

*“A Company of Good People”*

# Acrich 2

*Bloc Meeting Oct, 2011*



**SEOUL SEMICONDUCTOR**

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

## ■ Introducing new family of Acrich 2

World Top LED

### - Acrich 2 Family

| Power | Voltage (typ) | Luminous flux (min) | Luminous flux (typ) | Diameter | Available |
|-------|---------------|---------------------|---------------------|----------|-----------|
| 4W    | 230V          | 280lm               | 330lm               | 28mm     | Now       |
| 8W    | 230V          | 550lm               | 640lm               | 46mm     | Now       |
| 12W   | 230V          | 830lm               | 970lm               | 50mm     | Now       |
| 16W   | 230V          | 1050lm              | 1250lm              | 60mm     | Q2 2012   |

**4 W**



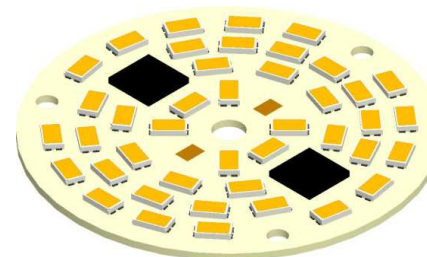
**8 W**



**12 W**



**16 W**



## ■ Introducing new family of Acrich 2

---

World Top LED

### -Acrich 2 Family

#### -Advantage

- Direct connection to AC power via 2 wires
- No separate AC-DC converter is needed
  - Low circuit cost
  - Reduce lamp weight
  - Lower power dissipation for better thermal management
  - Speeds up time to market
  - Long lifespan as converter (capacitor) is limiting factor
- Power efficiency higher than 90%
- Dimmable
- Reduced flicker

# ■ Introducing new family of Acrich 2

---

World Top LED

## -Acrich 2 Family

### -Target Markets

- Bulb replacement
- MR
- Downlight

### -Sales Material

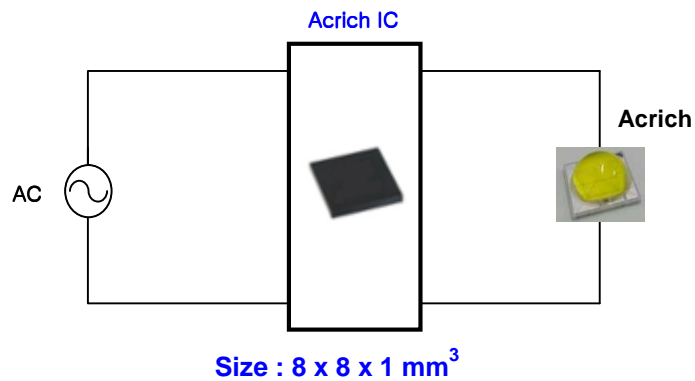
- Data sheet on our website (except 16W)
- Application note on our website
- Sales ppt presentation „Acrich 2 salespoint\_ FN\_ FN.ppt“ (distributed by mail)
- Samples in sufficient number for each of the 4 types (shipped 04.11.2011)

## ■ What is different?

### □ Acrich IC vs AC-DC converter

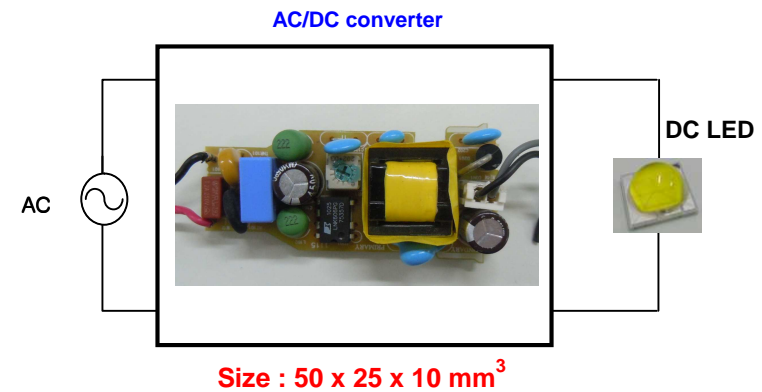
- ✓ Designing light bulb with Acrich 2 is the simplest way to minimize the number of component and space
- ✓ Only one component of LED can achieve cost reduction with its simple design

