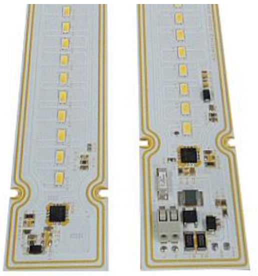
Integrated AC LED Solution

Acrich3 – 22W

SMJL-3P22W4P3



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 Acrich 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
- DOB Type (Driver On Board)
- Power Compensation
- ADIM (Analog Dimming Mode)
- High Power Factor
- Low THD
- Long Life Time
- Simple BOM
- Miniaturization
- Lead Free Product
- RoHS Compliant

Key Applications

- High Bay
- Troffer

Table 1. Product Selection

Part No.	Vin [Vac]	P [W]	Color	CCT [K]	CRI Min.
SMJL-3P22W4P3	230	21.7	Cool	4700 – 7000	80
			Neutral	3700 – 4700	
			Warm	2600 – 3700	

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Performance Characteristics

Table 2. Electro Optical Characteristics, T_a = 25ºC

Parameter	Symbol	Value			Unit	Mark
		Min.	Typ.	Max.		
Luminous Flux [1]	Φ_V	2350	2600	-	lm	Cool Neutral
		2250	2500	-		Warm
Correlated Color Temperature [2]	CCT	6000	6500	7000	K	A
		5300	5600	6000		B
		4700	5000	5300		C
		4200	4500	4700		D
		3700	4000	4200		E
		3200	3500	3700		F
		2900	3000	3200		G
		2600	2700	2900		H
CRI	Ra	80	-	-	-	
Input Voltage [3]	V_{in}		230		Vac	3P
Power Consumption	P	19.5	21.7	23.9	W	22
Operating Frequency	f		50 / 60		Hz	
Power Factor	PF		Over 0.97		-	
Viewing Angle	$2\Theta_{1/2}$		120		deg.	
Tolerance of Surge [4]	V_s	500	-	-	V	

Notes :

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

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

(3) 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℃.

(4) Surge withstand in accordance with IEC61000-4-5.(Line to Line)

Performance Characteristics

Table 3. Absolute Maximum Ratings, T_a = 25ºC

Parameter	Symbol	Unit	Value
Maximum Input Voltage	V_{in}	Vac	276
Power Consumption	P	W	29
Operating Temperature	T_{opr}	ºC	-30 ~ 85
Storage Temperature	T_{stg}	ºC	-40 ~ 100
ESD Sensitivity	-	-	±4,000V HBM

Thermal Resistance

Part	Package Power Dissipation [W]	Maximum Junction Temperature [℃]	$R\theta_{j-s}$ [℃/W]
MJT5630-7C	SAW8KG0B Max 0.58	125	27

The MJT5630-7C has a thermal resistance of 27℃/W from junction of the LED to the LED lead.

The maximum junction temperature of the MJT5630 is 125℃, therefore the maximum lead temperature T_{s_max} is

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

$= 125℃ - (27℃/W * 0.58W) = 109.34℃$

Although this is the maximum lead temperature, it is recommended to keep the lead temperature under 70℃.

Characteristic Graph

Fig 1. Relative Spectral Distribution vs. Wavelength Characteristic – Warm White

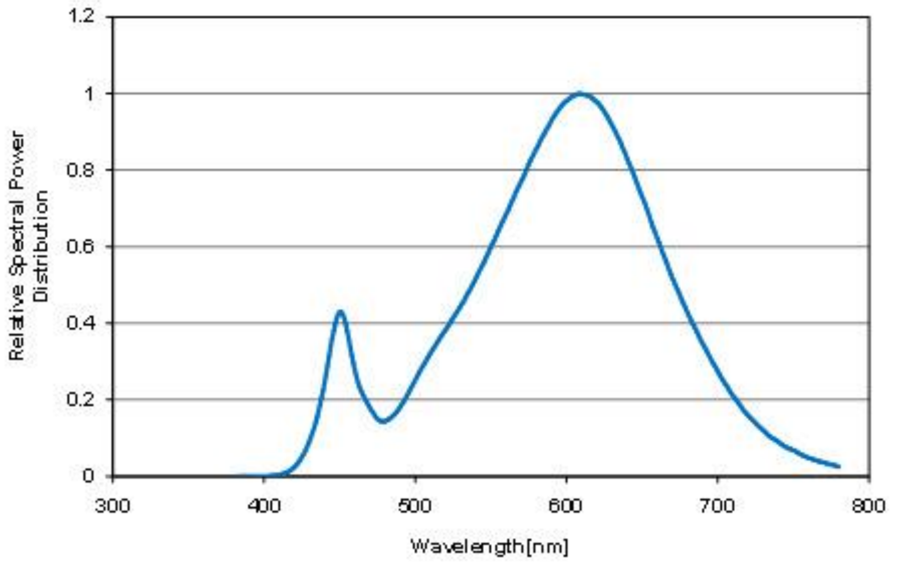
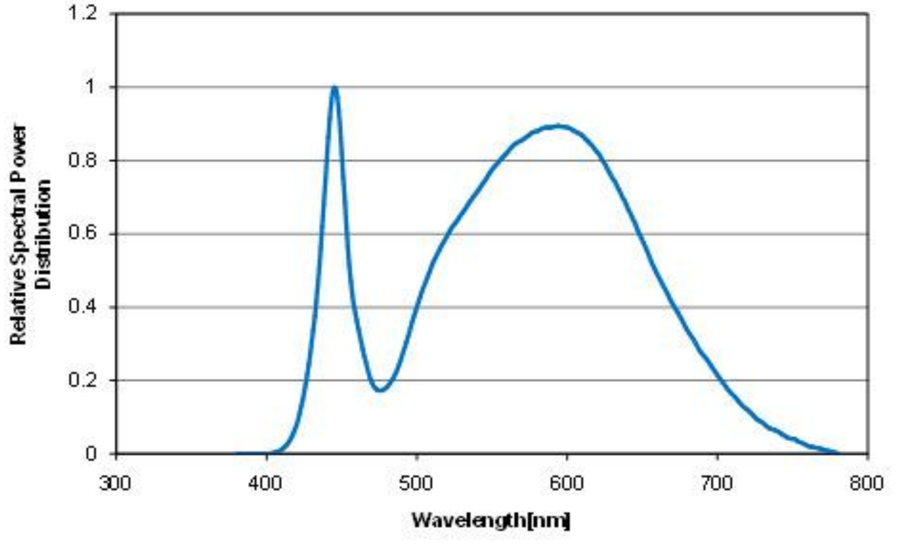
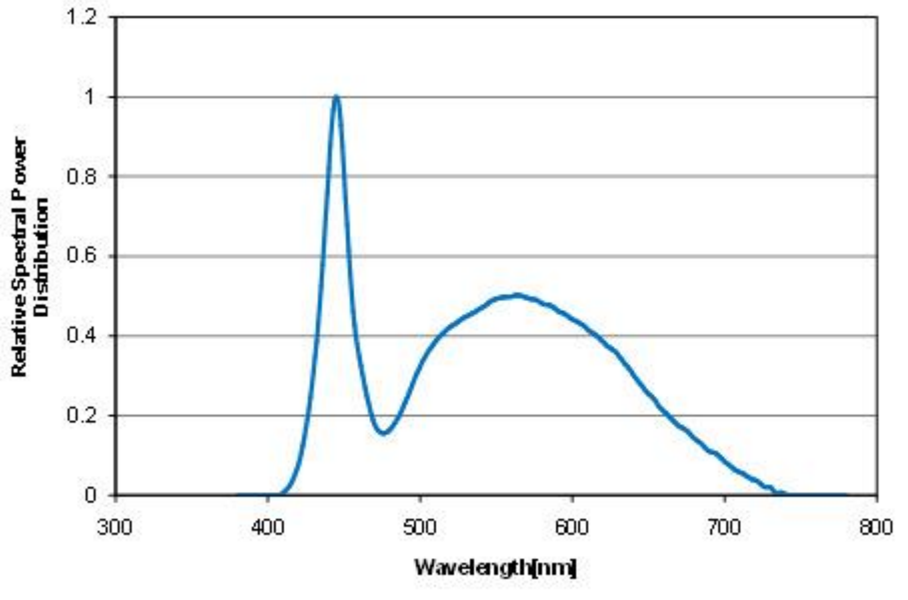


