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 – Transient Response simulation

This circuit simulates the transient response at the low-side current sensing with Op-Amps. You can observe the fluctuation of the output voltage when the source or load current, or effectively the input voltage or shunt voltage, is abruptly 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

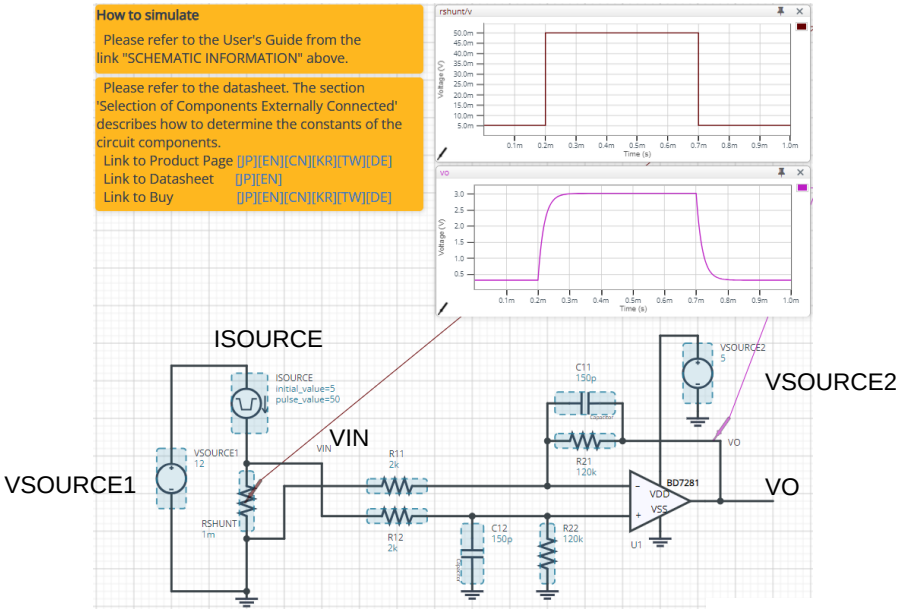


Figure 1. Simulation Schematic

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.

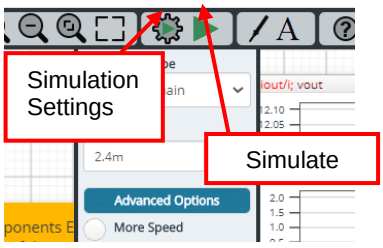


Figure 2. Simulation Settings and execution

Table 1. Simulation settings default setup

Parameters	Default	Note
Simulation Type	Time-Domain	Do not change Simulation Type
End Time	1ms	-
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 Min	Variable Range Max	Units
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	Initial_value	5	free		A
		Pulse_value	50	free		A
		ramptime_initial_to_pulse	1.0	fixed		ns
		ramptime_pulse_to_initial	1.0	fixed		ns
		Start_delay	0.2	fixed		ms
		Pulse_width	0.5	fixed		ms
		Period	1	fixed		s

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

3.1 ISOURCE parameter setup

Figure 3 shows how the ISOURCE parameters correspond to the VIN stimulus waveform.

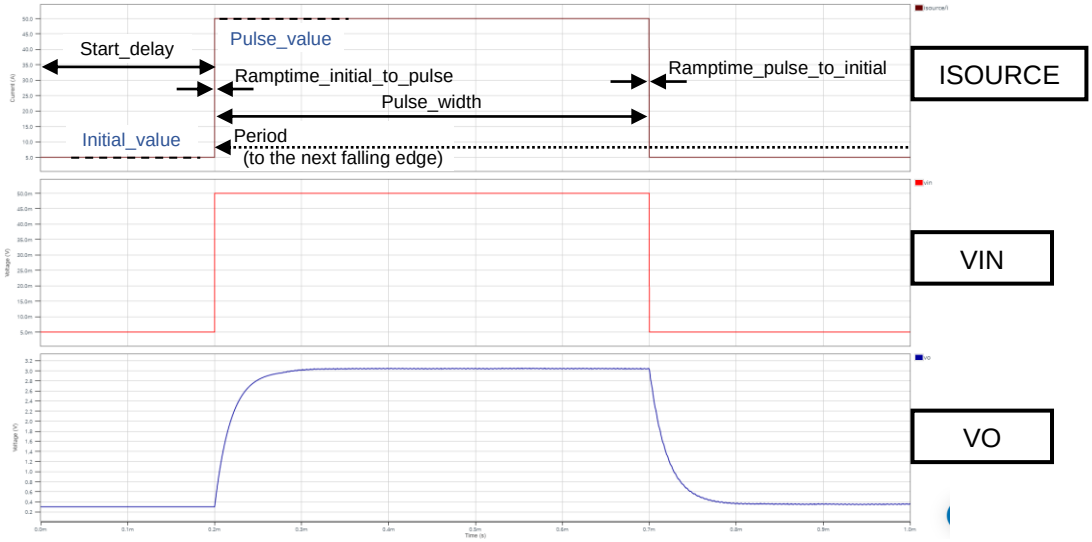


Figure 3. ISOURCE parameters and its waveform

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

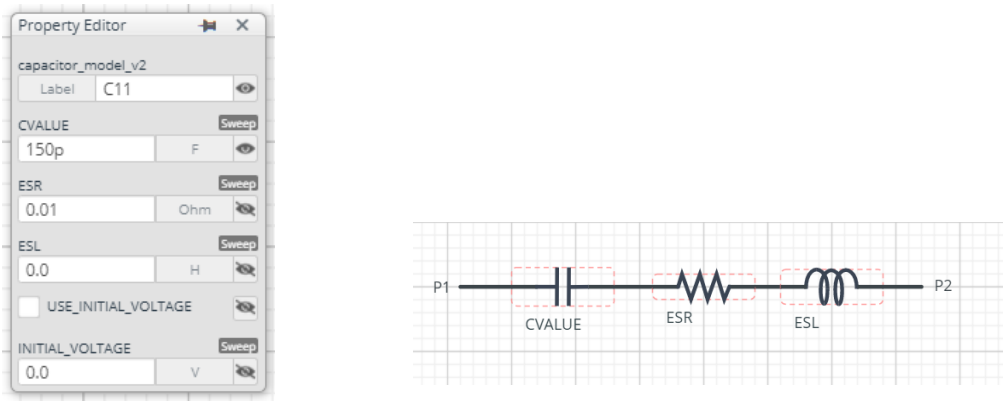
5.1 Bill of Material

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

5.2 Capacitor Equivalent Circuits



(a) Property editor (b) Equivalent circuit

Figure 4. 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 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.

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