

FEATURES

Full Evaluation Kit for the ADM1070 Hot Swap Controller Kit Contains Two Boards

- Main Evaluation Board for Bench Evaluation
- Micro Evaluation Board to Drop into User's System

Both Boards Feature

- On-Board FET to Control Load Current
- Programmable Operating Voltage Range (R1/R2 Ratio)
- Programmable Current Limit Levels (Value of R_{SENSE})
- Choice of Default or Custom Timing Values

Main Evaluation Board Features

- Edge Connectors Allow for Simulation of Real Hot Swap Events with ADM1070 Residing on Plug-In Module or Backplane

- External Signals Can Be Switched in through SMB Connectors to Override V_{IN} , SENSE, and UV/OV Signals

Microboard Features

- Drops onto a User's System, Replacing the Current Hot Swap Device

EVALUATION KIT CONTENTS

- ADM1070 Evaluation Board
- ADM1070 Microboard
- ADM1070 Data Sheet
- Evaluation Kit Documentation (This Document)
- Application Note
- Five ADM1070 Samples

ORDERING INFORMATION

Full ADM1070 Evaluation Kit: The EVAL-ADM1070EB contains the Main Evaluation Board and Micro Evaluation Board.

ADM1070 Micro Evaluation Kit: The EVAL-ADM1070MEB contains the Micro Evaluation Board only.

GENERAL DESCRIPTION

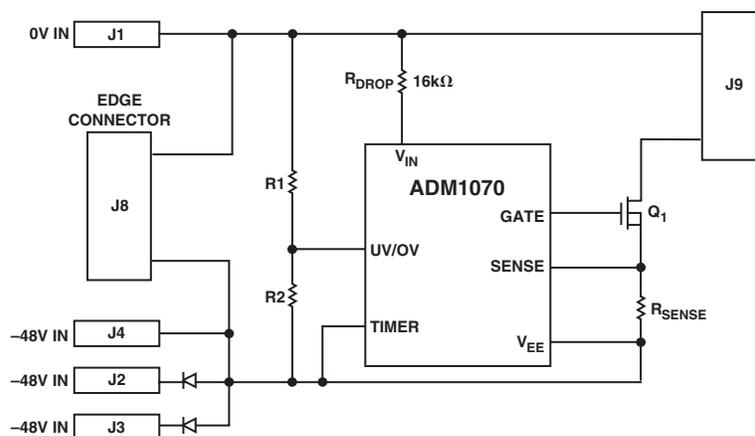
This Evaluation Kit allows the ADM1070 negative voltage Hot Swap Controller to be easily evaluated. The ADM1070 provides undervoltage and overvoltage protection by monitoring the supply voltage and provides robust current limiting by monitoring the load current. The device uses a FET in the power path to control the load current. The complete data sheet for the ADM1070 is available from Analog Devices and should be consulted in conjunction with this document.

SETTING UP THE ADM1070 MAIN EVALUATION BOARD

The user can set up the ADM1070 Evaluation Board with various configurations of supply voltage operating range, maximum allowable load current, and timing values as follows:

1. Choose values of resistors R1 and R2 to suit the desired operating voltage range. The default resistors' values ($R1 = 39\text{ k}\Omega$, $R2 = 1\text{ k}\Omega$) give an operating range of 36.4 V to 76.8 V. See Table IV on page 11 of the ADM1070 data sheet for other resistor ratios and their operating ranges.
2. Choose a maximum load current permitted before the ADM1070 will register a current fault. This is decided by the choice of resistor R6 (R_{SENSE}), see Table I of the ADM1070 data sheet.

FUNCTIONAL BLOCK DIAGRAM



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EVAL-ADM1070EB

3. If the default timing values are suitable, place Switch S2 in its default position (toward S1), tying the TIMER pin directly to –48 V. If different timing values are required, Switch S2 to its secondary position. TIMER is now tied to –48 V through the external capacitor C2. The default capacitor value is 220 pF. This capacitor can be changed to generate a different set of timing values. See Table III of the ADM1070 data sheet for a full list of capacitor values and the corresponding timing values.

SWITCH FUNCTIONS

There are three switches on the ADM1070 Evaluation Board (S1–S3). All switch left/right directions are indicated with the ADM1070 Board in upright position (i.e., red banana connector at the bottom left corner of the board).

Switch 1 (S1):

Right Position: Normal operation. The R1-R2 resistor divider generates a voltage level proportional to the supply voltage. This signal is fed into the UV/OV pin of the ADM1070 for undervoltage/overvoltage detection.

Left Position: Disconnects the on-board resistor divider from the ADM1070. An external signal can then be fed directly to UV/OV via the SMB connector J7 for testing purposes (i.e., to manually generate an overvoltage/undervoltage fault).

Switch 2 (S2):

Right Position: Ties the ADM1070 TIMER pin directly to –48 V. ADM1070 uses its default timing values.

Left Position: Ties the ADM1070 TIMER pin to –48 V through external capacitor C2. ADM1070 timing values now depend on the capacitor value (see ADM1070 data sheet for timing values for various capacitor values). Default external capacitor value is 220 pF.