Fig 2. Relative Spectral Distribution vs. Wavelength Characteristic – Neutral White



Characteristic Graph

Fig 3. Relative Spectral Distribution vs. Wavelength Characteristic – Cool White



Characteristic Graph

Fig 4. Relative Power Variation vs. Voltage, T_a=25℃, 230V

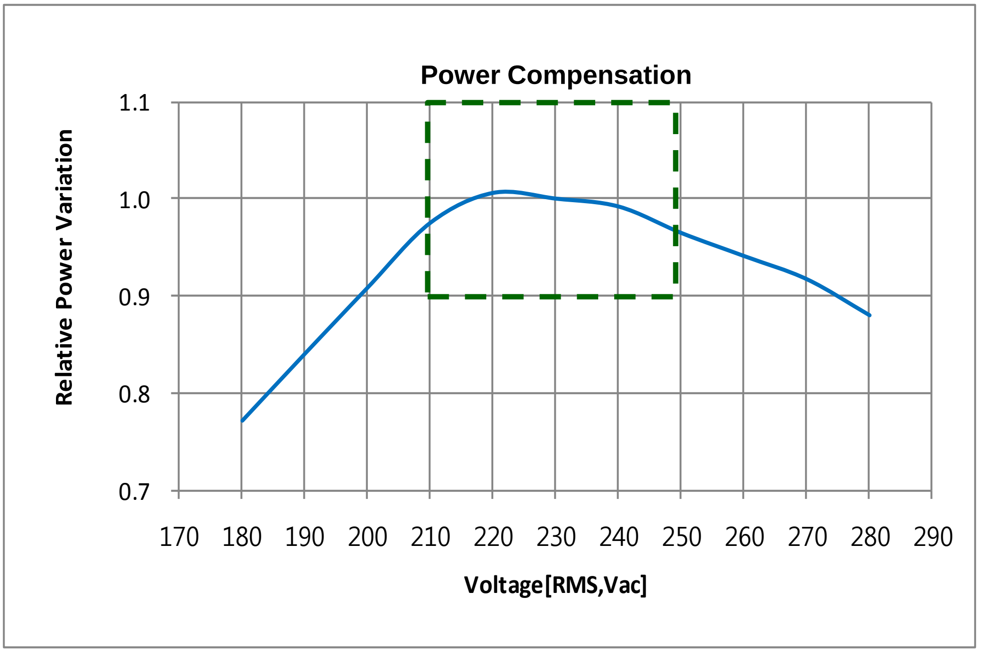
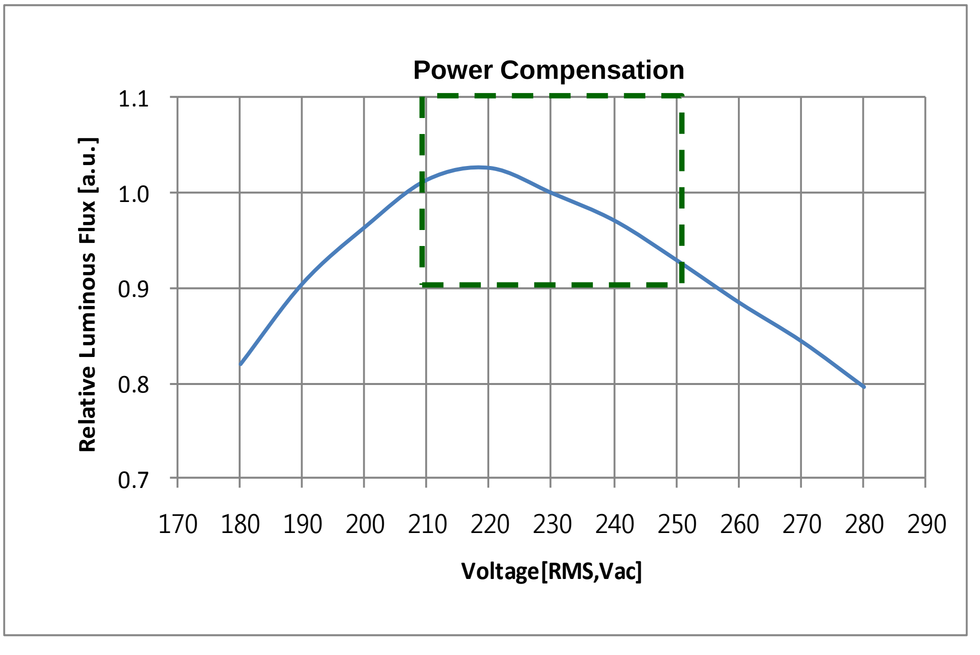
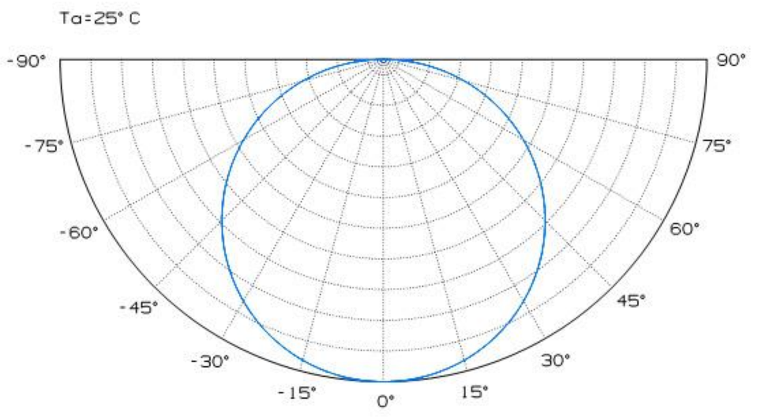


Fig 5. Relative Luminous Flux vs. Voltage, T_a=25℃, 230V



Characteristic Graph

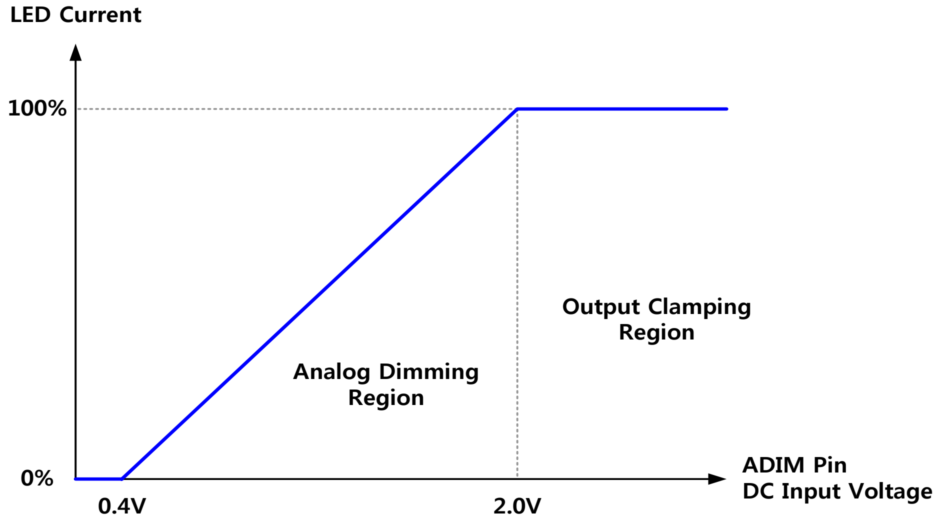
Fig 6. Radiant Pattern, T_a =25℃



Analog Dimming Mode

■ Operation

The LED brightness can be adjusted by applying DC voltage to ADIM pin. When 0.40V< ADIM pin voltage <2.0V, Acrich3.0 operates in positive polarity mode as shown below figure. When the ADIM DC voltage becomes over 2.0V, the LED brightness is clamped at their maximum flux. When ADIM DC voltage is decreased to 0.40V, LED current becomes off.



