SEOUL SEMICONDUCTOR

Seoul Semiconductor

Nov. 2014

Contents of presentation

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Intro

Company Overview

Corporate Overview

- **World Leading LED Manufacturer**
- **Vertically Integrated from Chip to Packaging and Modules**

	Seoul Semiconductor	Seoul Viosys
Establishment	Feb. 1992	Feb. 2002
Sales Revenue	810 Mil USD (2012) 1001 Mil USD (2013)	238 Mil USD
Employees	2,100	700
Financial Aspect	2.5 Bil USD Asset	476 Mil USD Asset
R&D investment	Avg. 15% of Annual Revenue	

World's 3rd largest LED supplier without captive market!

- ✓ Strategies Unlimited (2012) : World 5th
- ✓ IMS Report (2012) : World 5th

Seoul at a Glance

Average Annual Growth about 50% In Every 5 Years

Establishment

- Home Appliance Display

1st Growth

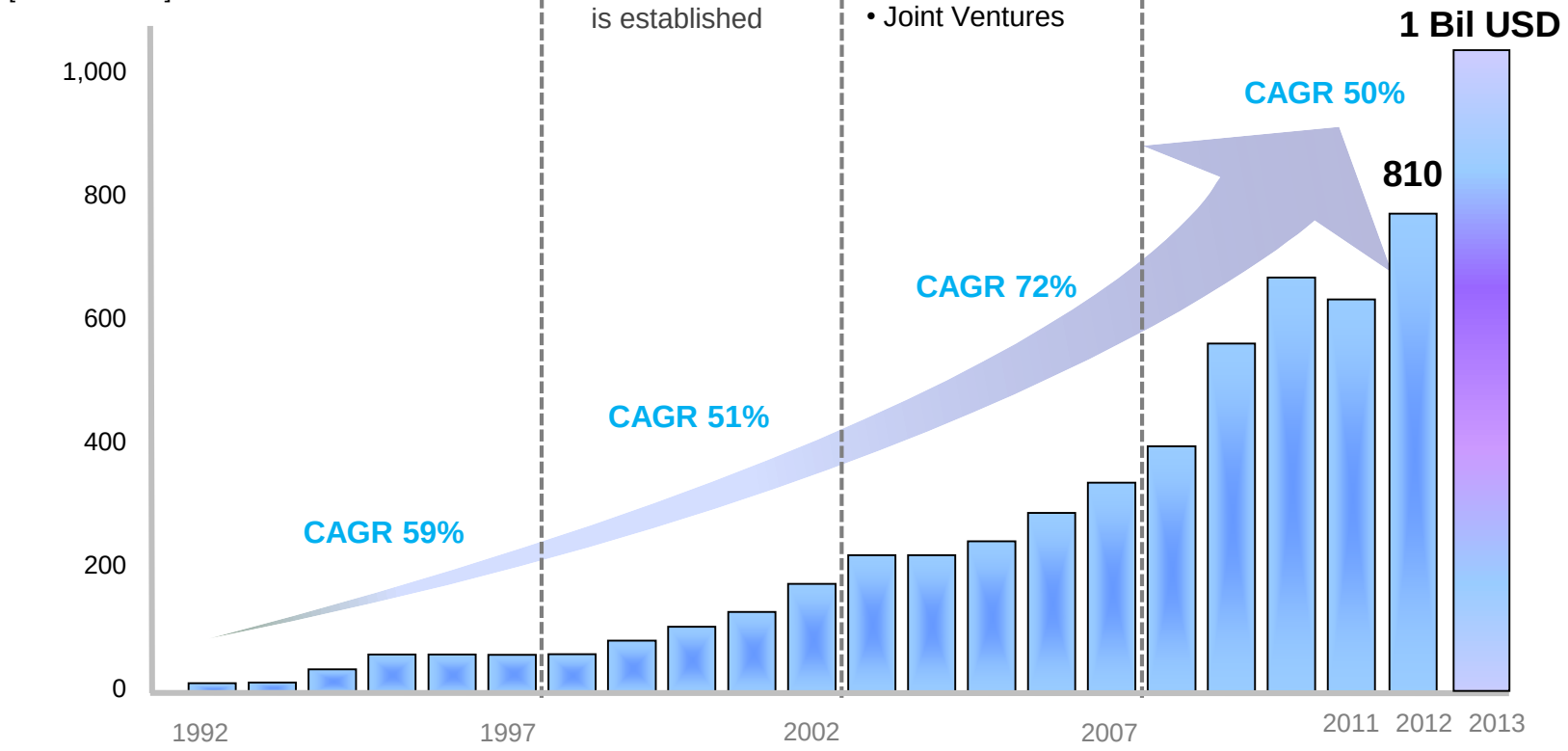
- Growth with BLU
- Single Digit growth
- Seoul Optodevice is established

2nd Growth

- Acrich launch
- UVC in Volume MP
- Lighting & Auto
- Joint Ventures

Global Top 5

- New Name “Seoul Viosys”
- Highest Revenue in 2012
- nPola launch



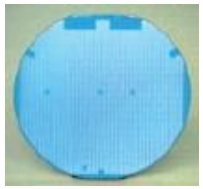
Source: Display search & Strategies Unlimited

Strategic positioning

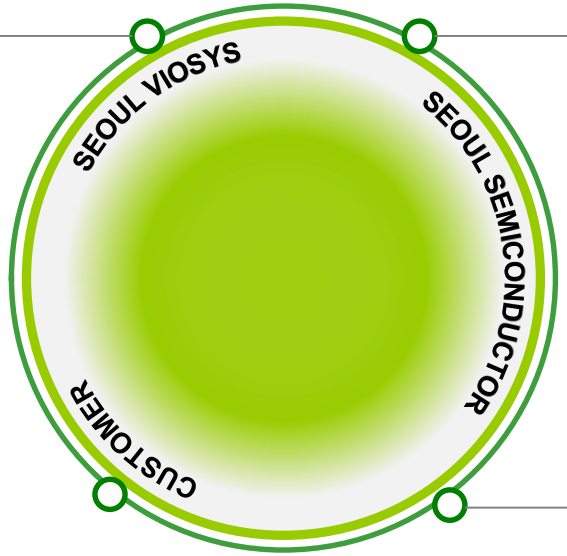
Seoul is vertically integrated & does not compete with Customers.

CHIP

Epi Growth



Fabrication



PACKAGED SOLUTION

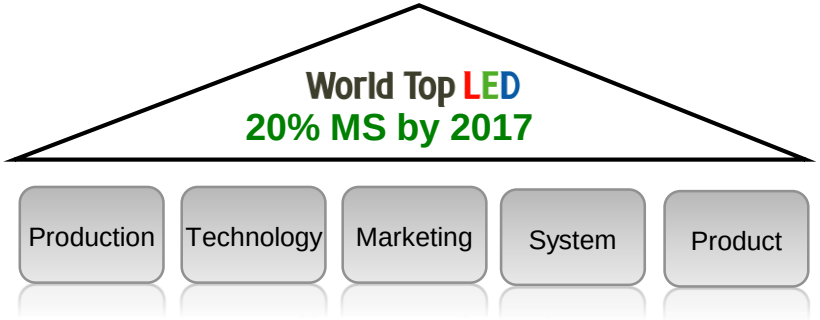
CUSTOM MODULES

- **INNOVATIVE SOLUTIONS**
- **FAST TIME TO MARKET**

Vision & Culture

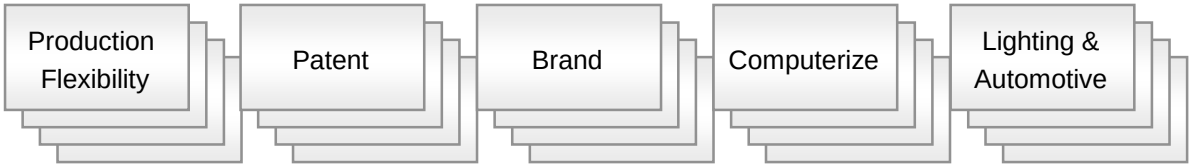
World Top Vision via 5 Strategies Based On Strong Culture

Vision



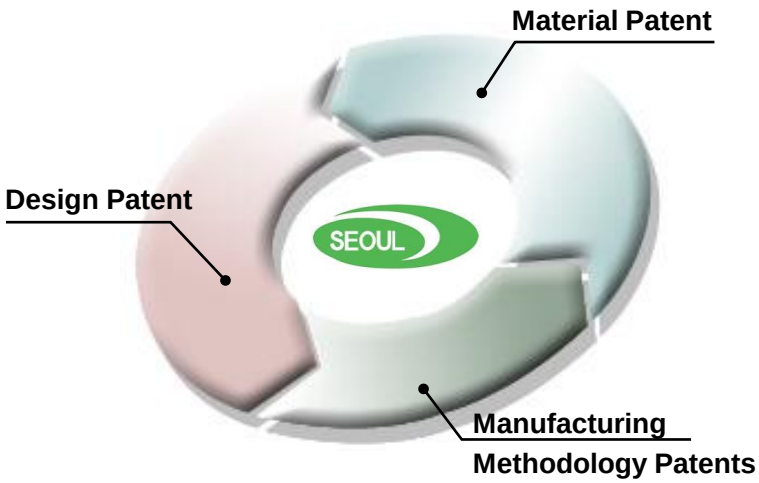
Crystal Ball Culture

Strategy



R&D & IP Capabilities

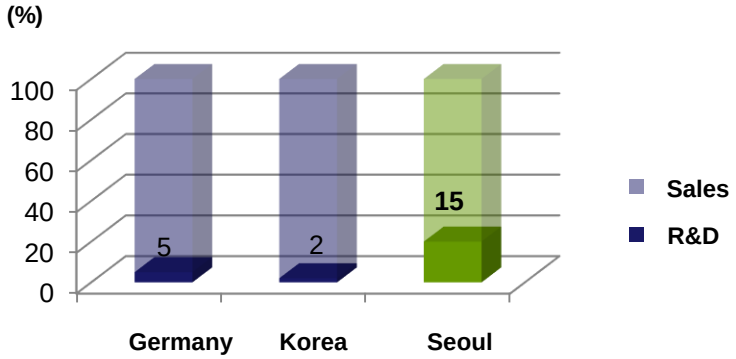
More Than 10,000 Patents and Annual Investment of 15% into R&D



Leading Patent Power by

IEEE

In 2012, IEEE Selected Seoul as the only LED manufacturer in Semiconductor Manufacturing Patent Power.



German "Hidden Champions" = about 5%

Standard Korean corp. = about 2%

vs

Seoul Semiconductor

Seoul Viosys

} **about 15%**

Scientific Consultation from Shuji Nakamura

Shuji Nakamura, a consultant of Seoul Semiconductor and Seoul Viosys, was Awarded the Nobel Prize in Physics 2014

Shuji Nakamura won the Nobel prize in Physics for his invention of blue LED!

*The 2014 physics award went to Isamu Akasaki and Hiroshi Amano of Japan and **Shuji Nakamura** of the University of California, Santa Barbara, for **"the invention of efficient blue light-emitting diodes, which has enabled bright and energy-saving white light sources."***
The three scientists, working together and separately, found a way to produce blue light beams from semiconductors in the early 1990s.

