

R2A20111SP

Power Factor Correction Controller IC

REJ03F0231-0200

Rev.2.00

Sep 29, 2009

Description

The R2A20111 is a power-factor correction (PFC) controller IC.

This IC adopts continuous conduction mode as PFC operation.

Various functions such as constant power limit, overvoltage detection, overcurrent detection, soft start, feedback-loop disconnection detection, and holding function of PFC operation through momentary outage (PFC hold function) are incorporated in a single chip. These functions reduce external circuitry.

The constant power limit function allows to eliminate a significant amount of coil noise which is generated due to overcurrent detection operation in case of conventional overload.

The PFC hold function enables quick recovery by continuing PFC operation after momentary outage. The hold time can be adjusted by an external capacitance.

Overcurrent detection pin is separately provided.

Latch mode shutdown function is incorporated.

A soft-start control pin provides for the easy adjustment of soft-start operation, and can be used to prevent overshooting of the output voltage.

Features

- Maximum ratings
 - Power-supply voltage V_{CC} : 24 V
 - Operating junction temperature T_{jopr} : -40 to 125°C
- Electrical characteristics
 - VREF output voltage VREF: 5.0 V \pm 3%
 - UVLO operation start voltage V_H : 10.5 \pm 0.9 V
 - UVLO operation stop voltage V_L : 9.0 \pm 0.7 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
 - Package lineup: SOP-16

