

# R2A20131SP

R03DS0032EJ0301

Rev.3.01

Jan 08, 2016

## Continuous Conduction Mode PFC Control IC

### Description

The R2A20131 is power factor correction control IC of continuous conduction mode.

The R2A20131 is built in Load Tracing Boost, Brownout, Over Voltage Protection, Over Current Protection, FeedBack loop Open detection and Power Good Function.

Load tracing boost function bring improvement of efficiency at light load with few external parts.

The feedback loop open detection, and over current protection are built in the R2A20131, and can constitute a power supply system of high reliability with few external parts.

Power Good Function monitors PFC output voltage and can adjust no-good level.

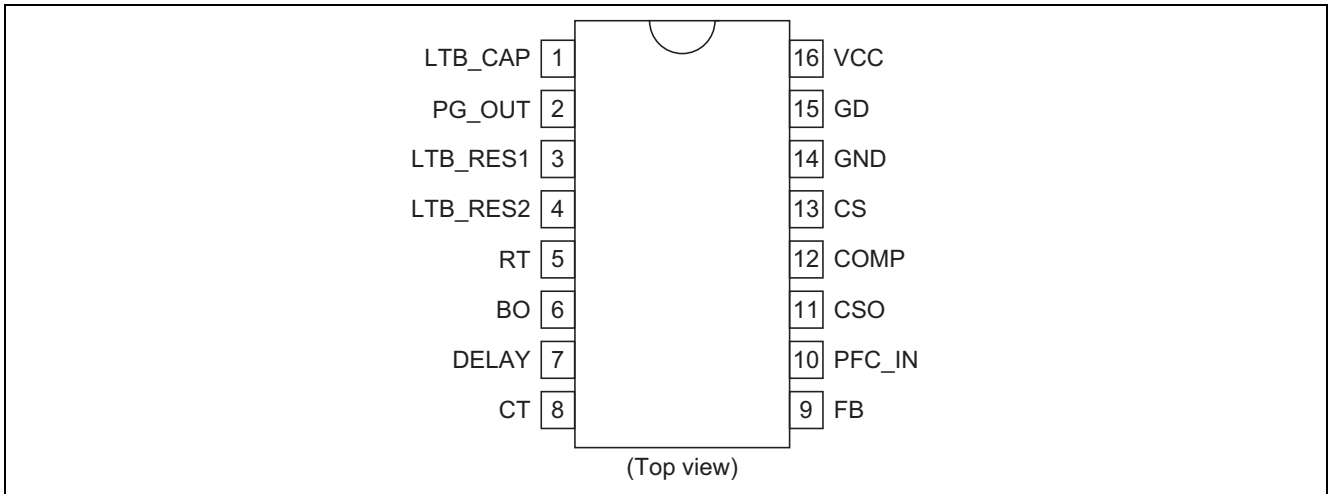
### Features

- Absolute Maximum Ratings
  - Supply voltage  $V_{cc}$ : 24 V
  - Junction temperature  $T_j$ :  $-40$  to  $+150^{\circ}\text{C}$
- Electrical Characteristics
  - Error amplifier reference voltage  $V_{fb}$ :  $2.51\text{ V} \pm 1.5\%$
  - UVLO operation start voltage  $V_{uvlh}$ :  $10.5\text{ V} \pm 0.7\text{ V}$
  - UVLO operation shutdown voltage  $V_{uvll}$ :  $9.3\text{ V} \pm 0.5\text{ V}$
  - UVLO hysteresis voltage  $H_{ysuvl}$ :  $1.2\text{ V} \pm 0.5\text{ V}$
- Functions
  - Boost converter control with continuous conduction mode
  - Load Tracing Boost (LTB) function:  $V_{out}$  is decreased at light load and AC 100 V system.
  - Brownout function
  - Over Voltage Protection
  - Feedback loop Open detection
  - Over Current Protection
  - Power good information (Open drain output)
  - Package: Pb-free SOP-16  
This Device uses Halogen-Free Molding Compound