<NY Times 2014/10/07>

Related Articles

American and 2 Japanese Physicists Share Nobel for Work on LED Lights
http://www.nytimes.com/2014/10/08/science/isamu-akasaki-hiroshi-amano-and-shuji-nakamura-awarded-the-nobel-prize-in-physics.html

Japanese Blue LED Inventors Awarded Nobel Prize in Physics 2014
http://www.ledinside.com/news/2014/10/japanese_blue_led_inventors_awarded_nobel_prize_for_physics

Blue LED creators receive Nobel Prize in Physics for 2014
http://www.ledsmagazine.com/articles/2014/10/blue-led-creators-receive-nobel-prize-in-physics-for-2014.html

Seoul Semiconductor congratulates Shuji Nakamura, who contributed to the human race and the environment through the blue LED invention!

*Shuji Nakamura and Seoul Semiconductor have been **engaged in joint R&D for over 10 years**.*

*He introduced **Acrich** along with **nPola** **as the future of LED technology** at the Global LED Forum 2014 in Seoul, Korea. (2014/09/25)*

Scientific Consultation from Shuji Nakamura

Shuji Nakamura, The winner of Nobel Prize in Physics "Have a big dream, Challenge from small companies"


Business & money

"노벨상, 미친 짓 해야 타는데 대기업선 힘들다"

Professor Nakamura, a consultant of Seoul Semiconductor emphasized at a press conference in Seoul Semiconductor HQ "Nobel Prize winning is possible in an environment where someone attempts things you can not even think of" (2014/10/21)

"Nobel Prize comes from small companies."

"Nobel Prize can be awarded when someone attempts crazy things."

News of Professor Shuji Nakamura was covered as top headline in business section.

An Interview with Professor Shuji Nakamura and his visit in Seoul Semiconductor were broadcasted on MBC 8 o'clock news

"Smart students in US go to a small company. Small companies have a great opportunity, so young people must go there and make a challenge"

Professor Shuji Nakamura lectured to 300 R&D people in Seoul Semiconductor after Nobel prize winning.

" 10 years ago, Shuji Nakamura visited Seoul Semiconductor and was touched by the Passion in developing LED and Vision of Seoul semiconductor. So, he started to have relationship with Seoul Semiconductor"

"Because Acrich can be used without converter, cost efficiency and design flexibility is high. It will lead global LED lighting Market"

Global Networks

Seoul Semiconductor supplies LEDs more than 60 countries world wide

02 Unique Technology

Product Line up

Unique Technology - Acrich

The World's First LED can be driven at both AC and DC
Acrich2 Can be Applied to Various Lighting Applications

Wide Voltage Range: 277V / 240V / 230V / 220V / 120V / 110V / 100V

Number of IC	X1				X2	…	Xn	Dimming
Wide Range of Power Distribution	4W	8W	12W	16W	32W		200W	Analog DC 0~10V Phase Cut
Application	MR (MR16) GU (GU10)	Bulb (A19) Tube		Down Light Spot, Par type Tube			High Watt Application Street Lighting Highway	Smart Lighting

Smart Lighting

Outdoor

Acrich3

Simplify Your Smart Lighting System with Acrich3

- Remarkably Improved TRIAC Dimming Compatibility
- Cost Efficient Dimming System than Conventional LED system
- Uniform Linear Analog Dimming
- Easy to build Smart Lighting interface
- More Energy Saving with Smart Lighting by Sensors

IR sensor Dimming Module
All Device on 1 Board

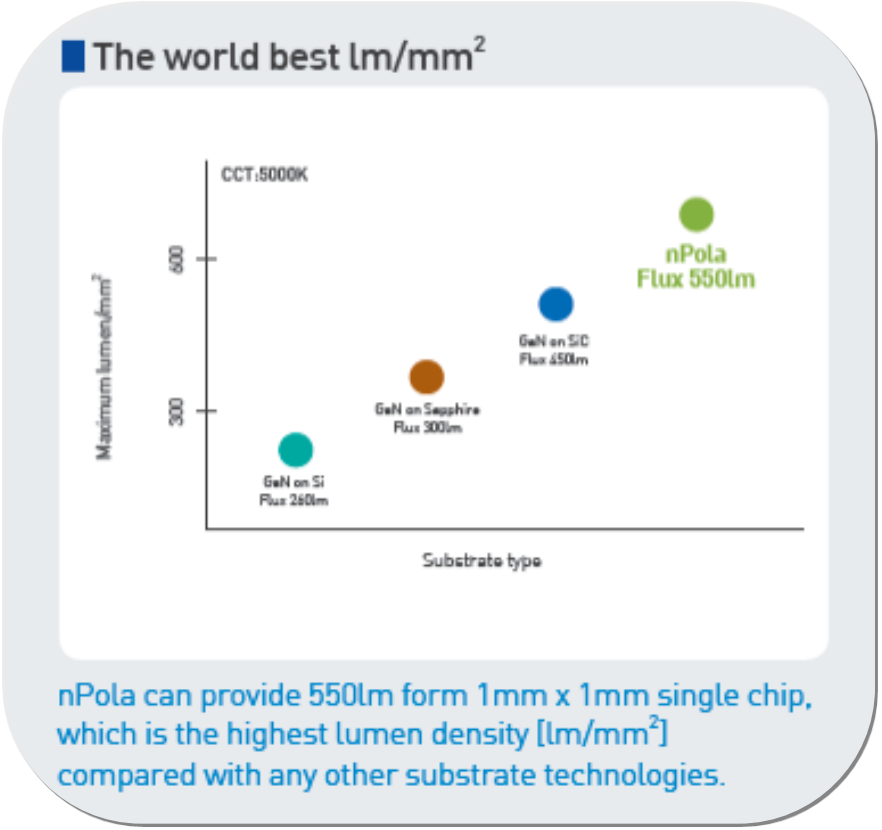
- Enables Simple and Compact Smart Lighting Module

Conventional Lighting Module	Acrich3 Smart Lighting
•AC/DC Converter •Separate Dimming Interface	•Compact Design •Save Space and Components by 6mm x 6mm Acrich IC •Easy Dimming Interface

Unique Technology - nPola

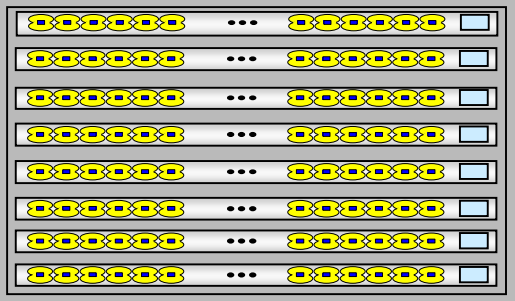
nPola Reaches 5 ~ 10 Times Higher Brightness on the Same Chip Size

nPola enables to decrease
Defect Density up to 1/10,000

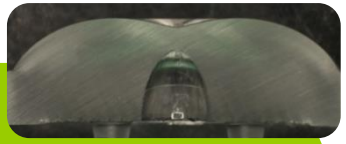


Unique Technology – Direct Backlit TV

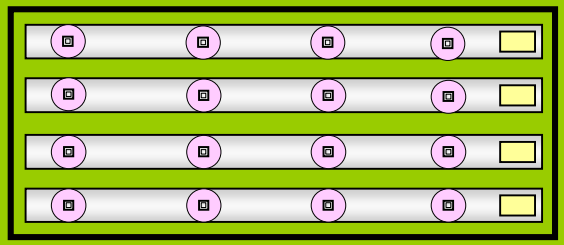
Lens Solution for Direct TV -
Much less LEDs and Huge cost saving replacing CCFL



Edge or Top view type LED Bar
Many LEDs → Higher Cost



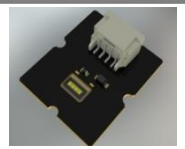
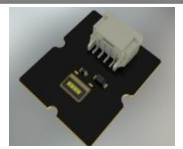
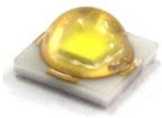
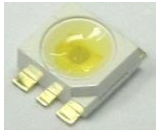
“Patented by Seoul Since 1997”



Direct Type Backlit
with LED + 2nd Optic system

Unique Technology – Automotive

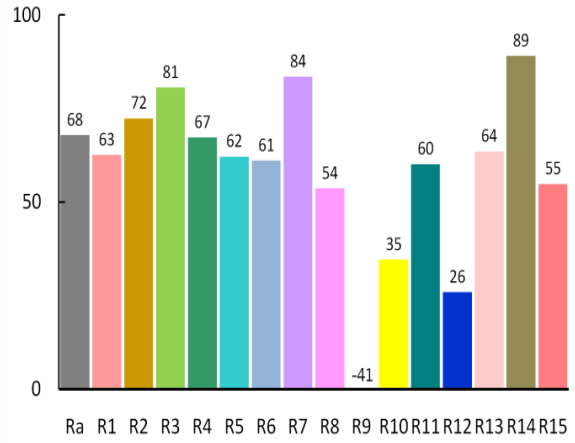
Seoul's automotive solutions for Head Lamp & DRL

	4-chip Multi	2-chip Multi	Z6	Z5	P8	T6
						
Low beam 	●	●				
Fog lamp 	●					
DRL/Position 			●	●	●	●

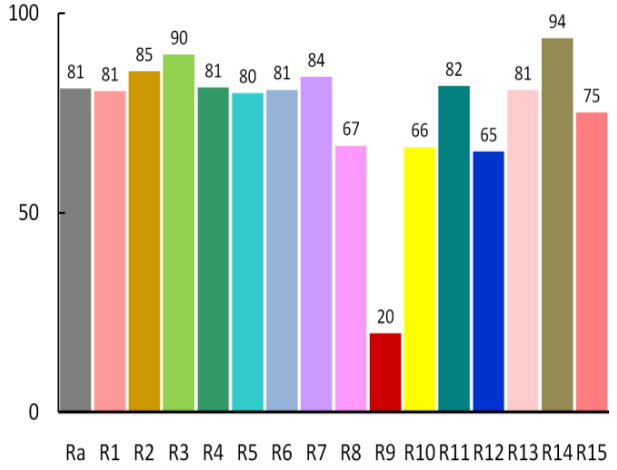
- Optimized LED solutions for Headlamp & DRL
- Small but powerful light output
- High reliability with Lowest Rth
- Low energy consumption
- Long lifetime to use

Unique Technology - Color Quality Leadership

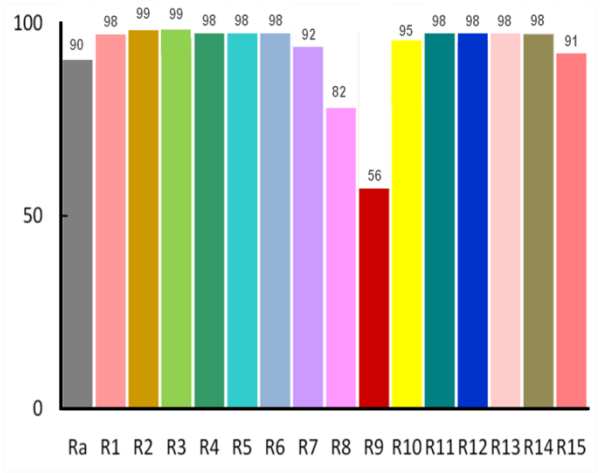
Normal LED, CRI=70



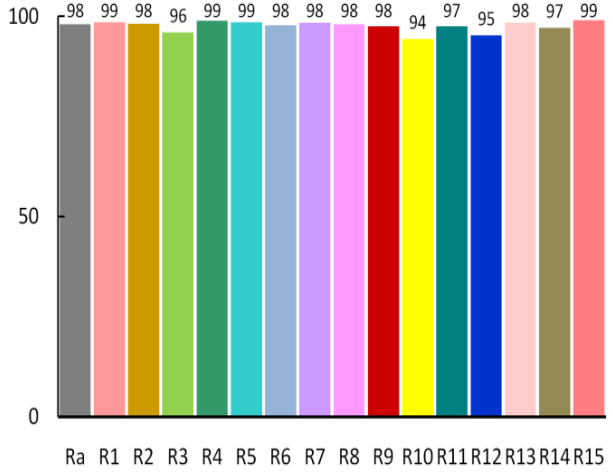
Normal LED, CRI=80



Normal LED, CRI=90



UV+RGB, CRI>95



03 Lighting Portfolio

Application & Products

Lighting Applications/Products

- Replacement retrofit

Bulb	Omni-directional Directional
LFT	T5 / T8
Spot light PAR / MR	PAR30 / PAR38 GU10 / MR16