■ External Resistor Setting – For Example

The V_{ADIM} voltage is set using a resistive voltage divider from the V_{DIM_IN} to ADIM pin. The recommended R_{ADIM1} resistor at 10kΩ. Calculate the R_{ADIM2} resistor using the following equation.

$$R_{ADIM2} = \frac{R_{ADIM1} \times V_{ADIM}}{V_{DIM\_IN} - V_{ADIM}}$$

Assumptions for the purposes of this example, the following are given as the application requirements:

- V_{DIM_IN} : External dimming voltage signals (0V : Min, 10V : Max)
- R_{ADIM1} : 10kΩ (Recommended value[1])
- V_{ADIM} : 2V (Constant value[2])

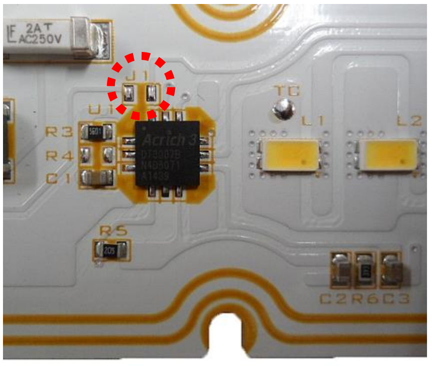
$$R_{ADIM2} = \frac{R_{ADIM1} \times V_{ADIM}}{V_{DIM\_IN} - V_{ADIM}} = \frac{10K\Omega \times 2V}{10V - 2V} = 2.5K\Omega$$

Notes :

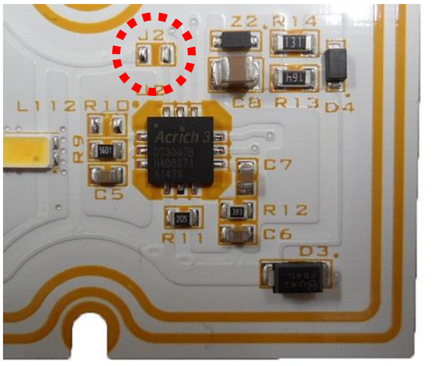
[1] Considering the power consumption of the IC, set the resistance value.

[2] When the Acrich3.0 V_{ADIM} Pin level is 2V, the LED Flux reaches the 100%.

Analog Dimming Mode



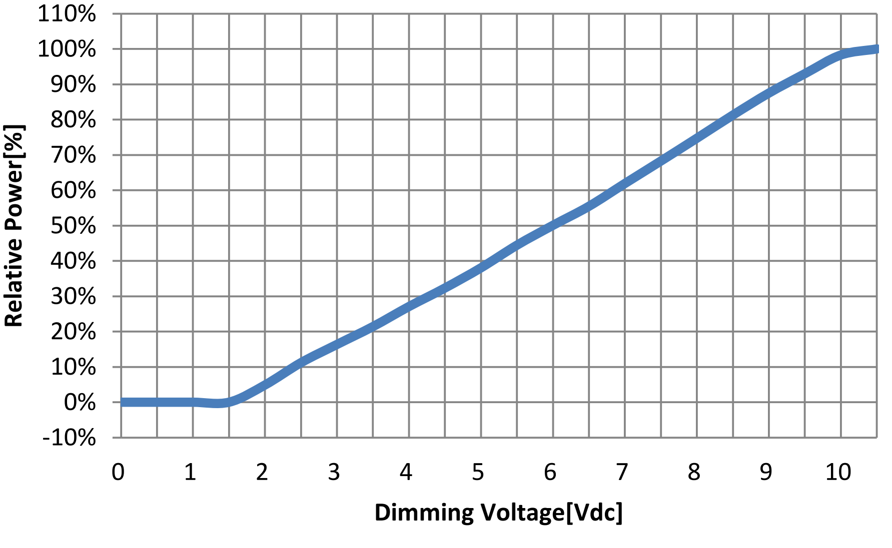
<J1 on A-Bar>



<J2 on B-Bar>

*Note : Soldering Jumper point, both J1 and J2, need to be soldered for operating Analog Dimming Mode

Fig 7. Relative Power Variation vs. Duty Ratio at T_a =25℃, 230V(Analog Dimming)

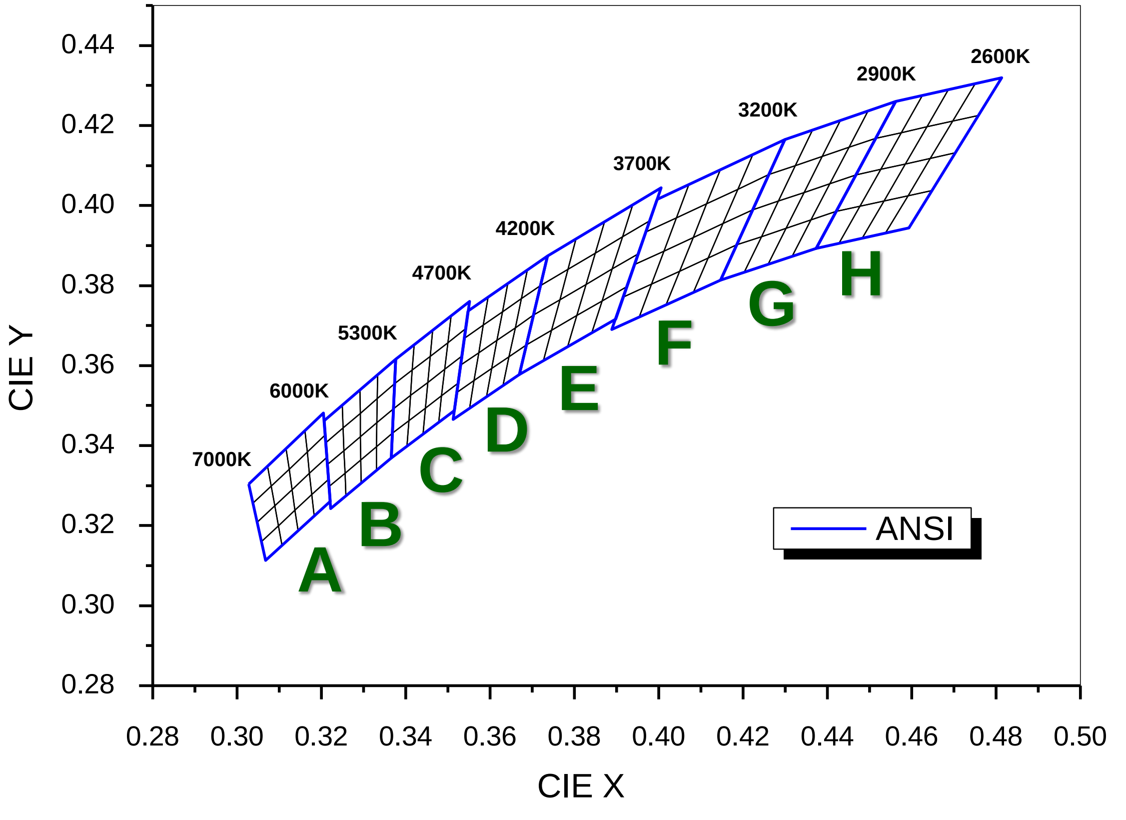


Notes :