### Ordering Information

| Part No.      | Package Name | Package Code | Package Abbreviation | Taping Abbreviation (Quantity) |
|---------------|--------------|--------------|----------------------|--------------------------------|
| R2A20131SP#W0 | —            | PRSP0016DH-B | SP                   | W (2,000 pcs/reel)             |

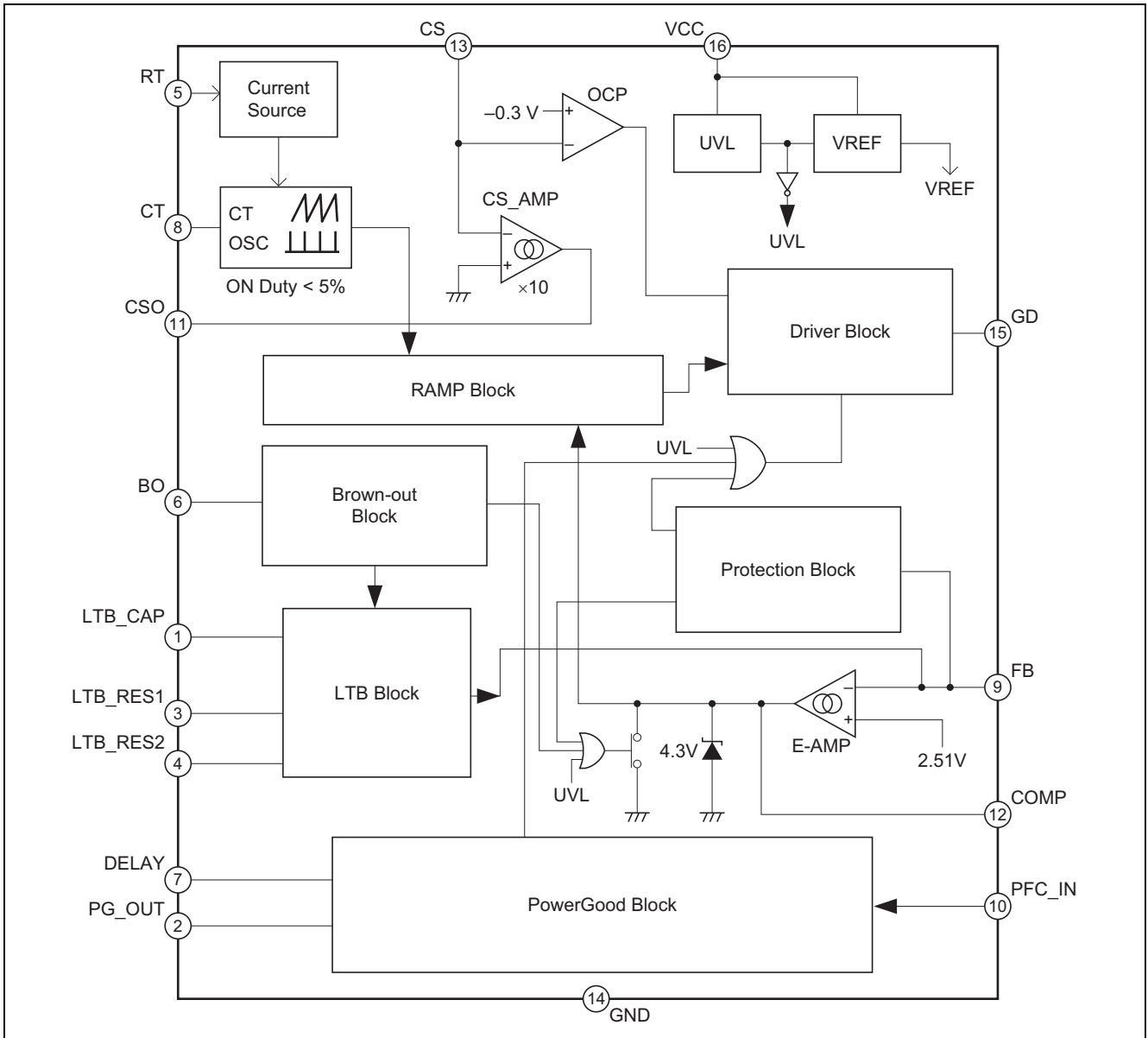
## Pin Arrangement



## Pin Functions

| Pin No. | Pin Name | Input/Output | Function  |
|---------|----------|--------------|---|
| 1       | LTB_CAP  | Input        | Load tracing boost stability capacitor connection terminal              |
| 2       | PG_OUT   | Output       | Power Good Output terminal for house keeping                            |
| 3       | LTB_RES1 | Output       | Load tracing boost adjust resistor connection terminal1                 |
| 4       | LTB_RES2 | Output       | Load tracing boost adjust resistor connection terminal2                 |
| 5       | RT       | Input/Output | Oscillator frequency setting and internal bias current setting terminal |
| 6       | BO       | Input        | Brownout input terminal   |
| 7       | DELAY    | Input/Output | PG_OUT ON Delay adjustable terminal                                     |
| 8       | CT       | Output       | Oscillator frequency setting terminal                                   |
| 9       | FB       | Input        | Error amplifier input terminal  |
| 10      | PFC_IN   | Input        | Power Good detection terminal   |
| 11      | CSO      | Output       | Current amplifier output terminal                                       |
| 12      | COMP     | Output       | Error amplifier output terminal   |
| 13      | CS       | Input        | Current detection terminal  |
| 14      | GND      | —            | Ground  |
| 15      | GD       | Output       | 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 sink current               | Isnk-gd    | 1.2          | A    | 3    |
| GD source current             | Isrc-gd    | -0.8         | A    | 3    |