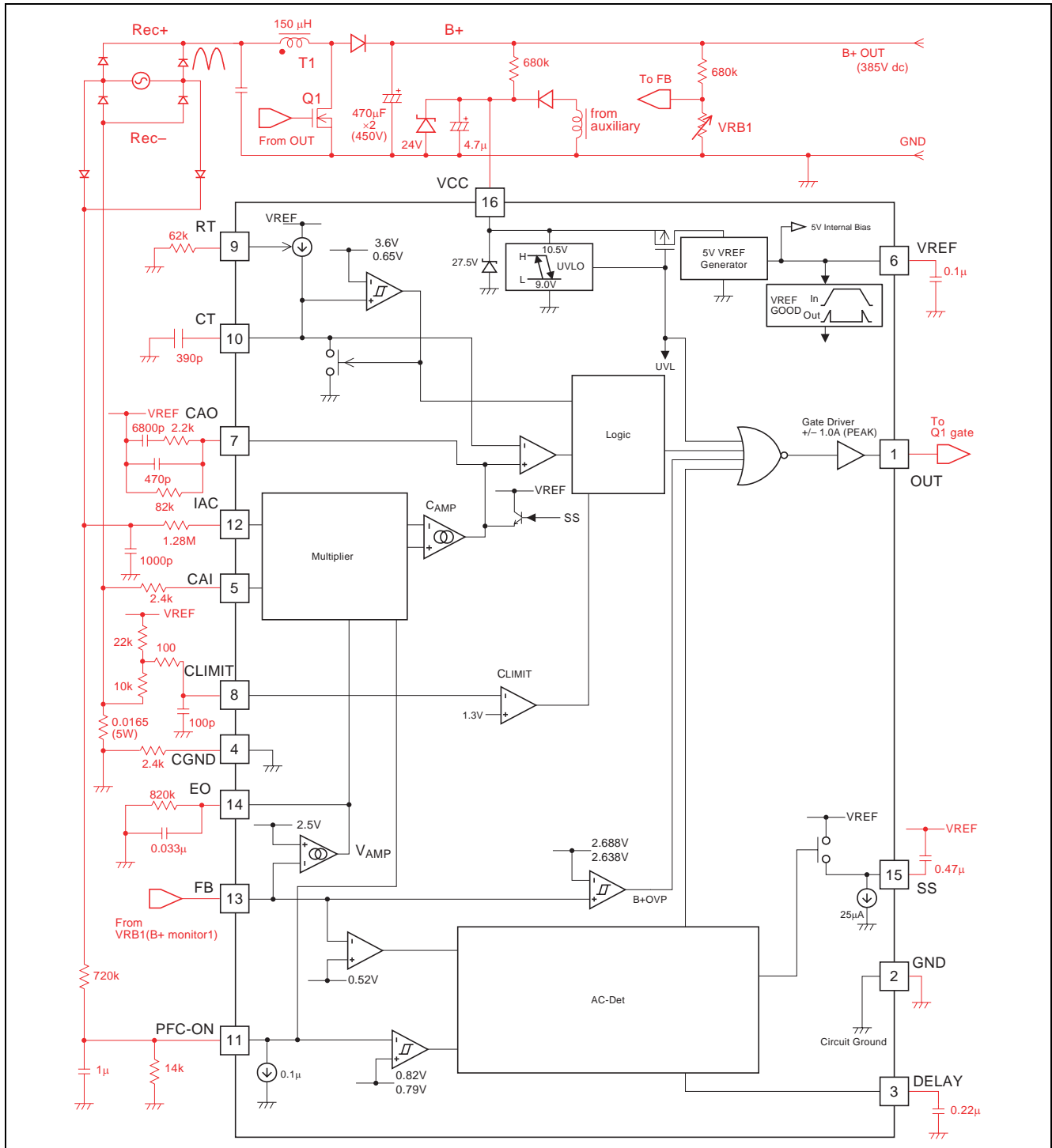
Applications

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

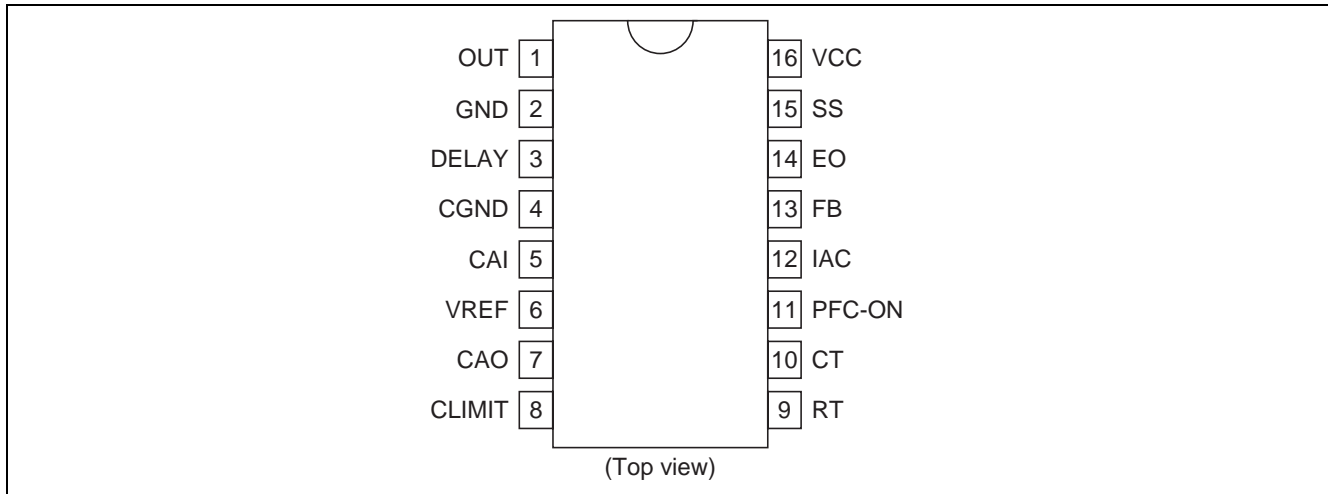
Ordering Information

| Part No. | Package Name | Package Code | Taping Spec. |
|--------------|--------------|--------------|------------------------------|
| R2A20111SPW0 | 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 _{pk-out} | ±1.0 | A | 3 |
| OUT DC current | I _{dc-out} | ±0.1 | A | |
| Terminal voltage | V _{i-group1} | −0.3 to V _{cc} | V | 4 |
| | V _{i-group2} | −0.3 to V _{ref} | V | 5 |
| CAO voltage | V _{cao} | −0.3 to V _{caoh} | V | |
| EO voltage | V _{eo} | −0.3 to V _{eoH} | V | |
| DELAY voltage | V _{delay} | −0.3 to +6.5 | V | |
| CAI voltage | V _{i-cs} | −1.5 to +0.3 | V | |
| RT current | I _{rt} | −200 | μA | |
| IAC current | I _{iac} | 0.6 | mA | |
| VREF current | I _{o-ref} | −5 | mA | |
| Power dissipation | P _t | 1 | W | 6 |
| Operating junction temperature | T _{j-opr} | −40 to +125 | °C | |
| Storage temperature | T _{stg} | −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 _{ja} | θ _{jc} | Note |
|---------|-----------------|-----------------|---|
| SOP16 | 120°C/W | — | 40 × 40 × 1.6 [mm], 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 | 9.6 | 10.5 | 11.4 | V | |
| | Shutdown threshold | VL | 8.3 | 9.0 | 9.7 | V | |
| | UVLO hysteresis | dVUVL | 1.0 | 1.5 | 2.0 | V | |
| | Startup current | Is | 140 | 200 | 260 | μA | VCC = 9.5 V |
