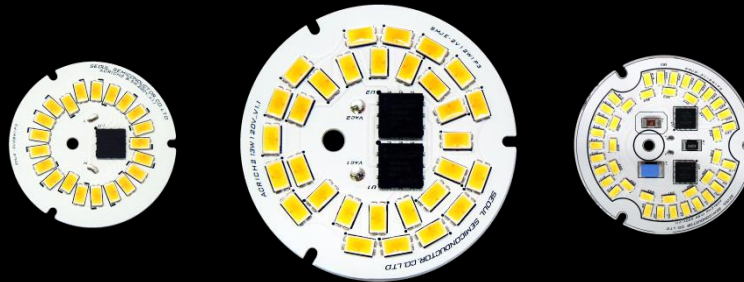




*Acrich2*

You create the form – we create the light

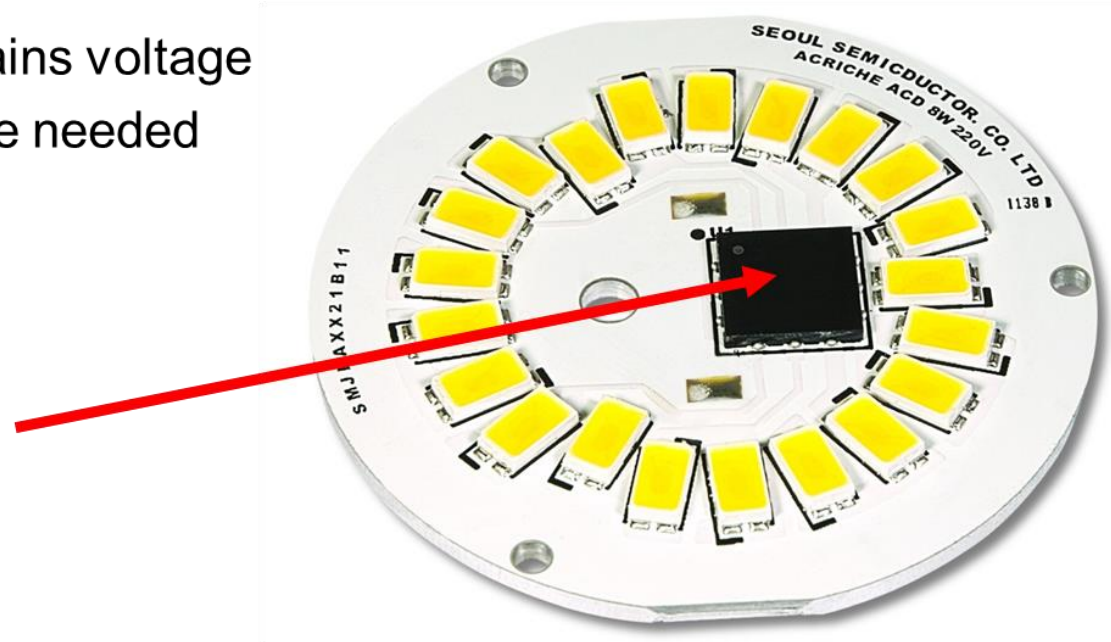
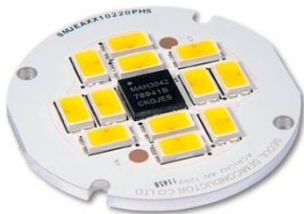


**Seoul Semiconductor**

15th Oct 2013, Angers

# Acrich is a New Way to Design with LEDs

- Connects directly to mains voltage
- No electronics expertise needed
- The A-IC “does it all”



**Acrich2**  
Semiconductor EcoLight



# Agenda

1. Basic idea of ***Acrich2***
2. Benefits of ***Acrich2***
3. Applications for ***Acrich2***
4. How does ***Acrich2*** work?
5. **Surge Protection Circuit**
6. ***Acrich2*** Modules
7. Safety of ***Acrich2*** Modules
8. ***Acrich2*** Dimming
9. ***Acrich2*** Certifications
10. **Multi Junction Technology**



# 1. Basic idea of *Acrich2* technology

Basic idea of using *Acrich2* technology is to show different way of using LED technology – without AC-DC converters. With *Acrich2* technology it is possible to save space and maintain, or even improve operation parameters of the device. Instead of AC-DC conversion, the IC on the *Acrich2* module, drives LEDs in way that it is no longer a problem to use AC sinus-shaped input voltage to drive LEDs efficiently.

## New generation: *Acrich2*



DC LED + Converter



Acrich 2 IC + Acrich LED





## 2. Benefits of *Acrich2* technology

- 1) Long lifetime of the module → Based on LED lifetime > 50 000h, not on electrolytic capacitors like in AC-DC converters.
- 2) Efficiency > 90% → High driver efficiency based on IC technology.
- 3) Power Factor > 0.97 → Effective power usage reduces losses.
- 4) THD < 25% → Effective power usage reduces losses.
- 5) Increased design freedom → Space savings allow easy designing and reduce costs of the system.
- 6) Faster time to the market → Faster design cycle or ready solutions.
- 7) Cost reduction in designing → Simple circuit, simple system, excellent performance.



