The ISL70061SEHEV1Z evaluation board (shown in Figure 3 on page 8) features the ISL70061SEH 10A PMOS load switch IC. The IC is a radiation hardened, single channel load switch featuring ultra-low $r_{ON}$ and controlled turn on rise time for use in space power supply switching applications. The ISL70061SEH device uses a PMOS pass device as the main switch that operates across an input voltage range of 3V to 5.5V and can support a maximum of 10A continuous current.

The ISL70061SEHEV1Z evaluation board provides a quick and easy method to evaluate the unique ISL70061SEH PMOS load switch part. To use this evaluation board properly requires a thorough knowledge of the operation of the IC. See the ISL70061SEH datasheet for information about the device operation, function, and performance.

This user manual explains how to configure and use the ISL70061SEHEV1Z board to evaluate the ISL70061SEH PMOS load switch IC.

**Key Features**
- VIN\_SENSE and VOUT\_SENSE turret connectors easily measure the device voltage at the SWI and SWO package pins
- Convenient test points and connections for test equipment
- Banana jacks for power, ground, logic, and load connections

**Specifications**
The evaluation board is configured and optimized for the following conditions:
- $V_{SWI} = 3V$ to 5.5V
- $I_{SWO} \leq 10A$
- Board temperature: +25°C

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISL70061SEHEV1Z</td>
<td>ISL70061SEH evaluation board</td>
</tr>
</tbody>
</table>

**Related Literature**
For a full list of related documents, visit our website:
- ISL70061SEH device page
Figure 1. ISL70061SEH1Z Evaluation Board Block Diagram
1. Functional Description

The ISL70061SEHEV1Z evaluation board contains the ISL70061SEH radiation hardened single channel 10A PMOS load switch IC.

The ISL70061SEH device is a single channel, low voltage, high current, load switch for use in space power-switching applications. The switch is a PMOS pass device with a simple logic input to turn the pass device on or off. The ISL70061SEH offers up to 10A continuous current with a typical $r_{ON}$ of 14mΩ with $V_{SWI} = 5.5V$ and 16mΩ with $V_{SWI} = 3.0V$. The device input voltage ($V_{SWI}$) range is 3V to 5.5V and an internal UVLO keeps the device in an OFF state when the $V_{SWI}$ drops below 2.2V. To reduce voltage drops and minimize inrush current, the device features internal controlled on-time with a typical fixed rise time of 625µs at $V_{SWI} = 5.5V$. The ISL70061SEH incorporates reverse current protection when the output voltage ($V_{SWO}$) increases above the $V_{SWI}$ voltage. Additionally, there is a selectable 122Ω MOSFET between SWO and GND to discharge the output when the main pass device is OFF. When the DON logic input is High, the discharge FET circuitry is enabled.

The ISL70061SEH is designed to operate in the harsh environment of space.

Figure 1 on page 3 shows the ISL70061SEHEV1Z evaluation board block diagram with Figure 3 on page 8 showing the board. The ISL70061SEHF/PROTO 14 Ld CDFP IC is soldered onto the center of the ISL70061SEHEV1Z evaluation board and is designated as U1.

The ISL70061SEHEV1Z evaluation board provides a simple platform to demonstrate the features and evaluate the performance of the ISL70061SEH load switch. The board provides easy access to the ISL70061SEH pins and convenient connectors/test points for test equipment. For more information, see the schematic (Figure 4 on page 9), top layer silkscreen (Figure 5 on page 10), and “Bill of Materials” on page 9. Performance data was taken using the ISL70061SEHEV1Z and basic lab equipment and is shown in Figures 8 through 15 starting on page 11.

1.1 Basic Layout

The following is the basic layout for the ISL70061SEHEV1Z (see Figure 3 on page 8 for the actual board picture).

Located in the center of the board is the ISL70061SEHF/PROTO load switch IC (U1). The evaluation board has a Pin 1 dot showing how the IC should be oriented onto the evaluation board. The ISL70061SEH Pin 1 indicator lead needs to be aligned with the evaluation board Pin 1 dot indicator. The board is provided with the IC soldered onto it.

