

# R2A20115SP

## Power Factor Correction Controller IC

REJ03D0923-0100

Rev.1.00

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### Description

R2A20115 is a power-factor correction (PFC) controller IC, which employs continuous conduction mode as PFC control mode. Various kinds of functions such as constant power limit, overvoltage detection, overcurrent detection, soft start function, feedback-loop open detection, and the function holding its operation through momentary outage (PFC hold function) are incorporated in a single chip. These functions reduce external circuitry.

The constant power limit function significantly reduces "coil vibration", which is caused by the operation of a conventional overcurrent detection circuit when the system is overloaded.

The PFC hold function enables quick recovery by keeping PFC operation active for a certain duration (hold time) during momentary outage/power failure. The hold time can be adjusted by an external capacitor.

This IC provides the separated pin used for detecting overcurrent, so that, the preset current value range for overcurrent detection becomes wider than before.

The shutdown function with latch mode is also implemented.

A soft-start control pin is provided for the easy adjustment of soft-start operation.

And also the dynamic over voltage protection function integrated in this IC reduces overshooting of the output voltage, which might occur for the duration of startup, recovery after momentary power failure and just after a sudden variation of a load.

### Features

- Maximum ratings
  - Power-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  $\pm$  1.6%
  - UVLO operation start voltage  $V_H$ : 10.4  $\pm$  0.7 V
  - UVLO operation stop voltage  $V_L$ : 8.9  $\pm$  0.5 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
  - Dynamic OVP (Over Voltage Protection)
  - Package lineup: SOP-16

