SW5908

AC direct control IC for

LED Lighting

Datasheet

Rev 0.2: Oct. 06, 2014

REVISION HISTORY

Revision	Date	Remark
Rev. 0.0	May. 15, 2014	First issued
Rev. 0.1	Jul. 26, 2014	Package's dimension changed
Rev. 0.2	Oct. 06, 2014	Pin description changed

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1. FEATURES

The Light Emitting Diodes (LEDs) are used as indicator lamps in many devices and are increasingly used for other lighting.

The SW5908 is an AC Direct driving LED controller IC. It is able to replace other lighting systems that are using AC voltage directly such as light bulb, halogen lamp and so on. It will give much convenience to the design because it requires a small number of external components. The SW5908 will help engineers to produce excellent products in LED lightings for energy efficiency, design efficiency, cost efficiency, and so on.

- AC application: 85V ~ 190V range

- Power: 10~20W (110V)

- No inductor / no electrolytic capacitor for long life operation

- Minimal external components for low system cost

- Four constant current driving channels

- Maximum current driving capacity of 240mA at CH4

- Excellent Power Factor Correction (> 0.9)

- Automatic Power Regulation: Power±3%@Typ. Vac±20% dependent on LED array string

- Analog & PWM Dimming Function

- Protection: Over Temperature Protection (OTP)