| GD DC sink current            | Idc-snk-gd | 0.12         | A    |      |
| GD DC source current          | Idc-src-gd | -80          | mA   |      |
| CS terminal voltage           | Vt-cs      | -5 to +0.3   | V    |      |
| BO terminal current           | Ibom       | 300          | μA   |      |
| RT terminal current           | Irt        | -200         | μA   |      |
| COMP terminal current         | Icomp      | ±1           | mA   |      |
| LTB_RES terminal current      | Iltb_res   | -100         | μA   |      |
| PG_OUT terminal current       | Ipg_out    | 25           | mA   |      |
| Terminal voltage              | Vt-group   | -0.3 to +5.5 | V    | 4    |
| Terminal voltage2             | Vt-group2  | -0.3 to VCC  | V    | 5    |
| Terminal voltage3             | Vt-group3  | -0.3 to +24  | V    | 6    |
| Power dissipation             | Pt         | 1            | W    | 7    |
| Operating ambient temperature | Ta-opr     | -40 to +125  | °C   |      |
| Junction temperature          | Tj         | -40 to +150  | °C   | 8    |
| Storage temperature           | Tstg       | -55 to +150  | °C   |      |

- Notes:
- Rated voltages are with reference to the GND terminal.
  - For rated currents, inflow to the IC is indicated by (+), and outflow by (-).
  - Shows the transient current when driving a capacitive load.
  - This is the rated voltage for the following pins:  
FB, COMP, BO, RT, CT, LTB\_CAP, LTB\_RES1, LTB\_RES2, CSO, PFC\_IN, DELAY
  - This is the rated voltage for the following pin:  
GD
  - This is the rated voltage for the following pin:  
PG\_OUT
  - In case of R2A20131SP (SOP):  $\theta_{ja} = 120^{\circ}\text{C}/\text{W}$   
This value is a thing mounting on  $40 \times 40 \times 1.6$  [mm], a glass epoxy board of wiring density 10%.
  - Stresses exceeding the absolute maximum ratings may damage the device.  
These are stress ratings only. Functional operation above the recommended operating ambient temperature range is not implied.  
Extended exposure to stresses above the absolute maximum ratings may affect device reliability.

