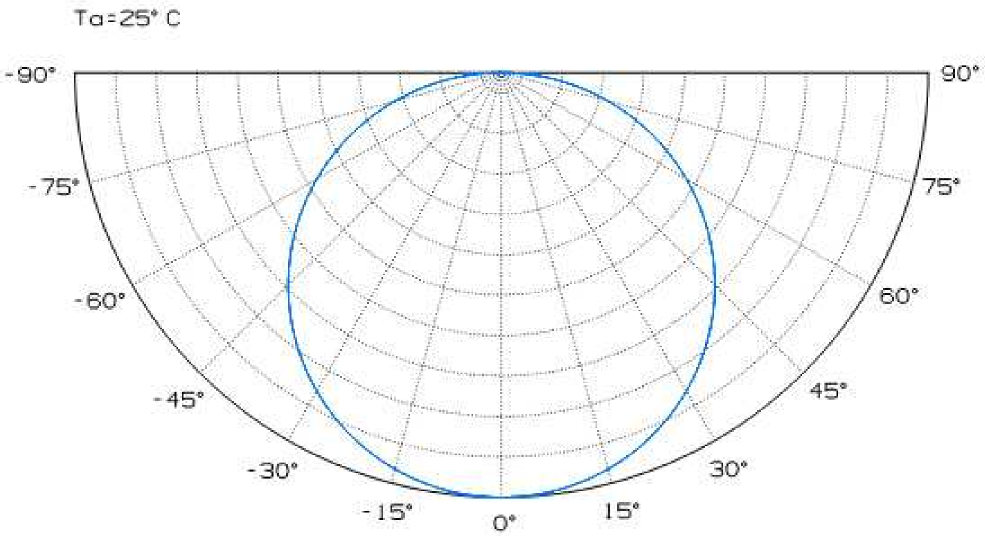


Fig 3-2. Relative Luminous Flux vs. Voltage at T_a =25℃, 120V



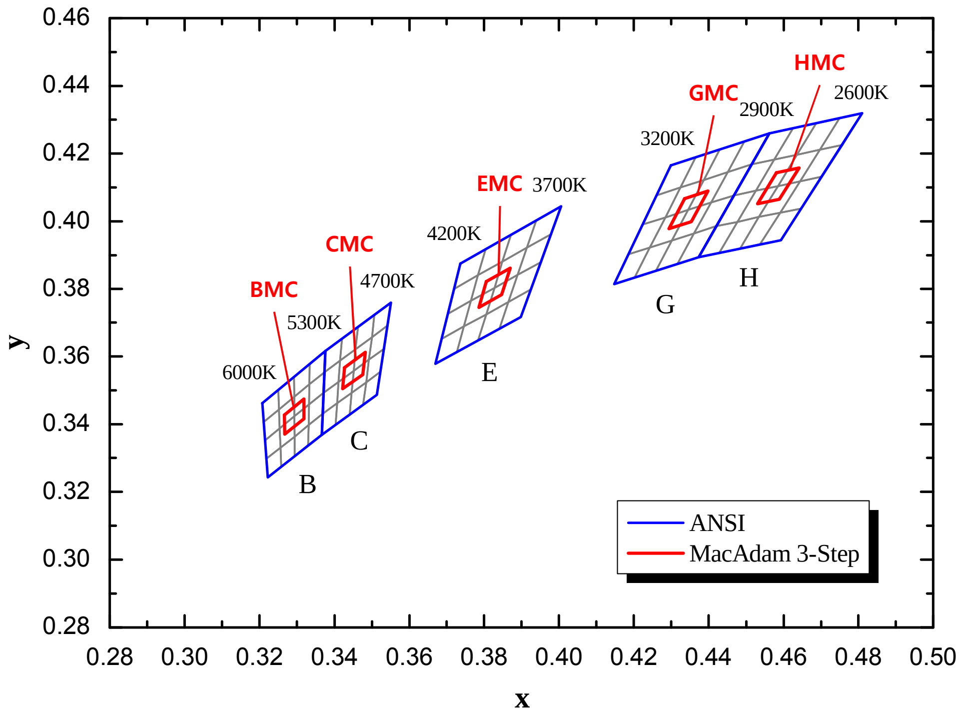
Luminous Flux Characteristics

Fig 4. Radiant Pattern, T_a =25℃



Color Bin Structure

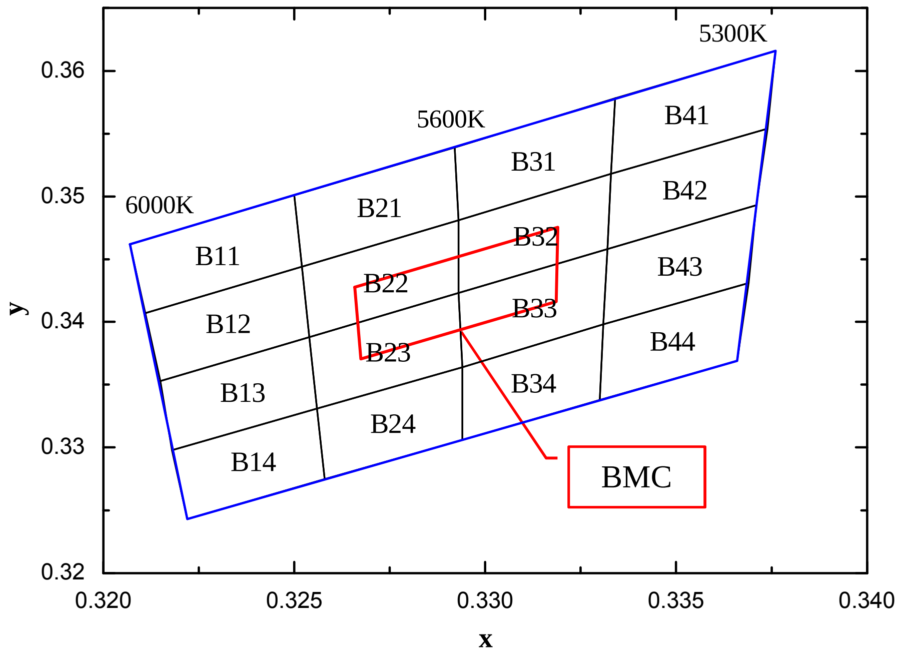
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y
BMC	0.3266	0.3428	CMC	0.3427	0.3568	EMC	0.3806	0.3822
	0.3268	0.3371		0.3423	0.3504		0.3786	0.3745
	0.3319	0.3416		0.3476	0.3547		0.3846	0.3782
	0.3319	0.3476		0.3482	0.3613		0.3870	0.3861
GMC	0.4336	0.4067	HMC	0.4581	0.4143			
	0.4294	0.3977		0.4531	0.4051			
	0.4354	0.3999		0.4589	0.4065			
	0.4398	0.4089		0.4641	0.4157			

Color Bin Structure

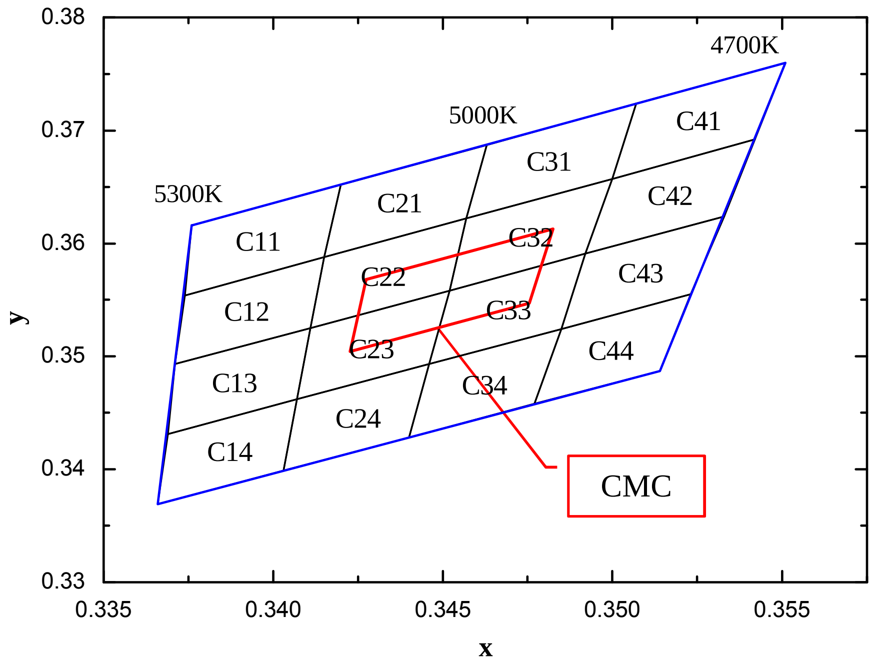
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
B11	0.3207	0.3462	B21	0.3250	0.3501	B31	0.3292	0.3539	B41	0.3334	0.3578
	0.3211	0.3407		0.3252	0.3444		0.3293	0.3481		0.3333	0.3518