Acrich 2 Solution



- ✓ Only one external component

AC-DC converter + DC LED

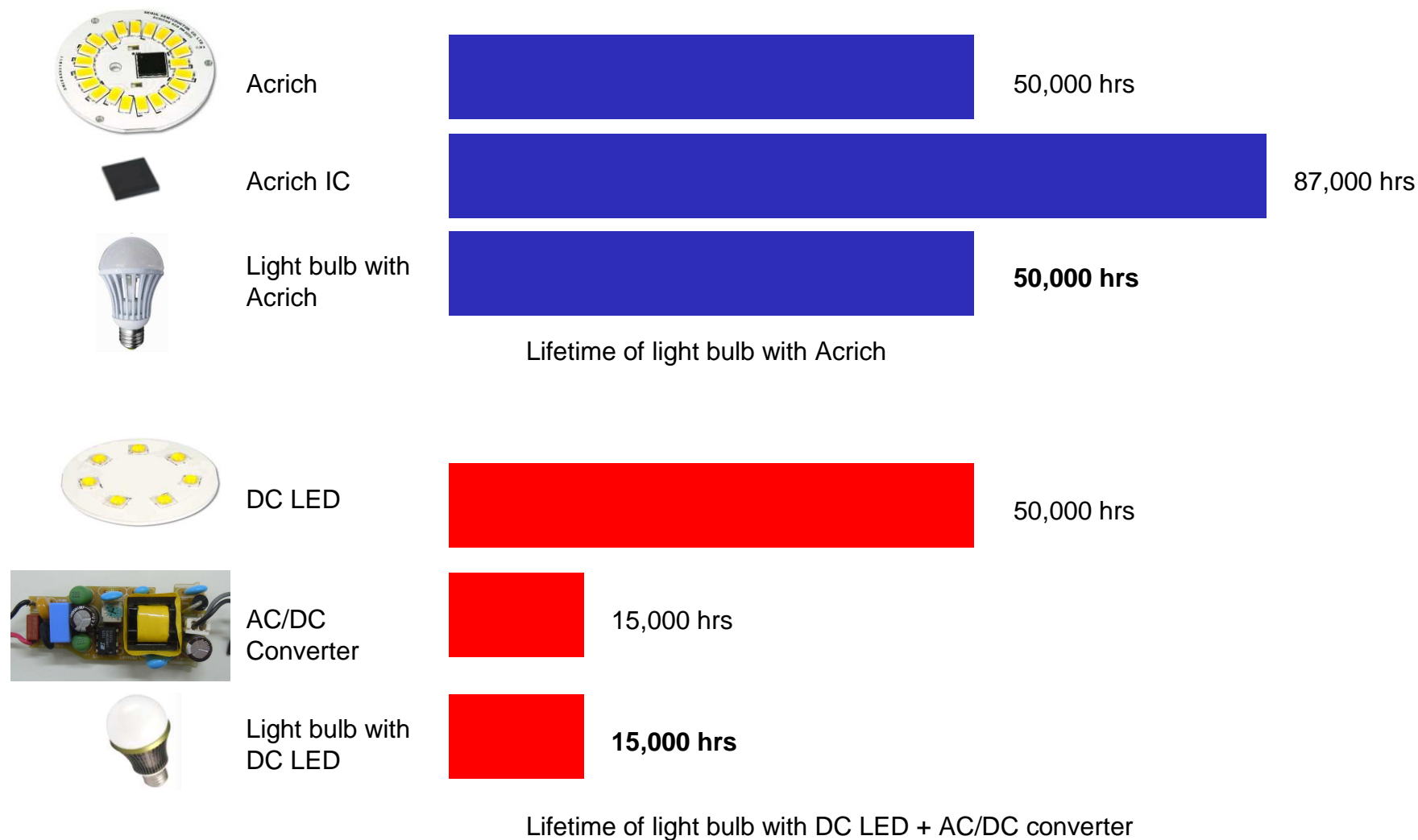


- ✓ Multiple components : 20~30ea

## What is different?

### □ Acrich 2 vs DC LED



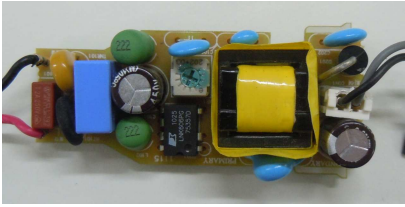
✓ A LED bulb lasts 50,000 hrs with Acrich 2.



## ■ What is different?

### □ Acrich 2 vs DC LED


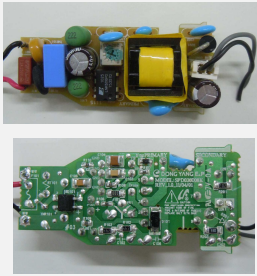
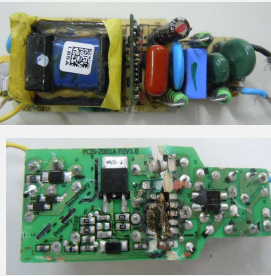
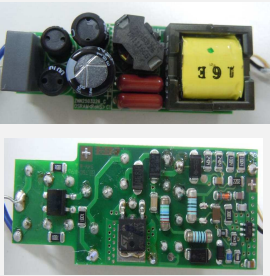
✓ Acrich 2 is the best solution in terms of power efficiency and THD.

|                    | Acrich 2   | DC LED   |
|--------------------|--|--|
| Circuit            |  | <br> |
| ✓ Power Efficiency | $\geq 90 \%$   | 75 ~ 85%   |
| ✓ Power Factor     | 0.95~0.97  | 0.5~0.9  |
| ✓ THD              | 10~25%   | 10~140%  |

## ■ DC module VS ACD module comparison

### □ Comparison chart – 8 W bulb, 220 V

✓ Acrich 2 is competitive !!!

|                               | Bulb  |  |   |   |                 |
|-------------------------------|---|--|---|---|-----------------|
|                               | ✓ Acrich 2  | A Company  | B Company   | C Company   | Remark          |
| Circuit                       | Acrich IC   | AC-DC Converter (electrolytic cap)   | AC-DC Converter (electrolytic cap)  | AC-DC Converter (electrolytic cap)  |                 |
| Circuit                       |  |  |  |  |                 |
| Relative lifetime (CAP temp.) | 100 % (NO cap)  | 22 % (70℃)   | 22 % (72℃)  | 16 % (80℃)  | Refer to P33~35 |
| Relative apparent power (PF)  | 100 % (0.97)  | 155 % (0.54)   | 87 % (0.96)   | 109 % (0.82)  | Refer to P36    |
| THD [%]                       | 23 %  | 65 %   | 9.1 %   | 25.9 %  |                 |
| Power [W]                     | 8.7 W   | 7.5 W  | 7.5 W   | 7.9 W   |                 |
| Efficacy [lm/W]               | 72 lm/W   | 75 lm/W  | 71 lm/W   | 54 lm/W   |                 |
| Driver Efficiency [%]         | 90 %  | 81 %   | 84 %  | 80 %  |                 |
| Flux [lm]                     | 615 lm  | 550 lm   | 523 lm  | 428 lm  |                 |

