Power Factor Correction
Boundary Current Mode Method
200 W 400 V
BD7692FJ Reference Board
<High Voltage Safety Precautions>

◇ Read all safety precautions before use

Please note that this document covers only the BD7692FJ evaluation board (BD7692FJ-EVK-001) and its functions. For additional information, please refer to the datasheet.

To ensure safe operation, please carefully read all precautions before handling the evaluation board

Depending on the configuration of the board and voltages used,

**Potentially lethal voltages may be generated.**

Therefore, please make sure to read and observe all safety precautions described in the red box below.

Before Use
[1] Verify that the parts/components are not damaged or missing (i.e. due to the drops).
[2] Check that there are no conductive foreign objects on the board.
[3] Be careful when performing soldering on the module and/or evaluation board to ensure that solder splash does not occur.
[4] Check that there is no condensation or water droplets on the circuit board.

During Use
[5] Be careful to not allow conductive objects to come into contact with the board.
[6] **Brief accidental contact or even bringing your hand close to the board may result in discharge and lead to severe injury or death.** Therefore, DO NOT touch the board with your bare hands or bring them too close to the board.
In addition, as mentioned above please exercise extreme caution when using conductive tools such as tweezers and screwdrivers.
[7] If used under conditions beyond its rated voltage, it may cause defects such as short-circuit or, depending on the circumstances, explosion or other permanent damages.
[8] Be sure to wear insulated gloves when handling is required during operation.

After Use
[9] The ROHM Evaluation Board contains the circuits which store the high voltage. Since it stores the charges even after the connected power circuits are cut, please discharge the electricity after using it, and please deal with it after confirming such electric discharge.
[10] Protect against electric shocks by wearing insulated gloves when handling.

This evaluation board is intended for use only in research and development facilities and should by handled only by qualified personnel familiar with all safety and operating procedures.
We recommend carrying out operation in a safe environment that includes the use of high voltage signage at all entrances, safety interlocks, and protective glasses.
PFC (power Factor Correction) IC

PFC BCM (Boundary Current Mode) Method

Output 200 W 400 V

BD7692FJ Reference Board

BD7692FJ-EVK-001

The BD7692FJ-EVK-001 reference board outputs 400 V voltage from the input of 90 Vac to 264 Vac. The output current supplies up to 0.5 A. The BD7692FJ which is BCM method PFC controller IC is used. The BD7692FJ supplies the system which is suitable for all of products that requires PFC. BCM is used for PFC part, and Zero Current Detection reduces both switching loss and noise. An auxiliary winding wire is not required because of ZCD by a resistor.

Electronics Characteristics

Not guarantee the characteristics, is representative value.

Unless otherwise noted; $V_{IN} = 230$ Vac, $I_{OUT} = 0.5$ A, $T_a = 25$ °C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage Range</td>
<td>$V_{IN}$</td>
<td>90</td>
<td>230</td>
<td>264</td>
<td>Vac</td>
</tr>
<tr>
<td>Input Frequency</td>
<td>$f_{LINE}$</td>
<td>47</td>
<td>50/60</td>
<td>63</td>
<td>Hz</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>$V_{OUT}$</td>
<td>384</td>
<td>400</td>
<td>416</td>
<td>V</td>
</tr>
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<td>Maximam Output Power</td>
<td>$P_{OUT}$</td>
<td>-</td>
<td>-</td>
<td>200</td>
<td>W  $I_{OUT} = 0.5$ A</td>
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<tr>
<td>Output Current Range (Note 1)</td>
<td>$I_{OUT}$</td>
<td>0.0</td>
<td>-</td>
<td>0.5</td>
<td>A</td>
</tr>
<tr>
<td>PF(Power Factor)</td>
<td>$PF$</td>
<td>0.93</td>
<td>0.97</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Efficiency</td>
<td>$\eta$</td>
<td>94</td>
<td>96.</td>
<td>-</td>
<td>%</td>
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<tr>
<td>Output Ripple Voltage (Note 2)</td>
<td>$V_{R}$</td>
<td>-</td>
<td>14</td>
<td>20</td>
<td>Vpp</td>
</tr>
<tr>
<td>Hold Time</td>
<td>$T_{HOLD}$</td>
<td>20</td>
<td></td>
<td></td>
<td>ms  $V_{OUT}$ min 280 V</td>
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<tr>
<td>Operating Temperature Range</td>
<td>$T_{OP}$</td>
<td>-10</td>
<td>+25</td>
<td>+65</td>
<td>°C</td>
</tr>
</tbody>
</table>

