Inside an AC LED Module
How Acrich2 Modules Operate

Seoul Semiconductor's latest innovation in off-line LED technology is a family of module solutions called Acrich2. Utilizing two key technologies, Acrich Multi-Junction Technology (MJT) LEDs and Acrich2 Integrated Circuits, these modules were designed to make it easy for lighting designers to use LEDs, reduce time to market and eliminate component count for solid state lighting solutions. Acrich2 modules eliminate the electrical design portion of using LEDs as a light source and allow the lighting designer to focus on the luminaire design. This technical bulletin outlines how the components inside the Acrich2 module operate and how they are combined to produce AC LED modules for more efficient and denser light sources.

Specialized LEDs

The Acrich MJT LEDs have a die made up of multiple 3.0V forward voltage drops unlike standard LEDs that have a single 3.0V forward voltage drop. They can be made in a variety of different packages sizes, lumen outputs and forward voltage options. The table below shows the different types of MJTs available. Greater details on Acrich MJT LEDs can be found in our white paper 'A Different Type of High Voltage LED'.

Part Number	Color Temp	Flux [lm]	VF	If (mA)	Product Image
SAW8KG0B	3700-7000K	42.8	22	20	
	2600-3700	37.8			
SAW8P42A	3700-7000K	29	12.6	20	
SAW8WA2A	3700-7000K	120	33	40	
	2600-3700	110		40	
SAW09HOA	4200-6000K	165	64	20	

A Unique Driver Device

The Acrich2 IC is a unique power switching circuit designed for creating LED modules that operate directly from line voltage. The IC operates in conjunction with an array of high-voltage LEDs by first rectifying the input voltage, and then matching the voltage to sections of the high voltage array (banks of LEDs) in successive voltage steps.

As shown in Figure 1, as the input voltage increases the banks of LEDs turn on in succession until the voltage reaches its peak. As the voltage decreases, the LEDs turn off in reverse order with the cycle repeating at twice the input voltage frequency.

The proper matching of the LED array voltage to the input voltage for each voltage step produces excellent power factor, low total harmonic distortion and high system efficiency. This step approach of dividing up the high voltage string of LEDs has another advantage over other AC solutions. By designing LED banks with lower forward voltages, the LEDs turn on earlier in the voltage cycle which minimizes the off time of the LEDs. The voltage stepping as well as the short off-time can be seen in Figure 2. With the addition of ceramic capacitors, the off-time can be further reduced.

The latest Acrich ICs were designed for a single IC to be used for solutions from 100 to 277V (singular not universal solutions) based on the LED arrangements.

Figure 1. *Acrich2 IC Voltage Matching*

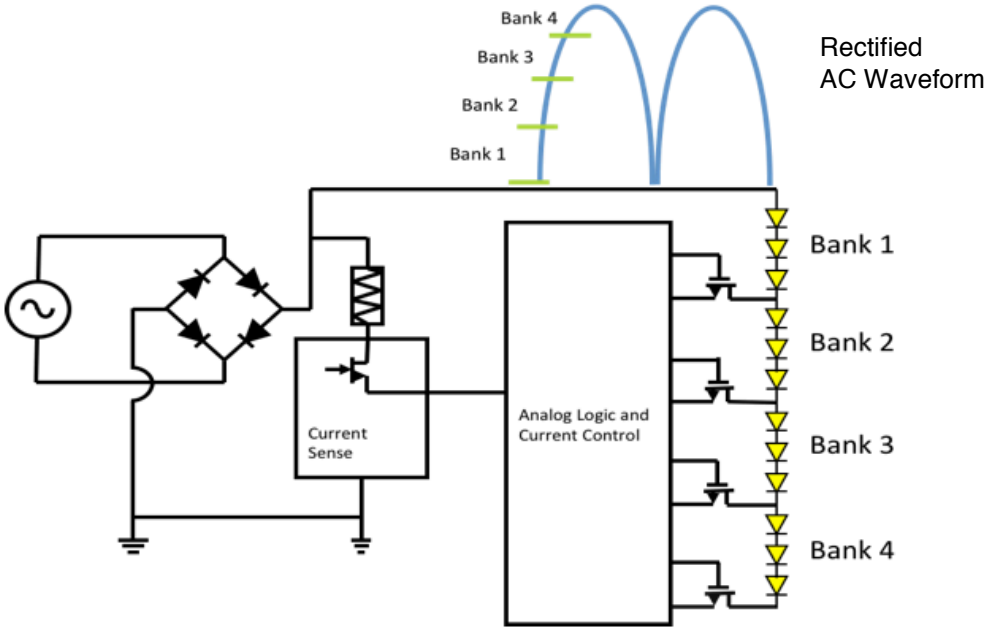
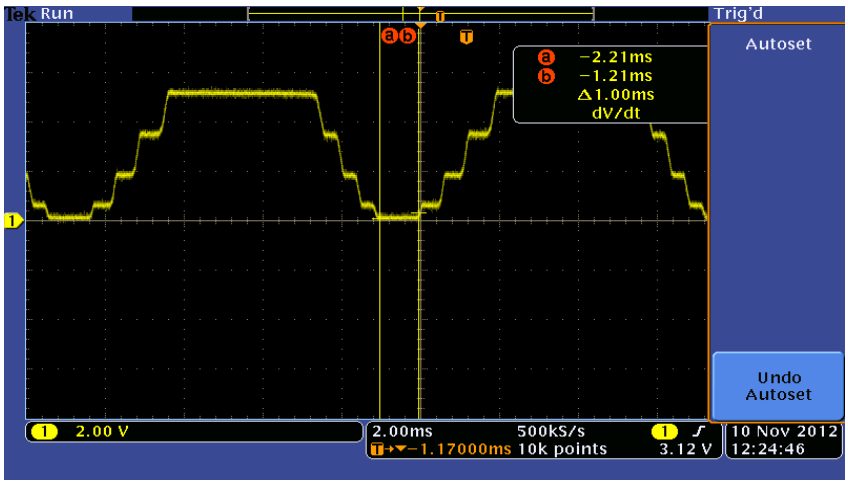


