

# Power factor correction IC FA1A10N power supply design example: 390V/200W

## **Reference Design**

#### 1. Overview

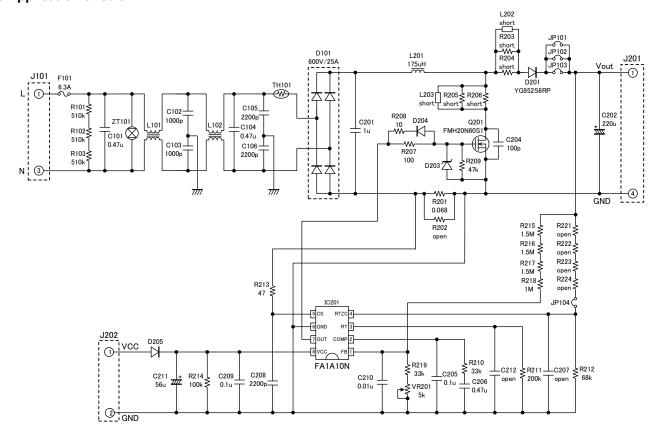
This document describes the design example of PFC circuit using critical conduction mode power-factor correction IC FA1A10N series. The input is universal (85Vac to 264Vac) and the output is 200W.

#### 2. Features

- •Low standby power due to no input voltage detection resistors
- •High-precision over current protection: 0.6V±2%
- •Improved power efficiency at light load due to Frequency reduction function
- Power factor improvement function
- •Soften Audible Noise at Startup Over Shoot Reduction function
- •Low current consumption by CMOS process
- •Start-up 500µA(typ.)、Operating 1.5mA(typ.)
- •Drive circuit for power MOSFET
  - Output peak current, source: 1000mA, sink: 1000mA
- •Short protection at feedback (FB) pin
- Under-voltage Lockout
- Restart timer
- •8-pin package (SOP)



#### 3. Application circuit

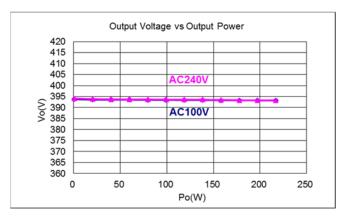


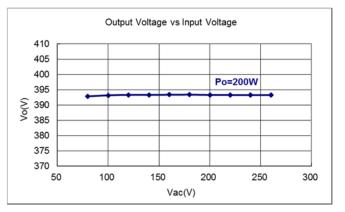


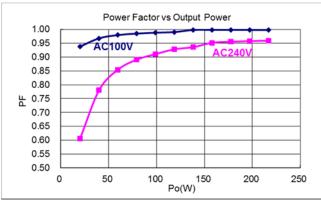
#### 4. Specifications of the power supply

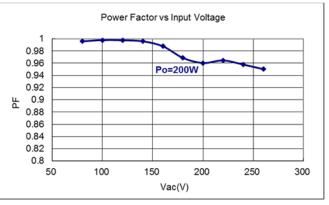
| Item                | Value  | Unit |  |  |
|---------------------|--|------|--|--|
| Input voltage       | 90 to 264  | Vac  |  |  |
| Output voltage      | 390  | Vdc  |  |  |
| Output power        | 200  | W    |  |  |
| Protection function | Overcurrent limiting of power MOSFET Overvoltage limiting Short protection at FB pin Soft Start function |      |  |  |