*Acrich2*



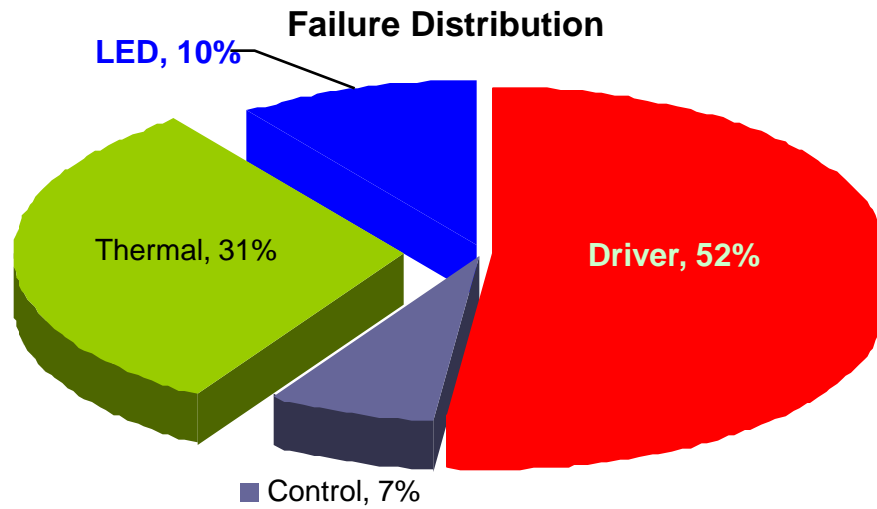
Simple design



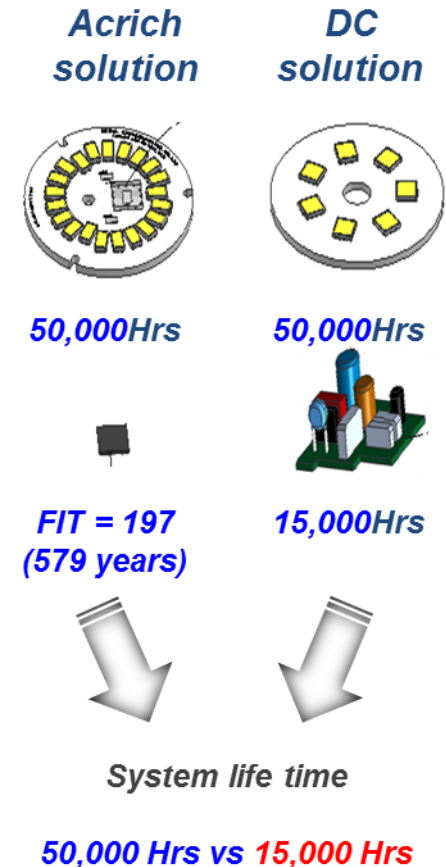
Light bulb

# SSL Fixture Reliability

- According to a Study, 52% of SSL Failures are caused by the Driver



In a recent study, Appalachian Lighting Systems analyzed the causes of failures in an SSL system. As you can see 52% of the failures were caused by the drivers, where only 10% are attributed to the LEDs. The components in the driver electronics are temperature sensitive, and can limit the lifetime of a system to 15K hrs or less. Seoul Semiconductor has developed a new solution within its Acrich product family that removes the driver electronics and replaces it with a Single IC solution for offline conversion and constant current control.





### 3. Typical applications for *Acrich2* technology



LED MR16



LED Bulb



LED Downlight



LED Tube



LED Panel



LED Street Light

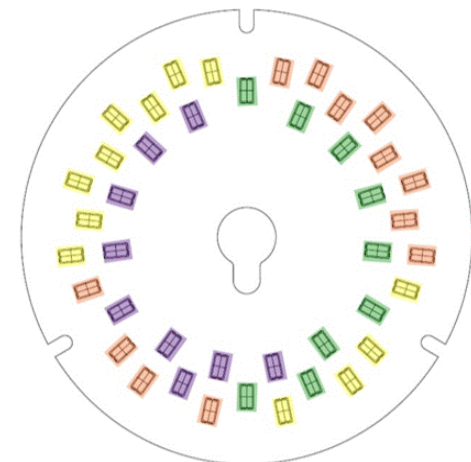
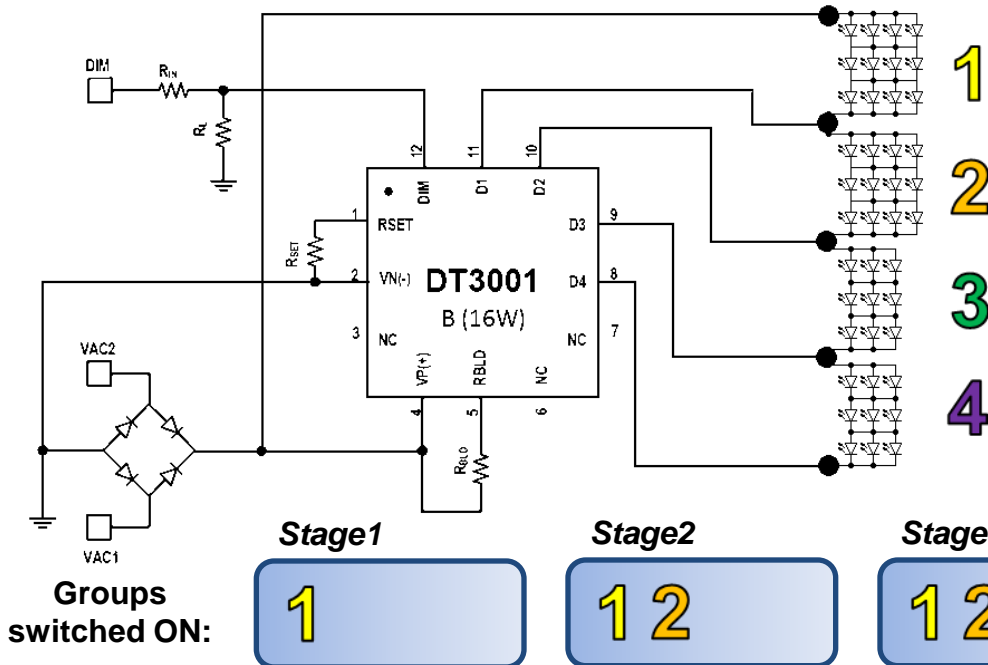


# 4. How does Acrich2 work?

**Acrich2** solutions operate thanks to dedicated, full analog Integrated Circuit (IC). Its task is to drive LEDs (divided to 4 sections = groups) in proper sequence, to achieve best fit to the original input Sin Wave. This 'fit' is necessary to maintain best levels of Power Factor and Total Harmonic Distortion on the market.

LEDs are divided to **4 Groups**, and there are **5 different Stages** of operation:  
**Stage0** = LEDs OFF                      **Stage1** = Group 1                      **Stage2** = Group 1+2  
**Stage3** = Group 1+2+3,              **Stage4** = Group 1+2+3+4              (see details below)

## Groups:



**SMJD-3V16W2P3**  
Sequence:



# 4. How does *Acrich2* work?

*Acrich2* solutions operate thanks to dedicated, full analog Integrated Circuit (IC). Its task is to drive LEDs (divided to 4 sections = groups) in proper sequence, to achieve best fit to the original input Sin Wave. This 'fit' is necessary to maintain best levels of Power Factor and Total Harmonic Distortion on the market.

LEDs are divided to **4 Groups**, and there are **5 different Stages** of operation:

**Stage0** = LEDs OFF

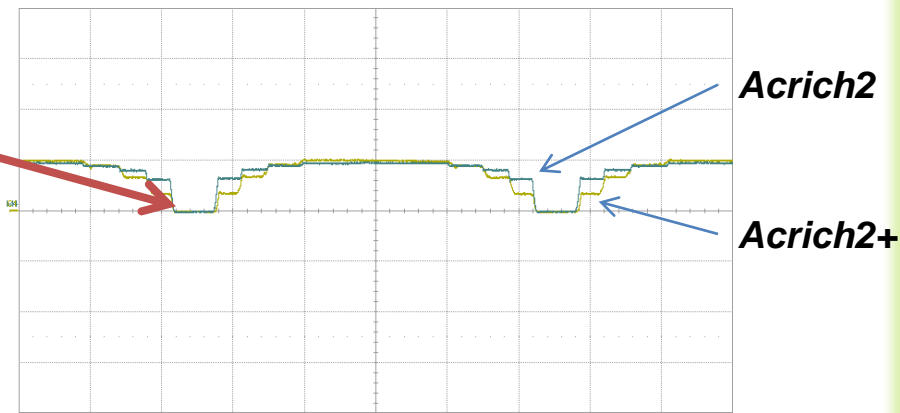
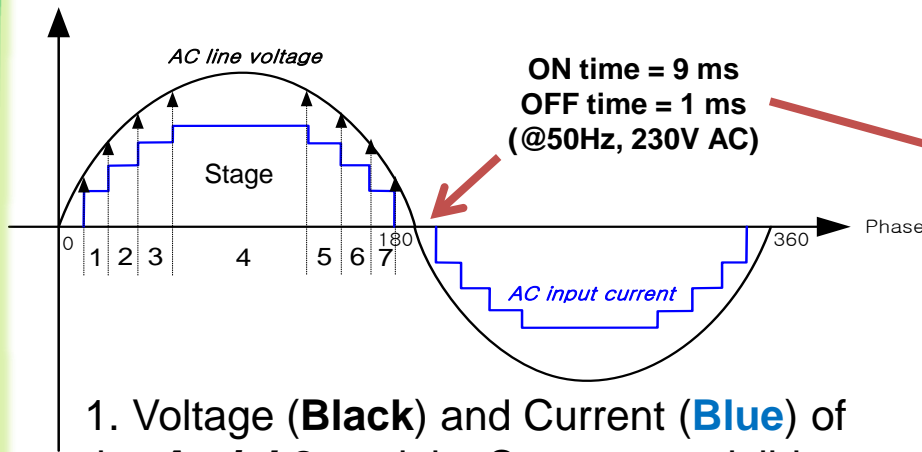
**Stage1** = Group 1