Switch 3 (S3):

Right Position: Normal operation. Voltage across the sense resistor is fed into the SENSE pin of the ADM1070. This voltage is used to detect overcurrent faults.

Left Position: Disconnects the on-board sense voltage from the ADM1070. An external signal can then be fed directly to SENSE via the SMB connector J6 for testing purposes (i.e., to manually generate an overcurrent fault).

CONNECTORS

There are nine connectors on the ADM1070 Evaluation Board (J1–J9).

J1 (Banana Connector-Red):

0 V Input Voltage Line

J2 (Banana Connector-Blue/Black):

–48 V Input Voltage Line (Diode OR-ed)

J3 (Banana Connector-Blue/Black):

–48 V Input Voltage Line (Diode OR-ed)

J4 (Banana Connector-Blue/Black):

–48 V Input Voltage Line (No Diode OR-ing)

J5 (SMB Connector):

V_{IN} voltage can be monitored at J5.

J6 (SMB Connector):

External SENSE voltage can be applied at J6 via Switch S3.

J7 (SMB Connector):

External UV/OV voltage can be applied at J7 via Switch S1.

J8 (Edge Connector):

Allows connection of a backplane board for powering the board and simulation of hot swap events.

J9 (Edge Connector):

Allows connection of a load board for simulation of hot swap events.

IMPORTANT

The following precautions are recommended when using the ADM1070 Evaluation Kit under high voltage conditions:

- Do not work alone.
- Always keep one hand in your pocket or behind your back when around a high voltage system.
- Wear footwear with a rubber bottom.
- Wear eye protection (safety goggles).
- Do not wear any jewelry or other articles that could accidentally contact circuitry and conduct current.
- Set up your work area away from possible grounds that you may accidentally contact.
- Work on an antistatic mat.
- Connect/disconnect any test leads with the equipment unpowered and unplugged. Use clip leads or solder temporary wires to reach locations difficult to access.
- Perform as many tests as possible with power off and the equipment unplugged.
- After tests performed with the power applied, turn off the power and disconnect the power supply from the board.
- Remember to fully discharge large load capacitors with an appropriate resistor.

OPERATING THE ADM1070 EVALUATION BOARD

There are many different tests and hot swap scenarios that can be modelled on the ADM1070 Evaluation Board:

- An overvoltage condition
- An undervoltage condition
- Powering up into a load (resistive, capacitive, RC combination)
- Powering up, then applying a load (resistive, capacitive, RC combination)
- Powering up into a shorted output
- Powering up, then shorting output
- A permanent overcurrent fault
- A temporary overcurrent fault
- A temporary overcurrent fault followed by a permanent overcurrent fault
- Three distinct levels of overcurrent fault (see the Controlling the Current section in the ADM1070 data sheet)

Note that all tests involving shorts can be simulated with the ADM1070 residing on both the plug-in module/board side and backplane side. See the ADM1070 Application Note for more details.

The ADM1070 Evaluation Board can be configured in two ways to emulate the two ways in which the ADM1070 can be used in a real system.

1. RESIDING ON A PLUG-IN BOARD

The typical method of employing the ADM1070 is to mount the device and its accompanying components on a plug-in board. This board is then slotted into the live backplane when required. When the power lines connect, the ADM1070 powers up. If the supply is stable and within tolerance, it turns the MOSFET on in a controlled manner, applying power to the load and powering up the rest of the board.

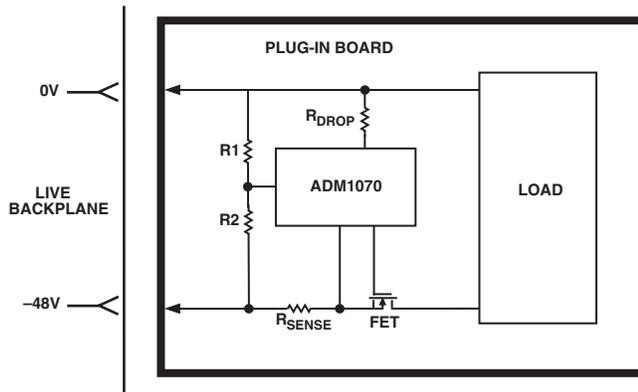


Figure 1. The ADM1070 Residing on a Plug-In Module

To evaluate the ADM1070 in this type of situation, the Evaluation Board should be set up as follows.

First, the board must be set up with the preferred load. The load can be connected to the board in many different ways.

- If a single load component will suffice it can be soldered directly onto the Evaluation Board in Position C4.
- A load can be connected via Connector J9. The user can custom build a board to simulate a plug-in module's load and plug it into edge Connector J9. (See Figure 11 for a schematic of the J9 pinout.)
- The user may connect a load via a crocodile clip directly to the pins of Connector J9 (although care must be taken not to cause a short across the pins of J9).
- If a no-load condition is required then nothing should be connected to J9 and no additional load components soldered to the Evaluation Board.