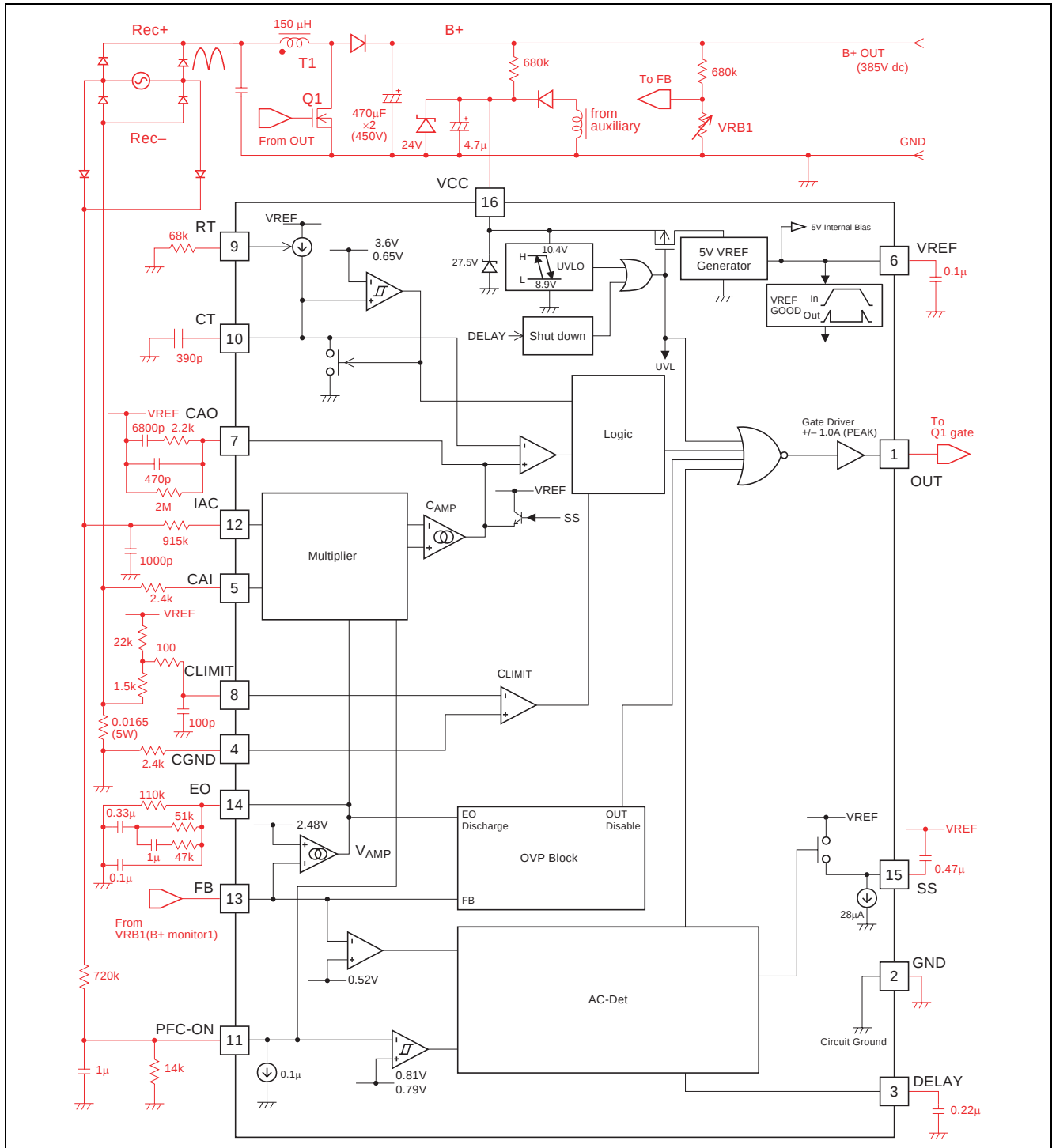
### Applications

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

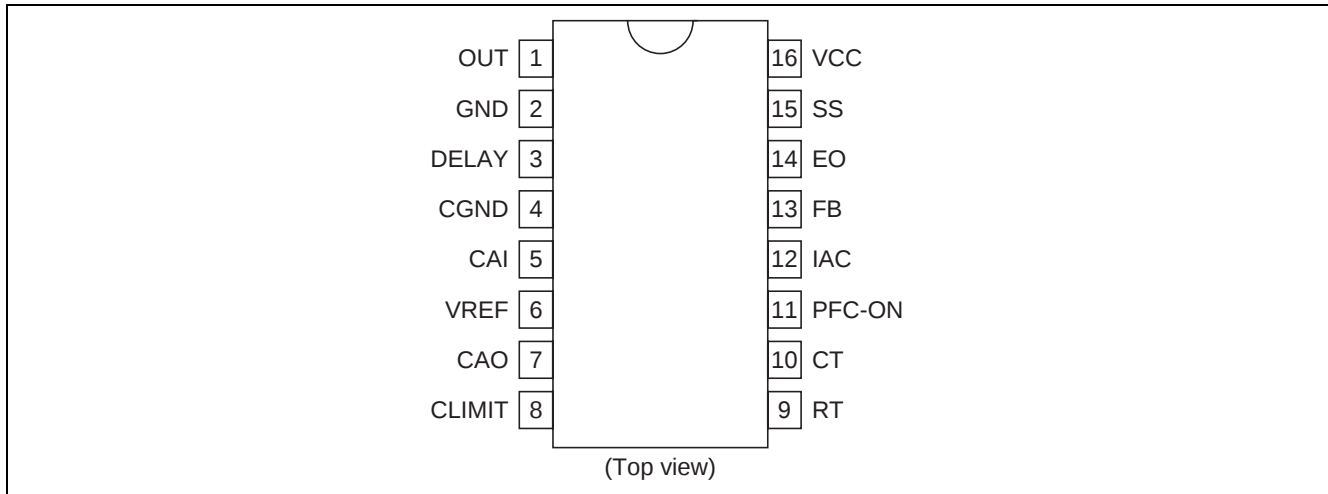
### Ordering Information

| Part No.     | Package Name | Package Code | Taping Spec.                 |
|--------------|--------------|--------------|------------------------------|
| R2A20115SPW0 | FP-16DAV     | PRSP0016DH-B | 2000 pcs./one taping product |

