

## Evaluating the **ADG5404F** Fault Protection and Detection, $10\ \Omega$ $R_{ON}$ , 4-Channel Multiplexer

### FEATURES

#### Supply voltages

Dual supply:  $\pm 5\text{ V}$  to  $\pm 22\text{ V}$

Single supply:  $8\text{ V}$  to  $44\text{ V}$

#### Protected against overvoltage on source pins

Signal voltages up to  $-55\text{ V}$  and  $+55\text{ V}$

#### LED for visual overvoltage indication

#### Parallel interface compatible with $3\text{ V}$ logic

#### On-board low dropout (LDO) regulator for digital supply and control if required

### ONLINE RESOURCES

#### Evaluation Kit Contents

[EVAL-ADG5404F](#)

#### Documents Needed

[ADG5404F](#) data sheet

### EQUIPMENT NEEDED

#### DC voltage source

$\pm 22\text{ V}$  for dual supply

$44\text{ V}$  for single supply

#### Optional digital voltage source: $3\text{ V}$ to $5\text{ V}$

#### Analog signal source

#### Method to measure voltage, such as digital multimeter (DMM)

### GENERAL DESCRIPTION

This user guide describes the evaluation board for the [ADG5404F](#), which is a 4-channel multiplexer. The [ADG5404F](#) has overvoltage detection and protection circuitry on the source pins and is protected against signals up to  $-55\text{ V}$  and  $+55\text{ V}$  in both the powered and unpowered state.

Figure 1 shows the [EVAL-ADG5404FEBZ](#) in a typical setup. The [ADG5404F](#) is soldered to the center of the board and wire screw terminals are provided to connect to each of the source and drain pins. Three screw terminals power the device, with a fourth terminal used to provide a user defined digital voltage, if required. Alternatively, an LDO regulator is provided for  $5\text{ V}$  digital voltage control and to supply the LED, which is mounted to provide visual indication of the fault status of the switch.

### TYPICAL SETUP

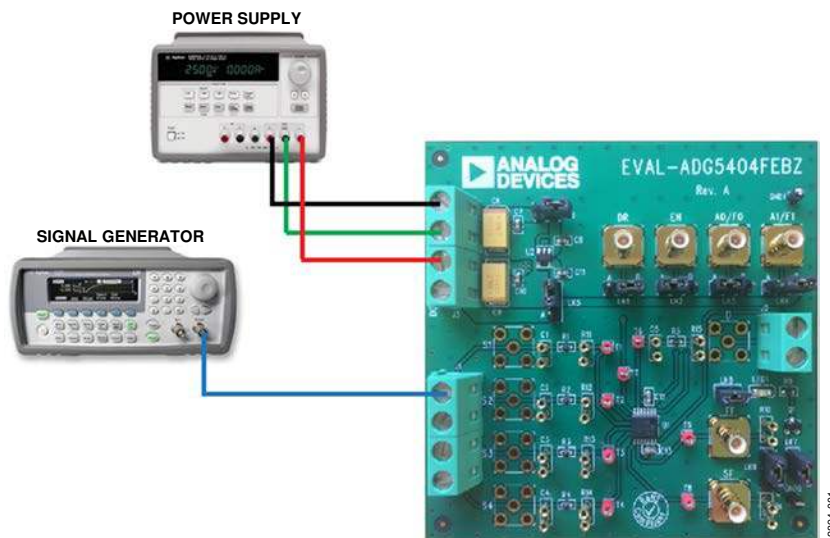


Figure 1. [EVAL-ADG5404FEBZ](#), Power Supply, and Signal Generator

**TABLE OF CONTENTS**

Features .....	1	Input Signals .....	4
Online Resources .....	1	Output Signals.....	4
Equipment Needed.....	1	Jumper Settings .....	5
General Description .....	1	Link Headers .....	5
Typical Setup .....	1	SMB Connectors.....	5
Revision History .....	2	Evaluation Board Schematics and Artwork .....	6
Getting Started .....	3	Ordering Information .....	10
Evaluation Board Setup Procedure .....	3	Bill of Materials .....	10
Evaluation Board Hardware .....	4		
Power Supplies .....	4		

**REVISION HISTORY**

**9/15—Rev. 0 to Rev. A**

Changes to the Title.....	1
Changes to Evaluation Board Setup Procedure Section.....	3
Added Evaluation Board Schematics and Artwork Section, Figure 3, and Figure 4; Renumbered Sequentially .....	6
Added Figure 5 and Figure 6.....	7
Added Figure 7 and Figure 8.....	8
Added Figure 9.....	9
Added Ordering Information Section, Bill of Materials, and Table 3 .....	10

**2/15—Revision 0: Initial Version**

# GETTING STARTED

## EVALUATION BOARD SETUP PROCEDURE

The EVAL-ADG5404FEBZ board operates independently and does not require any additional evaluation boards or software. An on-board LDO regulator provides digital control and the supply voltage.

