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Acrich IC 3.0

Seoul Semiconductor

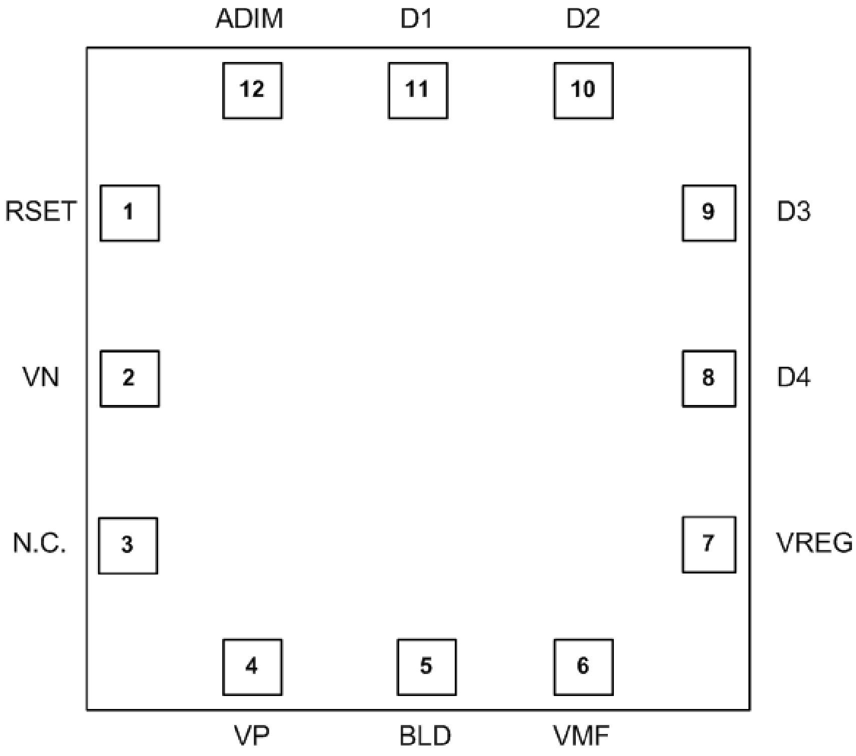
February 24th, 2015

01

IC Information

PIN Information

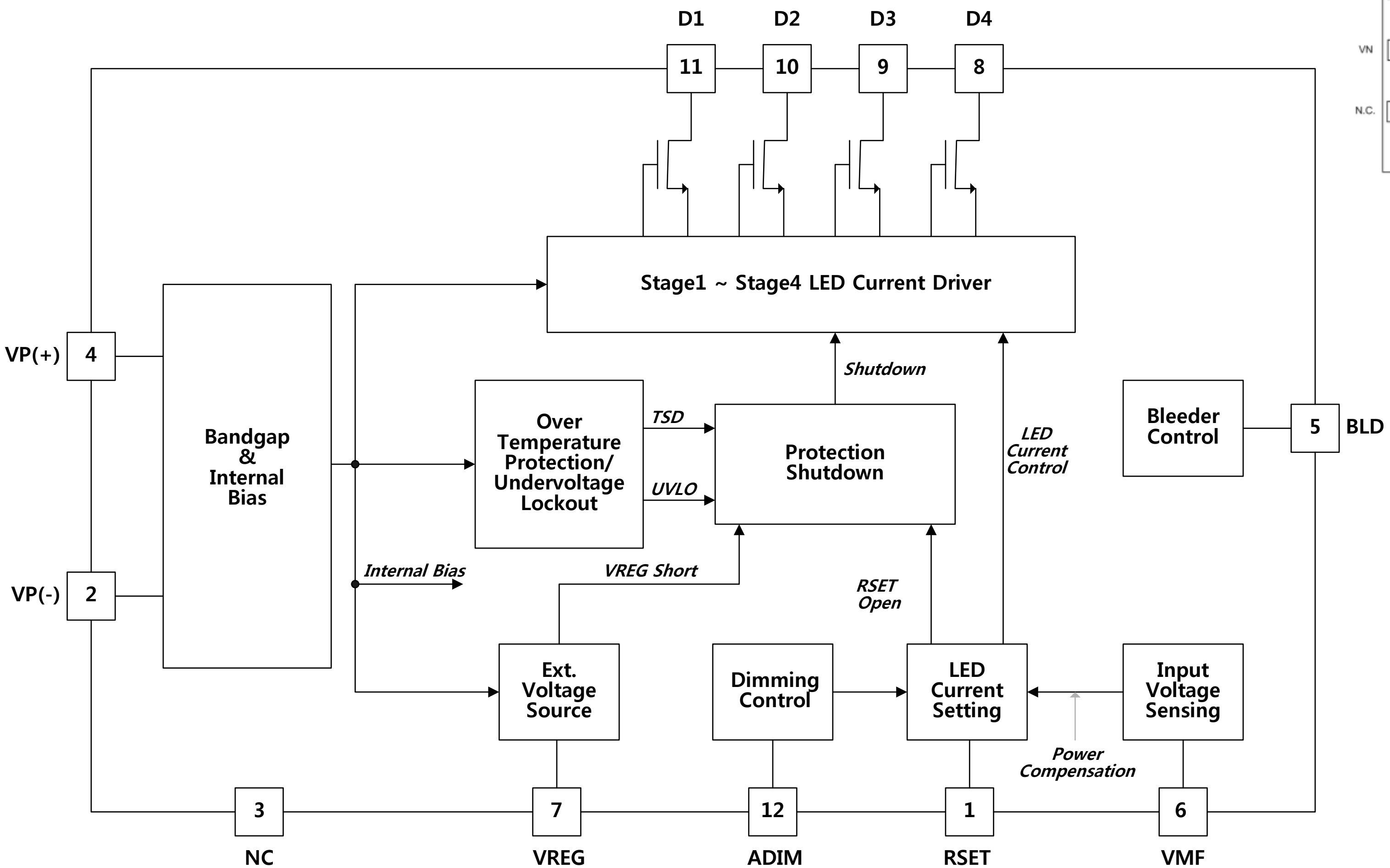
< TOP View >

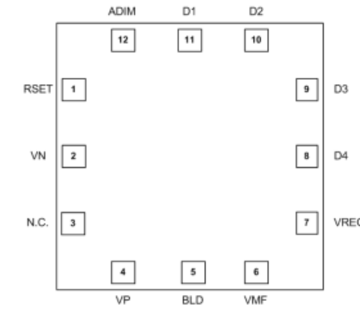


< PIN information>

Pin	Symbol	Description
1	RSET	Resistor Connection for Driver Current Setting
2	VN	Voltage Input (-)
3	N.C.	No Connection
4	VP	Voltage Input (+)
5	BLD	Supply bleeding current
6	VMF	Multi Function Voltage Input
7	VREG	Reference Voltage Output
8	D4	Driver Output – 4
9	D3	Driver Output – 3
10	D2	Driver Output – 2
11	D1	Driver Output – 1
12	ADIM	Analog Dimming Input (for Analog Dimming)

