

## ISL2800XEVAL1Z

ISL28006 Evaluation Board

AN1532  
Rev 1.00  
April 12, 2010

### Introduction

The ISL28006 evaluation board is a design platform containing all the circuitry needed to characterize critical performance parameters of the ISL28006 in either a high side or low-side current sense application. The ISL28006 is available in fixed 100V/V, 50V/V, 20V/V and adjustable gains.

### Reference Documents

- ISL28006 Data Sheet, [FN6548](#)

### Evaluation Board Schematic

The ISL2800XEVAL1Z evaluation board is configured with either the ISL28006-100, ISL28006-50, ISL28006-20 or the ISL28006-ADJ device (adjustable gain via external resistors  $R_{11}$  and  $R_{14}$ ). Note: When using the adjustable part, V-REF ( $J_1$ ) needs to be grounded.  $J_{13}$  is provided to enable accurate voltage measurements across the sense resistor  $R_3$ .

Figure 1 shows the basic application circuit and optional protection components for the fixed gain parts. Figure 2 shows the basic application circuit and optional protection components for the adjustable gain part. Figure 3 shows the complete schematic for the ISL2800XEVAL1Z evaluation board.

Components shown in red in both Figures 1 and 2 are optional transient protection and not required for clean environments. Note: The evaluation board comes equipped with the transient protection devices.

### Optional Transient Protection

For applications where the load and the power source are permanently connected, transient protection is not required and only an external current sense resistor ( $R_3$ ) is needed.

For applications where fast transients can generate voltage spikes that can overdrive the amplifier input and drive the output of the amplifier into the rails, a long overload recovery time will result. Common mode capacitors  $C_7$ ,  $C_9$  and differential capacitor  $C_8$  are used to filter the common mode and differential voltage spikes.

For switching applications or where fast transients are caused by hot plugging the source or load, external protection components may be needed. The external current limiting resistor ( $R_6$ ) in Figure 1 will limit the peak current through the internal ESD diodes to <20mA. This condition can occur in applications that experience high levels of in-rush current causing high peak voltages that can damage the internal ESD diodes of the ISL28006. If the current limiting resistor is required, it needs to be placed on the RS- input ( $R_6$ ).

Placing it on the RS+ input side ( $R_7$ ) will result in a much larger error voltage due to the ISL28006 taking its supply current from the sense current in high-side applications.

For example:

Current limiting resistor  $R_6$  with a value of 100 $\Omega$  will provide protection for a 2V transient with the maximum of 20mA flowing through the input while adding only an additional 13 $\mu$ V (worst case over-temperature) of  $V_{OS}$  as shown in Equation 1. Note: Worst case over-temperature input bias current on the RS- input is 130nA.

$$R_6 \times I_{RS-} = 100\Omega \times 130nA = 13\mu V \quad (\text{EQ. 1})$$

Current limiting resistor  $R_7$  with value of 100 $\Omega$  will provide the same transient protection, but with an error voltage of 800 $\mu$ V. Note: Worst case over-temperature input bias current on the RS+ input is 8 $\mu$ A as shown in Equation 2.

$$R_7 \times I_{RS+} = 100\Omega \times 8\mu A = 800\mu V \quad (\text{EQ. 2})$$

$R_7$  is a carry-over from our characterization board and was used to measure input bias current. The evaluation board is populated with a zero ohm resistor for  $R_7$ .

### Power Supplies

External power connections are made through the VS+ and Ground connections on the evaluation board. Capacitors  $C_2$  and  $C_4$  perform two duties, de-coupling the supplies and filtering of the power supply noise with  $R_{15}$ . Anti-reverse diodes  $D_1$  and  $D_3$  protect the circuit in the case of accidental polarity reversal of the supply. Resistor  $R_{12}$  is used to connect ground to the fixed gain parts.

### ISL2800XEVAL1Z and BOM

Figure 4 shows the top view of the ISL2800XEVAL1Z evaluation board. The evaluation board Bill of Materials is given in Table 2.