(Note 1) Please adjust operating time to keep any parts surface temperature under 105 °C

(Note 2) Not include spike noises
Operation Procedure

1. Operation Equipment
   (1) AC power supply 90 ~ 264 Vac, over 200 W
   (2) Electronic load capacity 0.5 A which supports input voltage 500 V
   (3) Multi meter
   (4) Power meter
   (5) DC power supply +15 V

2. Connect Method
   (1) AC power supply presetting range 90 ~ 264 Vac, Output switch is OFF.
   (2) Electronic load setting under 0.5 A, Load switch is OFF.
   (3) The reference board connects to measuring equipments and power supplies as in Fig. 1.
   (4) AC power supply switch is ON.
   (5) DC power supply (+15 V) switch is ON.
   (6) Check that output voltage is 400 V.
   (7) Electronic load switch is ON.
   (8) Operate with enough caution against electric shock because of non-isolated output voltage 400 V.

Figure 1. Connection Circuit
Derating

Maximum output power $P_o$ of the reference board is 200 W. The derating curve is shown in Fig. 2. If ambient temperature is over 40 °C, please adjust load continuous time to keep any parts surface temperature under 105 °C.

![Derating Curve](image)

Figure 2. Temperature derating curve
Schematics

\[ V_{IN} = 90 \sim 264 \text{ Vac}, \quad V_{OUT} = 400 \text{ V} \]

