Description

The ISL71001MEVAL1Z evaluation board (shown in Figure 4) features the ISL71001M.

The ISL71001M is a plastic packaged, radiation tolerant, high efficiency, monolithic synchronous buck regulator with integrated MOSFETs. This single-chip power solution operates over an input voltage range of 3V to 5.5V and provides a tightly regulated output voltage that is externally adjustable from 0.8V to ~85% of the input voltage.

Specifications

The ISL71001MEVAL1Z evaluation board is designed for ease of evaluation. The current rating of the ISL71001MEVAL1Z is 6A. The electrical ratings of ISL71001MEVAL1Z are shown in Table 1.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>3V to 5.5V</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>1MHz</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>1.2V</td>
</tr>
<tr>
<td>Output Current</td>
<td>6A rated</td>
</tr>
<tr>
<td>OCP Set Point</td>
<td>Typical 11A at ambient room temperature</td>
</tr>
</tbody>
</table>

Key Features

- Easy to use design
- 95% efficiency for 5V \( V_{IN} \) to 3.3V \( V_{OUT} \)
- Demonstrating lightweight plastic package POL
- External frequency sync input
- PG00D indicator
- OCP, OVP, UVP protection

Related Literature

- For a full list of related documents, visit our website - ISL71001M product page

Ordering Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL71001MEVAL1Z</td>
<td>Radiation tolerant synchronous buck controller evaluation platform</td>
</tr>
</tbody>
</table>
### Recommended Testing Equipment

The following materials are recommended to perform testing:

- 0V to 6V power supply with at least 5A source current capability
- Electronic or resistive load capable of sinking 10A current
- Digital Multimeters (DMMs)
- 100MHz quad-trace oscilloscope

### Quick Test Guide

1. Ensure that the circuit is correctly connected to the supply and electronic loads prior to applying any power. Refer to Figure 3 on page 3 for proper setup.
2. Turn on the power supply.
3. Adjust the input voltage, \( V_{IN} \), within the specified range and observe output voltage. The output voltage variation should be within 1%.
4. Adjust the load current within the specified range and observe output voltage. The output voltage variation should be within 1%.
5. Use an oscilloscope to observe output voltage ripple and phase node ringing. For accurate measurement, refer to Figure 2 for ideal output voltage ripple test setup.

### Functional Description

The ISL71001MEVAL1Z is an easy to use high-efficiency evaluation platform.

As shown in Figure 3 on page 3, 3V to 5.5V \( V_{IN} \) is supplied to J2 (+) and J3 (−). The regulated 1.2V output on J16 (+) and J17 (−) is rated to supply up to 6A to the load.

### Operating Range

The input voltage range is from 3V to 5.5V. The rated output load current is 6A across the entire operational voltage and -55°C to +125°C temperature envelope with the OCP point set a typical of 11A at room temperature ambient conditions.

### Evaluating the Other Output Voltages

The ISL71001MEVAL1Z output is preset to 1.2V, however, the output can be adjusted from 0.8V to ~85% of the input voltage, using the adjustable resistor, \( R_{17} \), and the J13 jumper installed. Remove J12 for adjustment.

If a hardwired output voltage is required, then programming resistor \( R_9 \) will depend on the desired output voltage of the regulator as shown in Equation 1 as the value of the feedback resistor, \( R_{12} \) is set at 1kΩ.

\[
R_9 = R_{12}\left(\frac{0.6}{V_{OUT} - 0.6}\right)
\]  

(EQ. 1)

Table 2 shows the component selection that should be used for the respective \( V_{OUT} \) of 1.8V, 2.5V, and 3.3V.

<table>
<thead>
<tr>
<th>( V_{OUT} ) (V)</th>
<th>( R_9 ) (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>499</td>
</tr>
<tr>
<td>2.5</td>
<td>316</td>
</tr>
<tr>
<td>3.3</td>
<td>221</td>
</tr>
</tbody>
</table>

### PCB Layout Guidelines

PCB design is critical to high-frequency switching regulator performance. Careful attention to layout requirements is necessary for successful implementation of any DC/DC converter. The ISL71001M switches at a high frequency and therefore, the switching times are short. At these switching frequencies, even the shortest trace has significant impedance.