Power must now be applied to the board via leads connected directly to a power supply. Power is normally applied through the red and black/blue banana connectors (J1–J4).

The higher potential (0 V) should be connected to socket J1 (red). The lower potential of the supply should be connected to J2 or J3 (black). A diode OR-ing scheme is employed at these terminals so that two supplies can be monitored simultaneously if required. In this situation, the supply with the higher potential will be used. If this supply potential drops below the voltage of the second redundant supply, then the board will switch over to the second supply.

The diodes can be bypassed by connecting the lower potential power supply to the board via Socket J4 (black).

A live insertion event can be recreated by turning on the power supply or by making the connection to the live supply. Care should be taken when applying live voltages to the Evaluation Board.

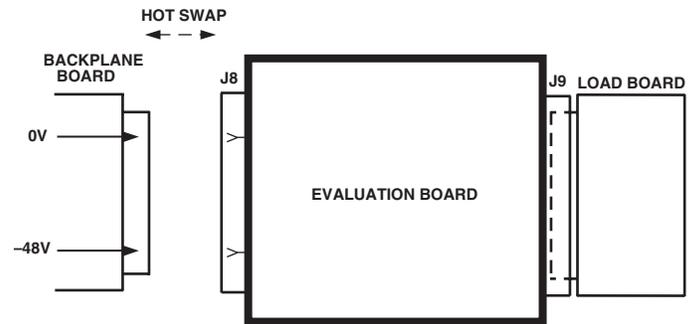


Figure 2. The ADM1070 Evaluation Board Simulating the Set-Up in Figure 1

The user can also apply power to the board via Connector J8. A simple backplane board can be constructed that plugs into Connector J8 and provides the –48 V supply. A live insertion event can now be simulated by plugging the Backplane Board (see Backplane Board section) with a live negative supply into Connector J8. A reseating event can be simulated by disconnecting the Evaluation Board and Backplane Boards and reconnecting them while the supply is live. This corresponds to a plug-in module being manually reseated. This method recreates a board insertion/removal scenario more accurately, since the plugging/unplugging of a board from a live supply triggers the ADM1070's response. Again, the proper precautions should be taken when connecting live voltages to the Evaluation Board.

2. RESIDING ON A BACKPLANE

The ADM1070 can also perform similar undervoltage and overvoltage protection and current limiting functions when placed on the backplane itself.

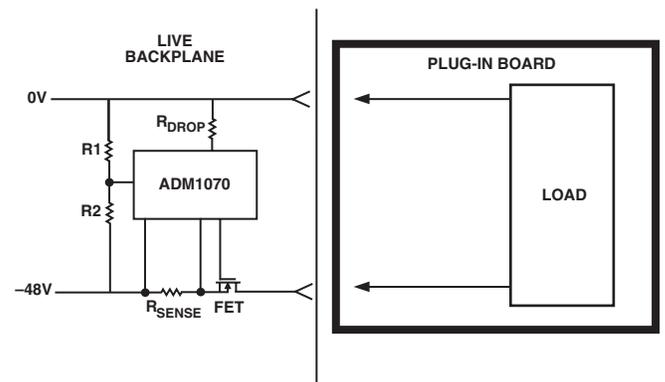


Figure 3. The ADM1070 Residing on a Backplane

This type of setup can also be recreated with the ADM1070 Evaluation Board. Power can be applied through a backplane board or with power leads (as described in the previous section). The power supply and the Evaluation Board should be connected together (by either method) and the power applied (see Figure 4). This unit now represents the live backplane with in-built ADM1070 circuitry in Figure 3.

A live insertion event can now be simulated by connecting the load to the Evaluation Board (via Connector J9, as described above). Reseating can be represented by disconnecting and reconnecting the load to/from the Evaluation Board.

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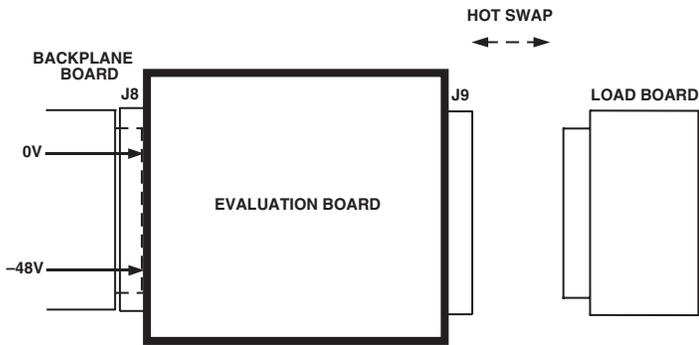


Figure 4. The ADM1070 Evaluation Board Simulating the Setup in Figure 3

Note that the ADM1070 can be employed on BOTH the plug-in board/module and the backplane sides of a system. This will provide the system with double protection.

SIGNAL MONITORING

When the Evaluation Board is under testing, many different signals can be monitored. There are 12 test points on the board (T1–T12).

