AC/DC Converter
Non-Isolation Buck Converter PWM method Output 10W 16.5V

BM2P161W Reference Board
BM2P161W-EVK-001

The BM2P161W-EVK-001 evaluation board outputs 16.5V voltage from the input of 90Vac to 264Vac. The output current supplies up to 0.6A. BM2P161W which is PWM method DC/DC converter IC built-in 650V MOSFET is used. The BM2P0161 contributes to low power consumption by built-in a 650 V starting circuit. Built-in current detection resistor and feed-back circuit realize compact power supply design. Current mode control imposes current limitation on every cycle, providing superior performance in bandwidth and transient response. The switching frequency is 65 kHz in fixed mode. At light load, frequency is reduced and high efficiency is realized. Built-in frequency hopping function contributes to low EMI. Low on-resistance 1.9 Ω 650 V MOSFET built-in contributes to low power consumption and easy design. The flywheel diode is a fast recovery diode of 3A/600 V RFN3BM6S, contributing to low power consumption. The conducted emission test is based on CISPR 22 Class B with best EMI design.

Electronics Characteristics

Not guarantee the characteristics, is representative value.
Unless otherwise noted : $V_{IN} = 230$Vac, $I_{OUT} = 500$mA, $Ta=25$℃

<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>90</td>
<td>230</td>
<td>264</td>
<td>Vac</td>
<td></td>
</tr>
<tr>
<td>Input Frequency</td>
<td>47</td>
<td>50/60</td>
<td>63</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>15.0</td>
<td>16.5</td>
<td>18.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Maximum Output Power</td>
<td>-</td>
<td>8.25</td>
<td>9.90</td>
<td>W</td>
<td>$I_{OUT} = 600$mA</td>
</tr>
<tr>
<td>Output Current Range (NOTE1)</td>
<td>0</td>
<td>500</td>
<td>600</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Stand-by Power</td>
<td>-</td>
<td>45</td>
<td>-</td>
<td>mW</td>
<td>$I_{OUT} = 0$A</td>
</tr>
<tr>
<td>Efficiency</td>
<td>-</td>
<td>84.7</td>
<td>-</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Output Ripple Voltage (NOTE2)</td>
<td>-</td>
<td>69</td>
<td>-</td>
<td>mVpp</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-10</td>
<td>25</td>
<td>65</td>
<td>℃</td>
<td></td>
</tr>
</tbody>
</table>

(NOTE1) Please adjust operating time, within any parts surface temperature under 105℃

(NOTE2) Not include spike noise
Operation Procedure

1. Operation Equipment
   (1) AC Power supply 90Vac~264Vac, over 10W
   (2) Electronic Load capacity 0.6A
   (3) Multi meter

2. Connect method
   (1) AC power supply presetting range 90~264Vac, Output switch is off.
   (2) Load setting under 0.6A. Load switch is off.
   (3) AC power supply N terminal connect to the board AC (N) of CN1, and L terminal connect to AC (L).
   (4) Load + terminal connect to VOUT, GND terminal connect to GND terminal
   (5) AC power meter connect between AC power supply and board.
   (6) Output test equipment connects to output terminal
   (7) AC power supply switch ON.
   (8) Check that output voltage is 16.5V.
   (9) Electronic load switch ON
   (10) Check output voltage drop by load connect wire resistance

   CN1: from the up
   ①:AC (N), ②:AC (L)

![Connection Circuit Diagram](image)

Figure 1. Connection Circuit

Deleting

Maximum Output Power Po of this reference board is 9.9W. The derating curve is shown on the right.
if ambient temperature is over 50℃, please adjust load continuous time by over 105℃ of any parts surface temperature.