Supply the evaluation board with a dual power source of up to ±22 V or a single supply of up to 44 V. For single-supply operation, connect VSS to GND using J3.

Set up a functionality test as follows:

- Connect a power supply to J3. For single-supply operation, connect VSS to GND using J3.
- Insert a header at LK6 to use the on-board LDO regulator, and set the header at LK5 to Position B.
- LK2 through LK4 control the digital signals for each switch on the ADG5404F.
  - When these three links are in Position A, the switches are open (off).
  - When these three links are in Position B, the S4 switch is closed (on), and it has a resistance of approximately 10 Ω.
- When LK9 is in Position A, LED1 lights up to indicate that no faults were detected at any of the source pins.

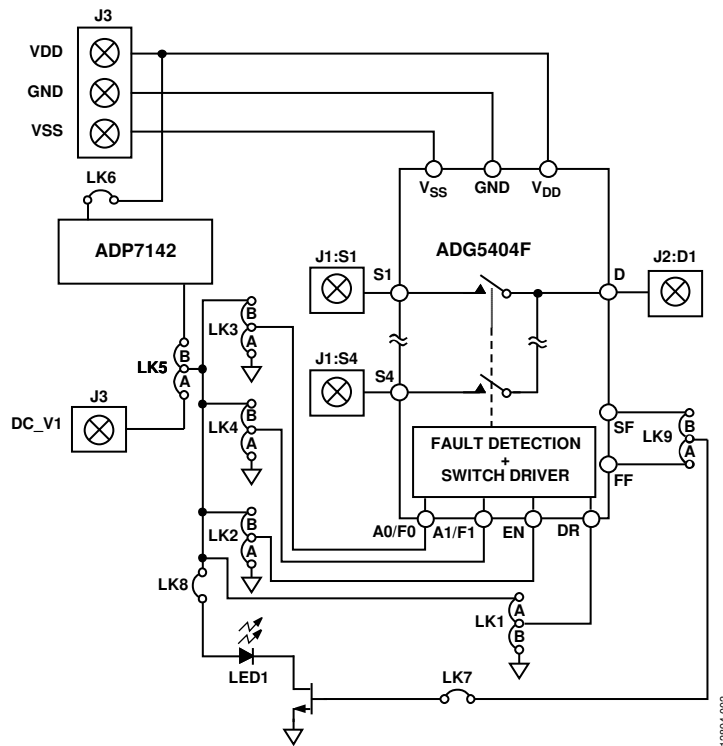


Figure 2. EVAL-ADG5404FEBZ Block Diagram

## EVALUATION BOARD HARDWARE

Use the [EVAL-ADG5404FEBZ](#) to evaluate the [ADG5404F](#). Figure 1 shows a typical setup where only a power supply and signal generator are required. Figure 2 shows a block diagram of the main components of the evaluation board.

The connectors on the board pass signals through the [ADG5404F](#) switch. The source pins have fault detection circuitry that reacts to an overvoltage. During an overvoltage event, the switch turns off and the FF pin pulls low. The SF pin pulls low when the source where the overvoltage occurs is the one selected by the A0/F0 and A1/F1 pins. See the [ADG5404F](#) data sheet for further details.

### POWER SUPPLIES

Connector J3 provides access to the supply pins of the [ADG5404F](#). VDD, GND, and VSS link to the appropriate pins on the [ADG5404F](#). For dual-supply voltages, power the evaluation board from  $\pm 5$  V to  $\pm 22$  V. For single-supply voltages, connect the GND and V<sub>SS</sub> terminals and power the evaluation board with 8 V to 44 V. Additionally, an on-board LDO regulator provides for digital control voltage. If necessary, connect a secondary voltage source to DC\_V1 and use it as the digital control voltage. To use DC\_V1, set the header at LK5 to Position A.

### INPUT SIGNALS

Two screw connectors connect the source and drain pins of the [ADG5404F](#). If extra connections are required, additional Subminiature Version B (SMB) connector pads are laid out.

