(C-012-D) DC-DC LLC Half-Bridge Buck Converter (Discrete)

ROHM PLECS Simulator
Simulation Example

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Simulation Parameters (Dialog)

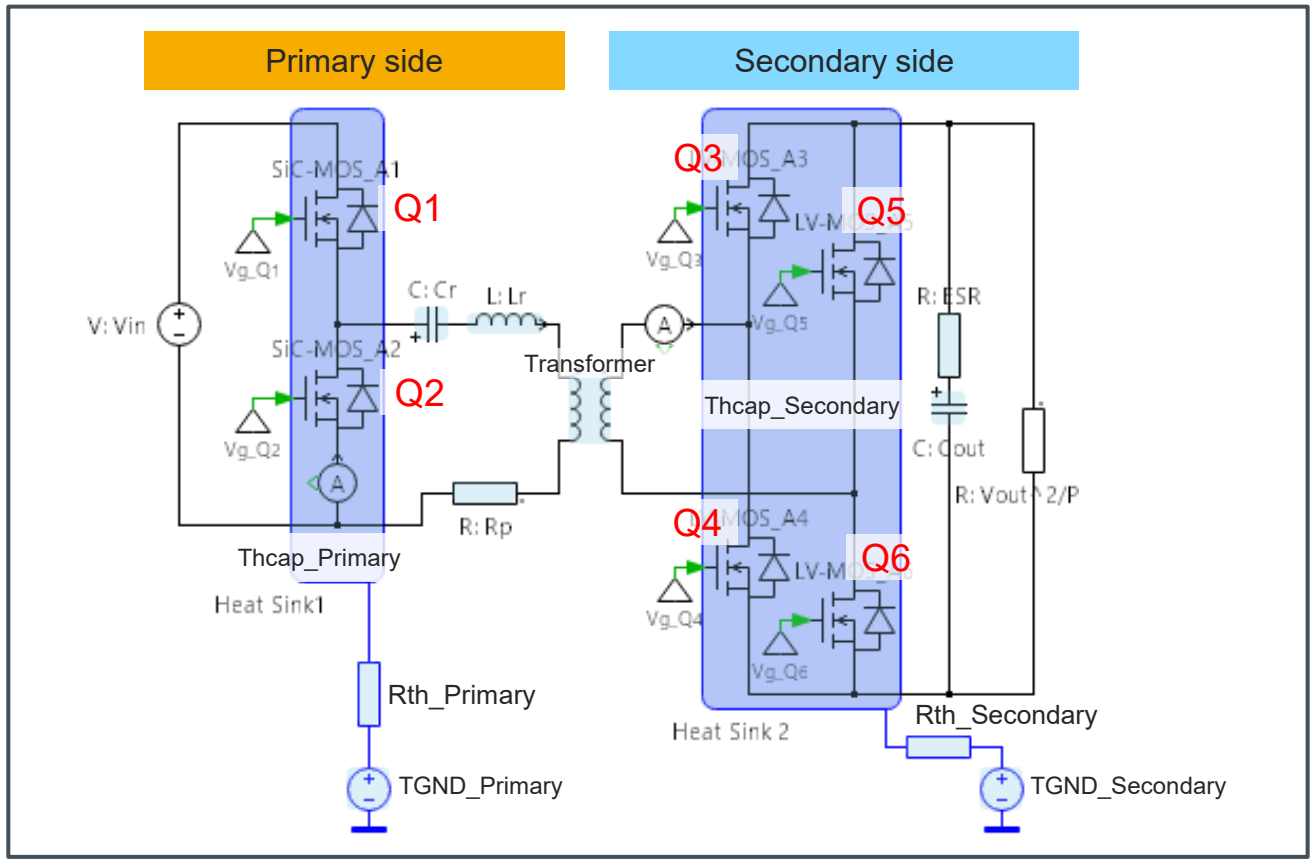
	Name	Content	unit	Default Value	Variable Range
	Transformer	Np: Primary-turns Ns: Secondary-turns Lm: Magnetizing Inductance	turns turns H	9 1 60u	1 ～ 1,000 1 ～ 1,000 1n～1
	Rp	Transformer Resistance	Ω	2m	1m ～ 1
	Lr	Resonant Inductance	H	12u	1n ～ 1
	Cr	Resonant Capacitance	F	100n	1n ～ 1
	Cout	Output Capacitance Initial Voltage	F V	4.7m 50	1n ～ 1 0 ～ 80
	ESR	ESR of Cout	Ω	15m	1m ～ 1
Primary	Thcap_Primary	Thermal Capacitance	J/K	0.1	1m ～ 100
Primary	Rth_Primary	Thermal Resistance	K/W	0.2	1m ～ 100
Primary	TGND_Primary	Ambient Temperature	℃	25	-40 ～ 175
Secondary	Thcap_Secondary	Thermal Capacitance	J/K	0.1	1m ～ 100
Secondary	Rth_Secondary	Thermal Resistance	K/W	0.2	1m ～ 100
Secondary	TGND_Secondary	Ambient Temperature	℃	25	-40 ～ 175