Block Diagram





Preliminary Specification

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
VP(+) to VN(-), D1~D4	V_{HV}	-0.3 ~ +450	V
VREG to VN(-)	V_{CC}	-0.3 ~ +9	V
Other Pins to VN(-)	V_{LV}	-0.3 ~ +6.5	V
Operating Ambient Temperature	T_A	-40 ~ +120	°C
Storage Temperature	T_{STG}	-40 ~ +120	°C
Maximum Junction Temperature	T_J	+150	°C
ESD	V_{HBMV}	1.5	kV
Power Dissipation(Note1)	P_D	3	W
Maximum Driver Stage Current(Note2)	I_{D4}	240@ V_{AC} = 100V	mA
		110@ V_{AC} = 220V	mA

- **Package power dissipation is dependent on the PCB board type, size, layout, pattern and thermal heat sink.**
- **The maximum drive current means the guaranteed operating current.**
- **The maximum drive current is not the DC current.**
- **It is the maximum peak current of the forth stage for guarantying normal operation in AC direct drive method.**
- **The operating current must be used within the allowed package dissipation.**
- **The operating drive current must be determined within the maximum drive current with margin.**

02

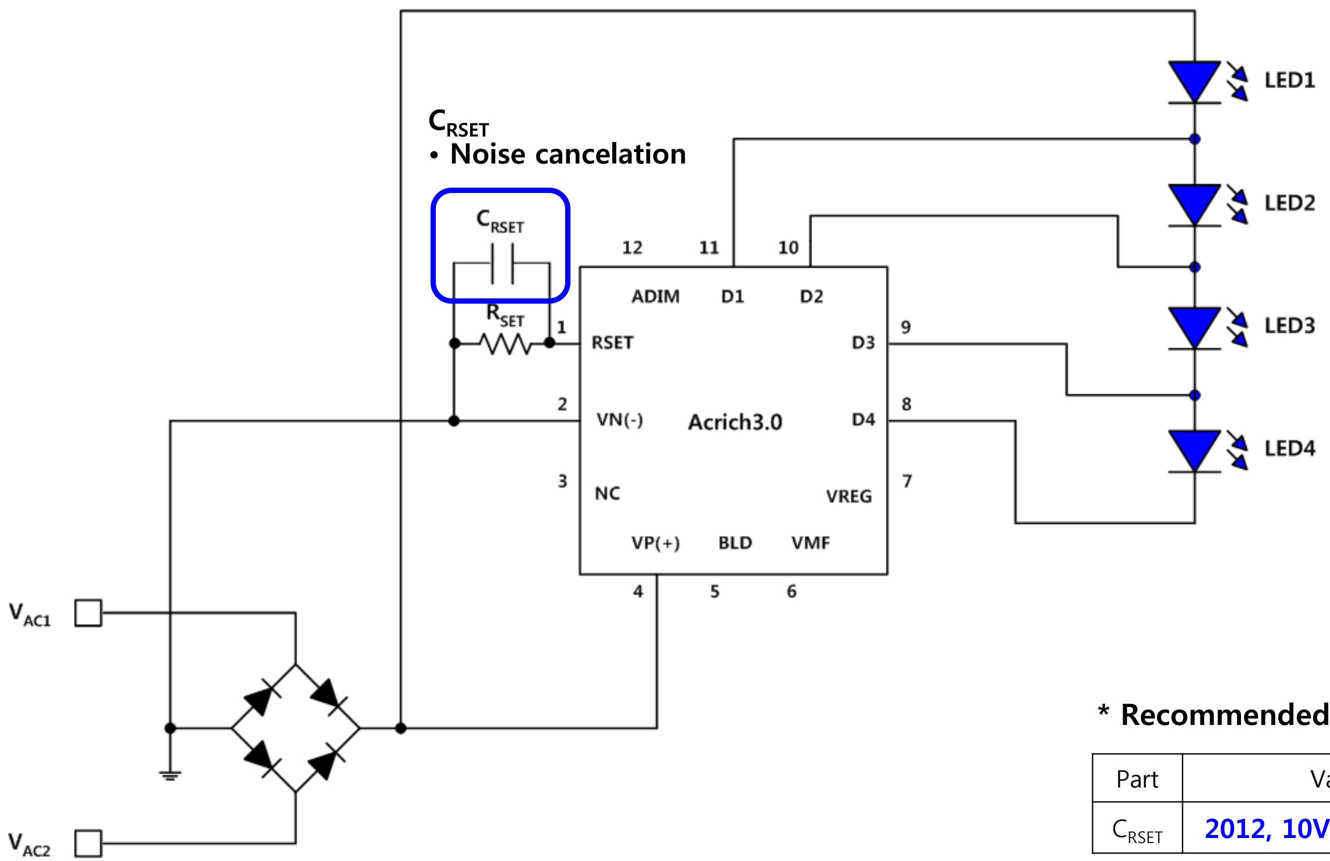
Application Circuit& Function Description

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% @0.4~2.0Vdc	External Dimming
Phase Cut Dimming	△	○ TRIAC Dimmer Compatible	
EMI immunity	Filter less @<45W Filter less @<45W		
Auxiliary Source Output	Non	7Vdc 5mA max.	For Remote Control
Power Factor	0.97	>0.97	
Temperature Protection	>130ºC	Turn Off >160ºC Turn On <130ºC 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

I. Normal Operation

Typical Application Circuit



*** Recommended C_{RSET}**

Part	Value
C_{RSET}	**2012, 10V/4.7nF, X7R**

Typical VAC	Recommend Typical V_F			
	LED1	LED2	LED3	LED4
120V	43V	43V	21.5V	21.5V
220V	64.5V	64.5V	64.5V	64.5V

I. Normal Operation

RSET Setting for Power Dissipation

The LED current can be set by using the R_{SET} pin. Therefore LED power dissipation can be set by adjusting the LED current. The resistor connected between R_{SET} pin and VN(-). The R_{SET} pin resistor can be set by the following a table. Use the table below to choose the value of R_{SET} for the desired power dissipation.

V_{AC}	Type	Power Dissipation	R_{SET} ± 1%
100V	A	4W	8.11kΩ
	B	8W	8.40kΩ
	C	12W	6.28kΩ
	C	16W	8.61kΩ
120V	A	4W	6.45kΩ
	B	8W	6.69kΩ
	C	12W	5.30kΩ
	C	16W	7.31kΩ
220V	A	4W	3.20kΩ
	A	8W	6.96kΩ
	B	12W	5.28kΩ
	B	16W	7.20kΩ

*** Note**

- **The R_{SET} values is based on the simulation results only.**
- **The actual R_{SET} values must be determined by the actual LED arrays and LED VF bin and board condition for given input power requirement.**
- **R_{SET} values are same at all operation mode (ADIM, Power Regulation & TRIAC).**
- **The size of R_{SET} is 1608.**