![Temperature Deleting Curve](image)

Figure 2. Temperature Deleting curve
Schematics

\[V_{IN} = 90 \sim 264 \text{Vac}, \quad V_{OUT} = 16.5 \text{V}\]

![Figure 3. BM2P161W-EVK-001 Schematics](image)

Bill of Materials

Table 1. BoM of BM2P161W-EVK-001

<table>
<thead>
<tr>
<th>Part Reference</th>
<th>Qty.</th>
<th>Type</th>
<th>Value</th>
<th>Description</th>
<th>Part Number</th>
<th>Manufacture</th>
<th>Configuration mm (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1</td>
<td>Film</td>
<td>0.1(\mu)F</td>
<td>X2</td>
<td>890324023023CS</td>
<td>Wurth</td>
<td>-</td>
</tr>
<tr>
<td>C3</td>
<td>1</td>
<td>Electrolytic</td>
<td>33(\mu)F</td>
<td></td>
<td>450BXW33MEFR12.5X25</td>
<td>Rubycon</td>
<td>-</td>
</tr>
<tr>
<td>C5</td>
<td>1</td>
<td>Ceramic</td>
<td>2.2(\mu)F</td>
<td>35V, X7R, ±10%</td>
<td>UMK316B725KL-T</td>
<td>Taiyo Yuden</td>
<td>3216 (1206)</td>
</tr>
<tr>
<td>C7</td>
<td>1</td>
<td>Ceramic</td>
<td>470(\mu)F</td>
<td>35V, Low-Z</td>
<td>UPW1V471MPD</td>
<td>Nichicon</td>
<td>-</td>
</tr>
<tr>
<td>C8</td>
<td>1</td>
<td>Ceramic</td>
<td>0.1(\mu)F</td>
<td>100V, X7R, ±20%</td>
<td>HMK107B7104MA-T</td>
<td>Taiyo Yuden</td>
<td>1608 (0603)</td>
</tr>
<tr>
<td>CN1</td>
<td>1</td>
<td>Connector</td>
<td>-</td>
<td>2pin</td>
<td>B2P-NV</td>
<td>JST</td>
<td>-</td>
</tr>
<tr>
<td>D1</td>
<td>1</td>
<td>FRD</td>
<td>3A</td>
<td></td>
<td>RPN3BM6S</td>
<td>ROHM</td>
<td>TO-252</td>
</tr>
<tr>
<td>D2</td>
<td>1</td>
<td>Diode</td>
<td>0.2A</td>
<td></td>
<td>RRE02VSM6S</td>
<td>ROHM</td>
<td>TUMD2SM</td>
</tr>
<tr>
<td>DB1</td>
<td>1</td>
<td>Bridge</td>
<td>1A</td>
<td>800V</td>
<td>D1UBA80</td>
<td>Shindengen</td>
<td>SOPA-4</td>
</tr>
<tr>
<td>F1</td>
<td>1</td>
<td>Fuse</td>
<td>1.0A</td>
<td>300Vac</td>
<td>36911000000</td>
<td>LitteleFuse</td>
<td>-</td>
</tr>
<tr>
<td>IC1</td>
<td>1</td>
<td>AC/DC Converter</td>
<td>-</td>
<td></td>
<td>BM2P161W-Z</td>
<td>ROHM</td>
<td>DIP7</td>
</tr>
<tr>
<td>L1</td>
<td>1</td>
<td>Coil</td>
<td>150(\mu)H</td>
<td>2.4A</td>
<td>XF1501Y-151</td>
<td>Alpha Trans</td>
<td>Φ13.5</td>
</tr>
<tr>
<td>LF1</td>
<td>1</td>
<td>Line Filter</td>
<td>13mH</td>
<td>1A</td>
<td>XF1482Y</td>
<td>Alpha Trans</td>
<td>-</td>
</tr>
<tr>
<td>R1</td>
<td>1</td>
<td>Resistor</td>
<td>10kΩ</td>
<td>0.25W, ±5%</td>
<td>MCR18EZP103</td>
<td>ROHM</td>
<td>3216 (1206)</td>
</tr>
<tr>
<td>ZNR1</td>
<td>1</td>
<td>Varistor</td>
<td>-</td>
<td>470V, 400A</td>
<td>V4702A05P</td>
<td>LitteleFuse</td>
<td>-</td>
</tr>
</tbody>
</table>
PCB

Size: 30 mm x 91 mm

Figure 4. Top Silkscreen (Top view)

Figure 5. Bottom Layout (Top view)
Performance Data

![Figure 6. Load Regulation (I_{OUT} vs. V_{OUT})](image)