- EMI safe operation: Neither power conversion nor clock generation

PACKAGE

- QFN 20pin, 6mm x 6mm, 0.8mm pitch

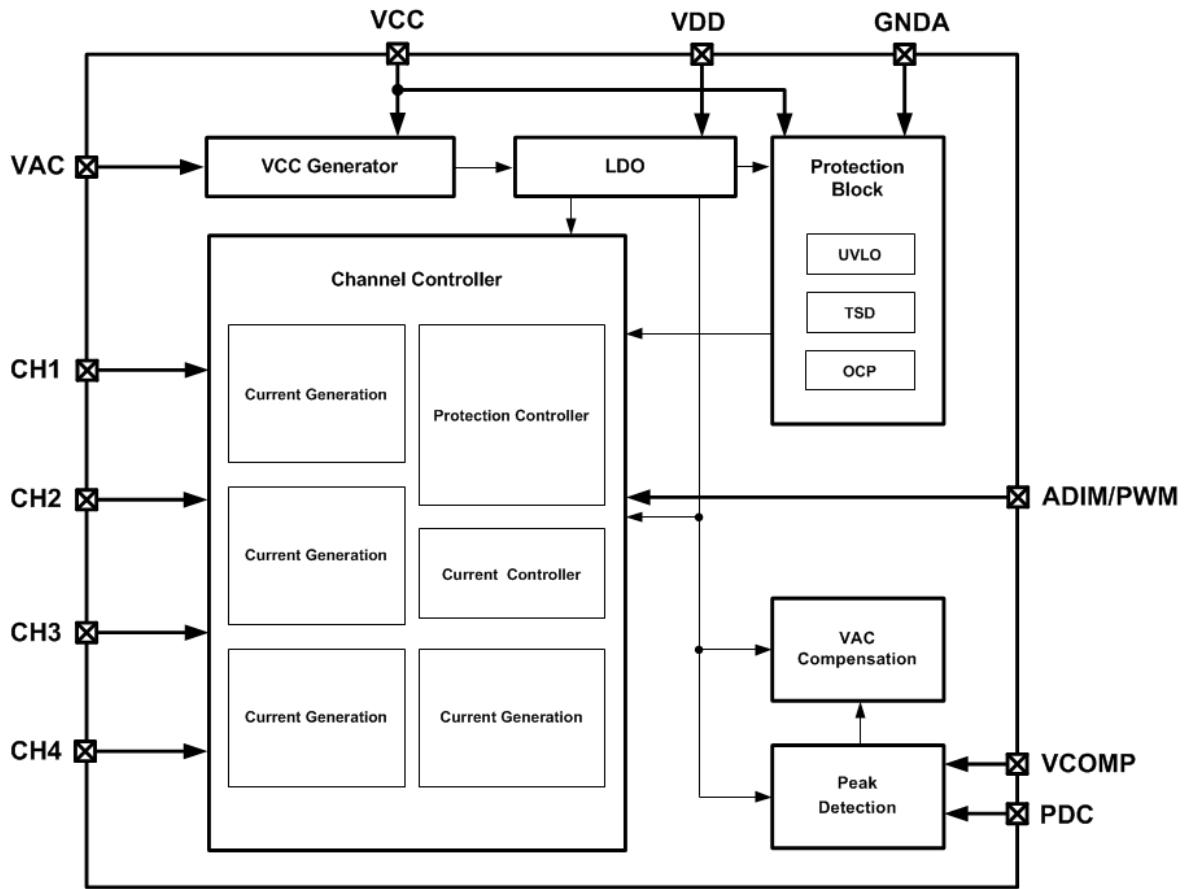# 2. FUNCTIONAL BLOCK DIAGRAM

Figure 1. Functional Block Diagram

3. PIN CONFIGURATION AND DESCRIPTIONS
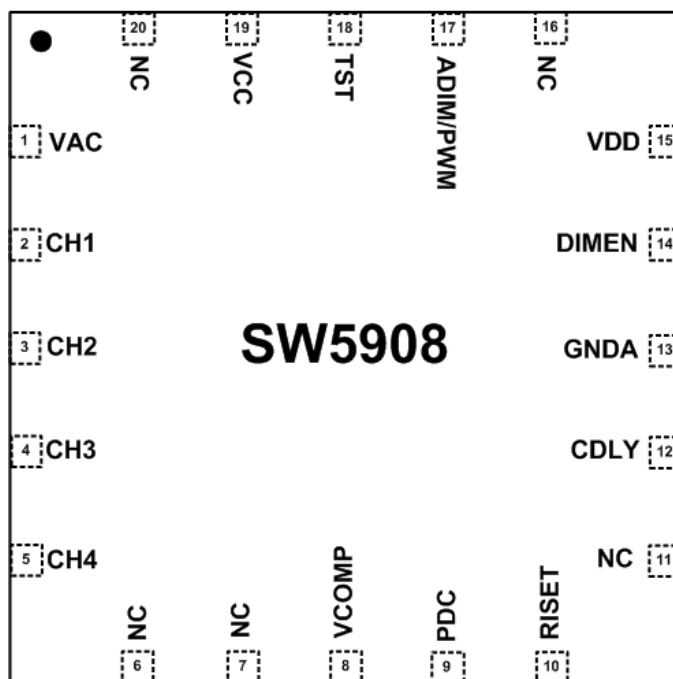
QFN20 6mm x 6mm

Figure 2. Pin Configuration

Table 1. Pin descriptions

Pin No.	Name	IN/OUT	Operating Voltage [V]	ABS Max. Rating [V]	Description
1	VAC	IN	190	270	IC Supply Input Voltage
2	CH1	IN	100	270	Channel 1 for LED channel current
3	CH2	IN	100	270	Channel 4 for LED channel current
4	CH3	IN	100	270	Channel 3 for LED channel current
5	CH4	IN	100	270	Channel 2 for LED channel current
6	NC	-	-	-	No Function
7	NC	-	-	-	No Function
8	VCOMP	IN/OUT	5.5	10	VAC compensation of typ. VIN
9	PDC	IN/OUT	5.5	10	External capacitor for peak detection of typ. VIN

10	RISET	IN/OUT	1.2	5	LED channel current set pin
11	NC	-	-	-	No Function
12	CDLY	IN/OUT	5.5	10	External capacitor for Channel On delay
13	GNDA	-			Analog GND
14	DIMEN	IN	5.5	10	ADIM enable pin
15	VDD	IN/OUT	5.5	10	Internal regulation voltage
16	NC	-	-	-	No Function
17	ADIM/PWM	IN	20	30	External capacitor for Channel On delay
18	TST	IN	-	-	IC internal block test pin and normal GND
19	VCC	IN/OUT	20	30	Pre-driving regulation voltage
20	NC	-	-	-	No Function

4. ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute maximum ratings

Parameter		Rating
VAC		-0.3 to 270V
CH1, CH2, CH3, CH4		-0.3 to 270V
RISET		-0.3 to 5.0V
PDC, VCOMP, VDD, CDLY, DIMEN		-0.3 to 10V
VCC, ADIM/PWM		-0.3 to 30V
Operating Temperature Range		-40 ~ +85°C
Storage Temperature Range		-40 ~ +150°C
Maximum Junction Temperature		150°C
ESD Rating	HBM (Human Body Model)	2000V
	CDM (Charged Device Model)	700V
	MM (Machine Model)	200V

5. PACKAGE THERMAL CHARACTERISTICS

Parameter	Symbol	Vaule	Unit
Junction to ambient thermal resistance	Θ_{JA}	32.0	°C/W
Junction to case thermal resistance	Θ_{JC}	3.2	°C/W

6. ELECTRICAL CHARACTERISTICS

Table 3. Recommended Operating Conditions, T_A = 25℃ unless otherwise noted

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Section						
Input voltage	V_{AC}		85	-	190	V
Operating Current	I_{VDD}			2.2		mA
LED Current Section						
Peak Detection Value	V_{PEAK}	Voltage level for Compensation	1.08	1.2	1.32	V
LED Current	I_{LED}	Maximum current of the Channel-4	216	240	264	mA
1-Channel FET leakage current	I_{Off_CH1}	V_{GS} =0V of the Channel-1	-1.1	-	1.1	uA
2-Channel FET leakage current	I_{Off_CH2}	V_{GS} =0V of the Channel-2	-1.1	-	1.1	uA
3-Channel FET leakage current	I_{Off_CH3}	V_{GS} =0V of the Channel-3	-1.1	-	1.1	uA
4-Channel FET leakage current	I_{Off_CH4}	V_{GS}=0V of the Channel-4	-1.1	-	1.1	uA
Channel Reference Voltage	V_{REF_CH4}	Reference Voltage of the Channel-4	1.08	1.2	1.32	V
Protection section						
Thermal shutdown threshold	T_{SHDN}			150		^{O}C
Thermal shutdown hysteresis	T_{HYS}			30		^{O}C

7. DETAILED DESCRIPTION

Power On Sequence

As the LED lighting will replace the traditional bulbs, it should not require more control signals than those available for the bulbs.

SW5908 is started by only V_{AC} power signal. V_{CC} is charged from 0V to $V_{CC(ON)}$ by V_{AC} using internal V_{CC} generation device. The

