

# R2A20111SP

## Power Factor Correction Controller IC

REJ03F0231-0200

Rev.2.00

Sep 29, 2009

### Description

The R2A20111 is a power-factor correction (PFC) controller IC.

This IC adopts continuous conduction mode as PFC operation.

Various functions such as constant power limit, overvoltage detection, overcurrent detection, soft start, feedback-loop disconnection detection, and holding function of PFC operation through momentary outage (PFC hold function) are incorporated in a single chip. These functions reduce external circuitry.

The constant power limit function allows to eliminate a significant amount of coil noise which is generated due to overcurrent detection operation in case of conventional overload.

The PFC hold function enables quick recovery by continuing PFC operation after momentary outage. The hold time can be adjusted by an external capacitance.

Overcurrent detection pin is separately provided.

Latch mode shutdown function is incorporated.

A soft-start control pin provides for the easy adjustment of soft-start operation, and can be used to prevent overshooting of the output voltage.

### Features

- Maximum ratings
  - Power-supply voltage  $V_{CC}$ : 24 V
  - Operating junction temperature  $T_{jopr}$ : -40 to 125°C
- Electrical characteristics
  - VREF output voltage VREF: 5.0 V  $\pm$  3%
  - UVLO operation start voltage  $V_H$ : 10.5  $\pm$  0.9 V
  - UVLO operation stop voltage  $V_L$ : 9.0  $\pm$  0.7 V
  - PFC output maximum ON duty  $D_{max-out}$ : 95% (typ.)
- Functions
  - Constant power limit function
  - Continuous conduction mode
  - Hold function of PFC operation on momentary outage (PFC hold function)
  - Overvoltage detection
  - Overcurrent detection
  - Soft start
  - Feedback loop disconnection detection
  - IC shutdown function
  - Package lineup: SOP-16

### Applications

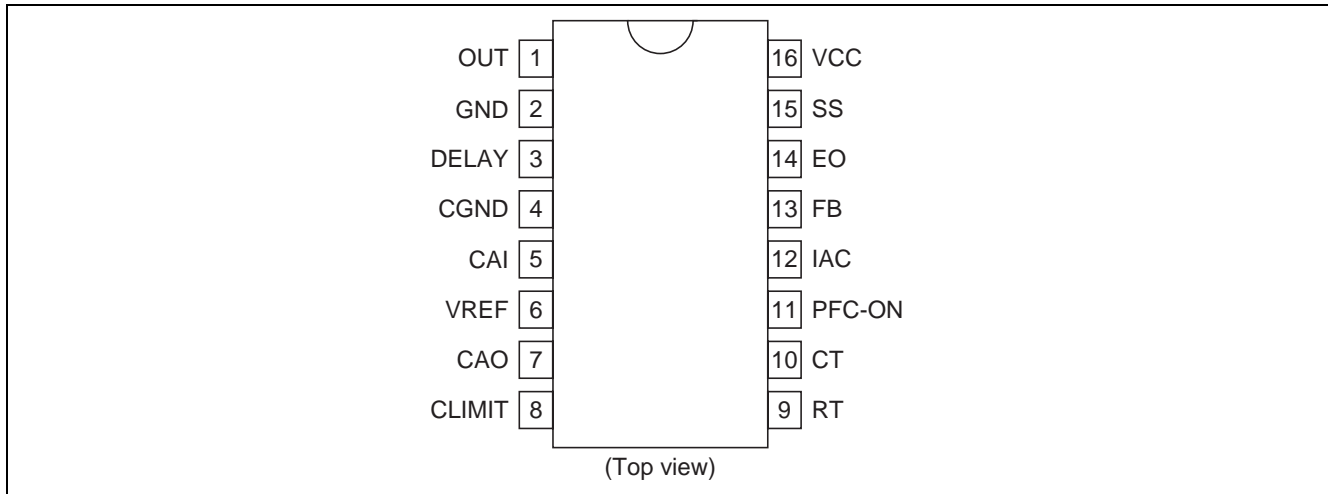
- Flat panel display
- Projector
- Desktop PC
- White goods

### Ordering Information

Part No.	Package Name	Package Code	Taping Spec.
R2A20111SPW0	FP-16DAV	PRSP0016DH-B	2000 pcs./one taping product



