

ROHM Solution Simulator

Automotive Low Noise & Rail-to-Rail Input/Output High Speed CMOS Operational Amplifiers (Op-Amps)

BD7281YG-C Low-Side Current Sensing Circuit with Offset – DC Sweep simulation

This circuit simulates DC sweep response at the low-side current sensing with Op-Amps. You can observe the output voltage and the ratio of output to input voltage or shunt voltage when the source or load current is changed. You can customize the parameters of the components shown in blue, such as VIN, or peripheral components, and simulate the low-side current sensing circuit with the desired operating condition.

You can simulate the circuit in the published application note: Low-Side Current Sensing Circuit Design. [\[JP\]](#) [\[EN\]](#) [\[CN\]](#)

General Cautions

- Caution 1:** The values from the simulation results are not guaranteed. Please use these results as a guide for your design.
- Caution 2:** These model characteristics are specifically at Ta=25°C. Thus, the simulation result with temperature variances may significantly differ from the result with the one done at actual application board (actual measurement).
- Caution 3:** Please refer to the Application note of Op-Amps for details of the technical information.
- Caution 4:** The characteristics may change depending on the actual board design and ROHM strongly recommend to double check those characteristics with actual board where the chips will be mounted on.

1 Simulation Schematic

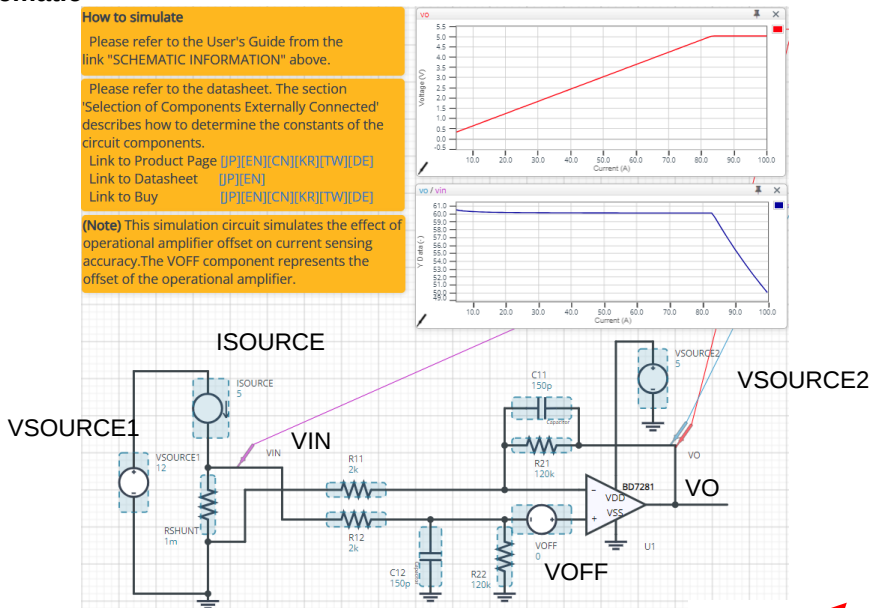


Figure 1. Simulation Schematic

2 How to simulate

The simulation settings, such as parameter sweep or convergence options, are configurable from the 'Simulation Settings' shown in Figure 2, and Table 1 shows the default setup of the simulation.

In case of simulation convergence issue, you can change advanced options to solve. Nothing is stated in the default statement in 'Manual Options'. You can modify it.

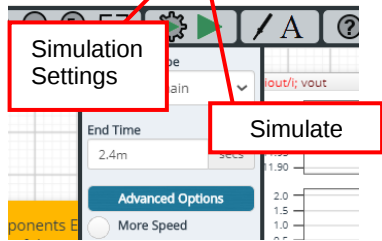


Figure 2. Simulation Settings and execution

Table 1. Simulation settings default setup

Parameters	Default	Note
Simulation Type	DC	Do not change Simulation Type
Parameter Sweep	ISOURCE	CURRENT_LEVEL from 5A to 100A by 1A
Advanced options	Simulation Resolution	1e-7
	Convergence Assist	-
Manual Options	-	-

3 Simulation Conditions

Table 2. List of the simulation condition parameters

Instance Name	Type	Parameters	Default Value	Variable Range		Units
				Min	Max	
VSOURCE1	Voltage Source	Voltage_level	12	free		V
		AC_magnitude	0.0	fixed		V
		AC_phase	0.0	fixed		°
VSOURCE2	Voltage Source For Op-Amp	Voltage_level	5	free ^(Note1)		V
		AC_magnitude	0.0	fixed		V
		AC_phase	0.0	fixed		°
VOFF	Voltage Source For OFFSET	Voltage_level	0.0	free ^(Note1)		V
		AC_magnitude	0.0	fixed		V
		AC_phase	0.0	fixed		°
ISOURCE	Current Source	Current_level	5	free		A
		AC_magnitude	0.0	fixed		A
		AC_phase	0.0	fixed		°

(Note 1) Set it to the guaranteed operating range of the Op-Amps.

4 Op-Amp model

Table 3 shows the model terminal function implemented. Note that BD7281YG-C is the behavior model for its low-side current sensing circuit, and no protection circuits or the functions not related to the purpose are not implemented.