Analog Dimming Condition : Input Dimming Voltage 0-10Vdc

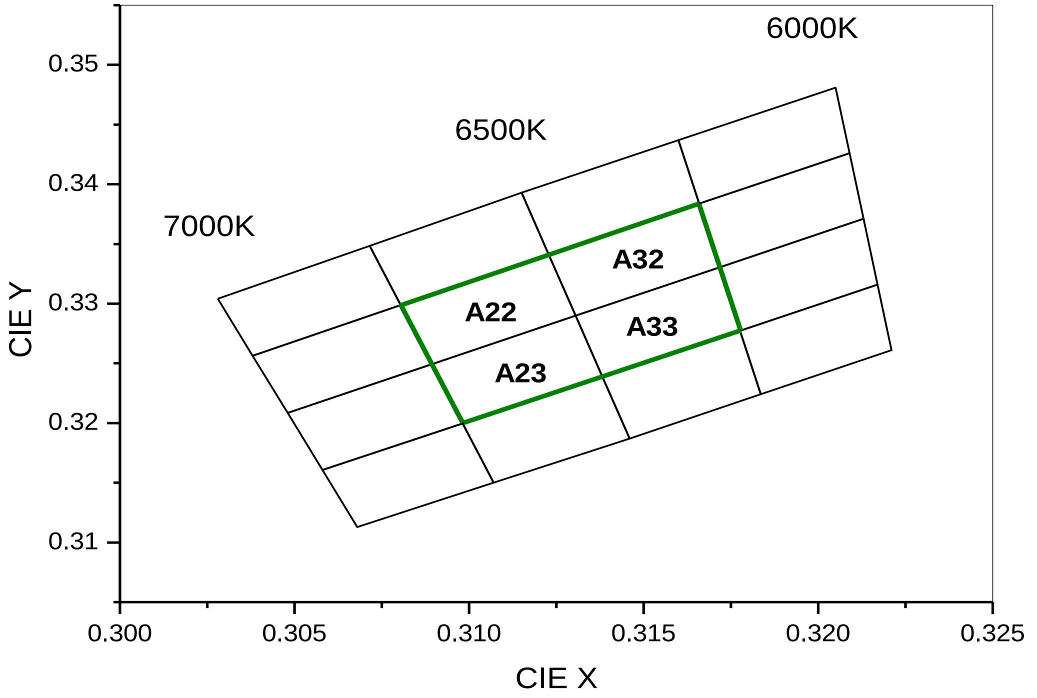
Color Bin Structure

CIE Chromaticity Diagram



Color Bin Structure

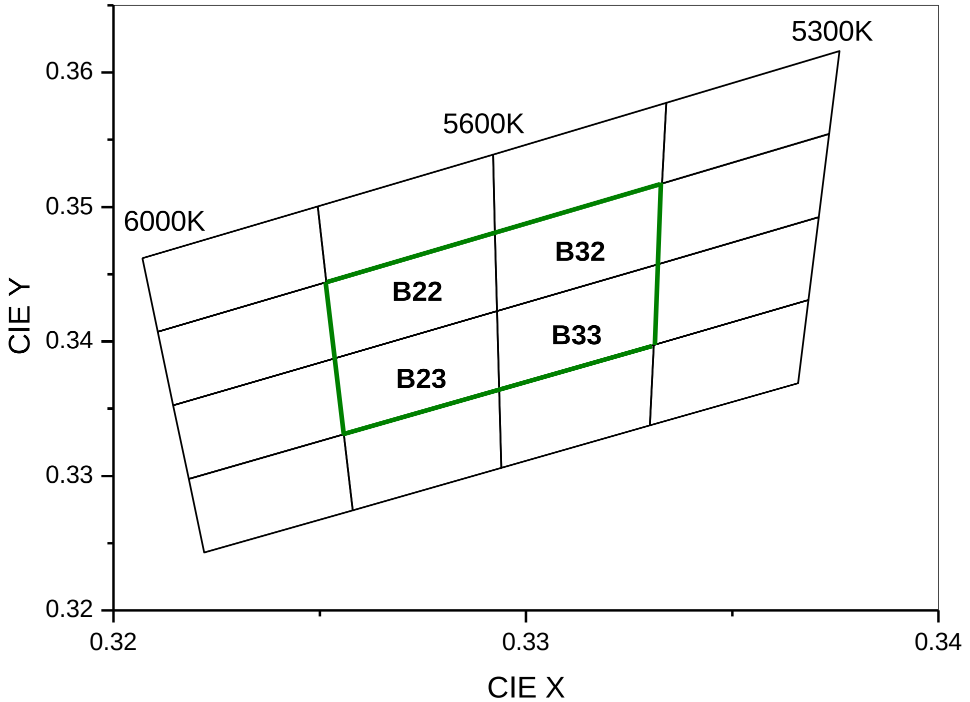
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
A22	0.3080	0.3299	**A23**	0.3089	0.3249	**A33**	0.3131	0.3290	**A32**	0.3123	0.3342
	0.3089	0.3249		0.3098	0.3200		0.3138	0.3239		0.3131	0.3290
	0.3131	0.3290		0.3138	0.3239		0.3178	0.3277		0.3172	0.3331
	0.3123	0.3342		0.3131	0.3290		0.3172	0.3331		0.3166	0.3384

Color Bin Structure

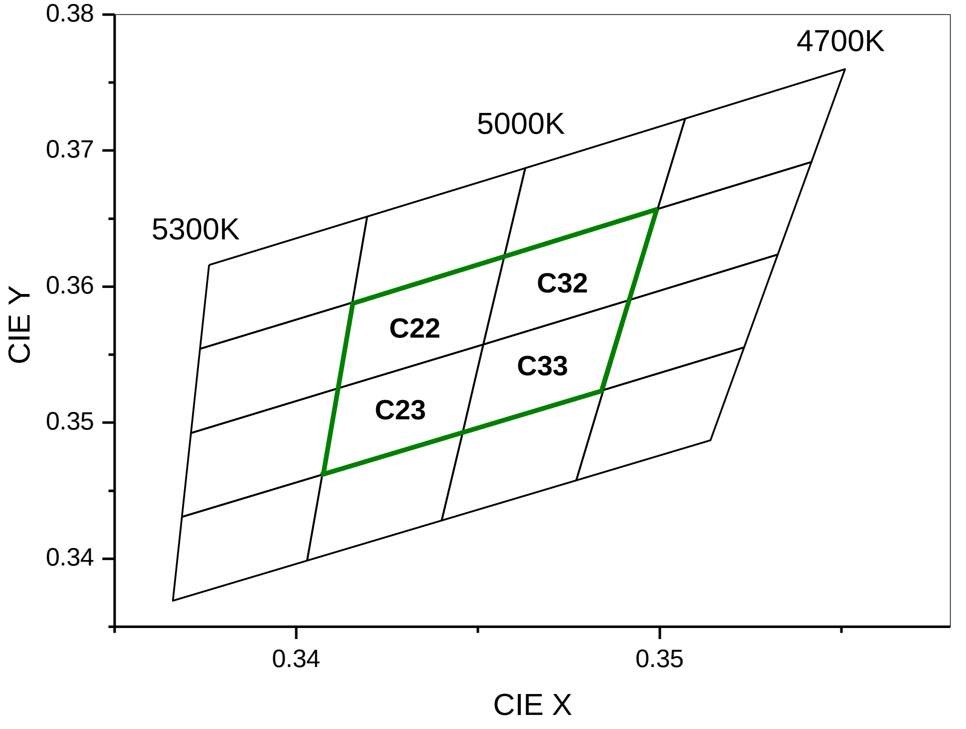
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
B22	0.3252	0.3444	**B23**	0.3254	0.3388	**B33**	0.3293	0.3423	**B32**	0.3293	0.3481
	0.3254	0.3388		0.3256	0.3331		0.3294	0.3364		0.3293	0.3423
	0.3293	0.3423		0.3294	0.3364		0.3331	0.3398		0.3332	0.3458
	0.3293	0.3481		0.3293	0.3423		0.3332	0.3458		0.3333	0.3518

