

R2A20112ASP

R03DS0047EJ0100

Rev.1.00

Jul 21, 2011

Critical Conduction Mode Interleaved PFC Control IC

Description

The R2A20112A controls a boost converter to provide an active power factor correction.

The R2A20112A adopts critical conduction mode for power factor correction and realizes high efficiency and a low switching noise by zero current switching.

Interleaving function improves ripple current on input or output capacitor by 180 degrees phase shift.

Soft-start, the feedback loop short detection, two mode over-voltage-protection, over-current-protection, Over current ON/OFF timer protection for boost Diode short and slave ZCD open detection are built in the R2A20112A, and can constitute a power supply system of high reliability with few external parts.

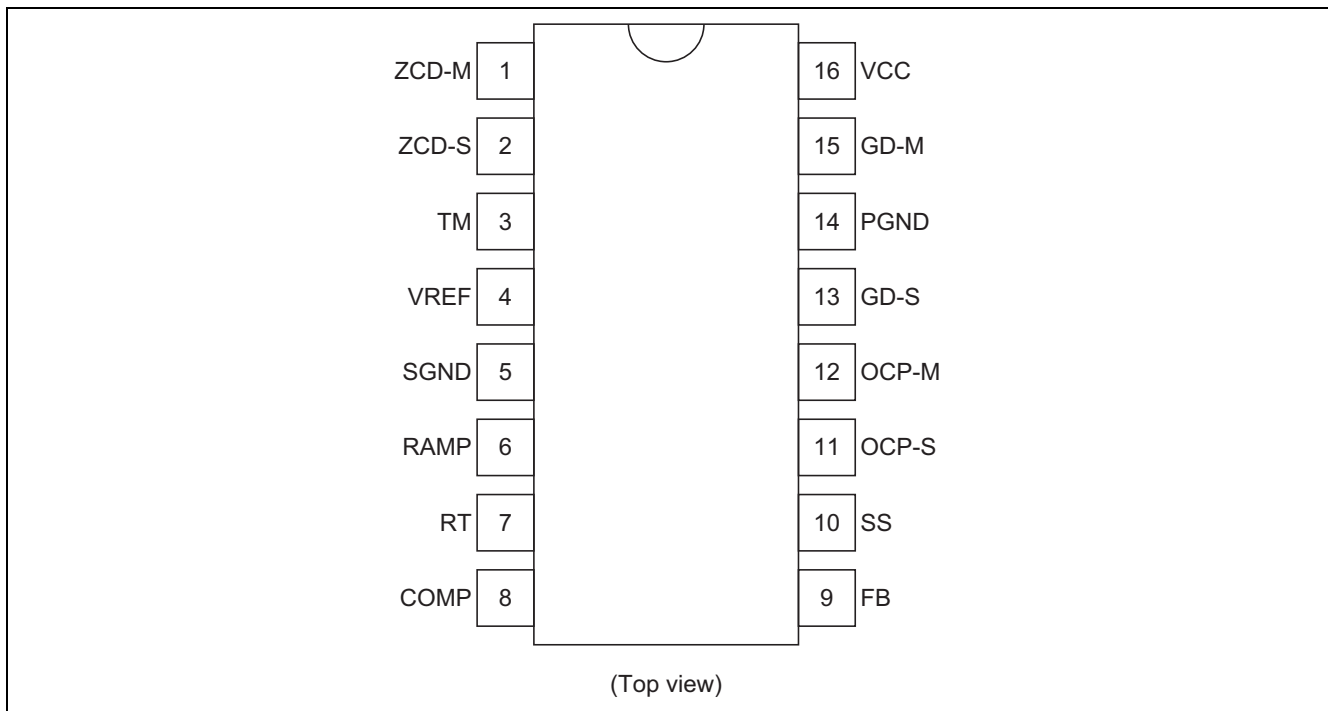
Features

- Absolute Maximum Ratings
 - Supply voltage V_{cc} : 24 V
 - Operating junction temperature T_{jopr} : -40 to +150°C
- Electrical Characteristics
 - VREF output voltage V_{ref} : 5.0 V \pm 1.5%
 - UVLO operation start voltage V_{uvlh} : 10.5 V \pm 0.7 V
 - UVLO operation shutdown voltage V_{uvll} : 9.3 V \pm 0.5 V
 - UVLO hysteresis voltage H_{ysuvl} : 1.2 V \pm 0.5 V
- Functions
 - Boost converter control with critical conduction mode
 - Interleaving control
 - Soft start function for the reference voltage of Error Amp
 - Two mode PFC output Over-voltage-protection
 - Mode1: Dynamic OVP corresponding to a voltage rise by dynamic load change.
 - Mode2: Static OVP corresponding to over-voltage in stable.
 - PFC output Dynamic-under-voltage-protection (DUVP)
 - Feedback loop open/short detection
 - Master and Slave independence over-current-protection
 - 280 μ s restart timer
 - Slave ZCD signal open detection
 - Over current ON/OFF timer protection for boost Diode short
- Package
 - Pb-free SOP-16

