

# R2A20135SP

R03DS0061EJ0200

Rev.2.00

Jul 24, 2013

## LED Lighting Power Controller

### Description

R2A20135 is LED lighting controller IC with dimming function.

High accuracy LED current feed-back system makes more efficient LED performance.

With non-Isolation step-down control makes it possible to reduce external parts and realize high power factor and efficiency. Moreover, this IC builds in the dimming function and can control many types dimming mode such as Triac, PWM, and DC dimming.

Switching mode can chosen Zero Current detect Mode or Fixed Frequency Mode according to the required features. By the Constant On Time control, both modes have power factor correct function.

Zero Current detect Mode is better performance for noise immunity, and Fixed Frequency Mode is for power factor correction and THD.

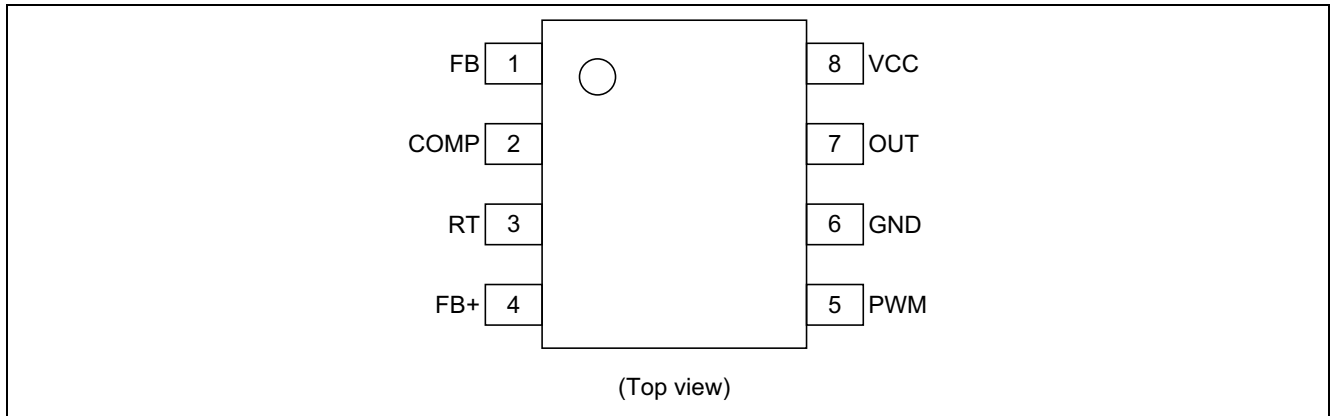
### Features

- Absolute Maximum Ratings
  - Supply voltage  $V_{cc}$ : 24 V
  - Operating junction temperature  $T_{jopr}$ : -40 to +150°C
- Electrical characteristics
  - UVLO operating start voltage  $V_H$ : 12 V  $\pm$  0.8 V
  - UVLO operating shutdown voltage  $V_L$ : 9.2 V  $\pm$  0.7 V
  - UVLO hysteresis voltage  $H_{ysv}$ : 2.8 V  $\pm$  0.7 V
- Functions
  - Dimming function (Triac, PWM, DC dimming)
  - Zero current detection mode (when  $R_{rt}$  is OPEN)
  - Fixed frequency mode (when  $R_{rt}$  is connected by GND)
  - Adjustable switching frequency (when  $R_{rt}$  is connected by GND)
  - Package lineup: Pb-free SOP-8 (JEDEC)

### Ordering Information

Part No.	Package Name	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
R2A20135SP#W5	—	PRSP0008DJ-A	SP	W (2,500 pcs/reel)

