To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document 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 Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. 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.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. 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.
5. When exporting the 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. You should not use Renesas Electronics products or the 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. 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.
6. 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.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. 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 categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. 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 an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "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.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. 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.
9. 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 system manufactured by you.
10. 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.
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.

R2A20112SP/DD

Critical Conduction Mode Interleaved PFC Control IC

REJ03D0904-0200
Preliminary
Rev.2.00
Nov 13, 2007

Description

The R2A20112 controls a boost converter to provide a active power factor correction.

The R2A20112 adopts critical conduction mode for power factor correction and realizes high efficiency and a low switching noise by zero current switching.

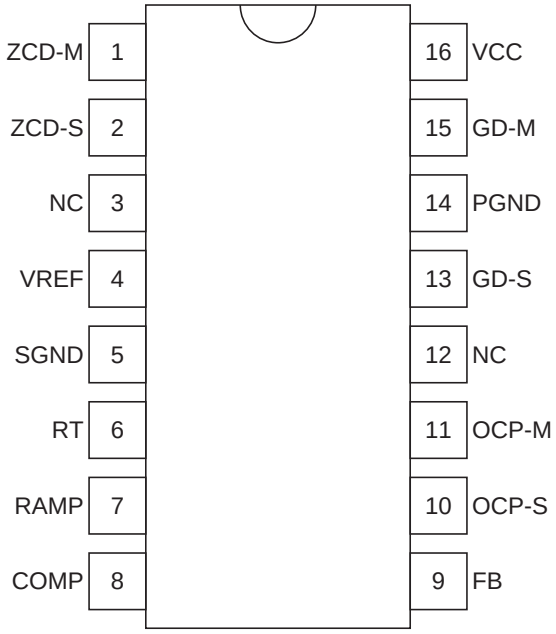
Interleaving function improve ripple current on input or output capacitor by 180 degrees phase shift.

The feedback loop open detection, two mode overvoltage protection, overcurrent protection are built in the R2A20112, and can constitute a power supply system of high reliability with few external parts.

Features

- Maximum Ratings
  - Supply voltage Vcc: 24 V
  - Operating junction temperature Tjopr: –40 to +150°C
- Electrical characteristics
  - VREF output voltage VREF: 5.0 V ± 3%
  - UVLO operation start voltage VH: 10.5 V ± 0.7 V
  - UVLO operation shutdown voltage VL: 9.3 V ± 0.5 V
  - UVLO hysteresis voltage Hysuvl: 1.2 V ± 0.5 V
- Functions
  - Boost converter control with critical conduction mode
  - Interleaving control
  - Two mode overvoltage protection
    Mode1: Dynamic OVP corresponding to a voltage rise by load change
    Mode2: Static OVP corresponding to overvoltage in stable
  - Feedback loop open detection
  - Master and Slave independence overcurrent protection
  - 280 µs restart timer
  - Package lineup: Pb-free SOP-16/DILP-16

