

# ISL73100SEHEV1Z

## User's Manual: Evaluation Board

High Reliability

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## ISL73100SEHEV1Z

### Evaluation Board

The ISL73100SEHEV1Z evaluation board is designed to evaluate the performance of the ISL70100SEH and ISL73100SEH. The ISL70100SEH and ISL73100SEH are radiation hardened 40V current-sense amplifiers built using the Renesas proprietary PR40 SOI process.

### Key Features

- Large current-sense resistor footprint (2512)
- Easy gain configuration using a single resistor
- Kelvin sensing for improved measurement accuracy

### Specifications

- Power supply voltage range: 2.7V to 40V
- Current-sense input common-mode range: -0.3V to 40V (regardless of power supply voltage)
- Board dimension: 4.25cmx5.25cm
- Board layers: Two
- Board revision: A

### Ordering Information

Part Number	Description
ISL73100SEHEV1Z	ISL73100SEHEV1Z evaluation board

### Related Literature

For a full list of related documents, visit our website:

- [ISL73100SEH](#), [ISL70100SEH](#) device pages

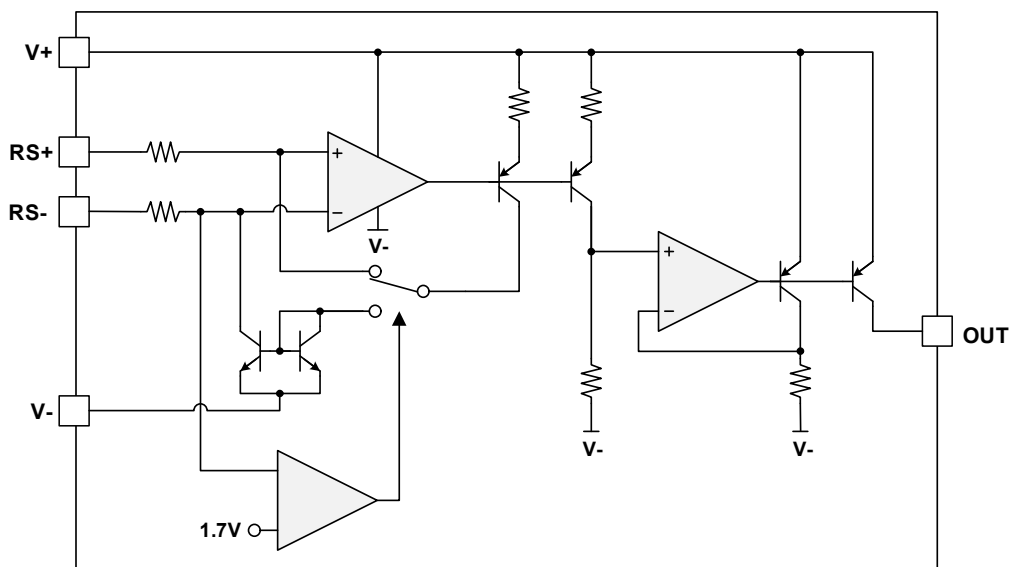


Figure 1. ISL73100SEHEV1Z Block Diagram

## 1. Functional Description

The evaluation board includes a 2512 sized SMD pad for populating a current-sense resistor and an output termination resistor to set the current-sense to output voltage scaling.

### 1.1 Operating Range

The ISL70100SEH and ISL73100SEH have a wide power supply range from 2.7V up to 40V. The input common-mode range extends from -0.3V to 40V, making them ideal to use in both high-side and low-side current-sense applications. The current-sense amplifiers are voltage-to-current converters that monitor current using an external sense resistor and output a scaled current of the sensed input voltage.