Color Bin Structure

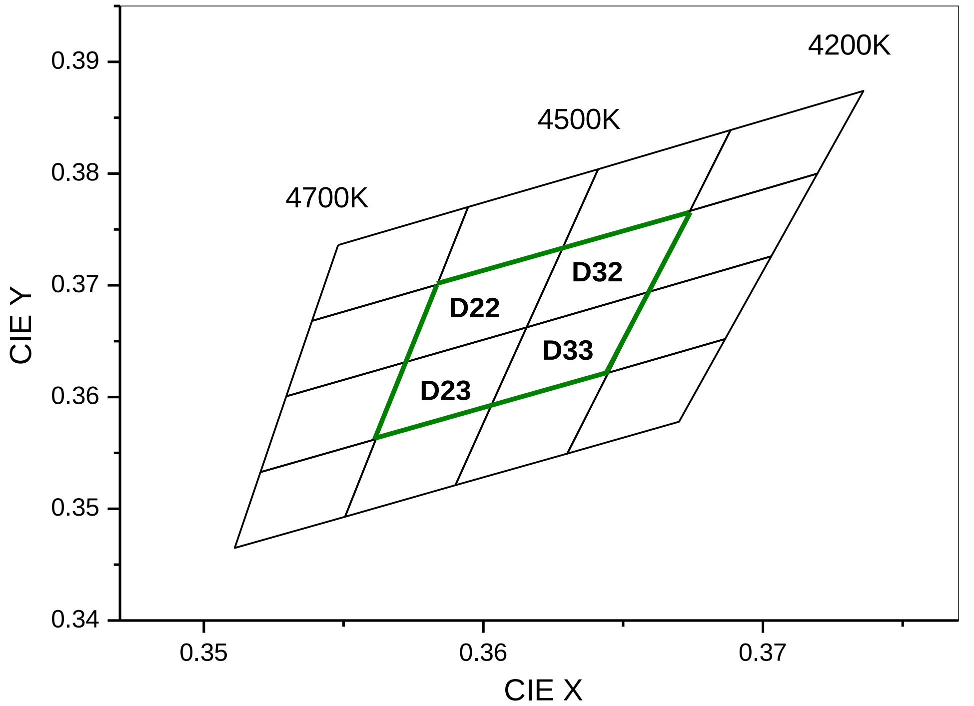
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
C22	0.3415	0.3588	C23	0.3411	0.3525	C33	0.3452	0.3558	C32	0.3457	0.3622
	0.3411	0.3525		0.3407	0.3462		0.3446	0.3493		0.3452	0.3558
	0.3452	0.3558		0.3446	0.3493		0.3485	0.3524		0.3492	0.3591
	0.3457	0.3622		0.3452	0.3558		0.3492	0.3591		0.3500	0.3657

Color Bin Structure

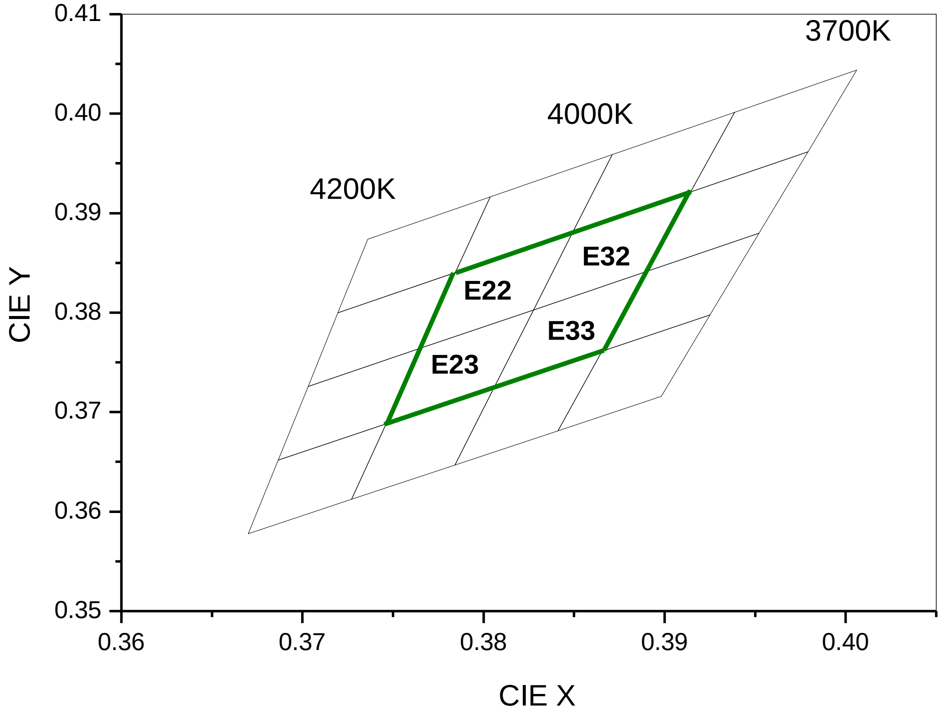
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
D22	0.3584	0.3701	D23	0.3573	0.3632	D32	0.3628	0.3733	D33	0.3616	0.3663
	0.3573	0.3632		0.3562	0.3562		0.3616	0.3663		0.3603	0.3592
	0.3616	0.3663		0.3603	0.3592		0.3659	0.3694		0.3645	0.3622
	0.3628	0.3733		0.3616	0.3663		0.3674	0.3767		0.3659	0.3694

Color Bin Structure

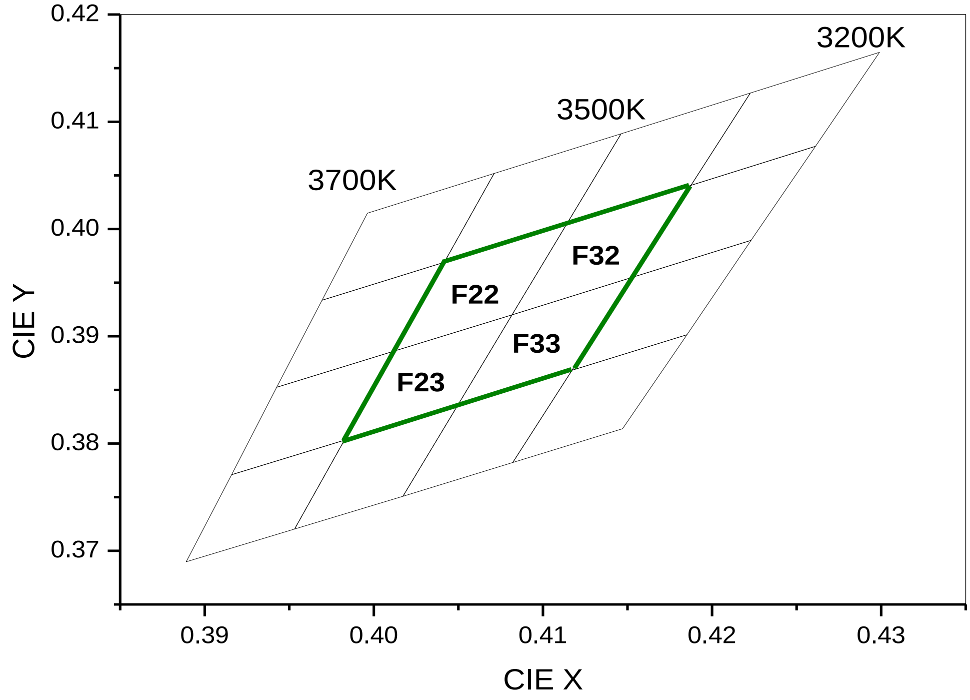
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
E22	0.3784	0.3841	E23	0.3765	0.3765	E33	0.3828	0.3803	E32	0.3849	0.3881
	0.3765	0.3765		0.3746	0.3689		0.3806	0.3725		0.3828	0.3803
	0.3828	0.3803		0.3806	0.3725		0.3865	0.3762		0.3890	0.3842
	0.3849	0.3881		0.3828	0.3803		0.3890	0.3842		0.3914	0.3922

Color Bin Structure

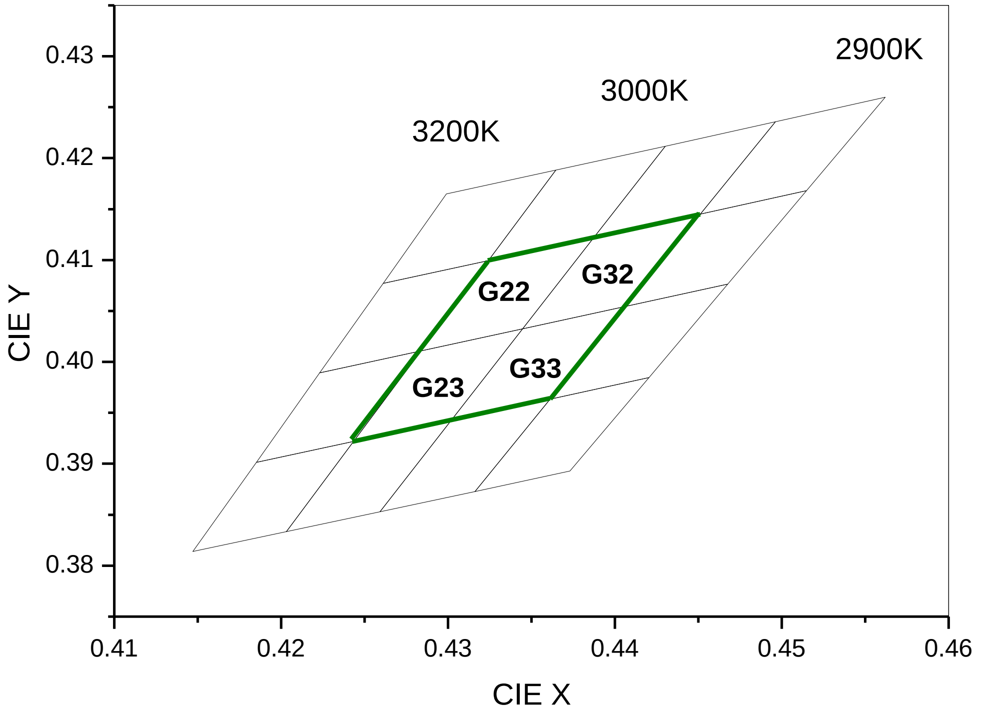
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
F22	0.4042	0.3969	F23	0.4012	0.3886	F33	0.4082	0.3920	F32	0.4114	0.4005
	0.4012	0.3886		0.3983	0.3803		0.4049	0.3836		0.4082	0.3920
	0.4082	0.3920		0.4049	0.3836		0.4117	0.3869		0.4152	0.3955
	0.4114	0.4005		0.4082	0.3920		0.4152	0.3955		0.4187	0.4041