| | Is temperature stability | dIs/dTa | — | −0.3 | — | %/°C | *1 |
| | Operating current | Icc | 3.45 | 4.5 | 6.45 | mA | IAC = 0 A, CL = 0 F |
| 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 = 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 | 58.5 | 65 | 71.5 | 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 | 1.17 | 1.25 | 1.33 | V | |
| Soft start | Sink current | Iss | 15.0 | 25.0 | 35.0 | μA | SS = 2 V |
| Current limit | Threshold voltage | VCL | 1.222 | 1.3 | 1.378 | V | |
| | Delay to output | td-CL | — | 100 | 200 | ns | CLIMIT = 2 to 0 V |
| VAMP | Feedback voltage | Vfb | 2.40 | 2.50 | 2.60 | V | FB-EO Short |
| | Input bias current | Ifb | −0.3 | 0 | 0.3 | μA | Measured pin: FB |
| | Open loop gain | Av-v | — | 53 | — | dB | *1 |
| | High voltage | Veoh | 5.2 | 5.7 | 6.2 | 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 | −90 | μA | FB = 1.0 V, EO = 2.5 V |
| | Sink current | Isnk-eo | 90 | 120 | 180 | μA | FB = 4.0 V, EO = 2.5 V |
| | Transconductance | Gm-v | 150 | 200 | 290 | 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 | — | 68 | — | dB | *1 |
| | High voltage | Vcaoh | 5.2 | 5.7 | 6.2 | V | |
| | Low voltage | Vcaol | — | 0.1 | 0.3 | V | |
| | Source current | Isrc-ca | −135 | −90 | −67 | μA | CAO = 2.5 V |
| | Sink current | Isnk-ca | 67 | 90 | 135 | μA | CAO = 2.5 V |
| | Transconductance | Gm-c | 530 | 700 | 1000 | μA/V | *1 |

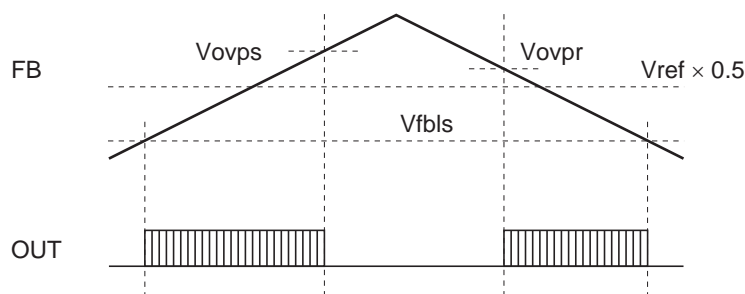
Note: 1. Design spec.

Electrical Characteristics (cont.)