### 1.2 Quick Start Guide

1. R2 is a 15mΩ 2512 sized to provide 150mV for 10A. The analog differential input voltage for RS+ to RS- is 0V to 150mV. If R2 needs to be changed, the product of the current-sense resistance and maximum load current must fall within 150mV.
2. With the load unbiased: Connect the current-sense terminals to the circuit load either in a high-side sense (RS+ goes to load positive supply rail, RS- goes to load positive terminal) or low-side sense (RS+ goes to load negative terminal, RS- goes to load negative supply rail) configuration.
3. Provide a power supply voltage to V+ (BA1) and GND (BA2) terminals of the ISL73100SEHEV1Z board. The power supply voltage range is 2.7V to 40V.
4. Power-up load.
5. The voltage on OUT (BNC1) with the 25kΩ output resistor is 50mV for every 1mV input sense voltage. The full-scale 150mV input produces 7.5V output.

**Note:** To use the full-scale output voltage at 150mV full-scale input sense voltage with the 25kΩ output resistor, the minimum supply range must be increased to 9.5V to account for the 2.0V output head-room to the V+ supply voltage.

### 1.3 Current-Sense Resistor

To pick the current-sense resistor value, a decision has to be made between power dissipation and measurement accuracy. As a general rule for all applications, the sense resistor should be as small as possible while still providing adequate input dynamic range across the operating range. The minimum accurately sensed input voltage is primarily limited by the offset voltage of the ISL70100SEH and ISL73100SEH.

The sense resistor value can be calculated when the maximum load current is determined. The maximum recommended sense voltage for the amplifier is 150mV, so dividing that by the maximum load current provides the sense resistor value.

The current-sense error is the amplifier offset voltage divided by the current-sense resistor.

On the ISL73100SEHEV1Z, the current-sense signal is connected to the R2 current-sense resistor in a Kelvin configuration for sense accuracy.

### 1.4 Current-Sense Amplifier Output Voltage (Gain Setting)

The ISL73100SEHEV1Z is populated with a 25kΩ resistor at the current-sense amplifier output to GND (BNC terminal OUT).

The overall gain ( $A_{CSA}$ ) on the ISL70100SEH can be adjusted using a single resistor on the output. The ISL70100SEH outputs 2μA for every 1mV of differential across the inputs. [Equation 1](#) can be used to calculate the output load resistance to get a specific gain:

$$(EQ. 1) \quad R_{OUT} = \frac{A_{CSA}}{gm}$$

For the 25k $\Omega$  resistor, the current-sense amplifier gain ACSA is  $(25\text{mV}/\mu\text{A}) * (2\mu\text{A}/\text{mV}) = 50\text{V}/\text{V}$ . Therefore, at full-scale of the 150mV input, 300 $\mu\text{A}$  output current, the 25k $\Omega$  output resistor produces a full-scale output voltage of 7.5V. Therefore, the output produces 50mV for every 1mV input sense voltage.

### 1.5 Power Supply Bias Range

The ISL73100SEHEV1Z can be biased anywhere from 2.7V to 40V. The current-sense input common-mode voltage range is from -0.3V to 40V, regardless of the V+ to V- power supply bias. The current-sense amplifier output voltage range is V- to 2.0V below V+.

The ISL73100SEHEV1Z is populated with a 25k $\Omega$  output resistor that produces 7.5V output voltage at 150mV full-scale input voltage. To achieve full-scale output voltage, the minimum power supply bias voltage is 9.5V.

If the minimum power supply of 2.7V is used with the 25k $\Omega$  output resistor, the maximum accurately sensed current would be 0.93A.

## 2. Layout Recommendations

To ensure the best accuracy, Renesas recommends connecting the sense inputs to the sense resistor using a Kelvin connection. This 4-terminal approach to measurements helps eliminate the losses due to parasitic resistances in the high current path. To ensure that the bandwidth of the amplifier is not inadvertently compromised, care must be taken to minimize stray capacitance on the output.