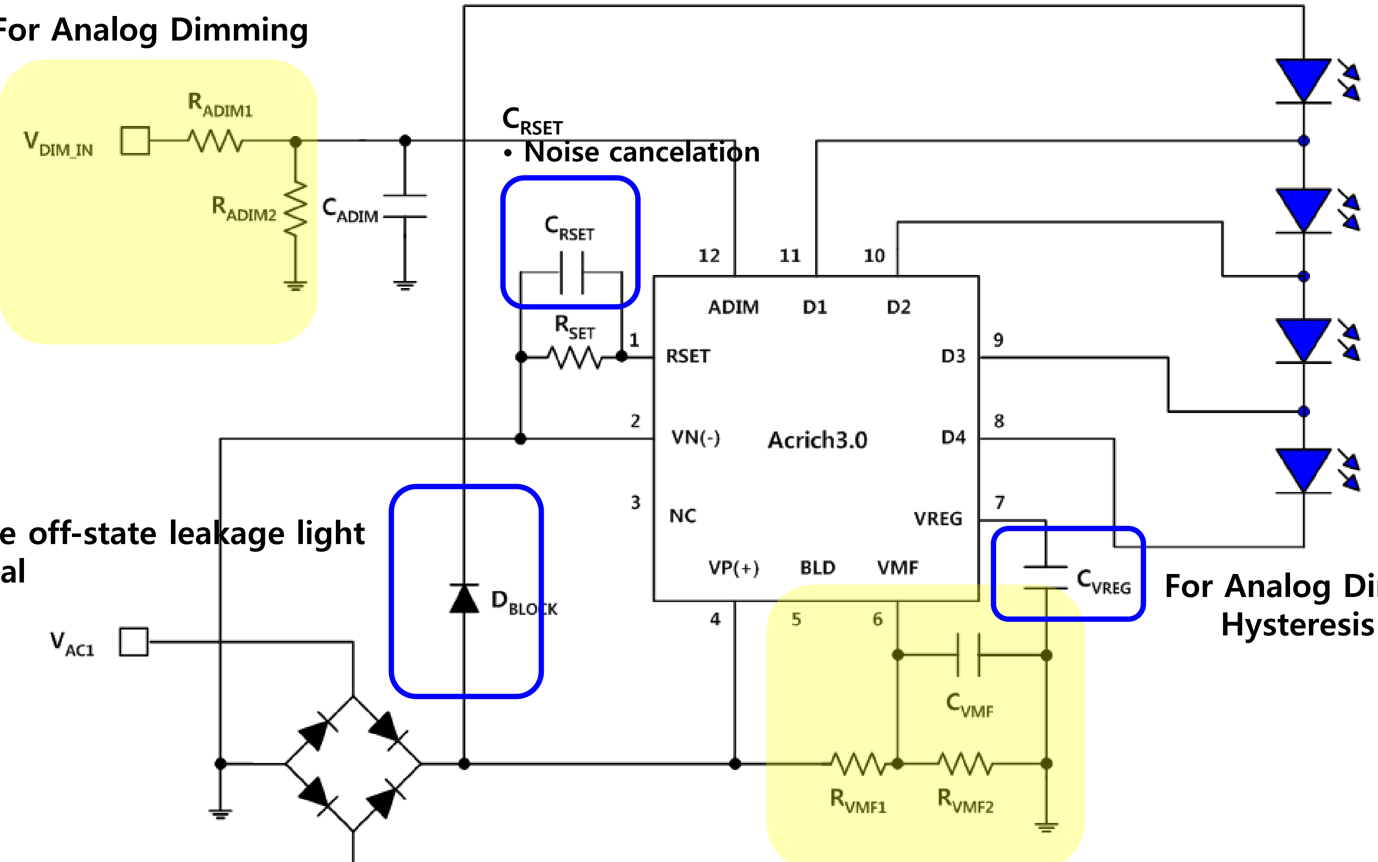
II. Analog Dimming Mode

Analog Dimming with Line Power Regulation – Application Circuit

For Analog Dimming

C_{RSET}
• Noise cancelation

D_{BLOCK}
• Remove off-state leakage light
• Optional

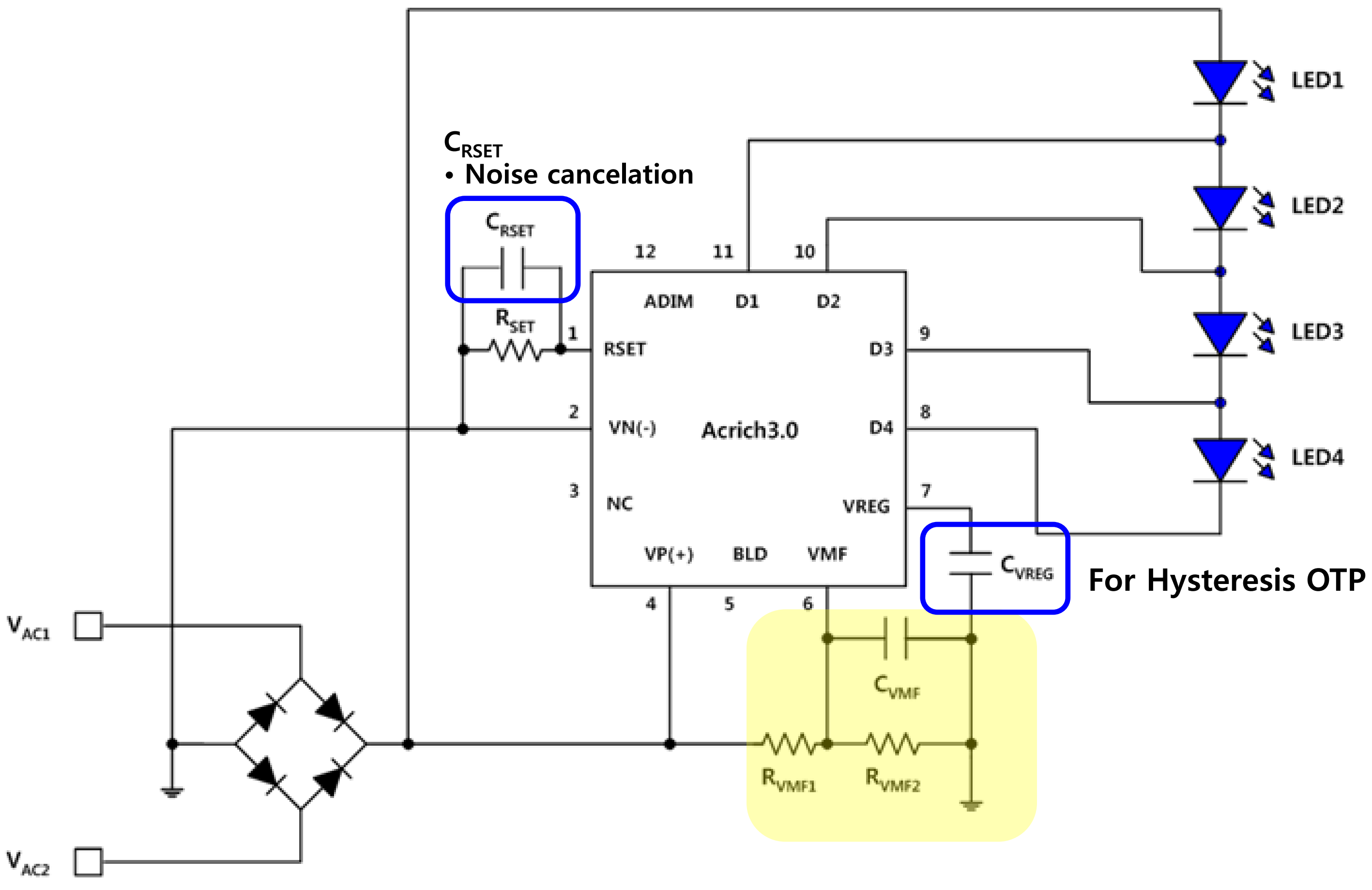


For Analog Dimming Hysteresis

• External components setting
: See section III Line Power Regulation Mode

Ⅲ. Line Power Regulation Mode

Application Circuit



III. Line Power Regulation Mode

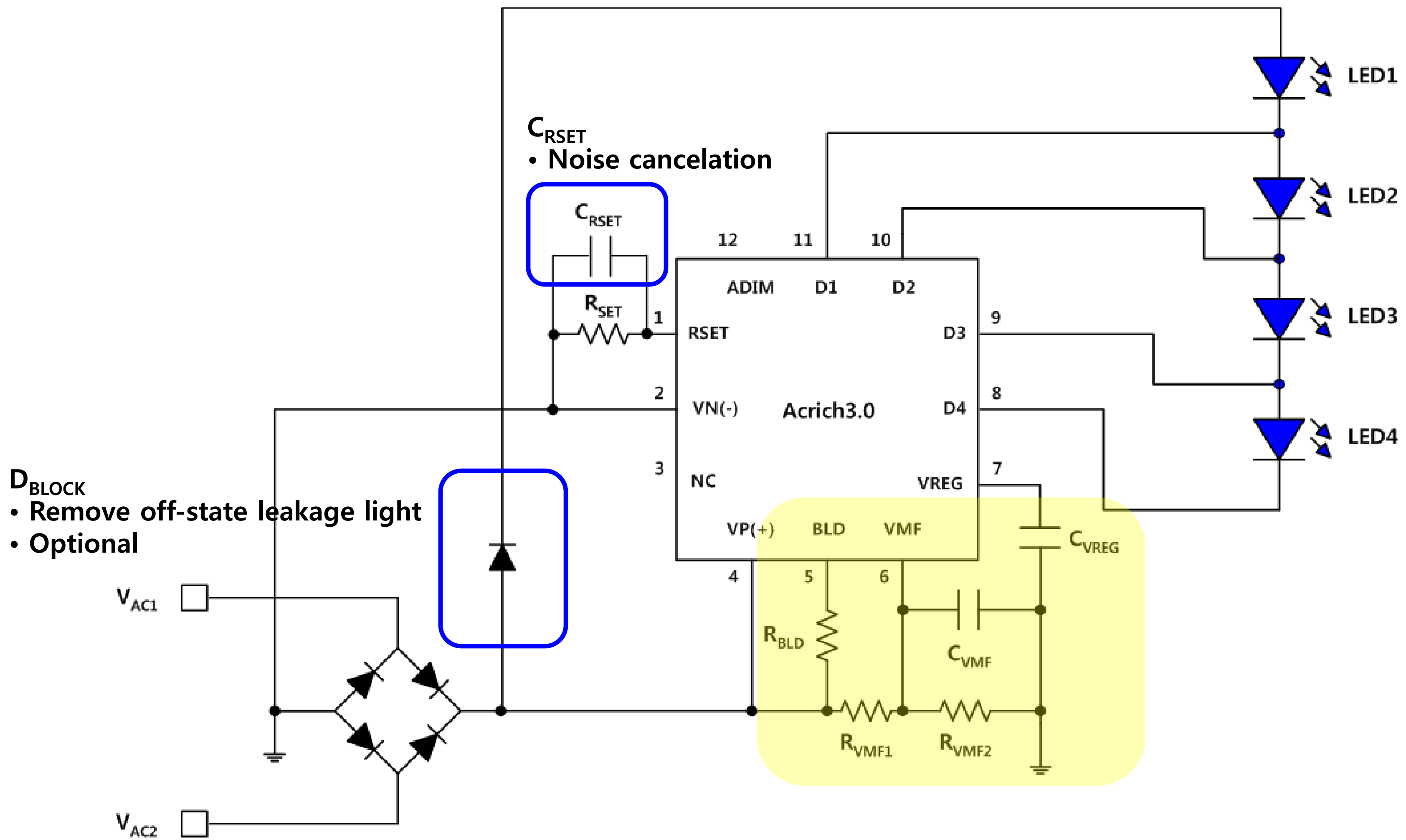
VMF pin detects external the voltage level of external VAC to implement line power regulation function. If use the line power regulation, set the VMF pin voltage to 3.5V by using external components. When the VMF pin is opened, line power regulation is not operated.
Refer to the following recommended external components in application. .

Value	100Vac		120Vac	220Vac		230Vac
	50Hz	60Hz	60Hz	50Hz	60Hz	50Hz
R_{VMF1}	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ
R_{VMF2}	77.6kΩ	77.1kΩ	64.6kΩ	35.4kΩ	35.7kΩ	33.9kΩ
C_{VMF}	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)

*** Note**
- All values of the external component is based on a simulation result only.
