DESCRIPTION
The EV5416-R-00B is an evaluation board for MP5416, a complete power management solution which integrates four high efficiency step-down DC/DC converters, five low dropout regulators and flexible logic interface.

COT control DC/DC converter provides fast transient response. 1.5MHz default fixed switching frequency during CCM mode greatly reduces external inductor and capacitor value. Full protection features include UVLO, OCP and thermal shutdown.

Output voltage is adjustable through I2C bus or preset by OTP (One Time Programmable). The power on/off sequence is also programmable by OTP or can be controlled through I2C bus online.

The MP5416 requires a minimal number external components, and is available in space-saving 28-pin QFN28 (4x4mm) package.

FEATURES
- High Efficiency Step-Down Converters
  - Buck1: 4.5A DC/DC Converter
  - Buck2: 2.5A DC/DC Converter
  - Buck3: 4A DC/DC Converter
  - Buck4: 2A DC/DC Converter
  - 2.8V to 5.5V Operating Input Range
  - Adjustable Switching Frequency
  - Programmable Forced PWM/Auto PFM/PWM Mode
  - Hiccup Over Current Protection
- Low Dropout Regulators
  - One RTC Dedicate LDO
  - Four Low Noise LDOs
  - Two Separate Input Power Supplies
  - 100mV Dropout at 300mA Load
- System
  - I2C Bus and OTP
  - Power On/off Button
  - Power On Reset Output
  - Flexible Power On/off Sequence via OTP
  - Flexible DC/DC, LDO On/off via OTP
  - ±4kV HBM and ±2kV CDM ESD Rating for all pins

APPLICATIONS
- Cable Modem, Set-Top-Box
- TV
- MID, Tablet
- POS Machine
- SSD
- IP Camera

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EV5416-R-00B EVALUATION BOARD

(L X W) 9.4CM X 8.6CM

<table>
<thead>
<tr>
<th>Board Number</th>
<th>MPS IC Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV5416-R-00B</td>
<td>MP5416GR-0001</td>
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</tbody>
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### Efficiency vs. Load Current

- **V\text{IN}=5V**, **Auto PFM/PWM Mode**

### OTP-EFUSE SELECTED TABLE BY DEFAULT

<table>
<thead>
<tr>
<th>OTP Items</th>
<th>Buck 1</th>
<th>Buck 2</th>
<th>Buck 3</th>
<th>Buck 4</th>
<th>LDORTC</th>
<th>LDO2</th>
<th>LDO3</th>
<th>LDO4</th>
<th>LDO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage</td>
<td>1.2V</td>
<td>1.5V</td>
<td>1.8V</td>
<td>3.3V</td>
<td>3.2V</td>
<td>3.3V</td>
<td>3.3V</td>
<td>1.1V</td>
<td>1.8V</td>
</tr>
<tr>
<td>Initial On/Off</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Mode</td>
<td>FPWM</td>
<td>PFM</td>
<td>FPWM</td>
<td>FPWM</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power-On Delay/Time Slot #</td>
<td>2ms/1</td>
<td>4ms/2</td>
<td>4ms/2</td>
<td>0ms/0</td>
<td>4ms/2</td>
<td>6ms/3</td>
<td>2ms/1</td>
<td>4ms/2</td>
<td></td>
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<tr>
<td>Automatic Turn-On</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Switching Frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5MHz</td>
<td></td>
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<tr>
<td>Push-Button Timer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 seconds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSTO Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buck 1 Peak Current Limit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.8A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Buck 3 Peak Current Limit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.6A</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(i\text{C Slave Address})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0x69</td>
<td></td>
<td></td>
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<tr>
<td>OTP Version</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0100</td>
<td></td>
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</tbody>
</table>
**EVALUATION BOARD SCHEMATIC**

![EVALUATION BOARD SCHEMATIC](image)

