# R2A20113ASP

## Critical Conduction Mode PFC Control IC

R03DS0026EJ0501
Rev.5.01
Jan 08, 2016

## Description

The R2A20113A controls a boost converter to provide an active power factor correction.

The R2A20113A adopts critical conduction mode for power factor correction and realizes high efficiency and a low switching noise by zero current switching.

Because the zero current is detected by using the GND current, the ZCD Auxiliary winding is unnecessary.

The feedback loop open detection, two mode overvoltage protection, overcurrent protection are built in the R2A20113A, and can constitute a power supply system of high reliability with few external parts.

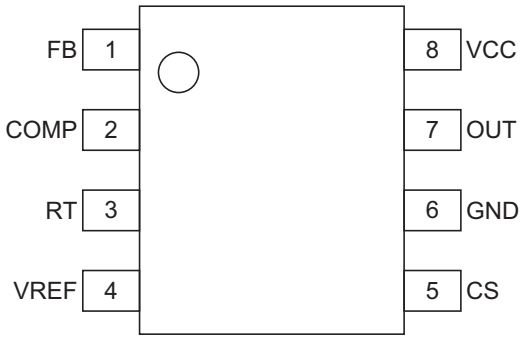
## Features

- Absolute Maximum Ratings
  - Supply voltage Vcc: 24 V
  - Junction temperature Tj: –40 to +150°C
- Electrical characteristics
  - UVLO operation start voltage VH: 12 V ± 0.8 V
  - UVLO operation shutdown voltage VL: 9.2 V ± 0.7 V
  - UVLO hysteresis voltage Hysuvl: 2.8 V ± 0.7 V
- Functions
  - Boost converter control with critical conduction mode
  - Two mode overvoltage protection
    Mode 1: Dynamic OVP corresponding to a voltage rise by load change
    Mode 2: Static OVP corresponding to overvoltage in stable.
  - Feedback loop open detection
  - Overcurrent protection
  - Dynamic UVP corresponding to a voltage fall by load change
  - Off Time Control function (Frequency Limitter)
  - Package lineup: Pb-free SOP-8 (JEDEC)

## Ordering Information

| Part No. | Package Name | Package Code | Package Abbreviation | Taping Abbreviation (Quantity) |
|---|---|---|---|---|
| R2A20113ASP#W5 | — | PRSP0008DJ-A | SP | W (2,500 pcs/reel) |