The [ADG5404F](#) is overvoltage protected on the source side, and the maximum voltage that can be applied to S1 through S4 is  $-55$  V or  $+55$  V. See the [ADG5404F](#) data sheet for more details.

Each trace on the source and drain side includes two sets of gold pin connectors for placing a load on the signal path to ground. Place a  $0 \Omega$  resistor in the signal path, or it can be replaced with a user defined value. Use the resistor combined

with the gold pin connectors to create a simple resistor/capacitor (RC) filter.

Use parallel interface channels (A0/F0 and A1/F1) to control the operation of the [ADG5404F](#) switches. Use the headers on LK2 through LK4 to manually control the operation of the switches, or connect an external controller directly to the control pins by using the SMB connectors (A0/F0, A1/F1, and EN) and by removing the link headers on LK2 through LK4.

### OUTPUT SIGNALS

The [ADG5404F](#) has two outputs. The FF pin indicates when the device operates normally or whether there is an overvoltage fault on one of the source pins. The SF pin also indicates when an overvoltage occurs on one of the source pins and transitions low only when an overvoltage occurs on the channel selected by the A0/F0 and A1/F1 inputs. For visual indication, an LED is mounted on the evaluation board. Use LK8 to connect the LED circuit. When the device operates normally, the FF pin remains high, and the LED turns on. If an overvoltage occurs at any of the source pins, the FF pin pulls low, and the LED turns off.

The LK9 selector allows the user to choose which output controls the LED. Setting the header to Position A allows the FF pin to control the LED. Setting the header to Position B, the SF pin controls the LED.

SMB connectors can interface the evaluation board with external controllers, and two gold pin connectors can connect a pull-up resistor between the FF and SF signals and the digital supply.

The DR pin allows the user to choose the state of the drain pin when the device deactivates during an overvoltage. The LK1 selector allows the user to choose between open circuit and pulling to the rails.

## JUMPER SETTINGS

### LINK HEADERS

Use the link headers to control the [ADG5404F](#) manually, to configure the digital control voltage, and to isolate the LED from the system. Table 2 lists the link header descriptions, and how the links can be used on the evaluation board.

Use LK3 and LK4 to control the switches of the [ADG5404F](#). Use LK2 to enable or disable the device.

Position A ties to GND and sets the logic low, whereas Position B ties to DC\_V1 and sets the logic high.

**Table 1. ADG5404F Truth Table**

LK2 (EN)	LK3 (A0)	LK4 (A1)	Connected Sx
A	X <sup>1</sup>	X <sup>1</sup>	All switches off
B	A	A	S1
B	B	A	S2
B	A	B	S3
B	B	B	S4

<sup>1</sup>X = don't care.

LK1 allows the user to configure the drain state during an overvoltage condition.

LK6 connects the on-board LDO regulator to the V<sub>DD</sub> supply. Remove the header to protect the LDO regulator from voltages higher than 28 V or to use an alternative digital control voltage. Change the header on LK5 to Position B to connect to DC\_V1.

LK8 connects the LED to the digital power supply, and LK7 connects the FF pin or the SF pin of the [ADG5404F](#) to the LED.

### SMB CONNECTORS

Control the parallel interface of the [ADG5404F](#) manually by using the link headers of LK2 through LK4, or access the interface by using the SMB connectors (A0/F0, A1/F1, and EN). To use the SMB connectors, remove the link headers of LK2 through LK4. Use the FF/SF SMB connectors to access the FF/SF digital outputs from the [ADG5404F](#).

**Table 2. Link Header Descriptions**

Link Header	Position	Description
LK1	A	VDD or VSS during an overvoltage
	B	Open circuit during an overvoltage
LK2	A	All switches off (disabled)
	B	Device enabled (EN pin), switch function set by A0/F0 and A1/F1 pins
LK3	A	Logic 0 on A0/F0 pin
	B	Logic 1 on A0/F0 pin
LK4	A	Logic 0 on A1/F1 pin
	B	Logic 1 on A1/F1 pin
LK5	A	DC_V1 digital voltage
	B	On-board LDO regulator digital voltage
LK6	Inserted	LDO regulator powered up
	Removed	LDO regulator unpowered
LK7	Inserted	FF/SF pins connected to LED
	Removed	FF/SF pins disconnected from LED
LK8	Inserted	LED powered up
	Removed	LED unpowered
LK9	A	FF pin controls the LED
	B	SF pin controls the LED