**Stage2** = Group 1+2

**Stage3** = Group 1+2+3,

**Stage4** = Group 1+2+3+4

(see details below)



1. Voltage (**Black**) and Current (**Blue**) of the *Acrich2* module. Stages are visible.

2. Light output of the *Acrich2/2+* modules.

Stage →	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	5 (3)	6 (2)	7 (1)	8 (0)
Group 1	OFF	ON	ON	ON	ON	ON	ON	ON	OFF
Group 2	OFF	OFF	ON	ON	ON	ON	ON	OFF	OFF
Group 3	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
Group 4	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF

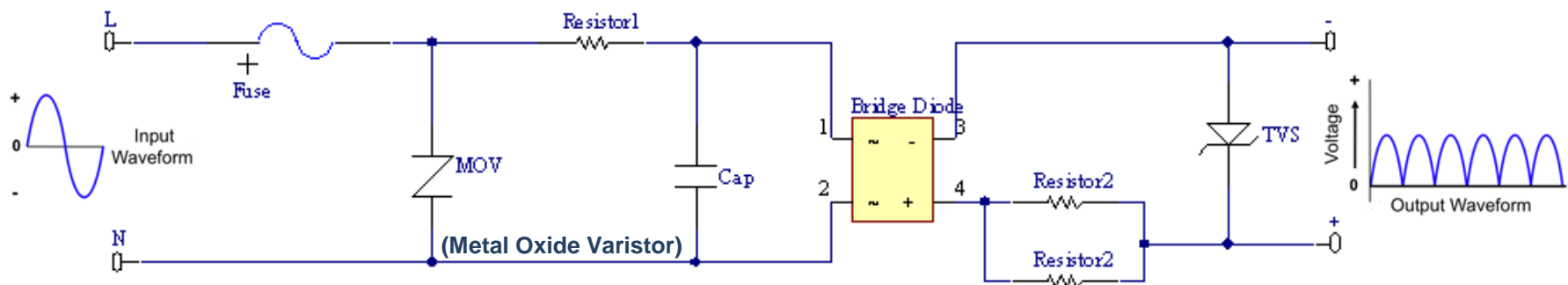
## 5. SPC = Surge Protection Circuit

Surge Protection Circuit is a device that helps to protect main unit against surge currents and surge voltage up to 1.5kV.

Main, most common parts in the SPC:

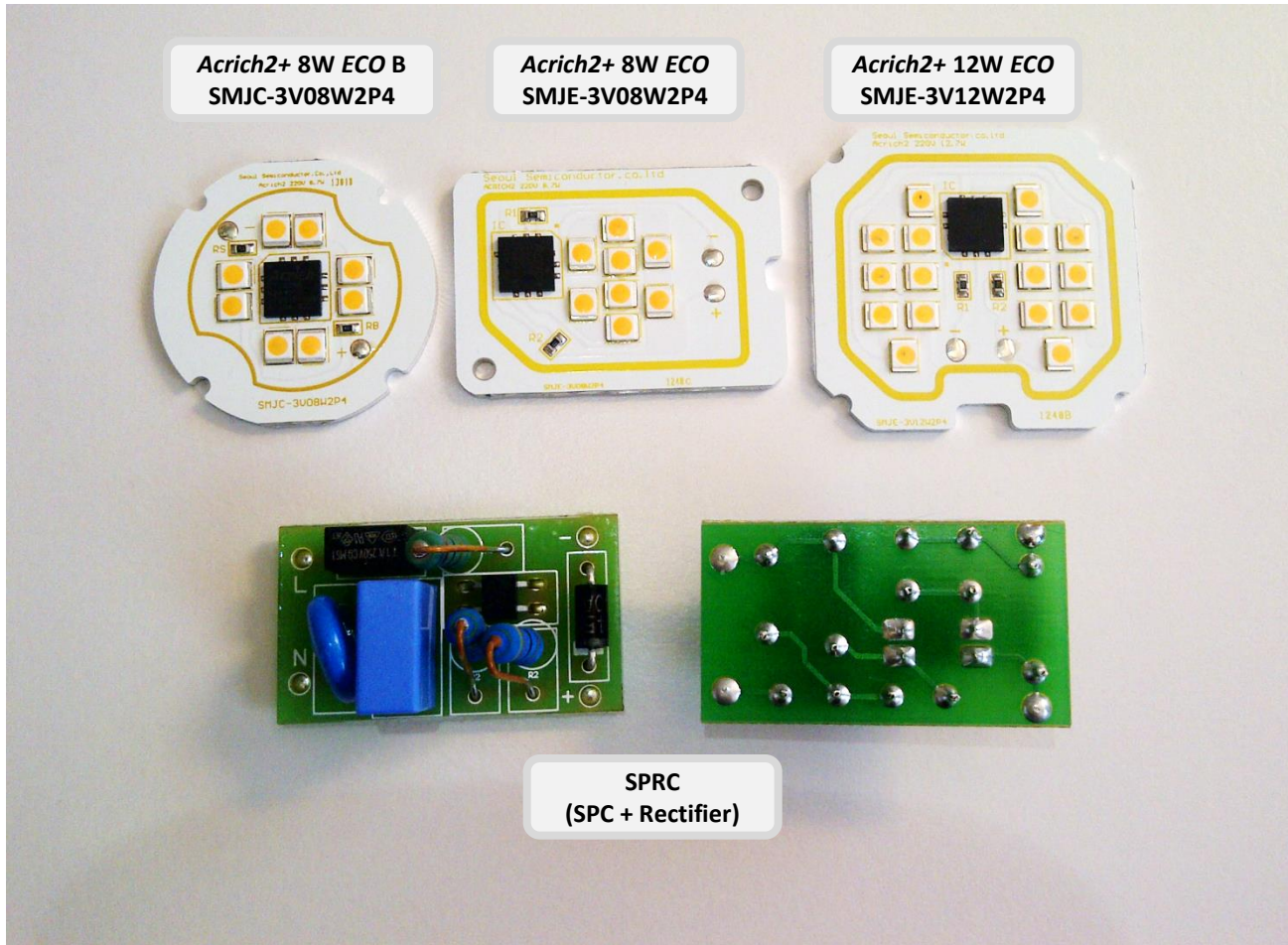
- Fuse: cuts of current when it is above nominal value of the fuse
- Varistor: shorts circuit when voltage is above nominal value
- TVS: in general, similar role as varistor
- Resistor: limits current in the circuit
- Capacitor: reduces voltage fluctuation and small peaks, improves EMI