Figure 3. BD7692FJ-EVK-001 Schematics
## Bill of Materials

**Table 1. BoM of BD7692FJ-EVK-001**

<table>
<thead>
<tr>
<th>Item</th>
<th>Spec</th>
<th>Parts name</th>
<th>Manufacture</th>
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<tbody>
<tr>
<td><strong>Capacitor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1, C2, C3</td>
<td>0.47 μF / 310 V</td>
<td>890 334 025 039 CS</td>
<td>WURTH</td>
</tr>
<tr>
<td>C4</td>
<td>1 μF / 400 Vdc</td>
<td>890 283 326 009 CS</td>
<td>WURTH</td>
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<tr>
<td>C5</td>
<td>150 μF / 450 V</td>
<td>861 021 486 027</td>
<td>WURTH</td>
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<tr>
<td>C6</td>
<td>0.33 μF / 500 V</td>
<td>GRM55DR72H334KW10</td>
<td>MURATA</td>
</tr>
<tr>
<td>C7</td>
<td>0.47 μF / 6.3 V</td>
<td>JMK107B7474KA-T</td>
<td>Taiyo Yuden</td>
</tr>
<tr>
<td>C8</td>
<td>1 μF / 25 V</td>
<td>TMIK107B7105KA-T</td>
<td>Taiyo Yuden</td>
</tr>
<tr>
<td>C9</td>
<td>100 pF / 100 V</td>
<td>HMK107S0101KA-T</td>
<td>Taiyo Yuden</td>
</tr>
<tr>
<td>C10, C20</td>
<td>1000 pF / 100 V</td>
<td>HMK107S0102MA-T</td>
<td>Taiyo Yuden</td>
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<td>C11</td>
<td>220 pF / 2 kV</td>
<td>885342209008</td>
<td>WURTH</td>
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<tr>
<td>C12</td>
<td>-</td>
<td>-</td>
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<td>C13, C14</td>
<td>2200 pF / 250 V</td>
<td>DE1E3RA222M4BQ01F</td>
<td>Murata</td>
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<td>C15, C16, C17</td>
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<td>C19</td>
<td>100 μF / 50 V</td>
<td>860 080 674 009</td>
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<td><strong>Diode</strong></td>
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<td></td>
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<tr>
<td>D1</td>
<td>FRD 600 V / 20 A</td>
<td>RFS20T36S</td>
<td>Rohm</td>
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<tr>
<td>D4</td>
<td>600 V / 2 A</td>
<td>RR2LAM6S</td>
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<td>D3</td>
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<tr>
<td>D6</td>
<td>FRD 200 V / 0.5 A</td>
<td>RF05VAM2STR</td>
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<td><strong>MOSFET</strong></td>
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<tr>
<td>Q1</td>
<td>600 V / 24 A</td>
<td>R6024KNX</td>
<td>Rohm</td>
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<td><strong>Diode-Bridge</strong></td>
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<td>DA1</td>
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<td>GBU15J-U1</td>
<td>Willas Corp</td>
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<td><strong>Resistor</strong></td>
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<td>R1, R2, R5, R6</td>
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<td>Rohm</td>
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<td>R3, R7</td>
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<td>R4</td>
<td>390k</td>
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<td>R8</td>
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<td>R9</td>
<td>120k</td>
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<td>Rohm</td>
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<td>R10</td>
<td>100</td>
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<td>R11</td>
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<td>R12</td>
<td>180</td>
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<td>R13</td>
<td>10k</td>
<td>MCR18PZP2Z103</td>
<td>Rohm</td>
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<tr>
<td>R14, R15, R16</td>
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<td>LTR18PZPFLK200</td>
<td>Rohm</td>
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<td>R17</td>
<td>10 / 2 W</td>
<td>ERG25S3100V</td>
<td>Panasonic</td>
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<td>R18</td>
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<td>-</td>
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</tr>
<tr>
<td>R20, R21, R22</td>
<td>130k</td>
<td>MCR18PZP2Z134</td>
<td>Rohm</td>
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<tr>
<td><strong>Fuse</strong></td>
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<tr>
<td>IC1</td>
<td>PFC</td>
<td>BD7692FJ</td>
<td>Rohm</td>
</tr>
<tr>
<td>FL1</td>
<td>35 mH / 3.5 A</td>
<td>7448040435</td>
<td>WURTH</td>
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<tr>
<td>FL2</td>
<td>15 mH / 6 A</td>
<td>GSTC1810-153N</td>
<td>Gang Song</td>
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<td>TH1</td>
<td>2 Ω / 4 A</td>
<td>2D2-13L3</td>
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<tr>
<td>L1</td>
<td>180 uH / 8.8 A</td>
<td>PFC3819QM-181K09B-50</td>
<td>TDK</td>
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<tr>
<td>L2, L3</td>
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<td>744 701 3</td>
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<td><strong>OTHER</strong></td>
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<tr>
<td>HEAT1, HEAT3</td>
<td>11.5 K/W</td>
<td>30PBE30-30B</td>
<td>Marusan</td>
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<td>HEAT2</td>
<td>22.9 K/W</td>
<td>IC-1625-STL</td>
<td>Sankyo Thremotec</td>
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<td>CN1</td>
<td>3pin</td>
<td>B03P-NV(LF)(SN)</td>
<td>JST</td>
</tr>
<tr>
<td>CN2</td>
<td>3pin</td>
<td>691137910003</td>
<td>WURTH</td>
</tr>
</tbody>
</table>

Materials may be changed without notifying.
PCB

Size:  200 mm x 112 mm

Figure 4. Top Silkscreen (Top view)

Figure 5. Bottom Layout (Top view)
BD7692FJ Overview

Feature

- Boundary Current Mode
- Low Power Consumption
- Under Voltage Lock Out at VCC
- Zero Current Detection by a resistor
- Reduction of both Switching Loss and Noise by ZCD
- Dynamic & Static Over Voltage Protection at VS
- High Precision Over-current Detection (±4%)
- Error Amplifier Input Short Protection
- Stable MOSFET Gate Driving by Built-in Clamper
- Over Voltage Protection
- Soft Start Function
- IS-GND Short Timer Operation

Key Specification

- Operating Power Supply Voltage Range: 10.0 V ~ 26.0 V
- Circuit Current: 470 μA (Typ.)
- Maximum Frequency: 450 kHz (R\text{RT} 120 kΩ)
- Operating Temperature Range: -40 °C ~ +105 °C

Dimension

W(Typ) x D(Typ) x H(Max)