### 2.1 ISL73100SEHEV1Z Evaluation Board

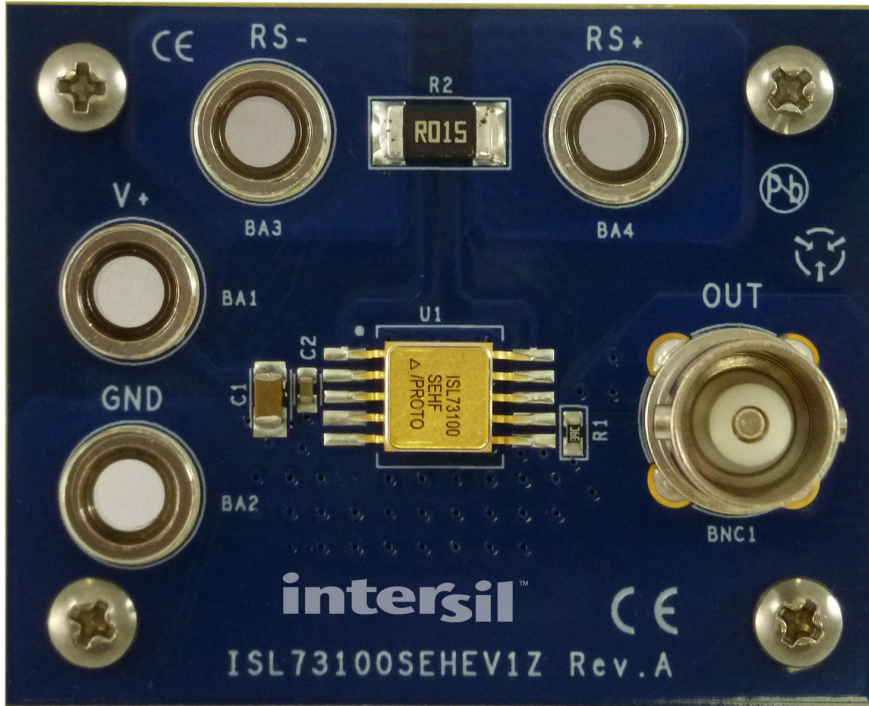


Figure 2. ISL73100SEHEV1Z (Top)

### 2.2 ISL73100SEHEV1Z Circuit Schematic

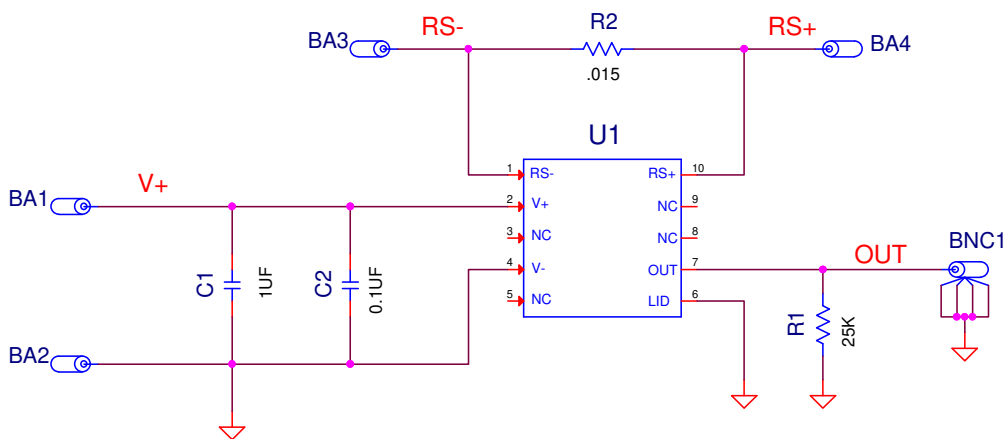


Figure 3. Schematic

### 3. Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
1		PWB-PCB, ISL73100SEHEV1Z, REVA, ROHS	Imagineering Inc	ISL73100SEHEV1ZREVAPCB
1	C2	CAP, SMD, 0603, 0.1 $\mu$ F, 100V, 10%, X7R, ROHS	Murata	GRM188R72A104KA35J
1	C1	CAP, SMD, 1206, 1 $\mu$ F, 100V, 10%, X7R, ROHS	Venkel	C1206X7R101-105KNE
1	BNC1	CONN-BNC, RECEPTACLE, TH, 4 POST, 50 $\Omega$ , SILVERCONTACT, ROHS	Amphenol	31-5329-51RFX
4	BA1-BA4	CONN-JACK, MINI BANANA, 0.175 PLUG, NICKEL/BRASS, ROHS	Keystone	575-4
1	U1	IC-PROTO, RAD HARD, CURRENT SENSE AMP, SMD, 10P, CDFP	Renesas	ISL73100SEHF/PROTO
1	R2	RES-AEC-Q200, SMD, 2512, 0.015 $\Omega$ , 3W, 1%, MF, ROHS	Bourns	CRA2512-FZ-R015ELF
1	R1	RES, SMD, 0603, 24.9k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF2492V
4	Four corners	SCREW, 4-40x1/4in, PHILLIPS, PANHEAD, STAINLESS, ROHS	Building Fasteners	PMSSS 440 0025 PH
4	Four corners	STANDOFF, 4-40x3/4in, F/F, HEX, ALUMINUM, 0.25 OD, ROHS	Keystone	2204