## Pin Arrangement

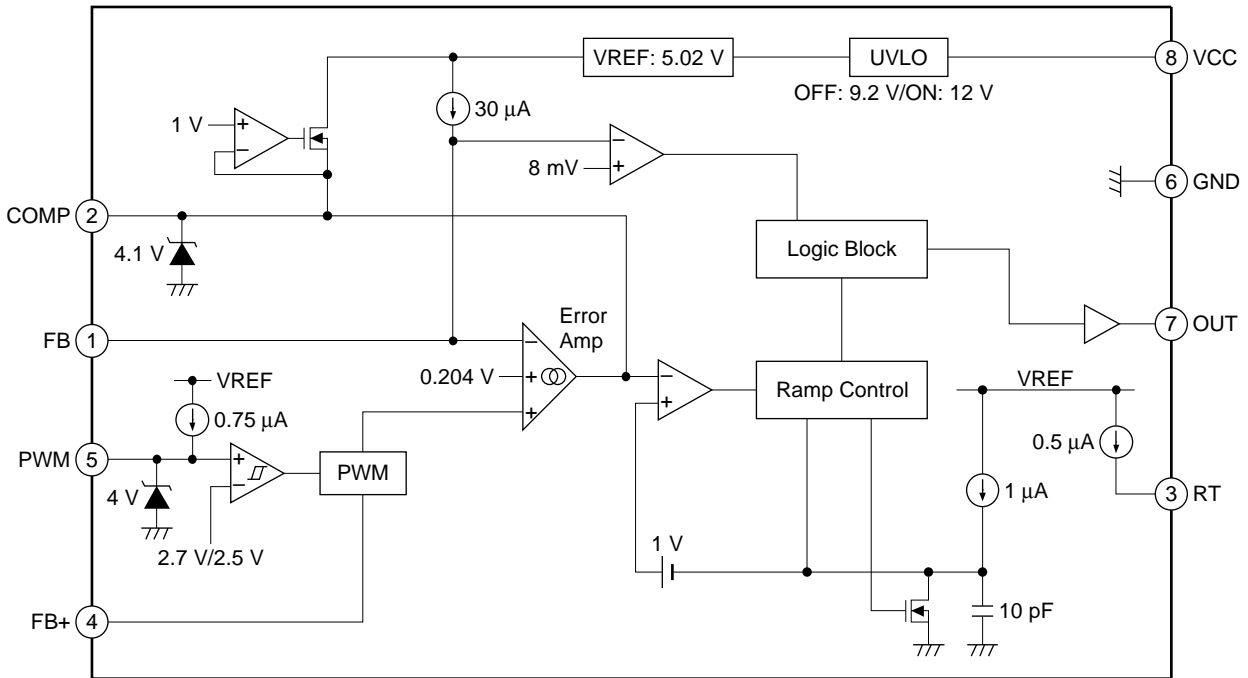


## Pin Function

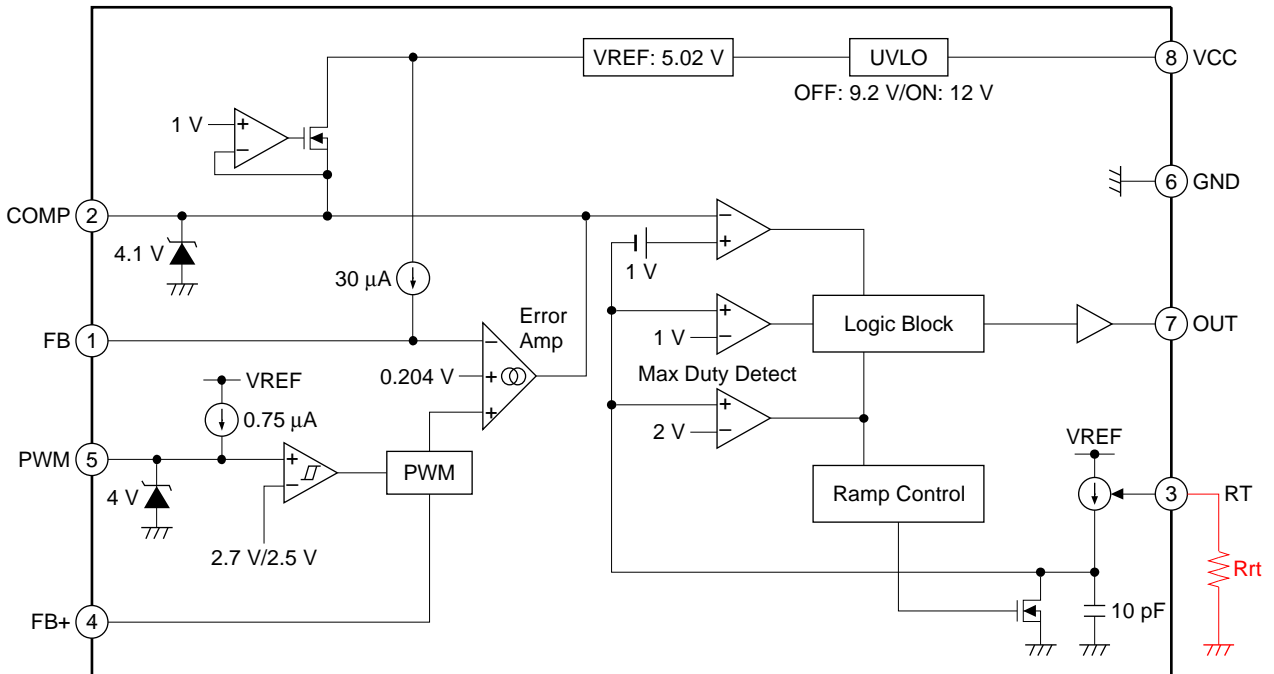
Pin No.	Pin Name	Input/Output	Function
1	FB	Input	Error amplifier input pin
2	COMP	Output	Error amplifier output pin
3	RT	Input/Output	A resistor connection pin for RAMP current setting
4	FB+	Input/Output	A conductor connection pin for PWM voltage stability and DC dimming
5	PWM	Input	Input PWM signal
6	GND	—	Ground
7	OUT	Output	Power MOSFET drive pin
8	VCC	Input	Supply voltage pin

### Block Diagram

· Rrt: OPEN (Zero Current Detection Mode)



· Rrt: Connect to GND (Fixed Frequency Mode)



## Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Note
Power supply voltage	VCC	-0.3 to +24	V	
FB pin voltage	Vt-fb	-0.3 to +5	V	
COMP pin voltage	Vt-comp	-0.3 to +5	V	
RT pin voltage	Vt-rt	-0.3 to +5	V	
FB+ pin voltage	Vt-fb+	-0.3 to +5	V	
PWM pin voltage	Vt-pwm	-0.3 to +5	V	
OUT pin peak current	l <sub>pk</sub> -snk-out	0.9	A	3
	l <sub>pk</sub> -src-out	-0.50		
OUT pin DC current	I <sub>dc</sub> -snk-out	100	mA	
	I <sub>dc</sub> -src-out	-50		
RT pin current	I <sub>rt</sub>	-200 to +100	μA	
PWM pin current	I <sub>pwm</sub>	500	μA	
Power dissipation	P <sub>t</sub>	0.68	W	4
Operating junction temperature	T <sub>jopr</sub>	-40 to +150	°C	
Storage temperature	T <sub>stg</sub>	-55 to +150	°C	

- Notes:
1. Rated voltages are with reference to the GND pin.
  2. For rated currents, inflow to the IC is indicated by (+), and outflow by (-).
  3. Shows the transient current when driving a capacitive load.
  4. In case of R2A20135SP:  $\theta_{ja} = 120^{\circ}\text{C/W}$   
This value is a thing mounting on  $40 \times 40 \times 1.6$  [mm], a glass epoxy board of wiring density 10%.