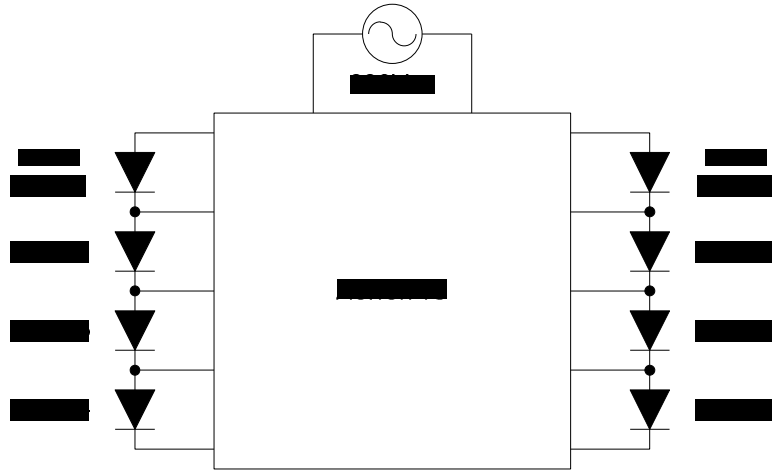
※ Condition. : CRI : 82 / CCT : 3000 K



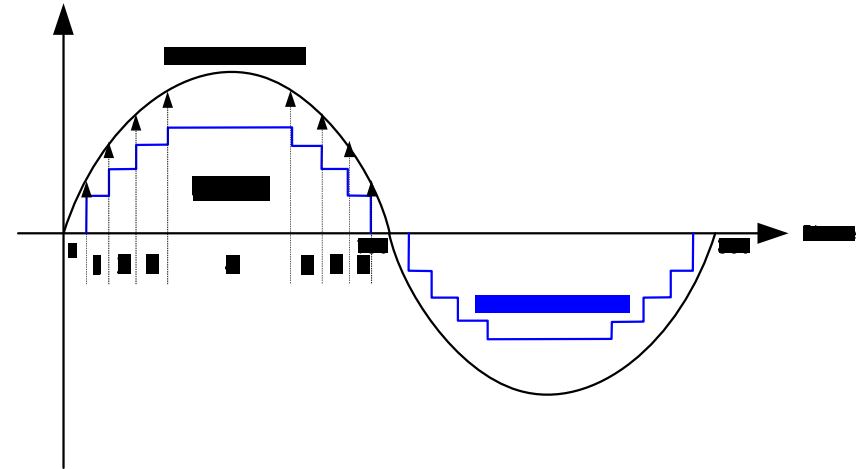
## ■ How Acrich IC works in Acrich 2

### □ Functional Description of Acrich 2 (Ex. 220V 8W application)

Circuit Diagram of Acrich 2



AC Input Current Wave  
( = Acrich's Driving Current )



### Description of the Acrich's Operation

- ◆ Operation of the Acrich group 1~4 same as a group 5~8
- ◆ Operation table of each Acrich group ( phase 0 ~ 180° )

| Region  | 1   | 2   | 3   | 4  | 5   | 6   | 7   |
|---------|-----|-----|-----|----|-----|-----|-----|
| Group 1 | ON  | ON  | ON  | ON | ON  | ON  | ON  |
| Group 2 | OFF | ON  | ON  | ON | ON  | ON  | OFF |
| Group 3 | OFF | OFF | ON  | ON | ON  | OFF | OFF |
| Group 4 | OFF | OFF | OFF | ON | OFF | OFF | OFF |

## Why Acrich IC ?

1. System Efficacy?
2. Power Factor?

## ■ System Efficacy

World Top LED

□ Driver efficiency is proportional to system efficacy.

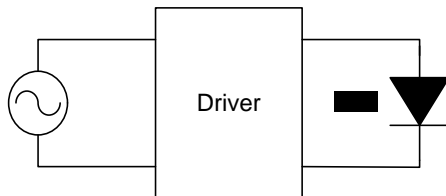
✓ Power efficiency of Acrich IC is greater than 90% while power efficiency of AC-DC converter is 75 ~ 85%.

$$\text{System Efficacy [lm/W]} = \frac{\text{Total Flux}}{\text{Input Power}} = \text{LED PKG Efficacy} \times \text{System Efficiency}$$

- Total Flux : Lumen which emit out of lamp [lm]
- Input Power : Active power [W] (lamp power consumption)
- System Efficiency = Driver Efficiency X Thermal Efficiency X Optical Efficiency