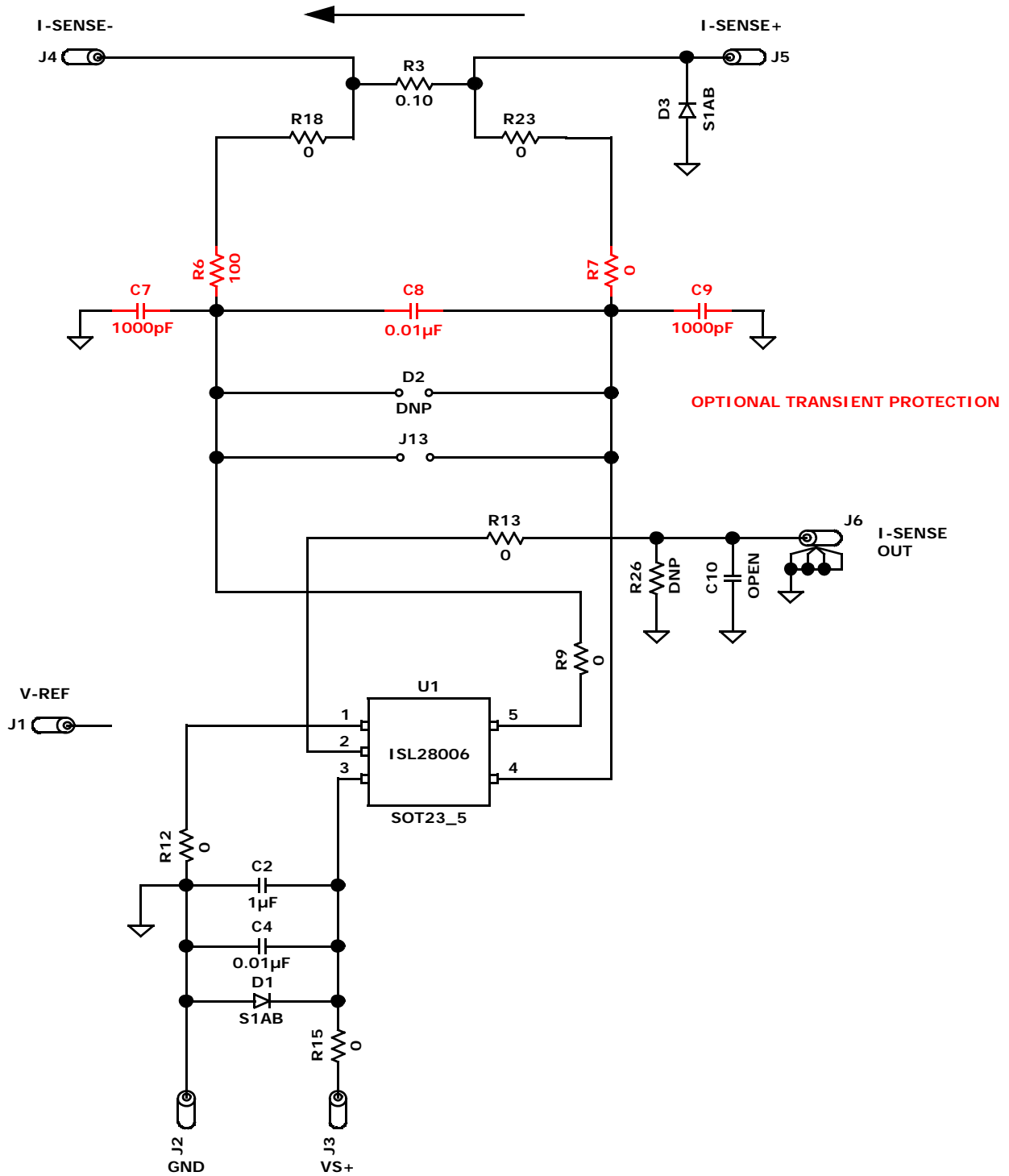


FIGURE 1. SIMPLIFIED ISL2800XEVAL1Z SCHEMATIC DIAGRAM FOR FIXED GAIN PARTS

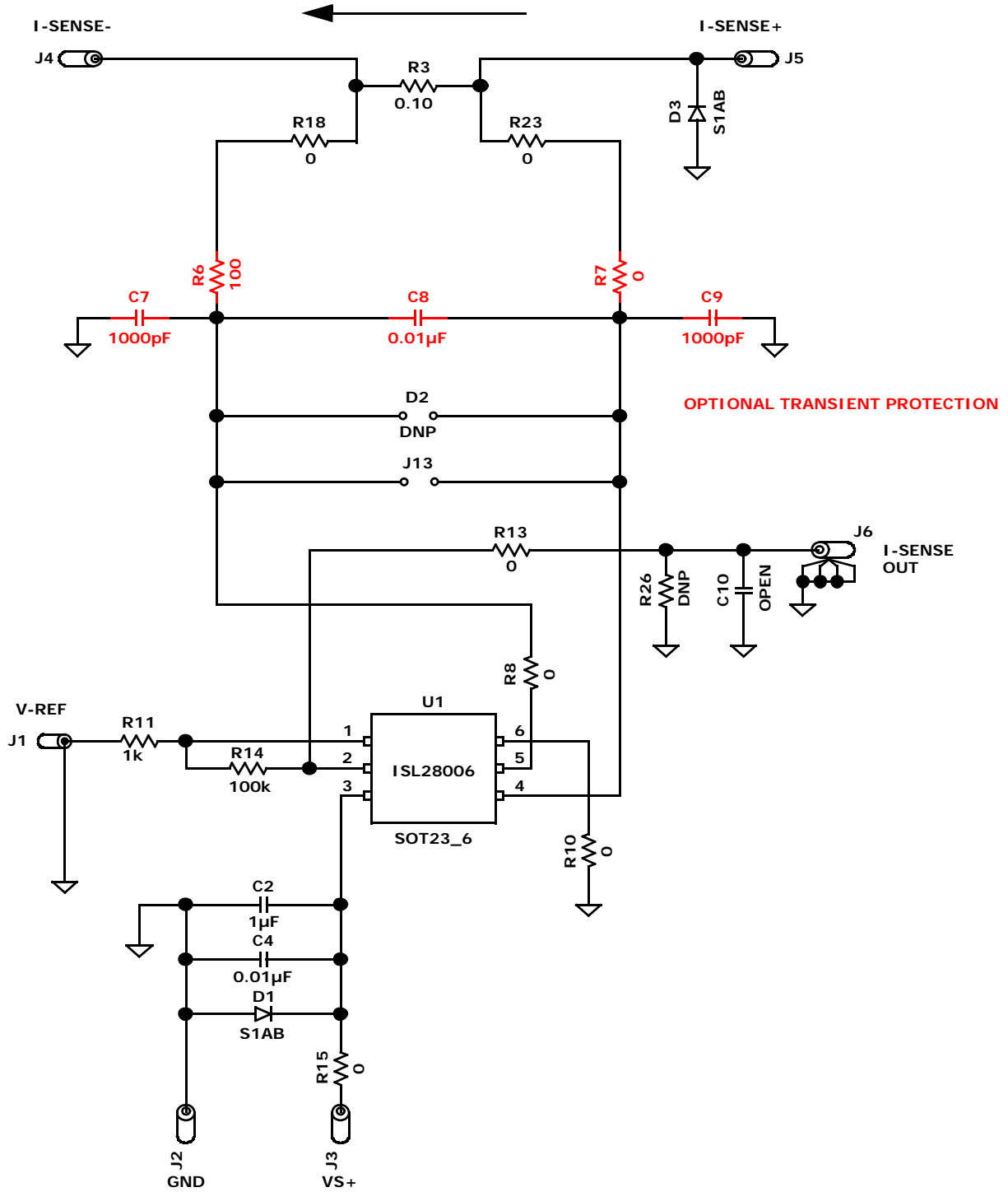


FIGURE 2. SIMPLIFIED ISL2800XEVAL1Z SCHEMATIC DIAGRAM FOR ADJUSTABLE GAIN PARTS

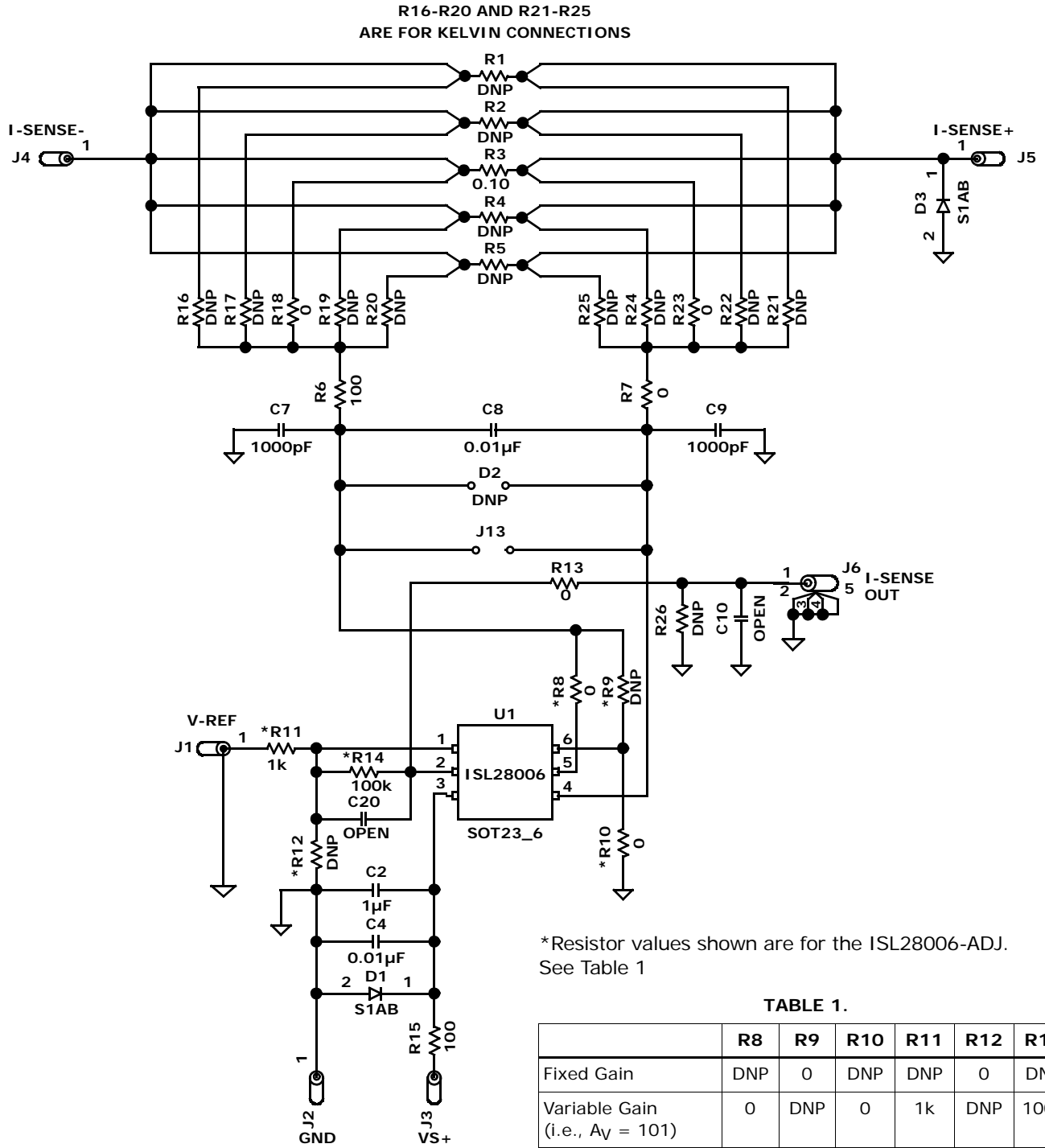


FIGURE 3. ISL2800XEVAL1Z SCHEMATIC DIAGRAM

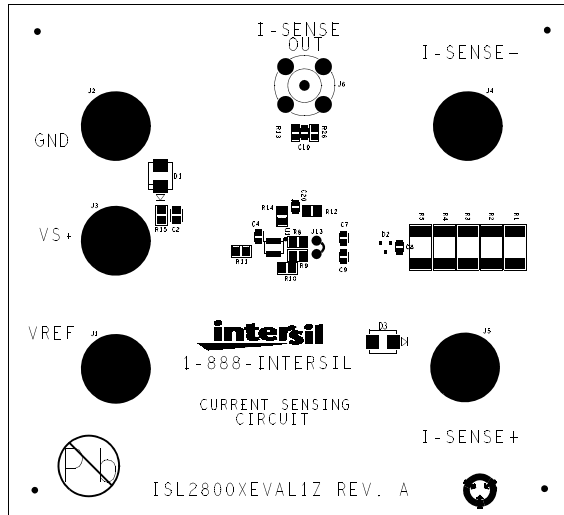


FIGURE 4. ISL2800XEVAL1Z TOP VIEW

TABLE 2. ISL2800XEVAL1Z COMPONENTS PARTS LIST

DEVICE #	DESCRIPTION	COMMENTS
C2	CAP, SMD, 0805, 1 $\mu$ F, 50V, 20%, X7R, ROHS	Power Supply Decoupling and Input Filter
C4, C8	CAP, SMD, 0603, 0.01 $\mu$ F, 50V, 10%, X7R, ROHS	Power Supply Decoupling/Input Filter and Differential Current Sense Filter
C7, C9	CAP, SMD, 0603, 1000pF, 50V, 10%, X7R, ROHS	Common Mode Current Sense Filter