## Pin Arrangement



## Pin Description

Pin No.	Pin Name	I/O	Function
1	OUT	Output	Power MOS FET gate driver output
2	GND	—	Ground
3	DELAY	Input/Output	Hold time adjust and IC shutdown
4	CGND	Input	Non-inverting input of current amplifier
5	CAI	Input/Output	Inverting input of current amplifier and Current output for PFC control
6	VREF	Output	Reference voltage output
7	CAO	Output	Current amplifier output
8	CLIMIT	Input	Overcurrent detection
9	RT	Input/Output	Timing resistor for settings of operational frequency, and the maximum CAI pin and DELAY pin current
10	CT	Output	Timing capacitor for operational frequency adjust
11	PFC-ON	Input	Detection of input AC voltage level
12	IAC	Input	Detection of input AC waveform
13	FB	Input	Voltage amplifier input
14	EO	Output	Voltage amplifier output
15	SS	Output	Timing capacitor for soft-start time adjust
16	VCC	Input	Power supply voltage input

## Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Note
Supply voltage	VCC	24	V	
OUT peak current	I <sub>pk-out</sub>	±1.0	A	3
OUT DC current	I <sub>dc-out</sub>	±0.1	A	
Terminal voltage	V <sub>i-group1</sub>	−0.3 to V <sub>cc</sub>	V	4
	V <sub>i-group2</sub>	−0.3 to V <sub>ref</sub>	V	5
CAO voltage	V <sub>cao</sub>	−0.3 to V <sub>caoh</sub>	V	
EO voltage	V <sub>eo</sub>	−0.3 to V <sub>eoH</sub>	V	
DELAY voltage	V <sub>delay</sub>	−0.3 to +6.5	V	
CAI voltage	V <sub>i-cs</sub>	−1.5 to +0.3	V	
RT current	I <sub>rt</sub>	−200	μA	
IAC current	I <sub>iac</sub>	0.6	mA	
VREF current	I <sub>o-ref</sub>	−5	mA	
Power dissipation	P <sub>t</sub>	1	W	6
Operating junction temperature	T <sub>j-opr</sub>	−40 to +125	°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. The transient current when driving capacitive load.  
 4. This is the rated voltage for the following pin:  
 OUT.  
 5. This is the rated voltage for the following pins:  
 CGND, VREF, CLIMIT, RT, CT, PFC-ON, IAC, FB, SS  
 6. Thermal resistance of packages

Package	θ <sub>ja</sub>	θ <sub>jc</sub>	Note
SOP16	120°C/W	—	40 × 40 × 1.6 [mm], Mounted on a glass epoxy printed board with 10% wiring density
	—	35°C/W	Infinite heat sink

## Electrical Characteristics

(Ta = 25°C, VCC = 12 V, RT = 27 kΩ, CT = 1000 pF)

	Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Supply	Start threshold	VH	9.6	10.5	11.4	V	
	Shutdown threshold	VL	8.3	9.0	9.7	V	
	UVLO hysteresis	dVUVL	1.0	1.5	2.0	V	
	Startup current	Is	140	200	260	μA	VCC = 9.5 V
	Is temperature stability	dIs/dTa	—	−0.3	—	%/°C	*1
	Operating current	Icc	3.45	4.5	6.45	mA	IAC = 0 A, CL = 0 F
VREF	Output voltage	Vref	4.85	5.00	5.15	V	Isource = 1 mA
	Line regulation	Vref-line	—	5	20	mV	Isource = 1 mA, VCC = 12 V to 23 V
	Load regulation	Vref-load	—	5	20	mV	Isource = 1 mA to 5 mA
	Temperature stability	dVref	—	±80	—	ppm/°C	Ta = −40 to 125°C *1
Oscillator	Initial accuracy	fout	58.5	65	71.5	kHz	Measured pin: OUT
	fout temperature stability	dfout/dTa	—	±0.1	—	%/°C	Ta = −40 to 125°C *1
	fout voltage stability	fout-line	−1.5	0.5	1.5	%	VCC = 12 V to 18 V
	CT peak voltage	Vct-H	—	3.6	4.0	V	*1
	Ramp valley voltage	Vct-L	—	0.65	—	V	*1
	RT voltage	Vrt	1.17	1.25	1.33	V	
Soft start	Sink current	Iss	15.0	25.0	35.0	μA	SS = 2 V
Current limit	Threshold voltage	VCL	1.222	1.3	1.378	V	
	Delay to output	td-CL	—	100	200	ns	CLIMIT = 2 to 0 V
VAMP	Feedback voltage	Vfb	2.40	2.50	2.60	V	FB-EO Short
	Input bias current	Ifb	−0.3	0	0.3	μA	Measured pin: FB
	Open loop gain	Av-v	—	53	—	dB	*1
	High voltage	Veoh	5.2	5.7	6.2	V	FB = 2.3 V, EO: Open
	Low voltage	Veol	—	0.1	0.3	V	FB = 2.7 V, EO: Open
	Source current	Isrc-eo	−180	−120	−90	μA	FB = 1.0 V, EO = 2.5 V
	Sink current	Isnk-eo	90	120	180	μA	FB = 4.0 V, EO = 2.5 V
	Transconductance	Gm-v	150	200	290	μA/V	FB = 2.5 V, EO = 2.5 V
CAMP	Input offset voltage	Vio-ca	—	(−10)	0	mV	*1
	Open loop gain	Av-ca	—	68	—	dB	*1
	High voltage	Vcaoh	5.2	5.7	6.2	V	
	Low voltage	Vcaol	—	0.1	0.3	V	
	Source current	Isrc-ca	−135	−90	−67	μA	CAO = 2.5 V
	Sink current	Isnk-ca	67	90	135	μA	CAO = 2.5 V
	Transconductance	Gm-c	530	700	1000	μA/V	*1