**EV5416-R-00B BILL OF MATERIALS**

<table>
<thead>
<tr>
<th>Qty</th>
<th>RefDes</th>
<th>Value</th>
<th>Description</th>
<th>Package</th>
<th>Manufacturer</th>
<th>Manufacturer P/N</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>C6, C6A, C7, C8, C8A, C9</td>
<td>22μF</td>
<td>Ceramic Cap,6.3V,X5R</td>
<td>0805</td>
<td>muRata</td>
<td>GRM21BR6J226ME39L</td>
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<tr>
<td>4</td>
<td>C1, C2, C3, C4</td>
<td>22μF</td>
<td>Ceramic Cap,10V,X5R</td>
<td>0805</td>
<td>muRata</td>
<td>GRM21BR61A106KE19L</td>
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<tr>
<td>2</td>
<td>C5, C10</td>
<td>1μF</td>
<td>Ceramic Cap,10V,X5R</td>
<td>0603</td>
<td>muRata</td>
<td>GRM188R61A105KA61D</td>
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<tr>
<td>5</td>
<td>C11, C12, C13, C14</td>
<td>2.2μF</td>
<td>Ceramic Cap,10V,X5R</td>
<td>0603</td>
<td>muRata</td>
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<td>1</td>
<td>C15</td>
<td>2.2μF</td>
<td>Ceramic Cap,10V,X7R</td>
<td>0805</td>
<td>muRata</td>
<td>GRM21BR71A225KA01L</td>
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<tr>
<td>1</td>
<td>R1</td>
<td>100k</td>
<td>Film Res,1%</td>
<td>0603</td>
<td>ROYAL</td>
<td>RL0603FR-07100KL</td>
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<tr>
<td>1</td>
<td>R2</td>
<td>49.9k</td>
<td>Film Res,1%</td>
<td>0603</td>
<td>ROYAL</td>
<td>RL0603FR-0749K9L</td>
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<tr>
<td>1</td>
<td>R3</td>
<td>10Ω</td>
<td>Film Res,1%</td>
<td>0603</td>
<td>ROYAL</td>
<td>RL0603FR-0710RL</td>
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<tr>
<td>2</td>
<td>R5</td>
<td>0Ω</td>
<td>Film Res,1%</td>
<td>1206</td>
<td>Yageo</td>
<td>RL1206FR-070RL</td>
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<tr>
<td>2</td>
<td>L1, L3</td>
<td>1μH</td>
<td>Inductor, DCR=4.6mΩ, Is=19A</td>
<td>SMD</td>
<td>Wurth</td>
<td>744311100</td>
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<tr>
<td>2</td>
<td>L2, L4</td>
<td>1.5μH</td>
<td>Inductor, DCR=6.6mΩ, Is=14A</td>
<td>SMD</td>
<td>Wurth</td>
<td>744311150</td>
</tr>
<tr>
<td>2</td>
<td>P1, P2</td>
<td></td>
<td>Tact Switch</td>
<td>SMD</td>
<td>Wurth</td>
<td>430181038816</td>
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<tr>
<td>1</td>
<td>U1</td>
<td></td>
<td>5V Power Management IC</td>
<td>QFN28 (4*4)</td>
<td>MPS</td>
<td>MP5416GR-0001</td>
</tr>
</tbody>
</table>
EVB TEST RESULTS

Performance waveforms are tested on the evaluation board of the Design Example section. $V_{\text{IN}} = 5\,\text{V}, \, T_A = 25^\circ\text{C}$, test using default spec parts, unless otherwise noted.

**Steady State**
Each Channel Buck with Half Load

**Steady State**
Each Channel Buck with Full Load

**nPBIN Power On**
Each Channel Buck without Load

**nPBIN Power off**
Each Channel Buck without Load

**Load Transient Response**
$I_{\text{OUT}}$ Transient from 2A to 4A, Slew Rate=0.8A/$\mu$s.

**Load Transient Response**
$I_{\text{OUT}}$ Transient from 1A to 2A, Slew Rate=0.8A/$\mu$s.

**Load Transient Response**
$I_{\text{OUT}}$ Transient from 2A to 4A, Slew Rate=0.8A/$\mu$s.

**SCP Entry**
Buck-4 Output 3.3V
EVB TEST RESULTS (continued)

Performance waveforms are tested on the evaluation board of the Design Example section. $V_{\text{IN}} = 5\text{V}, T_A = 25\degree\text{C}$, test using default spec parts, unless otherwise noted.
PRINTED CIRCUIT BOARD LAYOUT

Figure 1—Top Silk Layer

Figure 2—Top Layer

Figure 3—Inner Layer 1

Figure 4—Inner Layer 2

Figure 5—Bottom Layer
QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively.

2. Preset the power supply output between 3.5V and 5V, and then turn off the power supply.

3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins, respectively.

4. Turn the power supply on. The PMIC will automatically entry power on sequence.

Notes:
1) VOUT power terminals on EVB are including buck1-4; LDO1 to LDO5.
2) VIN1-4 terminals are short-circuit internally. Connect input DC voltage source to either of them is ok.