Simulation Parameters (Table)

	Name	Content	unit	Default Value	Variable Range
	Test_time	Test time in simulation	s	0.3	10u ～ 0.5
	Vin_dc	Input Voltage	V	800	400 ～ 1,200
	Vout_dc	Output Voltage	V	50	10 ～ 80
	Pout	Output Power	W	5,000	100～10,000
	fs_ref	Target Carrier Frequency	Hz	100k	10k～500k
Primary	Rg_on 1*	Gate Resistance (Source)	Ω	6.8	0.1 ～ 100
Primary	Rg_off 1*	Gate Resistance (Sink)	Ω	6.8	0.1 ～ 100
Primary	DT1	Dead Time	s	200n	0 ～1m
Secondary	Rg_on 2*	Gate Resistance (Source)	Ω	10	0.1 ～ 100
Secondary	Rg_off 2*	Gate Resistance (Sink)	Ω	10	0.1 ～ 100
Secondary	DT2	Dead Time	s	200n	0 ～1m
	T_init**	Initial Junction Temp.	℃	25	-40 ～ 175

*Common for all MOSFETs in the same side. **Common for all devices

Simulation Circuit



Power Devices

Name	Device Type	Part No.	Specification
Q1,2	SiC MOSFET	SCT4050KR	1200V/ 32A/ 50mΩ/ TO-247-4L
Q3～6	Si MOSFET	RS7N200BH	80V/ 200A/ 1.7mΩ/ DFN5060-8S