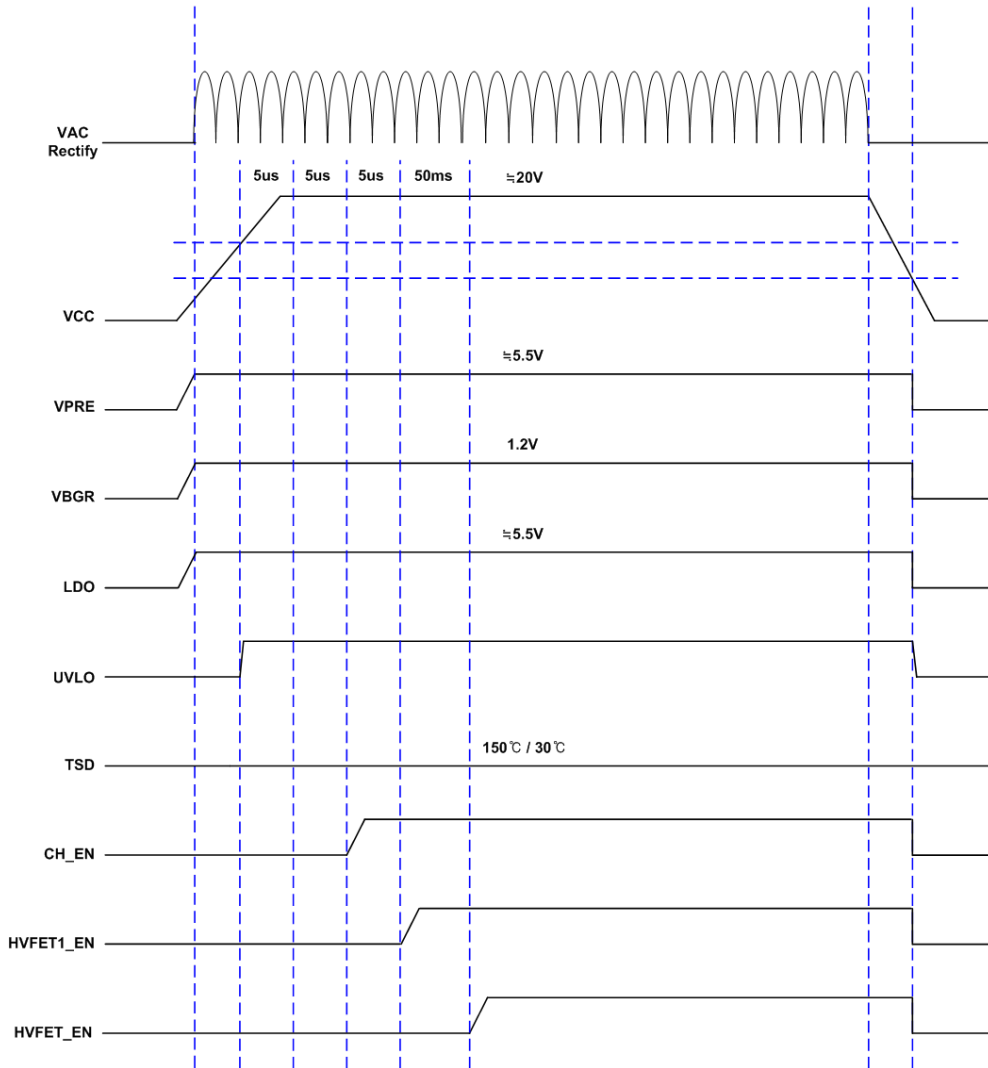delay time is controled by internal delay for supplied stable supply voltage and stable operation of internal block.

Figure 3. Power On Sequence

LED Channel Current Regulation

The SW5908 is 4-channel LED lighting driver IC that controls constant LED current regulation in order to control brightness at the LED lighting system by each channel was consist of high voltage FETs. The constant LED current regulation value can be controllable by an external resistor value using internal channel amplifier's reference voltage.
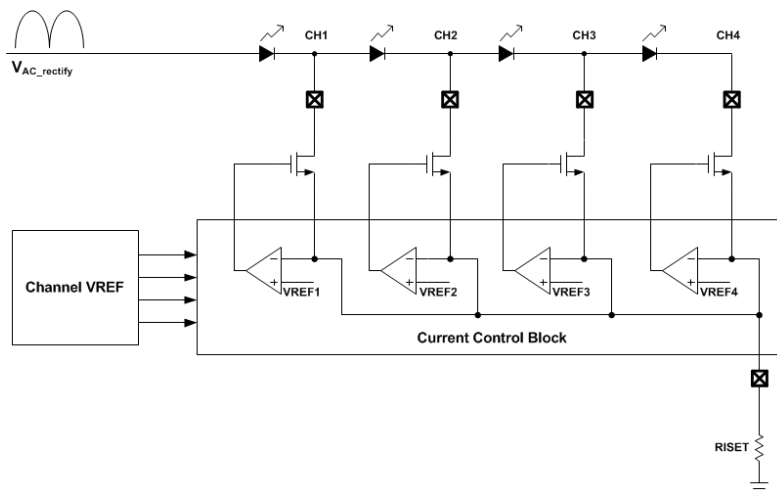

Figure 4. LED Channel Current Regulation

VAC Compensation

If there is some amount of change in input voltage within a range of ±20%, then there is going to be same amount change in input power, because internal reference voltage is fixed no matter what input voltage is.