## System Diagram



## 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 +150               | °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],<br>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        | 9.7  | 10.4  | 11.1 | V      |                                       |
|               | Shutdown threshold         | VL        | 8.4  | 8.9   | 9.4  | V      |                                       |
|               | UVLO hysteresis            | dVUVL     | 1.0  | 1.5   | 2.0  | V      |                                       |
|               | Startup current            | Is        | 75   | 100   | 145  | μA     | VCC = 9.5 V                           |
|               | Is temperature stability   | dIs/dTa   | —    | −0.3  | —    | %/°C   | *1                                    |
|               | Operating current          | Icc       | 2.4  | 3.4   | 4.4  | mA     | IAC = 0 A, CL = 0 F                   |
| VREF          | Output voltage             | Vref      | 4.92 | 5.00  | 5.08 | V      | Isource = 1 mA                        |
|               | Line regulation            | Vref-line | —    | 5     | 20   | mV     | Isource = 1 mA,<br>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      | 55.0 | 61.0  | 67.0 | 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       | 1.18 | 1.22  | 1.26 | V      |                                       |
| Soft start    | Sink current               | Iss       | 17.0 | 28.0  | 39.0 | μA     | SS = 2 V                              |
| Current limit | Threshold voltage          | VCL       | −15  | 0     | 15   | mV     |                                       |
|               | Delay to output            | td-CL     | —    | 200   | 300  | ns     | CLIMIT = 1 to −0.3 V                  |
| VAMP          | Feedback voltage           | Vfb       | 2.44 | 2.48  | 2.52 | V      | FB-EO Short                           |
|               | Input bias current         | Ifb       | −0.3 | −0.15 | 0    | μA     | Measured pin: FB                      |
|               | Open loop gain             | Av-v      | —    | 53    | —    | dB     | *1                                    |
|               | High voltage               | Veoh      | 4.75 | 4.9   | 5.05 | 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  | −80  | μA     | FB = 1.0 V, EO = 2.5 V *1             |
|               | Sink current               | Isnk-eo   | —    | 350   | —    | μA     | FB = 4.0 V, EO = 2.5 V *1             |
|               | Transconductance           | Gm-v      | 120  | 180   | 240  | 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     | —    | 55    | —    | dB     | *1                                    |
|               | High voltage               | Vcaoh     | 4    | 4.5   | 5    | V      |                                       |
|               | Low voltage                | Vcaol     | —    | 0.1   | 0.3  | V      |                                       |
|               | Source current             | Isrc-ca   | −150 | −105  | −67  | μA     | CAO = 2.5 V                           |
|               | Sink current               | Isnk-ca   | 67   | 105   | 150  | μA     | CAO = 2.5 V                           |
|               | Transconductance           | Gm-c      | 420  | 660   | 890  | μA/V   | *1                                    |

Note: 1. Design spec.

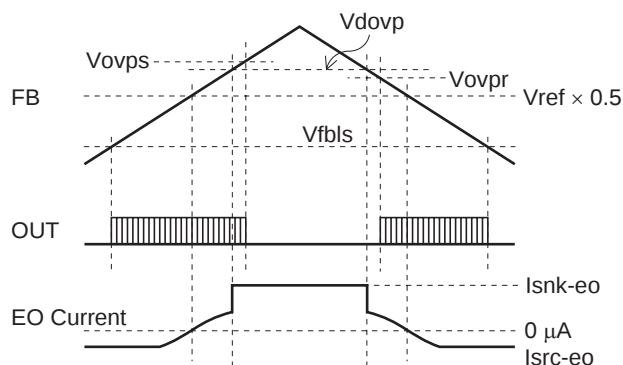
## Electrical Characteristics (cont.)