EVALUATION BOARD SCHEMATICS AND ARTWORK

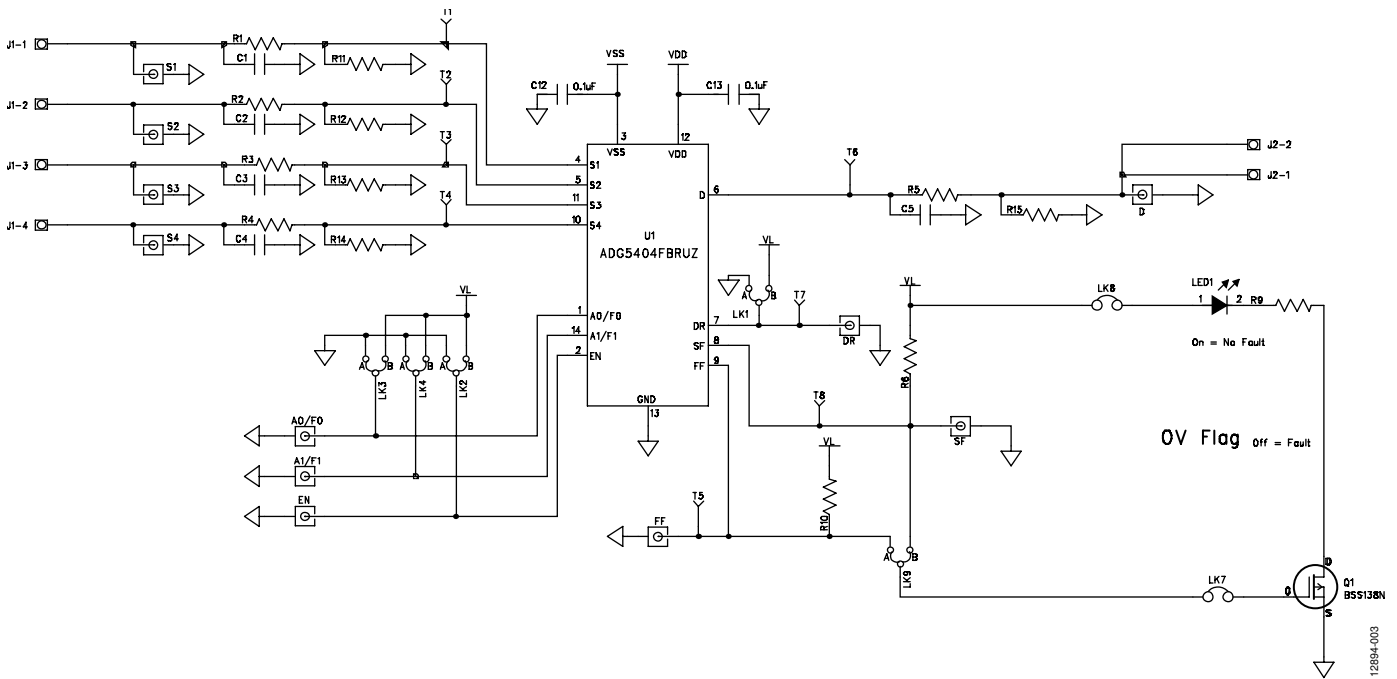


Figure 3. EVAL-ADG5404FEBZ Evaluation Board Schematic (Part 1)

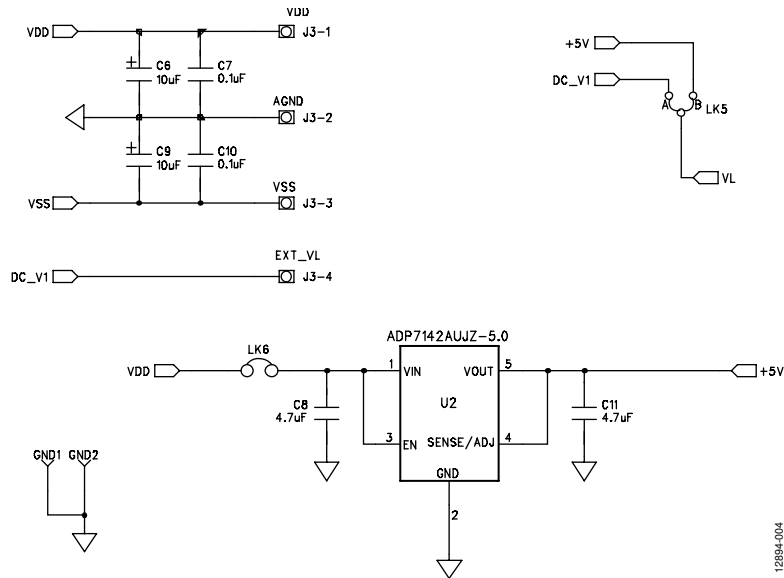


Figure 4. EVAL-ADG5404FEBZ Evaluation Board Schematic (Part 2)