Pin Arrangement

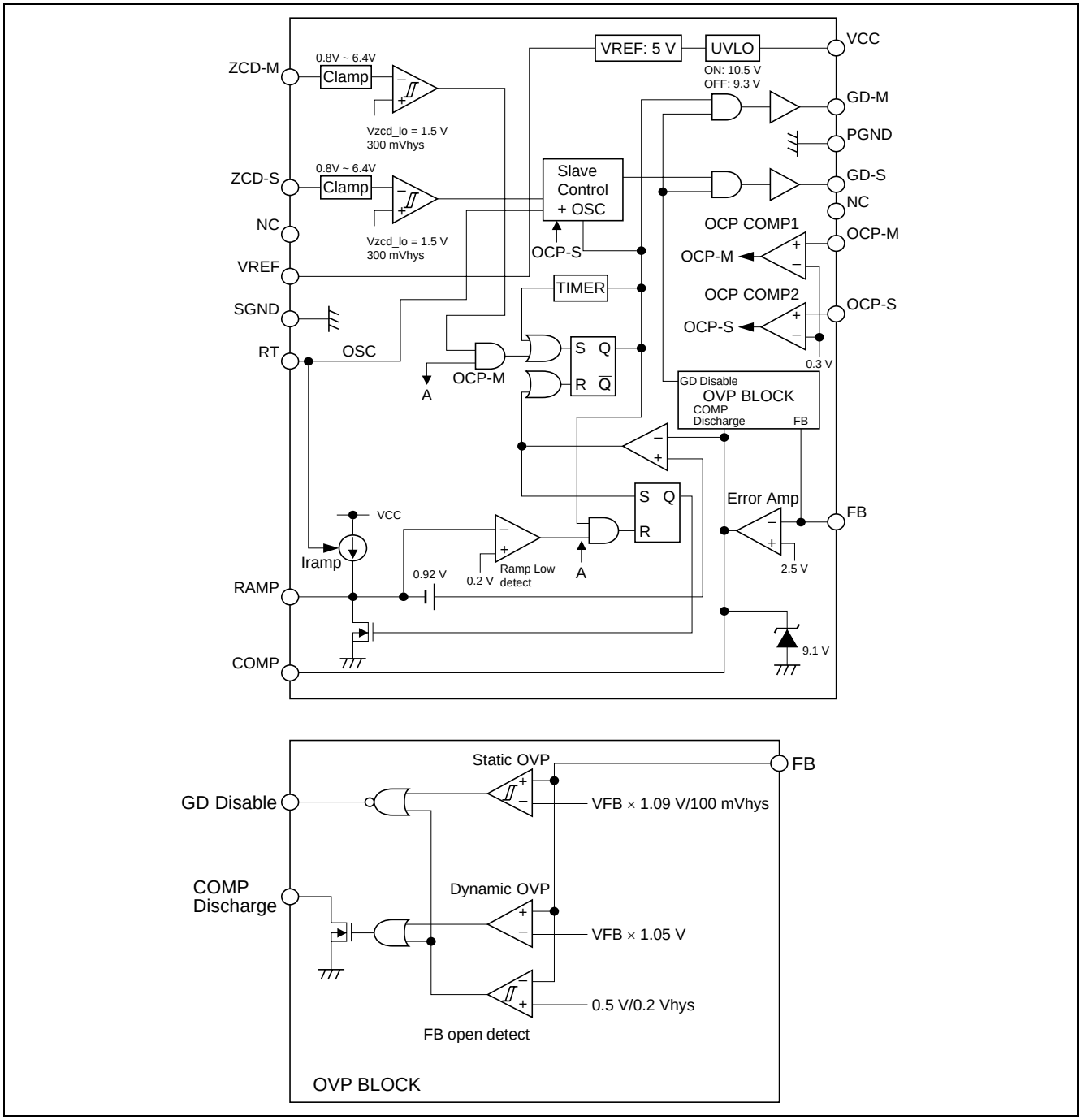


(Top view)

Pin Functions

Pin No.	Pin Name	Input/Output	Function
1	ZCD-M	Input	Master converter zero current detection input terminal
2	ZCD-S	Input	Slave converter zero current detection input terminal
3	N.C.	—	Open
4	VREF	Output	Reference voltage output terminal
5	SGND	—	Ground for small signal circuit
6	RT	Input/Output	Oscillator frequency setting terminal
7	RAMP	Input/Output	Ramp waveform setting terminal
8	COMP	Output	Error amplifier output terminal
9	FB	Input	Error amplifier input terminal
10	OCP-S	Input	Slave converter overcurrent detection terminal
11	OCP-M	Input	Master converter overcurrent detection terminal
12	N.C.	—	Open
13	GD-S	Output	Slave converter Power MOSFET drive terminal
14	PGND	—	Ground for power stage
15	GD-M	Output	Master converter Power MOSFET drive terminal
16	VCC	Input	Supply voltage terminal

Block Diagram



Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Ratings	Unit	Note
Supply voltage	Vcc	–0.3 to 24	V	
GD-M Peak current	Ipk-gdm	±200	mA	3
GD-M DC current	Idc-gdm	±10	mA	
GD-S Peak current	Ipk-gds	±200	mA	3
GD-S DC current	Idc-gds	±10	mA	
ZCD terminal current	Izcd	±10	mA	
RT terminal current	Irt	–200	μA	
Vref terminal current	Iref	–5	mA	
COMP terminal current	Icomp	±1	mA	
Terminal voltage	Vt-group1	–0.3 to Vcc	V	4
	Vt-group2	–0.3 to Vref	V	5
Vref terminal voltage	Vt-ref	–0.3 to Vref+0.3	V	
Power dissipation	Pt	1	W	6
Operating junction temperature	Tj-opr	–40 to +150	°C	
Storage temperature	Tstg	–55 to +150	°C	

Notes: 1. Rated voltages are with reference to the SGND terminal.
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. This is the rated voltage for the following pins:
RAMP, FB
5. This is the rated voltage for the following pins:
RT, OCP-M , OCP-S
6. In case of R2A20112DD (DILP): θja = 120°C/W
In case of R2A20112SP (SOP): θja = 120°C/W
This value is a thing mounting on 40 × 40 × 1.6 [mm], a glass epoxy board of wiring density 10%.