- T1:** 0 V Input (and Output) Line
- T2:** Voltage at ADM1070 UV/OV Pin
- T3:** Voltage at ADM1070 TIMER Pin
- T4:** –48 V Input Line
- T5:** –48 V Input Line
- T6:** Voltage at ADM1070 V_{IN} Pin
- T7:** Voltage at ADM1070 GATE Pin
- T8:** Voltage at ADM1070 SENSE Pin
- T9:** Voltage at Source Terminal of MOSFET (normally fed into ADM1070 SENSE pin). Voltage between this node and V_{EE} is the voltage across R_{SENSE} , which is used for current sensing.
- T10:** –48 V Input Line
- T11:** 0 V Input (and Output) Line
- T12:** Voltage at MOSFET Drain Terminal. Lower potential of output load voltage.

LOAD BOARD

A schematic diagram of a possible load board that emulates the load on a plug-in module and connects to Connector J9 is shown below. This board contains a series resistance and capacitance connected in parallel. A set of jumpers changes the manner in which the components are applied: resistor only, capacitor only, RC in parallel, or short circuit.

The board should be set up via the jumpers before power is applied. For example, to set up the load board to emulate an RC load, shorting links should be placed into both LK1 A and B jumpers and LK2 should be left open.

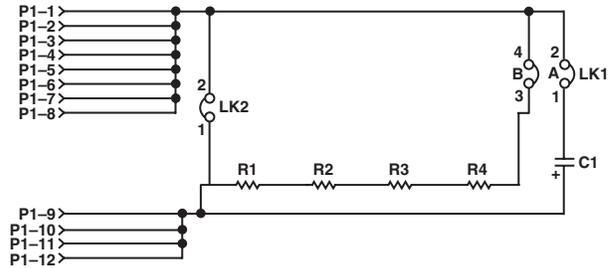


Figure 5. Schematic Diagram of Possible Load Board

BACKPLANE BOARD

The user can also employ a Backplane Board that emulates the backplane side of a user's system. This board provides an alternative way of applying power to the ADM1070 Evaluation Board (instead of power connectors J1–J4 of Evaluation Board). The Backplane Board should be inserted into edge Connector J8 of the ADM1070 Evaluation Board to apply power to the board. This may be useful when simulating live insertion and removal events with the ADM1070 Evaluation Kit, especially when simulating a situation where the ADM1070 resides on a plug-in module. A live insertion event can be recreated by plugging the Backplane Board (with a live supply) into the ADM1070 Evaluation Board (into Connector J8).

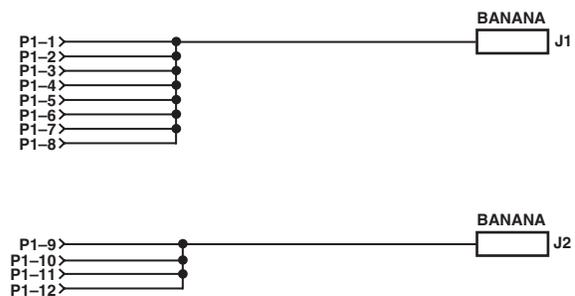


Figure 6. Schematic Diagram of Possible Backplane Board

MICROBOARD

The ADM1070 Evaluation Kit contains a second Evaluation Board. The ADM1070 Micro Evaluation Board is designed to drop onto a plug-in module or a backplane, replacing the current hot swap device. The performance of the ADM1070 can then be evaluated within the user's system.

The board contains:

- On-board FET to control load current
- Programmable operating voltage range (R1/R2 ratio)
- Programmable current limit levels (value of R_{SENSE})
- Programmable timing values (Capacitor C1)

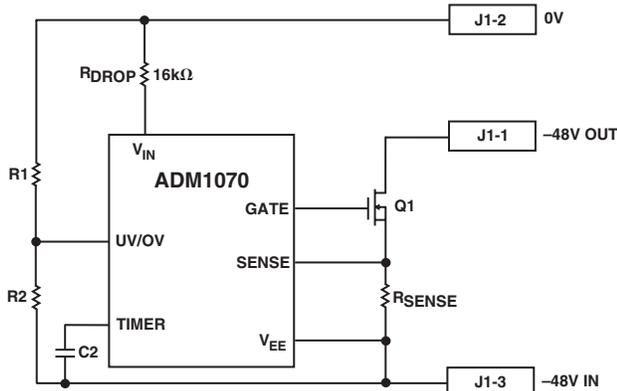


Figure 7. Microboard Functional Block Diagram

This Microboard contains the external components required by the ADM1070 to function on the plug-in module or backplane. By cutting various tracks around the current hot swap device and soldering the ADM1070 Microboard in position above it, the ADM1070 and its external components can be integrated into the system in place of the original hot swap circuitry. The ADM1070's performance can now be evaluated in the system itself.

