DESCRIPTION
The EV6509-F-00A is an evaluation board for the MP6509GF, a bipolar stepper motor driver with dual, built-in full bridges consisting of N-channel power MOSFETs.

The device operates from a 2.7V to 18V supply voltage range, and can deliver output currents up to 1.2A per channel. The safety features include sink and source current limits implemented with external sensors, under-voltage lockout (UVLO), and thermal shutdown. An over-temperature output flag is available to indicate thermal shutdown.

The EV6509-F-00A is a fully assembled and tested PCB. The input control signals for the MP6509 are applied through the connector, or generated on the board. The board can drive a bipolar stepper motor with both full step and half-step mode. It also can drive two independent DC motors.

ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>$V_{IN}$</td>
<td>2.7 to 18</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_{OUT}$</td>
<td>1.2</td>
<td>A</td>
</tr>
</tbody>
</table>

FEATURES
- Wide 2.7V to 18V Input Voltage Range
- Over-Current and Over-Temperature Indication
- Alternative Input Control Signals (External or Generated on Board)
- Four Selectable Current Attenuation Modes

APPLICATIONS
- POS Printers
- Video Security Cameras
- Battery-Powered Devices
- USB-Powered Devices

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QUICK START GUIDE

1. The power and control signals for the MP6509 are applied through connector CN1. Each pin in the
   connector is labeled on the EVB. The control signals for AIN1, AIN2, BIN1, and BIN2 can be
   generated on the board (see step 5 for more detailed information). CN1 also outputs the FAULT
   signal and VDD (5V) from the IC.

2. Preset the power supply (2.7V to 18V) between either the VIN and GND pins on CN1, or the
   external VIN and GND terminals.

3. Connector CN6 should be connected to the motor winding terminals. Each pin in the connector is
   labeled on the EVB as AOUT1, AOUT2, BOUT1, and BOUT2. The polarity of these connections
   affects the direction of the DC motor. For a stepper motor, one winding should be connected to
   AOUT1 and AOUT2, while the other should be connected to BOUT1 and BOUT2.

4. If SW5 is switched to the VIN position (top side), the SLEEP pin is pulled up to VIN by a resistor
divider. This ensures that the part does not enter sleep mode. If sleep mode is controlled externally,
   switch SW5 to the VSLP position (bottom side), and connect the SLEEP control signal from the
   external controller directly to the VSLP terminal.

5. Jumpers (CN2, CN3, CN4, and CN5) are used to select the source of the control signals (AIN1,
   AIN2, BIN2, and BIN1, respectively).

By placing a shunt between positions 1 and 2, the source of the control signals is routed to
connector CN1. This connection allows the user to control these signals through an external
controller.

If the shunt is placed between positions 2 and 3, the source of the control signals are routed to the
switches (SW1, SW2, SW3, SW4, SW6, and SW7). These switches can be used to set the state of
the input control signals. Refer to the MP6509 datasheet for more details on the state of the motor
outputs for various input combinations.

6. Diode LED1 indicates the FAULT pin status. If over-current protection (OCP) or over-temperature
   protection (OTP) occurs, the FAULT pin is pulled low, and the LED lights up.

7. R8, R9, and R10, as well as R11, R12, and R13 are the current-sense resistors connected directly
to SENA and SENB, respectively. The other sides of these resistors are connected to GND. These
resistors control the current through the MP6509, which is set to be 1.2A per channel. To change
the output current, the resistor values must also be changed. The relationship between the output
current limit and R8 through R10, and R11 through R13, can be calculated with Equation (1) and
Equation (2), respectively:

\[
I_{\text{LIM-A}} = \frac{200\text{mV}}{R8//R9//R10} 
\]  

(1)

\[
I_{\text{LIM-B}} = \frac{200\text{mV}}{R11//R12//R13} 
\]  