## Pin Arrangement

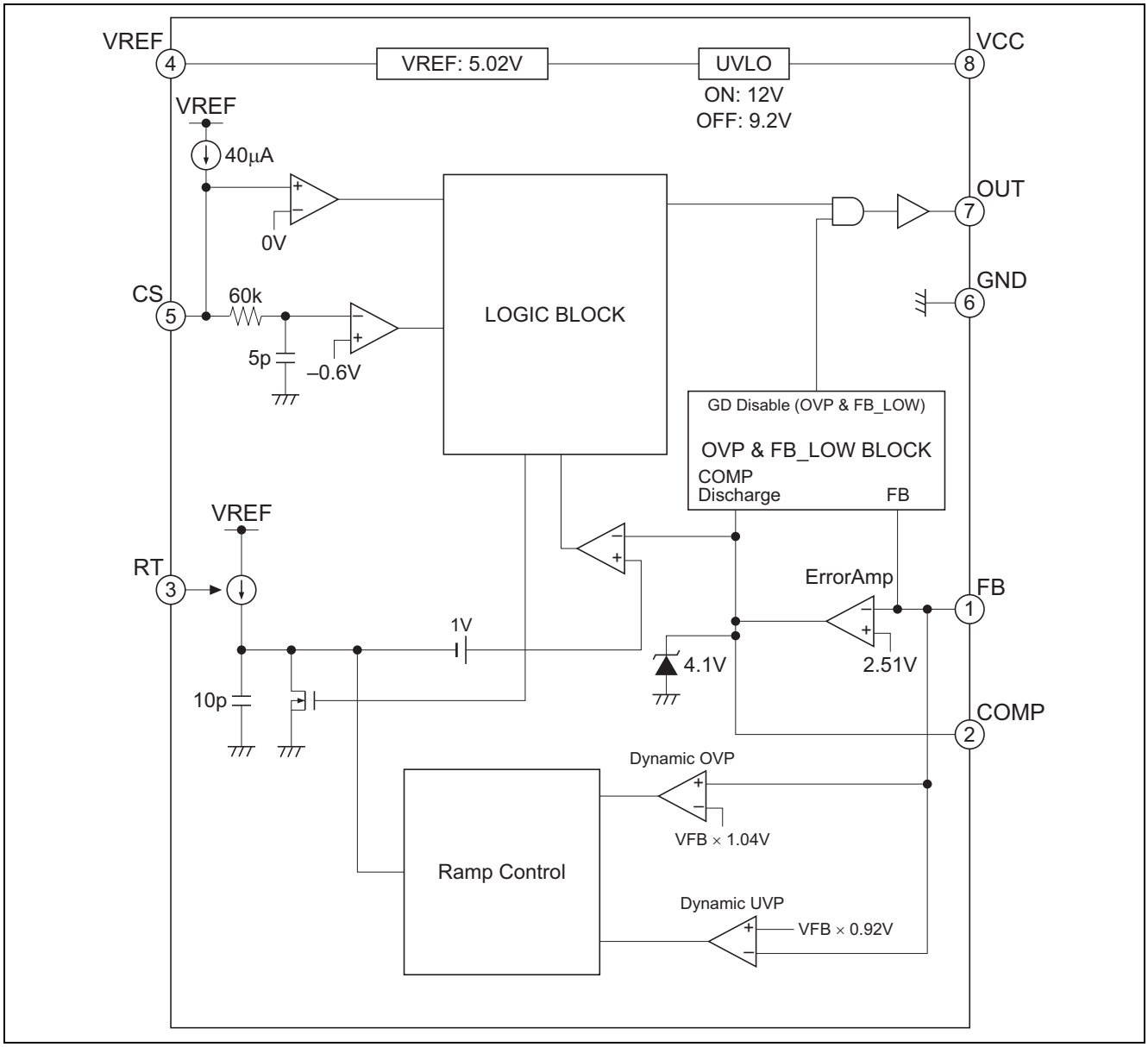



(Top view)

## Pin Function

| Pin No. | Pin Name | Function |
|---|---|---|
| 1 | FB | Error amplifier input terminal |
| 2 | COMP | Error amplifier output terminal |
| 3 | RT | A resistor connection terminal for RAMP current setting |
| 4 | VREF | Reference voltage output terminal |
| 5 | CS | Zero current detection and overcurrent detection input terminal |
| 6 | GND | Ground |
| 7 | OUT | Power MOSFET drive terminal |
| 8 | VCC | Supply voltage terminal |

## Block Diagram



## Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Ratings | Unit | Note |
|---|---|---|---|---|
| Power Supply Voltage | VCC | –0.3 to +24 | V | |
| OUT terminal peak current | Ipk-snk-out | 0.9 | A | 3 |
| | Ipk-src-out | –0.50 | | |
| OUT terminal DC current | Idc-snk-out | 100 | mA | |
| | Idc-src-out | –50 | | |
| COMP terminal current | Icomp | +1<br>–1 | mA | |
| RT terminal current | Irt | –60 to –2 | µA | |
| Vref terminal current | Iref | –5 | mA | |
| Vref terminal voltage | Vt-ref | –0.3 to Vref + 0.3 | V | |
| Vref terminal load capacitor | Cref | 0.1 to 1 | µF | |
| FB terminal voltage | Vt-fb | –0.3 to +5 | V | |
| CS terminal voltage | Vcs | –5 to +0.3 | V | |
| Power dissipation | Pt | 0.68 | W | 4 |
| Operating ambient temperature | Ta-opr | –40 to +125 | °C | |
| Junction temperature | Tj | –40 to +150 | °C | 5 |
| Storage temperature | Tstg | –55 to +150 | °C | |

Notes: 1. Rated voltages are with reference to the GND 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. In case of R2A20113ASP (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%.
5. 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, CS = 0.1 V, FB = COMP, RRT = 200 kΩ)

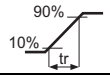
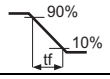
| Item | | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|---|
| Supply | UVLO turn-on threshold | Vuvlh | 11.2 | 12 | 12.8 | V | |
| | UVLO turn-off threshold | Vuvll | 8.5 | 9.2 | 9.9 | V | |
| | UVLO hysteresis | Hysuvl | 2.1 | 2.8 | 3.5 | V | |
| | Standby current | Istby | — | 130 | 250 | µA | VCC = Vuvlh – 0.2 V |
| | Operating current | Icc | — | 1.8 | 2.6 | mA | |
| VREF | Reference voltage | Vref | 4.945 | 5.020 | 5.095 | V | Isource = 0 mA |
| | Line regulation | Vref-line | — | 5 | 20 | mV | Isource = 0 mA<br>Vcc = 10 V to 24 V |
| | Load regulation | Vref-load | — | 5 | 20 | mV | Isource = 0 mA to –5 mA |
| | Temperature stability | dVref | — | ±80 | — | ppm/°C | Ta = –40 to +125°C *1 |
| | OVP-VREF threshold voltage | ovp-vref | Vref+ 0.2 | Vref+ 0.4 | Vref+ 0.6 | V | |
| Error amplifier | Feedback voltage | Vfb | 2.472 | 2.510 | 2.548 | V | FB-COMP short |
| | Input bias current | Ifb | –0.40 | –0.15 | –0.05 | µA | Measured pin: FB |
| | Open loop gain | Av | — | 65 | — | dB | *1 |
| | Upper clamp voltage | Vclamp-comp | 3.65 | 4.10 | 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 |
| | Source current | Isrc-comp | –13.5 | –10 | –6 | µA | FB = 1 V<br>COMP = 2.5 V |
| | Sink current | Isnk-comp | 6 | 10 | 13.5 | µA | FB = 3.5 V<br>COMP = 2.5 V |
| | Transconductance | gm | 25 | 46 | 75 | µs | FB = 2.45V ↔ 2.55 V<br>COMP = 2.5 V |
| RT | RAMP offset voltage | Voff_ramp | — | 1.0 | — | V | *1 |
| | RAMP amplitude | dVramp | 2.90 | 3.1 | 3.3 | V | *2 |
| | RT voltage | V-rt | 1.9 | 2.0 | 2.1 | V | |
| Zero current detector | ZCD threshold voltage | Vzcd | –4 | 0 | 4 | mV | |
| | Input bias current | Ics | –58 | –42 | –25 | µA | Vcs = 0 V |
| Restart | Restart time delay | Tstart | 75 | 150 | 330 | µs | FB = 2.0 V, COMP = 2.5 V |
| Off time control | Minimum off time | Toff-min | 1.0 | 1.4 | 1.8 | µs | |