## Electrical Characteristics

(Ta = 25°C, VCC = 15 V, FB = COMP, RRT = 200 kΩ)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions	
Supply	UVLO turn-on threshold	Vuvlh	11.2	12	12.8	V	
	UVLO turn-off threshold	Vuvll	8.5	9.2	9.9	V	
	UVLO hysteresis	Hysuvl	2.1	2.8	3.5	V	
	Standby current	Istby	—	130	200	μA	VCC = Vuvlh – 0.2 V
	Operating current	Icc	—	2.2	3.3	mA	
Error amplifier	Feedback voltage	Vfb	0.194	0.204	0.214	V	*3
	Minimum feedback voltage	Vfb_min	—	0	—	mV	
	Input bias current	Ifb	–50	–30	–15	μA	Vfb = 13 mV
	Open loop gain	Av	—	63	—	dB	
	Upper clamp voltage	Vclamp_comp	3.85	4.10	4.30	V	FB = 0 V COMP: Open
	Low voltage	VI-comp	—	0.9	—	V	FB = 0.4 V COMP: Open
	Source current	Isrc-comp	–14	–9	–5	μA	FB = 0 V COMP = 2.5 V
	Sink current	Isrc-comp	12	20	27	μA	FB = 1 V COMP = 2.5 V
	Transconductance	gm	25	45	70	μs	FB = 0.15 V ↔ 0.25 V COMP = 2.5 V
Zero current detector	ZCD threshold voltage	Vzcd	2	8	14	mV	
Restart	Restart time delay	Tstart	45	75	140	μs	FB = 0 V, COMP = 2.5 V, RT = Open
RT	RAMP offset voltage	Voffset_ramp	—	1.0	—	V	
	RAMP amplitude	dVramp	2.9	3.1	3.3	V	*2
	RT voltage1	V-rt1	1.9	2.0	2.1	V	RT-GND: 200 kΩ
	RT bias current	Irt	–0.7	–0.5	–0.2	μA	RT = 2.5 V
PWM	Maximum input frequency	Fpwm_max	—	—	100	kHz	*1
	Input bias current	Ipwm	–0.35	–0.75	–1.5	μA	
	Upper clamp voltage	Vclamp_pwm	3.5	4.0	4.5	V	Clamp current = 100 μA
	PWM high threshold voltage	Vr_pwm	2.40	2.70	3.00	V	
	PWM low threshold voltage	Vf_pwm	2.25	2.5	2.75	V	
FB+	Minimum output voltage	Vfb+_lo	—	0	10	mV	Vpwm = 0 V
OUT	Rise time	tr-out	—	30	100	ns	CL = 1000 pF
	Fall time	tf-out	—	30	100	ns	CL = 1000 pF
	OUT low voltage	Vol1-out	—	0.08	0.20	V	Isink = 20 mA
		Vol2-out	—	0.05	0.70	V	Isink = 10 mA, VCC = 5 V
	OUT high voltage	Voh-out	14.5	14.8	—	V	Isource = –20 mA
	OUT frequency	fout	43	48	53	kHz	RT-GND: 200 kΩ
	Maximum duty cycle	Dmax	47	52	57	%	RT-GND: 200 kΩ