Access to the load switch SWI input is located at the middle left side of the board through the banana jack labeled VIN. Connect a DC voltage source in the range of 3V to 5.5V from the positive terminal to the VIN banana jack and from the negative terminal to the GNDB banana jack.

Access to the load switch ON logic pin is at the banana jack labeled ON and is located at the lower middle left side of the evaluation board. Apply a digital signal in the range of 0V to VIN at the ON banana jack. The ON logic input controls the state of the PMOS pass device. The ON logic input is active high. When ON = HIGH (Logic 1), the switch is ON and when ON = LOW (Logic 0), the switch is OFF.

Access to the load switch DON logic pin is at the banana jack labeled DON located at the lower middle right side of the evaluation board. The ISL70061SEH device has a selectable discharge MOSFET circuit at the SWO output that is enabled when DON = HIGH (Logic 1). It is disabled when DON = LOW (Logic 0). This circuitry is activated for applications that need to quickly discharge the load switch output when the PMOS pass device is turned off. See the DON Logic Input section in the ISL70061SEH datasheet for a detailed description of the operation and functionality of the discharge MOSFET circuitry.

Access to the load switch SWO output is located at the middle right side of the board using the banana jack labeled VOUT. Connect a load source or resistor that draws no more than 10A of current between the VOUT banana jack and the GNDA banana jack.

The VIN_SENSE silver turret connector located at the lower left side of the board provides a connection point close to the SWI pins of the IC. The VOUT_SENSE silver turret connector located at the lower right side of the board provides a connection point close to the SWO pins of the IC. Connect a voltmeter between the VIN_SENSE and VOUT_SENSE turret connectors for precise calculation of the $r_{ON}$ of the load switch.
1.1.1 SWI Input Voltage (V_{SWI})

The ISL70061SEH load switch requires a DC supply voltage (V_{SWI}) in the range of 3.0V to 5.5V at the SWI input for proper operation. V_{SWI} powers the logic circuitry of the IC and drives the load connected at the SWO output when ON = HIGH (Logic 1).

The V_{SWI} power supply is connected at banana jacks VIN and GNDB. The power supply must be capable of delivering the required current to the load connected at the SWO output of the load switch. The load current should be ≤10A.

1.1.2 Logic Control

The ISL70061SEH has two logic control input pins: ON (pin 7) and DON (pin 9).

The Logic 1 V_{IH} level for the logic pins is from 1.2V to V_{SWI}. The Logic 0 V_{IL} level is from 0.4V to 0V. The V_{SWI} voltage can be 3.0V to 5.5V.

The ON logic input turns the load switch ON and OFF. When ON = LOW (Logic 0) the switch is OFF. When ON = HIGH (Logic 1), the switch is ON.

The DON logic input enables or disables the internal MOSFET output discharge circuitry of the load switch. When DON = LOW (Logic 0), the discharge MOSFET circuitry is deactivated (non-functional). When DON = HIGH (Logic 1), the discharge MOSFET circuitry is activated. During normal operation, when the discharge circuitry is activated, a 122Ω internal resistor gets connected at the SWO side of the switch to ground when the load switch is turned off, ON = LOW (Logic 0). Activate this circuitry for applications that need to quickly discharge the load switch output, when the PMOS pass device is turned off. See the DON Logic Input section in the ISL70061SEH datasheet for a detailed description of the operation and functionality of the discharge MOSFET circuitry.

Note: The DON pin has an internal 2MΩ pull-down resistor to ground and it can be left floating if this discharge function is not to be evaluated.

Connect the logic drivers at the ON and DON banana jacks on the evaluation board; the drivers control the ON and DON logic pins. Test points ON1 and DON1 are available to monitor the voltage levels at the logic pins with a voltmeter or oscilloscope. The ON and DON logic inputs have an internal 2MΩ pull-down resistor to ground and they can be left floating.

1.1.3 Test Points

For ease in connecting probes to make measurements, the board has various test points available (see Table 1).