Notes: *1 Design spec

*2 dVramp = Vclamp_comp – Voff_ramp

## Electrical Characteristics (cont.)

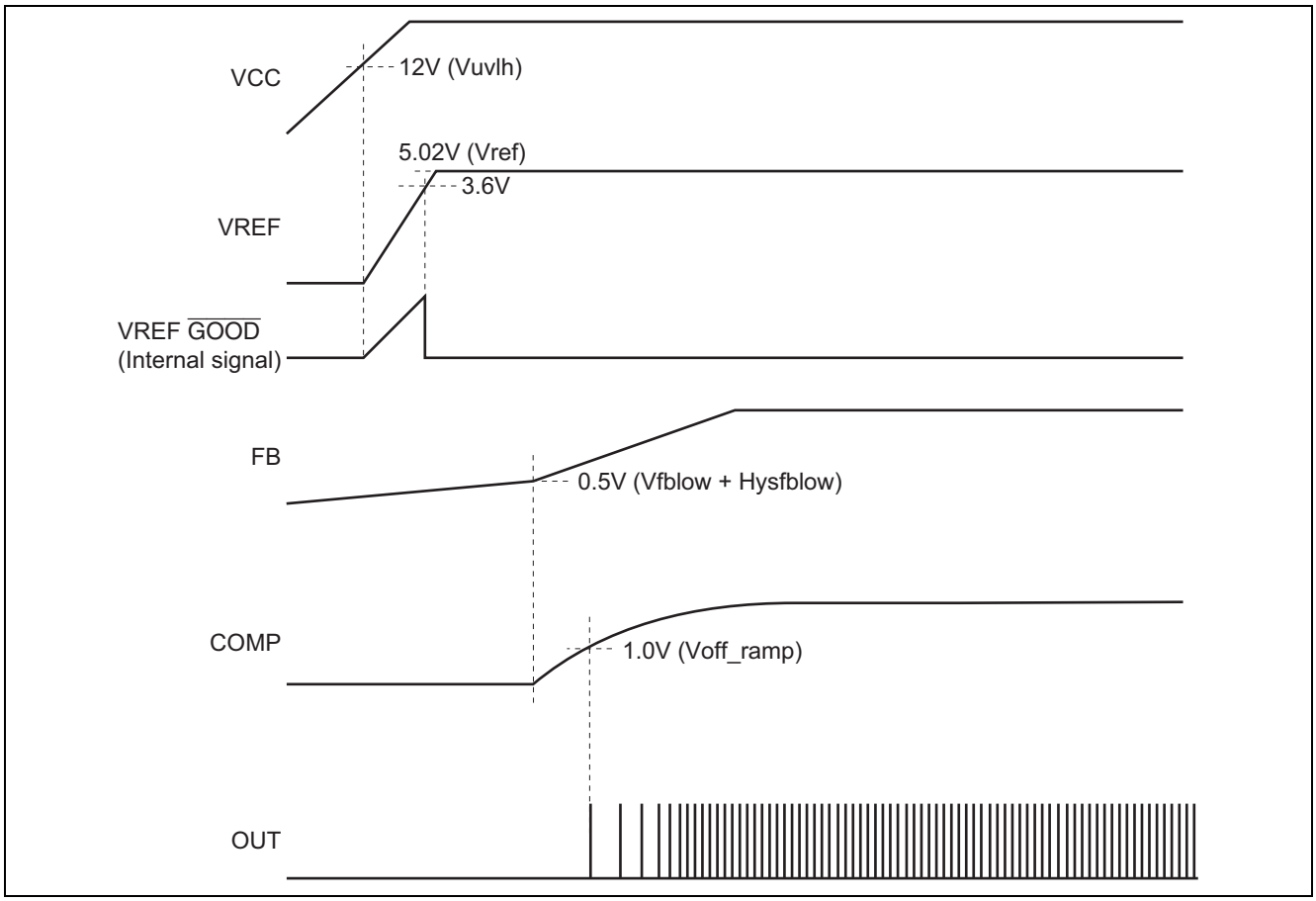
(Ta = 25°C, VCC = 12 V, CS = 0.1 V, FB = COMP, RRT = 200 kΩ)