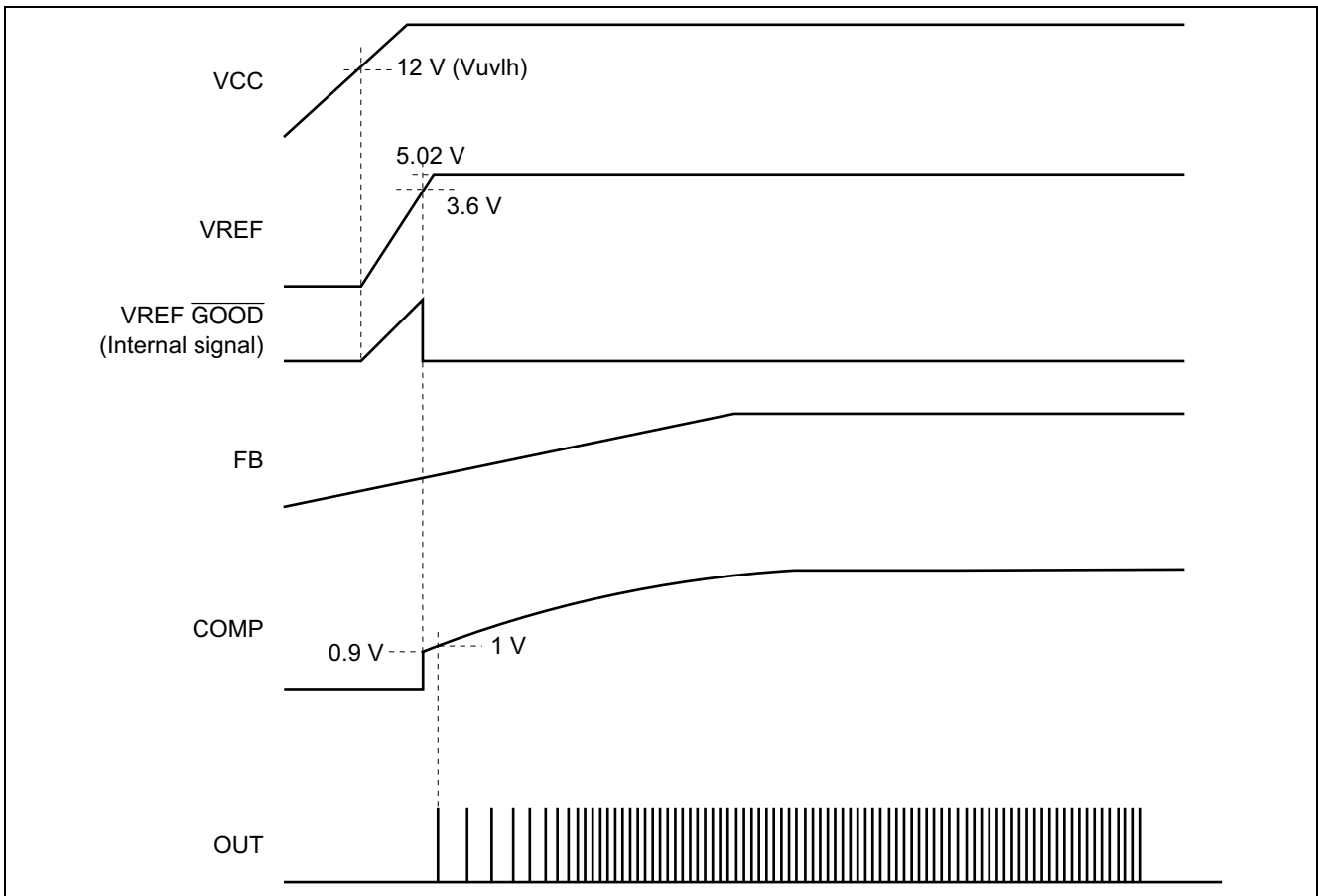
Notes: \*1 Design spec

\*2 dVramp = Vclamp\_comp – Voff\_ramp

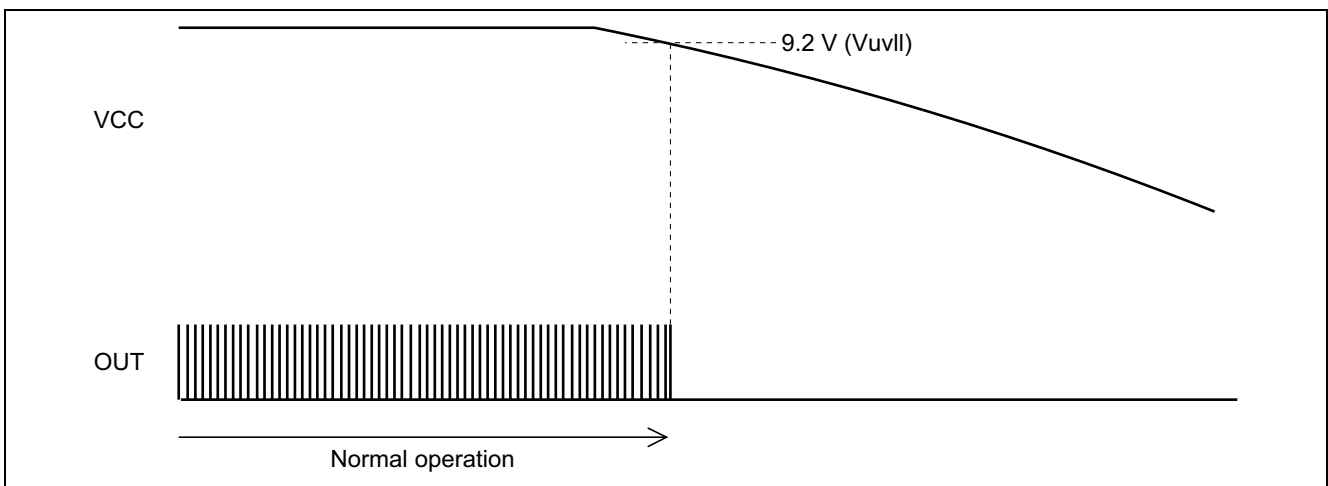
\*3 There is the possibility of change for the standard value.

## Waveforms (Zero Current Detection Mode/Fixed Frequency Mode common)

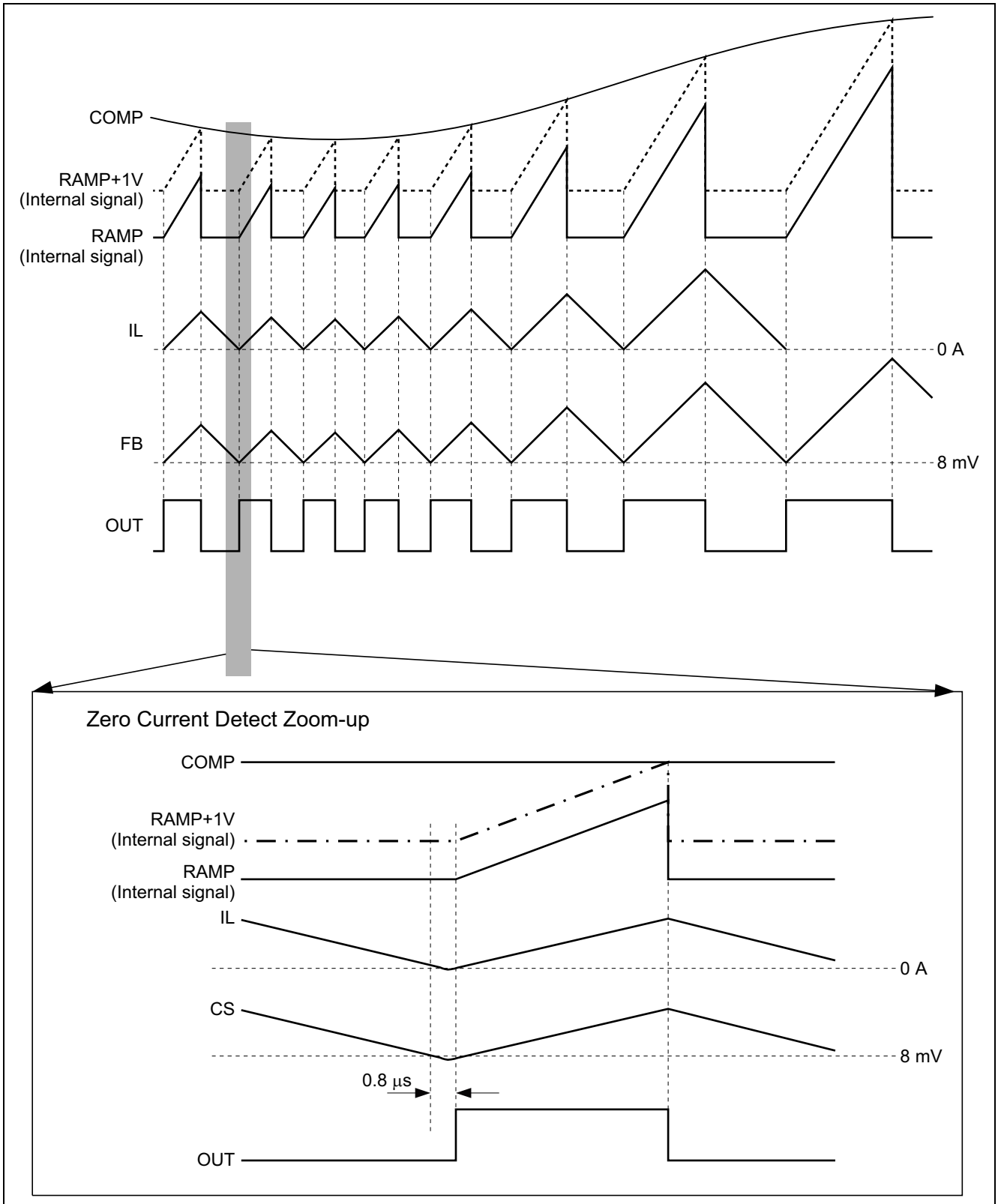
### 1. Start-up Timing (Zero Current Detection Mode/Fixed Frequency Mode common)