Figure 2. *Light Output Waveform*



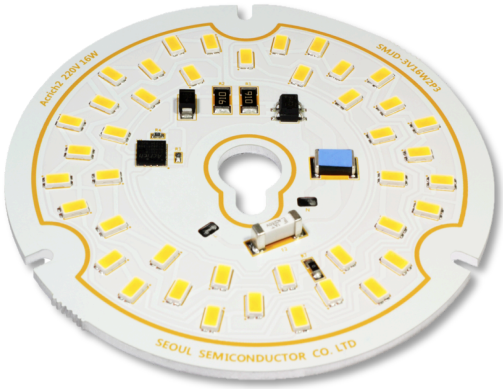
A Variety of Designs

By combining variations of the MJT characteristics with the Acrich IC, a selection of LED modules optimized for different applications such as diffuse-source flood applications or focused narrow beam applications can be designed.

As an example, there are several types of 17W modules that meet different application requirements. The SMJD-xV16W1P4 is designed for down light applications so the high power SAW8WA2A MJT LED is used to produce a smaller aperture giving a more intense source that can be focused. This module is only 62mm in diameter allowing it to fit into small fixtures.

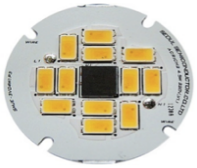
In comparison, the SMJD-xV16P3 utilizes the mid power SAW8KG0B MJT LED and is designed for ceiling light applications such as flush mount fixtures. It is 100mm in diameter, providing a large emitting area to flood the fixture and room with light.

SMJD-xV16WP4 Down Light Module



SMJD-xV16P3 Flush Mount Module

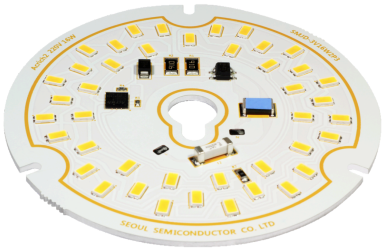
Acrich2 module solutions are available in two basic configurations, one that incorporates the required circuitry for meeting UL and other agency safety requirements. In the second configuration, the board size is limited the protection circuitry is on a separate daughter board. They are also available as standard products that range from 4.3 to 17 watts and light outputs from 350 to 1800 lumens in ANSI standard color binning options.



4.3W
400 lumens
Diameter: 30mm

8.7W
670 lumens
Diameter: 30mm

17W Eco
1360 lumens
Diameter: 62mm



17W
1780 lumens
Diameter: 100m

Part Number	Power	Color Temp	Luminous Flux [lm] 120V Min	Typ	220V Min	Typ	# of LEDs per Module
SMJC-XV04W1P3	4.3W	4700-6000 2600-3200	330	400	340	410	12
SMJE-XV08W2P4	8.7W	4700-6000 2600-3200	580	670	580	670	8
SMJE-XV16W2P4	17W	2600 - 6000	870 1140 1300	1000 1210 1360	870 1140 1300	1000 1210 1360	42
SMJD-XV16W2P3	17W	2600 - 6000	1140 1480 1700	1300 1590 1780	1140 1480 1700	1300 1590 1780	16

Please visit http://www.seoulsemicon.com for more information on the Acrich2 module offerings.

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Dave Neal is a director of Applications Engineering for Seoul Semiconductor leading applications efforts in the North American general illumination customer base.

Dave has more than 20 years of experience in engineering design and applications support in the semiconductor industry. He has been working in the LEDs and Solid State Lighting industry since 2001. Prior to joining Seoul Semiconductor North America, he held design, application and management positions at Avnet Electronics Marketing, Lockheed Martin and GE.

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