	0.3252	0.3444		0.3293	0.3481		0.3333	0.3518		0.3374	0.3554
	0.3250	0.3501		0.3292	0.3539		0.3334	0.3578		0.3376	0.3616
B12	0.3211	0.3407	B22	0.3252	0.3444	B32	0.3293	0.3481	B42	0.3333	0.3518
	0.3215	0.3353		0.3254	0.3388		0.3293	0.3423		0.3332	0.3458
	0.3254	0.3388		0.3293	0.3423		0.3332	0.3458		0.3371	0.3493
	0.3252	0.3444		0.3293	0.3481		0.3333	0.3518		0.3374	0.3554
B13	0.3215	0.3353	B23	0.3254	0.3388	B33	0.3293	0.3423	B43	0.3332	0.3458
	0.3218	0.3298		0.3256	0.3331		0.3294	0.3364		0.3331	0.3398
	0.3256	0.3331		0.3294	0.3364		0.3331	0.3398		0.3369	0.3431
	0.3254	0.3388		0.3293	0.3423		0.3332	0.3458		0.3371	0.3493
B14	0.3218	0.3298	B24	0.3256	0.3331	B34	0.3294	0.3364	B44	0.3331	0.3398
	0.3222	0.3243		0.3258	0.3275		0.3294	0.3306		0.3330	0.3338
	0.3258	0.3275		0.3294	0.3306		0.3330	0.3338		0.3366	0.3369
	0.3256	0.3331		0.3294	0.3364		0.3331	0.3398		0.3369	0.3431