Electrical Characteristics

(Ta = 25°C, Vcc = 12 V, RT = 22 kΩ, OCP = GND, CRAMP = 680 pF, RZCD-GND = 51 kΩ, FB = COMP)

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	—	120	200	μA	Vcc = 8.9 V, ZCD = Open
	Operating current	Icc	—	4.9	7.0	mA	
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 = 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]

Note: 1. Design spec.

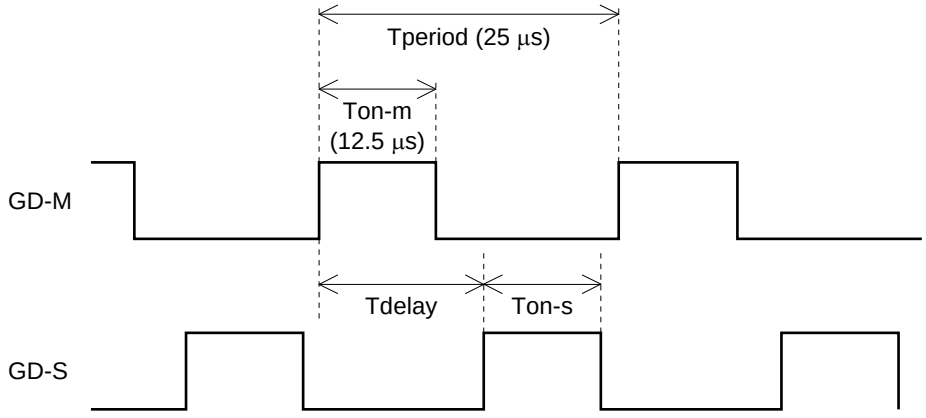
Electrical Characteristics (cont.)

(Ta = 25°C, Vcc = 12 V, RT = 22 kΩ, OCP = GND, CRAMP = 680 pF, RZCD-GND = 51 kΩ, FB = COMP)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Error amplifier	Feedback voltage	Vfb	2.40	2.50	2.60	V	FB-COMP short, RAMP = 0 V
	Input bias current	Ifb	–0.5	0	0.5	μA	Measured pin: FB
	Open loop gain	Av	—	60	—	dB	*1
	Upper clamp voltage	Vclamp-comp	8.0	9.1	10.6	V	FB = 2.0 V, COMP: Open
	Low voltage	Vl-comp	—	0.1	0.3	V	FB = 3.0 V, COMP: Open
	Source current	Isrc-comp	—	–120	—	μA	FB = 1.5 V, COMP = 2.5 V
	Sink current 1	Isnkcomp1	—	120	—	μA	*1
	Sink current 2	Isnkcomp2	—	300	—	μA	FB = 3.5 V, COMP = 2.5 V
	Transconductance	gm	150	200	290	μs	FB = 2.45 V ↔ 2.55 V, COMP = 2.5 V
RAMP	RAMP charge current	Ic-ramp	130	150	170	μA	RAMP = 0 V to 7 V
	RAMP discharge current	Id-ramp	7	16	29	mA	FB = 1 V, COMP = 2 V, RAMP = 0 V to 1.5 V to 1 V
	Low voltage	Vl-ramp	—	17	200	mV	FB = 1 V, COMP = 3 V, RAMP = 0 V to 2.5 V to open Isink = 100 μA
Zero current detector	Upper clamp voltage	Vzcdh	5.8	6.4	7.0	V	Isource = –3 mA
	Lower clamp voltage	Vzcdl	0.3	0.8	1.3	V	Isink = 3 mA
	ZCD low threshold voltage	Vzcd_lo	1.05	1.50	1.75	V	*1
	ZCD hysteresis	Hyszcd	180	300	390	mV	*1
	Input bias current	Izcd	–1	—	1	μA	1.2 V < Vzcd < 5 V
Slave control	Phase delay	Phase	160	180	200	deg.	*1, *2
	On time ratio	Ton-ratio	–5	—	5	%	*1, *2
Restart	Restart time delay	Tstart	210	280	350	μs	Cramp = 3300 pF FB = 2.0 V, COMP = 5 V

Note: 1. Design spec.

2.



$$\text{Phase} = \frac{\text{Tdelay}}{\text{Tperiod}} \times 360 \text{ [deg.]}$$

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

Electrical Characteristics (cont.)