Simulation Screen Overview

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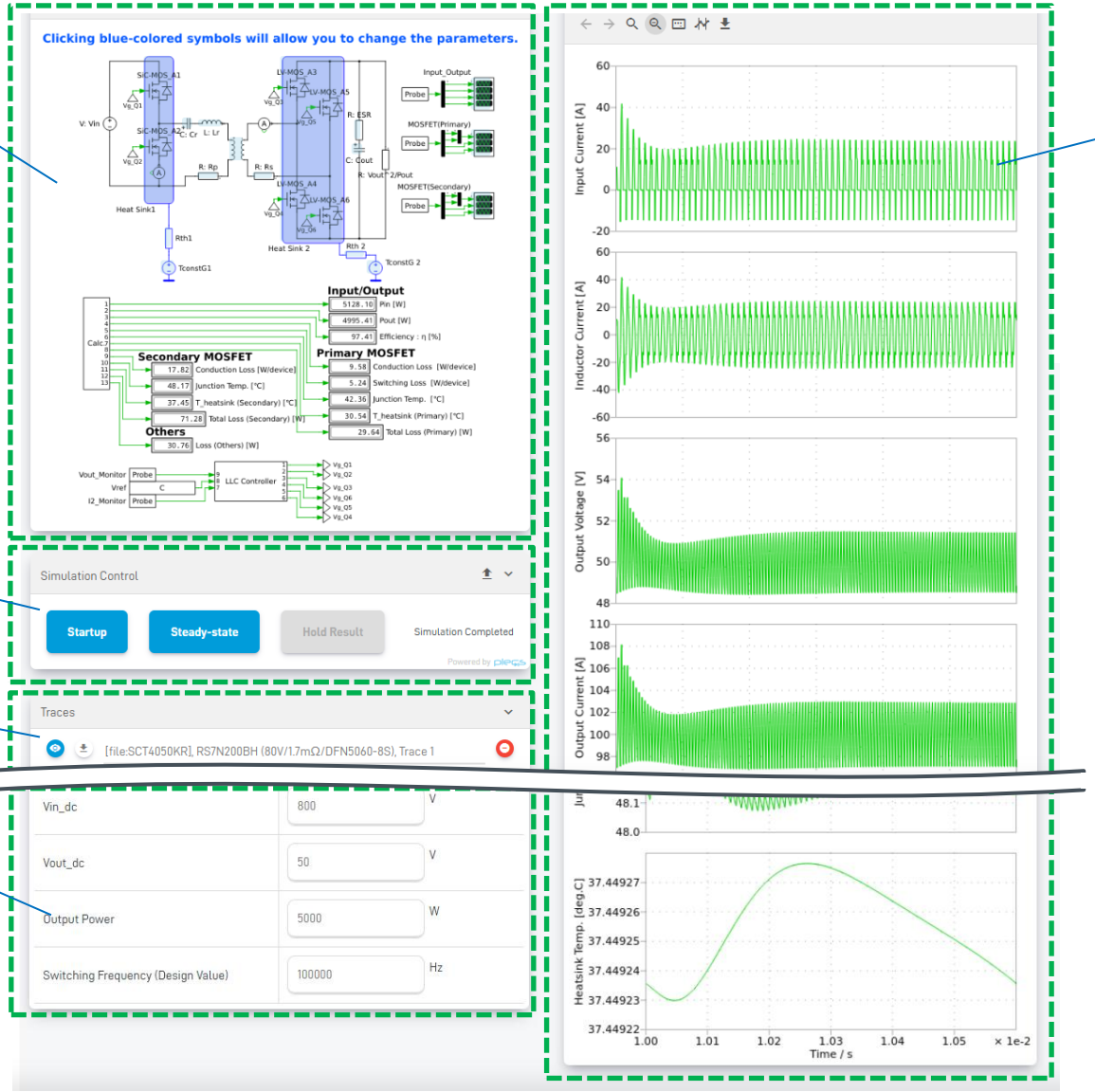
Schematic window
- Dialog parameters setting
- Results display