Color Bin Structure

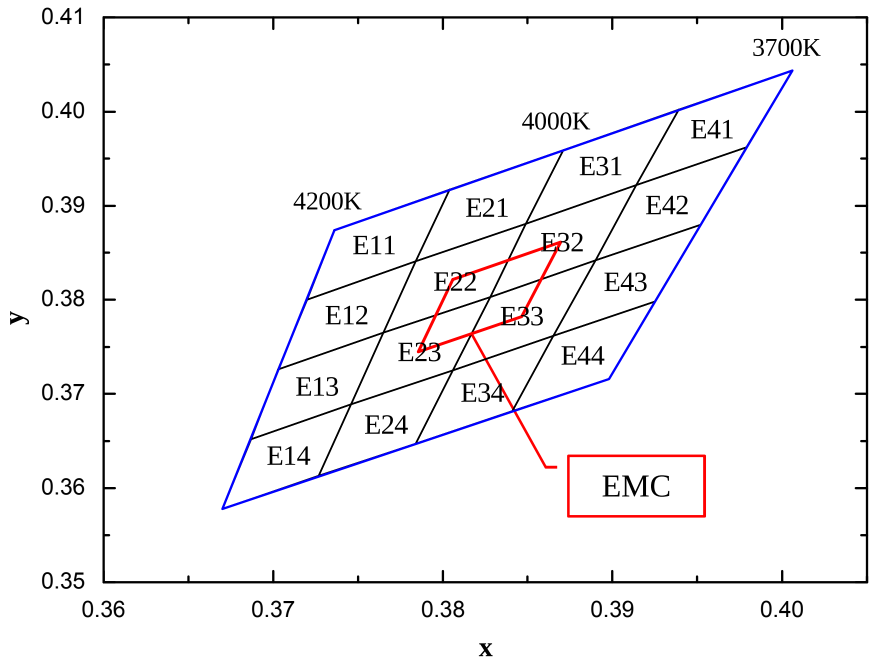
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
C11	0.3376	0.3616	C21	0.3420	0.3652	C31	0.3463	0.3687	C41	0.3507	0.3724
	0.3374	0.3554		0.3415	0.3588		0.3457	0.3622		0.3500	0.3657
	0.3415	0.3588		0.3457	0.3622		0.3500	0.3657		0.3542	0.3692
	0.3420	0.3652		0.3463	0.3687		0.3507	0.3724		0.3551	0.3760
C12	0.3374	0.3554	C22	0.3415	0.3588	C32	0.3457	0.3622	C42	0.3500	0.3657
	0.3371	0.3493		0.3411	0.3525		0.3452	0.3558		0.3492	0.3591
	0.3411	0.3525		0.3452	0.3558		0.3492	0.3591		0.3533	0.3624
	0.3415	0.3588		0.3457	0.3622		0.3500	0.3657		0.3542	0.3692
C13	0.3371	0.3493	C23	0.3411	0.3525	C33	0.3452	0.3558	C43	0.3492	0.3591
	0.3369	0.3431		0.3407	0.3462		0.3446	0.3493		0.3485	0.3524
	0.3407	0.3462		0.3446	0.3493		0.3485	0.3524		0.3523	0.3555
	0.3411	0.3525		0.3452	0.3558		0.3492	0.3591		0.3533	0.3624
C14	0.3369	0.3431	C24	0.3407	0.3462	C34	0.3446	0.3493	C44	0.3485	0.3524
	0.3366	0.3369		0.3403	0.3399		0.3440	0.3428		0.3477	0.3458
	0.3403	0.3399		0.3440	0.3428		0.3477	0.3458		0.3514	0.3487
	0.3407	0.3462		0.3446	0.3493		0.3485	0.3524		0.3523	0.3555