SOP-J8 4.90 mm x 6.00 mm x 1.65 mm
Pitch 1.27 mm

Table 2. BD7692FJ PIN description

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>I/O</th>
<th>Function</th>
<th>ESD Diode</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>VCC</td>
</tr>
<tr>
<td>1</td>
<td>VS</td>
<td>I</td>
<td>Feedback input</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>EO</td>
<td>I/O</td>
<td>Error amp output</td>
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</tr>
<tr>
<td>3</td>
<td>RT</td>
<td>I/O</td>
<td>Maximum frequency setting</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>OVP</td>
<td>I</td>
<td>Over voltage protection</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>IS</td>
<td>I</td>
<td>Zero current and over current detection</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>-</td>
<td>GND</td>
<td>○</td>
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<tr>
<td>7</td>
<td>OUT</td>
<td>O</td>
<td>External MOSFET gate control</td>
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</tr>
<tr>
<td>8</td>
<td>VCC</td>
<td>I</td>
<td>VCC</td>
<td>-</td>
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</tbody>
</table>
Design Overview

1 Key Parameter

- \( V_{\text{IN}} \): Input Voltage Range AC 90 V ~ 264 Vac
- \( V_{\text{OUT}} \): Output Voltage DC 400 V ±16 V
- \( I_{\text{OUT (Max)}} \): Maximum Output Current 0.5 A
- \( F_{\text{SW}} \): Switching Frequency Min 65 kHz:
- Hold time: Hold Time 20 ms, Hold Voltage 280 V

2 Inductor Selection

2.1 Calculating Inductance of L1

The inductance of L1 is calculated from the following equation,

\[
L = \frac{V_{\text{IN MIN}}^2 \times (V_{\text{OUT}} - 1.41 \times V_{\text{IN MIN}}) \times \eta}{(2 \times F_{\text{SW MIN}} \times P_{\text{OUT}} \times V_{\text{OUT}})} = 200 \ \mu\text{H}
\]

where \( V_{\text{IN MIN}} \) (Minimum Input Voltage) = 90 V, \( \eta \) (Efficiency) = 0.94, \( F_{\text{SW MIN}} \) (Minimum Switching Frequency) = 65 kHz,

\( P_{\text{OUT}} \) (Maximum Output Power) = 200 W, \( V_{\text{OUT}} \) (Output Voltage) = 400 V.

Peak current of BCM is twice more than that of input current. Therefore,

\[
I_{\text{LPK}} = \frac{P_{\text{O}}}{V_{\text{IN}}} \times 1.41 \times 2 = 6.67 \ \text{A}
\]

Adopt Generic Inductor for PFC from TDK (180 \( \mu \text{H}, \text{PFC3819QM-181K09B-50})

Calculation of switching frequency

ton and toff is calculated from the following equation,

\[
I_{\text{LPK}} = \frac{V_{\text{IND MIN}}}{L} \times t_{\text{ON}} = \frac{(V_{\text{OUT}} - V_{\text{IND MIN}})}{L} \times t_{\text{OFF}}
\]

Where \( V_{\text{IND MIN}} = 90 \times 1.41 = 127 \ \text{V}, V_{\text{OUT}} = 400 \ \text{V}, L = 180 \ \mu\text{H}, I_{\text{LPK}} = 6.67 \ \text{A}.

Therefore,

\[
ton = I_{\text{LPK}} \times L / V_{\text{IND MIN}} = 6.67 \times 180 \ \mu\text{H} / 127 = 9.45 \ \mu\text{s}
\]

\[
t_{\text{OFF}} = I_{\text{LPK}} \times L / (V_{\text{OUT}} - V_{\text{IND MIN}}) = 6.67 \times 180 \ \mu\text{H} / (400 - 127) = 4.40 \ \mu\text{s}
\]

\[
F_{\text{SW}} = 1 / (ton + toff) = 1 / (9.45 + 4.40) = 72.2 \ \text{kHz}
\]
Design Overview – Continued

3 Selection of Diode

3.1 Flywheel Diode: D1

The fast recovery diode is used as flywheel diode. The reverse voltage applied to the diode is VOUTMAX = 416 V. Consider the derating and select 600 V diode.

The RMS current of the diode is,

\[ ID_{RMS} = 4 × Po / (3 × η × VIN ) × \sqrt{\frac{2 × 1.41 × VIN}{3.14 × VOUT}} = 1.42 \text{ A} \]

where \( Po = 200 \text{ W} \), \( η = 0.94 \), \( VIN = 90 \text{ V} \), \( VOUT = 400 \text{ V} \).