## Electrical Characteristics

(Ta = 25°C, VCC = 12 V, RT = 33 kΩ, PFC\_IN = GND, CT = 470 pF, CS = GND, FB = COMP, BO = 4 V, LTB\_RES1 = 33 kΩ, LTB\_RES2 = 33 kΩ)

|                         | 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       | —                | 100     | 180              | μA   | VCC = 8.9 V   |
|                         | Operating current          | Icc         | —                | 2.5     | 4                | mA   |   |
| Brownout                | BO threshold voltage       | Vbo         | 1.35             | 1.40    | 1.45             | V    |   |
|                         | BO pin hysteresis current  | Ibo         | (3.3)<br>×0.92   | (3.3)   | (3.3)<br>×1.08   | μA   | BO = 1 V, RT = 33 kΩ  |
|                         | BO pin current             | Ibo2        | 0.05             | 0.15    | 0.4              | μA   | BO = 2 V  |
| Error amplifier         | Feedback voltage           | Vfb         | 2.472            | 2.51    | 2.548            | V    | FB-COMP short   |
|                         | Input bias current         | Ifb         | -0.4             | -0.15   | -0.05            | μA   | Measured pin: FB<br>FB = 3 V  |
|                         | Open loop gain             | Av          | —                | 50      | —                | dB   | *1  |
|                         | Upper clamp voltage        | Vclamp_comp | 4.0              | 4.3     | —                | V    | FB = 2.0 V<br>COMP: Open  |
|                         | Low voltage                | Vl-comp     | —                | 0.1     | 0.3              | V    | FB = 3.0 V<br>COMP: Open  |
|                         | Transconductance           | gm          | 100              | 180     | 270              | μs   | FB = 2.5 V<br>COMP: 2.5 V   |
| Oscillator              | Initial accuracy           | fGD         | 58.5             | 65      | 71.5             | kHz  | Measured pin: GD  |
|                         | 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  |
|                         | RT voltage                 | Vrt         | 1.595            | 1.65    | 1.705            | V    |   |
| Over current protection | OCP threshold voltage      | Vocp        | -0.315           | -0.3    | -0.285           | V    |   |
|                         | CS bias current            | Ics         | -130             | -100    | -60              | μA   | Measured pin: CS  |
| Current AMP             | CSO output voltage         | V-cso       | 0.8              | 1       | 1.2              | V    | CS = -0.1 V   |
| Load tracing boost      | Source current             | Iltb        | (-21.2)<br>×1.05 | (-21.2) | (-21.2)<br>×0.95 | μA   | BO = 2V, LTB_CAP = 0 V<br>FB = 2.5 V, PFC_IN = 3 V<br>Measure pin: FB |
|                         | High threshold voltage     | Vltb-hi     | 3.2              | 3.6     | 4.0              | V    | Measured pin: BO  |
|                         | Low threshold voltage      | Vltb-lo     | 2.9              | 3.2     | 3.5              | V    |   |
| POWER GOOD function     | PFC_IN threshold voltage 1 | Vpfc_in1    | 2.42             | 2.5     | 2.58             | V    |   |
|                         | PFC_IN hysteresis current  | Ipfc_in1    | (-10)<br>×1.08   | (-10)   | (-10)<br>×0.92   | μA   | PFC_IN = 3 V, RT = 33 kΩ  |
|                         | PFC_IN current             | Ipfc_in2    | -0.4             | -0.15   | -0.05            | μA   | PFC_IN = 2 V  |
|                         | PG OUT leak current        | Ipgh        | —                | —       | 5                | μA   | PFC_IN = GND<br>VPG_OUT = 5 V   |
|                         | PG OUT low voltage         | Vpgl        | —                | —       | 0.4              | V    | PFC_IN = 3 V<br>PG OUT sink current = 20 mA                           |