- Outdoor & Industrial

Street lighting	100W / 150W / 200W
Bay lighting	50W / 100W / 150W

- Commercial

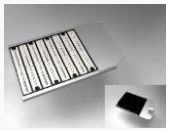
Down light	D/L 4” D/L 6” D/L 8”
Ceiling / Flat panel	Direct type Edge type

* Under development

5630 series		Acrich2, 2+ series
3030 series		*2525 series(DC,MJT)
3020 series		* MJT 3030
COB Type		

5630 series	
5050 series	
3020 series	
MJT5630	

Z5 series	
COB series	
MJT2525	
Acrich2, 2+ series	



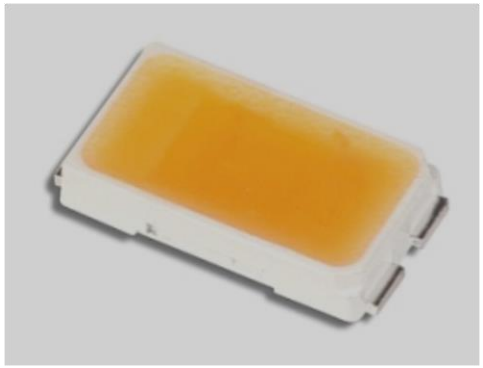
Z5 series	
COB series	
3030 series	
MJT 4040	

5630 series		Acrich2, 2+ series
COB type		*2525 series(DC,MJT)
3030 series		

5630 series		Acrich2, 2+ series
5050 series		
3030 series		

04 Mid Power

5630C



Size : 5.6 * 3.0
Thickness : 0.75 mm

Advantages & Benefits

- 0.3~0.5W single Chip Package
- High lm/W
- High CRI solutions (min CRI 80/ min CRI 90)
- Macadam 3 step binning (2600-3200K)
- Optimized for Bulb lighting Solution
- Cost Competitive (Very attractive pricing due to volume)

Applications

- Retrofit Lamps
- (bulb, candle, GU10, tube)
- Channel Light
- Refrigerator (home appliance)
- Architectural Light
- Decorative Light
- Spot Light
- Down Light

Electrical Optical Characteristics

P/N	STW8Q14C				STW9Q14C
CCT	5000K			3000K	3000K
P [W]	0.18W [Typ]	0.18W [R&D Max]	0.3W [Typ]	0.3W [Typ]	0.3W[Typ]
Current [mA]	60mA	60mA	100mA	100mA	100mA
FLUX [LM]	27	30	43	39.7	33.5
VF [V]	2.81	2.8	3.0	3.0	3.0
Lm/W	160	180	143	132	111
CRI	Min 80	Min 80	Min 80	Min 80	Min.90

5630C Available ranks

Table 7. Intensity rank distribution

CCT	CIE	IV Rank				
8000 ~ 7000K	A	U7	V5	W5	X5	J15
7000 ~ 6000K	B	U7	V5	W5	X5	J15
6000 ~ 5300K	C	U7	V5	W5	X5	J15
5300 ~ 4700K	D	U7	V5	W5	X5	J15
4700 ~ 4200K	E	U7	V5	W5	X5	J15
4200 ~ 3700K	F	U7	V5	W5	X5	J15
3700 ~ 3200K	G	U7	V5	W5	X5	J15
3200 ~ 2900K	H	U7	V5	W5	X5	J15

RANK	Luminous Intensity [2] I_V (cd)		Luminous Flux [3] Φ_V (lm)		CRI R_a
	Min	Max	Min	Max	Min.
U7	11.7	12.5	36.3	38.8	80
V5	12.5	13.5	38.8	41.9	80
W5	13.5	14.5	41.9	45.0	80
X5	14.5	15.2	45.0	47.1	80
J15	15.2	16.0	47.1	48.9	80

Brightness rank

Typical Forward Voltage (V_f) @ I_F = 100mA		
Bin Code	Min.	Max.
Y2	2.8	2.9
Y3	2.9	3.0
Z1	3.0	3.1
Z2	3.1	3.2
Z3	3.2	3.3

Vf rank

Specification of 5630D

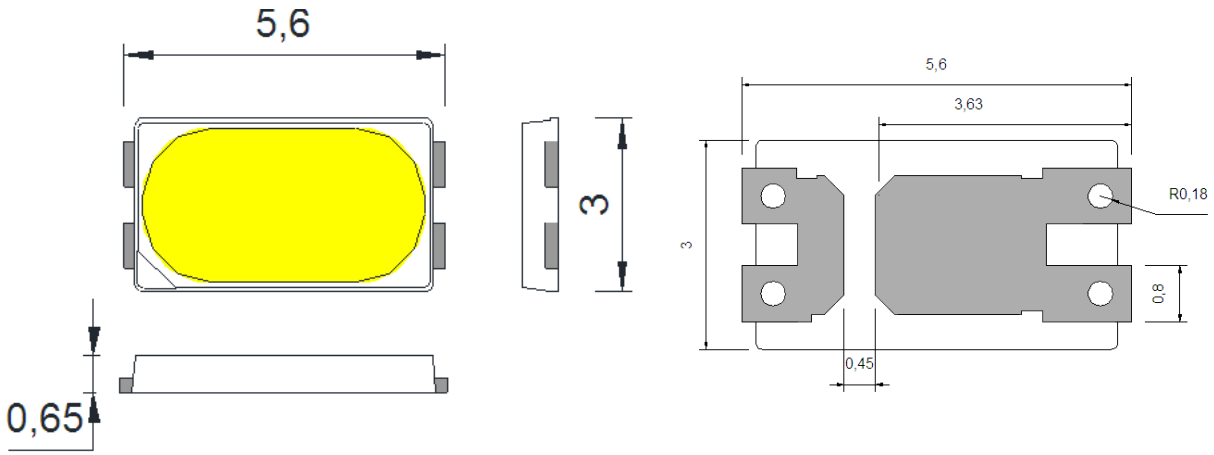
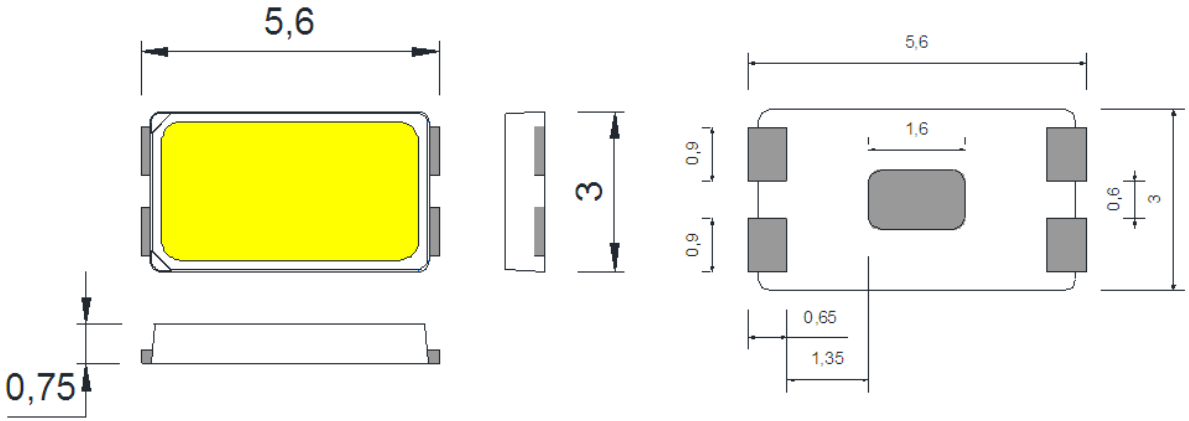
Advantages & Benefits

- **Best performance of lm/W up to 200lm/W**
- Pin to Pin available with 5630C
- Max Current up to 200mA current
- Enhanced Reliability

Product Characteristics (@ 60mA, Ta=25℃)

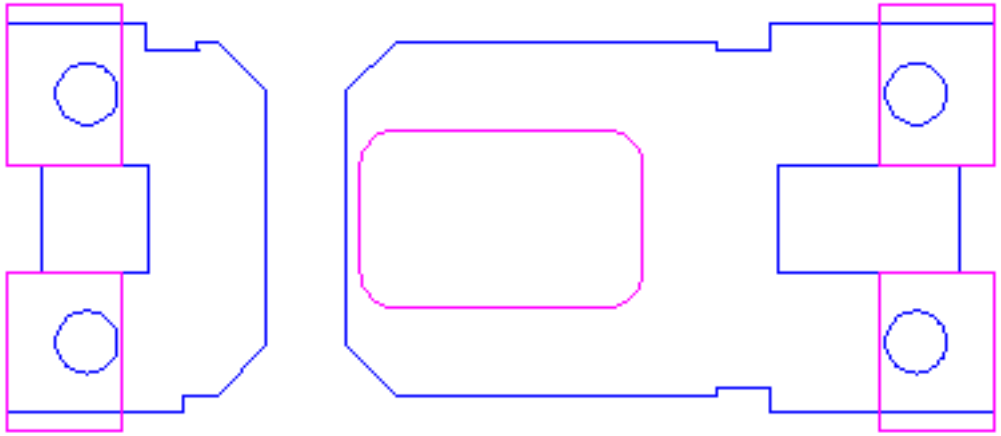
Part Number	CCT (K)	Typical Luminous flux (lm)	Typical Forward Voltage (V_f)	Lm/W	CRI, R_a	Viewing Angle	Note
	Typ.	60mA	60mA	60mA	Min.		
STW8Q14D	5000	30.8 [Typ]	2.8	184	80	120	MP level
		33.2 [Max]	2.76	200	80	120	R&D Max
	3000	28.3 [Typ]	2.8	168	80	120	MP level
		30 [Max]	2.76	181	80	120	R&D Max