### 2. Stop Timing (Zero Current Detection Mode/Fixed Frequency Mode common)

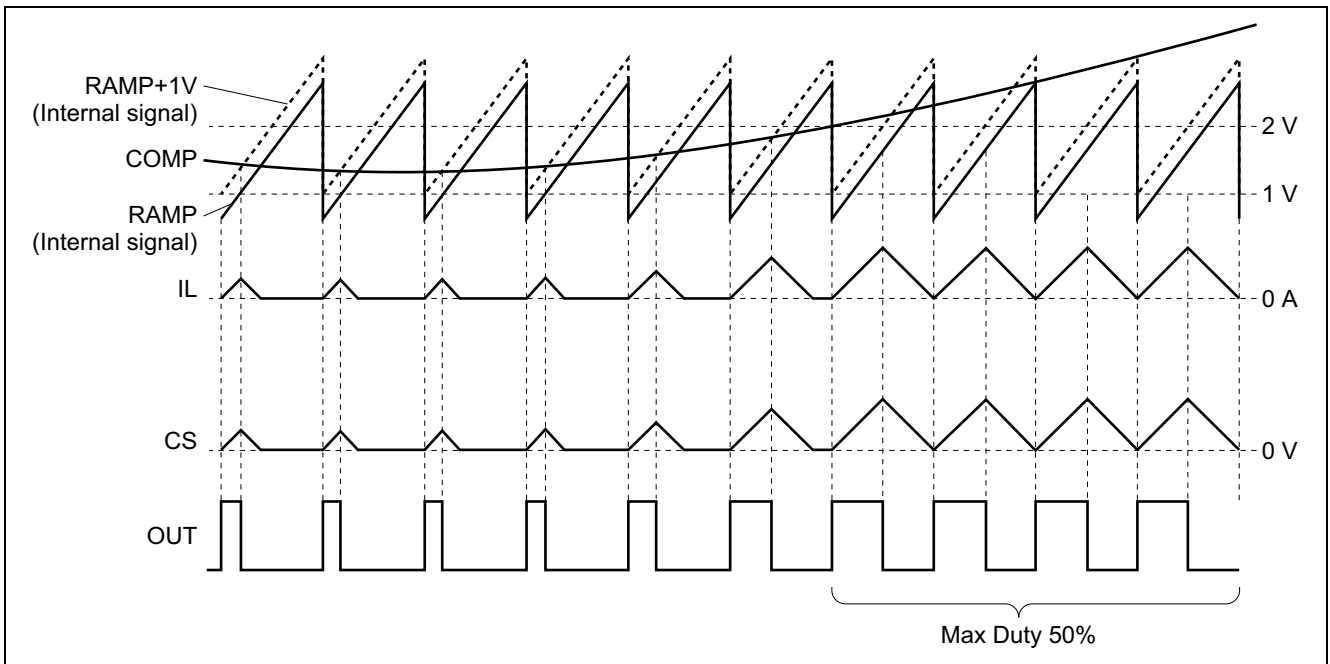


3. Gate Drive Output (Zero Current Detection Mode)

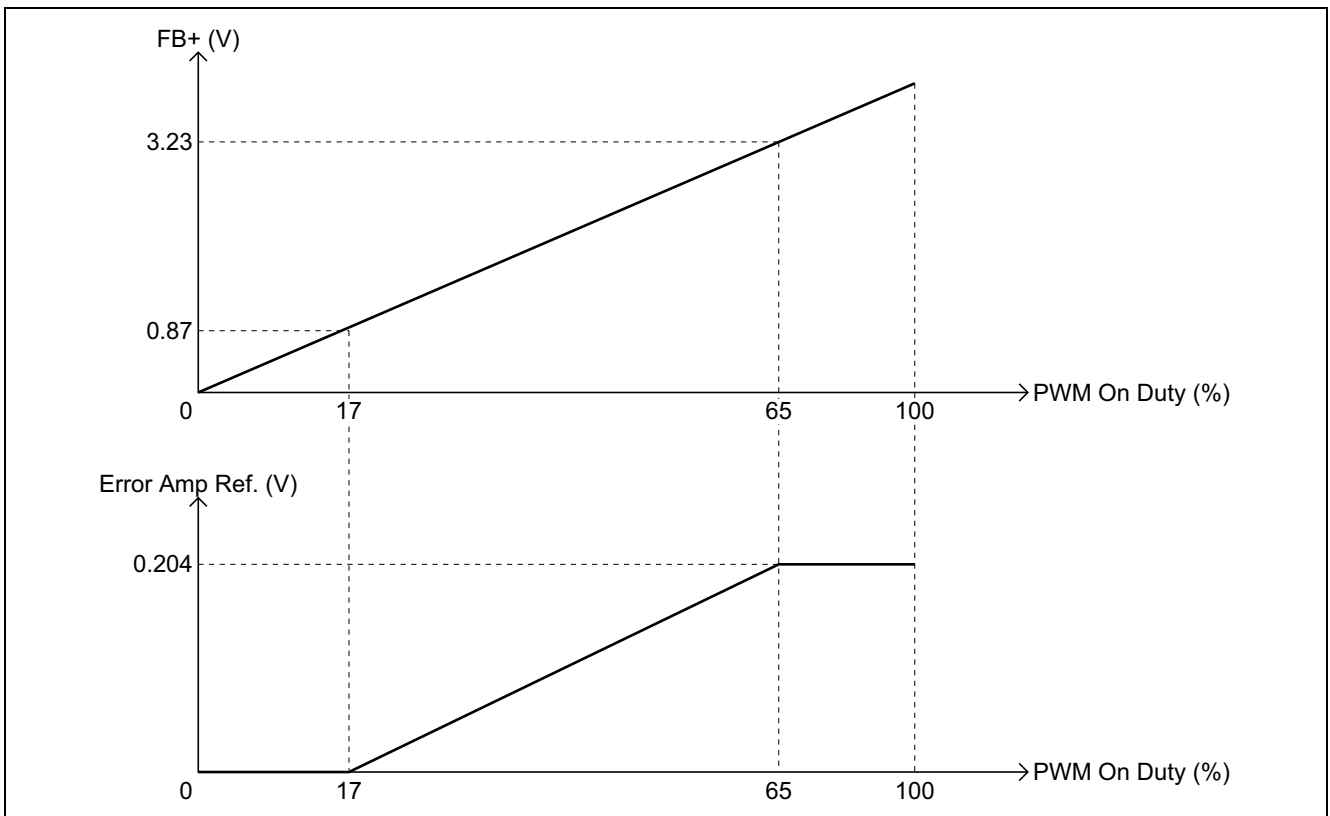


#### 4. Gate Drive Output (Fixed Frequency Mode)

##### 4.1 Error Amp Control Mode



#### 5. PWM Characteristics

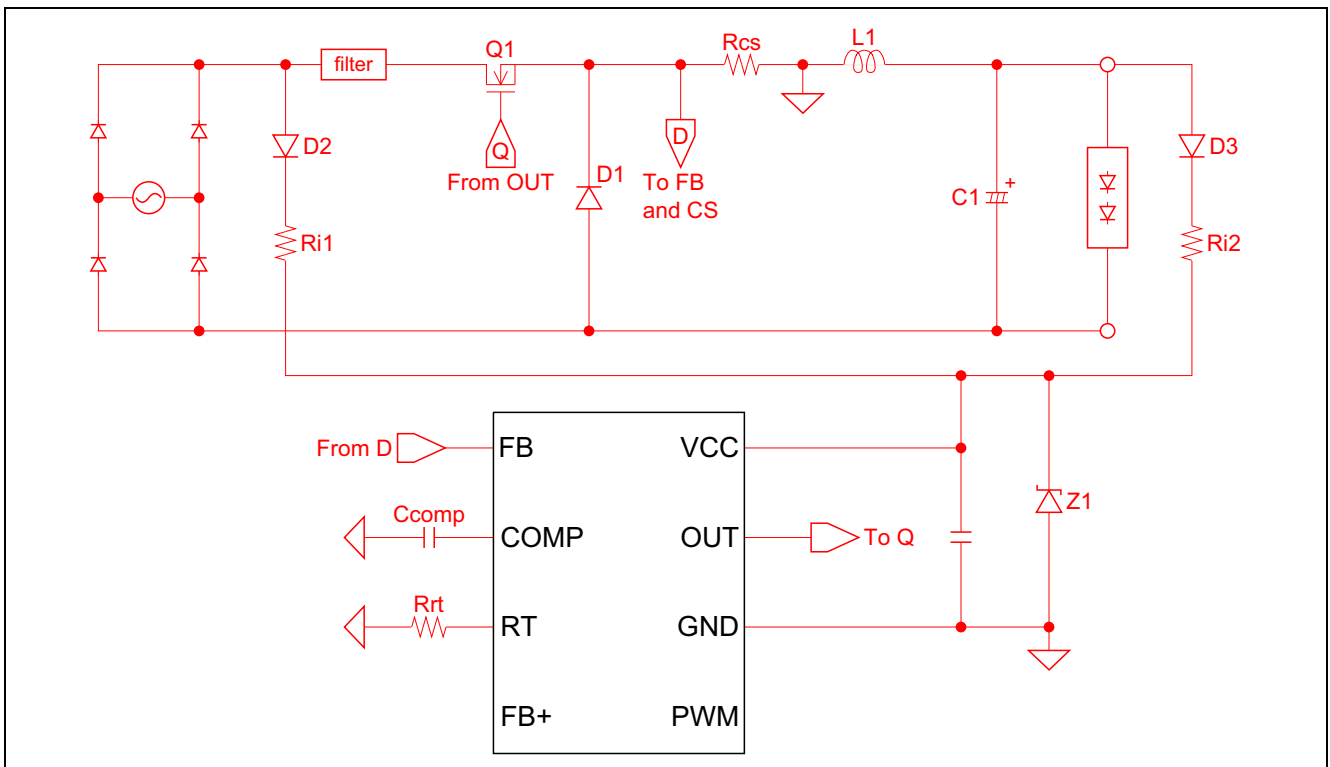




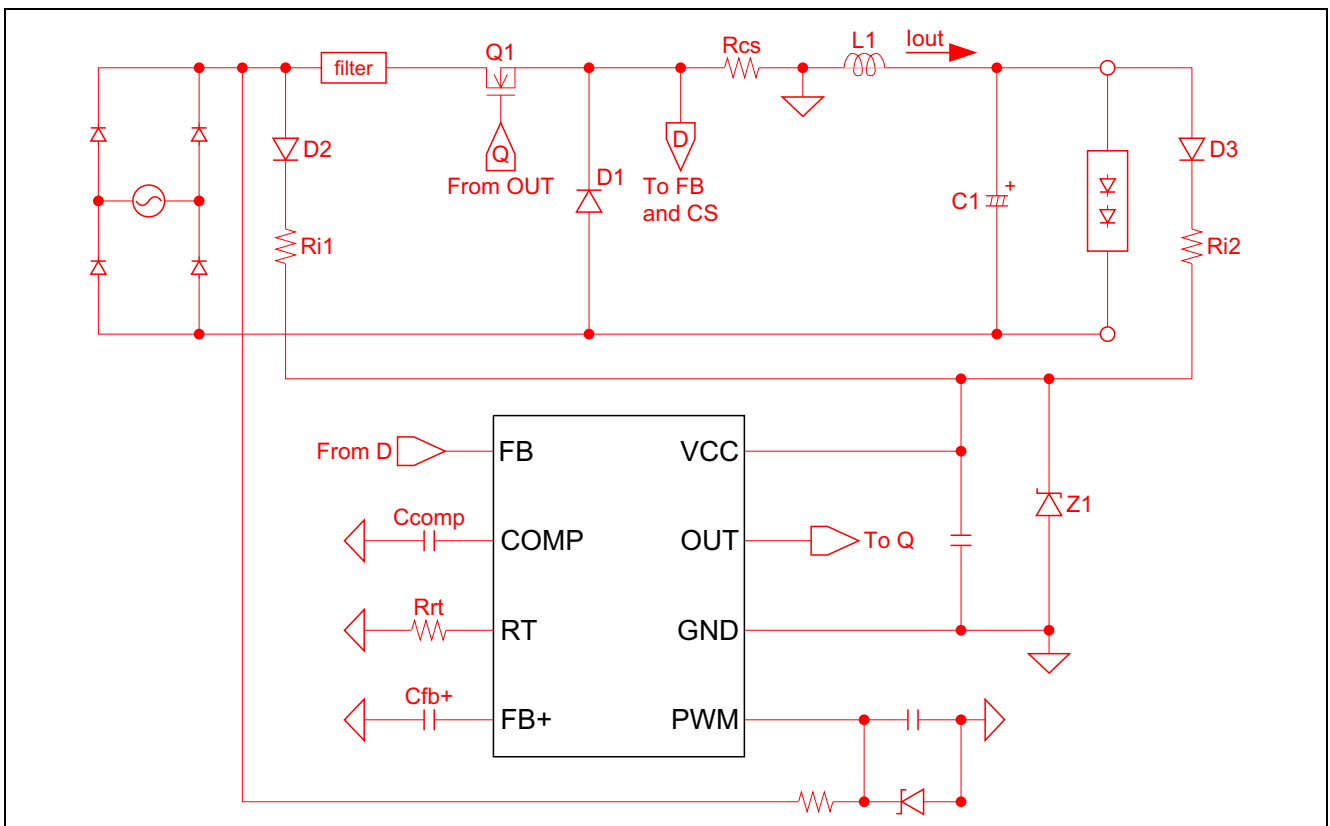
## System Diagram

### 1. Step-down Fixed Frequency Mode

#### 1.1 Non Dimming

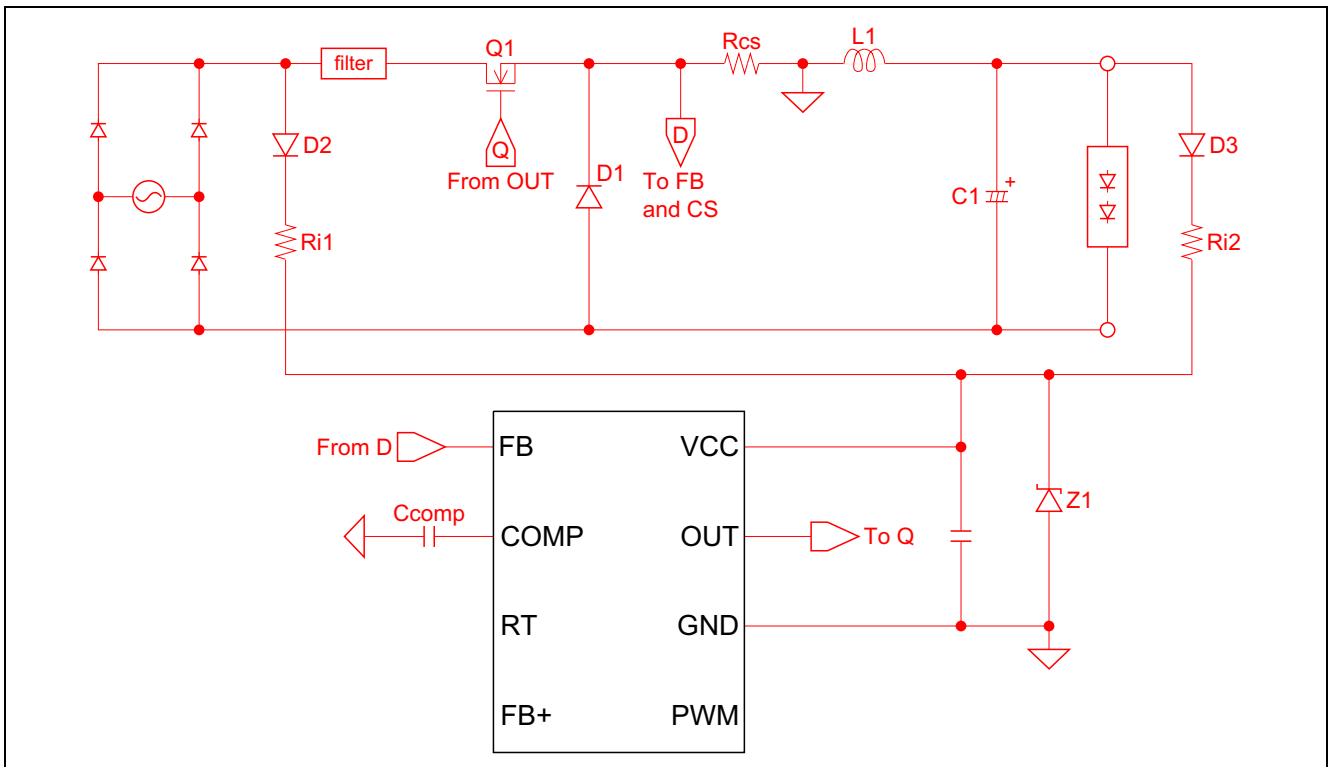