Simulation control

Trace selection

Table parameters setting



Waveforms

Simulation Results

Simulation Mode: Steady State

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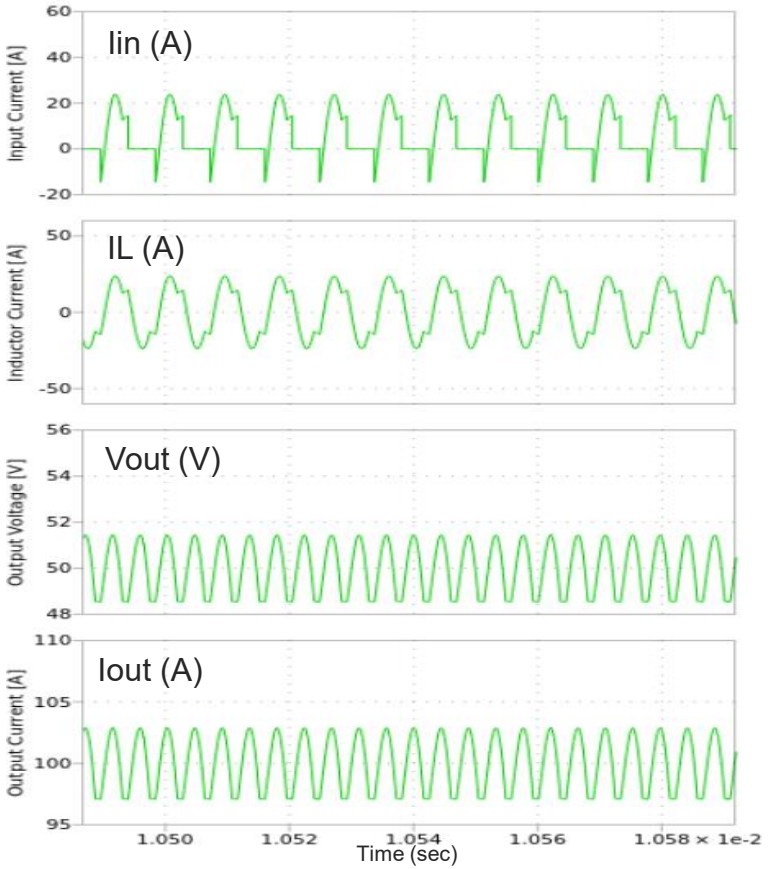
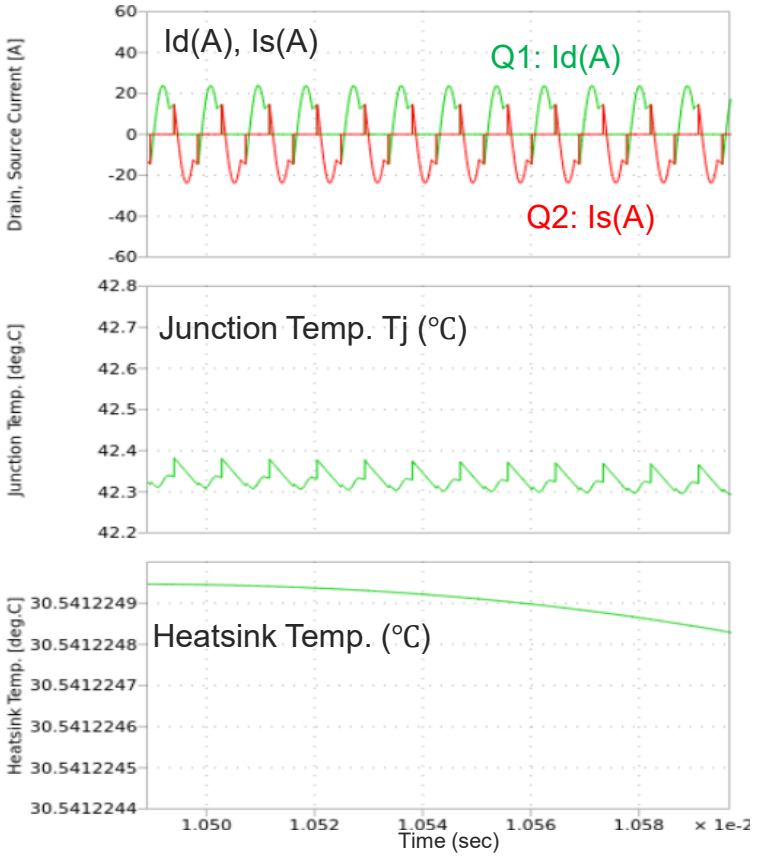
Input and Output



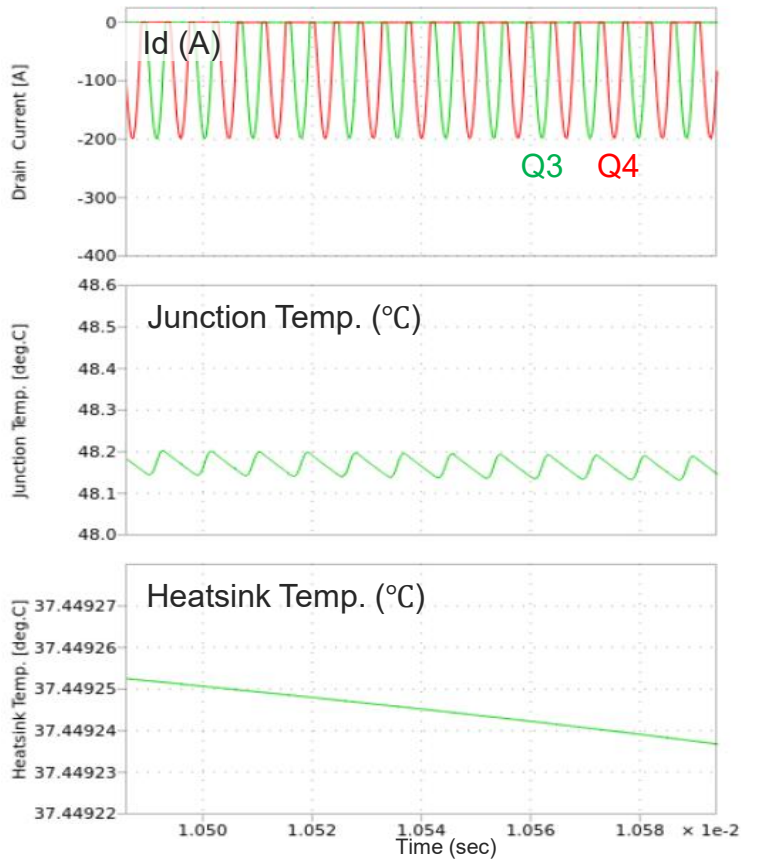
Contents	Results
Input Power : Pin	5.128 (kW)
Output Power: Pout	4.995 (kW)
Efficiency: η	97.41 (%)