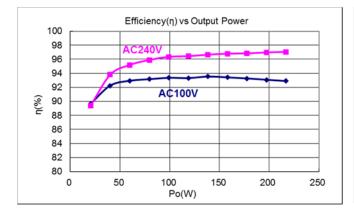
## 5. Characteristics

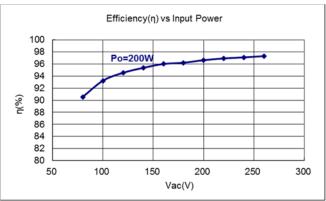




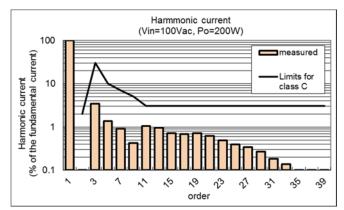


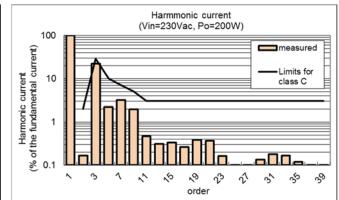






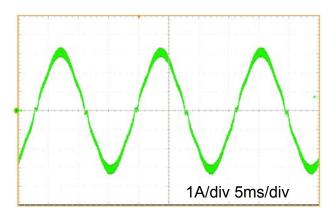




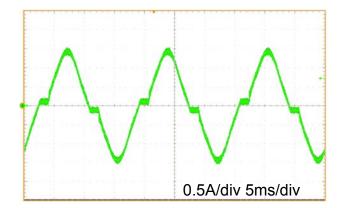


## 6. Operation waveform (AC input current)

100Vac Po=200W



240Vac Po=200W





#### 9.Bill of material

| IC201   | Component | Item         | Value       | Part. No          | Maker  | Note    |
|---|-----------|--------------|-------------|-------------------|--------|---------|
| Q201   MOSFET   FMH20N60S1   Fuji   D101   Bridge Diode   G00V/25A   D25SB60   SHINDENGEN   YG95256RP   Fuji   D203   Zenner Diode   27V 0.2W   ERA91-002   Fuji   D205   Diode   ERA91-002   Fuji   D205   D1004   ERA91-002   Fuji   D205   D1004   ERA91-002   Fuji   D205   D1004   ERA91-002   Fuji   D205   D205 | IC201     | PFC IC       |             | FA1A10N / 11N     | Fuji   |         |
| D101  | Q201      |              |             | FMH20N60S1        | Fuji   |         |
| D203   Zenner Diode   27V 0.2W   ERA91-002   Fuji   | D101      | Bridge Diode | 600V/25A    | D25SB60           |        |         |
| D204   Diode   ERA91-002   Fuji   | D201      | Diode        |             | YG952S6RP         | Fuji   |         |
| D204   Diode   ERA91-002   Fuji   | D203      | Zenner Diode | 27V 0.2W    |                   |        |         |
| D205  | D204      |              |             | ERA91-002         | Fuji   |         |
| L201  | D205      | Diode        |             | 1SS244            |        |         |
| L201  | L101.L102 | Inductor     | 15mH 4A     |                   |        |         |
| C101   Film capacitor   AC275V,0.47uF   LE474-M   OKAYA   | •         | Inductor     | Lp=175uH    |                   |        | PQ32/30 |
| C102,C103   Ceramic capacitor   AC250V,1000pF   DE1E3KX102MA4BL01   MURATA  |           |              |             | LE474-M           | OKAYA  |         |
| C104         Film capacitor         AC275V,0.47uF         LE474-M         OKAYA           C105,C106         Ceramic capacitor         AC250V,2200pF         DE1E3KX222MA4BL01         MURATA           C201         Film capacitor         630V, 1uF         C           C202         Electrolytic capacitor         2kV,100pF         C           C204         Ceramic capacitor         50V, 0.1uF         C           C205,C209         Ceramic capacitor         50V, 0.47uF         C           C206         Ceramic capacitor         50V, 0.47uF         C           C207,C210         Ceramic capacitor         50V, 1000pF         C           C208         Ceramic capacitor         50V, 2200pF         C           C211         Electrolytic capacitor         50V, 2200pF         C           C211         Electrolytic capacitor         50V, 56uF         T           R101,R102,R103         Resister         1/8W, 510kΩ         T           R201         Resister         3W, 0.068Ω         T           R201         Resister         1/4W, 10Ω         T           R208         Resister         1/8W, 33kΩ         T           R210         Resister         1/8W, 33kΩ         T   | C102.C103 |              |             | DE1E3KX102MA4BL01 | MURATA |         |
| C105,C106   Ceramic capacitor   AC250V,2200pF   DE1E3KX222MA4BL01   MURATA  | - ,       | ·            |             |                   |        |         |
| C201         Film capacitor         630V, 1uF           C202         Electrolytic capacitor         450V, 270uF           C204         Ceramic capacitor         2kV,100pF           C205,C209         Ceramic capacitor         50V, 0.1uF           C206         Ceramic capacitor         50V, 0.47uF           C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 33kΩ           R210         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 200kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R216, R216, R217, R217         Resister         1/8W, 15MΩ           R218         Resister         1/8W, 15MΩ           R219         Resister         1/8W, 33kΩ   |           |              |             |                   |        |         |
| C202         Electrolytic capacitor         450V, 270uF           C204         Ceramic capacitor         2kV,100pF           C205,C209         Ceramic capacitor         50V, 0.1uF           C206         Ceramic capacitor         50V, 1000pF           C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R210         Resister         1/8W, 47kΩ           R211         Resister         1/8W, 33kΩ           R212         Resister         1/8W, 68kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R216, R216, R216, R217         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1MΩ           R219         Resister         1/8W, 33kΩ   | •         |              |             |                   |        |         |