**SPRC is the SPC with BridgeDiode on the same board (Surge Protection Rectifier Circuit).**



1. SPRC circuit for **Acrich2+ ECO** modules.

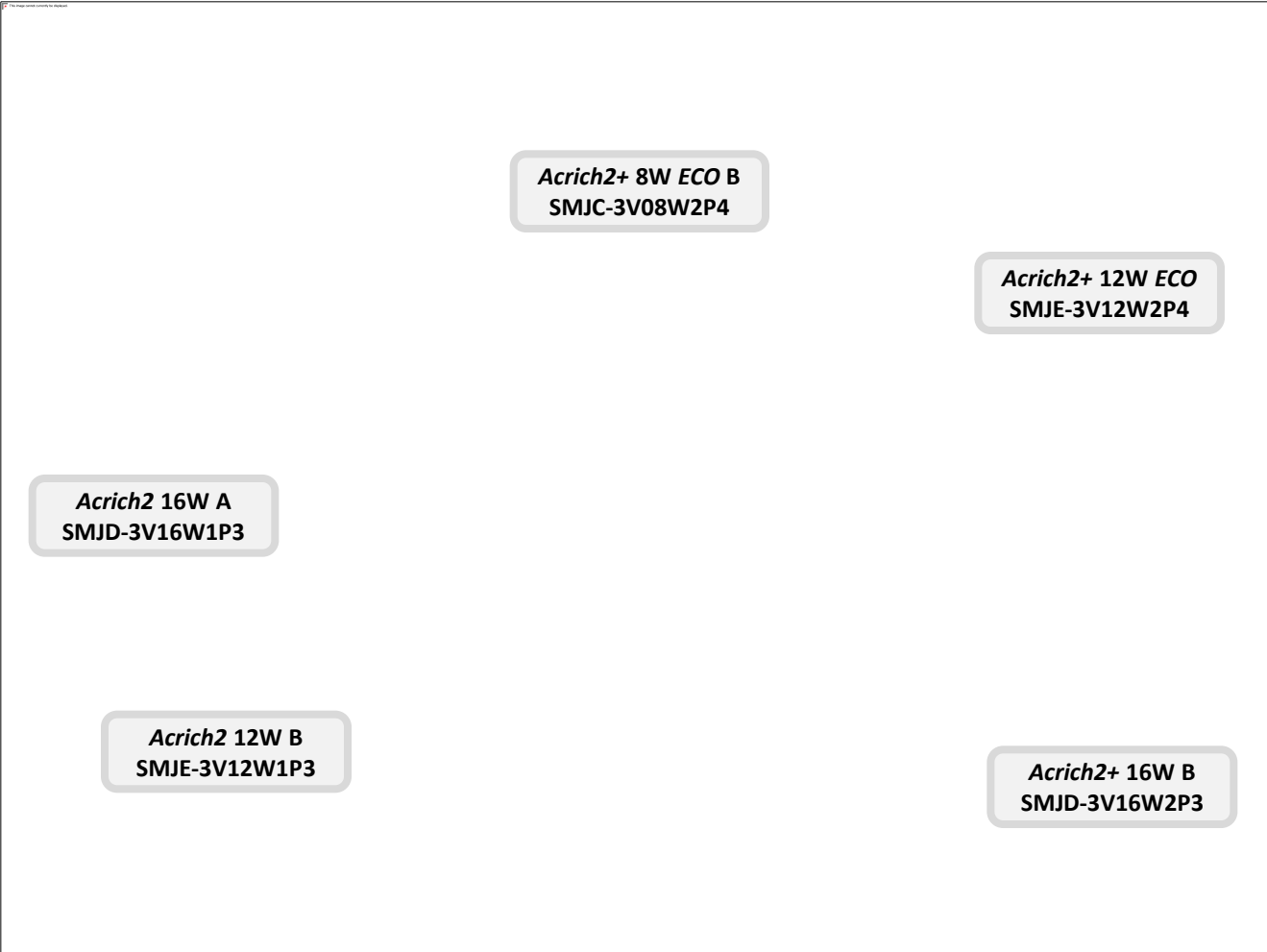
## 6. Acrich2+ Modules – ECO version



Acrich2+ ECO Modules with SPRC (top & bottom)



# 6. *Acrich2* Modules – scale overview and comparison



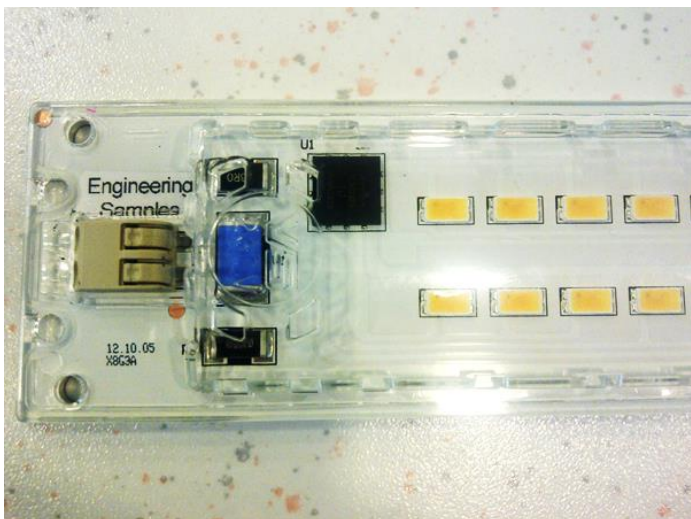
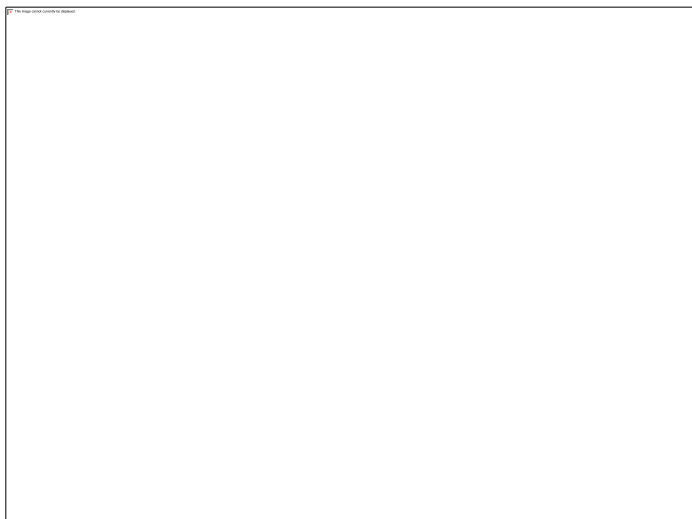
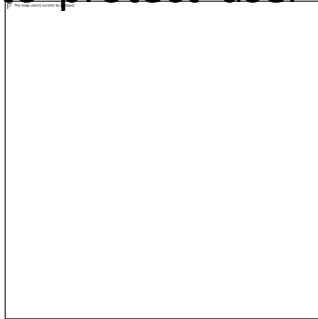
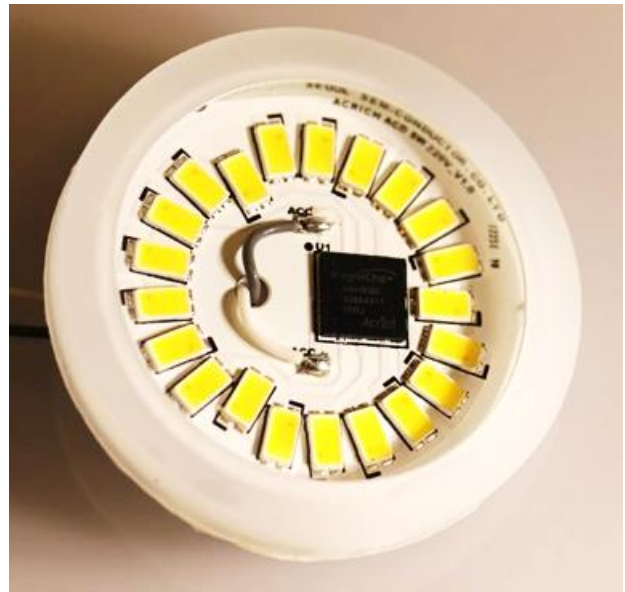
*Acrich2* Modules with Stabilo pen, 2€ coin, a pin and ruler (cm)

