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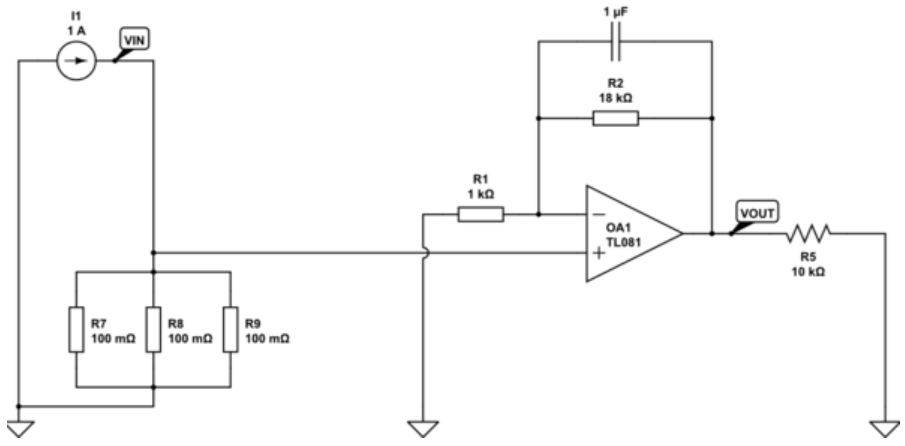
ROHM BD7281YG-C Low Side Current Sensing Circuit DC Sweep Simulation



Specifications

The ROHM Solution Simulator is designed for simulating Automotive Low Noise & Rail-to-Rail Input/Output High Speed CMOS Operational Amplifiers (Op-Amps). It allows users to observe output voltage and ratio changes based on input or shunt voltage variations.

Product Usage Instructions

This circuit simulates a 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 customise 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 the 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.

Simulation Schematic

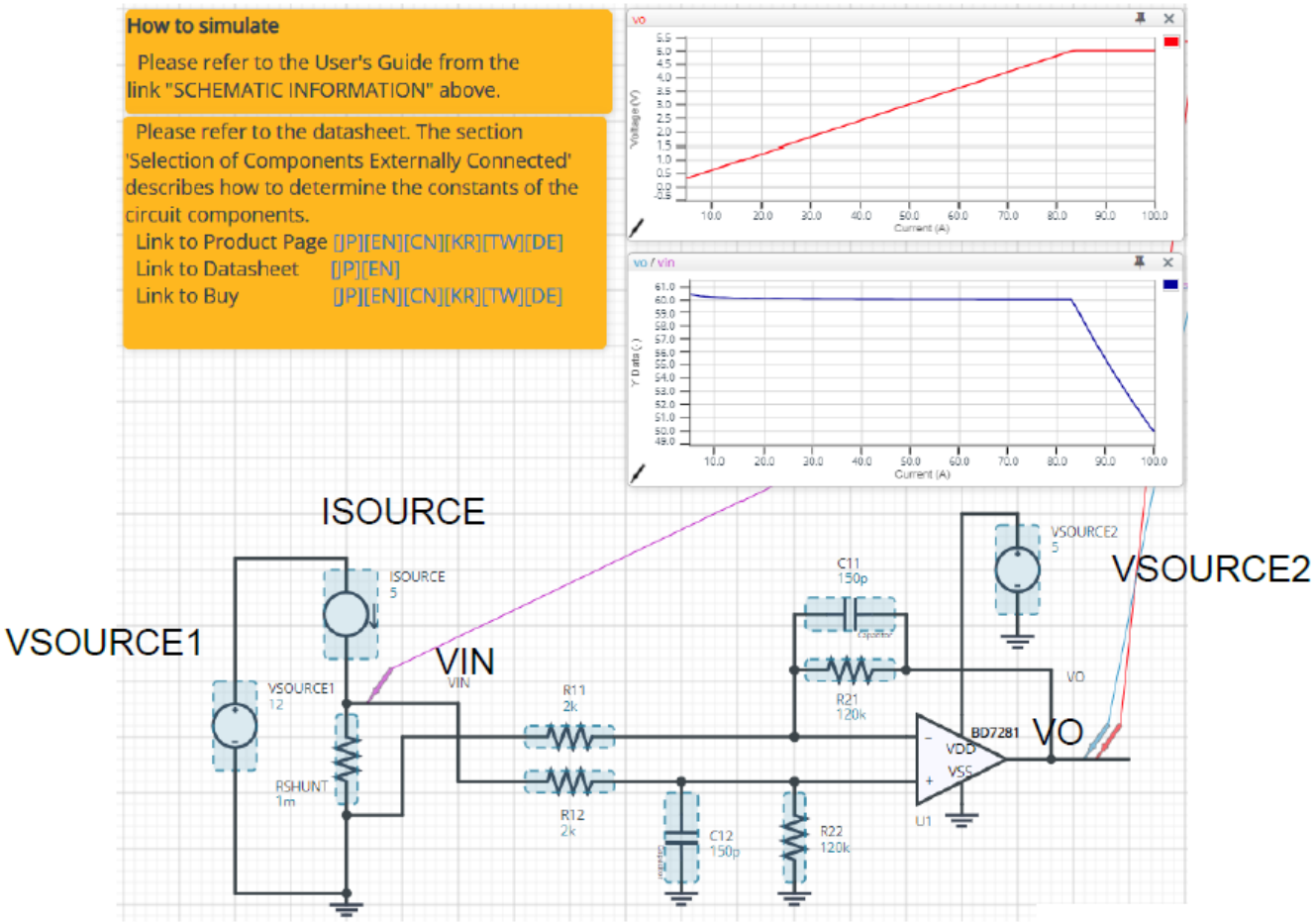


Figure 1. Simulation Schematic

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 a simulation convergence issue, you can change the advanced options to solve it. Nothing is stated in the default statement in ‘Manual Options’. You can modify it.