Transition speed of the current from the upper FET devices to the lower FET devices causes voltage spikes across the interconnecting impedances and parasitic circuit elements. These voltage spikes can degrade efficiency, generate EMI, and increase ringing.

Careful component selection and proper PC board layout minimizes the magnitude of these voltage spikes and undesirable voltage drops. A multilayer printed circuit board is recommended.

### PCB Plane Allocation

A minimum of four layers of two ounce copper is recommended. Layers 1 and 4 should be used primarily for input and output power, signals, components, and ground as required. Layers 2 and 3 should be dedicated ground planes with the LX isolation void.

### LX Connection

Use a small island of copper to connect the LXx pins of the IC to the output inductor on layers. Void the copper on Layer 2 adjacent to the island to minimize capacitive coupling to the power and ground planes.

Keep all other signal traces as short as possible.
PCB Component Placement

Components should be placed as close as possible to the IC to minimize stray inductance and resistance. Prioritize the placement of bypass capacitors on the pins of the IC in the order shown: VREF, AVDD, DVDDD, PVINx (high-frequency capacitors), EN, PGOOD, and PVINx (bulk capacitors).

Locate the output feedback voltage resistor divider as close as possible to the FB pin of the IC. The top leg of the divider should connect directly to the inductor output with a Kelvin trace and the bottom leg of the divider should connect directly to AGND. AGND should be connected to the power ground closest to an output capacitor using a Kelvin trace. The midpoint junction of the resistive divider should connect directly to the FB pin.

A small series R-C snubber connected from the LXx pins to the PGNDx pins may be used to damp high-frequency ringing on the LXx pins if desired.

The ISL71001MEVAL1Z, for purposes of characterization and evaluation, has four individual COUT bulk capacitors, three 47µF ceramic, and one 150µF Tantalum. These can be reconfigured by removal or replacement with the evaluators preference.

The ISL71001MEVAL1Z performance illustrated in this document is with all COUT capacitors installed.

The ISL71001MEVAL1Z output inductor provided, L1, is not optimized for any single operating point but is generally adequate for the purposes of the characterization and evaluation. See the ISL71001M datasheet for more details on component selection.
FIGURE 5. ISL71001MEVAL1Z SCHEMATIC
## ISL71001MEVAL1Z Bill of Materials

<table>
<thead>
<tr>
<th>MANUFACTURER PART</th>
<th>QTY</th>
<th>REFERENCE DESIGNATOR</th>
<th>DESCRIPTION</th>
<th>MANUFACTURER</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL71001MNZ</td>
<td>1</td>
<td>U1</td>
<td>6A Radiation Tolerant Sync Buck Regulator</td>
<td>INTERSIL</td>
</tr>
<tr>
<td>T530D157M010ATE006</td>
<td>1</td>
<td>C14</td>
<td>150µF, 6mΩ ESR Conductive Polymer Capacitor</td>
<td>KEMET</td>
</tr>
<tr>
<td>CDRH127/LD-1R0NC</td>
<td>1</td>
<td>L1</td>
<td>1µH Power Inductor</td>
<td>SUMIDA</td>
</tr>
<tr>
<td>GRM188R71A105KA61D</td>
<td>3</td>
<td>C3, C6, C7</td>
<td>1µF Multilayer Cap</td>
<td>MURATA</td>
</tr>
<tr>
<td>GRM32ER71A476KE15L</td>
<td>5</td>
<td>C1, C2, C11-C13</td>
<td>47µF Ceramic Chip Cap</td>
<td>MURATA</td>
</tr>
<tr>
<td>H1045-00102-16V10</td>
<td>1</td>
<td>C10</td>
<td>Multilayer Cap</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H1045-00103-16V10</td>
<td>2</td>
<td>C4, C9</td>
<td>Multilayer Cap</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H1045-00104-16V10</td>
<td>1</td>
<td>C5</td>
<td>Multilayer Cap</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H1045-00224-16V10</td>
<td>1</td>
<td>C8</td>
<td>Multilayer Cap</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H1045-00472-50V10</td>
<td>1</td>
<td>C15</td>
<td>Multilayer Cap</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2511-00010-1/16W1</td>
<td>2</td>
<td>R2, R3</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2511-00R00-1/16W1</td>
<td>1</td>
<td>R13</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2511-01000-1/16W1</td>
<td>1</td>
<td>R14</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2511-01001-1/16W1</td>
<td>5</td>
<td>R1, R6, R9, R10, R12</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2511-01002-1/16W1</td>
<td>2</td>
<td>R5, R7</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>H2513-04990-1/16W1</td>
<td>1</td>
<td>R4</td>
<td>Thick Film Chip Resistor</td>
<td>GENERIC</td>
</tr>
<tr>
<td>131-4353-00</td>
<td>2</td>
<td>J11, J14</td>
<td>Scope Probe Test Point PCB Mount</td>
<td>TEKTRONIX</td>
</tr>
<tr>
<td>3296W-1-502</td>
<td>1</td>
<td>R11</td>
<td>Trimmer Potentiometer</td>
<td>BOURNS</td>
</tr>
<tr>
<td>575-4</td>
<td>4</td>
<td>J2, J3, J16, J17</td>
<td>Solder Mount Banana Plug</td>
<td>KEYSTONE</td>
</tr>
</tbody>
</table>
ISL71001MEVAL1Z PCB Layout