- The actual R_{VMF2} values must be determined by the actual LED arrays and board condition.
- The size of the external component is 2012.

IV. TRIAC Dimming Mode

■ Application Circuit



IV. TRIAC Dimming Mode

Phase Cut Off Angle Setting - External Components Setting

Refer to the following recommended external components in application.

Typical VAC	100V/50Hz			220V/50Hz			230V/50Hz		
Phase Cut Off Angle	60°	50°	40°	60°	50°	40°	60°	50°	40°
R_{VMF1}	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ
R_{VMF2}	19.32kΩ	23.33kΩ	28.91kΩ	10.39kΩ	12.92kΩ	16.00kΩ	9.91kΩ	12.50kΩ	16.18kΩ
C_{VMF}	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)

Typical VAC	100V/60Hz			120V/60Hz			220V/60Hz		
Phase Cut Off Angle	60°	50°	40°	60°	50°	40°	60°	50°	40°
R_{VMF1}	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ	2MΩ
R_{VMF2}	19.08kΩ	23.13kΩ	28.37kΩ	18.84kΩ	24.29kΩ	32.26kΩ	9.99kΩ	12.38kΩ	15.89kΩ
C_{VMF}	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)	10uF (10V)

*** Note**

- All values of the external component is based on the simulation results only.

- The actual R_{VMF2} values must be determined by the actual LED arrays and board condition.

- The size of the external component is 2012.