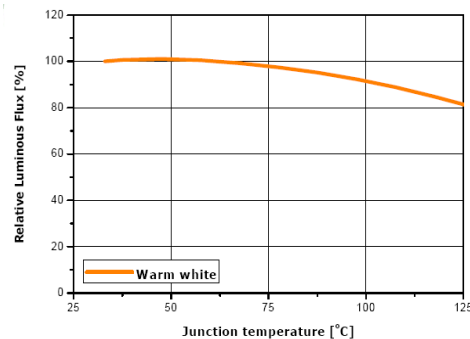
### Driver Efficiency [%]

$$= \frac{\text{LED power consumption}}{\text{Total input power consumption}}$$



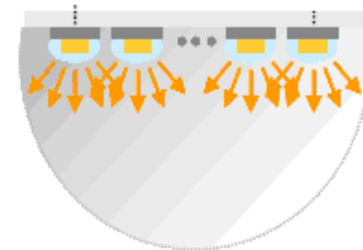
### Thermal Efficiency [%]

$$= \frac{\text{Lamp Flux (at thermal saturation)}}{\text{Lamp Flux (initial)}}$$



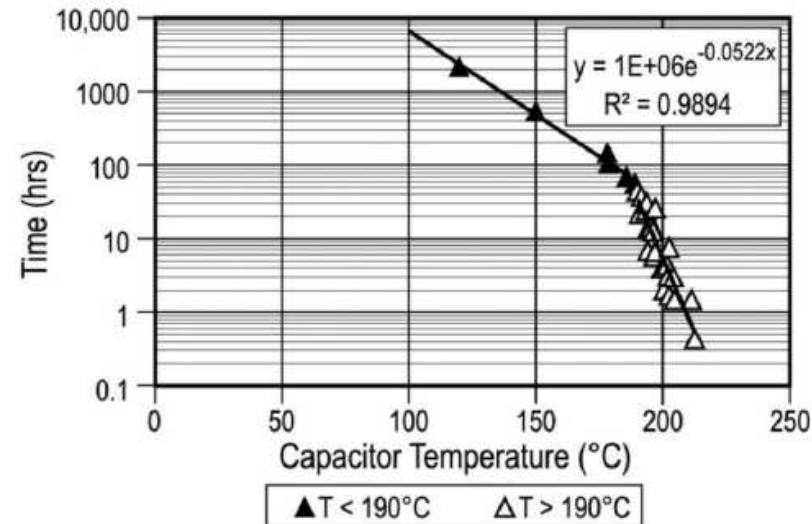
### Optical Efficiency [%]

$$= \frac{\text{Lamp Output Flux}}{\text{PKG Total Flux}}$$



## Life time of Electrolytic Capacitor

### Research data from RPI



< Electrolytic capacitor's lifetime with exponential curve fitting >

|  |        |        |       |       |
|--|--------|--------|-------|-------|
| $T_{\text{AMBIENT}}(^{\circ}\text{C})$                 | 70℃    | 70℃    | 70℃   | 70℃   |
| $T_{\text{ELECTROLYTIC\_CAPACITOR}}(^{\circ}\text{C})$ | 80℃    | 85℃    | 90℃   | 95℃   |
| Lifetime prediction (hrs)                              | 15,360 | 11,831 | 9,113 | 7,020 |

Manufacturer : Nichicon, Aluminum Electrolytic Capacitor, PW Series – Long Life, (@ 105℃ 4000 to 8000hrs)

※ Source : “An Accelerated Test Method for Predicting the Useful Life of An LED Driver,” IEEE Trans. Power Electronics, vol. 26, no. 8, Aug. 2011.