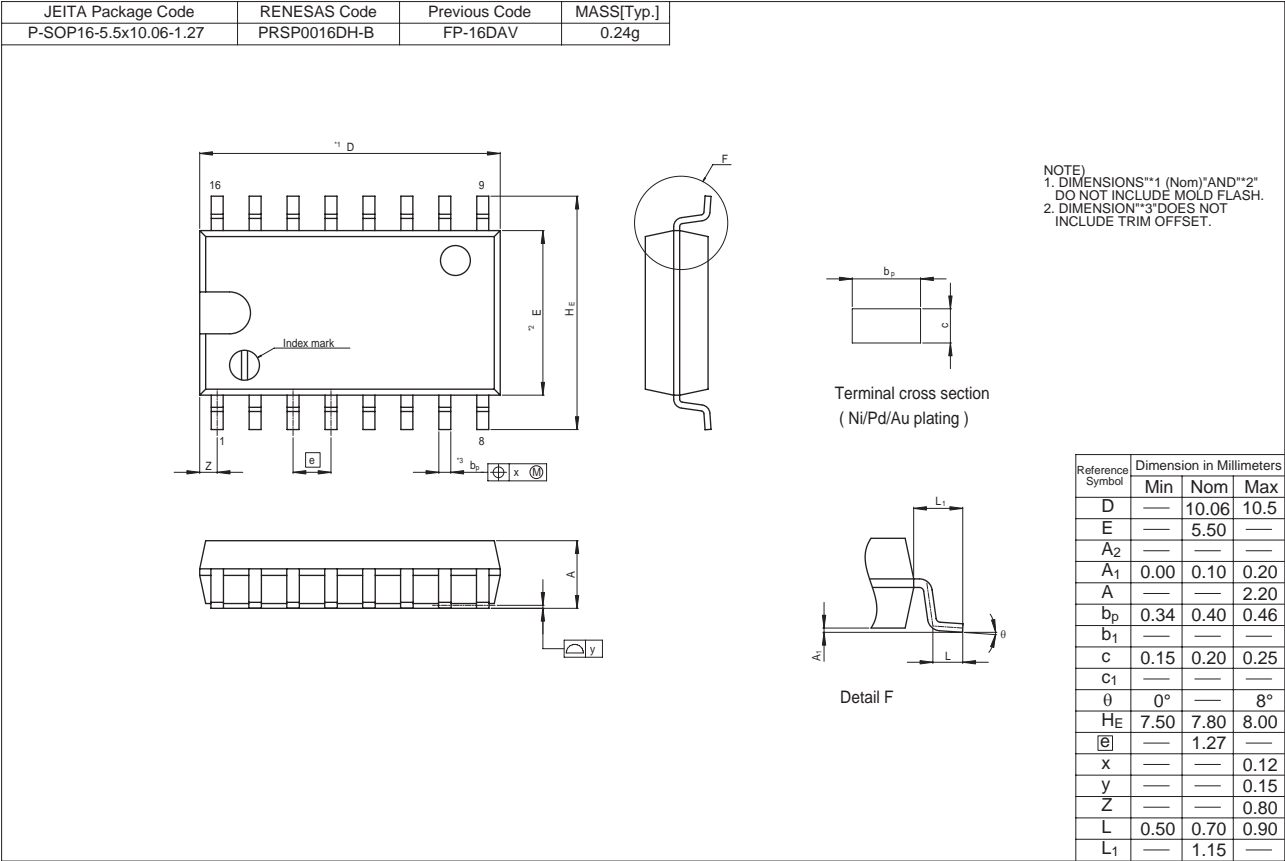
(Ta = 25°C, VCC = 12 V, RT = 27 kΩ, CT = 1000 pF)

| | Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|--------------------|-------------------------------------|------------|--------|-------|--------|------|--|
| IAC/ Multiplier | IAC pin voltage | Viac | 1.6 | 2.3 | 3.0 | V | IAC = 100 μA |
| | Imo current 1 | Imo1 | -61.3 | -51.5 | -41 | μA | EO = 2.5 V, IAC = 150 μA PFC-ON = 1.2 V |
| | Imo current 2 | Imo2 | -197.9 | -165 | -131.5 | μA | EO = Vcaoh, IAC = 150 μA PFC-ON = 1.2 V |
| | Imo current 3 | Imo3 | -32.8 | -27 | -21.2 | μA | EO = 2.5 V, IAC = 375 μA PFC-ON = 2.5 V |
| | Imo current 4 | Imo4 | -110.4 | -92 | -73.6 | μA | EO = Vcaoh, IAC = 375 μA 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 | — | 0.05 | 0.2 | V | Iout = 20 mA |
| | | Vol2-out | — | 0.5 | 2.0 | V | Iout = 200 mA (Pulse test) |
| | | Vol3-out | — | 0.03 | 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 | 120 | 190 | 260 | μA | VCC = 9 V |
| Supervisor | PFC enable voltage | Von-pfc | 0.74 | 0.82 | 0.9 | 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 | 1.05 | 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 * ² |
| | B+ OVP reset voltage | dVovpr | 0.075 | 0.138 | 0.200 | V | Input pin: FB * ² |
| | FB low set voltage | Vfbls | 0.425 | 0.52 | 0.615 | V | Input pin: FB |
| | DELAY source current | Isrc-delay | -47.5 | -42.5 | -38 | μA | DELAY = 1 V RT = 27 kΩ |
| | DELAY sink current | Isnk-delay | — | 770 | — | μA | DELAY = 1 V RT = 27 kΩ * ¹ |

Notes: 1. Design spec.

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

Package Dimensions



Notes:

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