Diode which tolerate large peak forward current should be selected because inrush current at turn-on. Small noisy FRD is recommended.

Considering heat generation of parts, VRFS20TF6S (20 A / 600 V) is used.

4 Selection of MOSFET

4.1 MOSFET: Q1

Select the MOSFET which have small Rds (on) and is fast. Absolute Maximum Ratings is calculated from the following equations.

\[ VDSS > VOUTMAX / 0.8 = 520 \text{ V} \]
\[ ID > 2 × 1.41 × Po / VINMIN / η = 6.67 \text{ A} \]

RMS current flowing the MOSFET is

\[ IQ_{RMS} = 2 × Po / (3 × η × VINMIN) × \sqrt{\frac{3 – 8 × 1.41 × VINMIN}{3.14 × VOUT}} = 2.33 \text{ A} \]

Assuming that loss at RDS (on) is 0.9 W, RDS (on) is determined.

\[ PD = IQ^2 × Rds (on) \]
\[ RDS (on) = Pd / IQ^2 = 0.165 \text{ Ω} \]

Considering the above conditions, R6024KNX (VDS = 600 V, ID = 24 A, RDS (on) = 0.15 Ω) is used.
Design Overview – Continued

5  Selection of Capacitor

5.1  Input Capacitor : C4

The input capacitor is used for noise measures.  
Film capacitor is used.  
Rated voltage is over VINMAX × 1.41 = 373 V.  
Capacitance is 1 µF.

5.2  VCC Capacitor : C19

The VCC capacitor is required for stable operation of the IC.  
Rated voltage over 25 V and capacitance 1.0 µF ~ 100 µF should be used.  
Here, we use the capacitor which has rated voltage 50 V and capacitance 100 µF.

5.3  Output capacitor : C5

For the output capacitor, select output voltage Vo of 450 V or more in consideration of derating.  
Capacitance is determined from both output ripple voltage and hold time.

From output ripple voltage,  
\[ C5 \geq \frac{I_o}{(2 \times 3.14 \times f_{\text{LINE}} \times V_R)} = 80 \, \mu F \]  
where \( I_o = 0.5 \, A \), \( f_{\text{LINE}} = 50 \, Hz \), \( V_R = 20 \, V \).

From hold time,  
\[ C5 \geq 2 \times P_o \times THOLD / (V_o^2 - V_{o\text{MIN}}^2) = 116 \, \mu F \]  
where \( THOLD \) (Hold time) = 20 ms , \( V_o = 384 \, V \), \( V_{o\text{MIN}} = 280 \, V \).

Capacitance should be more than 116 µF, therefore 150 µF is selected.

We add a 0.33 µF / 630 V ceramic capacitor in parallel to reduce output switching noise.

6  Selection of Resistor

6.1  Resistor determining output voltage : R1, R2, R3, R4

VS of BD7692FJ is 2.5 V, and output voltage is determined from the following equation.  
\[ V_{OUT} = VS \times \left( 1 + \frac{R1 + R2}{R3 \parallel R4} \right) \]  
R3 and R4 are selected after R1 and R2 are selected.  
Selecting \( R1 = R2 = 1 \, M\Omega \),  
\[ V_{OUT} / Vs - 1 = (R1 + R2) / (R3 \parallel R4) \]  
R3 // R4 = \( (R1 + R2) / (V_{OUT} / Vs - 1) \)  
Substituting \( V_{OUT} = 400 \, V \), \( Vs = 2.5 \, V \), \( R1 = R2 = 1 \, M\Omega \),  
\begin{align*}  
R3 // R4 & = 12.58 \, k\Omega \\
Selecting R3 & = 13 \, k\Omega , \, R4 \, is \, determined \, to \, be \, 390 \, k\Omega .
\end{align*}
Design Overview – Continued

6.2 OVP resistor : R5, R6, R7
Over voltage protection function operates when OVP terminal voltage exceeds typical OVP voltage by abnormal operation of V5 feedback circuit. Switching operation is stopped 60μs typ after OVP terminal voltage exceeds 2.7 Vtyp. Over voltage protection voltage is $2.7 \times ( \frac{R5 + R6}{R7}$.
Assuming that Over voltage protection voltage = 418 V, $R5 = R6 = 1 \text{ MΩ}$, $R7$ is determined to be 13 kΩ.