Color Bin Structure

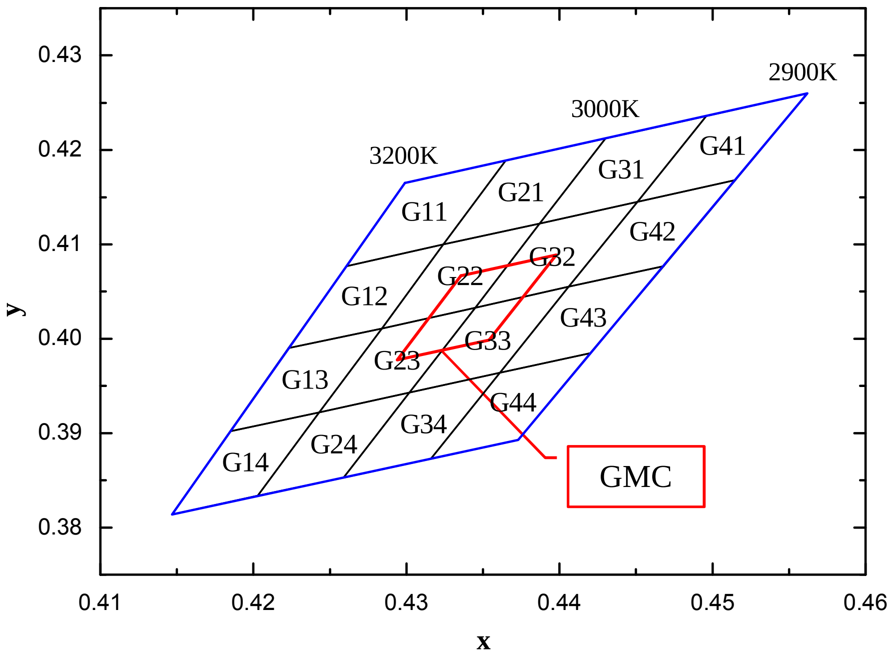
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
E11	0.3736	0.3874	E21	0.3804	0.3917	E31	0.3871	0.3959	E41	0.3939	0.4002
	0.3720	0.3800		0.3784	0.3841		0.3849	0.3881		0.3914	0.3922
	0.3784	0.3841		0.3849	0.3881		0.3914	0.3922		0.3979	0.3962
	0.3804	0.3917		0.3871	0.3959		0.3939	0.4002		0.4006	0.4044
E12	0.3720	0.3800	E22	0.3784	0.3841	E32	0.3849	0.3881	E42	0.3914	0.3922
	0.3703	0.3726		0.3765	0.3765		0.3828	0.3803		0.3890	0.3842
	0.3765	0.3765		0.3828	0.3803		0.3890	0.3842		0.3952	0.3880
	0.3784	0.3841		0.3849	0.3881		0.3914	0.3922		0.3979	0.3962
E13	0.3703	0.3726	E23	0.3765	0.3765	E33	0.3828	0.3803	E43	0.3890	0.3842
	0.3687	0.3652		0.3746	0.3689		0.3806	0.3725		0.3865	0.3762
	0.3746	0.3689		0.3806	0.3725		0.3865	0.3762		0.3925	0.3798
	0.3765	0.3765		0.3828	0.3803		0.3890	0.3842		0.3952	0.3880
E14	0.3687	0.3652	E24	0.3746	0.3689	E34	0.3806	0.3725	E44	0.3865	0.3762
	0.3670	0.3578		0.3727	0.3613		0.3784	0.3647		0.3841	0.3682
	0.3727	0.3613		0.3784	0.3647		0.3841	0.3682		0.3898	0.3716
	0.3746	0.3689		0.3806	0.3725		0.3865	0.3762		0.3925	0.3798