5630C & 5630D

제품명	도면	외관
5630D		
5630C		

5630C & 5630D

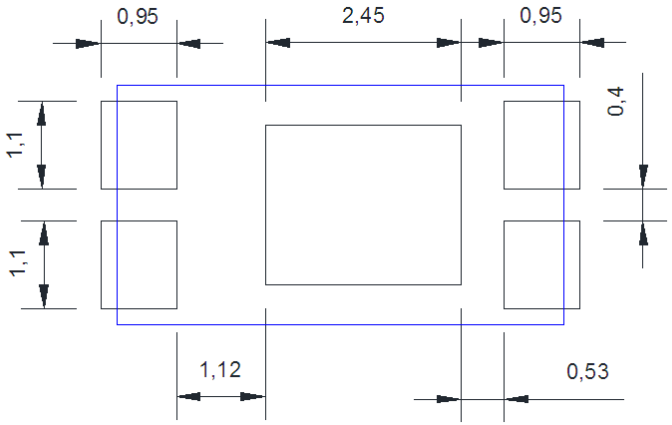
Bottom Pattern _ 5630C & 5630D



Blue : 5630D
Red : 5630C

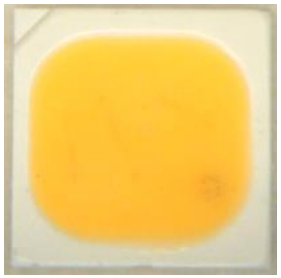
*** 'Pin to Pin' is available, but recommend to use NEW Solder Pad for stable SMT**

Recommend Solder Pad



Blue : Out body PKG

PKG Specification – 3030A, 6V



Size : 3.0 * 3.0
Thickness : 0.65 mm

Advantages & Benefits

- 0.6-1W 2 Chip TOP PKG
- High reliability product
- Compact & Compatible Size
- Macadam 3 step binning (2600-3200K)
- **Optimized for Bulb lighting Solution**
- High Luminous Flux up to 70lm @0.6W (@5000K)

Applications

- Retrofit Lamps (bulb, candle, GU10, Tube)
- Spot Light, Strip Light (Architectural lighting)
- Refrigerator , Indicator (Home Appliance)
- Game (Entertainment)

Electrical Optical Characteristics

	STW8C2SA				STW9C2SA	
CCT	5000K		3000K		2700K	
PKG SIZE	3.0*3.0*0.65 (2 chip)					
Current [mA]	100					
CRI	Min 80				Min 90	
P [W]	0.6W	1W	0.6W	1W	0.6W	1W
FLUX [lm]	81	116	72	103	61.5	86.1
Efficacy[lm/W]	132	126	118	111	102	89

3030A, 6V Available ranks

Table 7. Intensity rank distribution

Available ranks

CCT	CIE	IV Rank			
6000- 7000K	A	K21	K24	K26	K28
5300- 6000K	B	K21	K24	K26	K28
4700 ~ 5300K	C	K21	K24	K26	K28
4200 ~ 4700K	D	K21	K24	K26	K28
3700 ~ 4200K	E	K21	K24	K26	K28
3200 ~ 3700K	F	K21	K24	K26	K28
2900 ~ 3200K	G	K21	K24	K26	K28
2600 - 2900K	H	K21	K24	K26	K28

Typical Forward Voltage (V_F) @ I_F = 100mA		
Bin Code	Min.	Max.
Z58	5.8	6.0
Z60	6.0	6.2
Z62	6.2	6.4
Z64	6.4	6.6

Vf rank

RANK	Luminous Intensity [2] I_V (cd)		Luminous Flux [3] Φ_V (lm)		CRI R_a
	Min	Max	Min	Max	Min.
K21	21.5	24	66.7	74.4	80
K24	24	26	74.4	80.6	80
K26	26	27.5	80.6	85.3	80

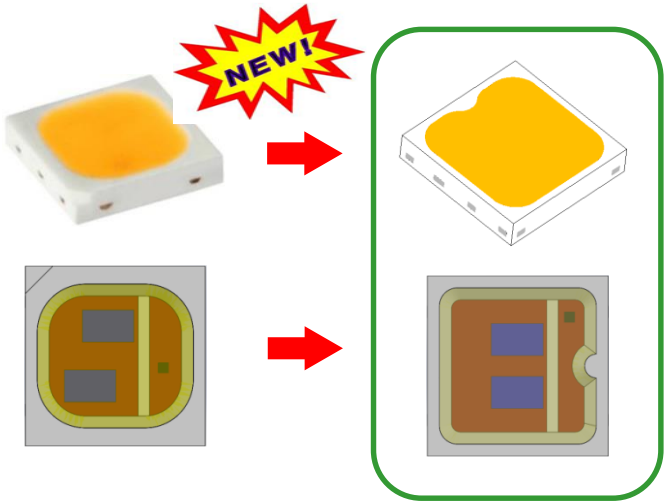
Brightness rank

Product Brief for 3030B

Product Overview : New 3030, 3030B(0.6W)

Outline design

Chip array design



Advantages & Benefits

- **High Efficiency (Maximum LES)**
- **Compact size (Flexible design)**
- **Best cent/lm (10% Up)**
- **High Reliability using EMC reflector**
- **Color uniformity improve**

Product Characteristics (Ta=25℃)

Part Number	CCT (K)	Typical Luminous Intensity(cd)	Typical Luminous flux(lm)	Lm/W	CRI, R_a	Viewing Angle	Note
	Typ.	100mA	100mA	100mA	Min.	Typ.	
STW8C2SA	2700	25.0 [Typ]	75.0 [Typ]	125.0	81.5	120	3030A
STW8C2SB	**2700**	**26.3 [Typ]**	**81.3 [Typ]**	**135.5**	**81.5**	**120**	**3030B**
STW9C2SB	**2700**	**22.4 [Typ]**	**69.2 [Typ]**	**115.3**	**90**	**120**	**3030B**

Development Schedule(STW8C2SB)

Start	ES	CS	MP	LM80 (6000hr)	
03/15/14’	06/13/14’	06/23/14’	06/30/14’	6/16/14’	02/27/15’

N3020B-NZ (STW8B12B-NZ)

Size : 3.0 *2.0
Thickness : 0.6mm

Advantages & Benefits

Size	3.0 x 2.0 x 0.6mm
Binning	6 BIN (3&4 STEP Center)
Flux Output	22.5 lm, 125 lm/W
	LM-80 6,000 hours 27th Jan 2015
Key Points	No Zener for cost saving

Applications

- Indoor lighting
- Automotive
- Portable Torch
- Home appliance

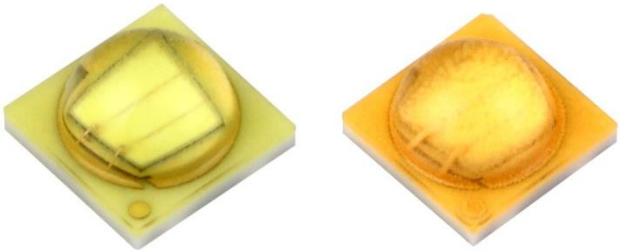
Electrical Optical Characteristics

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward Current		I_F	-	60		mA
Forward Voltage		V_F	2.9	-	3.3	V
Luminous Intensity (Flux)	5000K	I_v	-	7.5 (22.5)	-	cd (lm)
	3000K			6.32 (18.8)		
CRI		R_a	80	-	90	Deg.
Viewing Angle		$2\Theta_{1/2}$		120		Deg.
Junction Temperature		T_j			125	ºC
Storage Temperature		T_{stg}	-40		+100	ºC
Thermal resistance (J to S)		$R\theta_{J-S}$		25		℃/W
ESD Sensitivity(HBM)		-	2K			V

05 High Power Roadmaps

Z5M1 Specification

Z5M1 series



Size: 3.5x3.5x2.0 [t]

Advantages & Benefits

- High brightness and efficiency Up to 160lm and 155lm/W
- Cost competitive
- Good thermal characteristic : RΘj-s 4.5[K/W]
- Macadam 3 step in warm white

LM80 schedule

- 6,000 hour (Feb, 2014) @ 700mA & 1A

Product Characteristics (Ta=25℃)

Part Number	CCT (K)	Typical Luminous Flux Φ_V (lm)			Typical Forward Voltage (V_f)			CRI, R_a	Viewing Angle
	Typ.	350mA	700mA*	1.2A*	350mA	700mA*	1.2A*	Min.	Typ.
SZ5-M1-W0-00	5000	157 (143)	285 (259)	432	2.95 (2.78)	3.14 (2.96)	3.33	70	118
SZ5-M1-WN-00	4000	154 (140)	280 (254)	423	2.95 (2.78)	3.14 (2.96)	3.33	70	118
SZ5-M1-WN-C8	4000	138 (126)	250 (229)	382	2.95 (2.78)	3.14 (2.96)	3.33	80	118
SZ5-M1-WW-C8	3000	132 (120)	240 (218)	364	2.95 (2.78)	3.14 (2.96)	3.33	80	118

※ ( ) : Junction temperature 85℃ condition data

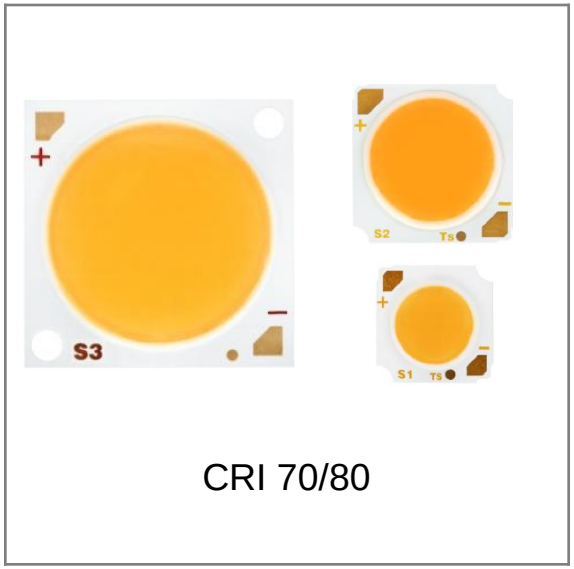
Z5M1 Specification

Available brightness ranks – CRI 80

Table 5. Bin Code description (@I_F=350mA, T_j=25℃)

Part Number	Luminous Flux (lm)			Color Chromaticity Coordinate	Typical Forward Voltage (V_F)		
	Bin Code	Min.	Max.		Bin Code	Min.	Max.
SZ5-M1-W0-00	V2	130	140	Refer to page.12	G	2.75	3.00
	V3	140	150		H	3.00	3.25
	W1	150	160		I	3.25	3.50
	W2	160	170				
SZ5-M1-WN-00	V2	130	140	Refer to page.13	G	2.75	3.00
	V3	140	150		H	3.00	3.25
	W1	150	160		I	3.25	3.50
	W2	160	170				
SZ5-M1-WN-C8	U3	109	118.5	Refer to page.13	G	2.75	3.00
	V1	118.5	130		H	3.00	3.25
	V2	130	140		I	3.25	3.50
	V3	140	150				
SZ5-M1-WW-C8	U3	109	118.5	Refer to page.14	G	2.75	3.00
	V1	118.5	130		H	3.00	3.25
	V2	130	140		I	3.25	3.50
	V3	140	150				

PKG Specification - COB CRI 70/80



CRI 70/80

Advantages & Benefits

- 4.8~37W wide range for fixture
- **Excellent Thermal resistance $R_{\Theta J\text{-}S}$ (0.4~1.4K/W)**
- High CRI solutions (min CRI 80/ min CRI 90)
- **Macadam 3, 4 step binning (2700K, 3000K, 4000K)**
- Optimized for commercial area
- Cost Competitive (Very attractive pricing due to volume)
- Uniformed shadow