Primary side



Contents	Results
Conduction Loss: Pcond (primary)	9.58 (W/device)
Switching Loss: Psw (primary)	5.24 (W/device)
Junction Temp. : Tj (primary)	42.36 (℃)
Heatsink Temp.: T_hs (primary)	30.54 (℃)
Total Loss: Ptot (primary)	29.64 (W)

Secondary side



Contents	Results
Conduction Loss: Pcond (secondary)	17.82 (W/device)
Junction Temp. : Tj (secondary)	48.17 (℃)
Heatsink Temp.: T_hs (secondary)	37.45 (℃)
Total Loss: Ptot (secondary)	71.28 (W)

How to change the devices

The figure of “(A-011-D) DC-AC Totem-Pole PFC Diode Rectification (Discrete)” is used as an example in this page.

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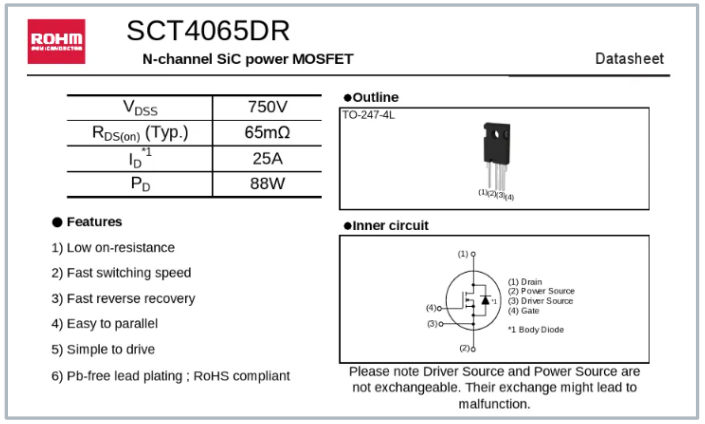
You can select the simulation devices at “Step-2: Device Selection”

Please check the checkboxes of the devices you want to simulate (Square checkboxes allow you to select up to three devices simultaneously.)

You can also select IDEAL devices (no-loss) .

In addition, clicking PDF icon will allow you to view the datasheet of the certain device.