SETTING-UP THE ADM1070 MICROBOARD

The user can set up the ADM1070 Evaluation Board with different configurations of supply voltage operating range and maximum allowable load current as follows:

1. Choose values of resistors R1 and R2 to suit the desired operating voltage range. The default resistors' values ($R1 = 39\text{ k}\Omega$, $R2 = 1\text{ k}\Omega$) give an operating range of 36.4 V to 77.2 V. See the ADM1070 data sheet for other resistor ratios and their operating ranges.
2. Choose a maximum load current permitted before the ADM1070 will register a current fault. This is decided by the choice of resistor R_{SENSE} . See the ADM1070 data sheet for full details.
3. The board is set up to use default timing values. A shorting link is mounted on the board in place of Capacitor C1, tying the TIMER pin directly to -48 V. If different timing values are required, a capacitor must be soldered into position in place of the shorting link. TIMER is now tied to -48 V through the external capacitor C1. Different values of C1 generate different timing values. See the ADM1070 data sheet for a full list of capacitor values and the corresponding timing values.

INTEGRATING THE ADM1070 MICROBOARD WITH THE USER'S SYSTEM

The user must modify his or her current system to remove the existing hot swap circuitry and replace it with the ADM1070 Microboard. The following description refers to a situation when the hot swap circuitry resides on a plug-in module. The same method applies to cases where a backplane side hot swap system is implemented. First, the existing hot swap device and its accompanying components must be located. The user must then disconnect this portion of the system by cutting the relevant tracks on the board, or alternatively, removing the relevant components.

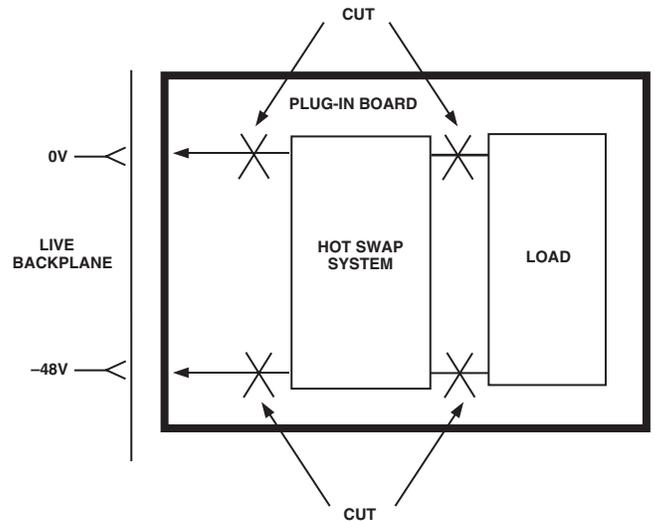


Figure 8. Removing Existing Hot Swap Circuitry from the User's System

The ADM1070 Microboard can now be integrated into the user's system in place of the original hot swap system. The board should be soldered into position above the old hot swap circuitry. The ADM1070 Microboard has an insulating coating on its underside to protect the user's system. If the underside of the board was not protected, shorts could occur on the module or backplane below it.

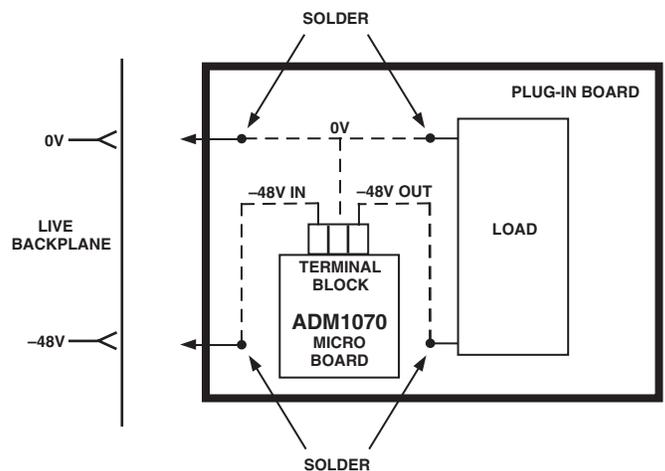


Figure 9. Integrating the ADM1070 Microboard into the User's System

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EXAMPLE

The user wants to simulate a live insertion event with the ADM1070 Evaluation Board. The user's application operates with a -48 V supply voltage. The plug-in board load can be represented by a capacitive load of $100\text{ }\mu\text{F}$. The ADM1070 will be mounted on the backplane.

Set Up:

1. Resistor values of $R1 = 39\text{ k}\Omega$ and $R2 = 1\text{ k}\Omega$ should be used for a -48 V supply (see Table IV, page 11, ADM1070 data sheet). Default resistor ratio used.
2. User's maximum load current = 1.4 A . An R_{SENSE} of $47\text{ m}\Omega$ gives maximum load current = 1.3 A (see Table I, ADM1070 data sheet). Default value used.
3. Default timing values can be used. Switch 2 placed in Position A.

The Evaluation Board should be set up as described in the Residing On a Backplane section. A $100\text{ }\mu\text{F}$ load should set up (Default Capacitor $C4 = 100\text{ }\mu\text{F}$ load). To generate the wave forms below on an oscilloscope, the following test points should be monitored.

GATE Waveform: Connect an oscilloscope probe between T7 (GATE) and T5 (-48 V).

SENSE Waveform: Connect an oscilloscope probe between T8 (SENSE) and T10 (-48 V).