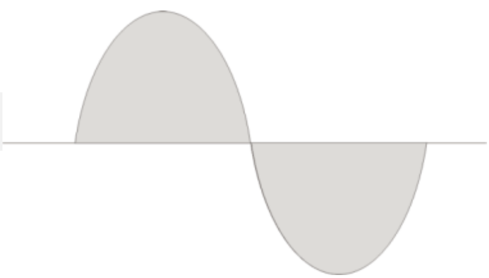
IV. TRIAC Dimming Mode

A "chopped" waveform at a dimmed level - Reduced

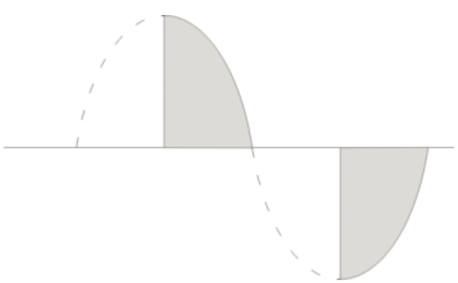
Dimming type

TRIAC Dimming output

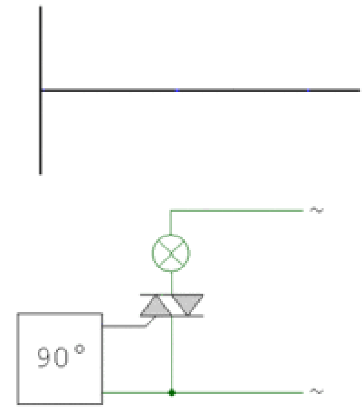
Full wave



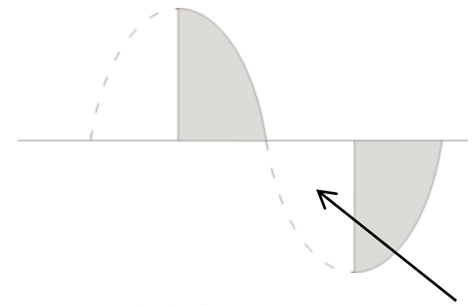
Leading edge



Dimming principal

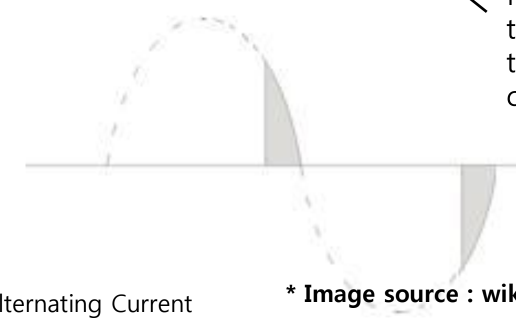


Mid (50%) dimming



No power transmitted for this part of the cycle

Min (5%) dimming

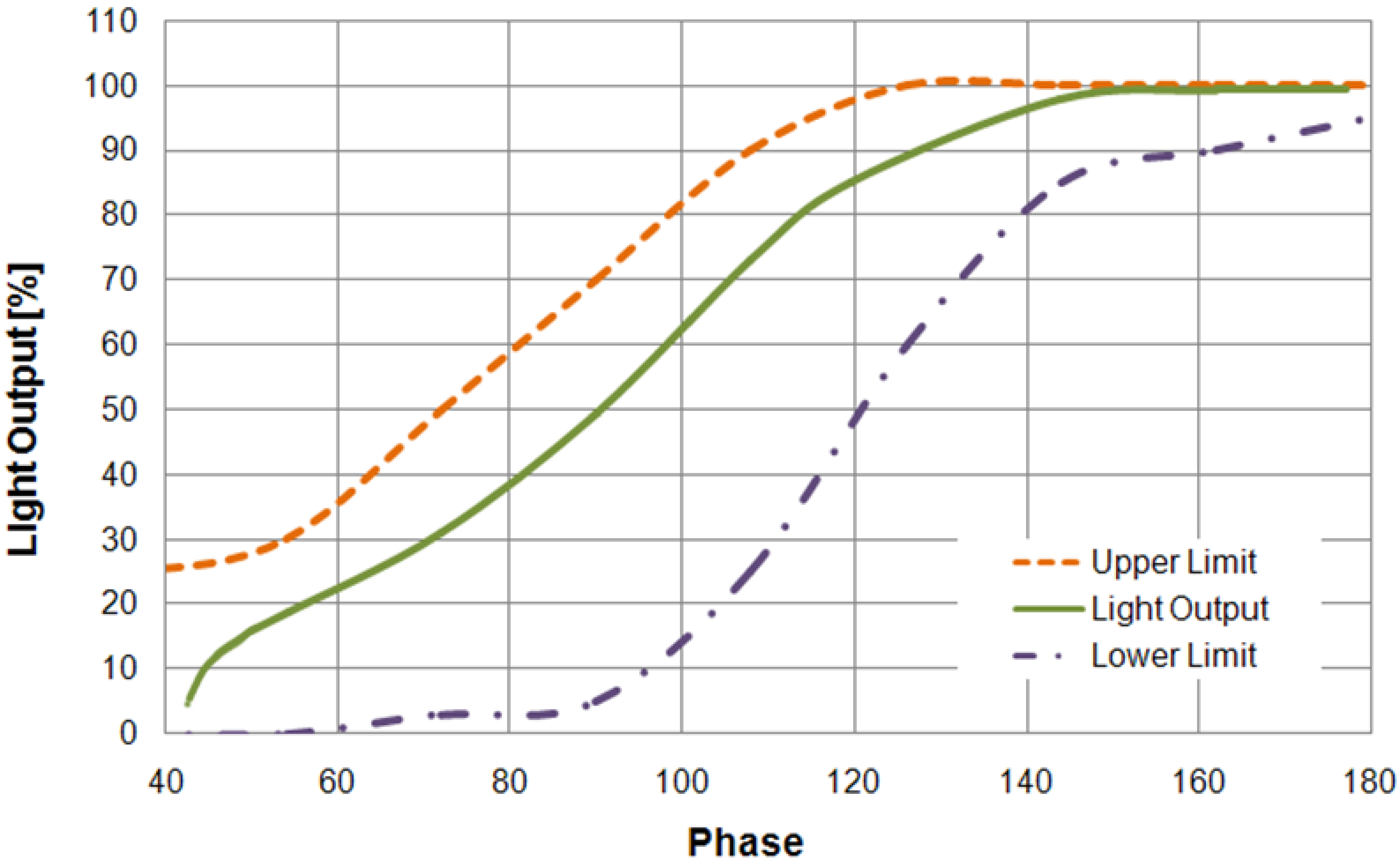


* TRIAC : TRIode for Alternating Current

*** Image source : wikipedia.org**

IV. TRIAC Dimming Mode

Dimming Profile (NEMA SSL-6)

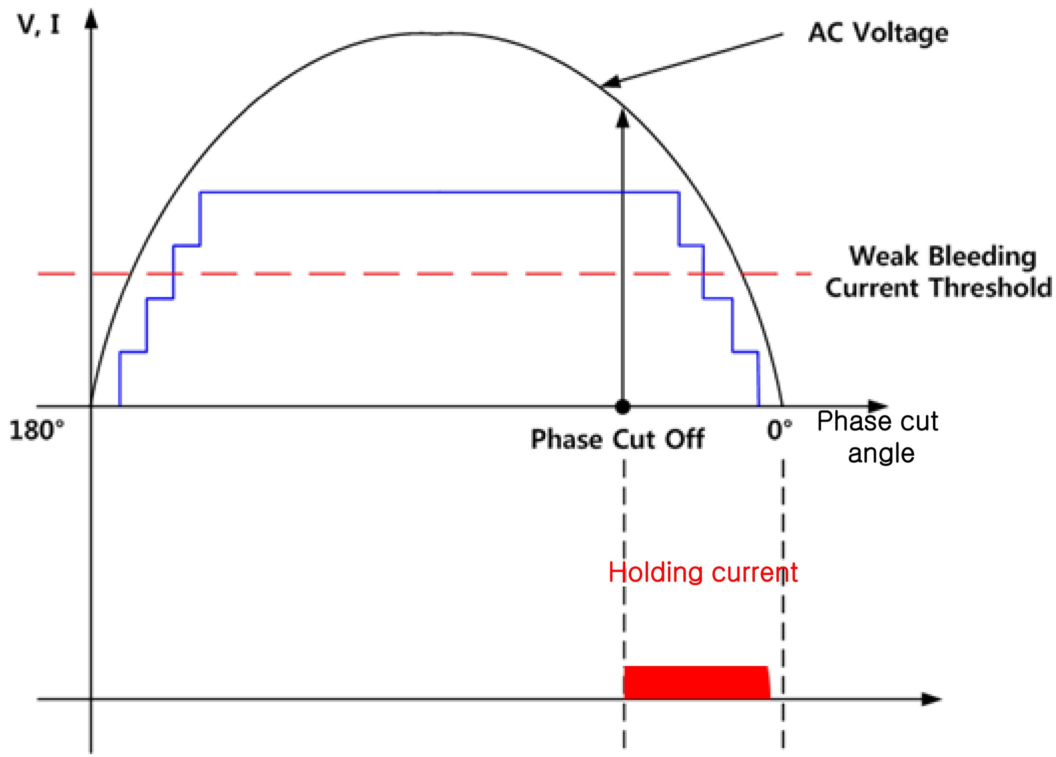


IV. TRIAC Dimming Mode

Active Bleeder Operation of Bleeder Current

The active bleeder can cover a wider range of TRIAC turn-on in a line input cycle compared to passive bleeder. The Bleeder current is the internal current source. Their maximum output current can be adjusted by the resistor value connected between the BLD pin and VP(+). The Bleeder current is 0~30mA(peak).