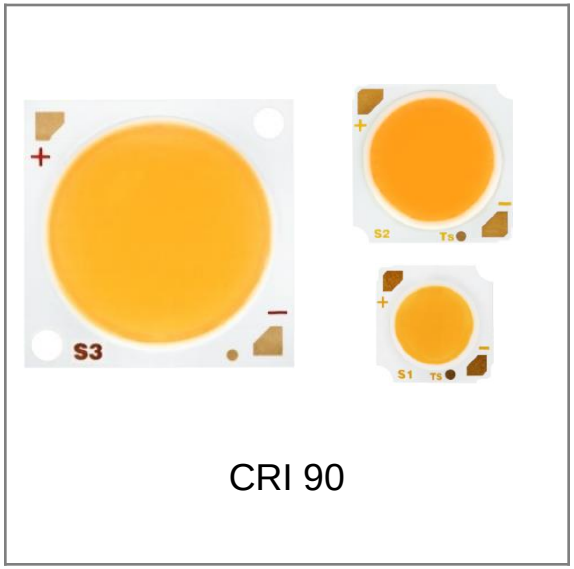
Applications

- Retrofit Lamps (bulb, candle, GU10, tube)
- **Downlight – Commercial area**
- **Street lighting – Outdoor area**
- Architectural Light
- Decorative Light
- **Spot Light**

Electrical Optical Characteristics

Part name		SBW*1F1B (For MR16)			SDW*1F1C			SDW*2F1C			SDW*3F1C			SDW*4F1C			SDW*5F1C		
Package size[mm] LED Size[mm]		13.5*13.5*2.3(t) Φ8.4						19.0*19.0*2.3(t) Φ14.0						28.0*28.0*2.3(t) Φ22.2					
Operating Condition	IF[mA]	500			180			350			500			700			1000		
	VF[V]	9.5			37			37			37			37			37		
	Power [W]	4.8			6,7			13,0			18,5			25,9			37,0		
Characte -ristics	CCT	Flux [lm] typ	lm/W	CRI [typ]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]
	5000K	600	125	68	870	130	70	1780	135	70	2520	135	70	3650	140	70	5030	135	70
	4000K	-	-	-	805	120	80	1620	125	80	2275	123	80	3400	130	80	4650	125	80
	3000K	-	-	-	750	110	80	1500	115	80	2150	115	80	3140	120	80	4300	115	80
	2700K	480	100	80	710	115	80	1440	110	80	2050	110	80	3000	115	80	4100	110	80

PKG Specification - COB CRI90



CRI 90

Advantages & Benefits

- 4.8~37W wide range for fixture
- **Excellent Thermal resistance $R_{\Theta J\text{-}S}$ (0.4~1.4K/W)**
- High CRI solutions (min CRI 80/ min CRI 90)
- **Macadam 3, 4 step binning (2700K, 3000K, 4000K)**
- Optimized for commercial area
- Cost Competitive (Very attractive pricing due to volume)
- Uniformed shadow

Applications

- Retrofit Lamps (bulb, candle, GU10, tube)
- **Downlight – Commercial area**
- **Street lighting – Outdoor area**
- Architectural Light
- Decorative Light
- **Spot Light**

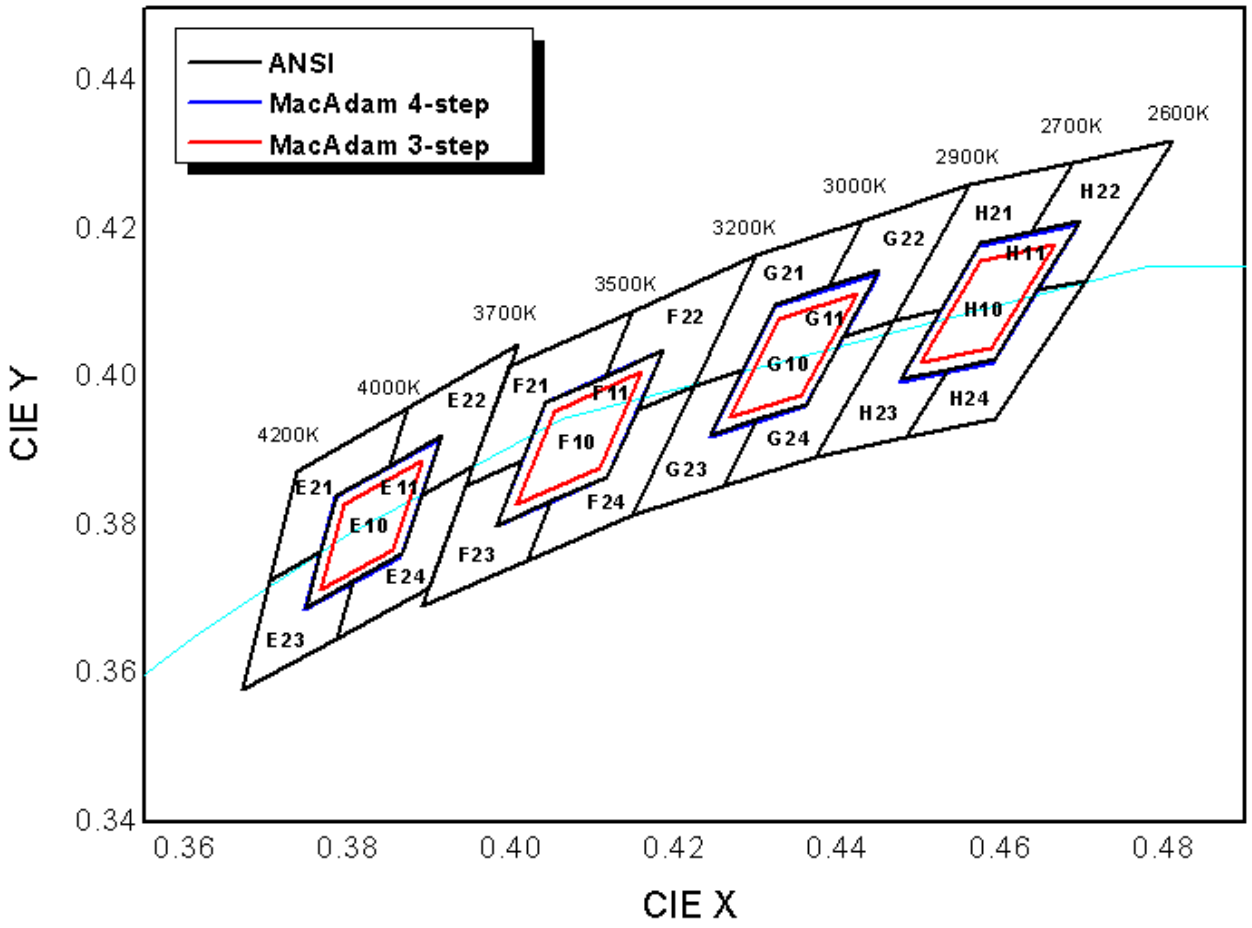
Electrical Optical Characteristics

Part name		SDW*1F1C			SDW*2F1C			SDW*3F1C			SDW*4F1C			SDW*5F1C		
Package size[mm] LED Size[mm]		13.5*13.5*2.3(t) Φ8.4			19.0*19.0*2.3(t) Φ14.0						28.0*28.0*2.3(t) Φ22.2					
Operating Condition	IF[mA]	180			350			500			700			1000		
	VF[V]	37			37			37			37			37		
	Power [W]	6,7			13,0			18,5			25,9			37,0		
Characte -ristics	CCT	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]	Flux [lm] typ	lm/W	CRI [min]
	4000K	705	**105**	90	1390	**107**	90	1940	**105**	90	2845	**110**	90	3885	**105**	90
	3000K	655	**98**	90	1300	**100**	90	1810	**98**	90	2640	**102**	90	3625	**98**	90
	2700K	625	**93**	90	1235	**95**	90	1720	**93**	90	2510	**97**	90	3440	**93**	90

MacAdam 3-step for COB

- 3-step / 4-step / ANSI available

→ Sorted chip input for COB



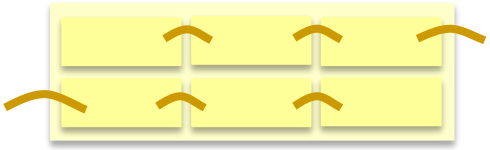
06

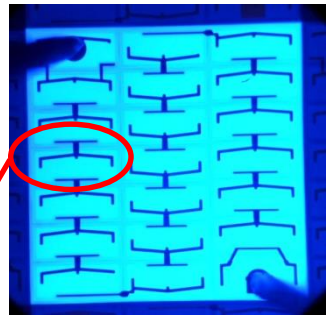
MJT Series

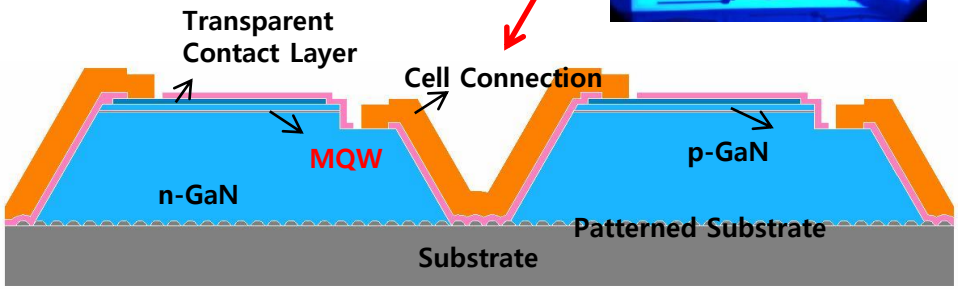
Unique MJT technology

- ✓ MJT creates a high voltage LED (up to 69V DC) on one single chip
- ✓ Serial connection of LED segments without wire bonds utilizing IC-technology
- ✓ MJT is a patented technology by Seoul Semiconductor
- ✓ New driver concepts feasible
  - → Dedicated Ics for driving MJT available
  - → Components for driver can be reduced or eliminated (e.g coil, Elco)
  - → **cost and space for driver goes down**

COB type LEDs







MJT 2525

Size : 2.5x2.5x1.14 [t]

Advantages & Benefits

- High voltage operation **(Typ. 23 V)**
- Compact size (Flexible design)
- Best lm/$ performance
- Energy Star Bin system – NOW Full CCT Range
- Long Life Time

Table 8. Bin Code description, T_a=25℃, I_F=40mA

Part Number	Luminous Flux (lm)			Color Chromaticity Coordinate	Typical Forward Voltage (V)		
	Bin Code	Min.	Max.		Bin Code	Min.	Max.
SAW8FS72A	T2	85.0	90.0	Refer to Page 13 ~ 20	A	21.5	22.5
	U1	90.0	95.0		B	22.5	23.5
	U2	95.0	101.0		C	23.5	24.5
	U3	101.0	107.0		-	-	-
	V1	107.0	115.0		-	-	-

MJT 5630

Size : 5.6x3.0x0.75 [t]

Advantages & Benefits

- High voltage operation **(Typ. 21.5V)**
- Energy Star Bin system

LM80 schedule

- 10,000 Hrs done

7. Test Results

Items	Case Temperature of LM-80-08		Case Temperature of customer
	55 ℃	85 ℃	105 ℃
Total Test Time (h)	9 000	9 000	9 000
Average Luminous Flux (lm)	43.0	42.5	42.5
Average Voltage (V)	21.5	21.3	21.5
Average Color Temperature (K)	2 676	2 668	2 676
Test Current (mA)	20	20	20
Sample Temperature[Ts] (℃)	55	85	105
Surrounding Air Temperature[Ta] (℃)	> 50	> 80	> 100
Average Lumen maintenance at final time (%)	95.94	95.27	91.10
Average Chromaticity shift[$\Delta u'v'$] at final time	0.005	0.004	0.004