Color Bin Structure

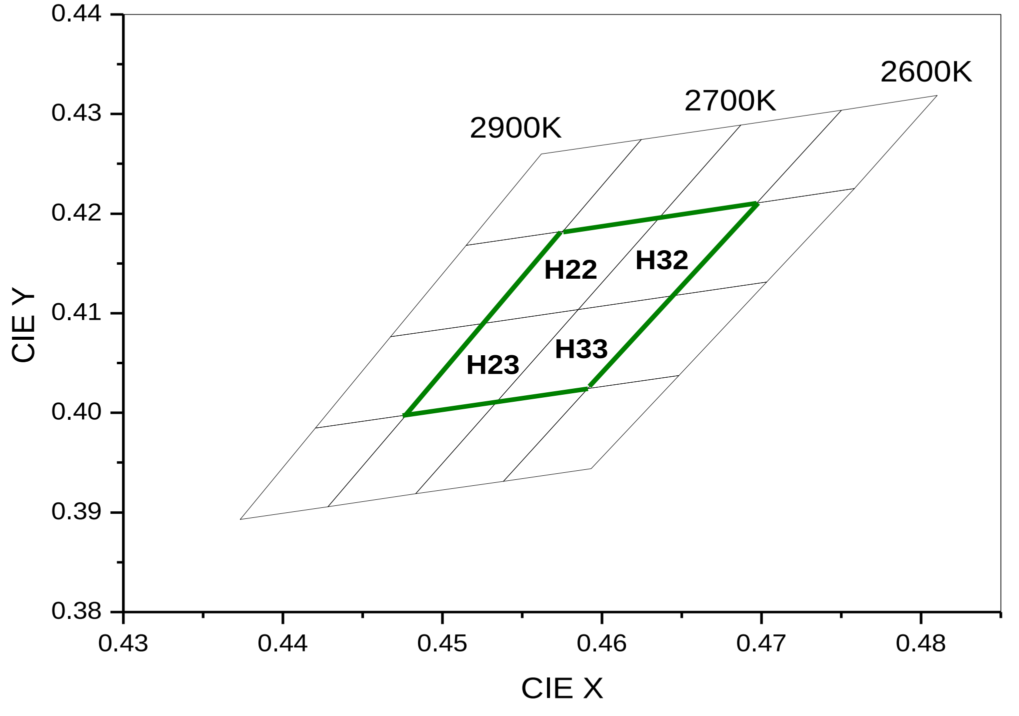
CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
G22	0.4324	0.4100	G23	0.4284	0.4011	G33	0.4345	0.4033	G32	0.4387	0.4122
	0.4284	0.4011		0.4243	0.3922		0.4302	0.3943		0.4345	0.4033
	0.4345	0.4033		0.4302	0.3943		0.4361	0.3964		0.4406	0.4055
	0.4387	0.4122		0.4345	0.4033		0.4406	0.4055		0.4451	0.4145

Color Bin Structure

CIE Chromaticity Diagram



Bin	x	y	Bin	x	y	Bin	x	y	Bin	x	y
H22	0.4575	0.4182	H23	0.4526	0.4090	H33	0.4585	0.4104	H32	0.4636	0.4197
	0.4526	0.4090		0.4477	0.3998		0.4534	0.4012		0.4585	0.4104
	0.4585	0.4104		0.4534	0.4012		0.4591	0.4025		0.4644	0.4118
	0.4636	0.4197		0.4585	0.4104		0.4644	0.4118		0.4697	0.4211

Part List

Table 4-1. Part List of Module A

No	Part	Reference	Specification	Quantity
1	PCB	-	FR-4 1.0T, Double side, White PSR, Size 570x39mm	1
2	LED	L1~56	SAW8KG0B(MJT5630-7C)	56
3	Acrich3.0 IC	U1	DT3007B	1
4	Fuse	F	250V 2A	1
5	MOV	V	391VAC	1
6	Bridge Diode	D1	600V 1A	1
7	TVS	Z1	440V, 600W, 5%, Unidirectional	1
8	Resistor	R1, R2	R6432 10Ω 5%(J)	2
9	Connector	CN1,CN2	Wago 2060-402	2
10		CN3	Wago 2060-401	1
11	Resistor	R3	R2012 5.6KΩ 1%(F)	1
12		R5	R2012 2MΩ 5%(J)	1
13		R6	R2012 39KΩ 5%(J)	1
14		R7	R2012 10KΩ 5%(J)	1
15		R8	R2012 2.4KΩ 5%(J)	1
16	MLCC	C1	C2012 100nF	1
17		C2, C3,C4	C2012 10uF	3

Notes :

The above specification is subject to change without further notice for the improvement of products.