#### 1.2 Triac Dimming

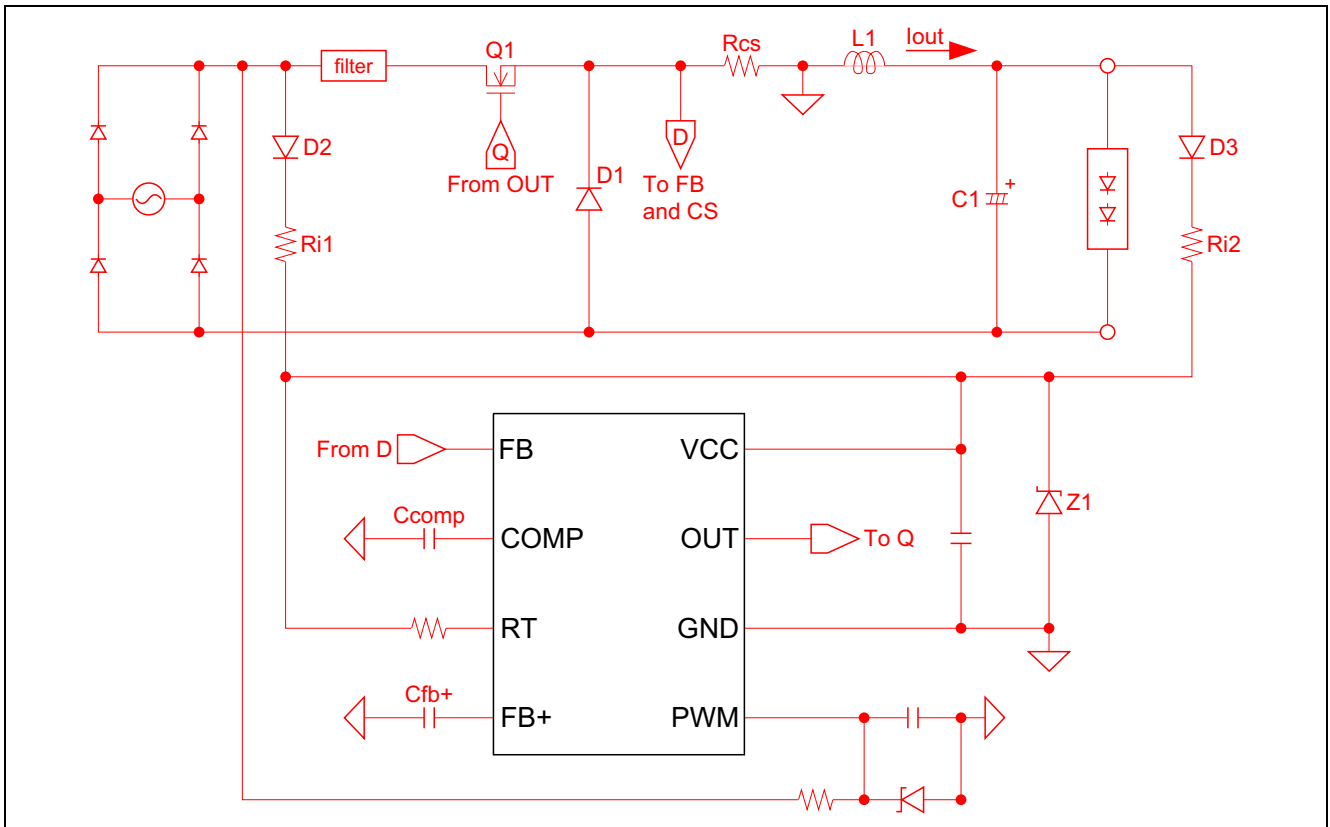


## 2. Step-down Zero Current Detection Mode

### 2.1 Non Dimming

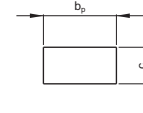
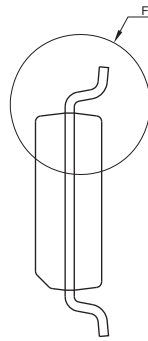
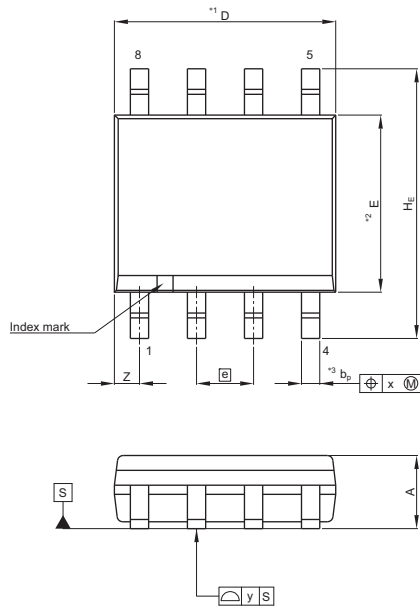


### 2.2 Triac Dimming

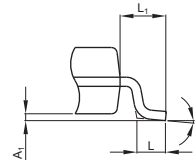


### Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP8-3.94x4.93-1.27	PRSP0008DJ-A	—	0.073g



Terminal cross section  
(Ni/Pd/Au plating)



Detail F

NOTE)  
1. DIMENSIONS\*1 (Nom)\*AND\*2\*  
DO NOT INCLUDE MOLD FLASH.  
2. DIMENSION\*3\*DOES NOT  
INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	4.80	4.93	4.98
E	3.81	3.94	3.99
A <sub>2</sub>	—	1.47	—
A <sub>1</sub>	0.10	0.15	0.25
A	—	—	1.73
b <sub>p</sub>	0.35	0.41	0.49
b <sub>1</sub>	—	—	—
c	0.19	0.20	0.25
c <sub>1</sub>	—	—	—
$\theta$	0°	—	8°
H <sub>E</sub>	5.84	5.99	6.20
e	—	1.27	—
x	—	—	0.25
y	—	—	0.10
Z	—	0.56	—
L	0.41	0.64	0.89
L <sub>1</sub>	—	1.03	—

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.  
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.  
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.  
Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



### SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

**Renesas Electronics Canada Limited**  
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada  
Tel: +1-905-898-5441, Fax: +1-905-898-3220

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-65030, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China  
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics Korea Co., Ltd.**  
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141