Table 3. BD7281YG-C model terminals used for the simulation

Terminals	Description
+IN	Non-inverting input
-IN	Inverting input
VDD	Positive power supply
VSS	Negative power supply / Ground
OUT	Output

(Note 2) This model is not compatible with the influence of ambient temperature.

(Note 3) Use the simulation results only as a design guide and the data reported herein is not a guaranteed value.

5 Peripheral Components

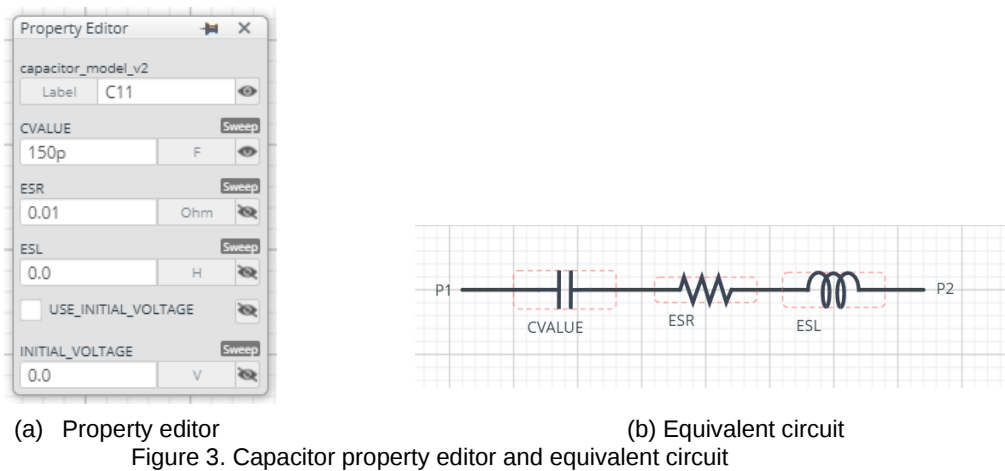
5.1 Bill of Material

Table 4 shows the list of components used in the simulation schematic. Each of the capacitors has the parameters of equivalent circuit shown below. The default values of equivalent components are set to zero except for the ESR of C. You can modify the values of each component.

Table 4. List of capacitors used in the simulation circuit

Type	Instance Name	Default Value	Variable Range		Units
			Min	Max	
Resistor	RSHUNT	1m	0.1m	1	Ω
	R11, R12	2	free		k Ω
	R21, R22	120	free		k Ω
Capacitor	C11, C12	150	free		pF

5.2 Capacitor Equivalent Circuits



The default value of ESR is 0.01 Ω .
(Note 4) These parameters can take any positive value or zero in simulation but it does not guarantee the operation of the IC in any condition. Refer to the datasheet to determine adequate value of parameters.

6 Recommended Products

- 6.1 Op-Amp
BD7281YG-C : Nano Cap™, Low Noise & Input/Output Rail-to-Rail High Speed CMOS Operational Amplifier for Automotive. [JP](#) [EN](#) [CN](#) [KR](#) [TW](#) [DE](#)
- 6.2 Shunt resistor
PSR100 Series : High Power Ultra-low Ohmic Shunt Resistors [JP](#) [EN](#) [CN](#)

Technical Articles and Tools can be found in the Design Resources on the product web page.

Notice

- 1) The information contained in this document is intended to introduce ROHM Group (hereafter referred to as ROHM) products. When using ROHM products, please verify the latest specifications or datasheets before use.
- 2) ROHM products are designed and manufactured for use in general electronic equipment and applications (such as Audio Visual equipment, Office Automation equipment, telecommunication equipment, home appliances, amusement devices, etc.) or specified in the datasheets. Therefore, please contact the ROHM sales representative before using ROHM products in equipment or devices requiring extremely high reliability and whose failure or malfunction may cause danger or injury to human life or body or other serious damage (such as medical equipment, transportation, traffic, aircraft, spacecraft, nuclear power controllers, fuel control, automotive equipment including car accessories, etc. hereafter referred to as Specific Applications). Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties arising from the use of ROHM Products for Specific Applications.
- 3) Electronic components, including semiconductors, can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against physical injury, and damage to any property, which a failure or malfunction of products may cause.
- 4) The information contained in this document, including application circuit examples and their constants, is intended to explain the standard operation and usage of ROHM products, and is not intended to guarantee, either explicitly or implicitly, the operation of the product in the actual equipment it will be used. As a result, you are solely responsible for it, and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties arising from the use of such information.
- 5) When exporting ROHM products or technologies described in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, such as the Foreign Exchange and Foreign Trade Act and the US Export Administration Regulations, and follow the necessary procedures in accordance with these provisions.
- 6) The technical information and data described in this document, including typical application circuits, are examples only and are not intended to guarantee to be free from infringement of third parties intellectual property or other rights. ROHM does not grant any license, express or implied, to implement, use, or exploit any intellectual property or other rights owned or controlled by ROHM or any third parties with respect to the information contained herein.
- 7) No part of this document may be reprinted or reproduced in any form by any means without the prior written consent of ROHM.
- 8) All information contained in this document is current as of the date of publication and subject to change without notice. Before purchasing or using ROHM products, please confirm the latest information with the ROHM sales representative.
- 9) ROHM does not warrant that the information contained herein is error-free. ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties resulting from errors contained in this document.



Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

<https://www.rohm.com/contactus>