Note: \*1 Design spec

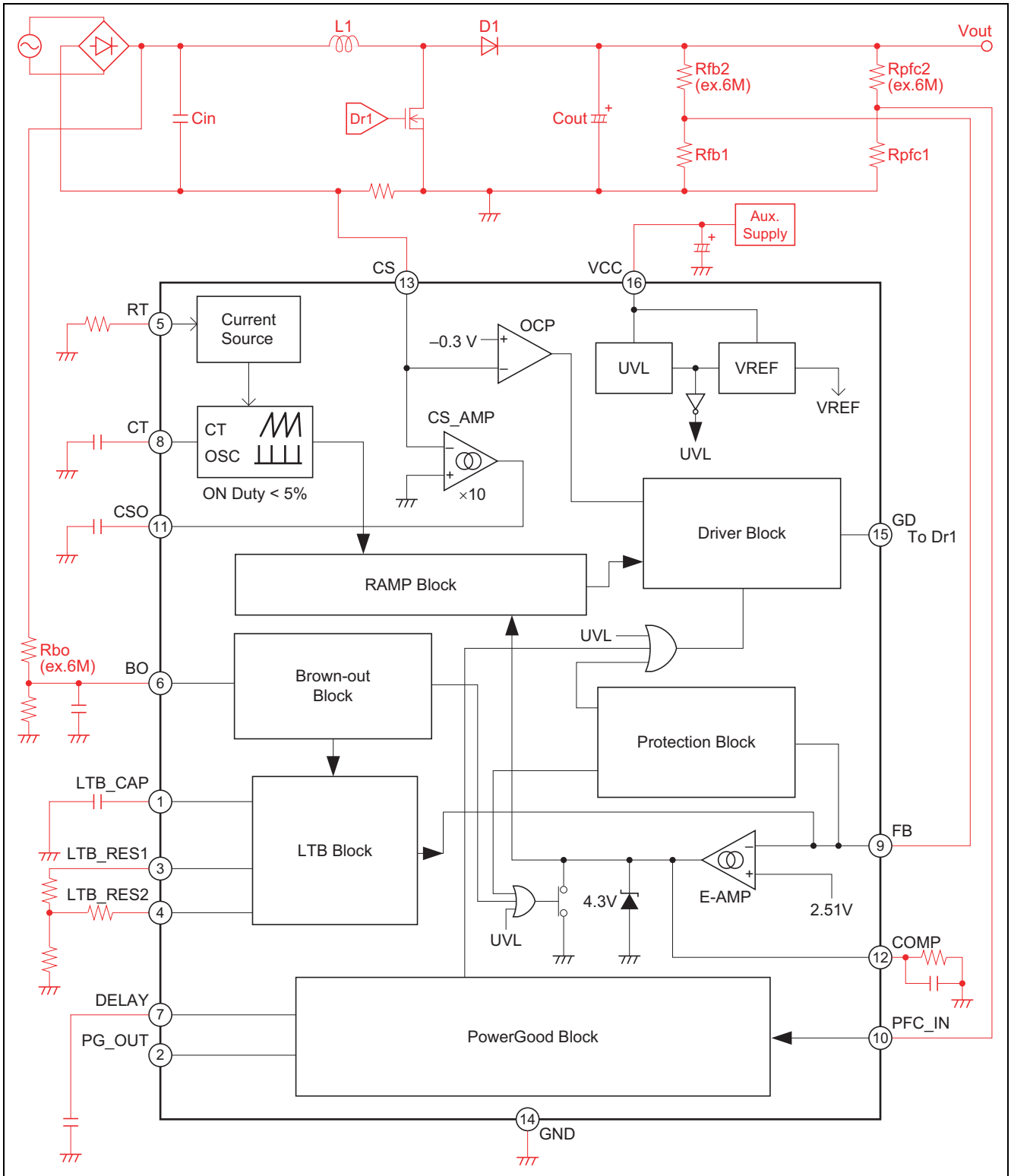
**Electrical Characteristics (cont.)**

(Ta = 25°C, VCC = 12 V, RT = 33 kΩ, PFC\_IN = GND, CT = 470 pF, CS = GND, FB = COMP, BO = 4 V, LTB\_RES1 = 33 kΩ, LTB\_RES2 = 33 kΩ)