Active Bleeder current profile

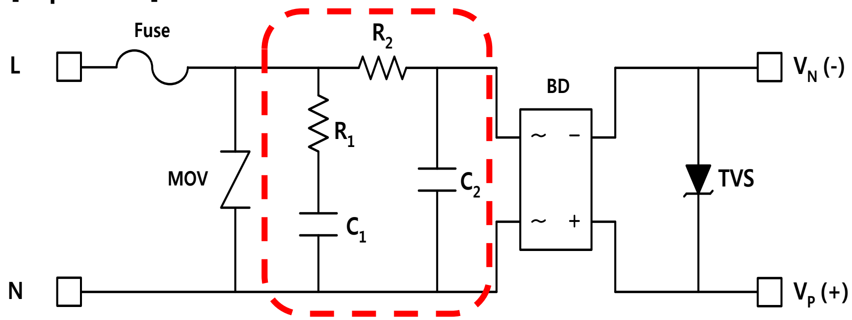


IV. TRIAC Dimming Mode

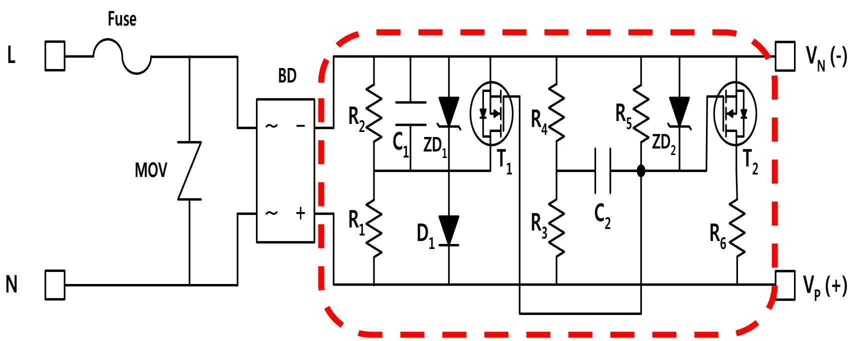
Passive Bleeder - Preliminarily Electric schematic of SPC and module

The passive bleeder is designed to supply latching and holding current to eliminate misfire and flicker.

[Option 1]

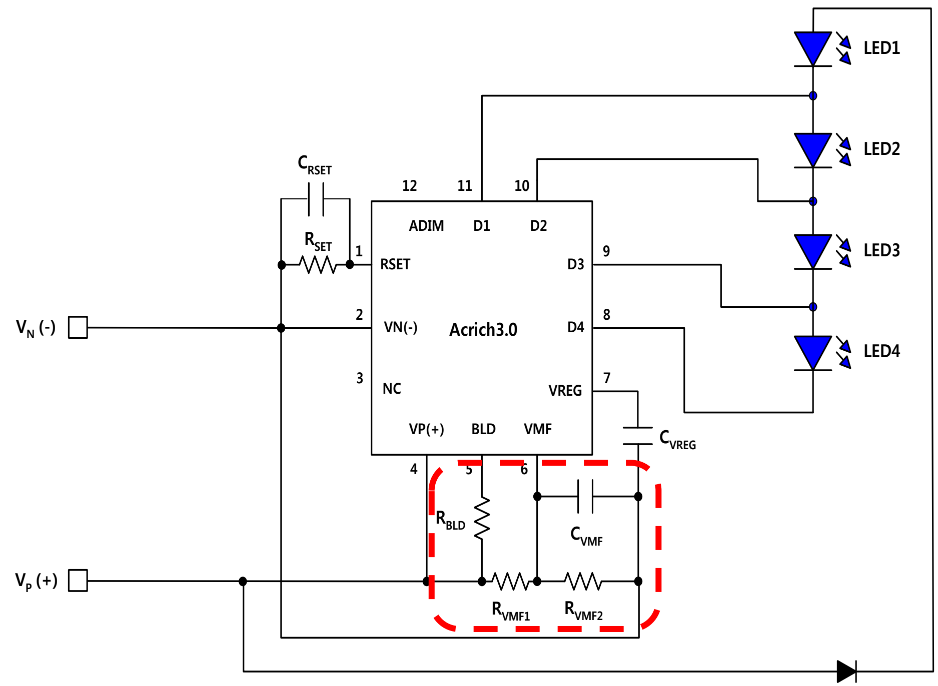


[Option 2] – All components use a small size.