## 7. Increasing safety of *Acrich2* modules

*Acrich2* solutions operate in **230V AC**, which may be very dangerous with direct contact. Parts should be covered and out of reach by any accidental or aware touch.

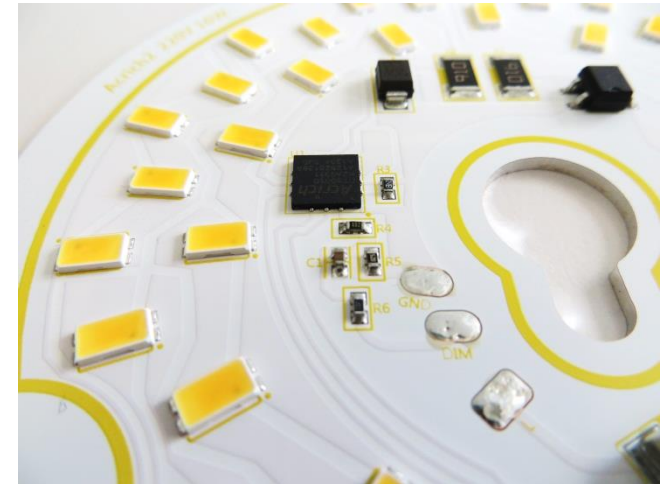
*Acrich2* modules are **not light engines**. Actions have to be taken by customer to protect user against electric shock.

To avoid dangerous accidents, it is recommended to use transparent covers, like on attached pictures.



## 8. Dimming

- **Industry wide Issue – Not just AC**
  - Must test dimmer/fixture combinations to verify performance
  - No dimming performance or interface standard
  - Legacy and backwards compatibility issues
  - Old technology used for new technology
- **Performance requirements**
  - Initial light Loss
  - Dead travel
  - Dimming curve
  - Minimum light level
  - Flicker
  - Noise
- ***Acrich2* modules will dim with some (not all) triac dimmers**
  - Different dimmers have different performance
    - Different manufactures
    - Different models from same manufacturer
  - Digital dimmers have worst performance
    - Internal dimmer circuit does not handle lack of current feedback well



*Acrich2+ SMJD-3D16W2P3*

# 8. Dimming

## ▶ Test Condition

- Source : 220 & 230V AC source
- Acrich 2+ 16W module(1KΩ Bleeder Resistor)

## ▶ Test results

- Leading edge dimmer (Non-compatible)



Legrand Trailing Edge Dimmer

1) Dead travel section / block, 2) Flicker, 3) Oscillation, 4) Abnormal wave form in Transient section (Bigger wave)

Dimmer Spec.					A2+				
No.	Country	Manufac.	Model	Voltage/ Freq.	Flicker range	Dead travel[1]	Noise	Dim range	Remark
1	EU	Xinbao Elec.	XB-TG-3	230/50	~ 90°	X	X	0 ~ 97%	-
2		DOYLE & TRATT	MAX LOAD 300	230/50	~ 90°	X	O	7 ~ 90%	-
3			MAX LOAD 300	230/50	~ 90°	X	O	5 ~ 83%	-
4		KOPP	8002	230/50	~ 80°	X	X	18 ~ 93%	No flicker @60Hz
5			8068	230/50	~ 90°	X	X	6 ~ 84%	-
6		GIRA	30200	230/50	Oscillation, All section with Flicker & Noise				
7		Merten	572599	230/50	~ 90°	X	X	3 ~ 96%	-
8		Licht-Management	JUNG	230/50	~ 90°	X	X	3 ~ 90%	-
9		BUSCH-JAEGER	2250U	230/50	Oscillation, All section with Flicker & Noise				
10		Legrand	Leading	230/50	~ 90°	O	X	0 ~ 75%	-
11			Trailing	230/50	X	X	X	5 ~ 80%	Good compatibility with Acrich
12		Unitec-1	-	230/50	Oscillation, All section with Flicker & Noise				
13		Unitec-2	-	230/50	~ 90°	X	X		-

## 8. Dimming – RELCO dimmers

Varialuce per moduli LED **Acrich<sup>2</sup>**  
Dimmer for **Acrich<sup>2</sup>** LED modules

**NEW**

[www.relcogroup.com](http://www.relcogroup.com)

**Relco** Since 1967 | **Leuci** Since 1918 | **VLM** Since 1945

Wide, universal offer + nice design



Designed for **Acrich<sup>2</sup>** technology!





# 8. Dimming – TELECO remote dimmers

**Dimmer for the manual or radio control of 230V Acrich2 modules.**

**Radio integrated:** TVDRL868A01 wireless and manual push button command.

**No radio integrated:** TVDRL000A01 manual push button command.

- Maximum power 100W.
- Minimum power 7W.
- Protected against short circuits.
- IN-OUT connection without additional wiring.
- Switching ON and OFF gradually.
- Minimum level settable.
- 4 preset and programmable scenes.
- Remote control with radio transmitter.
- Push button input.
- Stabilization circuit.
- Power supply 230Vac.
- Protection degree IP20.



**Advantages:**

- Easy IN and OUT wiring with no need of additional wires
- Preprogrammed

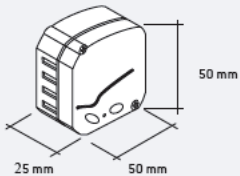
**For the wireless control of:**

- Acrich2 modules  
8,7W - 13W - 17W - 17,5W

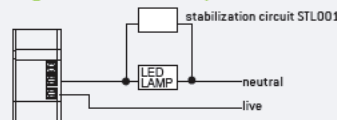
**Stabilization circuit - STL001**

The stabilization circuit must be connected in parallel to the load.