Part List

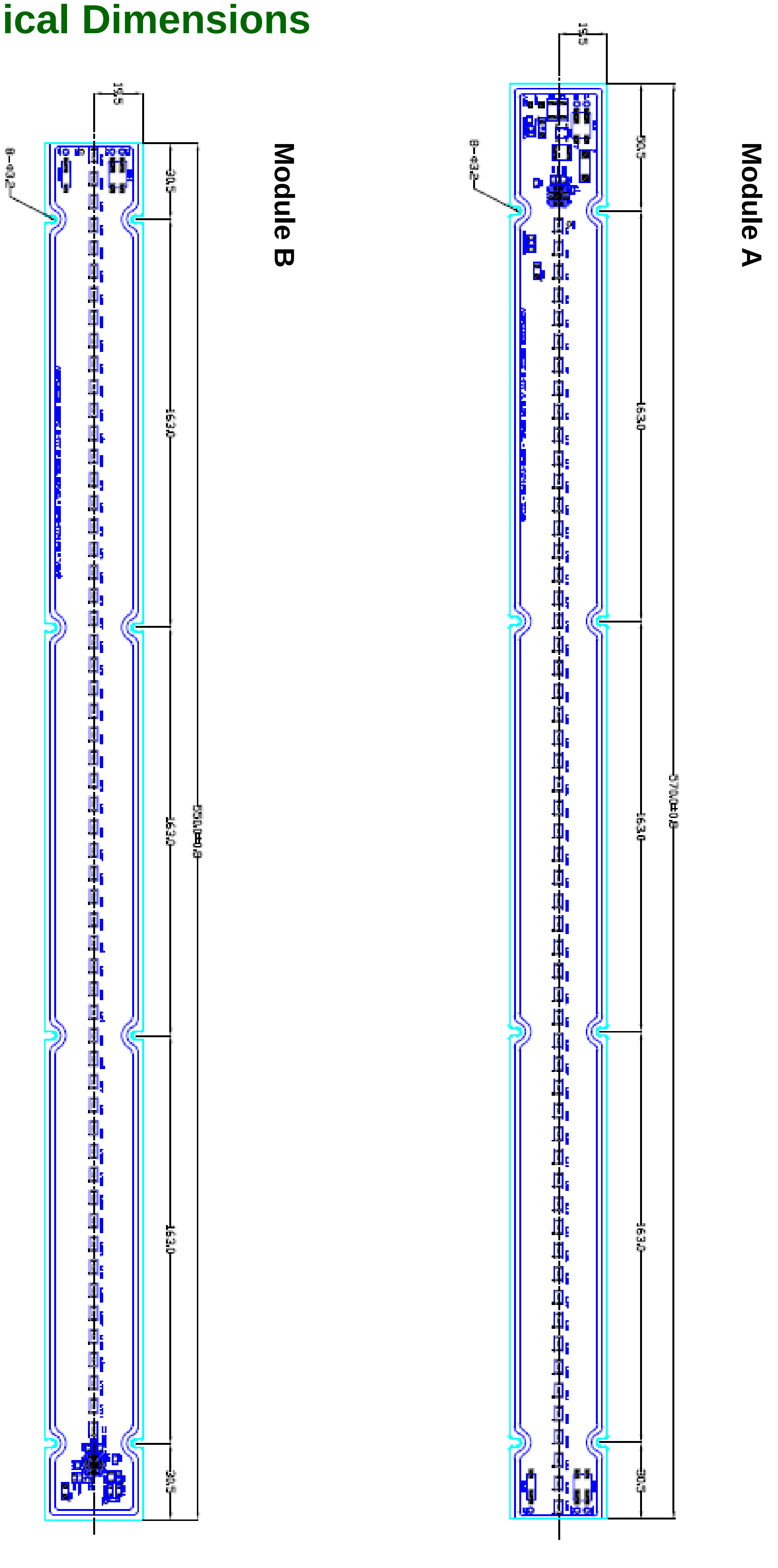
Table 4-2. Part List of Module B

No	Part	Reference	Specification	Quantity
1	PCB	-	FR-4 1.0T, Double side, White PSR, Size 550x39mm	1
2	LED	L57~112	SAW8KG0B(MJT5630-7C)	56
3	Acrich3.0 IC	U2	DT3007B	1
4	Connector	CN4	Wago 2060-402	1
5		CN5	Wago 2060-401	1
6	Resistor	R9	R2012 5.6KΩ 1%(F)	1
7		R11	R2012 2MΩ 5%(J)	1
8		R12	R2012 39KΩ 5%(J)	1
9	MLCC	C5	C2012 100nF	1
10		C6, C7	C2012 10uF	2
11	Resistor	R13	R3216 300KΩ 5%(J)	1
12		R14	R3216 10KΩ 5%(J)	1
13	MLCC	C8	C3225 10uF X7R	1
14	Zener Diode	Z2	MMSZ5258B(36V Zener)	1
16	Diode	D4	FRD 1000V 1A	1

Notes :

The above specification is subject to change without further notice for the improvement of products.