V_{OUT} Waveform: Connect an oscilloscope between T11 (0 V) and T12 (-48 V OUT).

The oscilloscope should be set to trigger on the rising edge of the GATE voltage. A live insertion event can be modeled by inserting the load board into the Evaluation Board Connector J9. Great care should be taken when handling and connecting live boards.

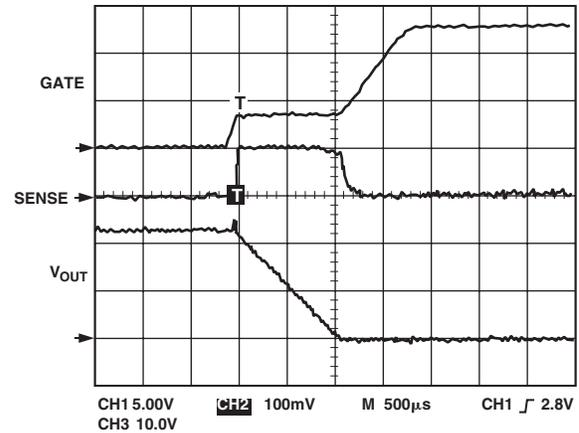


Figure 10. Live Insertion Waveforms

EVAL-ADM1070EB

Evaluation Board Bill of Materials

Part Type	Ref Des	Part Decal	Part No.	Source	(Notes)
ADM1070	U1	SOT-23-6	ADM1070	ANALOG DEVICES	
ADM1070_SKT	U2	SOT-23-6_SKT	FEC 302-7363	FARNELL	
CAP, 0.1 μ F	C1	805	FEC 755-849	FARNELL	(NOT MOUNTED)
CAP, 0.1 μ F	C2	805			(NOT MOUNTED)
CAP, 1 μ F	C3	805			(NOT MOUNTED)
CAP+, 100 μ F	C4	CAP_ELEK_8MM			(NOT MOUNTED)
CAP	C5	805			(NOT MOUNTED)
CAP	C6	805			(NOT MOUNTED)
RES, 39 k Ω	R1	805	FEC 912-049	FARNELL	(NOT MOUNTED)
RES, 1 k Ω	R2	805	FEC 911-859	FARNELL	
RES, 8.2 k Ω 0.25 W	R3, R4	1206	FEC 512-849	FARNELL	
RES	R5	805			
RES1206, 0R47	R6	1206	FEC 156-231	FARNELL	
IRFR3910	Q1	DKPAK	FEC 706-486	FARNELL	
DIODE	D1, D2	DO35	FEC 505-950	FARNELL	
BANANA	J1	BANANA	FEC 150-039	FARNELL	
BANANA	J2-J4	BANANA	FEC 150-040	FARNELL	
SMB	J5-J7	SMB	FEC 310-682	FARNELL	
CON\12P\ED\SKT	J8, J9	CON-12P-156-SRA	S5061-ND	DIGIKEY	
SW-SPDT-SLIDE	S1-S3	SW-SPDT-SLIDE	FEC 733-647	FARNELL	
TESTPOINT	T1-T12	TESTPOINT	FEC 240-333	FARNELL	
Stick-on Feet		Stick-on Feet	FEC 148-922	3M	