SCT4065DR

N-channel SiC power MOSFET

Datasheet

V_{DSS}	750V
$R_{DS(on)}$ (Typ.)	65mΩ
I_D *1	25A
P_D	88W

●Outline

TO-247-4L

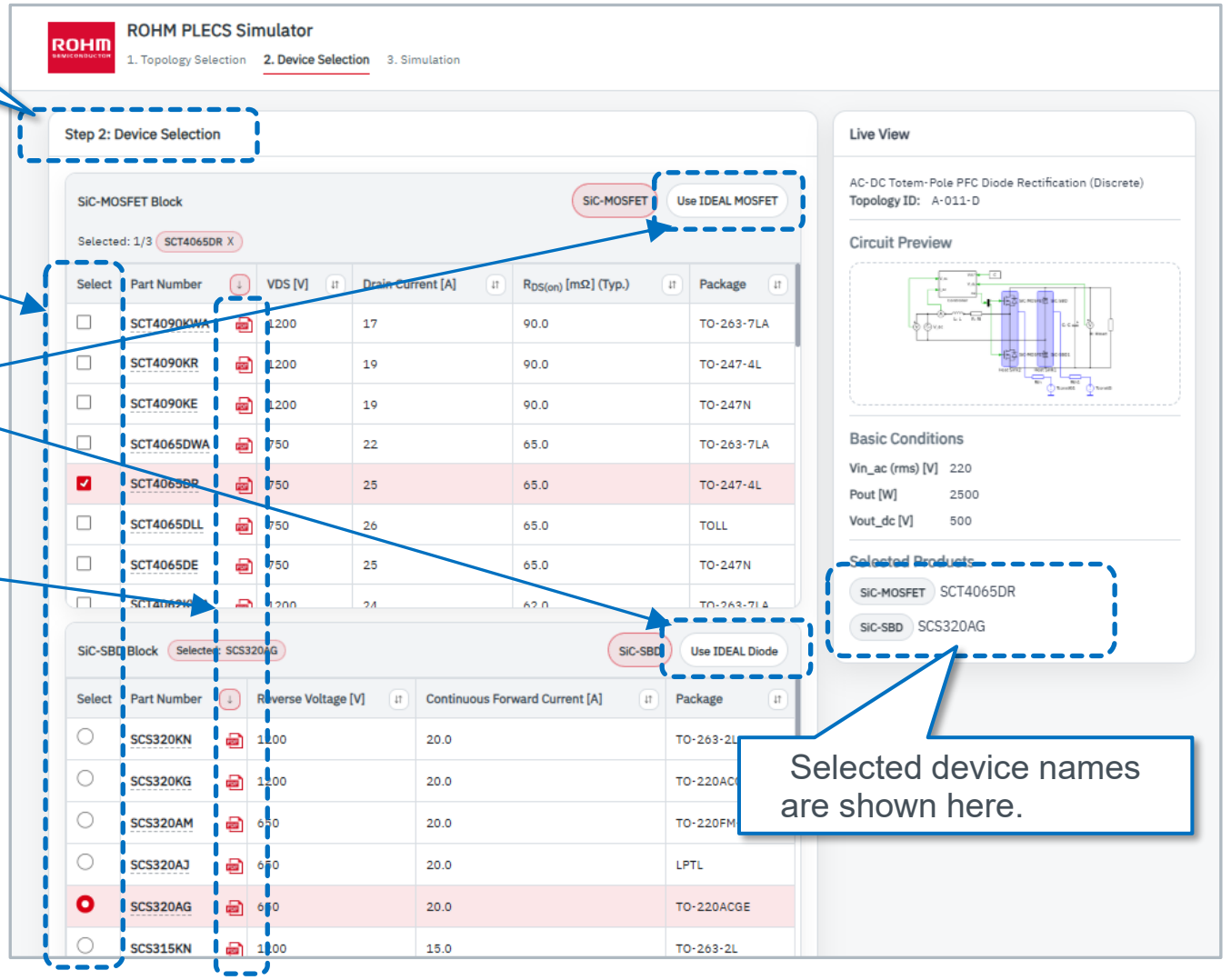
●Inner circuit

(1) Drain
(2) Power Source
(3) Driver Source
(4) Gate
*1 Body Diode

● Features

1) Low on-resistance
2) Fast switching speed
3) Fast reverse recovery
4) Easy to parallel
5) Simple to drive
6) Pb-free lead plating ; RoHS compliant

Please note Driver Source and Power Source are not exchangeable. Their exchange might lead to malfunction.



How to change Dialog parameters

The figure of “(A-011-D) DC-AC Totem-Pole PFC Diode Rectification (Discrete)” is used as an example in this page.