| Item | | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|---|
| Out | Rise time | tr-out | — | 35 | 100 | ns | CL = 1000 pF   |
| | Fall time | tf-out | — | 35 | 100 | ns | CL = 1000 pF   |
| | Out low voltage | Vol1-out | — | 0.08 | 0.2 | V | Isink = 20 mA |
| | | Vol2-out | — | 0.05 | 0.7 | V | Isink = 10 mA, VCC = 5 V |
| | Out high voltage | Voh-out | 11.5 | 11.8 | — | V | Isource = –20 mA |
| Over current protection | OCP threshold voltage | Vocp | –0.63 | –0.6 | –0.57 | V | |
| Over & Under voltage protection | Dynamic OVP threshold voltage | Vdovp | — | Vfb× 1.040 | — | V | *1 |
| | Dynamic UVP threshold voltage | Vduvp | — | Vfb× 0.920 | — | V | *1 |
| | Static OVP threshold voltage | Vsovp | Vfb× 1.075 | Vfb× 1.090 | Vfb× 1.105 | V | |
| | Static OVP hysteresis | Hys-sovp | 50 | 100 | 150 | mV | |
| | FB low detect threshold voltage | Vfblow | 0.25 | 0.3 | 0.35 | V | |
| | FB low detect hysteresis | Hysfblow | 0.16 | 0.20 | 0.24 | V | |