## 4. Board Layout

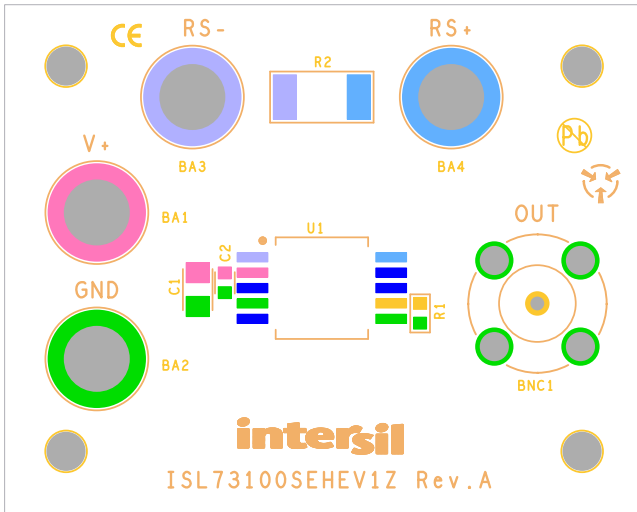


Figure 4. Silk Screen Top

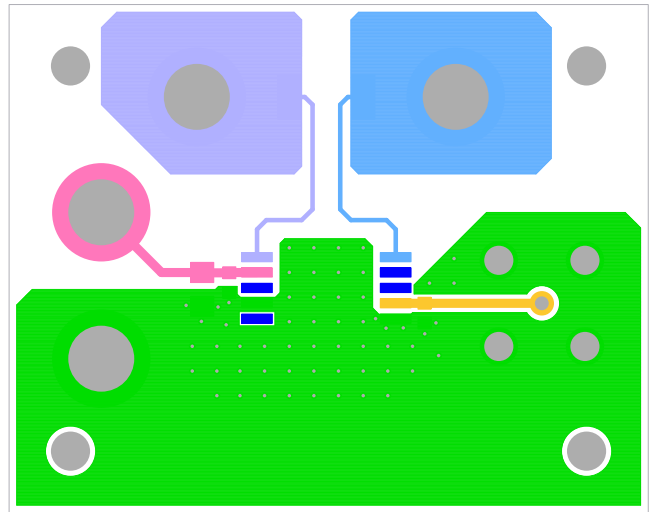


Figure 5. Top Layer Component Side

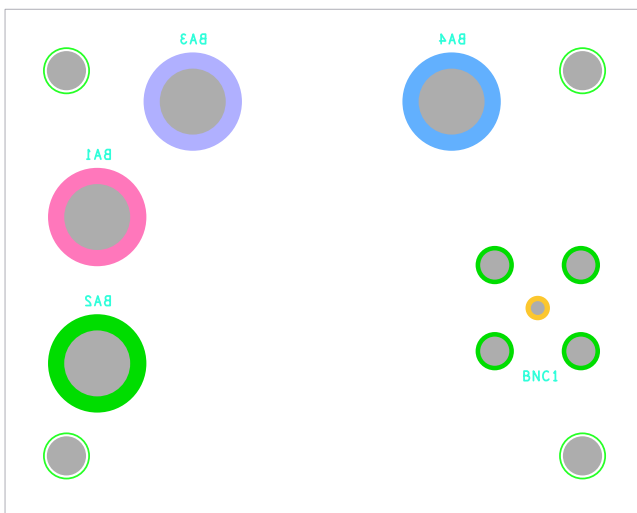


Figure 6. Silk Screen Bottom

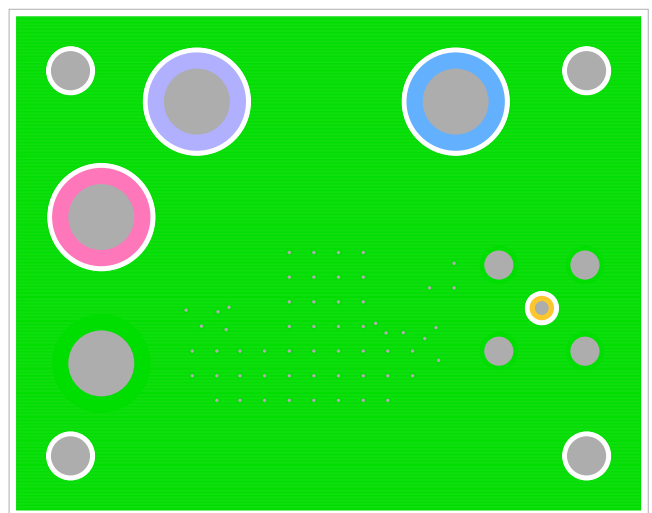


Figure 7. Bottom Layer Solder Side

### 5. Typical Performance Curves

Recommended operating conditions,  $V_+ = V_{RS+} = 12V$ ,  $V_- = 0V$ ,  $V_{SEN} = (V_{RS+} - V_{RS-})$ ,  $R_{OUT} = 5k\Omega$  and  $T_A = +25^\circ C$  unless otherwise specified.