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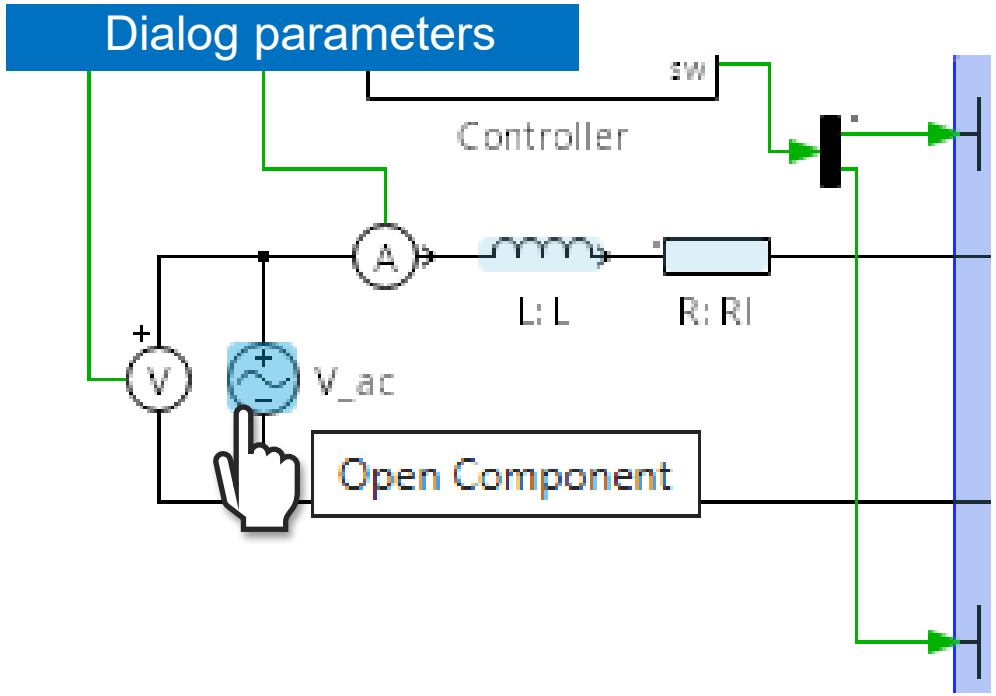
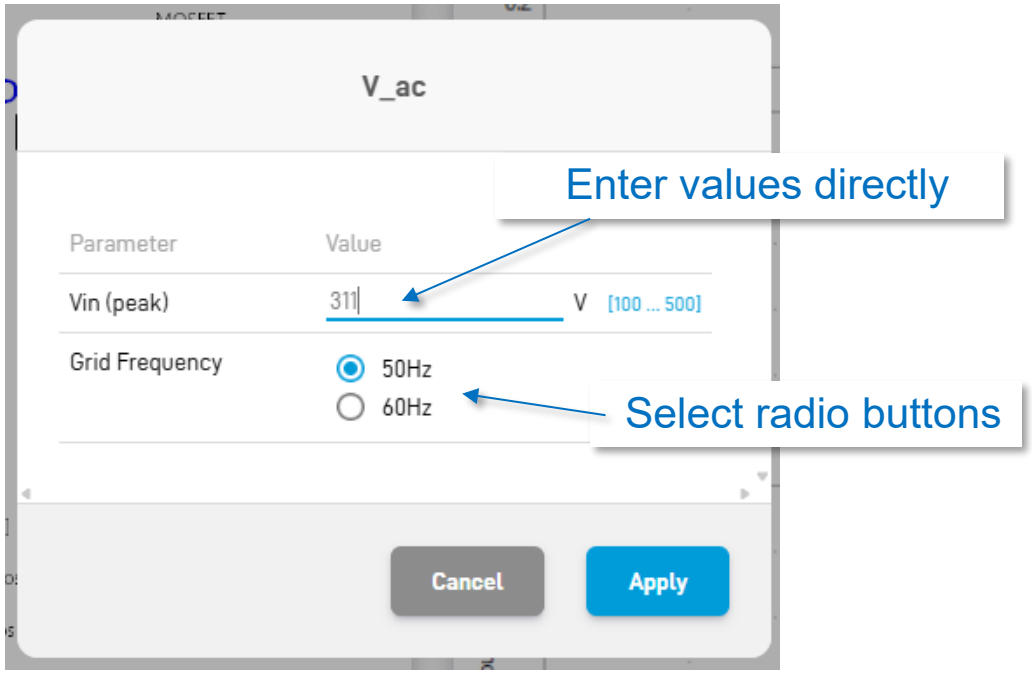
- Symbols whose parameters can be changed are colored light-blue in the circuit diagram.
- Over your mouse cursor to the symbol that you want to change the parameter and the symbol color is turned to blue (e.g. “V_ac” symbol in the below).
- Click the mouse’s left button.