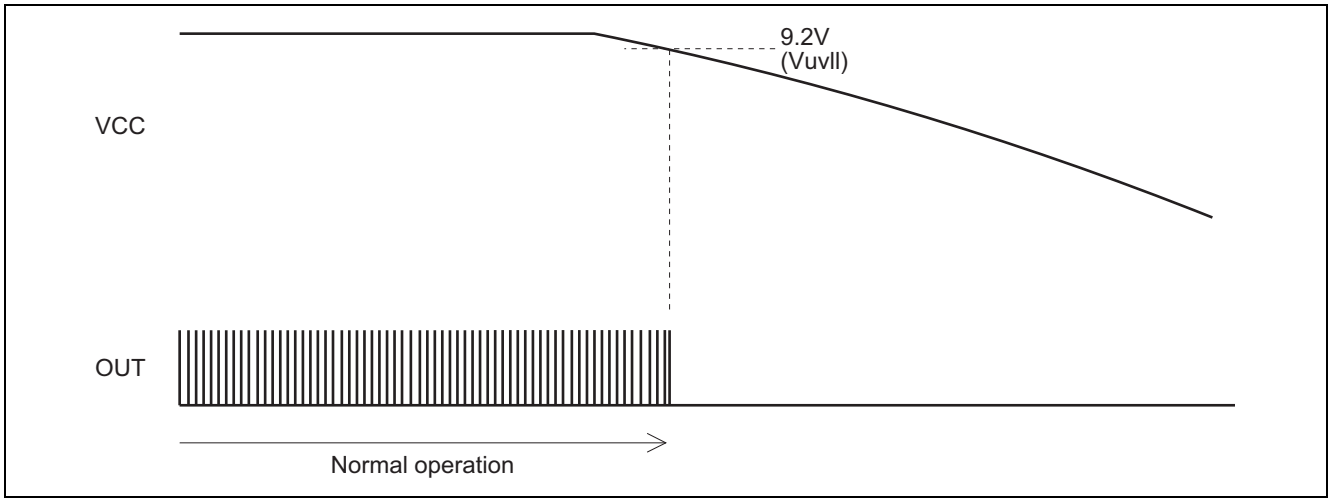
Note: *1 Design spec

## Waveforms

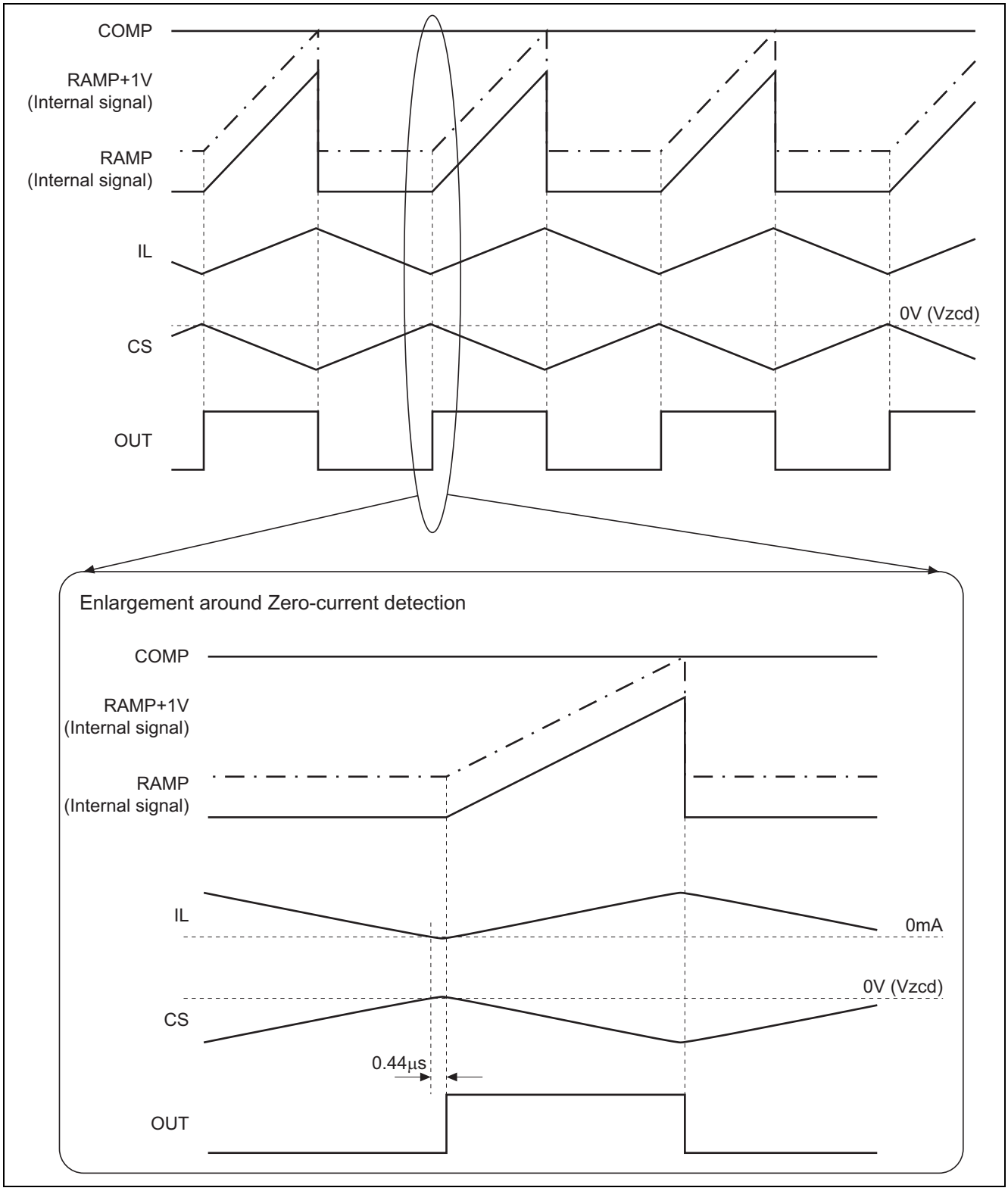