Product Characteristics (Ta=25℃) ➔ Watt : 0.43W

Part Number	CCT [K]	Typical Luminous Flux Φ_V [lm]	Efficiency [lm/W]	Typical Forward Voltage [V]	CRI, R_a
	Typ.	20mA	20mA	20mA	Min.
SAW8KG0B (Cool)	5300	57	133	21.5	80
SAW8KG0B (Warm)	3000	52	121	21.5	80

MJT 4040

Size : 4.0x4.0x2.2 [t]

Advantages & Benefits

- High voltage operation **(Typ. 62.5V)**
- Energy Star Bin system
- Long Life Time

LM80 schedule

- 08/08/2013 @ 3,000 Hrs (In progress)

Product Characteristics (Ta=25℃) ➔ Watt : 1.25W

Part Number	CCT [K]	Typical Luminous Flux Φ_V [lm]	Efficiency [lm/W]	Typical Forward Voltage [V]	CRI, R_a
	Typ.	20mA	20mA	20mA	Min.
SAW09H0A (Cool)	5300	180	144	62.5	70

MJT 5050

Size : 5.0 x 5.0 x 0.65 [t]

Advantages & Benefits

- High voltage operation **(Typ. 65V)**
- High current operation (Typ. 20, 40, 60mA)
- Energy Star Bin system

LM80 schedule

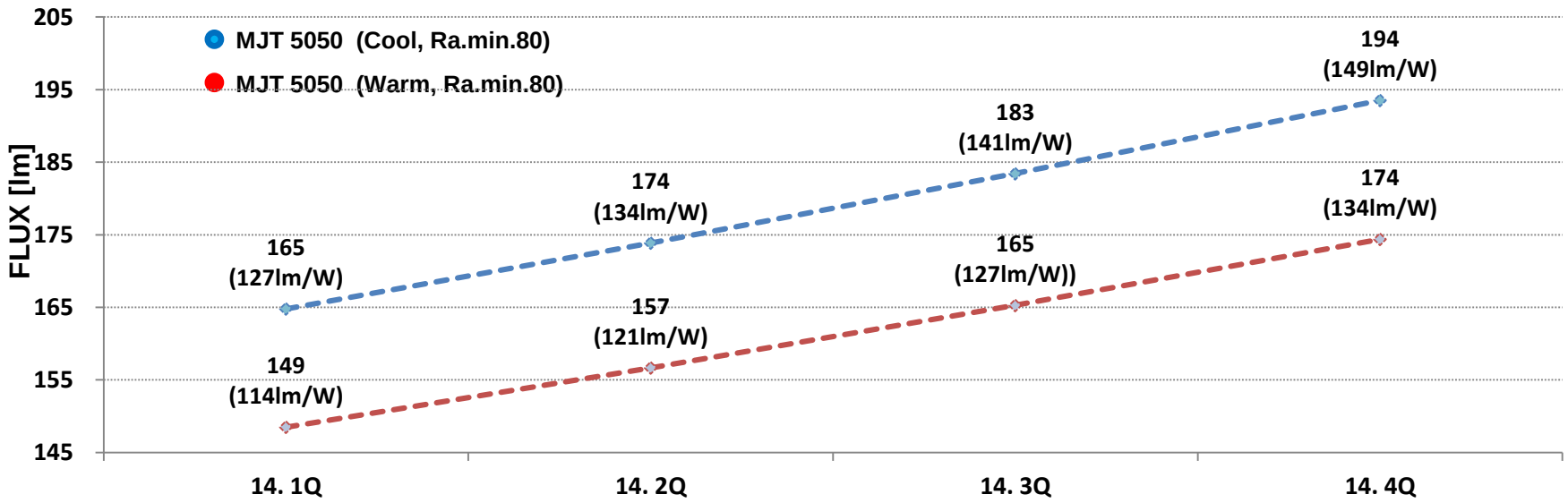
- 1000hr ➔ 2014.01.23

Product Characteristics

Watt : 1.25W @ Ta=25℃

Part Number	CCT [K]	Typical Luminous Flux Φ_V [lm]	Efficiency [lm/W]	Typical Forward Voltage [V]	CRI, R_a
	Typ.	20mA	20mA	20mA	Min.
SAW8LH0A (Warm)	3,000	149	114	65	80
SAW8LH0A (Cool)	5,000	165	127	65	80

MJT 5050 Roadmap @ Ta=25℃ / 20mA driving



MJT 3030

Advantages & Benefits

Size	3.0 x 3.0 x 0.65mm
Flux Output	3000K, Typ. 103lm 135lm/W @350mA
Key Points	High voltage operation (Typ. 22.5V)
	Energy Star Bin system
	LM-80 Applicable
	Best lm/$ performance
	Optimized for Bulb lighting Solution

Applications

- Indoor lighting
- Automotive
- Portable Torch
- Home appliance

Electrical Optical Characteristics

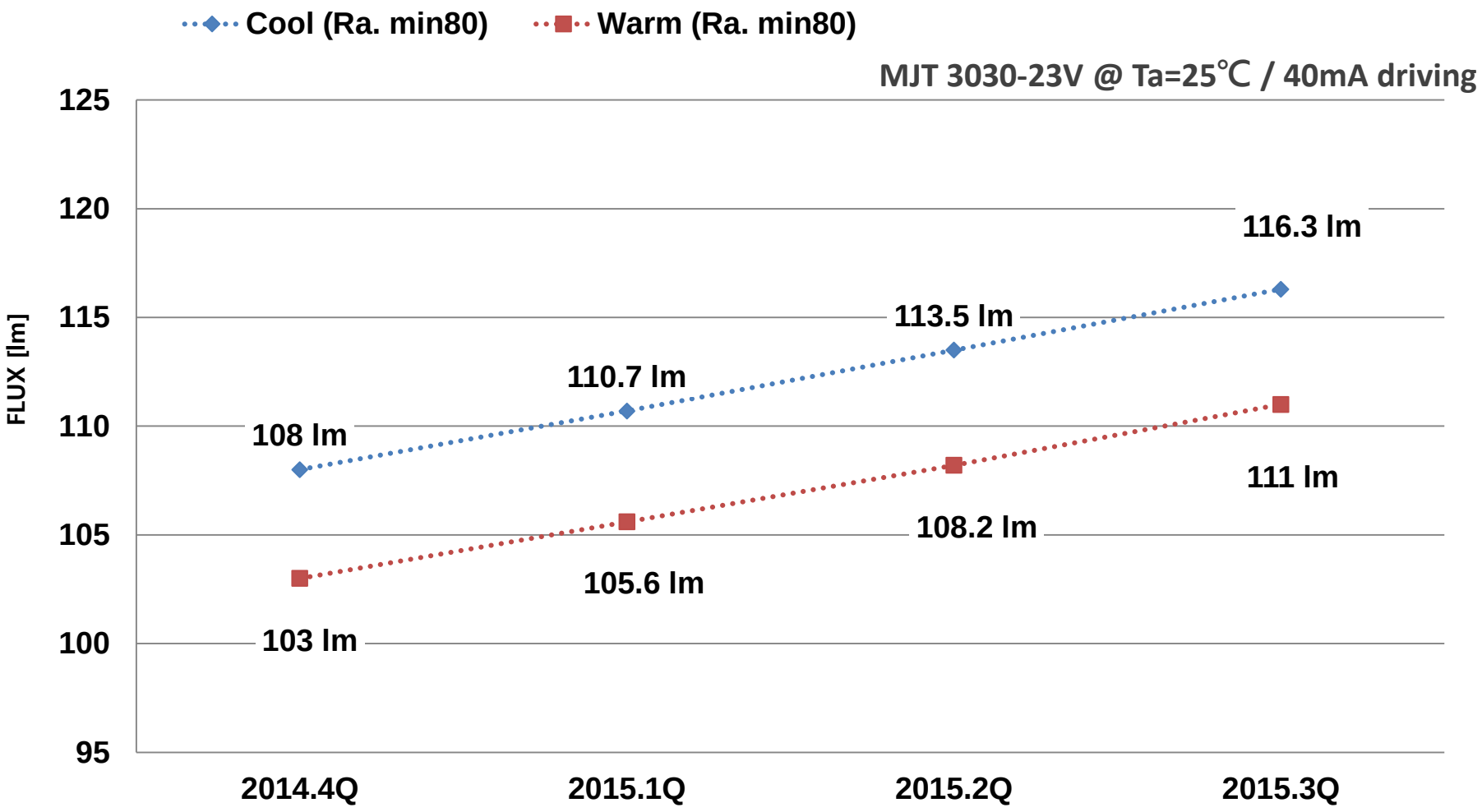
Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Forward Current	I_F	-	40	60	mA
Forward Voltage	V_F	21.5	-	24.5	V
Luminous Flux 3000K	I_v	-	34 (103)	-	cd (lm)
CRI	R_a	80	-	-	Deg.
Viewing Angle	$2\Theta_{1/2}$	-	120	-	Deg.
Junction Temperature	T_j	-	-	125	ºC
Storage Temperature	T_{stg}	- 40	-	+ 100	ºC
Thermal resistance (J to S)	$R\theta_{J-S}$	-	9	-	℃/W
ESD Sensitivity(HBM)	-	5k	-	-	V

The best lumen maintenance of 98.56% (@85℃)

LM80 Testing Result

Test Current [A]	Ts [℃]	Average Lumen Maintenance (%)					
		1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
0.04	55	99.62	100.83	100.86	99.71	99.46	98.81
	85	99.61	100.00	99.93	99.80	99.48	98.56
	105	98.89	97.68	96.96	96.11	95.20	93.84

Road Map


Cool (Ra. min80)
Warm (Ra. min80)
MJT 3030-23V @ Ta=25℃ / 40mA driving
FLUX [lm]
125
120
115
110
105
100
95
108 lm
110.7 lm
113.5 lm
116.3 lm
103 lm
105.6 lm
108.2 lm
111 lm
2014.4Q
2015.1Q
2015.2Q
2015.3Q

07

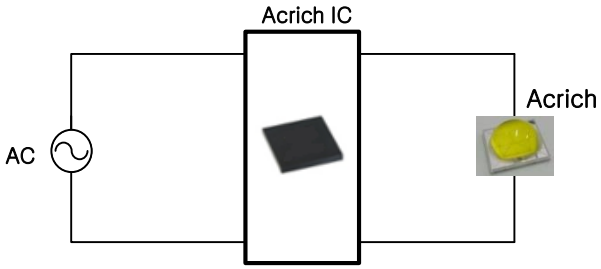
Acrich Module

Acrich module benefits (Summary)

No AC-DC Converter !