Color Bin Structure

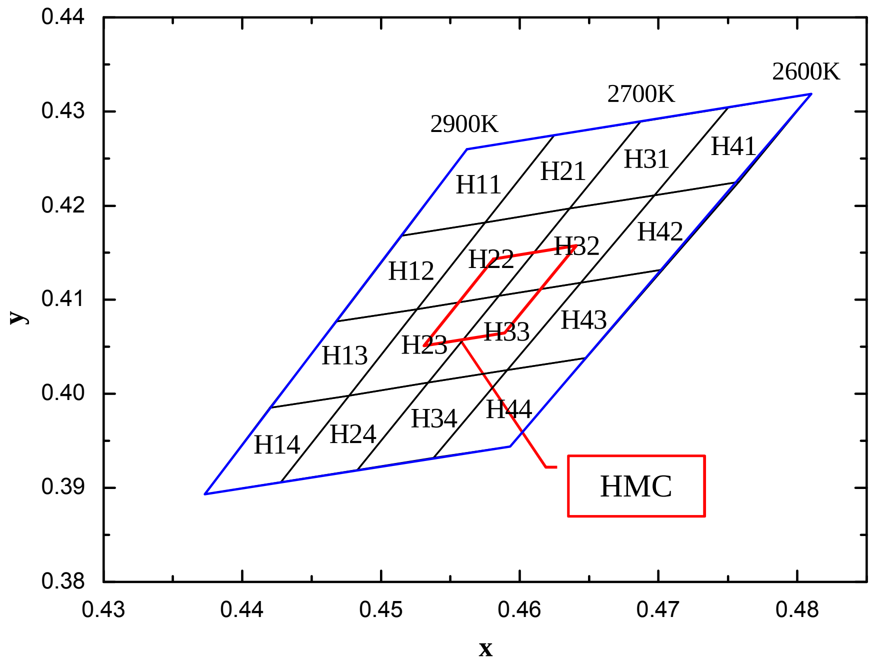
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
G11	0.4299	0.4165	G21	0.4364	0.4188	G31	0.4430	0.4212	G41	0.4496	0.4236
	0.4261	0.4077		0.4324	0.4099		0.4387	0.4122		0.4451	0.4145
	0.4324	0.4100		0.4387	0.4122		0.4451	0.4145		0.4514	0.4168
	0.4365	0.4189		0.4430	0.4212		0.4496	0.4236		0.4562	0.4260
G12	0.4261	0.4077	G22	0.4324	0.4100	G32	0.4387	0.4122	G42	0.4451	0.4145
	0.4223	0.3990		0.4284	0.4011		0.4345	0.4033		0.4406	0.4055
	0.4284	0.4011		0.4345	0.4033		0.4406	0.4055		0.4468	0.4077
	0.4324	0.4100		0.4387	0.4122		0.4451	0.4145		0.4515	0.4168
G13	0.4223	0.3990	G23	0.4284	0.4011	G33	0.4345	0.4033	G43	0.4406	0.4055
	0.4185	0.3902		0.4243	0.3922		0.4302	0.3943		0.4361	0.3964
	0.4243	0.3922		0.4302	0.3943		0.4361	0.3964		0.4420	0.3985
	0.4284	0.4011		0.4345	0.4033		0.4406	0.4055		0.4468	0.4077
G14	0.4243	0.3922	G24	0.4302	0.3943	G34	0.4302	0.3943	G44	0.4361	0.3964
	0.4203	0.3834		0.4259	0.3853		0.4259	0.3853		0.4316	0.3873
	0.4147	0.3814		0.4203	0.3834		0.4316	0.3873		0.4373	0.3893
	0.4185	0.3902		0.4243	0.3922		0.4361	0.3964		0.4420	0.3985