<table>
<thead>
<tr>
<th>Designator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND1, GND2, GND3</td>
<td>Ground test point</td>
</tr>
<tr>
<td>JVIN</td>
<td>VIN (SWI) test point</td>
</tr>
<tr>
<td>JVOUT</td>
<td>VOUT (SWO) test point</td>
</tr>
<tr>
<td>VIN_SENSE</td>
<td>SWI sense test point (Measurement point close to the IC SWI pins)</td>
</tr>
<tr>
<td>VOUT_SENSE</td>
<td>SWO sense test point (Measurement point close to the IC SWO pins)</td>
</tr>
<tr>
<td>ON1</td>
<td>ON logic input test point</td>
</tr>
<tr>
<td>DON1</td>
<td>DON logic input test point</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Designator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>ISL70061SEH/PROTO 14Ld CDFP IC</td>
</tr>
<tr>
<td>GND, GNDA, GNDB</td>
<td>Ground connection</td>
</tr>
<tr>
<td>VIN</td>
<td>VIN (SWI) power supply connection (3V_{DC} to 5.5V_{DC})</td>
</tr>
<tr>
<td>VOUT</td>
<td>VOUT (SWO) output load connection</td>
</tr>
<tr>
<td>ON</td>
<td>ON logic input</td>
</tr>
</tbody>
</table>
1.2 Quick Start Guide

1.2.1 Required Equipment

The following equipment is needed to configure the board:

- One 5.5V DC power supply capable of delivering 10A
- One 3V DC power supply capable of delivering 100mA
- One voltmeter (Keithley 2000 multimeter or equivalent)
- One ammeter (Keithley 2000 multimeter or equivalent)
- One 5Ω resistor (10W)

1.2.2 Configuring and Using the Board

1. Configure the board as shown in Figure 2 on page 7.
2. Set the 3V DC supply at the ON banana jack to 0V. This will turn the load switch OFF.
3. Set the 5.5V DC supply at the VIN banana jack (SWI input) to 5.0V. Enable the supply.
4. Check that the load switch is in the OFF state and the current through the ammeter is at ≈ 0A.
5. Increase the 3V DC supply at the ON banana jack to 3V. This turns the load switch ON. The ammeter should now read ≈ 1A.
6. Read the VDIFF voltmeter connected between VIN SENSE and VOUT SENSE, which gives the voltage directly across the load switch IC. Calculate the rON of the load switch by dividing the VDIFF voltage by the current through the ammeter. The rON calculated should be approximately 14mΩ.
7. To vary the output load resistance, replace the load resistor with a DC electronic load, such as a Chroma 63102A. By varying the output load resistance to draw current from 0A up to 10A through the load switch, you can measure the rON of the load switch at various load and VIN voltage conditions.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DON</td>
<td>DON logic input</td>
</tr>
<tr>
<td>C1 - C3</td>
<td>SWI Input channel capacitors (C1 and C2 not populated on the evaluation board)</td>
</tr>
<tr>
<td>C4 - C5</td>
<td>SWI Input decoupling capacitors</td>
</tr>
<tr>
<td>C6 - C7</td>
<td>SWO Output decoupling capacitors</td>
</tr>
<tr>
<td>C8 - C10</td>
<td>SWO Output channel capacitors (C9 and C10 not populated on the evaluation board)</td>
</tr>
<tr>
<td>R1</td>
<td>Output load resistor connection to ground (not populated on the evaluation board)</td>
</tr>
</tbody>
</table>
Figure 2. Basic Evaluation Test Setup for Functional Operation Testing
2. PCB Layout Information

This section contains the evaluation board picture, schematic, bill of materials, and board layout.