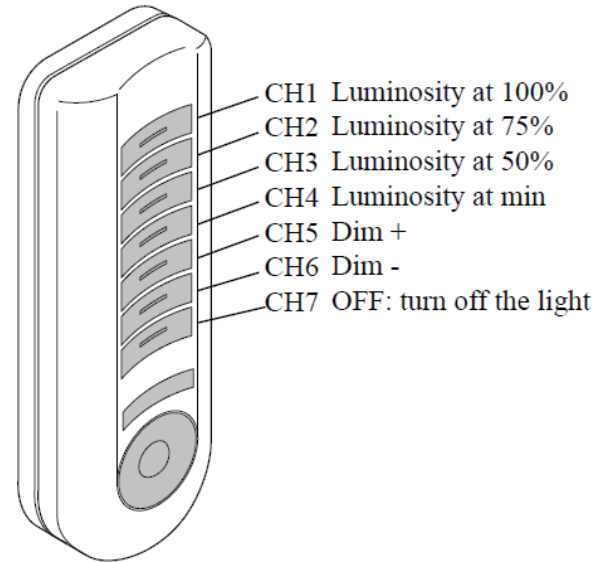
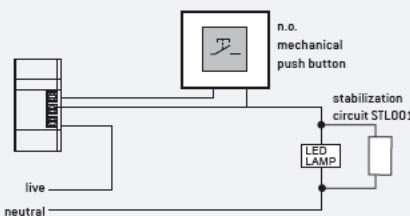
**Dimensions**



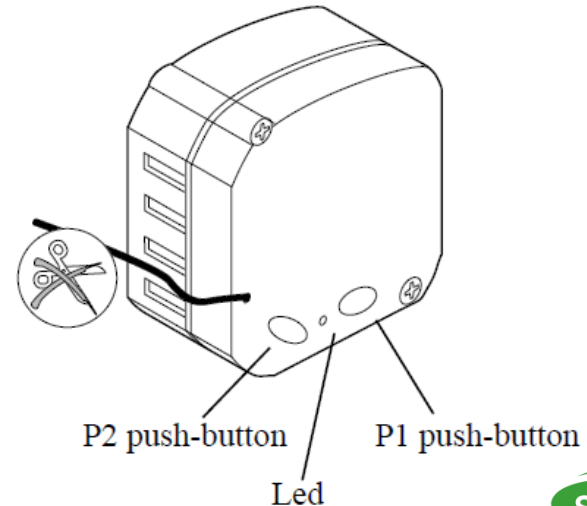
**Wiring without mechanical push button**



**Wiring with mechanical push button**



Designed for **Acrich2** technology!



# 8. Dimming

## Analog dimming 0-10V / PWM

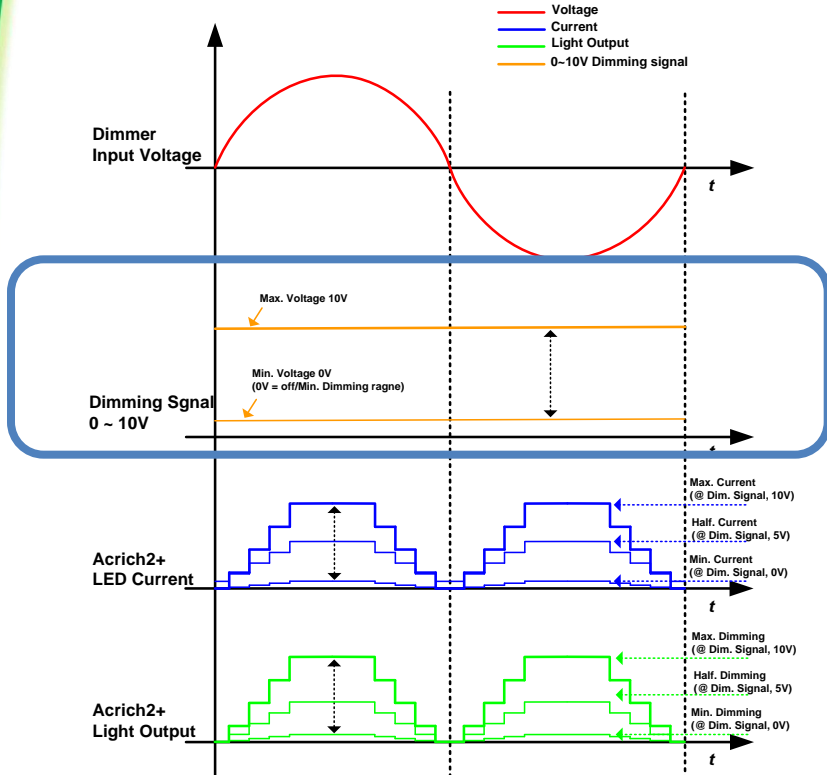


Figure 1. Analog Dimming Timing chart

**Acrich2+ 16W**  
**SMJD-3D16W2P3**

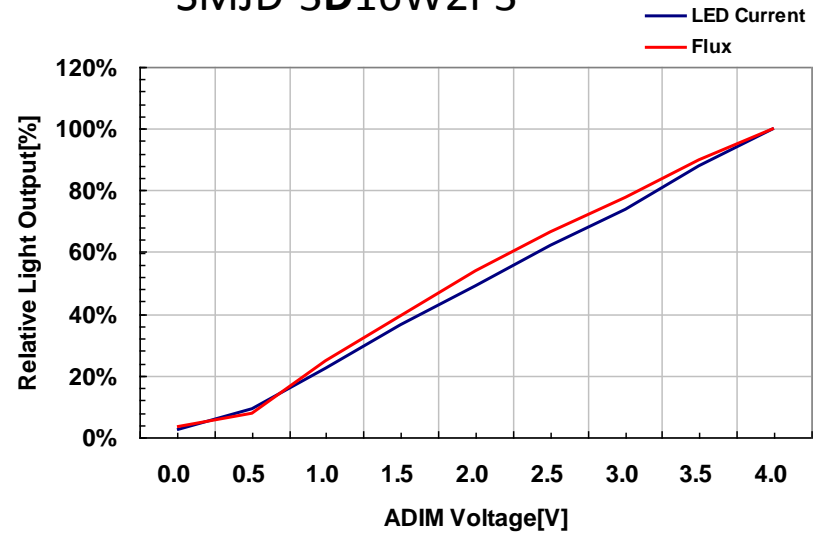


Figure 2. Analog Dimming Curve  
(Measurements performed at Acrich2+ 16W Module, set to have 100% at 4V of analog dimming voltage)

Table 1. Specification of ADIM

Input Signal	DC Voltage [Vdc]	PWM (Pulse Width Module)	Relative Light Output [%]
Minimum	0	Max. Amplitude : 10V	2~5 (Typ. 5%)
Maximum	10	Duty Ratio : 0~100% (@20~30kHz)	100



# 9. Certifications



## NOTICE OF AUTHORIZATION TO APPLY THE UL MARK

02/06/2012

Seoul Semiconductor  
Mr. Hyunwoo Paik  
1b-36, 727-5 Wonsi-dong  
Danwon-gu  
Ansan-city Kyunggi-do 425-851, Kr

Our Reference: File E315508, Vol. 1 Project Number 11CA60662  
Your Reference: PAIK, HYUNWOO MR.  
Project Scope: Component, LED Modules, Model SMJEA3012220, SMJEA3011220

Dear Mr. Hyunwoo.Paik:

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.