![Figure 7. LOAD Regulation (I_{OUT} vs. Efficiency)](image)

![Figure 8. Load Regulation (I_{OUT} vs. P_{LOSS})](image)

![Figure 9. LOAD Regulation (I_{OUT} vs. P_{LOSS})](image)

Table 2. Load Regulation (V_{IN}=100Vac)

<table>
<thead>
<tr>
<th>I_{OUT} (mA)</th>
<th>V_{OUT} (V)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 mA</td>
<td>16.725 V</td>
<td>85.05 %</td>
</tr>
<tr>
<td>250 mA</td>
<td>16.690 V</td>
<td>85.71 %</td>
</tr>
<tr>
<td>375 mA</td>
<td>16.670 V</td>
<td>85.99 %</td>
</tr>
<tr>
<td>500 mA</td>
<td>16.640 V</td>
<td>86.02 %</td>
</tr>
</tbody>
</table>

Table 3. Load Regulation (V_{IN}=230Vac)

<table>
<thead>
<tr>
<th>I_{OUT} (mA)</th>
<th>V_{OUT} (V)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 mA</td>
<td>16.703 V</td>
<td>82.66 %</td>
</tr>
<tr>
<td>250 mA</td>
<td>16.653 V</td>
<td>84.06 %</td>
</tr>
<tr>
<td>375 mA</td>
<td>16.637 V</td>
<td>84.45 %</td>
</tr>
<tr>
<td>500 mA</td>
<td>16.617 V</td>
<td>84.73 %</td>
</tr>
</tbody>
</table>
Figure 10. LINE Regulation (\(I_{\text{OUT}}\) vs. \(V_{\text{OUT}}\))

Figure 11. LINE Regulation (\(I_{\text{OUT}}\) vs. Efficiency)

Figure 12. Switching Frequency (\(I_{\text{OUT}}\) vs. \(F_{\text{SW}}\))

Figure 13. Coil Peak Current (\(I_{\text{OUT}}\) vs. \(I_{\text{peak}}\))
Figure 14. VOUT Ripple Voltage ($I_{\text{OUT}}$ vs. $V_{\text{ripple}}$)

- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=10\text{mA}$
- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=100\text{mA}$
- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=600\text{mA}$

Figure 15. VOUT Ripple Voltage.1

- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=10\text{mA}$

Figure 16. VOUT Ripple Voltage.2

- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=100\text{mA}$

Figure 17. VOUT Ripple Voltage.3

- $V_{\text{IN}}=100\text{Vac}$, $I_{\text{OUT}}=600\text{mA}$

Figure 18. VOUT Ripple Voltage.4

- $V_{\text{IN}}=230\text{Vac}$, $I_{\text{OUT}}=10\text{mA}$

Figure 19. VOUT Ripple Voltage.5

- $V_{\text{IN}}=230\text{Vac}$, $I_{\text{OUT}}=100\text{mA}$

Figure 20. VOUT Ripple Voltage.6

- $V_{\text{IN}}=230\text{Vac}$, $I_{\text{OUT}}=600\text{mA}$
Table 4. Parts surface temperature  ※Ta:25℃, measured 30minutes after startup

<table>
<thead>
<tr>
<th>Part</th>
<th>Condition</th>
<th>$V_{IN}=90\text{Vac, } I_{OUT}=0.5\text{A}$</th>
<th>$V_{IN}=90\text{Vac, } I_{OUT}=0.6\text{A}$</th>
<th>$V_{IN}=264\text{Vac, } I_{OUT}=0.5\text{A}$</th>
<th>$V_{IN}=264\text{Vac, } I_{OUT}=0.6\text{A}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>51.6℃</td>
<td>60.7℃</td>
<td>56.2℃</td>
<td>62.5℃</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>55.2℃</td>
<td>65.2℃</td>
<td>61.9℃</td>
<td>67.8℃</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>47.0℃</td>
<td>61.4℃</td>
<td>56.3℃</td>
<td>70.2℃</td>
<td></td>
</tr>
</tbody>
</table>
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<High Voltage Safety Precautions>

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.