2.1 ISL70061SEHEV1Z Evaluation Board

![ISL70061SEHEV1Z Evaluation Board (Top View)](image)

*Figure 3. ISL70061SEHEV1Z Evaluation Board (Top View)*
2.2 ISL70061SEH Circuit Schematic

Figure 4. ISL70061SEHEV1Z Rev. A Evaluation Board Schematic

2.3 Bill of Materials

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference Designator</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Manufacturer Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>GND1, GND2, VIN SENSE, VOUT SENSE</td>
<td>Test Point Turret, 0.150 Pad, 0.100 Thole, CONN-TURRET, Terminal Post, TH, ROHS</td>
<td>Keystone</td>
<td>1514-2</td>
</tr>
<tr>
<td>3</td>
<td>ON1, DON1, GND3</td>
<td>Test Point, Miniature, Red, 0.100 Pad, 0.040 Thole</td>
<td>Keystone</td>
<td>5000</td>
</tr>
<tr>
<td>2</td>
<td>JVIN, JVOUT</td>
<td>Test Point, Miniature, Orange, 0.100 Pad, 0.040 Thole</td>
<td>Keystone</td>
<td>5003</td>
</tr>
<tr>
<td>7</td>
<td>ON, DON, GND, VIN, GND, GNDB, VOUT</td>
<td>Banana Plug, Solder Mount, L = 0.218in</td>
<td>Keystone</td>
<td>575-8</td>
</tr>
<tr>
<td>2</td>
<td>C5, C6</td>
<td>Multilayer CAP, 0.1µF</td>
<td>Generic</td>
<td>H1046-00104-50V5</td>
</tr>
<tr>
<td>2</td>
<td>C4, C7</td>
<td>Multilayer CAP, 10µF</td>
<td>Generic</td>
<td>H1065-00106-25V10</td>
</tr>
<tr>
<td>2</td>
<td>C3, C8</td>
<td>CAP, SMD, 330µF, Tantalum, Ultra-Low ESR, High Capacitance</td>
<td>Kemet</td>
<td>T530X337M010ATE005</td>
</tr>
<tr>
<td>1</td>
<td>R1</td>
<td>Resistor, Metal Film Chip, (Not Populate)</td>
<td>Generic</td>
<td>H2506-DNP-DNP-1</td>
</tr>
<tr>
<td>4</td>
<td>C1, C2, C9, C10</td>
<td>CAP, Tantalum, Ultra-Low ESR 30mΩ (Not Populate)</td>
<td>AVX</td>
<td>TPME157K016R0030-DNP</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>Radiation Hardened 10A PMOS Load Switch</td>
<td>Renesas</td>
<td>ISL70061SEHF/PROTO</td>
</tr>
</tbody>
</table>
2.4 Board Layout

Figure 5. Top Layer Silk Screen

Figure 6. Top Layer

Figure 7. Bottom Layer
3. Typical Performance Curves

Unless otherwise noted, $V_{SWI} = 5.5\text{V}$; $I_{SWO} = 1\text{A}$; $C_{SWI} = 10\mu\text{F}$, $C_{L} = 1\mu\text{F}$, $T_{A} = +25\text{°C}$

![Figure 8. $r_{ON}$ vs $V_{SWI}$ vs Temperature](image8)

![Figure 9. $r_{ON}$ vs $I_{SWO}$ vs Temperature](image9)

![Figure 10. $r_{ON}$ vs $I_{SWO}$ vs Temperature](image10)

![Figure 11. $t_{RISE}$ vs Temperature vs $V_{SWI}$](image11)

![Figure 12. Turn-On Waveform](image12)

![Figure 13. Turn-Off Waveform](image13)
Unless otherwise noted, $V_{SWI} = 5.5\,V$; $I_{SWO} = 1\,A$; $C_{SWI} = 10\,\mu F$, $C_L = 1\,\mu F$, $T_A = +25^\circ C$ (Continued)

![Figure 14. Turn-On Waveform](image1)

![Figure 15. Turn-Off Waveform](image2)
### 4. Revision History

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Oct.15.19</td>
<td>Initial release</td>
</tr>
</tbody>
</table>
Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.

2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.

3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.

4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.

5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.

   *Standard*: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   *High Quality*: Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.

6. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.

7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.

8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.

10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.

11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.

12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters
TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information
For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks
Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.