ZERTIFIKAT ◆ CERTIFICATE ◆ 认证证书 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT



## CERTIFICATE

No. B 12 12 64846 012

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

**Production Facility(ies):** 64846

**Certification Mark:**



**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

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

**Test report no.:** CPSA0144742

*(Signature)*  
( Ian Young-Yul Hwang )



**Date,** 2012-12-20

Page 1 of 1

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

TUV®

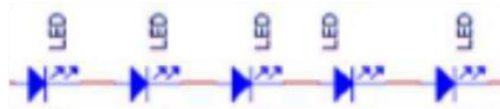
→ Not done for each module but one each as example



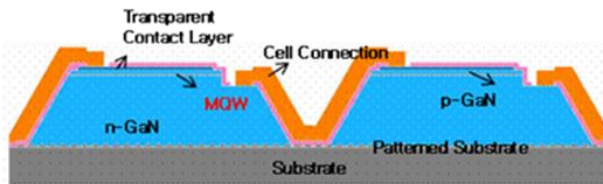
# 10. Multi Junction Technology

## What is MJT

- MJT is a acronym for **M**ulti **J**unction **T**echnology
- MJT features a serial connection of numerous LED segments **on one chip**



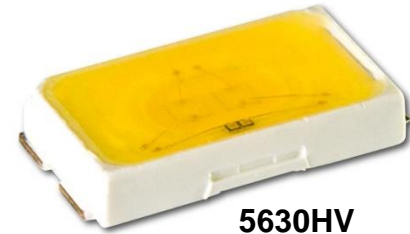
- MJT utilizes no wire bonds to connect the LED segments on the chip



- MJT is based on InGaN to emit blue light.



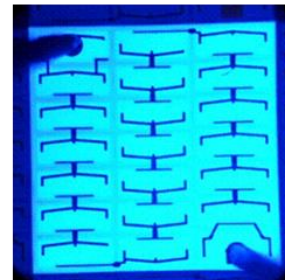
3528HV



5630HV

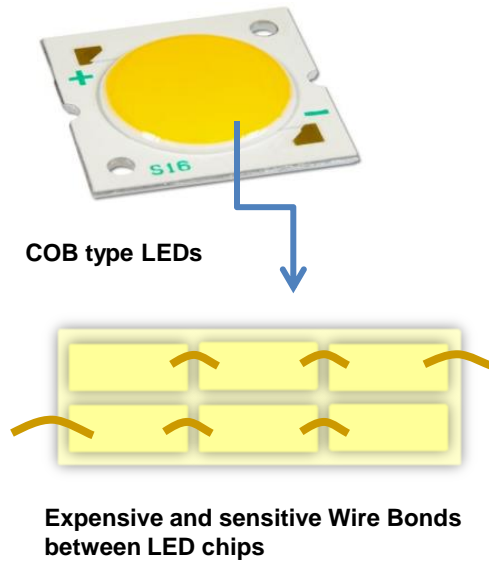


4040HV

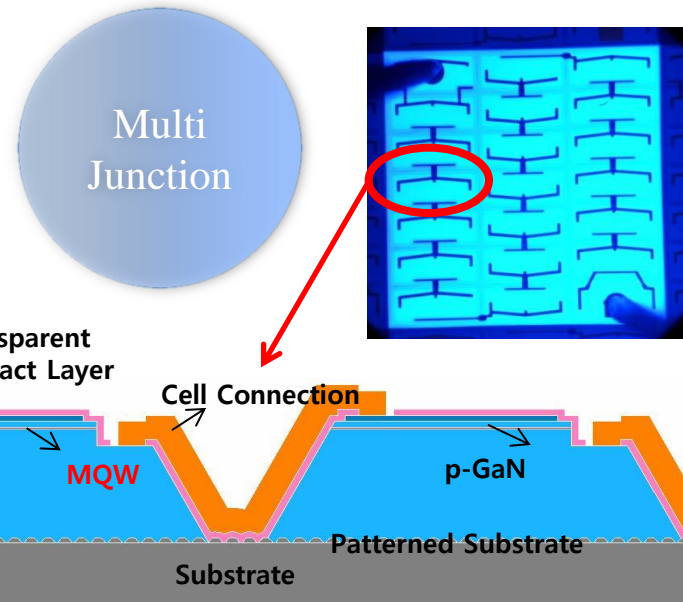


# 10. Multi Junction Technology

- Free to cover DC and AC by Patented Multi Junction Technology
- Less Process, Less Chip, Less Wire-> Better Yield
- 19~32V of Safety Extra-Low Voltage
- MJT has higher reliability than COB
- MJT requires less space than COB

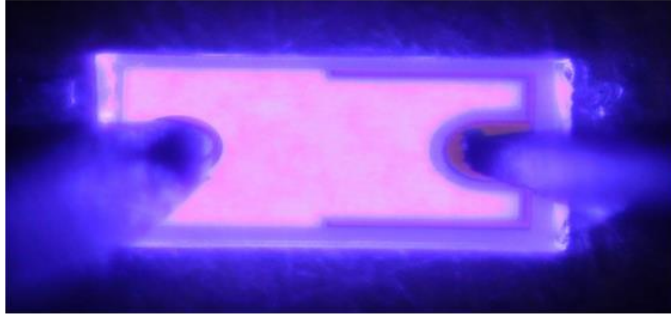


VS

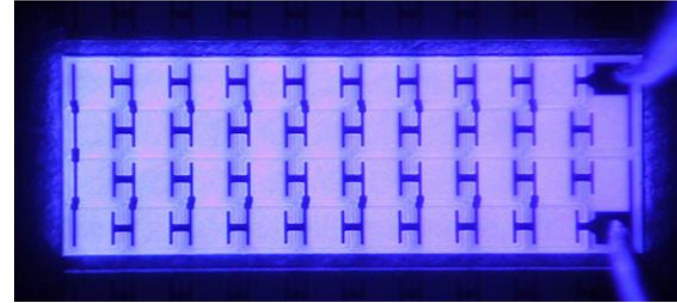


# What is MJT

5630HV



Standard LED  
Single P-N Junction



Acrich LED  
Multiple P-N Junctions  
Single Monolithic Chip

The Number of Cells can be changed based on performance required  
Multiple Cells can be combined in a package

## Advantages of MJT

- ✓ MJT creates a high voltage LED (up to 69V DC) but use of only one single chip
- ✓ MJT is **NO Chip on board COB** (many single chips on one pcb)
- ✓ MJT is a patented technology by Seoul Semiconductor
- ✓ SSC MJT uses approved popular mid power packages
- ✓ Full ANSI color range available
- ✓ LM 80 tested (5630HV) or test ongoing
- ✓ New driver concepts feasible
  - ✓ No conversion from 230V AC down to 24V DC necessary
    - 5630HV  $V_f = 22V$
    - 5630LV  $V_f = 3.1V$
  - ✓ Components for drives can be reduced or eliminated (e.g coil)
    - **cost and space for driver goes down**