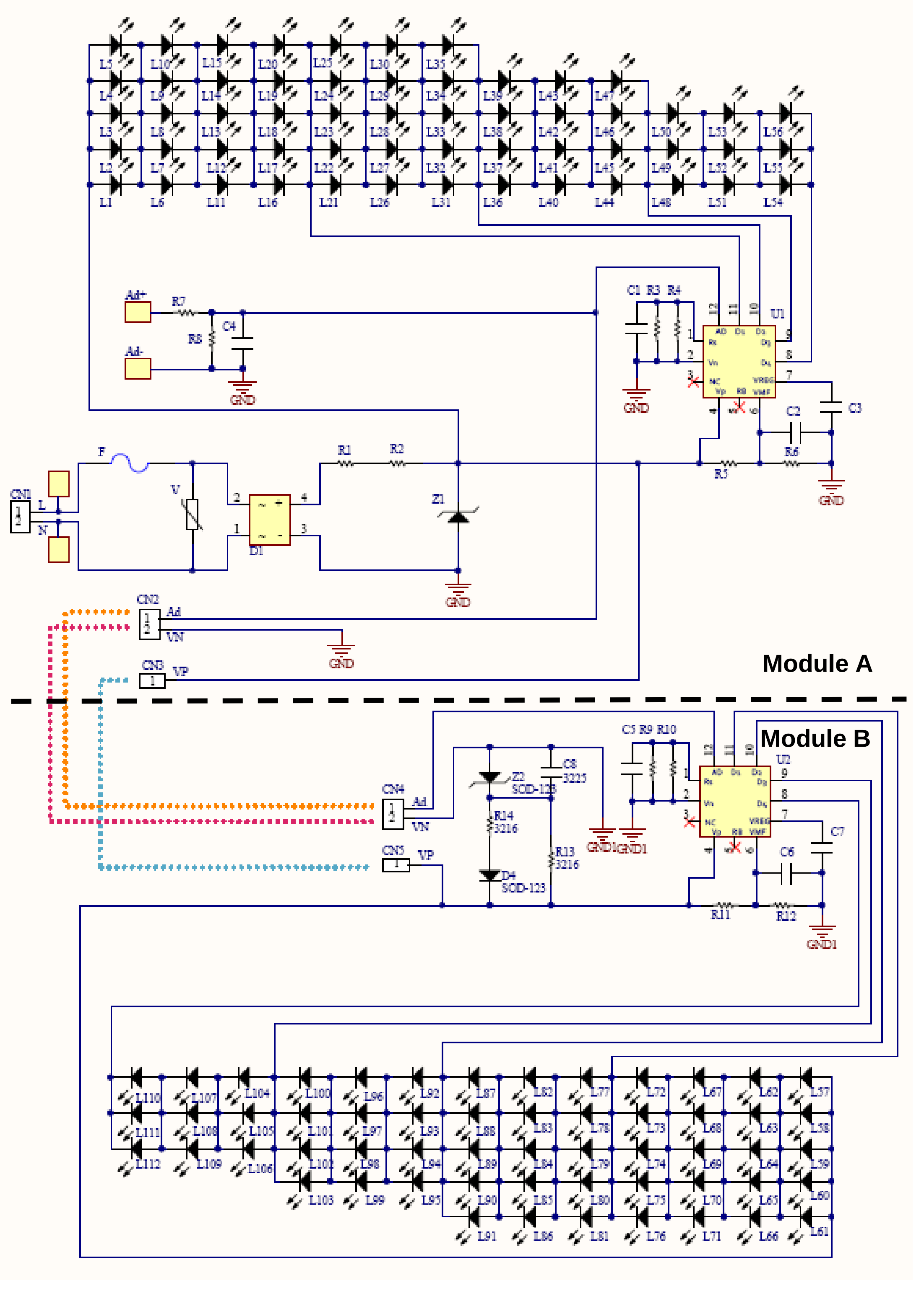
Mechanical Dimensions



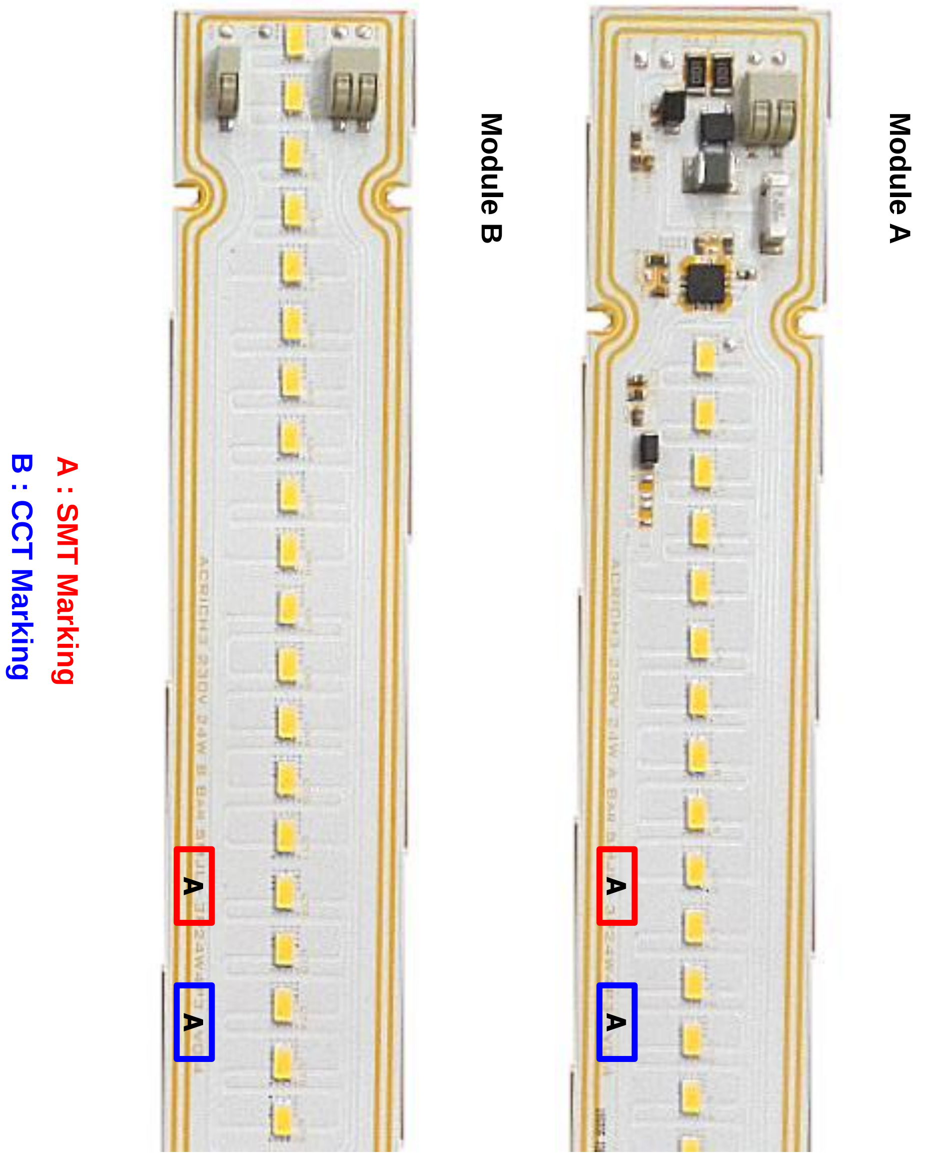
*** Notes :**

[1] All dimensions are in millimeters. (Tolerance unless noted : ± 0.2)
[2] Scale : none

Circuit Drawing



Marking Information



A : ex) 131207 ① Z4 G22 ② ③

① SMT Date (YYMMDD, 6 Digits)
② LED PKG. Luminous Intensity Bin (2 Digits)
③ LED PKG. Color Bin (3 Digits)

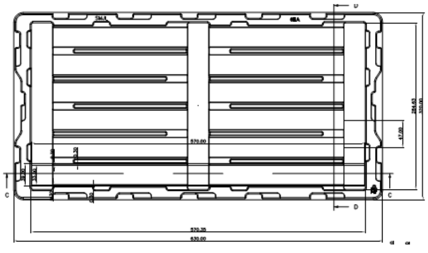
B : ex) 6500K ①

① CCT Marking (5 Digits)

LED Rank	CCT Marking
AXX	6500K
BXX	5600K
CXX	5000K
DXX	4500K
EXX	4000K
FXX	3500K
GXX	3000K
HXX	2700K

Packing Information

1) Tray Specification

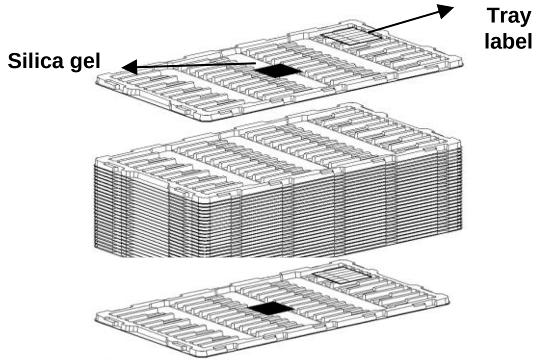


-Tray size : 630(W) x 320(L) x 15(H)mm(0.7T)

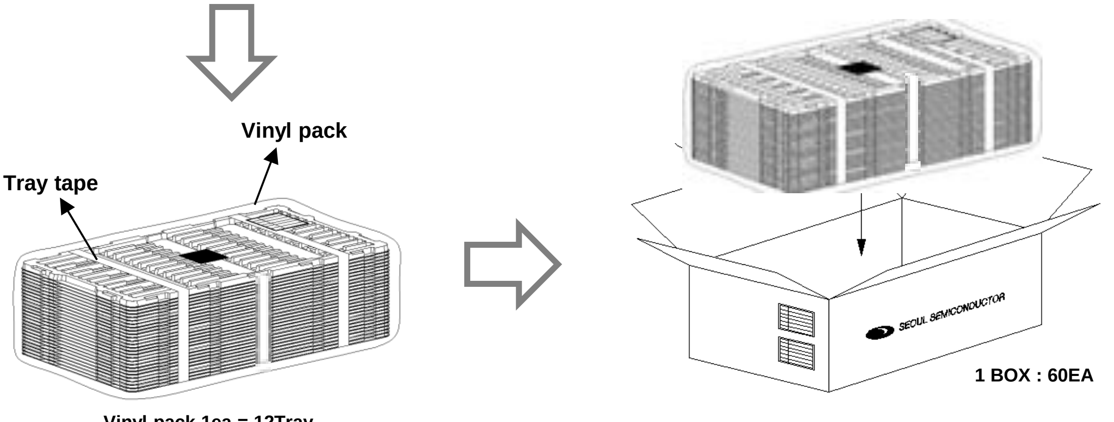
- Module Quantity per Tray : 1 Tray = 6ea Module

2) Packing Process

- Box size : 650(W) x 330(L) x 165(H)mm
- 2 dummy tray is on the top and bottom at each pack.
- Taping at 3 points(Left, Center, Right), and attach label at the top of the tray packing.
- Insert packing tray into vinyl pack, and add silica gel in the packing.
- Put sealing pack into box, and fill into absolved materials in empty space of the Box.
- After checking contents of Label on Box, attach the right position of Box.
  (LED Rank label + TOTAL Quantity label)



2 dummy tray is on the top at each pack.



Vinyl pack 1ea = 12Tray
(10 Module Tray + 2 Dummy Tray)

1 Box = 6ea/Tray X 10 Tray = 60ea

Label Information

Model No.	SMJL-3P22W4P3-A (1)
CCT	XXXXK(2)
Type	A-Type (3)
Quantity	60
Date	YYMDDXXXXX-XXXXXXX
SEOUL	SEOUL SEMICONDUCTOR CO.,LTD.

Notes

(1) The model number designation is explained as follow
SMJL : Seoul Semiconductor internal code
3 : Input Voltage (3 = 230V)
P : Analog Dimming
22W : About Power Consumption
4 : IC Version (Acrich3.0)
P3 : MJT PKG (SAW8KG0B)
-A : Module Type (-A / -B)

(2) It represents the CCT Marking. See Page 25.

(3) It represents Module Type(A-Type or B-Type).

TOTAL Quantity XXX	
SEOUL	SEOUL SEMICONDUCTOR CO.,LTD.

Handling of Silicone Resin for LEDs

(1) Acrich series is encapsulated with silicone resin for high optical efficiency.

(2) Please do not touch the silicone resin area with sharp objects such as pincette(tweezers).

(3) Finger prints on silicone resin area may affect the performance.

(4) Please store LEDs in covered containers to prevent dust accumulation as this may affect performance.

(5) Excessive force more than 3000gf to the silicone lens can result in fatal or permanent damage with LEDs.

(6) Please do not cover the silicone resin area with any other resins such as epoxy, urethane, etc.

Precaution for Use

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

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

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Seoul Semiconductor (SeoulSemicon.com) manufacturers and packages a wide selection of light emitting diodes (LEDs) for the automotive, general illumination/lighting, 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", deep UV LEDs, "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, high-brightness LEDs, mid-power LEDs, side-view LEDs, through-hole type LED lamps, custom displays, and sensors. The company is vertically integrated from epitaxial growth and chip manufacture in it's fully owned subsidiary, Seoul Viosys, through packaged LEDs and LED modules in three Seoul Semiconductor manufacturing facilities. Seoul Viosys also manufactures a wide range of unique deep-UV wavelength devices.

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