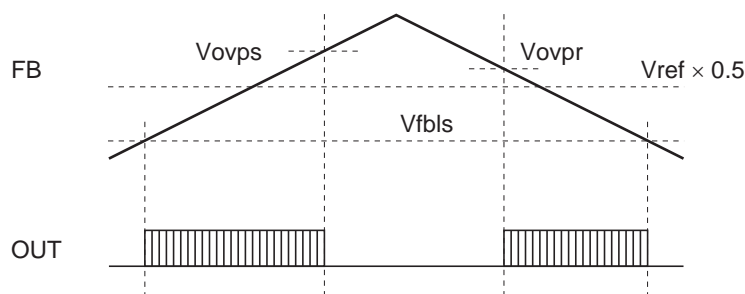
Note: 1. Design spec.

## Electrical Characteristics (cont.)

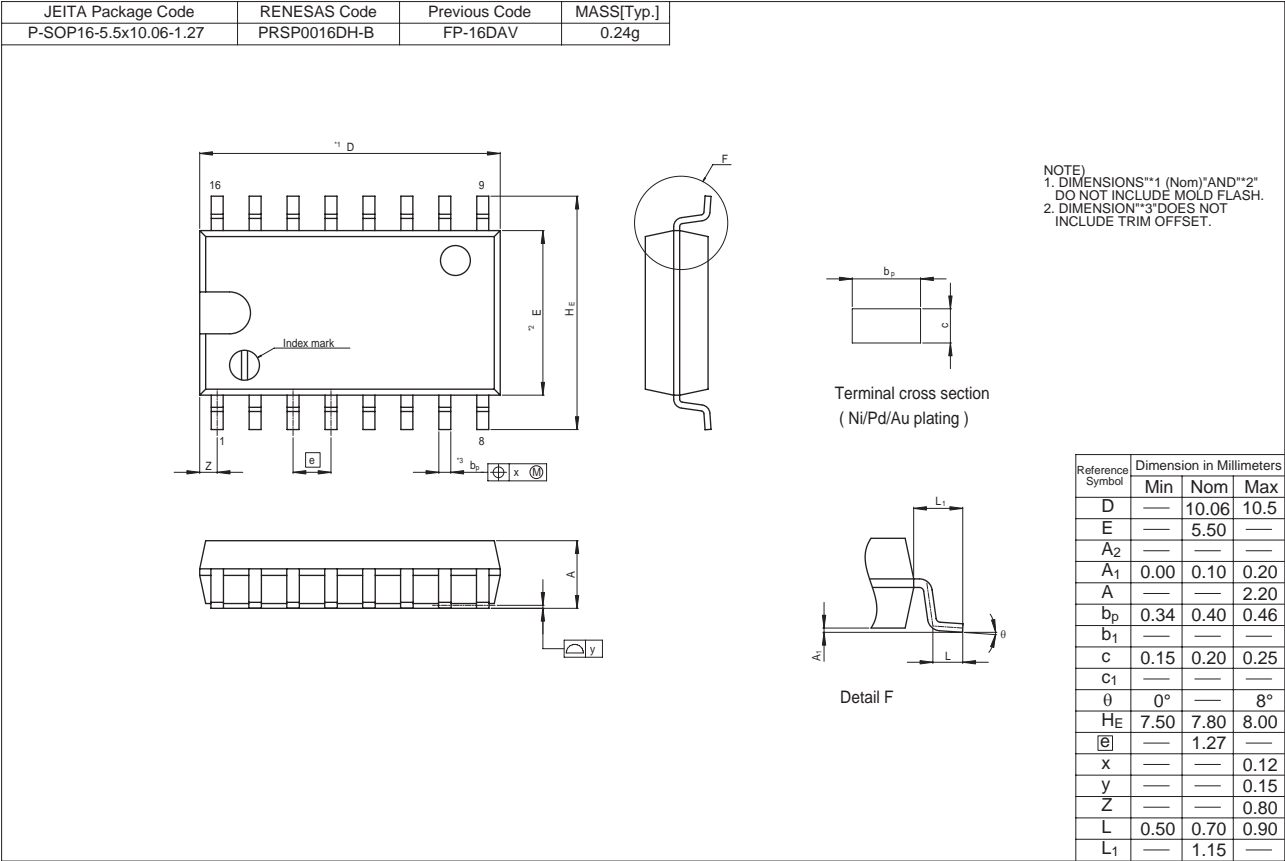
(Ta = 25°C, VCC = 12 V, RT = 27 kΩ, CT = 1000 pF)