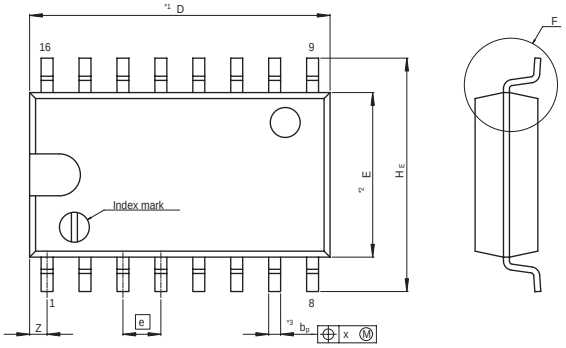
(Ta = 25°C, Vcc = 12 V, RT = 22 kΩ, OCP = GND, CRAMP = 680 pF, RZCD-GND = 51 kΩ, FB = COMP)

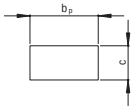
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Gate drive	Master gate drive rise time	tr-gdm	—	30	100	ns	CL = 100 pF, Cramp = 3300 pF FB = 2.0 V, COMP = 5 V
	Slave gate drive rise time	tr-gds	—	30	100	ns	CL = 100 pF, Cramp = 3300 pF FB = 2.0 V, COMP = 5 V
	Master gate drive fall time	tf-gdm	—	30	100	ns	CL = 100 pF, Cramp = 3300 pF FB = 2.0 V, COMP = 5 V
	Slave gate drive fall time	tf-gds	—	30	100	ns	CL = 100 pF, Cramp = 3300 pF FB = 2.0 V, COMP = 5 V
	Master gate drive low voltage	Vol1-gdm	—	0.05	0.2	V	Isink = 2 mA
		Vol2-gdm	—	0.03	0.7		Isink = 1 mA, VCC = 5 V
	Master gate drive high voltage	Voh-gdm	11.5	11.9	—	V	Isource = –2 mA
	Slave gate drive low voltage	Vol1-gds	—	0.05	0.2	V	Isink = 2 mA
		Vol2-gds	—	0.03	0.7		Isink = 1 mA, VCC = 5 V
	Slave gate drive high voltage	Voh-gds	11.5	11.9	—	V	Isource = –2 mA *[1]
Over current protection	OCP threshold voltage	Vocp	0.27	0.3	0.33	V	
Over voltage protection	Dynamic OVP threshold voltage	Vdovp	VFB× 1.035	VFB× 1.050	VFB× 1.065	V	
	Static OVP threshold voltage	Vsovp	VFB× 1.075	VFB× 1.090	VFB× 1.105	V	COMP = Open
	Static OVP hysteresis	Hys-sovp	50	100	150	mV	COMP = Open
	FB open detect threshold voltage	Vfbopen	0.45	0.50	0.55	V	COMP = Open
	FB open detect hysteresis	Hysfbopen	0.16	0.20	0.24	V	COMP = Open

Note: 1. Design spec.

Package Dimensions

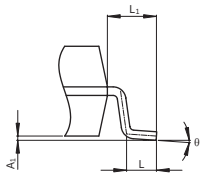
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP16-5.5x10.06-1.27	PRSP0016DH-B	FP-16DAV	0.24g





Terminal cross section
(Ni/Pd/Au plating)

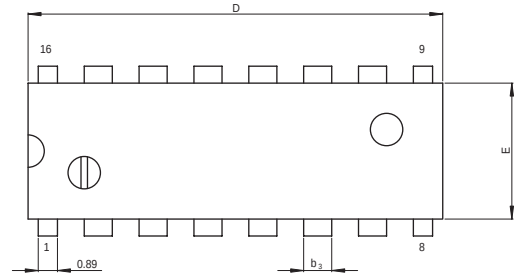
NOTE)
1. DIMENSIONS"*1 (Nom)"AND"*2"
DO NOT INCLUDE MOLD FLASH.
2. DIMENSION"*3"DOES NOT
INCLUDE TRIM OFFSET.

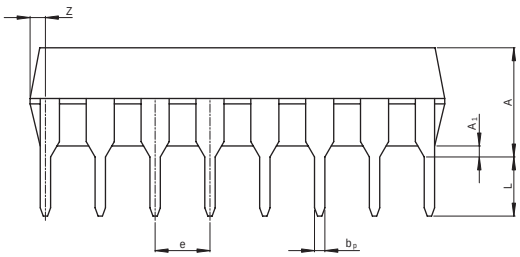


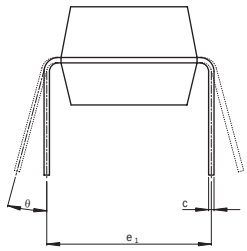
Detail F

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	—

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP16-6.3x19.2-2.54	PRDP0016AE-B	DP-16FV	1.05g







(Ni/Pd/Au plating)

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e_1	—	7.62	—
D	—	19.2	20.32
E	—	6.3	7.4
A	—	—	5.06
A_1	0.51	—	—
b_p	0.40	0.48	0.56
b_3	—	1.30	—
c	0.19	0.25	0.31
θ	0°	—	15°
e	2.29	2.54	2.79
Z	—	—	1.12
L	2.54	—	—

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

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, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

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, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

Colophon .7.0