| C204         Ceramic capacitor         2kV,100pF           C205,C209         Ceramic capacitor         50V, 0.1uF           C206         Ceramic capacitor         50V, 0.47uF           C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R102, R210         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 68kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R216, R216, R216, R217         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1MΩ           R219         Resister         1/8W, 33kΩ   | -         |              | ·           |                   |        |         |
| C205,C209         Ceramic capacitor         50V, 0.1uF           C206         Ceramic capacitor         50V, 0.47uF           C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 47Ω           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R216, R216, R216, R217         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1MΩ           R219         Resister         1/8W, 33kΩ   |           |              |             |                   |        |         |
| C206         Ceramic capacitor         50V, 0.47uF           C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 47kΩ           R213         Resister         1/8W, 47kΩ           R214         Resister         1/8W, 47kΩ           R214         Resister         1/8W, 100kΩ           R215,R216, Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 33kΩ  | -         |              |             |                   |        |         |
| C207,C210         Ceramic capacitor         50V, 1000pF           C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 68kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1.5MΩ           R219         Resister         1/8W, 3kΩ  | •         |              |             |                   |        |         |
| C208         Ceramic capacitor         50V, 2200pF           C211         Electrolytic capacitor         50V, 56uF           R101,R102, Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 68kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R217         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1MΩ           R219         Resister         1/8W, 33kΩ   |           | ·            |             |                   |        |         |
| C211         Electrolytic capacitor         50V, 56uF           R101,R102, R103         Resister         1/8W, 510kΩ           R201         Resister         3W, 0.068Ω           R207         Resister         1/4W, 100Ω           R208         Resister         1/4W, 10Ω           R209         Resister         1/8W, 47kΩ           R210         Resister         1/8W, 33kΩ           R211         Resister         1/8W, 200kΩ           R212         Resister         1/8W, 68kΩ           R213         Resister         1/8W, 47Ω           R214         Resister         1/8W, 100kΩ           R215,R216, R217         Resister         1/8W, 1.5MΩ           R218         Resister         1/8W, 1MΩ           R219         Resister         1/8W, 33kΩ   |           |              |             |                   |        |         |
| R101,R102, R103       Resister       1/8W, 510kΩ         R201       Resister       3W, 0.068Ω         R207       Resister       1/4W, 100Ω         R208       Resister       1/4W, 10Ω         R209       Resister       1/8W, 47kΩ         R210       Resister       1/8W, 33kΩ         R211       Resister       1/8W, 200kΩ         R212       Resister       1/8W, 68kΩ         R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216, R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ   |           |              |             |                   |        |         |
| R103       Resister       3W, 0.068Ω         R207       Resister       1/4W, 100Ω         R208       Resister       1/4W, 10Ω         R209       Resister       1/8W, 47kΩ         R210       Resister       1/8W, 33kΩ         R211       Resister       1/8W, 200kΩ         R212       Resister       1/8W, 68kΩ         R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216, R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  |           |              | ·           |                   |        |         |