C10, C20	CAP, SMD, 0603, DNP-Place Holder, ROHS	User Selectable Capacitors - Not Populated
D1, D3	Diode-Rectifier, SMD, S1AB, 50V, ROHS	Reverse Power Protection
U1 (ISL28006-100EVAL1Z)	ISL28006FH100Z-T7, SOT-23, ROHS	
U1 (ISL28006-50EVAL1Z)	ISL28006FH50Z-T7, SOT-23, ROHS	
U1 (ISL28006-20EVAL1Z)	ISL28006FH20Z-T7, SOT-23, ROHS	
U1 (ISL28006-ADJEVAL1Z)	ISL28006FHADJZ-T7-T7, SOT-23, ROHS	
R16, R17, R19, R20, R21, R22, R24, R25	Resistor, SMD, 0603, MF, DNP-Place Holder	User Selectable Kelvin Connection - Not Populated
R26	Resistor, SMD, 0603, MF, DNP-Place Holder	User Selectable Output Load Resistor - Not Populated
R3	Resistor, SMD, 2512, 0.1 $\Omega$ , 1W, 1%, TF, ROHS	SENSE resistor
R1, R2, R4, R5	Resistor, SMD, 2512, DNP-Place Holder	User Selectable SENSE Resistors - Not Populated
R6, R7, R13, R18, R23	Resistor, SMD, 0603, 0 $\Omega$ , 1/10W, TF, ROHS	Zero Ohm User Selectable Resistors
R15	Resistor, SMD, 0603, 100 $\Omega$ , 1/10W, TF, ROHS	Current Limiting Resistors
R11	Resistor, SMD, 0603, 1k $\Omega$ , 1/10W, 1%, TF, ROHS (Variable Gain) RES, SMD, 0603, DNP-Place Holder (Fixed Gain)	Gain and Other User Selectable Resistors
R14	Resistor, SMD, 0603, 100k $\Omega$ , 1/10W, 1%, TF, ROHS (Variable Gain) RES, SMD, 0603, DNP-Place Holder (Fixed Gain)	Gain and Other User Selectable Resistors
R8, R10	Resistor, SMD, 0603, 0 $\Omega$ , 1/10W, 1%, TF, ROHS (Variable Gain) Resistor, SMD, 0603, DNP-Place Holder (Fixed Gain)	Gain and Other User Selectable Resistors
R9, R12	Resistor, SMD, 0603, DNP-Place Holder (Variable Gain) Resistor, SMD, 0603, 0 $\Omega$ , 1/10W, 1%, TF, ROHS (Fixed Gain)	Gain and Other User Selectable Resistors

## 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 these 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.  
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.  
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



### SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.  
Tel: +1-408-432-8888, Fax: +1-408-434-5351

**Renesas Electronics Canada Limited**  
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852-2886-9022

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics India Pvt. Ltd.**  
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

**Renesas Electronics Korea Co., Ltd.**  
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Renesas Electronics:](#)

[ISL28006FH-50EVAL1Z](#)