# Life time of Electrolytic Capacitor

## Rubycon – PX Series, General Purpose

< Lifetime Estimation >

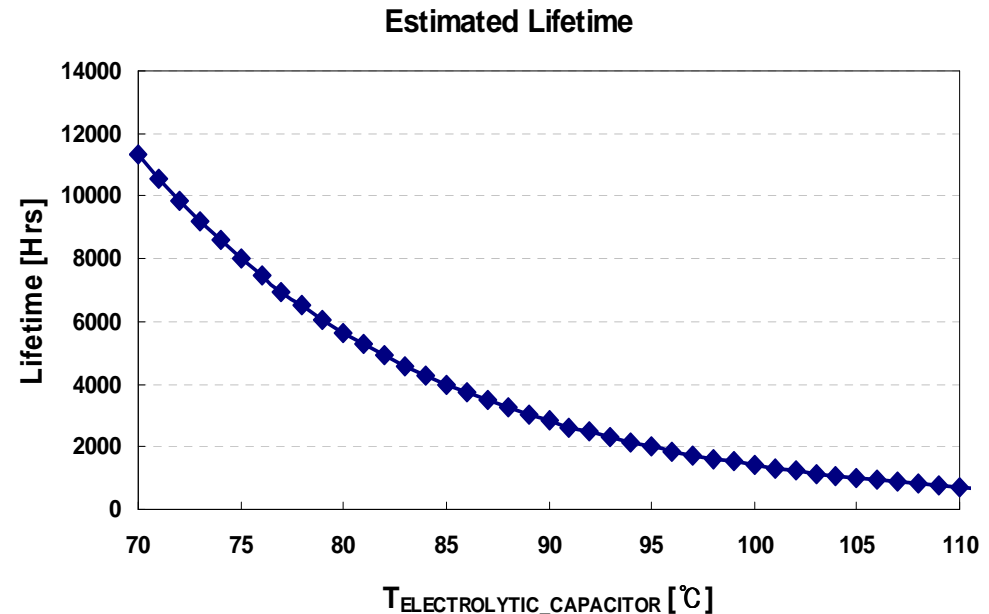
$$L = L_0 \times 2^{\frac{T_{\max} - T_a}{10}}$$

L : Estimated lifetime (Hrs)

L<sub>0</sub> : Lifetime at rated Temperature (Hrs)

T<sub>max</sub> : Rated Temperature (°C)

T<sub>a</sub> : Ambient Temperature (°C)



|  |       |       |       |       |
|--|-------|-------|-------|-------|
| T <sub>AMBIENT</sub> (°C)                | 70°C  | 70°C  | 70°C  | 70°C  |
| T <sub>ELECTROLYTIC_CAPACITOR</sub> (°C) | 80°C  | 85°C  | 90°C  | 95°C  |
| Estimated Lifetime (hrs)                 | 5,656 | 4,000 | 2,828 | 2,000 |

Manufacturer : Rubycon, Aluminum Electrolytic Capacitor, PX-Series, General purpose (@ 105°C 1000hrs)

# Life time of Electrolytic Capacitor

## Rubycon – RX50 series, General Purpose

< Lifetime Estimation >

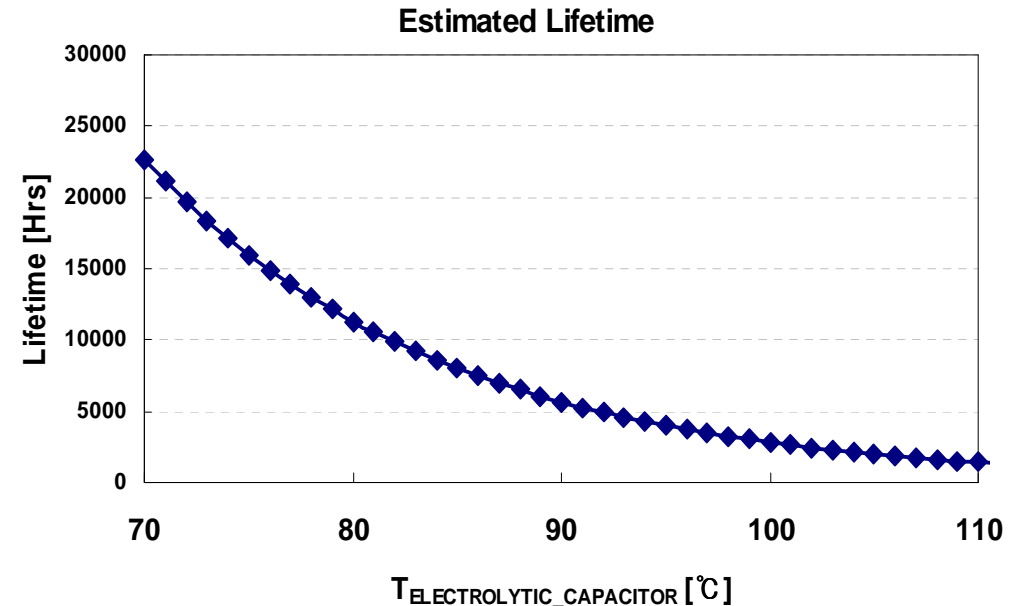
$$L = L_0 \times 2^{\frac{T_{\max} - T_a}{10}}$$