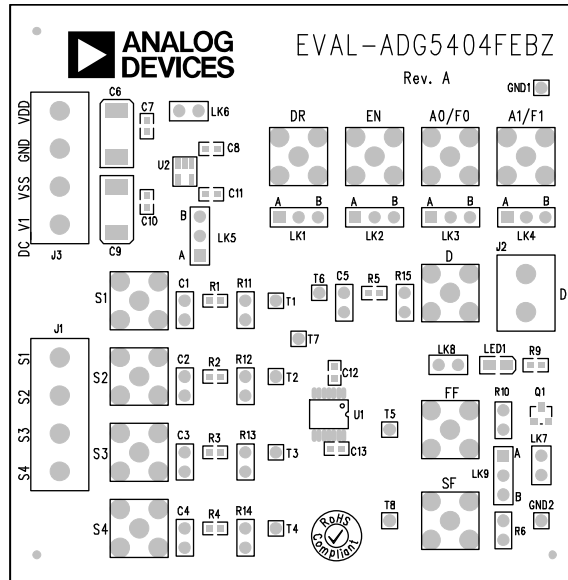


Figure 5. EVAL-ADG5404FEBZ Silkscreen

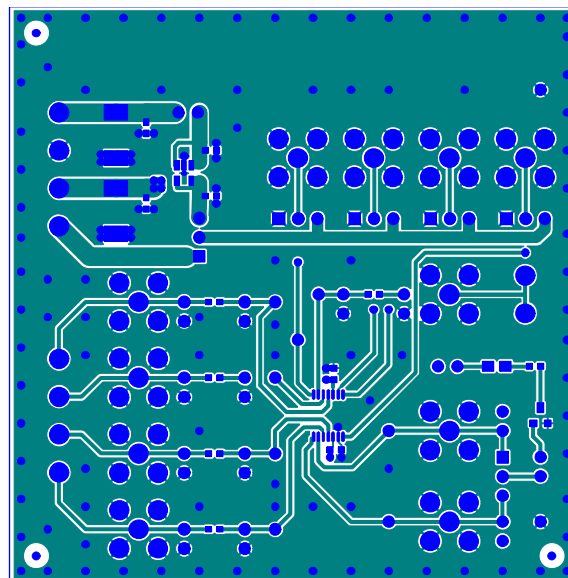


Figure 6. EVAL-ADG5404FEBZ Top Layer

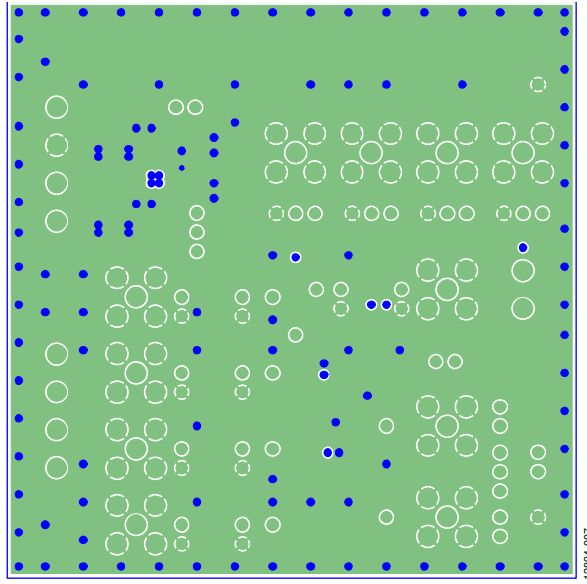


Figure 7. EVAL-ADG5404FEBZ Layer 2

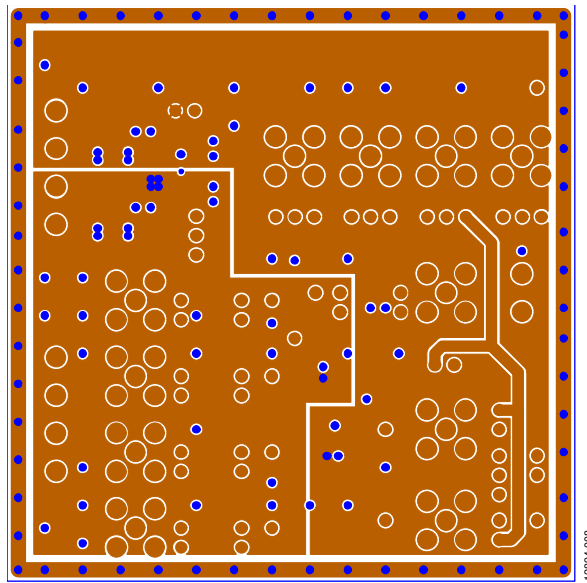


Figure 8. EVAL-ADG5404FEBZ Layer 3



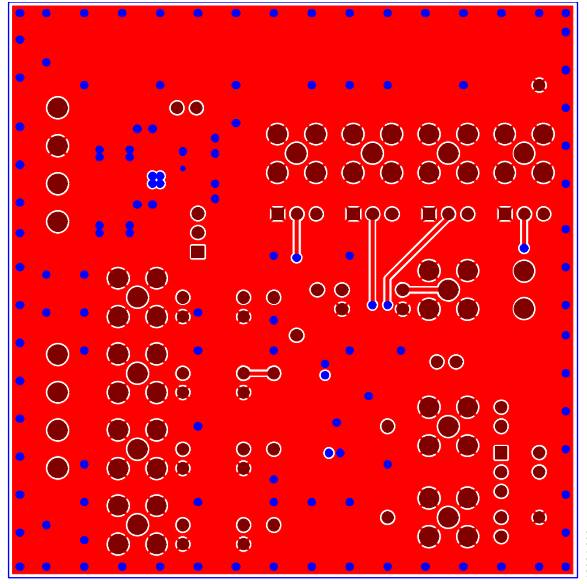


Figure 9. EVAL-ADG5404FEBZ Bottom Layer

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 3.

Reference Designator	Description	MFR Part Number	Stock Code
A0/F0, A1/F1, D, DR, EN, FF, SF	50 Ω SMB socket	SMB1251B1-3GT30G-50	FEC 1111349
C1 to C5, R6, R10 to R15	Socket pin, PCB, PK100 (2 pins only)	66-3472	FEC 329563
C6, C9	10 μF, 50 V tantalum capacitors, D size	TAJD106K050RNJ	FEC 143-2387
C7, C10, C12, C13	0.1 μF, 50 V, X7R, multilayer ceramic capacitors, 0603 size	GRM188R71H104KA93D	FEC 882-0023
C8, C11	Capacitors, MLCC, X5R, 4.7 μF, 35 V, 0603 size	GRM188R6YA475KE15D	FEC 2426960
GND1, GND2	Black test points	20-2137	FEC 873-1128
J1, J3	4-pin terminal blocks (5 mm pitch)	CTB5000/4	FEC 151791