FIGURE 6. SILKSCREEN TOP

FIGURE 7. TOP LAYER

FIGURE 8. SECOND LAYER

FIGURE 9. THIRD LAYER

FIGURE 10. BOTTOM LAYER

FIGURE 11. SILKSCREEN BOTTOM

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Typical Evaluation Board Performance Curves

\( V_{IN} = 5V, V_{OUT} = 1.2V, T_{A} = 25^\circ C, \) unless otherwise noted.

**FIGURE 12.** 5V \( V_{IN} \) EFFICIENCY FOR MULTIPLE \( V_{OUT} \) LEVELS

**FIGURE 13.** 3.3V \( V_{IN} \) EFFICIENCY FOR MULTIPLE \( V_{OUT} \) LEVELS

**FIGURE 14.** 5V \( V_{IN} \) EFFICIENCY, 3.3V \( V_{OUT} \) OVER TEMPERATURE

**FIGURE 15.** 3.3V \( V_{IN} \) EFFICIENCY, 1.2V \( V_{OUT} \) OVER TEMPERATURE

**FIGURE 16.** \( L_X, V_{OUT} \), AND INDUCTOR CURRENT WAVEFORMS, \( I_0 = 0A \)

**FIGURE 17.** \( L_X, V_{OUT} \), AND INDUCTOR CURRENT WAVEFORMS, \( I_0 = 6A \)
Typical Evaluation Board Performance Curves  

$V_{IN} = 5V$, $V_{OUT} = 1.2V$, $T_A = 25^\circ C$, unless otherwise noted. (Continued)

**FIGURE 18. ENABLED START-UP WAVEFORMS**

**FIGURE 19. DISABLED TURN OFF WAVEFORMS**

**FIGURE 20. 0.5V PREBIASED START-UP TO 2.5V $V_{OUT}$ WAVEFORMS**  
$I_O = 0A$

**FIGURE 21. START-UP TO 2.5V $V_{OUT}$ WAVEFORMS $I_O = 0A$**

**FIGURE 22. START-UP TO 2.5V $V_{OUT}$ WAVEFORMS $I_O = 5A$**

**FIGURE 23. $V_{IN}$ LOAD AND D.C. LINE REGULATION 1.2V $V_{OUT}$**
Typical Evaluation Board Performance Curves  

V\text{IN} = 5\text{V}, \ \text{VOUT} = 1.2\text{V}, \ \text{T_A} = 25\degree\text{C}, \text{unless otherwise noted. (Continued)}

**FIGURE 24. INTO OVERCURRENT WAVEFORMS**

**FIGURE 25. OUT OF OVERCURRENT RECOVERY WAVEFORMS**

**FIGURE 26. GAIN PHASE GRAPH**

**FIGURE 27. ISL71001M THERMAL IMAGE WITH 6A LOAD, MAXIMUM TEMPERATURE = +42\degree\text{C}**

**FIGURE 28. LOAD TRANSIENT 0 TO 6A**

**FIGURE 29. LOAD TRANSIENT 3.5A TO 6A**