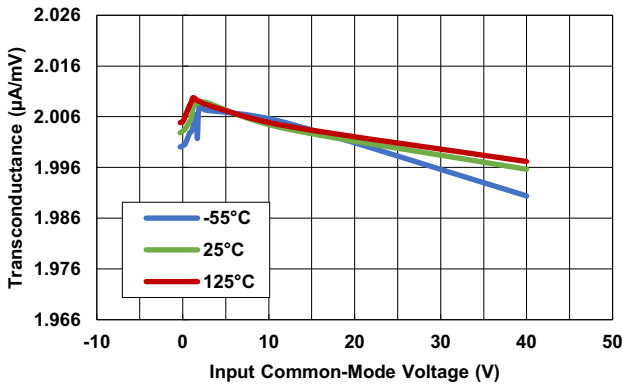


Figure 8. Transconductance,  $V_+ = 12V$

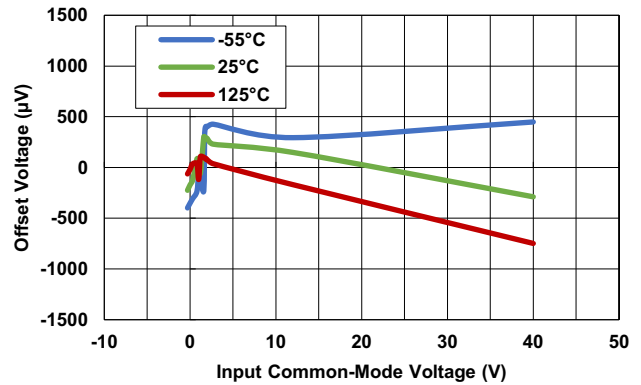


Figure 9. Common-Mode Voltage vs  $V_{OS}$ ,  $V_+ = 12V$

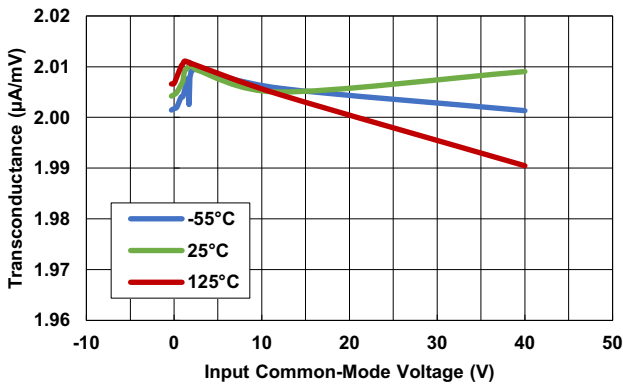


Figure 10. Transconductance,  $V_+ = 40V$

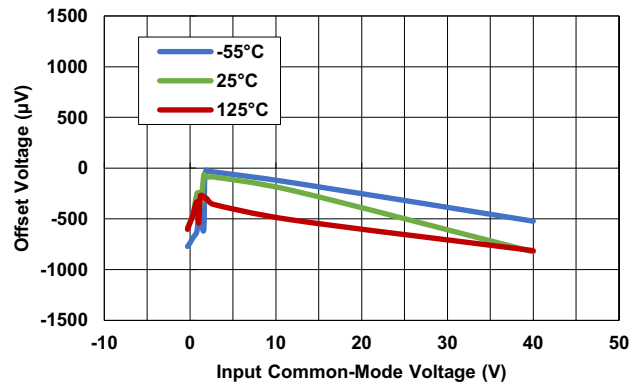


Figure 11. Common-Mode Voltage vs  $V_{OS}$ ,  $V_+ = 40V$