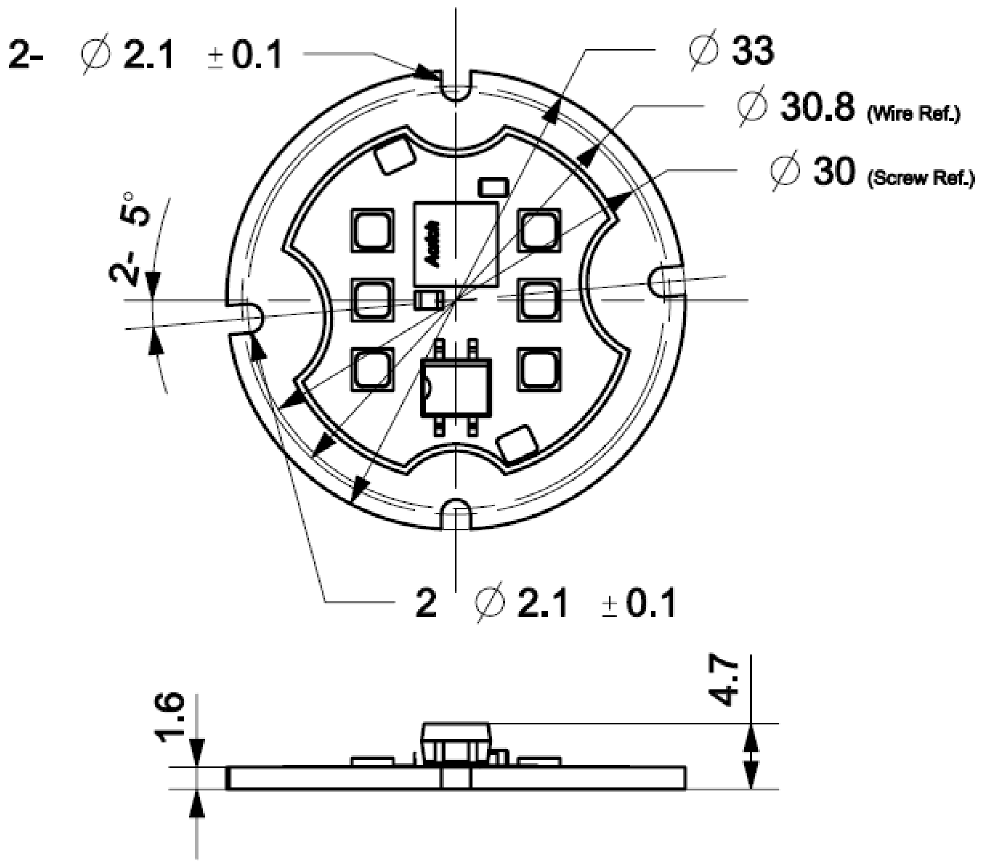
Color Bin Structure

CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
H11	0.4562	0.4260	H21	0.4625	0.4275	H31	0.4687	0.4289	H41	0.4750	0.4304
	0.4515	0.4168		0.4575	0.4182		0.4636	0.4197		0.4697	0.4211
	0.4575	0.4182		0.4636	0.4197		0.4697	0.4211		0.4758	0.4225
	0.4625	0.4275		0.4687	0.4289		0.4750	0.4304		0.4810	0.4319
H12	0.4515	0.4168	H22	0.4575	0.4182	H32	0.4636	0.4197	H42	0.4697	0.4211
	0.4468	0.4077		0.4526	0.4090		0.4585	0.4104		0.4644	0.4118
	0.4526	0.4090		0.4585	0.4104		0.4644	0.4118		0.4703	0.4132
	0.4575	0.4182		0.4636	0.4197		0.4697	0.4211		0.4758	0.4225
H13	0.4468	0.4077	H23	0.4526	0.4090	H33	0.4585	0.4104	H43	0.4644	0.4118
	0.4420	0.3985		0.4477	0.3998		0.4534	0.4012		0.4591	0.4025
	0.4477	0.3998		0.4534	0.4012		0.4591	0.4025		0.4648	0.4038
	0.4526	0.4090		0.4585	0.4104		0.4644	0.4118		0.4703	0.4132
H14	0.4420	0.3985	H24	0.4477	0.3998	H34	0.4534	0.4012	H44	0.4591	0.4025
	0.4373	0.3893		0.4428	0.3906		0.4483	0.3919		0.4538	0.3932
	0.4428	0.3906		0.4483	0.3919		0.4538	0.3932		0.4593	0.3944
	0.4477	0.3998		0.4534	0.4012		0.4591	0.4025		0.4648	0.4038

Mechanical Dimensions



Notes :

(1) All dimensions are in millimeters. (Tolerance : ± 0.2)
(2) Scale : None

Marking Information

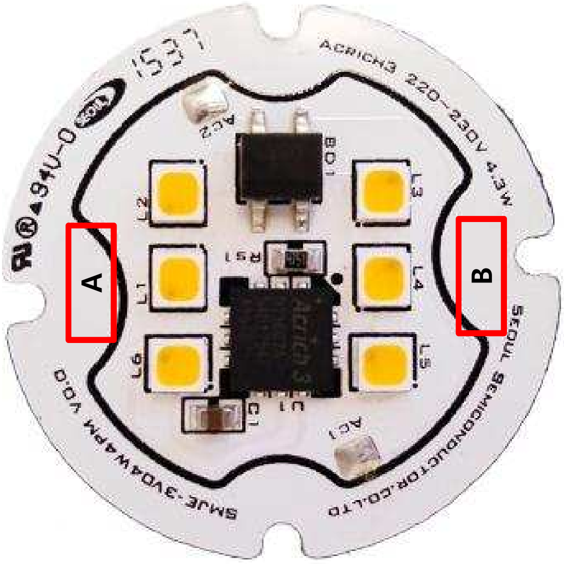


Fig 1. Marking point

A :	160510 A42E048ALL1	SMT Date (YYMMDD, 6 Digits) MP Information (10Digits) + Lot (1Digit)
B :	00001	Product Series Number (5 Digits)

Table 1. MP information

A38E048ALL

FLUX	BIN
0lm	A
1000lm	B
2000lm	C
3000lm	D
4000lm	E
5000lm	F
6000lm	G
7000lm	H
8000lm	I
9000lm	J
10000lm	K
11000lm	L
12000lm	M
13000lm	N
14000lm	O

CCT
A~H

BIN*
0A
03
04
MC

CRI**
7
8
9

VF
ALL

*

0A : All Bin
03 : Center 4bin Mixing(3-step)
04 : Center 4bin Mixing(4-step)
MC : BMC center1Bin(3-step)