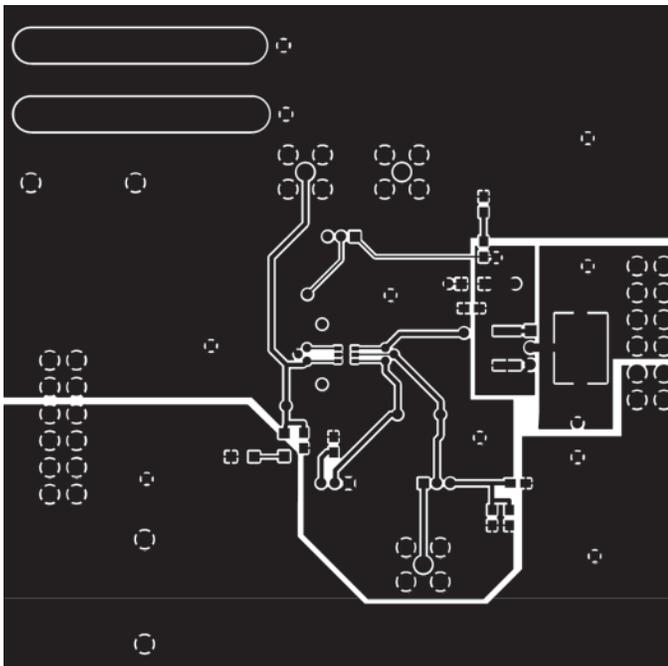


Figure 12. ADM1070 Evaluation Board Component Side Silkscreen

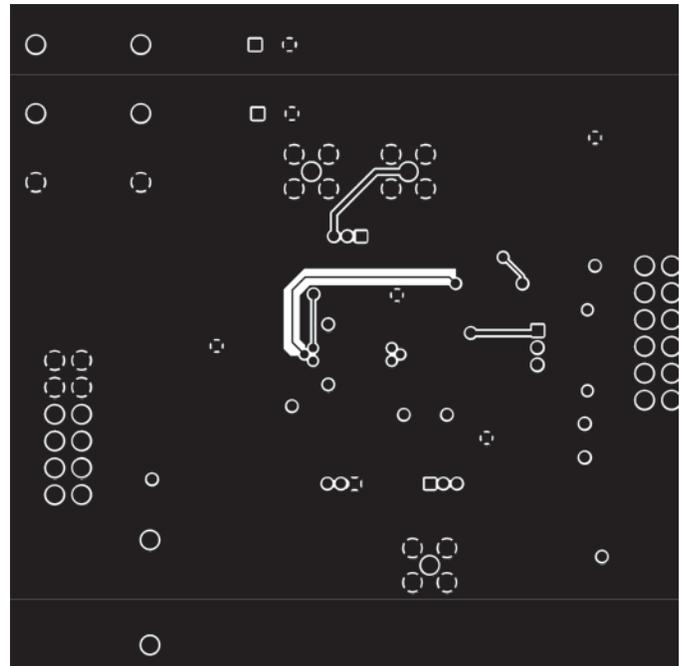


Figure 13. ADM1070 Evaluation Board Solder Side

Silkscreen

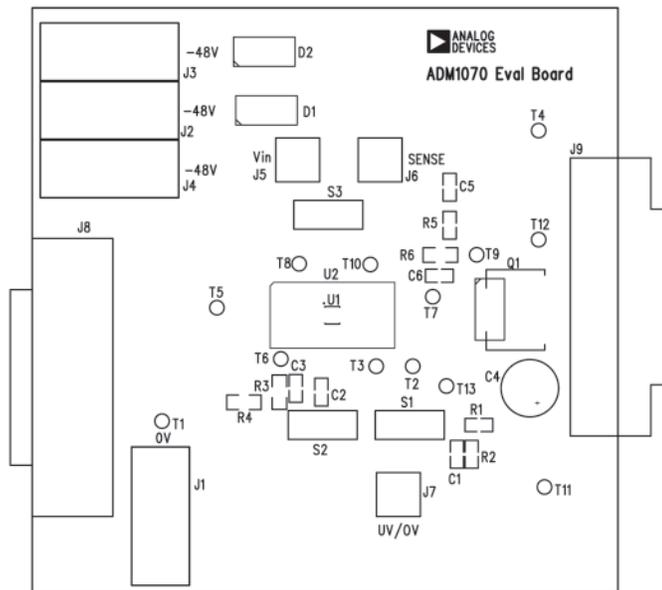


Figure 14. ADM1070 Evaluation Board Component Placement Drawing

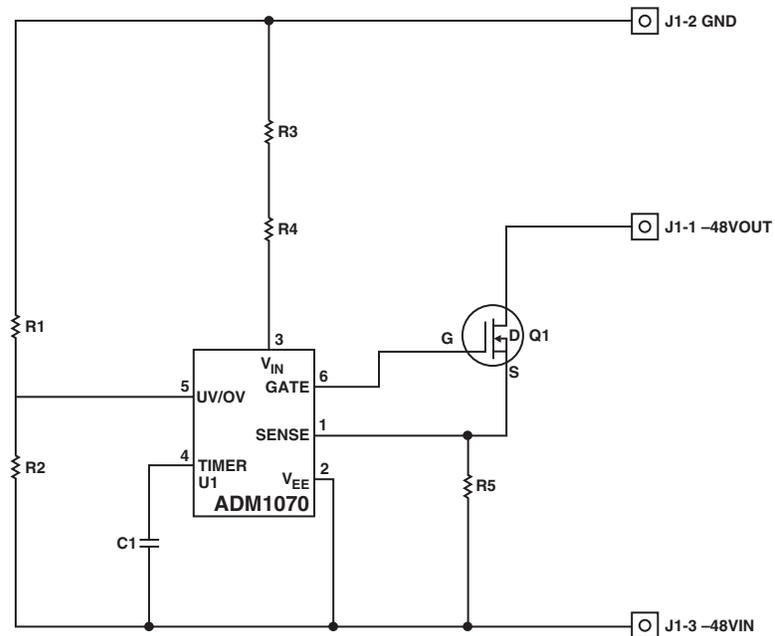


Figure 15. ADM1070 Microboard Circuit Diagram

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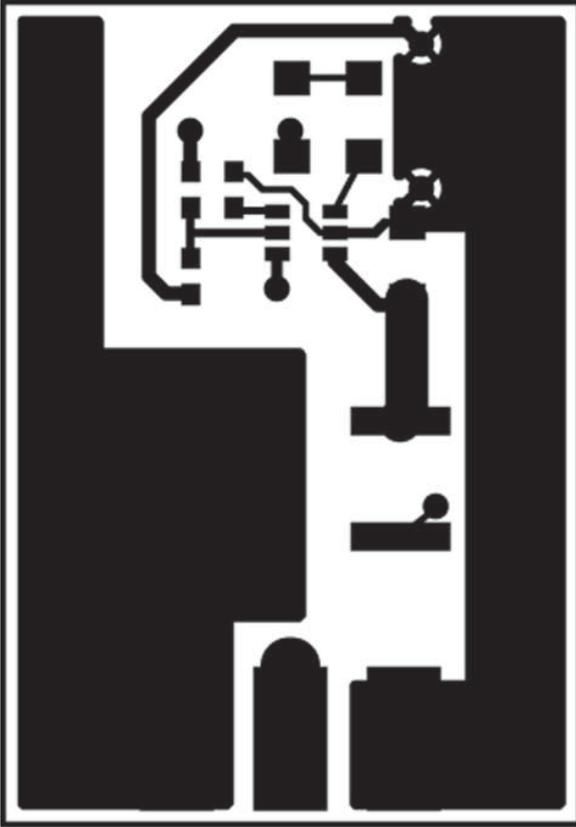


Figure 16. ADM1070 Microboard Component Side Silkscreen