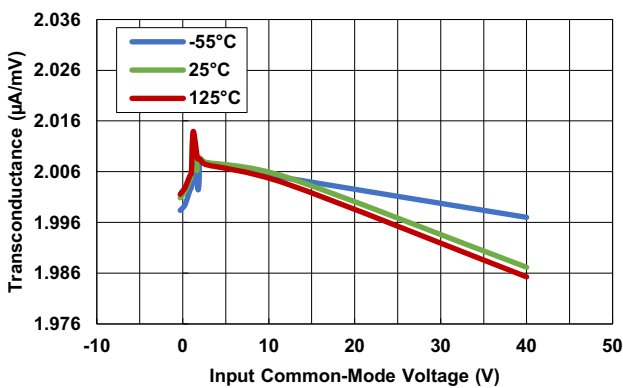


Figure 12. Transconductance,  $V_+ = 2.7V$

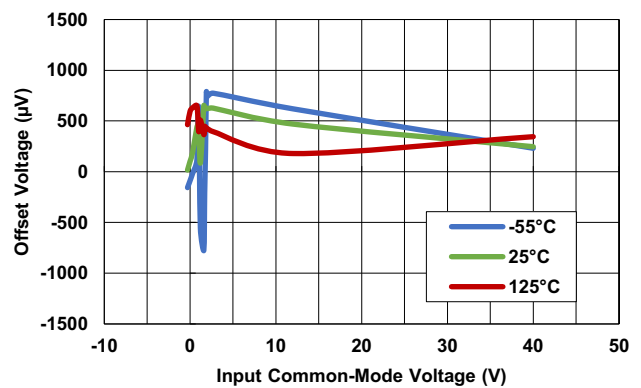


Figure 13. Common-Mode Voltage vs  $V_{OS}$ ,  $V_+ = 2.7V$



Recommended operating conditions,  $V_+ = V_{RS+} = 12V$ ,  $V_- = 0V$ ,  $V_{SEN} = (V_{RS+} - V_{RS-})$ ,  $R_{OUT} = 5k\Omega$  and  $T_A = +25^\circ C$  unless otherwise specified.