L : Estimated lifetime (Hrs)

L<sub>0</sub> : Lifetime at rated Temperature (Hrs)

T<sub>max</sub> : Rated Temperature (°C)

T<sub>a</sub> : Ambient Temperature (°C)



|                             |        |       |       |       |
|-----------------------------|--------|-------|-------|-------|
| T <sub>AMBIENT</sub> (°C)   | 70°C   | 70°C  | 70°C  | 70°C  |
| T <sub>CAPACITOR</sub> (°C) | 80°C   | 85°C  | 90°C  | 95°C  |
| Estimated Lifetime (hrs)    | 11,313 | 8,000 | 5,656 | 4,000 |

Manufacturer : Rubycon, Aluminum Electrolytic Capacitor, RX50-Series, Low Impedance. (@ 105°C 2000 Hrs)

### □ What is Power Factor

$$\triangleright \text{Power Factor} = \frac{\text{Active Power [W]}}{\text{Input Apparent Power [VA]}}$$

The power factor of an AC electric power system is defined as the ratio of the real power flowing to the load over the apparent power in the circuit, and is a dimensionless number between 0 and 1 (frequently expressed as a percentage, e.g. 0.5 pf = 50% pf). Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the current and voltage of the circuit. Due to energy stored in the load and returned to the source, or due to a non-linear load that distorts the wave shape of the current drawn from the source, the apparent power will be greater than the real power.

※ Power loss is inversely proportional to power factor.

| Active Power | Power Factor | Apparent electric power | Power Loss |
|--------------|--------------|-------------------------|------------|
| 8 W          | 0.5          | 16.0 VA                 | 8.0 VA     |
|              | 0.8          | 10.0 VA                 | 2.0 VA     |
|              | 1.0          | 8.0 VA                  | 0.0 VA     |

## ■ Introducing new family of Acrich 2

---

### **-Acrich 2 Family - Questiones and answers**

**-Is there UL listing**

- UL approval is expected for Dez 2011

**-Is there a eye safety test report**

- Eye safety is done on the LED (not the module). Test report is expected for end of Nov.

**-Is there a LM 80 report**

- LM 80 Test is started. As of the amount of test hours (6000h) final report is expected for Q3 2012

**-Is only 3000K available**

- Other CCT than 3000K is possible. If there is a customer need for a different CCT we have to feedback HQ

**- What color binning is available**

- Right now we offer the main Bins G and H. A subbinning, as with our other products in 6 Bins per main bin, is planned

**-Is there information on Tj, Rth, dielectric strength**

- Data shets will be updated in November and include this information



### **-Acrich 2 Family - Questiones and answers**

- Is there a luminous flux binning**
  - Not right now.**
  
- What are our expectations on intensity for the future**
  - We expect an increase of luminous flux of 5% per quarter.**
  
- Is there an application note on thermal management**
  - This will be released in November 2011**
  
- Why is flickering improved compared to former products**
  - Based on the used IC we could reduce the off time of the LED remarkable.  
Therefore there is no impression of flickering any more**
  
- Do we suggest an optic for the 4W unit for MR**
  - We are in conact with a lens manufacturer and expect samples begin of 2012**