| R207       Resister       1/4W, 100Ω         R208       Resister       1/4W, 10Ω         R209       Resister       1/8W, 47kΩ         R210       Resister       1/8W, 33kΩ         R211       Resister       1/8W, 200kΩ         R212       Resister       1/8W, 68kΩ         R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216, R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ   |           | Resister     | 1/8W, 510kΩ |                   |        |         |
| R208       Resister       1/4W, 10Ω         R209       Resister       1/8W, 47kΩ         R210       Resister       1/8W, 33kΩ         R211       Resister       1/8W, 200kΩ         R212       Resister       1/8W, 68kΩ         R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216, R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  | R201      | Resister     | 3W, 0.068Ω  |                   |        |         |
| R209       Resister $1/8W$ , $47kΩ$ R210       Resister $1/8W$ , $33kΩ$ R211       Resister $1/8W$ , $200kΩ$ R212       Resister $1/8W$ , $68kΩ$ R213       Resister $1/8W$ , $47Ω$ R214       Resister $1/8W$ , $100kΩ$ R215,R216, R217       Resister $1/8W$ , $1.5MΩ$ R218       Resister $1/8W$ , $1MΩ$ R219       Resister $1/8W$ , $33kΩ$   | R207      | Resister     | 1/4W, 100Ω  |                   |        |         |
| R210       Resister $1/8W$ , $33kΩ$ R211       Resister $1/8W$ , $200kΩ$ R212       Resister $1/8W$ , $68kΩ$ R213       Resister $1/8W$ , $47Ω$ R214       Resister $1/8W$ , $100kΩ$ R215,R216, R217       Resister $1/8W$ , $1.5MΩ$ R218       Resister $1/8W$ , $1MΩ$ R219       Resister $1/8W$ , $33kΩ$   | R208      | Resister     | 1/4W, 10Ω   |                   |        |         |
| R211       Resister $1/8W$ , $200kΩ$ R212       Resister $1/8W$ , $68kΩ$ R213       Resister $1/8W$ , $47Ω$ R214       Resister $1/8W$ , $100kΩ$ R215,R216, R217       Resister $1/8W$ , $1.5MΩ$ R218       Resister $1/8W$ , $1MΩ$ R219       Resister $1/8W$ , $33kΩ$   | R209      | Resister     | 1/8W, 47kΩ  |                   |        |         |
| R212       Resister       1/8W, 68kΩ         R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216,<br>R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ   | R210      | Resister     | 1/8W, 33kΩ  |                   |        |         |
| R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216,       Resister       1/8W, 1.5MΩ         R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  | R211      | Resister     | 1/8W, 200kΩ |                   |        |         |
| R213       Resister       1/8W, 47Ω         R214       Resister       1/8W, 100kΩ         R215,R216,<br>R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  | R212      | Resister     | 1/8W, 68kΩ  |                   |        |         |
| R214       Resister       1/8W, 100kΩ         R215,R216,<br>R217       Resister       1/8W, 1.5MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  | R213      | Resister     |             |                   |        |         |
| R215,R216,       Resister       1/8W, 1.5MΩ         R217       Resister       1/8W, 1MΩ         R218       Resister       1/8W, 1MΩ         R219       Resister       1/8W, 33kΩ  | R214      |              | ·           |                   |        |         |
| R218Resister1/8W, 1MΩR219Resister1/8W, 33kΩ   |           | Resister     | 1/8W, 1.5MΩ |                   |        |         |
| R219 Resister 1/8W, 33kΩ  |           | Resister     | 1/8W. 1MΩ   |                   |        |         |
|   | _         |              |             |                   |        |         |
| R221 Resister 1/δW, 2.2MΩ   | R221      | Resister     | 1/8W, 2.2MΩ |                   |        |         |
| R224 Resister 1/8W, 390kΩ   |           |              | ·           |                   |        |         |
| VR201 Variable Resistor 5kΩ   |           |              | ·           |                   |        |         |
| F101 Fuse AC250V 6.3A   | -         |              | -           |                   |        |         |
| ZT101 Transient/Surge Absorber SVR471D10  | -         |              |             |                   |        |         |
| TH101 Thermistor 3D-22  |           |              |             |                   |        |         |
| J101 Connector B2P3-VH JST  | -         |              | -           |                   | JST    |         |
| J201 Connector B4P-VH JST   |           |              |             |                   |        |         |
| J202 Connector B2B-EH JST   |           |              |             |                   |        |         |



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  - Machine tool Audio Visual equipment Home appliance Personal equipment
  - Industrial robot etc.
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