In order to compensate the phenomena, the peak value of input voltage is sampled and compared to the standard input voltage. Then the system modulates level of channel ref voltage by the amount of the deviation of peak and standard input voltage in order to compensate input power.
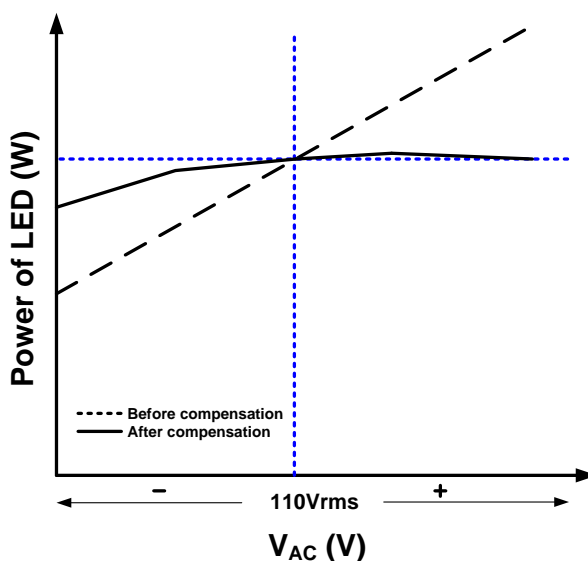

Figure 5. VAC Compensation

Dimming Operation

The SW5908 LED brightness can be adjusted by applying the external PWM signal. PWM dimming command feed PWM to ADMI/PWM pin. When PWM duty 10% > PWM > 100% operated in negative polarity dimming mode.
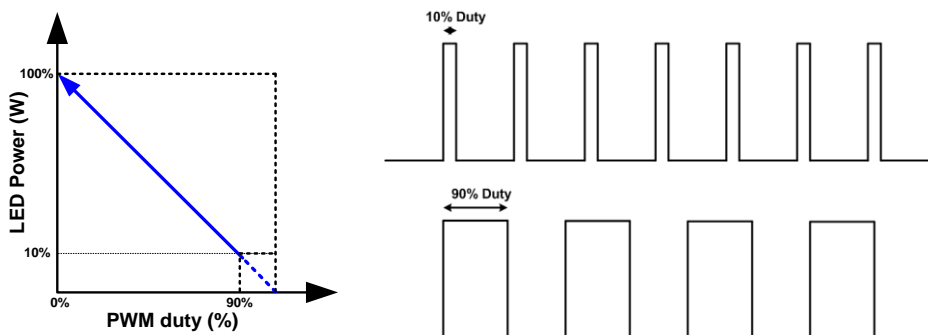

Figure 6. PWM Dimming Operation

Also LED brightness can be adjusted by applying the external analog voltage. Analog dimming command feeds external voltage to ADIM/PWM pin. External analog voltage range is 1V < V_{ADIM} < 10V. SW5908 operates in positive polarity mode as below figure. When the V_{ADIM} is over 9.6V, the LED brightness reaches the 100%.
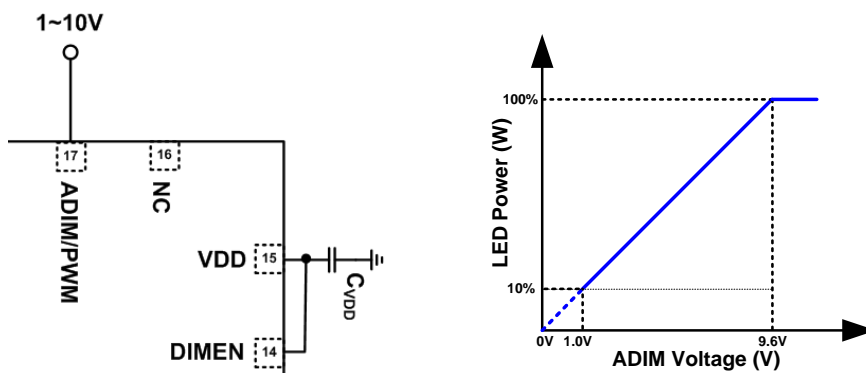