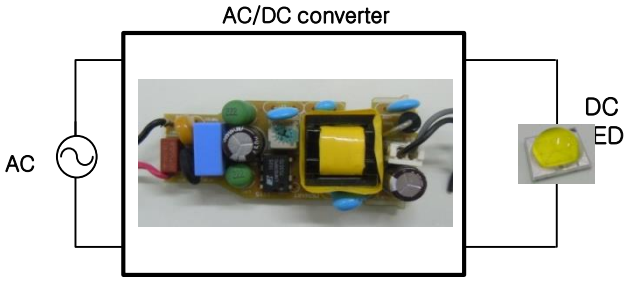
- ✓ Smaller Heat Sink → Cost saving
- ✓ Less Quality Issue → High reliability
- ✓ Longer Life time → Low maintenance cost
- ✓ Higher Power Factor → Eco-friendly
- ✓ More Design Flexibility → Aesthetic design

Acrich 2 Solution

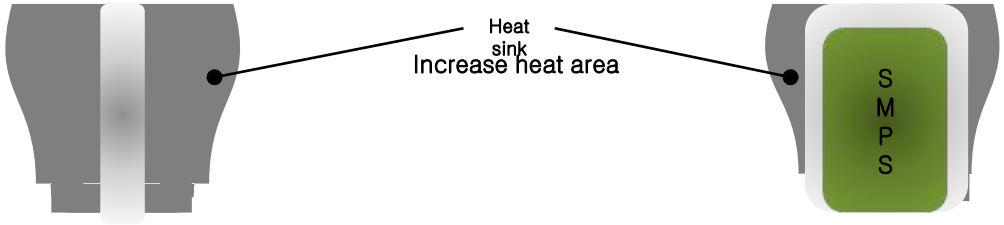


Size : 8 x 8 x 1 mm³
✓ Only one external component

AC-DC converter + DC LED



Size : 50 x 25 x 10 mm³
✓ Multiple components : 20~30ea

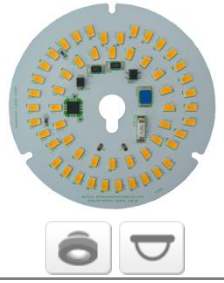


✓ Heat sink for Acrich 2

✓ Heat sink for nor. Solution(include converter)

Standard Module line up (Summary)

[Size : mm]

Pd[W]	4	8~9	10	12~13	16~17	18~22
MP			-			-
	Φ 33	Φ 46		Φ 50	Φ 70	
	-		-			-
		Φ 30, 35.9x25.3		36.5 x 34	Φ 100	
Design & Plan	-	-				
			Φ 100	Φ78	293x36	600 X 33

- Appendix -

Safety standard – UL, TUV/CE

NOTICE OF AUTHORIZATION TO APPLY THE UL MARK

09/20/2012

Seoul Semiconductor
Ms. Mira Yun
1b-25, 727-5 Wonsi-dong
Danwon-gu
Ansan-city Kyunggi-do 425-851, Kr

Our Reference: File E315508, Vol. 1 Project Number 12CA48920
Your Reference: YUN, MIRA MS.
Project Scope: LED MODULE - SMJE-2V12W1P3, SMJE-2V08W1P3 / 2 ALT MODELS

Dear Ms. Mira Yun:

UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements.

This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark only at authorized factories under UL's Follow-Up Service Program.

To provide the manufacturer with the intended authorization to use the UL Mark, the addressee must send a copy of this notice to each manufacturing location currently authorized in File E315508, Vol. 1.

This authorization is effective from the date of this Notice and only for products at the indicated manufacturing locations. Records in the Follow-Up Services Procedure covering the product are now being prepared and will be sent in the near future. Until then, this letter authorizes application of the UL Mark for 90 days from the date of this letter.

Products that bear the UL Mark shall be identical to those that were evaluated by UL and found to comply with UL's requirements. If changes in construction are discovered, appropriate action will be taken for products not in conformance with UL's requirements and continued use of the UL Mark may be withdrawn. UL may elect to withdraw use of the UL Mark if the Applicant or Manufacturer fails to comply with UL's requirements including ongoing compliance of the product, under UL's Follow-Up Service.

NOTICE OF COMPLETION
AND
AUTHORIZATION TO APPLY THE UL MARK

2013/01/31

Seoul Semiconductor
Ms. Mira Yun
1b-25, 727-5 Wonsi-dong
Danwon-gu
Ansan-city Kyunggi-do 425-851, Kr

Our Reference: File E315508, Vol. 1 Project Number 13CA02180
Your Reference: YUN, MIRA MS.
Project Scope: LED MODULE - SMJD-2V16W2P3 / 1 BASIC

Dear Ms. Mira Yun:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File E315508, Vol. 1.

Records in the Follow-Up Services Procedure covering the product are now being prepared and will be sent in the near future. Until then, this letter authorizes application of the UL Mark for 90 days from the date indicated above.

Additional requirements related to your responsibilities as the Applicant can be found in the document "Applicant responsibilities related to Early Authorizations" that can be found at the following web-site:
http://www.ul.com/EAResponsibilities

Any information and documentation provided to you involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

We are excited you are now able to apply the UL Mark to your products and appreciate your business. Feel free to contact me or any of our Customer Service representatives if you have any questions.

Very truly yours,

JangSu Yun
+822 2009 9348
Engineer Project Associate
JangSu.Yun@ul.com

Reviewed by:

William R. Carney
847/664-1088
Chief Engineer Director I
William.R.Carney@ul.com

SEO8415-879B02

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Attestation of Conformity
No. N8 12 12 64846 013

Product Service

Holder of Certificate: SEOUL SEMICONDUCTOR CO., LTD.
148-29, Gasan-dong, Geumcheon-gu
Seoul 153-801
REPUBLIC OF KOREA

Product: LED Module

Model(s): SMJD-3V16W1P3

Parameters:

Rated supply voltage:	200-240V~
Rated frequency:	50/60 Hz
Rated input power:	17.5 W
Protection class:	II
Degree of protection against ingress of liquids:	IPX0

Tested according to: EN 62031:2008

This Attestation of Conformity is issued on a voluntary basis according to the Low Voltage Directive 2006/95/EC relating to electrical equipment designed for use within certain voltage limits. It confirms that the listed equipment complies with the principal protection requirements of the directive. It refers only to the particular sample submitted for testing and certification. See also notes overleaf.

Test report no.: CPSA0144742

Date, 2012-12-20 (Ian Young-Yul Hwang)

After preparation of the necessary technical documentation as well as the EC conformity declaration the required CE marking can be affixed on the product. Other relevant directives have to be observed.

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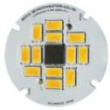
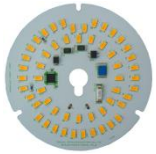
TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany


4W
UL/TUV


8W
UL/TUV

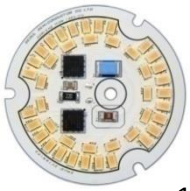

8W
UL


10W
UL


12W
UL/TUV


12W
UL

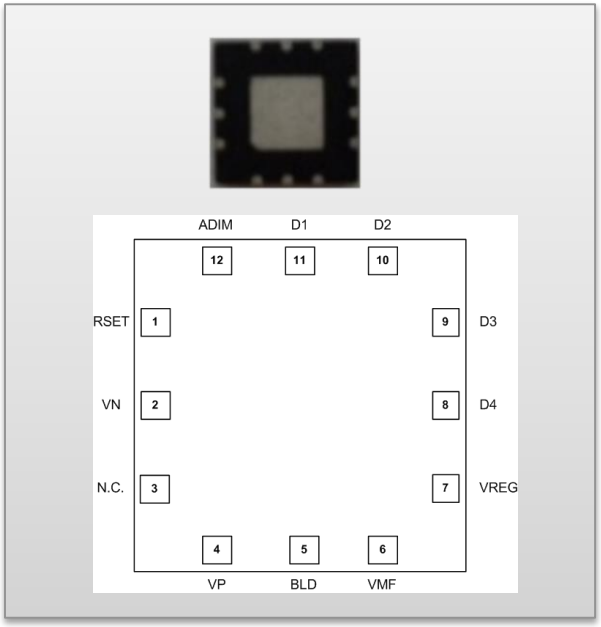

12W
UL/TUV



17W
UL/TUV

NEW Acrich with AIC3.0

- Acrich2.5 Pin to Pin
- High Power Factor: >0.97
- Low Harmonic Distortion: I_THD<15%
- Improvement a Analog Dimming Function
  - **0~100% Light Output Control**
  - **Auxiliary Source : 5V, 5mA**
- **Line Voltage Regulation**
- **Advanced Solution for TRIAC Dimmer**
  - Enhancement TRIAC Dimmer Compatibility
  - Non Visible Flicker while Dimming
  - Remove Partial Light Output on Dim. Conditions
- Strengthen Protection : OTP, Open/Short, UVLO