Ordering Information

Part No.	Package Name	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
R2A20112ASPW0	FP-16DAV	PRSP0016DH-B	SP	W (2,000 pcs/reel)

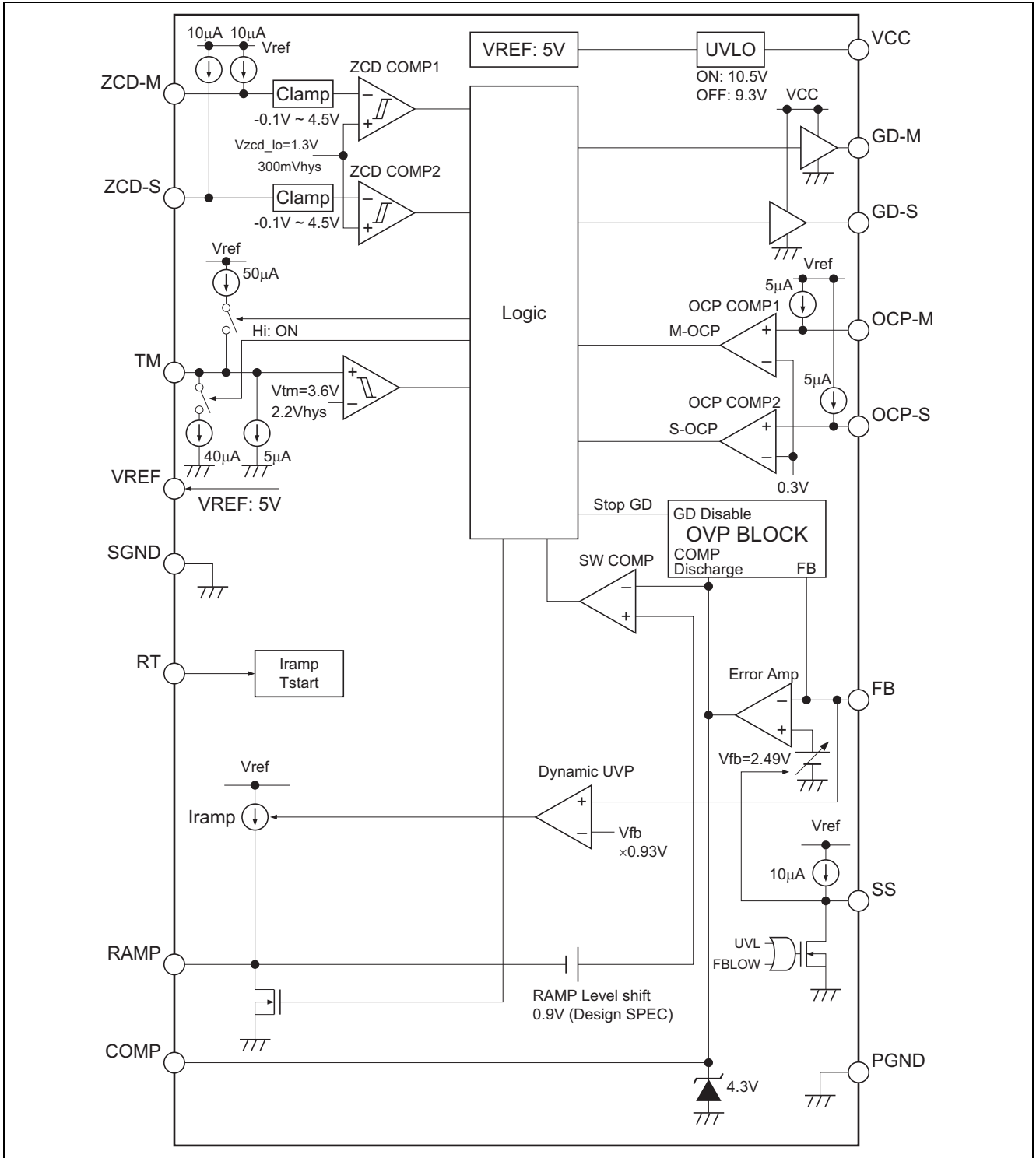
Pin Arrangement



Pin Functions

Pin No.	Pin Name	Function
1	ZCD-M	Master converter zero current detection input terminal
2	ZCD-S	Slave converter zero current detection input terminal
3	TM	Over current ON/OFF timer protection terminal
4	VREF	Reference voltage output terminal
5	SGND	Signal Ground
6	RAMP	Ramp waveform setting terminal
7	RT	Oscillator frequency setting terminal
8	COMP	Error amplifier output terminal
9	FB	Error amplifier input terminal
10	SS	Soft start time setting terminal
11	OCP-S	Slave converter overcurrent detection terminal
12	OCP-M	Master converter overcurrent detection terminal
13	GD-S	Slave converter Power MOSFET drive terminal
14	PGND	Power Ground
15	GD-M	Master converter Power MOSFET drive terminal
16	VCC	Supply voltage terminal

Block Diagram



Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Notes
Supply voltage	VCC	-0.3 to +24	V	
GD terminal peak current	l _{pk-gd}	-300 +1200	mA	3
GD terminal DC current	l _{dc-gd}	-15 +60	mA	