Figure 7. Analog Dimming Operation

Over Temperature Protection

The junction temperature of SW5908 should not exceed the maximum limit. Over temperature protection is implemented by internal thermal shutdown circuitry, which activates at 150℃ to make the LED current stops regulating immediately. Over temperature protection helps prevent catastrophic failures from accidental device overheating. Even when the junction temperature drops below 150℃, the 1-4 channel still stop the LED current regulating.
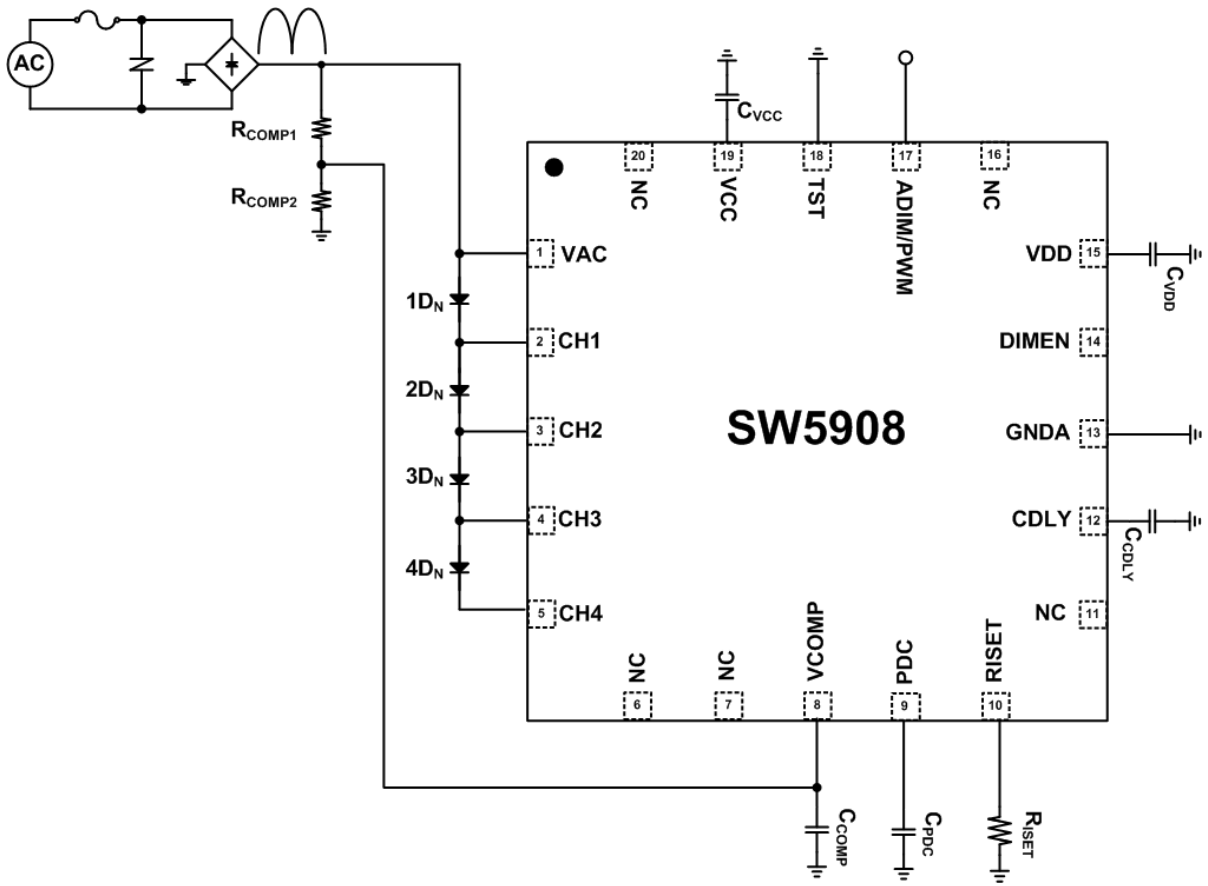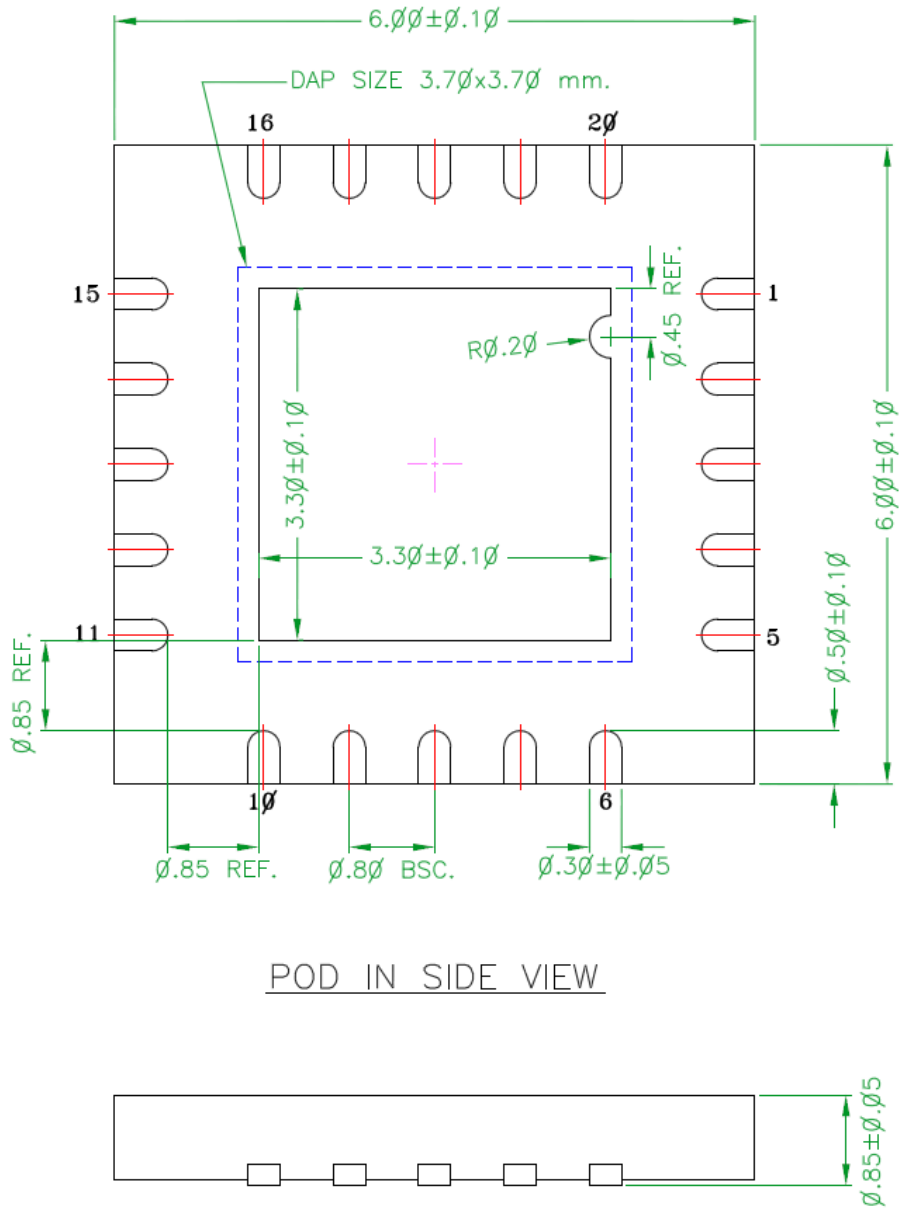
8. APPLICATION INFORMATION

Figure 6. Typical Application Circuit

Table 4. Recommended Component Values

Component	Typ. Value	Component	Typ. Value	Component	Typ. Value	Component	Typ. Value
R_{COMP1}	3Mohm	R_{COMP2}	12Kohm	C_{CDLY}	10nF	C_{COMP}	10nF
R_{ISET} (1%)	5ohm	C_{VDD}	2.2uF	C_{VCC}	10uF	C_{PDC}	2.2uF

9. PACKAGING INFORMATION

QFN, 20 pins, 6mm x 6mm x 0.85mm, 0.8mm pitch,

POD IN SIDE VIEW

Figure 9. Package Dimensions