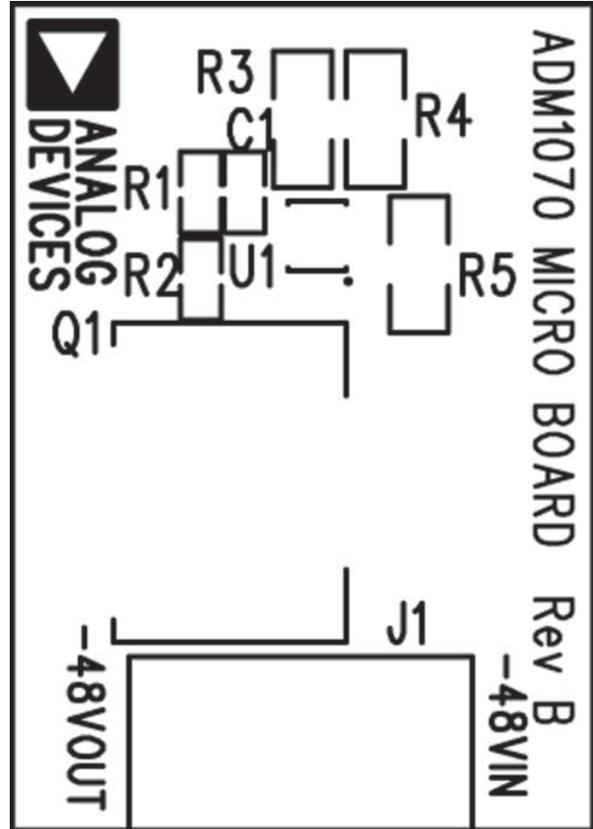


Figure 18. ADM1070 Microboard Component Placement Drawing

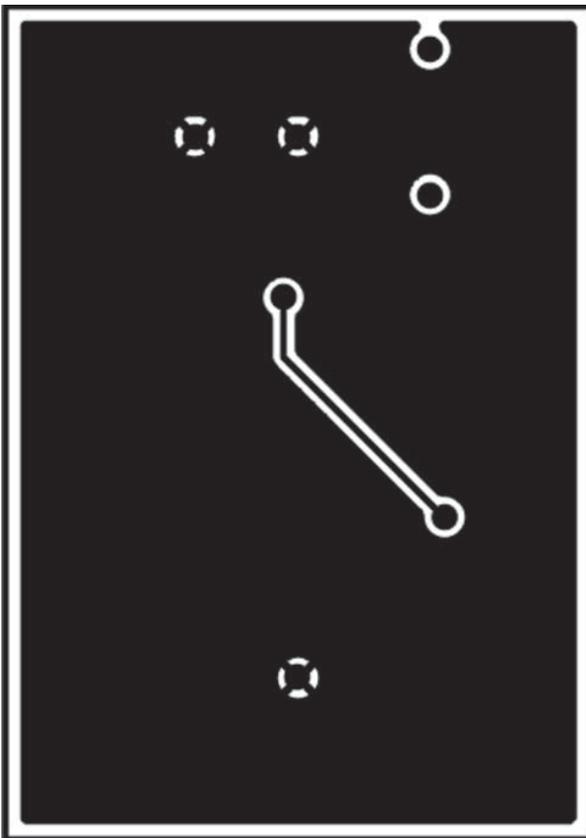


Figure 17. ADM1070 Microboard Solder Side Silkscreen

Microboard Bill of Materials

Part Type	Ref Des	Part Decal	Part No.	Source
ADM1070	U1	SOT-23-6	ADM1070	ANALOG DEVICES
RES, 39 k Ω	R1	805	FEC 912-049	FARNELL
RES, 1 k Ω	R2	805	FEC 911-859	FARNELL
RES, 8.2 k Ω 0.25 W	R3, R4	1206	FEC 512-849	FARNELL
RES1206, 0R47	R5	1206	FEC 156-231	FARNELL
IRFR3910	Q1	D2PAK	FEC 706-486	FARNELL
CON\POWER3	J1	CON\POWER3	FEC 151-786	FARNELL