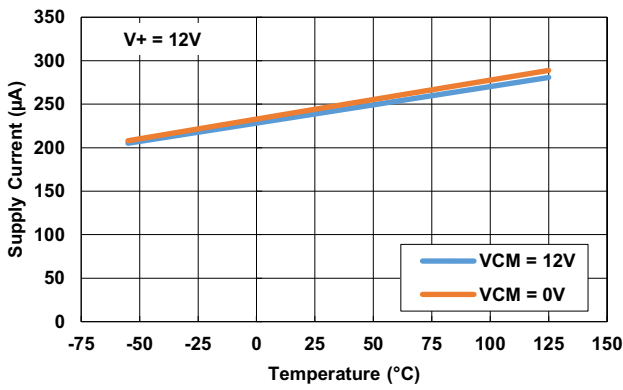


Figure 14. Supply Current,  $V_+ = 12V$

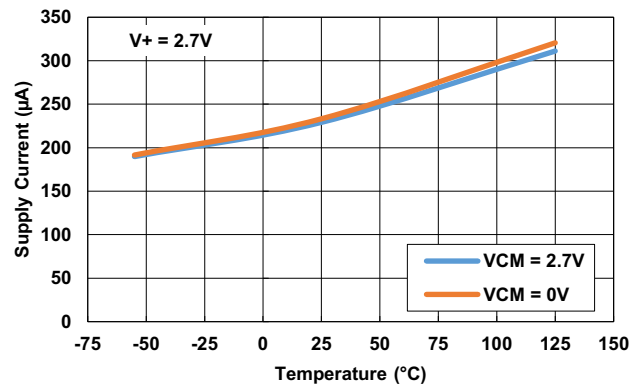


Figure 15. Supply Current,  $V_+ = 2.7V$

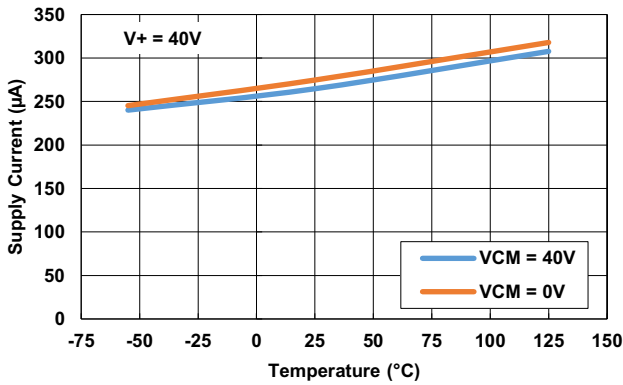


Figure 16. Supply Current,  $V_+ = 40V$

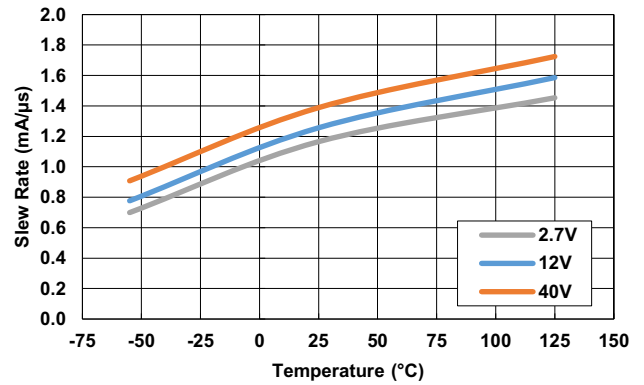


Figure 17. Slew Rate

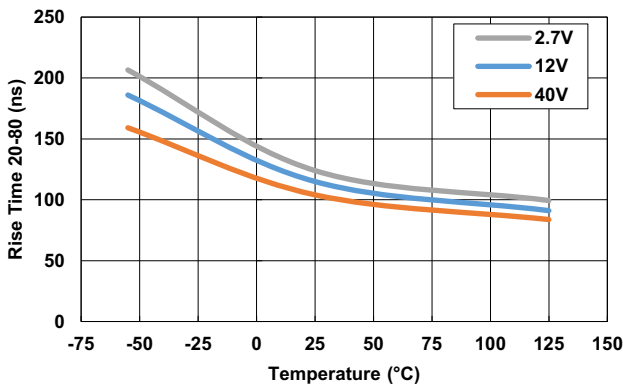


Figure 18. Rise Time

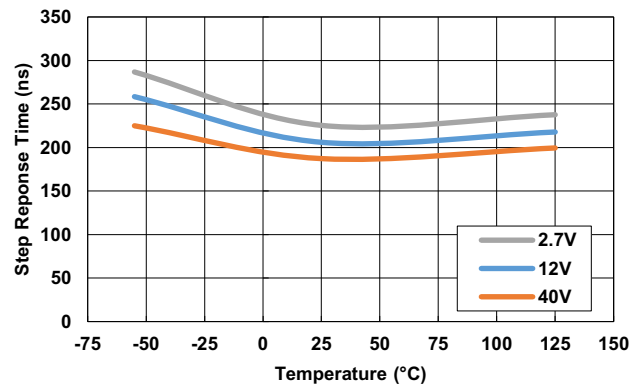


Figure 19. Step Response Time

Recommended operating conditions,  $V_+ = V_{RS+} = 12V$ ,  $V_- = 0V$ ,  $V_{SEN} = (V_{RS+} - V_{RS-})$ ,  $R_{OUT} = 5k\Omega$  and  $T_A = +25^\circ C$  unless otherwise specified.