	Item	Symbol	Min	Typ	Max	Unit	Test Conditions
IAC/ Multiplier	IAC pin voltage	Viac	1.6	2.3	3.0	V	IAC = 100 μA
	Imo current 1	Imo1	-61.3	-51.5	-41	μA	EO = 2.5 V, IAC = 150 μA PFC-ON = 1.2 V
	Imo current 2	Imo2	-197.9	-165	-131.5	μA	EO = Vcaoh, IAC = 150 μA PFC-ON = 1.2 V
	Imo current 3	Imo3	-32.8	-27	-21.2	μA	EO = 2.5 V, IAC = 375 μA PFC-ON = 2.5 V
	Imo current 4	Imo4	-110.4	-92	-73.6	μA	EO = Vcaoh, IAC = 375 μA PFC-ON = 2.5 V
OUT	Minimum duty cycle	Dmin-out	—	—	0	%	CAO = 4.0 V
	Maximum duty cycle	Dmax-out	90	95	98	%	CAO = 0 V
	Rise time	tr-out	—	30	100	ns	CL = 1000 pF
	Fall time	tf-out	—	30	100	ns	CL = 1000 pF
	Low voltage	Vol1-out	—	0.05	0.2	V	Iout = 20 mA
		Vol2-out	—	0.5	2.0	V	Iout = 200 mA (Pulse test)
		Vol3-out	—	0.03	0.7	V	Iout = 10 mA, VCC = 5 V
	High voltage	Voh1-out	11.5	11.9	—	V	Iout = -20 mA
		Voh2-out	10.0	11.0	—	V	Iout = -200 mA (Pulse test)
Shut down	Shut down voltage	Vshut	3.30	4.00	4.70	V	Input: DELAY
	Reset voltage	Vres	—	—	4.0	V	Input: Vcc
	Shut down current	Ishut	120	190	260	μA	VCC = 9 V
Supervisor	PFC enable voltage	Von-pfc	0.74	0.82	0.9	V	Input pin: PFC-ON
	PFC disable voltage	Voff-pfc	0.71	0.79	0.86	V	Input pin: PFC-ON
	PFC disable delay threshold voltage	Vd-pfc	1.05	1.20	1.30	V	Input pin: DELAY
	Input current	Ipfc-on	-1.0	-0.2	1	μA	PFC-ON = 2 V
	B+ OVP set voltage	dVovps	0.125	0.188	0.250	V	Input pin: FB * <sup>2</sup>
	B+ OVP reset voltage	dVovpr	0.075	0.138	0.200	V	Input pin: FB * <sup>2</sup>
	FB low set voltage	Vfbls	0.425	0.52	0.615	V	Input pin: FB
	DELAY source current	Isrc-delay	-47.5	-42.5	-38	μA	DELAY = 1 V RT = 27 kΩ
	DELAY sink current	Isnk-delay	—	770	—	μA	DELAY = 1 V RT = 27 kΩ * <sup>1</sup>

Notes: 1. Design spec.

2.  $dVovps = Vovps - Vref \times 0.5$  $dVovpr = Vovpr - Vref \times 0.5$ 

Package Dimensions



Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
  - (1) artificial life support devices or systems
  - (2) surgical implantations
  - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
  - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas 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 applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



**RENESAS SALES OFFICES**

<http://www.renesas.com>

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

**Renesas Technology America, Inc.**  
450 Holger Way, San Jose, CA 95134-1368, U.S.A  
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

**Renesas Technology Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

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

**Renesas Technology Hong Kong Ltd.**  
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong  
Tel: <852> 2265-6688, Fax: <852> 2377-3473

**Renesas Technology Taiwan Co., Ltd.**  
10th Floor, No.99, Fushing North Road, Taipei, Taiwan  
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

**Renesas Technology Singapore Pte. Ltd.**  
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

**Renesas Technology Korea Co., Ltd.**  
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea  
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

**Renesas Technology 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: <603> 7955-9390, Fax: <603> 7955-9510