ZCD terminal current	l _{zcd}	+3 -3	mA	
RT terminal current	l _{rt}	-200	μA	4
Vref terminal current	l _{ref}	-5	mA	
Vref terminal load capacitor	C _{ref min}	1000	pF	
	C _{ref max}	1	μF	
COMP terminal current	l _{comp}	±1	mA	
Terminal voltage	V _{t-group1}	-0.3 to V _{cc}	V	5
	V _{t-group2}	-0.3 to V _{ref}	V	6
Vref terminal voltage	V _{t-ref}	-0.3 to V _{ref} + 0.3	V	
OCP terminal voltage	V _{t-ocp}	*-1 to V _{ref}	V	7
Power dissipation	P _t	1	W	8
Operating junction temperature	T _{j-opr}	-40 to +150	°C	
Storage temperature	T _{stg}	-55 to +150	°C	

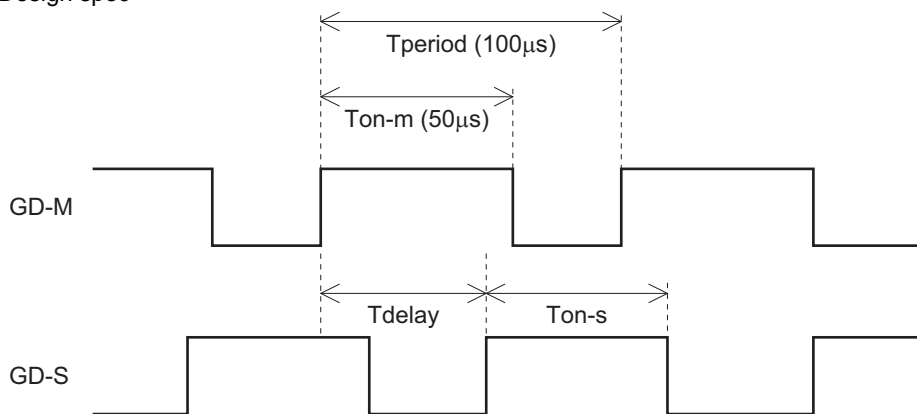
- Notes:
- Rated voltages are with reference to the PGND terminal.
 - For rated currents, inflow to the IC is indicated by (+), and outflow by (-).
 - Shows the transient current when driving a capacitive load.
 - RT terminal's resistor is fixed 33 kΩ to GND.
 - This is the rated voltage for the following pins:
Nothing
 - This is the rated voltage for the following pins:
FB, SS, RAMP, TM
 - Minus value is peak voltage. Do not impress the DC voltage of the minus.
 - θ_{ja} = 120°C/W
This value is a thing mounting on 40 × 40 (thickness: 1.6 mm) [mm²],
a glass epoxy board of wiring density 10%.