**Acrich2**  
Semiconductor EcoLight



**5630HV**



# SSC: MJT Packages Overview

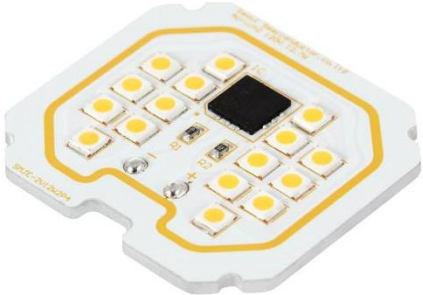
Flux [lm]	 SAW8P42A	 SAW8KGOB	 SAW8WA2A	 SAW09H0A
180lm				<b>4040</b>
130lm			<b>3528</b>	
80lm				
30lm	<b>6540</b>	<b>5630</b>		
	30 lm 20mA, 13V <b>0.25W</b>	43 lm 20mA, 22V <b>0.4W</b>	120 lm 40mA, 32.5V <b>1.3W</b>	165lm 20mA, 65V <b>1,3W</b>

Values based on DC conditions

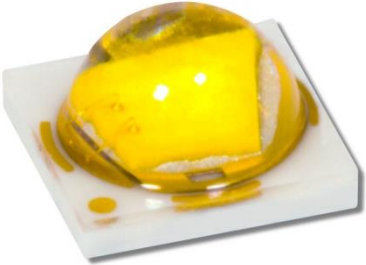




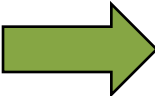
# But not only *Acrich2* offers benefits...



**Acrich2+ ECO 12W  
SMJE-3V12W2P4**



**HighPower Z5M  
SZ5-M0-WW-C8**



**Example Downlight  
Fixture**



**MidPower New3030  
STW8C2SA**





**SEOUL SEMICONDUCTOR**

# ***Acrich Success Story***

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*Oct, 2013*

# Application for MJT5630 (Success story)



4.5W GU10



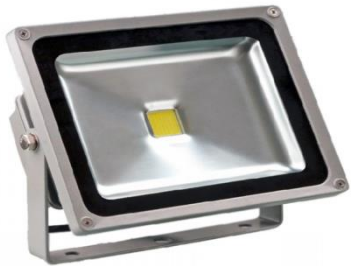
9W Bulb



13W CFL



BR lamp



Flood light



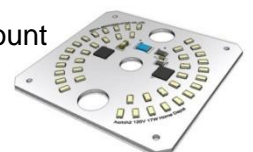
LED engine



6" inch down light



Flush mount



# About **Acrich2** Win Case

SMJE-3V08WPOS



[Size :  $\Phi$  46mm]

Application



9W Bulb

Specification

Parameter	Symbol	Value (Typ.)		Unit
Luminous Flux	$\Phi_v$	800	700	lm
Color Temp.	CCT	5000	3000	K
CRI	$R_a$	82		-
Operating Voltage	$V_{opt}$	220		V[RMS]
Power (D)	$P_D$	8.9		W

RFP

SOP

Success points

Jan-`12

July-`12

**Extended supports**

( Close relationship )

**Simple design**

( Fast adoption )

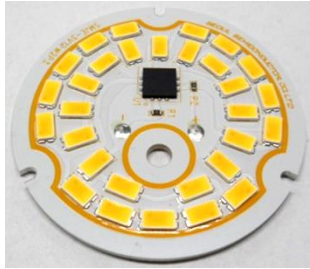
Customer	'P', Korea
Application	Bulb
Acrich product	MJT5630 / Acrich2 IC with SPC
USP	<ol style="list-style-type: none"> <li>1. Low Profile (Thanks to High Voltage)</li> <li>2. Competitive Price (low cost converter)</li> <li>3. Small &amp; Compact converter size</li> </ol>

# About **Acrich2** Win Case

SMJE-3V12WPOS

Application

Specification



[Size :  $\Phi$  50mm]



13W CFL

Parameter	Symbol	Value (Typ.)		Unit
Luminous Flux	$\Phi_v$	1200	1020	lm
Color Temp.	CCT	5000	3000	K
CRI	$R_a$	82		-
Operating Voltage	$V_{opt}$	220 / 120		V[RMS]
Power (D)	$P_D$	12.7		W

RFP

SOP

Success points

Dec-`12

Feb-`13

**Extended supports**

( Close relationship )

**Simple design**

( Fast adoption )

Customer	'P', Korea
Application	Bulb (CFL)
Acrich product	MJT5630 / Acrich2 IC with SPC
USP	<ol style="list-style-type: none"> <li>1. Low Profile (Thanks to High Voltage)</li> <li>2. Competitive Price (low cost converter)</li> <li>3. Small &amp; Compact converter size</li> </ol>

# About **Acrich2** Win Case

## Custom module



[Size :  $\Phi$  70mm]

## Application



6" inch down light

## Specification

Parameter	Symbol	Value (Typ.)		Unit
Luminous Flux	$\Phi_v$	1350	1200	lm
Color Temp.	CCT	5000	3000	K
CRI	$R_a$	82		-
Operating Voltage	$V_{opt}$	220		V[RMS]
Power (D)	$P_D$	15		W

RFP

SOP

Success points

Dec-`12

Feb-`13

**Extended supports**

( Close relationship )

**Simple design**

( Fast adoption )

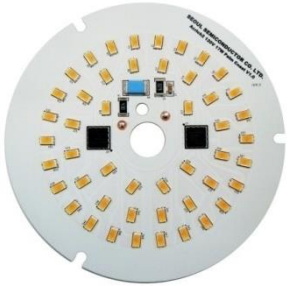
Customer	'H', Korea
Application	Down light
Acrich product	MJT5630 / Acrich2 IC with SPC
USP	1. Easy, Simple 2. Competitive Price

# About **Acrich2** Win Case

SMJD-HD120V17

Application

Specification



[SMJD-PC120V17]



Flush mount

Parameter	Symbol	Value (Typ.)	Unit
<b>Luminous Flux</b>	$\Phi_V$	<b>1,450</b>	lm
<b>Color Temp.</b>	CCT	3000	K
<b>CRI</b>	$R_a$	82	-
<b>Operating Voltage</b>	$V_{opt}$	120	V[RMS]
<b>Power (D)</b>	$P_D$	17	W

RFP

SOP

Success points

Dec-`11

Aug-`12

**Niche application**  
( Flush mount )

**Win-Biz**  
(N.A & China team work)

<b>Customer</b>	'P', 'H', USA
<b>Application</b>	Flush mount
<b>Acrich product</b>	MJT5630 / Acrich2 IC with SPC (Custom module)
<b>USP</b>	1. Easy, Simple 2. Competitive Price

# Application for MJT3528 (Success story)

## SAW8WA2A

[MJT 3528 10 cell]



## Application

AC-DC Converter space ↓



Parameter	Symbol	Value (Typ.)	
Luminous Flux	$\Phi_V$	132	124
Color Temp.	CCT	3,700-7,000	2,600-3,700
CRI	$R_a$	82	
Operating Voltage	$V_{opt}$	40	
Power (D)	$P_D$	1.3	

**Peanut Bulb (1 LED)**    **G9 lamp (4 LEDs)**    **Candle lamp (4 LEDs)**

**CCT : 6000, 2900K**    **CCT : 4000, 2700K**    **CCT : 3000, 2700K**

1. Compact size
2. Low power (Krypton, G lamp)
3. Low cost solution (THD, PF)



YOU CREATE THE FORM  
WE CREATE THE LIGHT



Thank You



SEOUL

Better Be Bright.