**

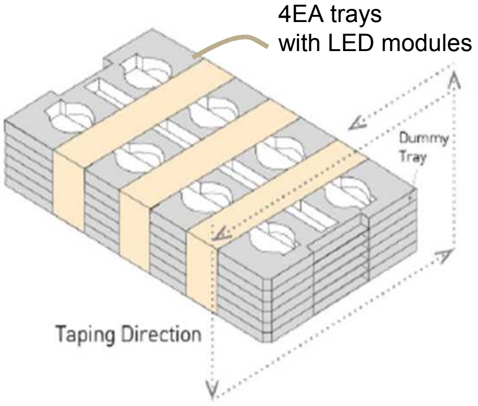
7 : CRI70
8 : CRI80
9 : CRI90

Packing

1. Tray information

• 60 PCS LED modules packed per tray

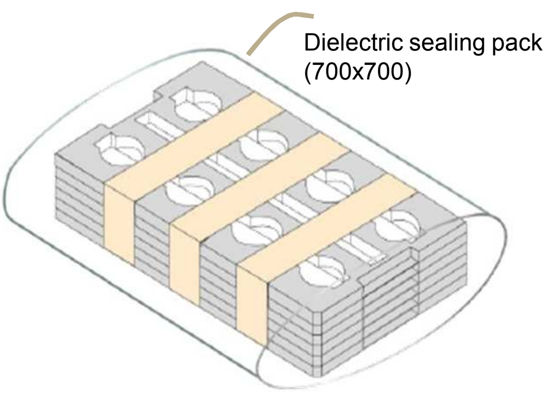
2. Tray stack and taping



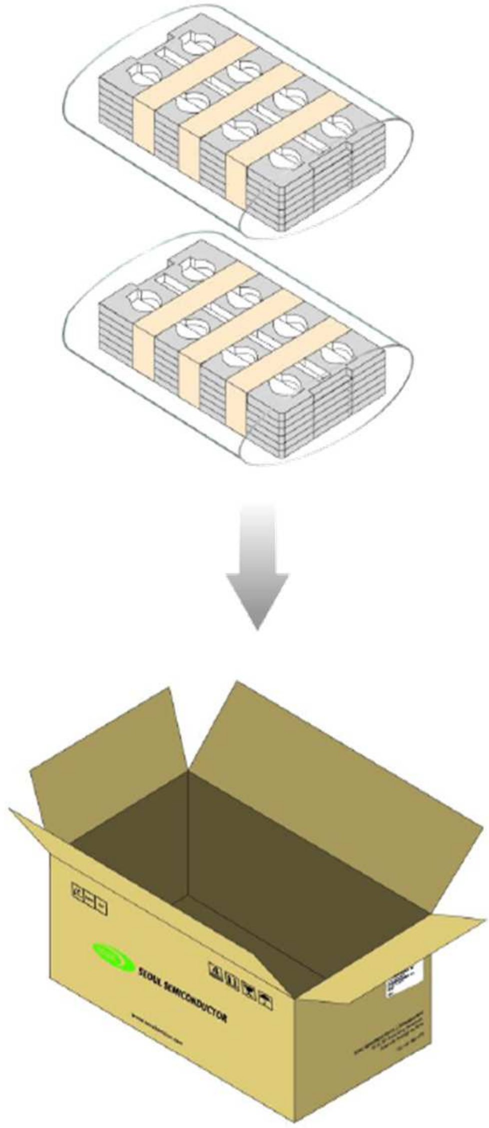
• 4 LED module trays and additional 2 dummy trays each up and down of box

• Add silica gel (1EA) on top of the tray

3. Sealing packing



4. Box information & packing



• 480 PCS modules per BOX 1EA

** 1 Box : 60 PCS per tray x 8 trays = 480 PCS

Label Information

Model No.	SMJE-XV04W4P# (1)
Rank	A38X038ALL (2)
Type	3-Step (3)
Quantity	XX
Lot No.	YYMMDDXXXXX-XXXXXXX
SEOUL	SEOUL SEMICONDUCTOR CO.,LTD.

Notes

(1) The model number designation is explained as follow
 SMJE : Seoul Semiconductor internal code
 XV : Input Voltage(2V = 120V, 3V = 230V)
 04W : Power Consumption
 4 : Acrich IC (Acrich3)
 P# : MJT PKG (PD:SAW8C72A / PE:SAW9C72A / PM:SAW8CF2A / PN:SAW9CF2A)

(2) It represents the LED module rank.
 A38 : Module Flux Bin(A29, A38)
 X : CCT (B,C,E,G,H)
 0X : Step (03, 04, 0A)
 8 : CRI (8 or 9)
 ALL : VF All

(3) It represents McAdam 4-Step(STD) or McAdam 3-Step(3-Step), All

(4) It is attached to the top of a sealing pack & the bottom right corner of the box.