### 1. Start-up



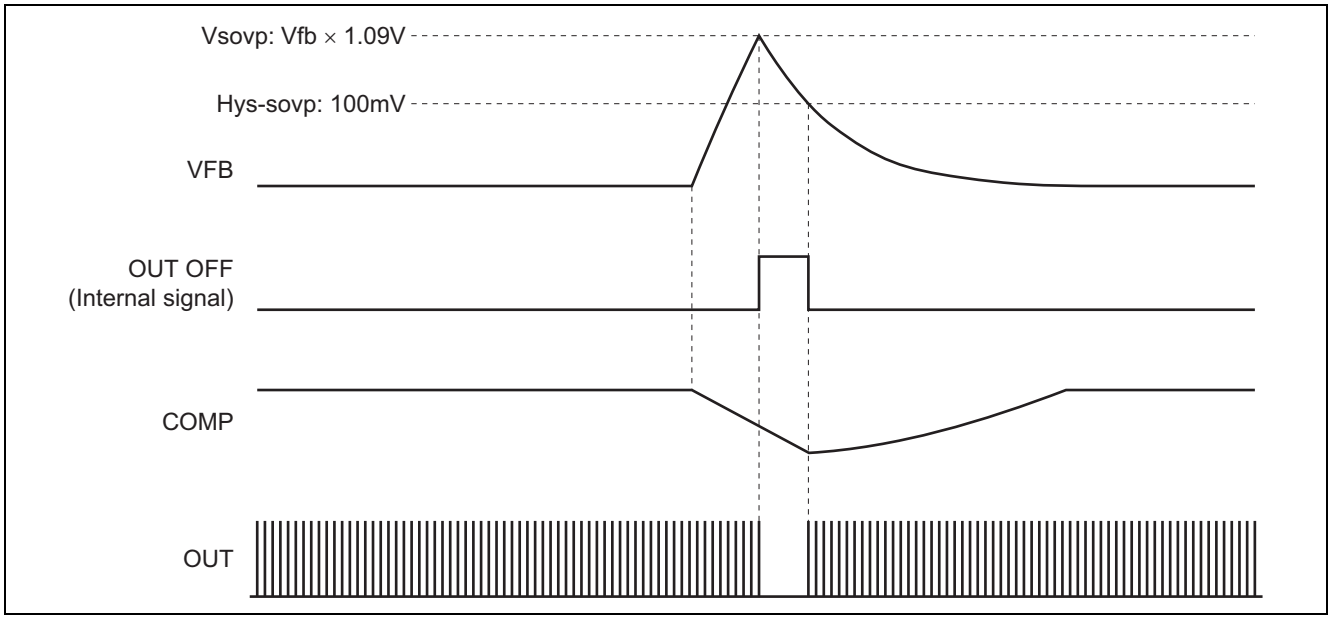

### 2. Shut-down



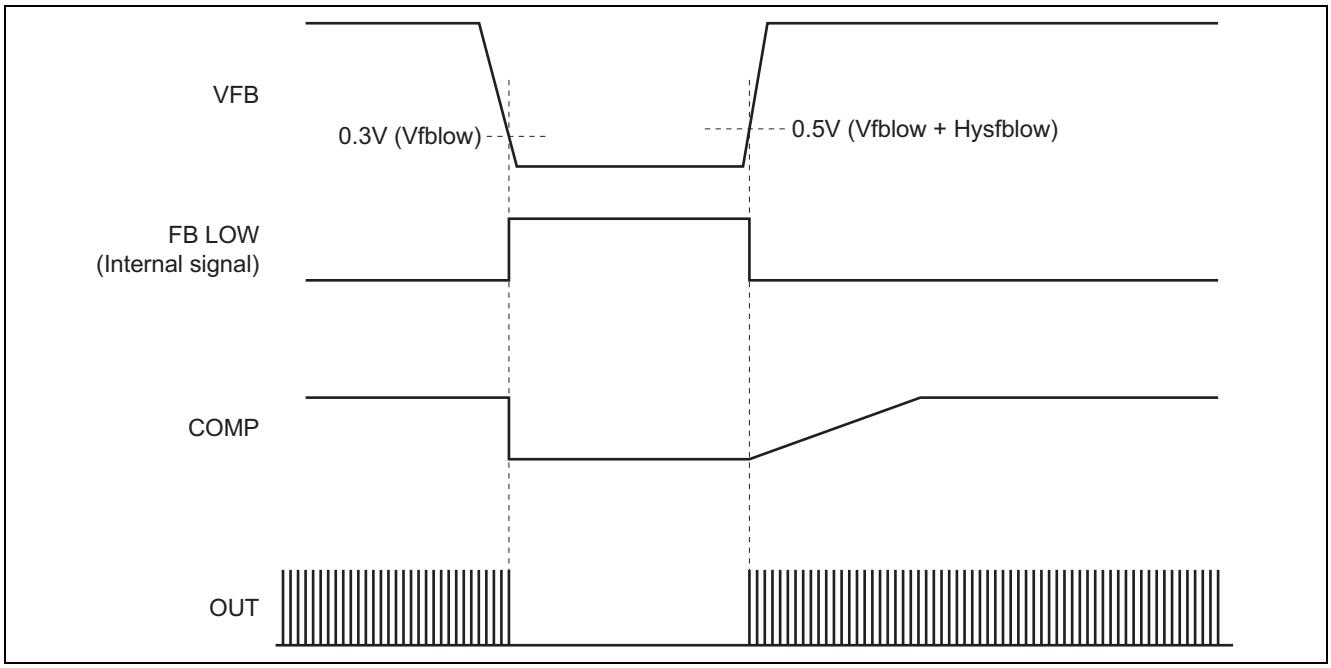