Electrical Characteristics

(Ta = 25°C, VCC = 12 V, RT = 33 kΩ, RAMP = 820 pF, TM = 2.2 μF, SS = 1.0 μF, OCP = GND)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Supply	UVLO turn-on threshold	Vuvlh	9.8	10.5	11.2	V	
	UVLO turn-off threshold	Vuvll	8.8	9.3	9.8	V	
	UVLO hysteresis	Hysuvl	0.7	1.2	1.7	V	
	Standby current	Istby	—	85	170	μA	VCC = 8.9 V
	Operating current	Icc	—	4.2	6.3	mA	
VREF	Output voltage	Vref	4.925	5.00	5.075	V	Isource = -1 mA
	Line regulation	Vref-line	—	5	20	mV	Isource = -1 mA Vcc = 10 V to 24 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
Error amplifier	Feedback voltage	Vfb	2.452	2.490	2.528	V	FB-COMP short
	Input bias current	Ifb	-0.5	-0.3	-0.1	μA	Measured pin: FB FB = 3 V *1
	Open loop gain	Av	—	60	—	dB	*1
	Upper clamp voltage	Vclamp-comp	4.2	4.3	4.4	V	FB = 2.0 V
	Low voltage	VI-comp	—	0.1	0.3	V	FB = 3.0 V
	Source current	Isrc-comp	—	-120	—	μA	FB = 1.5 V COMP = 2.5 V *1
	Sink current	Isnk-comp	—	330	—	μA	FB = 3.5 V COMP = 2.5 V
Ramp	RAMP charge current at DUVP disable condition	Ic-ramp1	-60	-50	-40	μA	FB = 2.4 V
	RAMP charge current at DUVP enable condition	Ic-ramp2	-32	-25	-18	μA	FB = 2 V
	RAMP discharge current	Id-ramp	7	15	29	mA	RAMP = 1 V
	Low voltage	VI-ramp	—	17	200	mV	I sink = 100 μA
Slave control	Phase delay	Phase	160	180	200	deg	FB = 2.5 V, COMP = 2 V *1,2
	On time ratio	Ton-ratio	0	—	5	%	

Notes: *1 Design spec
*2

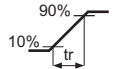
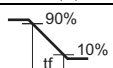


$$\text{Phase} = \frac{T_{\text{delay}}}{T_{\text{period}}} \times 360 \text{ [deg]}$$

$$\text{Ton-ratio} = \left(1 - \frac{T_{\text{on-s}}}{T_{\text{on-m}}}\right) \times 100 \text{ [%]}$$

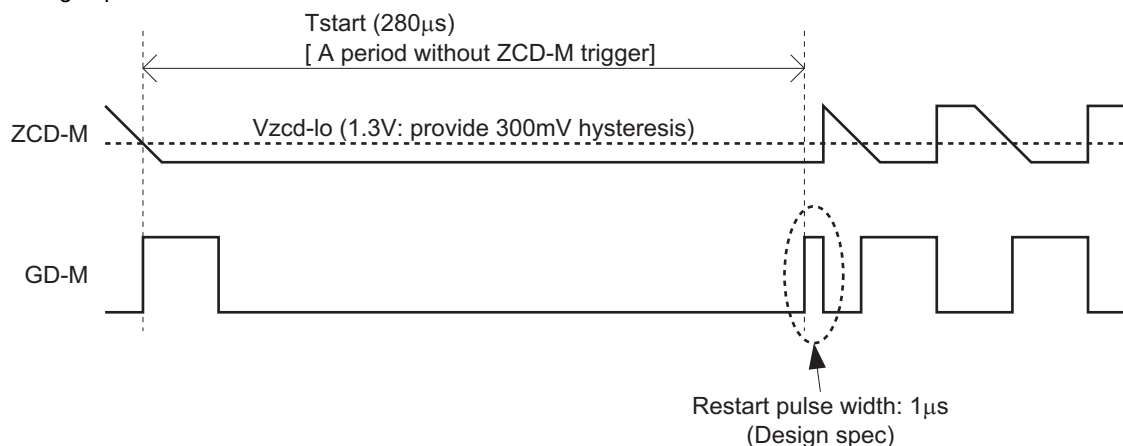
Electrical Characteristics (cont.)