TOTAL Quantity XX
SEOUL SEOUL SEMICONDUCTOR CO.,LTD.

Notes

(1) It is attached to the bottom right corner of the box.

Precaution for Use

(1) Please review the Acrich3 Application Note for proper protective circuitry usage.

(2) Please note, Acrich3 products run off of high voltage, therefore caution should be taken when working near Acrich3 products.

(3) Make sure proper discharge prior to starting work.

(4) DO NOT touch any of the circuit board, components or terminals with body or metal while circuit is active.

(5) Please do not add or change wires while Acrich3 circuit is active.

(6) Long time exposure to sunlight or UV can cause the lens to discolor.

(7) Please do not use adhesives to attach the LED that outgas organic vapor.

(8) Please do not use together with the materials containing Sulfur.

(9) Please do not assemble in conditions of high moisture and/or oxidizing gas such as Cl, H_2S, NH_3, SO_2, NO_x, etc.

(10) Please do not make any modification on module.

(11) Please be cautious when soldering to board so as not to create a short between different trace patterns.

(12) Do not impact or place pressure on this product because even a small amount of pressure can damage the product. The product should also not be placed in high temperatures, high humidity or direct sunlight since the device is sensitive to these conditions.

(13) When storing devices for a long period of time before usage, please following these guidelines:
* The devices should be stored in the anti-static bag that it was shipped in from Seoul-Semiconductor with opening.
* If the anti-static bag has been opened, re-seal preventing air and moisture from being present in the bag.

(14) LEDs and IC are sensitive to Electro-Static Discharge (ESD) and Electrical Over Stress (EOS). The Acrich3 product should also not be installed in end equipment without ESD protection. Below is a list of suggestions that Seoul Semiconductor purposes to minimize these effects.

a. ESD (Electro Static Discharge)

Electrostatic discharge (ESD) is the defined as the release of static electricity when two objects come into contact. While most ESD events are considered harmless, it can be an expensive problem in many industrial environments during production and storage. The damage from ESD to an LEDs may cause the product to demonstrate unusual characteristics such as:

Precaution for Use

- Increase in reverse leakage current lowered turn-on voltage
- Abnormal emissions from the LED at low current

The following recommendations are suggested to help minimize the potential for an ESD event.
One or more recommended work area suggestions:

- Ionizing fan setup
- ESD table/shelf mat made of conductive materials
- ESD safe storage containers

One or more personnel suggestion options:
- Antistatic wrist-strap
- Antistatic material shoes
- Antistatic clothes

Environmental controls:
- Humidity control (ESD gets worse in a dry environment)

b. EOS (Electrical Over Stress)

Electrical Over-Stress (EOS) is defined as damage that may occur when an electronic device is subjected to a current or voltage that is beyond the maximum specification limits of the device.
The effects from an EOS event can be noticed through product performance like:

- Changes to the performance of the LED package
  (If the damage is around the bond pad area and since the package is completely encapsulated the package may turn on but flicker show severe performance degradation.)
- Changes to the light output of the luminaire from component failure
- Components on the board not operating at determined drive power

Failure of performance from entire fixture due to changes in circuit voltage and current across total circuit causing trickle down failures. It is impossible to predict the failure mode of every LED exposed to electrical overstress as the failure modes have been investigated to vary, but there are some common signs that will indicate an EOS event has occurred:

- Damaged may be noticed to the bond wires (appearing similar to a blown fuse)
- Damage to the bond pads located on the emission surface of the LED package
  (shadowing can be noticed around the bond pads while viewing through a microscope)
- Anomalies noticed in the encapsulation and phosphor around the bond wires
- This damage usually appears due to the thermal stress produced during the EOS event

c. To help minimize the damage from an EOS event Seoul Semiconductor recommends utilizing:

- A surge protection circuit
- An appropriately rated over voltage protection device
- A current limiting device

Company Information

Published by

Company Information

Seoul Semiconductor (www.SeoulSemicon.com) manufacturers and packages a wide selection of light emitting diodes (LEDs) for the automotive, general illumination/lighting, Home appliance, signage and back lighting markets. The company is the world’s fifth largest LED supplier, holding more than 10,000 patents globally, while offering a wide range of LED technology and production capacity in areas such as “nPola”, "Acrich", the world’s first commercially produced AC LED, and "Acrich MJT - Multi-Junction Technology" a proprietary family of high-voltage LEDs.

The company’s broad product portfolio includes a wide array of package and device choices such as Acrich and Acirch2, high-brightness LEDs, mid-power LEDs, side-view LEDs, and through-hole type LEDs as well as custom modules, displays, and sensors.

Legal Disclaimer

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