### 3. Gate Drive Output



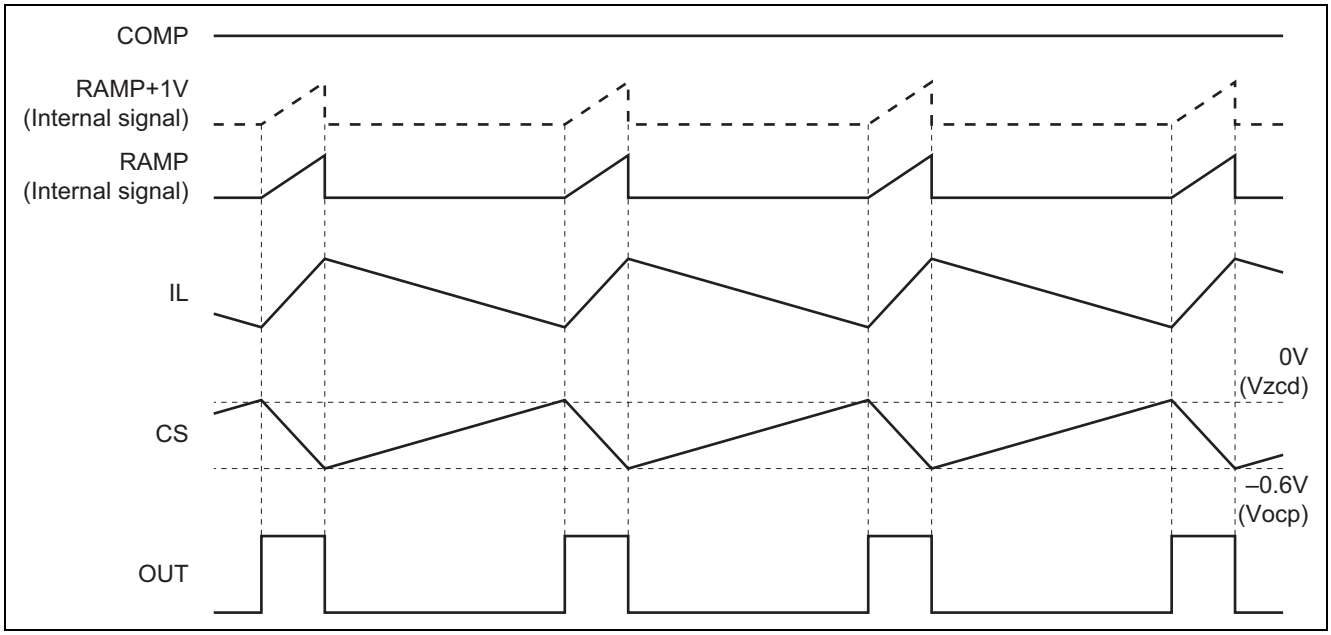
### 4. Overvoltage Protection (OVP)