6.3 RT terminal : R9 (RIS)
RT terminal determine maximum ON time and maximum frequency.
$$\text{ton}\text{Max} = 2 \times L \times Po / (Vinmin^{2} \times \eta)$$
Assuming that $L = 180 \, \mu\text{H}$, $Po = 200 \, \text{W}$, $VINMIN = 90 \, \text{V}$, $\eta = 0.94$ , $\text{ton\_Max}$ is determined to be 9.5 μs.
Select $R9 = 120 \, \text{kΩ}$.

6.4 Resistor connected to IS terminal : R14, R15, R16
Zero Current Detection and Over Current Detection
Zero Current Detection circuit detects zero crossing of inductor current.
When IS terminal voltage becomes higher than ZCD voltage, OUT terminal voltage becomes high with a delay of ZCD delay time (1.5 μs typ).
Resistance is selected in order that over current detection voltage is - 0.6 V typ or less.

$$\text{RIS} \leq 0.6 / IPK = 0.6 / 6.67 = 0.09 \, \Omega$$
Considering wiring resistance of PCB, R14, R15 and R16 are all 0.2 Ω.
Resistor loss is $I^2 \times R$.
$$2.33^2 \times 0.067 = 0.36 \, \text{W}$$
Considering margin, it is 2 W or more in total.

6.5 Phase Compensation Capacitor of GmAMP : C7,C8,R8
$C7 = 0.47 \, \mu\text{F}$, $C8 = 1 \, \mu\text{F}$, $R6 = 10 \, \text{kΩ}$ are selected.
Performance Data

Constant Load Regulation

Figure 8. Load Regulation ($P_o$ vs $V_{OUT}$)

Figure 9. Line Regulation ($V_{OUT}$ vs $V_{IN}$)

Figure 10. PF (PF vs $P_o$)

Figure 11. PF (PF vs $V_{IN}$)
Performance data – Continued

Efficiency

![Efficiency vs Po](chart1.png)
Figure 12. Efficiency (Efficiency vs $P_o$)

![Efficiency vs Vin](chart2.png)
Figure 13. Efficiency (Efficiency vs $V_{in}$)

Harmonic Current

![Harmonic Current AC100V 200W](chart3.png)
Figure 14. Harmonic Current ($V_{in}$ 100 V$_{ac}$)

![Harmonic Current AC230V 200W](chart4.png)
Figure 15. Harmonic Current ($V_{in}$ 230 V$_{ac}$)
Performance Data – Continued

Input Current

Figure 16. Input Current $V_{IN} = 100\, V_{ac}$, $I_{OUT} = 0.5\, A$

Figure 17. Input Current $V_{IN} = 230\, V_{ac}$, $I_{OUT} = 0.5\, A$

Figure 18. $V_{DS}, I_D$ $V_{IN} = 90\, V_{ac}$, $I_O = 0.5\, A$

Figure 19. $V_{DS}, I_D$ ZOOM
Performance Data – Continued

**Hold time**

![Hold time diagram](image)

*Figure 20. Hold time*

**Start Up** $I_o = 0.5$ A

![Start Up diagram 1](image)

*Figure 21. Start Up $V_{IN} = 90$ V$_{ac}$*

![Start Up diagram 2](image)

*Figure 22. Start Up $V_{IN} = 264$ V$_{ac}$*
Performance Data - Continued

Load Transient  \( I_o = 0.05 \ A \Leftrightarrow 0.5 \ A \)

![Figure 23. Load Transient \( V_{IN} = 90 \ V_{ac} \)](image1)

![Figure 24. Load Transient \( V_{IN} = 264 \ V_{ac} \)](image2)

Output ripple  \( I_o = 0.5 \ A \)

![Figure 25. Output ripple \( V_{IN} = 90 \ V_{ac} \)](image3)

![Figure 26. Output ripple \( V_{IN} = 264 \ V_{ac} \)](image4)
Performance Data - Continued

EMI

- Conducted Emission: CISPR22 Pub 22 Class B

Figure 27. $V_{IN} = 100 \, V_{ac} / 60 \, Hz, \ I_{OUT} = 0.5 \, A$

Figure 28. $V_{IN} = 230 \, V_{ac} / 60 \, Hz, \ I_{OUT} = 0.5 \, A$
Notes

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