(Ta = 25°C, VCC = 12 V, RT = 33 kΩ, RAMP = 820 pF, TM = 2.2 μF, SS = 1.0 μF, OCP = GND)

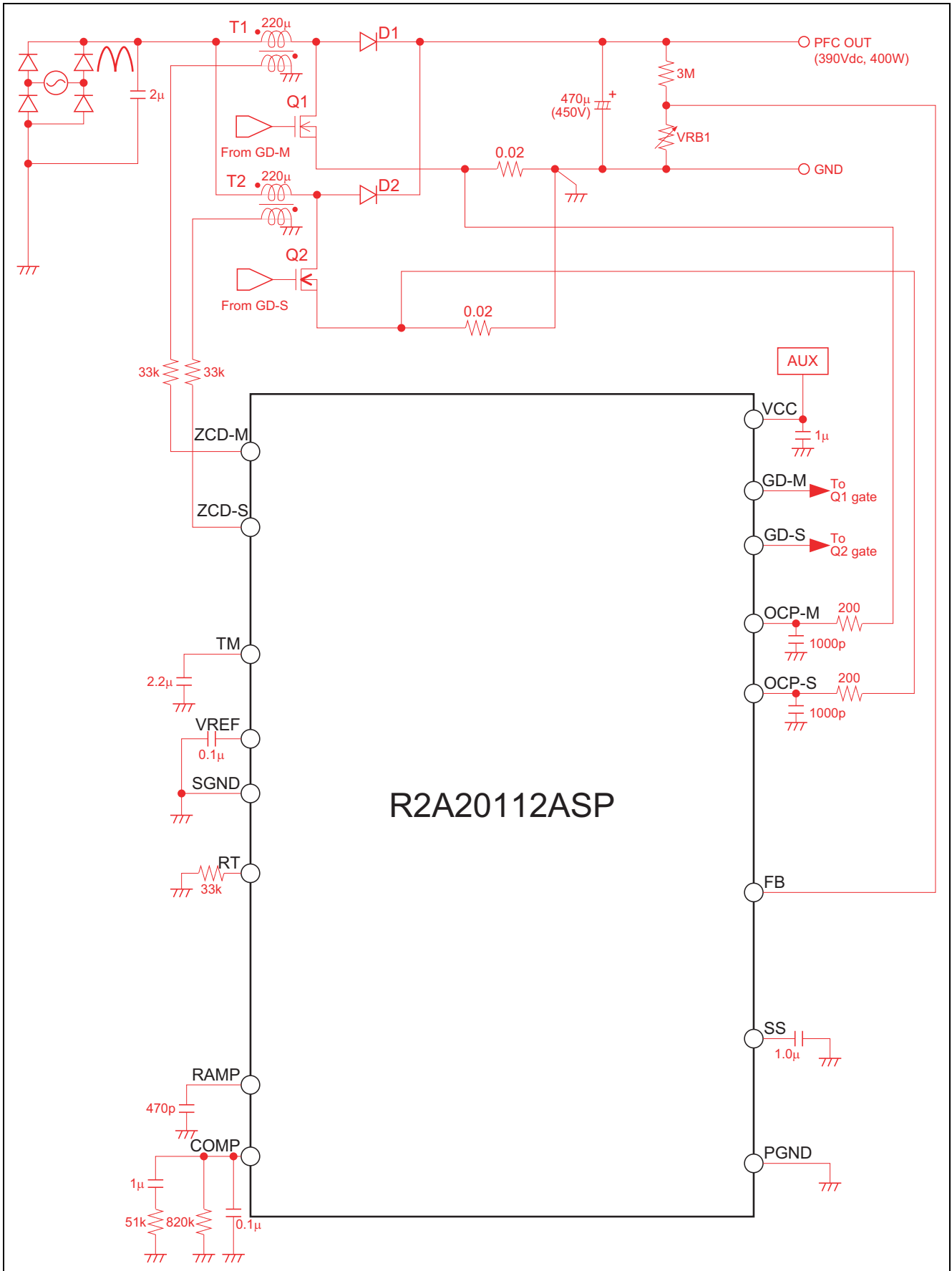
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Gate drive (GD-M & GD-S)	Gate drive rise time	tr-gd	—	20	100	ns	FB-COMP short CL = 100 pF 
	Gate drive fall time	tf-gd	—	5	30	ns	FB-COMP short CL = 100 pF 
	Gate drive low voltage	Vol1-gd	—	0.02	0.1	V	Isink = 2 mA
		Vol2-gd	—	0.01	0.2	V	Isink = 1 mA, VCC = 5 V
Gate drive high voltage	Voh-gd	11.5	11.9	—	V	Isource = -2 mA *1	
Over current protection (OCP-M & OCP-S)	OCP threshold voltage	Vocp	0.27	0.30	0.33	V	
	OCP source current	Iocp	-10	-5	-2.5	μA	OCP = 0 V
ON/OFF timer protection for Boost diode short	ON/OFF timer threshold voltage	Vtm	3.52	3.6	3.68	V	
	ON/OFF timer hysteresis	Hys-tm	2.1	2.2	2.3	V	
	Charge current	Isrc-tm	-54	-45	-36	μA	TM = 2 V, OCP-M = 1 V
	Discharge current at TM disable condition	I _{snk-tm1}	36	45	54	μA	TM = 2 V
	Discharge current at TM enable condition	I _{snk-tm2}	4.2	5	5.8	μA	TM = 5 V to 2 V
PFC output abnormality protection	Dynamic OVP threshold voltage	Vdovp	Vfb× 1.035	Vfb× 1.050	Vfb× 1.065	V	COMP = 2.5 V
	Static OVP threshold voltage	Vsovp	Vfb× 1.075	Vfb× 1.090	Vfb× 1.105	V	COMP = 2.5 V
	Static OVP hysteresis	Hys-sovp	50	100	150	mV	COMP = 2.5 V
	Dynamic UVP threshold voltage	Vduvp	—	Vfb× 0.930	Vfb× 0.950	V	COMP = 2.5 V *1
	FB low detect threshold voltage	Vfblow	0.45	0.50	0.55	V	COMP = 2.5 V
	FB low detect hysteresis	Hysfblow	0.16	0.20	0.24	V	COMP = 2.5 V
Zero current detector (ZCD-M & ZCD-S)	Upper clamp voltage	Vzcdh	4.0	4.5	5.0	V	Isource = -3 mA
	Lower clamp voltage	Vzcdl	-0.5	-0.1	0.4	V	Isink = 3 mA
	ZCD low threshold voltage	Vzcd-lo	0.9	1.3	1.6	V	*1
	ZCD hysteresis	Hyszcd	130	300	410	mV	*1
	Input bias current	Izcd	-14	-10	-6	μA	1.2 V < Vzcd < 2.5 V
ZCD-S open detector	Slave ZCD open detect delay time	tzcds	—	100	—	ms	ZCD-S: OPEN Gate drive 10 kHz *1
Soft start	Charge current	Ic-ss	-14	-10	-6	μA	SS = 3 V, FB = 1 V
Restart	Restart time delay	Tstart	210	280	350	μs	ZCD-M = 10 kΩ to GND ZCD-S = 10 kΩ to GND *2