< SPC with Bleeder circuit >

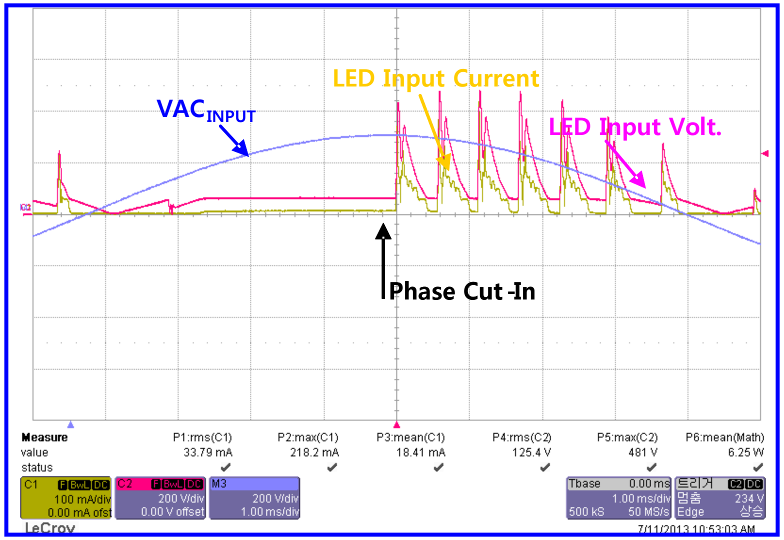
Daughter board type



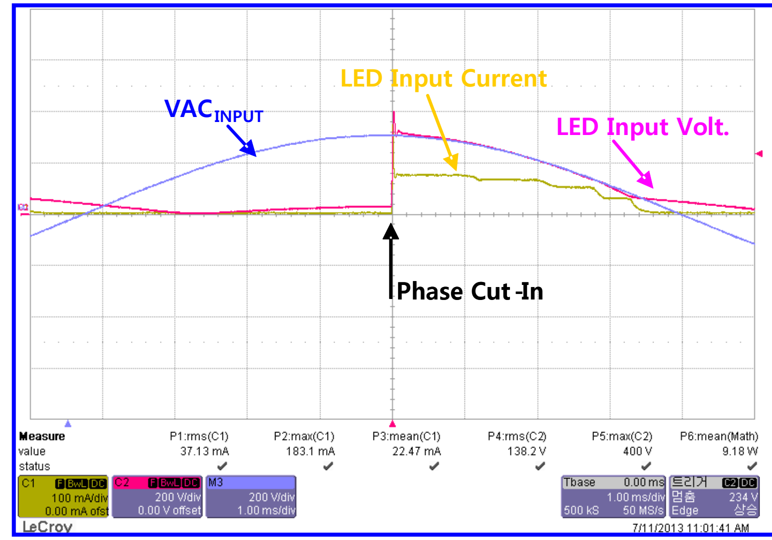
< Acrich module TRIAC dimmable >

IV. TRIAC Dimming Mode

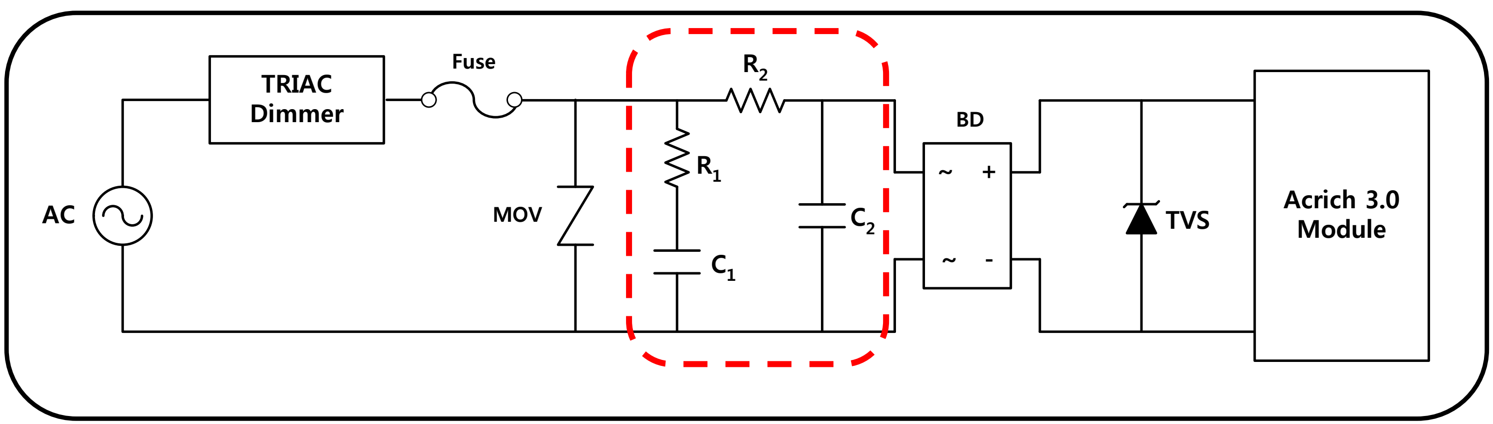
Waveforms comparisons (w/o Vs. with bleeder circuit)