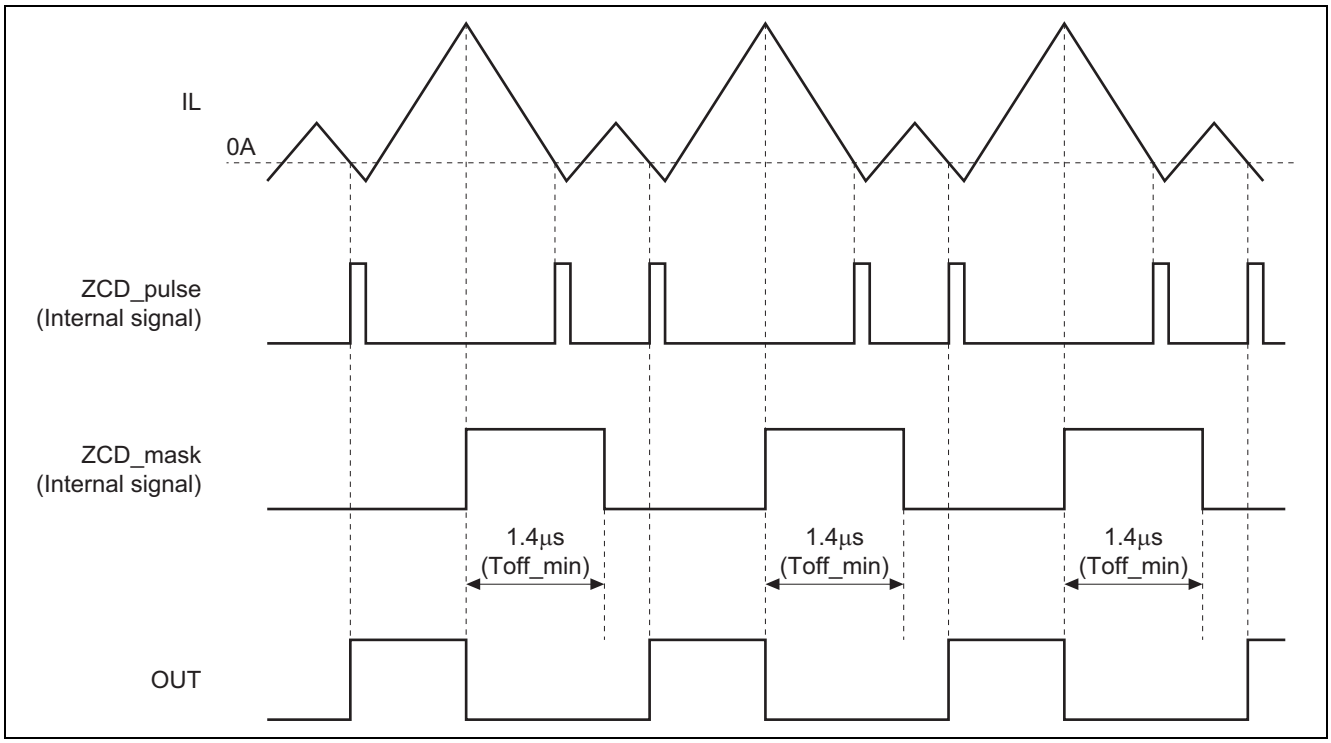

### 5. FB Low Detection



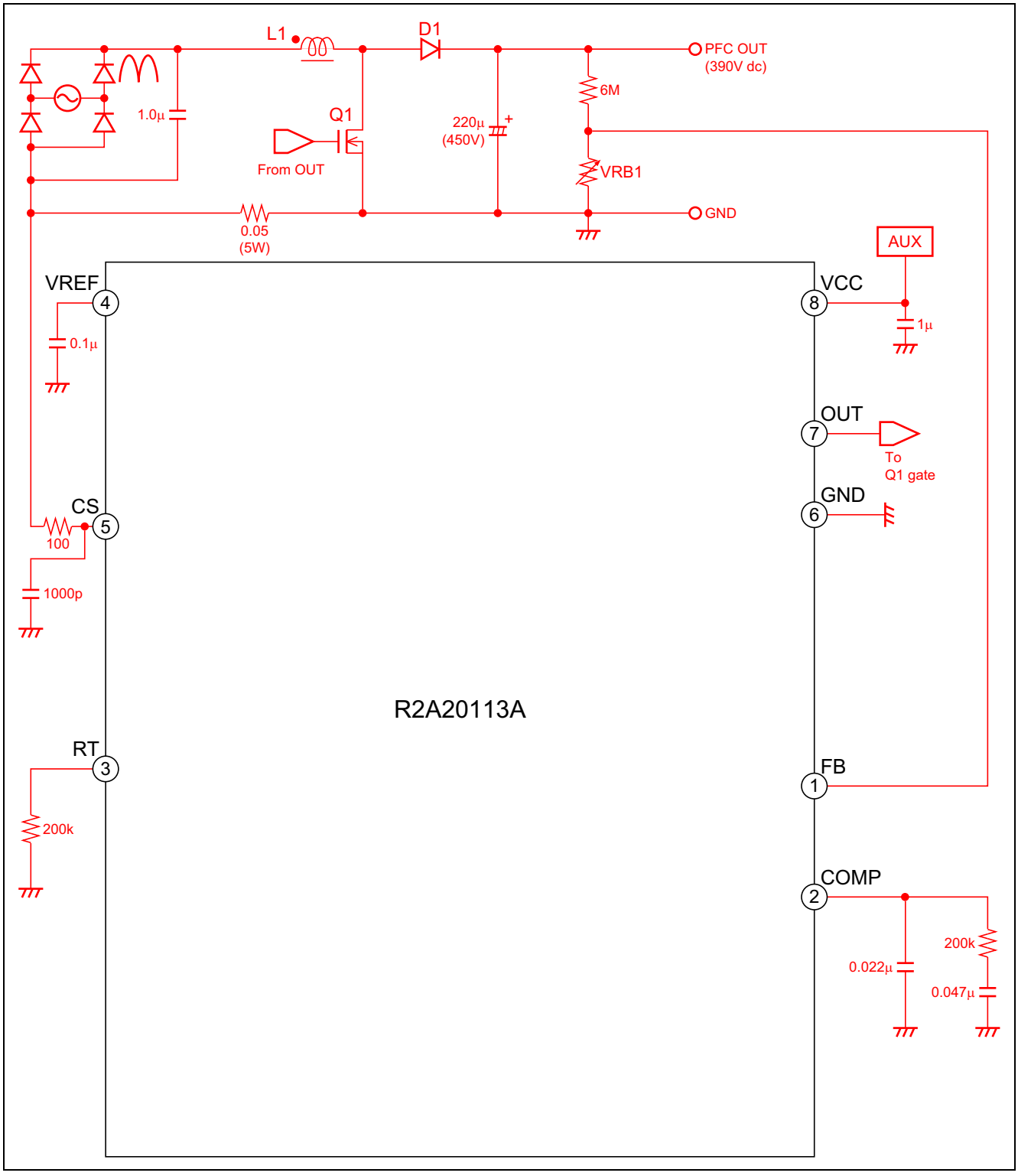
### 6. Overcurrent Protection (OCP)




### 7. Off Time Control (Frequency Limiter)

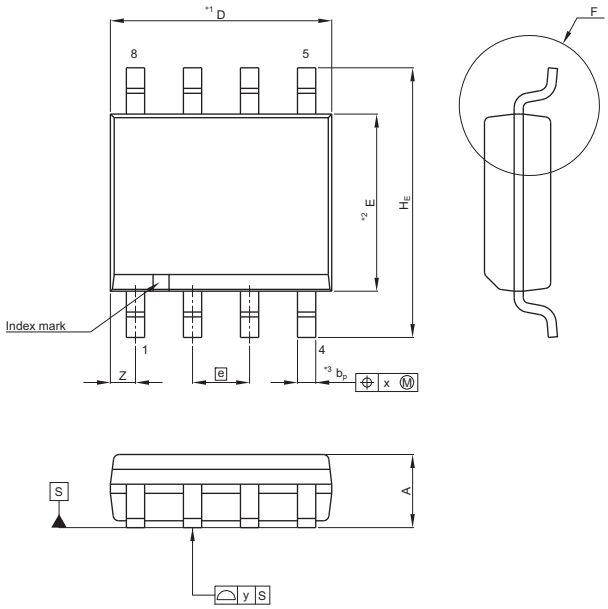


## System Diagram

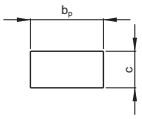


## Package Dimensions

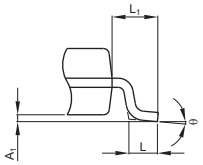
| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-SOP8-3.94x4.93-1.27 | PRSP0008DJ-A | — | 0.073g |




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




Terminal cross section
(Ni/Pd/Au plating)




Detail F

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| D | 4.80 | 4.93 | 4.98 |
| E | 3.81 | 3.94 | 3.99 |
| $A_2$ | — | 1.47 | — |
| $A_1$ | 0.10 | 0.15 | 0.25 |
| A | — | — | 1.73 |
| $b_p$ | 0.35 | 0.41 | 0.49 |
| $b_1$ | — | — | — |
| c | 0.19 | 0.20 | 0.25 |
| $c_1$ | — | — | — |
| θ | 0° | — | 8° |
| $H_E$ | 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 |
| $L_1$ | — | 1.03 | — |

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