| Item                    |                                 | Symbol      | Min           | Typ           | Max           | Unit                    | Test Conditions                     |
|-------------------------|---------------------------------|-------------|---------------|---------------|---------------|-------------------------|-------------------------------------|
| Gate drive              | Gate drive rise time            | tr-gd       | —             | 30            | 100           | ns                      | GD: 1.2 V to 10.8 V<br>CL = 1000 pF |
|                         | Gate drive fall time            | tf-gd       | —             | 30            | 100           | ns                      | GD: 10.8 V to 1.2 V<br>CL = 1000 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                     |
|                         | Maximum duty                    | Dmax        | 90            | 95            | 98            | %                       | COMP: Open, FB = 2 V<br>CSO = GND   |
| Minimum duty            | Dmin                            | —           | —             | 0             | %             | FB = 2.5 V<br>COMP: GND |                                     |
| Over voltage protection | OVP threshold voltage           | Vovp        | VFB×<br>1.065 | VFB×<br>1.080 | VFB×<br>1.095 | V                       | COMP = 2.5 V                        |
|                         | OVP hysteresis                  | Hys-ovp     | 50            | 100           | 150           | mV                      | COMP = 2.5 V                        |
|                         | FB low detect threshold voltage | Vfblow      | 0.25          | 0.3           | 0.35          | V                       | COMP = 2.5 V                        |
| PG on delay             | DELAY threshold voltage         | Vdelay      | 2.85          | 3             | 3.15          | V                       | PFC-IN = 3 V                        |
|                         | DELAY charge current            | Ichrg-delay | -7            | -5            | -3            | μA                      | DELAY = 2.5 V,<br>PFC-IN = 3 V      |

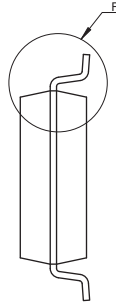
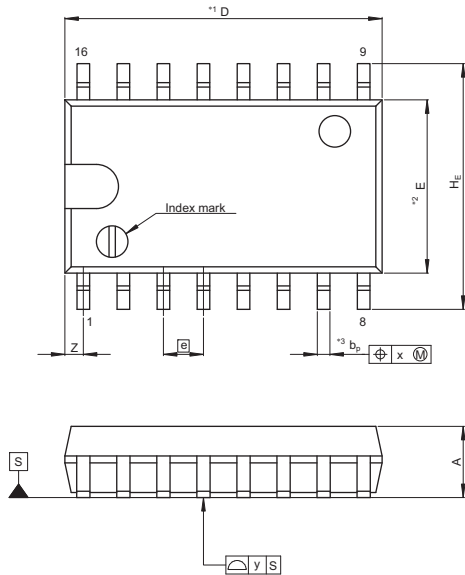
Note: \*1 Design spec

### System Diagram

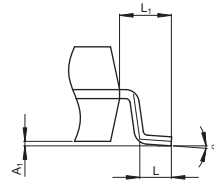
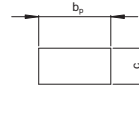


### Package Dimensions

|                        |              |               |            |
|------------------------|--------------|---------------|------------|
| 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 <sub>2</sub>   | —                        | —     | —    |
| A <sub>1</sub>   | 0.00                     | 0.10  | 0.20 |
| A                | —                        | —     | 2.20 |
| b <sub>p</sub>   | 0.34                     | 0.40  | 0.46 |
| b <sub>1</sub>   | —                        | —     | —    |
| c                | 0.15                     | 0.20  | 0.25 |
| c <sub>1</sub>   | —                        | —     | —    |
| θ                | 0°                       | —     | 8°   |
| H <sub>E</sub>   | 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 <sub>1</sub>   | —                        | 1.15  | —    |



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