w/o bleeder circuit

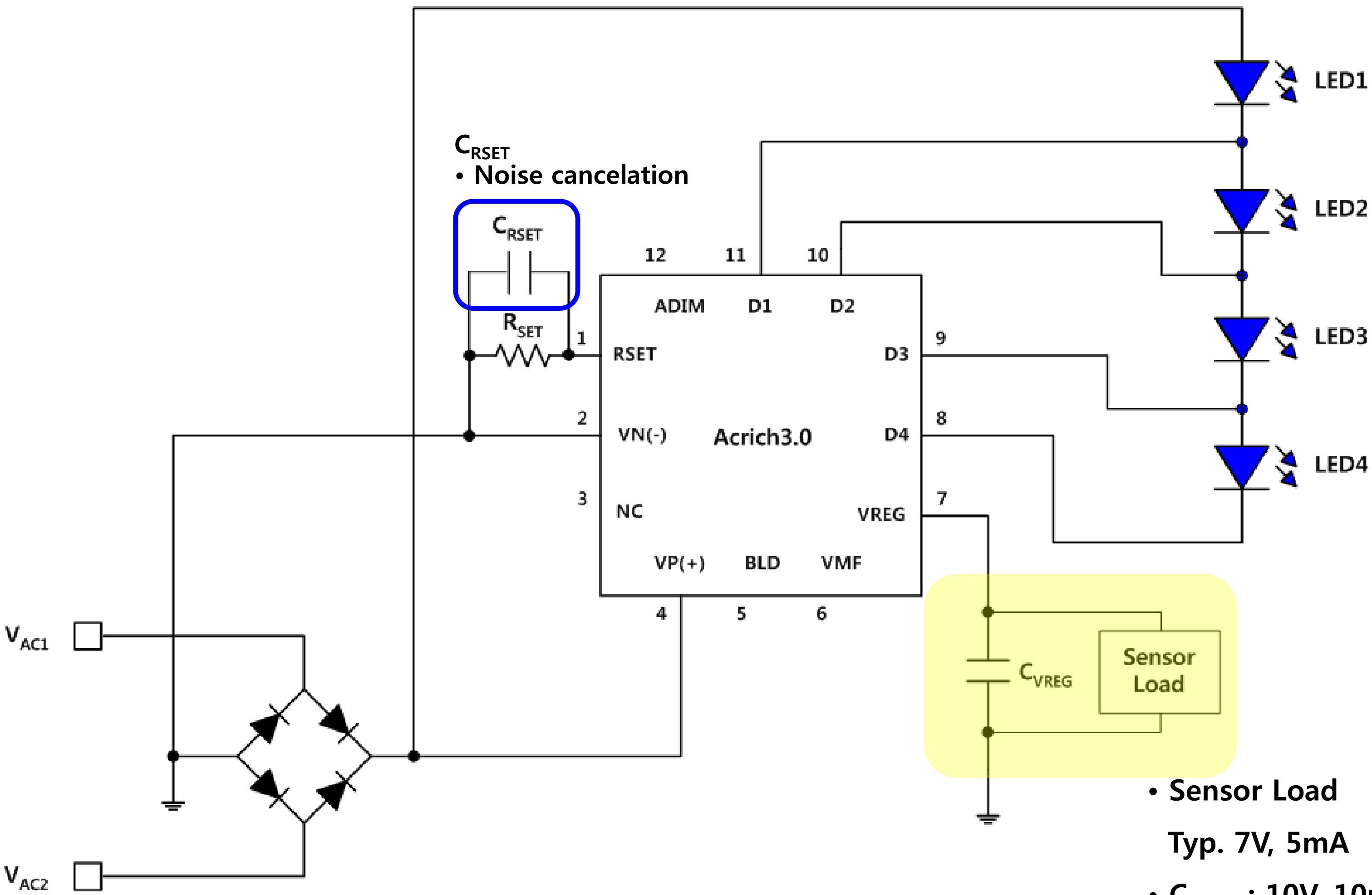


With bleeder circuit



V. Auxiliary Power for Sensor Application

■ Application Circuit

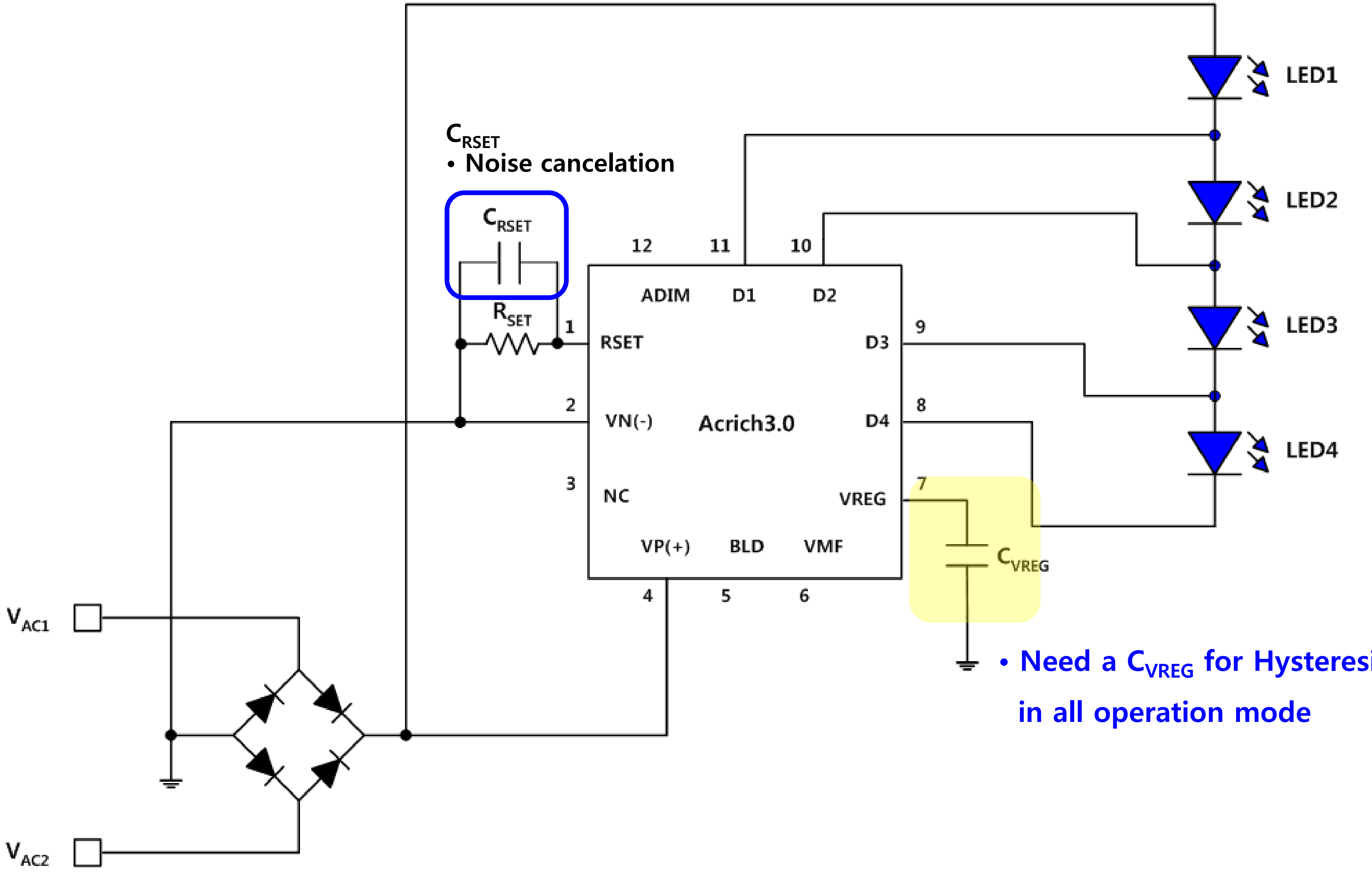


- Sensor Load
  Typ. 7V, 5mA
- C_{VREG} : 10V, 10uF, 2012

VI. Protection

① Over Temperature Protection (OTP) – Hysteresis Application Circuit

The LED is off when the temperature exceeds 160°C and restarts when the junction temperature falls. If a capacitor is connected to VREG, the Acrich3.0 IC restarts by the VREG reset.



• Need a C_{VREG} for Hysteresis OTP in all operation mode

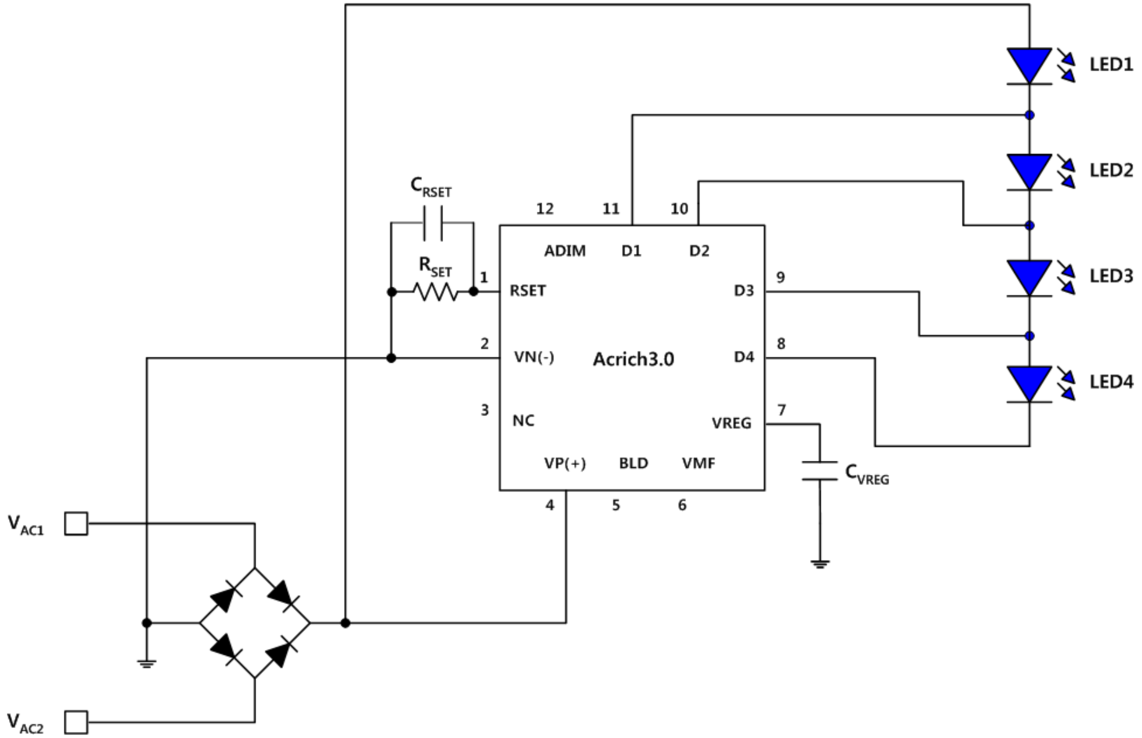
VI. Protection

② RSET Open/Short Protection

When RSET Pin is opened, the Acrich3.0 is shut down, that is, all the LED output currents become zero. When RSET Pin is shorted to VN(-), all the output currents have its extremely low current level below a few hundreds of uA determined by the offset voltages of the amplifiers consisting the LED current sources.

③ VREG Short Protection

When VREG Pin is shorted to VIN(-), the Acrich3.0 becomes shut down.



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