J2	2-pin terminal block (5 mm pitch)	CTB5000/2	FEC 151789
LED1	LED, SMD, green, 0805	KP-2012SGC	FEC 1318243
LK1	2-way solder bridge, solder in Position B	Not applicable	Do not insert
LK2 to LK5, LK9	3-pin SIL headers and shorting link	M20-9990345, M7567-05	FEC 1022248, 150410
LK6 to LK8	2-pin (0.1" pitch) headers and shorting shunt	M20-9990246	FEC 1022247, 150-411
Q1	Transistor, N-MOSFET, 60 V, 0.23 A, SOT-23	BSS138N	FEC 115-6434
R1 to R5	Resistors, 0603 1%, 0 Ω	MC0063W06030R	FEC 9331662
R9	Resistor, 1 kΩ, 0.063 W, 1%, 0603 size	MC0063W060311K	FEC 9330380
S1 to S4	50 Ω SMB sockets	SMB1251B1-3GT30G-50	Do not insert
T1 to T8	Red test points	20-313137	FEC 873-1144
U1	Fault protection and detection, 10 Ω R <sub>ON</sub> , 4-channel multiplexer	<a href="#">ADG5404FBRUZ</a>	<a href="#">ADG5404FBRUZ</a>
U2	40 V, 200 mA, low noise, CMOS LDO	<a href="#">ADP7142AUJZ-5.0</a>	<a href="#">ADP7142AUJZ-5.0-R7</a>



#### ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

#### Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100,000). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.