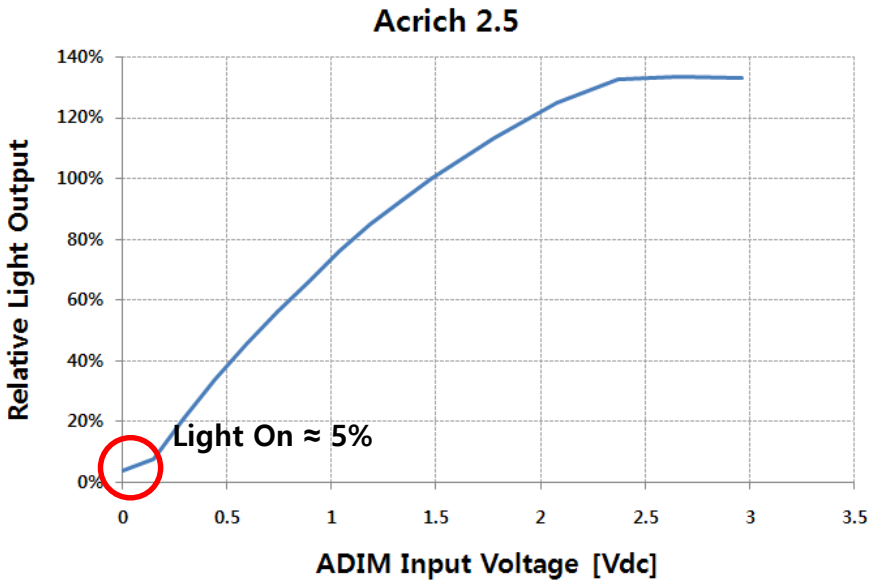
NEW Acrich with AIC3.0

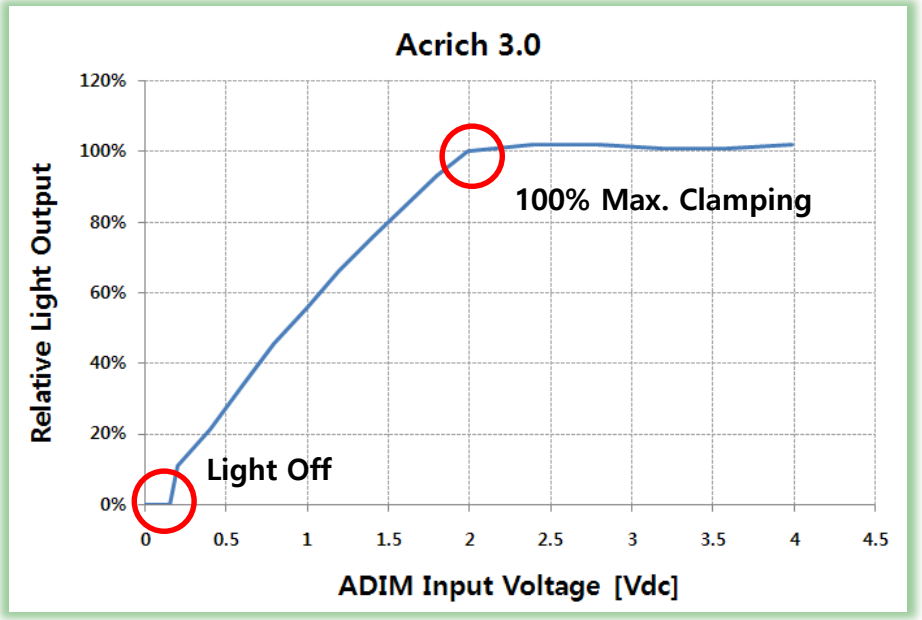
Function	Acrich V2.0	Acrich V3.0	Remarks
PKG	QFN 6x6mm	QFN 6x6mm	
Operating Temperature	-30~100ºC	-30~100ºC	
Line Voltage	90~270V	90~270V	AC rms
Input Power at 100V	1~16W	1~16W	16W max.
Input Current	10~200mA	10~200mA	200mA max.
LED String	4 Step	4 Step	
Conversion Efficiency @220V	90%	90%	
Conversion Efficiency @120V	86%	86%	
Line Voltage regulation	No	± 5% @Typ. Vac+20%	
THD	<15%	<15%	
H.D. (>25W)	Pass	Pass	IEC 61000-3-2
Analog Dimming	5~100% 0.05~1.5Vdc	0~100% @0.2~1.5Vdc	External Dimming
Phase Cut Dimming	△	○ TRIAC Dimmer Compatible	
EMI immunity	Filter less @<45W Filter less @<45W		
Auxiliary Source Output	Non	5Vdc 5mA max.	For Remote Control
Power Factor	0.97	>0.97	
Temperature Protection	>130ºC	Turn Off >150ºC Turn On <120ºC Added Hysteresis Protection	
Built in Active Bleeder Driver	No	Internal MOSFET	20mA pk
UVLO	No	Yes	More Stability Operation
Power Setting Protection	No	Yes	Open Short Protection for Rset used Potentiometer

NEW Acrich with AIC3.0

1. Analog Dimming

- ✓ Support Light Off : < 0.2V (V_{ADIM})
- ✓ 100% Max. Clamping : > 2.0V (V_{ADIM}) *





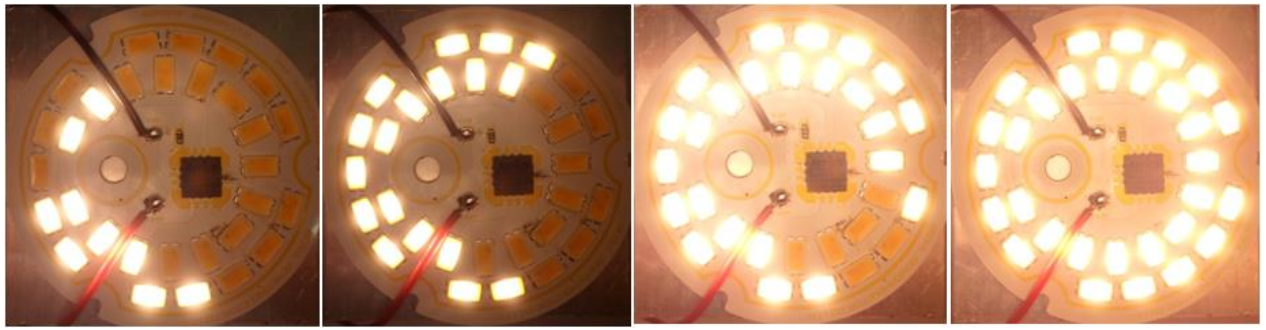
* AIC input voltage (Module voltage input will be vary)

NEW Acrich with AIC3.0

4. Compliance with TRIAC dimming system

Full Group gradual dimming fuction

Conventional Step
ACLED Driver



< Min. Phase > < 90° Phase > < Max. Phase >

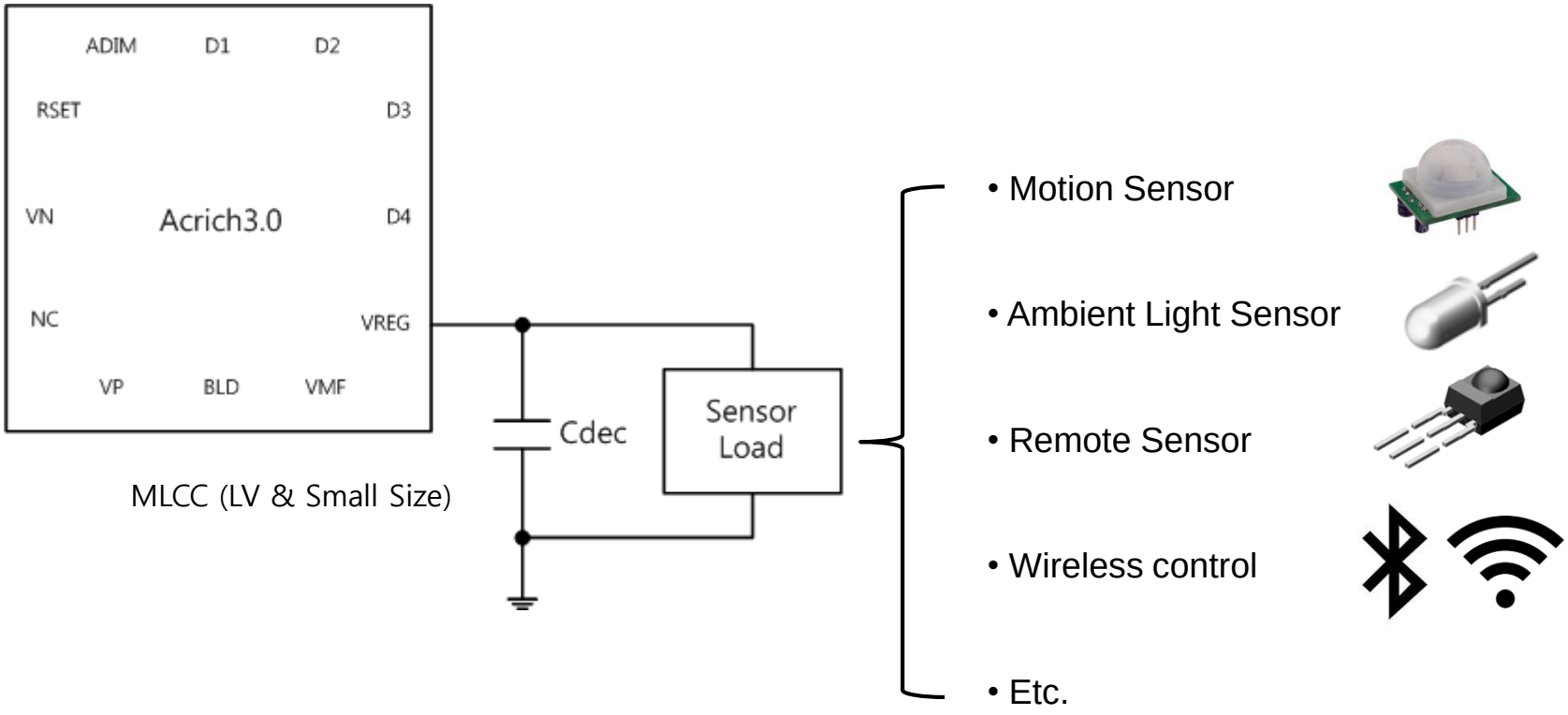
NEW Acrich 3.0

< Min. Phase > < 90° Phase > < Max. Phase >

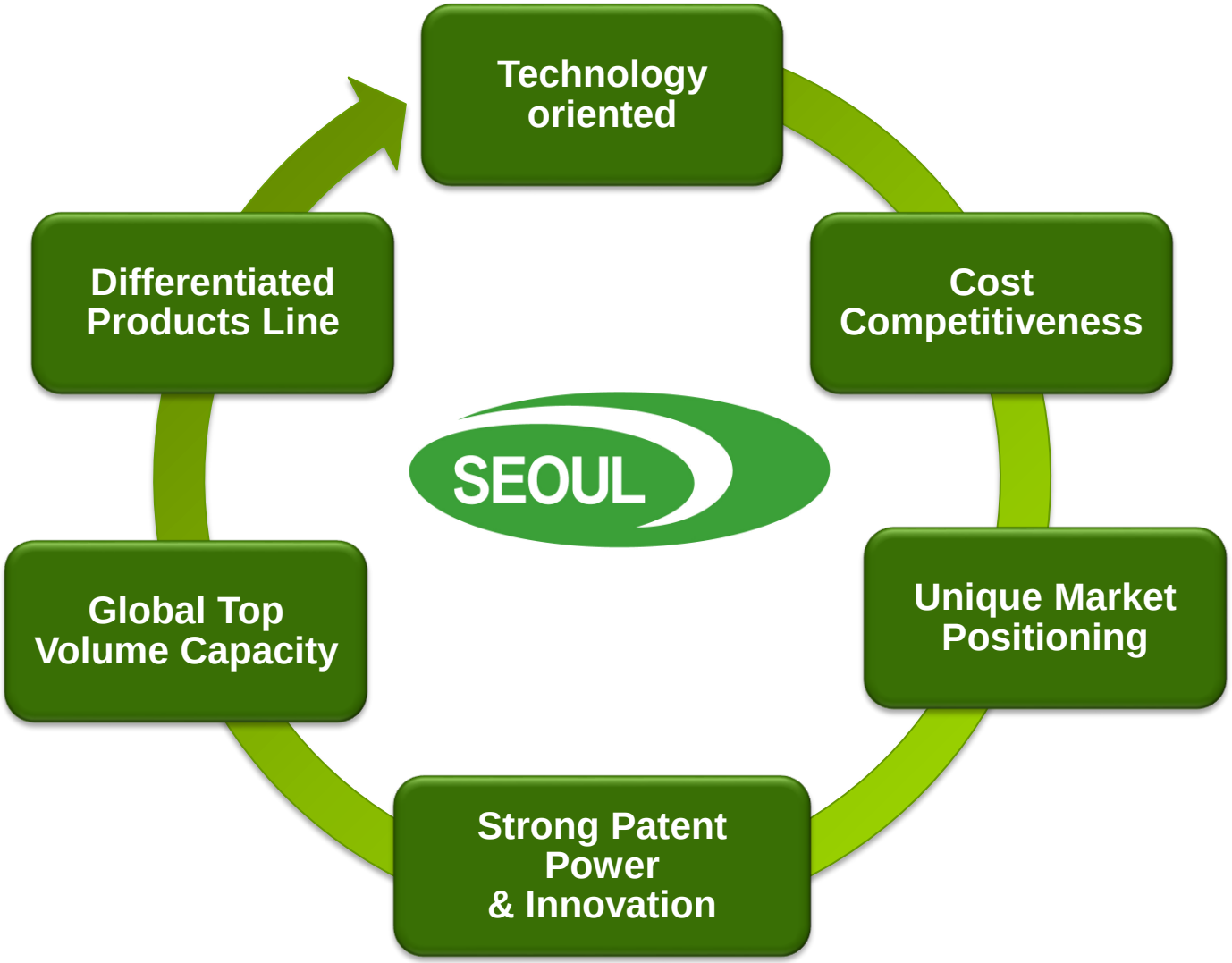
NEW Acrich with AIC3.0

2. Auxiliary Source Output

- ✓ For Sensor Application
- ✓ Don’t need a additional power source for Sensor Appl.



Conclusion – Why Seoul Semiconductor?



THANK YOU!

www.seoulsemicon.com