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

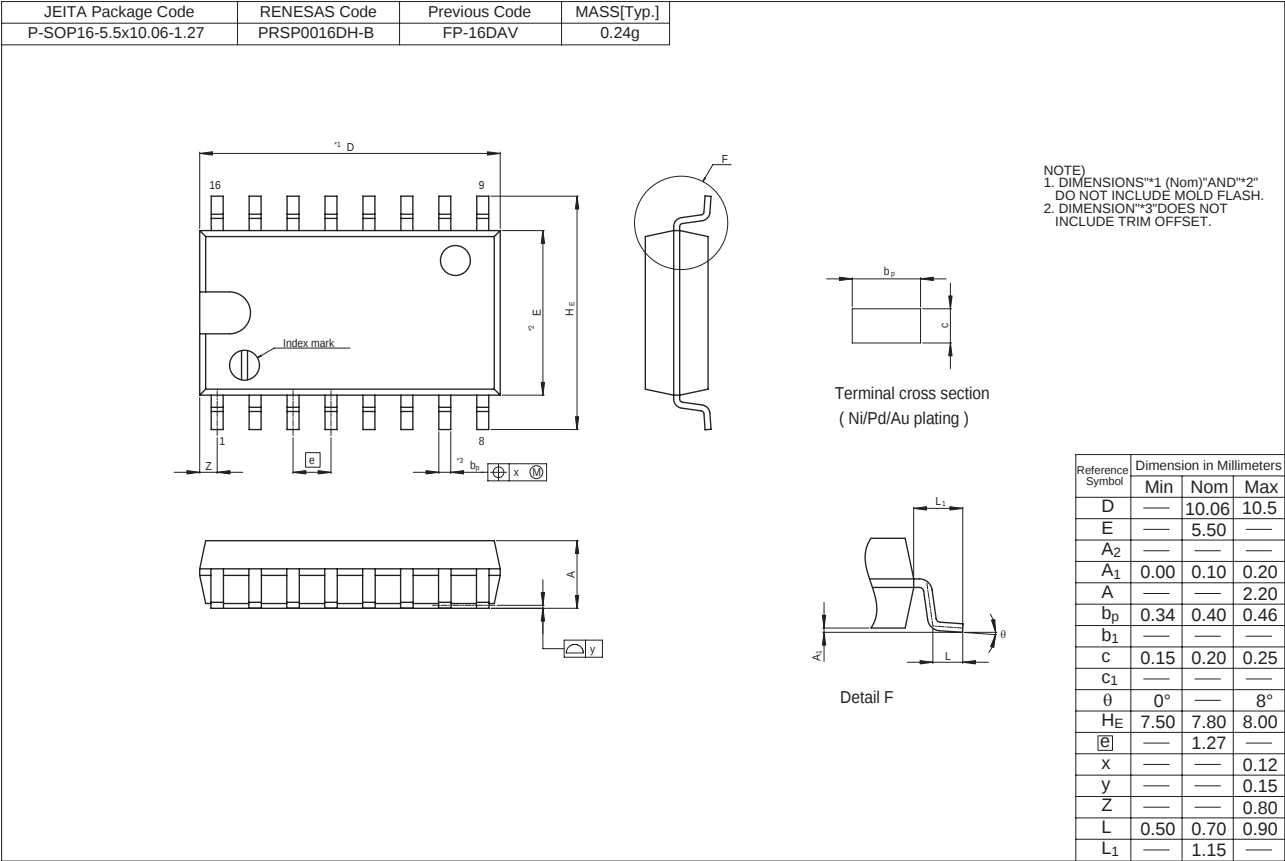
|                    | Item                                | Symbol     | Min   | Typ   | Max   | Unit | Test Conditions                            |
|--------------------|-------------------------------------|------------|-------|-------|-------|------|--------------------------------------------|
| IAC/<br>Multiplier | IAC pin voltage                     | Viac       | 0.4   | 1.4   | 2.0   | V    | IAC = 100 μA                               |
|                    | Imo current 1                       | Imo1       | −57   | −47   | −37   | μA   | EO = 2.5 V, IAC = 150 μA<br>PFC-ON = 1.2 V |
|                    | Imo current 2                       | Imo2       | −158  | −125  | −91.5 | μA   | EO = Vcaoh, IAC = 150 μA<br>PFC-ON = 1.2 V |
|                    | Imo current 3                       | Imo3       | −35.5 | −30   | −24.5 | μA   | EO = 2.5 V, IAC = 375 μA<br>PFC-ON = 2.5 V |
|                    | Imo current 4                       | Imo4       | −98.5 | −80   | −61.5 | μA   | EO = Vcaoh, IAC = 375 μA<br>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   | —     | 0.08  | 0.2   | V    | Iout = 20 mA                               |
|                    |                                     | Vol2-out   | —     | 0.5   | 2.0   | V    | Iout = 200 mA (Pulse test)                 |
|                    |                                     | Vol3-out   | —     | 0.07  | 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      | 45    | 95    | 190   | μA   | VCC = 9 V                                  |
| Supervisor         | PFC enable voltage                  | Von-pfc    | 0.73  | 0.81  | 0.89  | 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     | 1.10  | 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     | 0.010 | 0.050 | 0.100 | V    | Input pin: FB * <sup>2</sup>               |
|                    | Dynamic OVP set/reset voltage       | dVdovp     | 0.045 | 0.065 | 0.085 | V    | Input pin: FB * <sup>2</sup>               |
|                    | FB low set voltage                  | Vfbls      | 0.47  | 0.52  | 0.57  | V    | Input pin: FB                              |
|                    | DELAY source current                | Isrc-delay | −50.5 | −45.5 | −40.5 | μA   | DELAY = 1 V<br>RT = 27 kΩ                  |
|                    | DELAY sink current                  | Isnk-delay | —     | 815   | —     | μA   | DELAY = 1 V<br>RT = 27 kΩ * <sup>1</sup>   |

Notes: 1. Design spec.

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



Package Dimensions



Notes:

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