(2)
Figure 1: Evaluation Board Schematic
<table>
<thead>
<tr>
<th>Qty</th>
<th>Ref</th>
<th>Value</th>
<th>Description</th>
<th>Package</th>
<th>Manufacturer</th>
<th>Manufacturer P/N</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>2.2μF</td>
<td>Ceramic capacitor, 10V, X7R</td>
<td>0603</td>
<td>Murata</td>
<td>GRM188R71A225KE15D</td>
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<tr>
<td>2</td>
<td>C2, C5</td>
<td>0.1μF</td>
<td>Ceramic capacitor, 25V, X7R</td>
<td>0603</td>
<td>Murata</td>
<td>GRM188R71E104KA01D</td>
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<tr>
<td>1</td>
<td>C3</td>
<td>100μF</td>
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<td>DIP</td>
<td>Jianghai</td>
<td>CD287-50V100</td>
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<tr>
<td>1</td>
<td>C4</td>
<td>10μF</td>
<td>Ceramic capacitor, 50V, X7R</td>
<td>1206</td>
<td>Murata</td>
<td>GRM32ER71H106KA12L</td>
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<tr>
<td>6</td>
<td>R1, R2,</td>
<td>0Ω</td>
<td>Film resistor, 5%</td>
<td>0603</td>
<td>Royal Ohm</td>
<td>0603J0000T5E</td>
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<tr>
<td></td>
<td>R3, R4,</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>R14, R15</td>
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<tr>
<td>1</td>
<td>R5</td>
<td>20kΩ</td>
<td>Film resistor, 1%</td>
<td>0603</td>
<td>Yageo</td>
<td>RC0603FR-0720KL</td>
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<tr>
<td>1</td>
<td>R6</td>
<td>80.6kΩ</td>
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<td>0603</td>
<td>Yageo</td>
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<tr>
<td>1</td>
<td>R7</td>
<td>499Ω</td>
<td>Film resistor, 1%</td>
<td>0603</td>
<td>Yageo</td>
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<tr>
<td>6</td>
<td>R8, R9,</td>
<td>500mΩ</td>
<td>Film resistor, 1%</td>
<td>1206</td>
<td>Yageo</td>
<td>RL1206FR-070R5L</td>
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<tr>
<td></td>
<td>R10, R11,</td>
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<tr>
<td></td>
<td>R12, R13</td>
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<tr>
<td>1</td>
<td>ZD1</td>
<td>5.1V, 5mA</td>
<td>Zener diode  SOD-123</td>
<td>Diodes</td>
<td>BZT52C5V1</td>
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<tr>
<td>1</td>
<td>LED1</td>
<td>Red</td>
<td>LED</td>
<td>0805</td>
<td>Bright LED</td>
<td>BL-HUF35A-TRB</td>
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<td>7</td>
<td>SW1, SW2,</td>
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<td>SPDT Button</td>
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<td>SW3, SW4,</td>
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<td></td>
<td>SW5, SW6,</td>
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<td>SW7</td>
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<tr>
<td>1</td>
<td>CN1</td>
<td>10-bits/2.54mm</td>
<td>Connector</td>
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<td>Any</td>
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<tr>
<td>6</td>
<td>CN2, CN3,</td>
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<td>3-bits/2.54mm</td>
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<td>CN6, CN7</td>
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<tr>
<td>6</td>
<td>CN2, CN3,</td>
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<td>2.54mm Short jumper</td>
<td>DIP</td>
<td>Any</td>
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<td></td>
<td>CN4, CN5,</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>CN6, CN7</td>
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<tr>
<td>1</td>
<td>CN8</td>
<td>4-bits/2.54mm</td>
<td>Connector</td>
<td>DIP</td>
<td>Any</td>
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<tr>
<td>4</td>
<td>VIN, VSLP, GND</td>
<td>Φ = 1mm</td>
<td>Connector</td>
<td>DIP</td>
<td>Any</td>
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<tr>
<td>1</td>
<td>U1</td>
<td>18V, 1.2A</td>
<td>Stepper motor driver</td>
<td>TSSOP-20 EP</td>
<td>MPS</td>
<td>MP6509GF</td>
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</tbody>
</table>
EVB TEST RESULTS

Performance waveforms are tested on the evaluation board, $V_{IN} = 12V$, $I_{OUT} = 1.2A$, $ATT1 = ATT2 = L$, $f_{STEP} = 200Hz$, $R + L$ load: $L = 1.5mH$, $R = 3.3\Omega$, $T_A = 25^\circ C$, unless otherwise noted.

Steady State (Full Step)

Steady State (Half-Step)

Power Ramp Up (Full Step)

Power Ramp Up (Half-Step)

Sleep Entry (Full Step)

Sleep Recovery (Full Step)

Sleep Entry (Half-Step)

Sleep Recovery (Half-Step)

80% Current Attenuation (Full Step)

$ATT1 = H, ATT2 = L$
EVB TEST RESULTS (continued)
Performance waveforms are tested on the evaluation board, $V_{IN} = 12V$, $I_{OUT} = 1.2A$, ATT1 = ATT2 = L, $f_{STEP} = 200Hz$, $R + L$ load: $L = 1.5mH$, $R = 3.3\Omega$, $T_A = 25^\circ C$, unless otherwise noted.

- **80% Current Attenuation (Half-Step)**
  - ATT1 = H, ATT2 = L
  - Waveform showing waveforms for AIN1, AOUT1, AOUT2, and IOUTA.
  - 2ms/div.

- **50% Current Attenuation (Full Step)**
  - ATT1 = L, ATT2 = H
  - Waveform showing waveforms for AIN1, AOUT1, AOUT2, and IOUTA.
  - 2ms/div.

- **50% Current Attenuation (Half-Step)**
  - ATT1 = L, ATT2 = H
  - Waveform showing waveforms for AIN1, AOUT1, AOUT2, and IOUTA.
  - 2ms/div.

- **20% Current Attenuation (Full Step)**
  - ATT1 = H, ATT2 = H
  - Waveform showing waveforms for AIN1, AOUT1, AOUT2, and IOUTA.
  - 2ms/div.

- **20% Current Attenuation (Half-Step)**
  - ATT1 = H, ATT2 = H
  - Waveform showing waveforms for AIN1, AOUT1, AOUT2, and IOUTA.
  - 2ms/div.
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