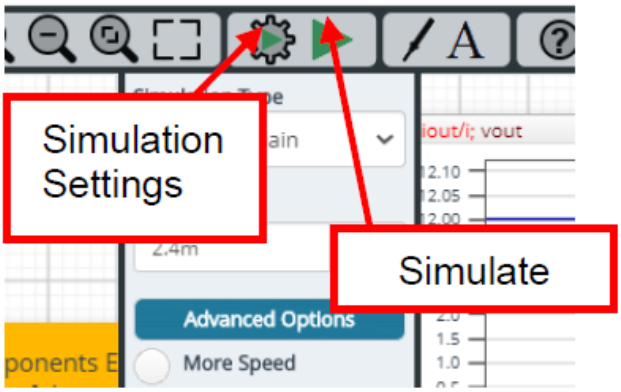


Figure 2. Simulation Settings and execution

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	–	–

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		°
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.

Op-Amp model

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

Table 3. BD7281YG-C model terminals are 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.

Peripheral Components

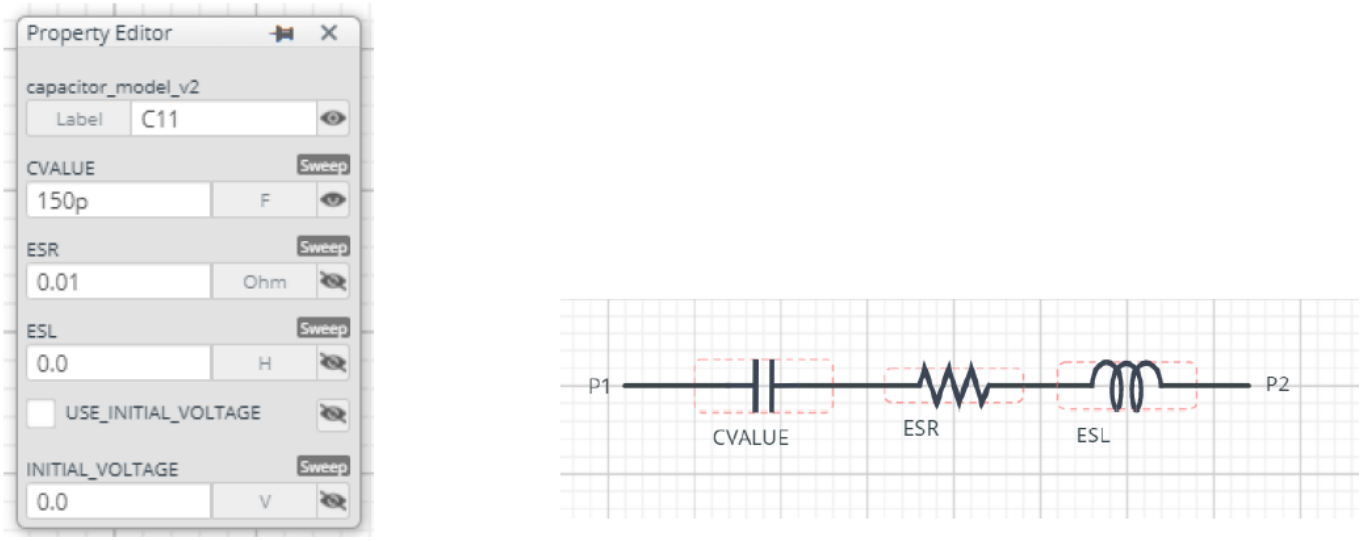
Bill of Materials

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		kΩ
	R21, R22	120	free		kΩ
Capacitor	C11, C12	150	free		pF

Capacitor Equivalent Circuits



- Property editor
- Equivalent circuit

Figure 3. Capacitor property editor and equivalent circuit

The default value of ESR is 0.01Ω.

(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 the adequate value of parameters.

- **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]
- **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.

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FAQS

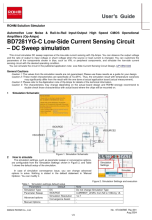
Q: Can I change the simulation type from DC to AC?

A: No, it is recommended to keep the Simulation Type as DC for accurate results.

Q: What should I do if I encounter simulation convergence issues?

A: You can change advanced options in the Simulation Settings to resolve convergence problems.

Documents / Resources

	ROHM BD7281YG-C Low Side Current Sensing Circuit DC Sweep Simulation [pdf] User Guide BD7281YG-C, BD7281YG-C Low Side Current Sensing Circuit DC Sweep Simulation, BD7281YG-C, Low Side Current Sensing Circuit DC Sweep Simulation, Sensing Circuit DC Sweep Simulation, DC Sweep Simulation, Simulation

References

- User Manual

ROHM

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