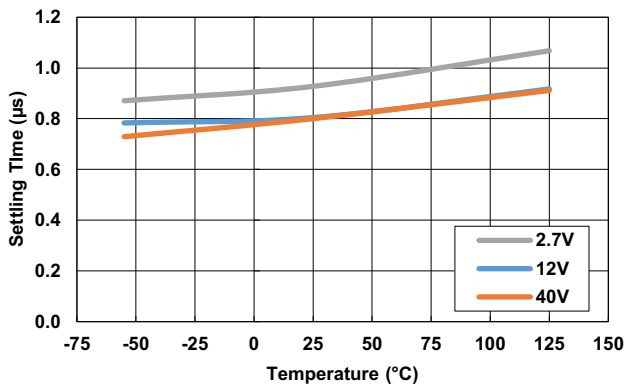


Figure 20. Settling Time

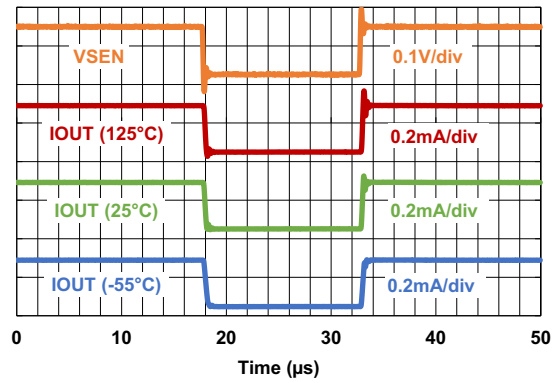


Figure 21. Input Step Response

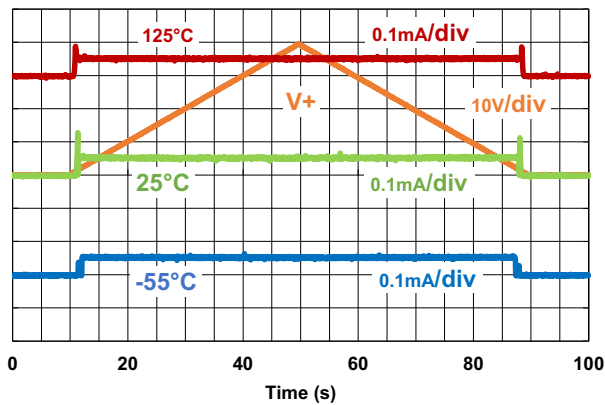


Figure 22. Power Supply Ramp at 1V/s

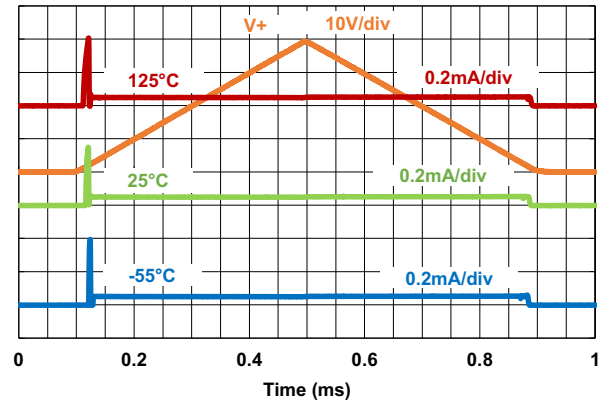


Figure 23. Power Supply Ramp at 1V/10µs

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## 6. Revision History

Rev.	Date	Description
1.00	May.28.20	Initial release

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