Notes: *1 Design spec

*2

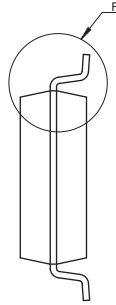
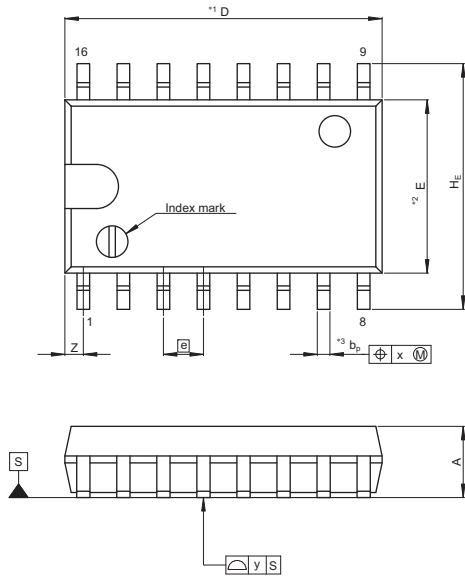


System Diagram

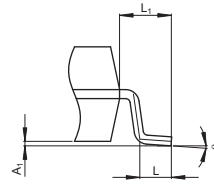
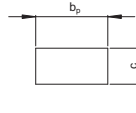


Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP16-5.5x10.06-1.27	PRSP0016DH-B	FP-16DAV	0.24g



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	—	10.06	10.5
E	—	5.50	—
A ₂	—	—	—
A ₁	0.00	0.10	0.20
A	—	—	2.20
b _p	0.34	0.40	0.46
b ₁	—	—	—
c	0.15	0.20	0.25
c ₁	—	—	—
θ	0°	—	8°
H _E	7.50	7.80	8.00
[e]	—	1.27	—
x	—	—	0.12
y	—	—	0.15
Z	—	—	0.80
L	0.50	0.70	0.90
L ₁	—	1.15	—

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Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-586-6000, Fax: +1-408-586-6130

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: +44-1628-585-100, Fax: +44-1628-585-900

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.
1 HarbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6276-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jin 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