- A new window like the below is opened.
- You can change the parameters by entering the value directly* or selecting radio buttons.
- Push “Apply” button after changing all parameters.



*Note: Parameters can be entered directly are limited by Min. and Max. values to avoid unexpected system errors.
(e.g. “Vin(peak)” is limited between 100 and 500V in the above.)

How to change Table parameters

The figure of “(A-011-D) DC-AC Totem-Pole PFC Diode Rectification (Discrete)” is used as an example in this page.

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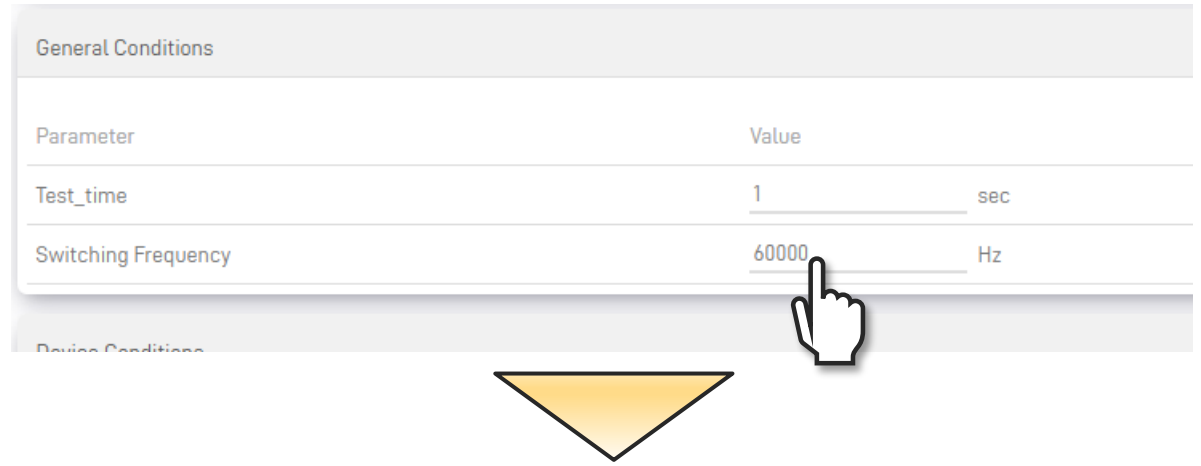
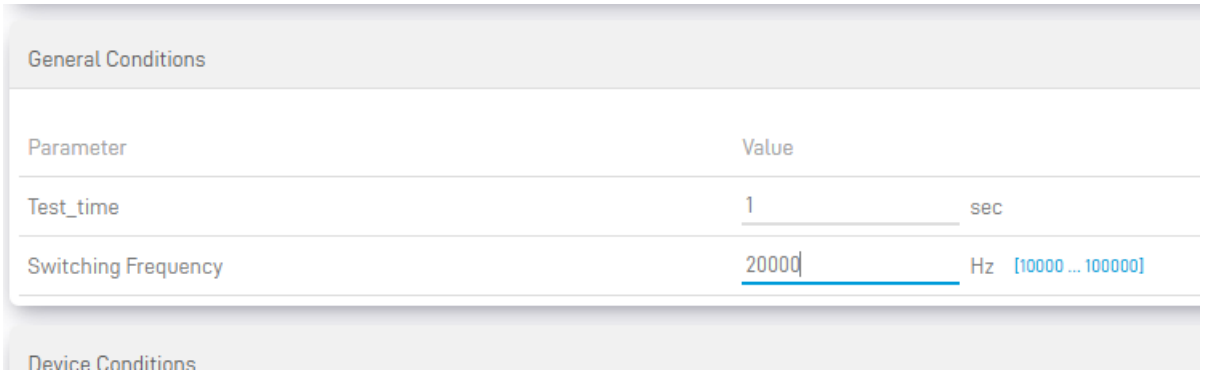
Table parameters





Choose the parameter that you want change on the parameter tables (e.g. ”60kHz” of Switching Frequency in the left figure.)

- A blue under-line and variable range of the parameter are appeared.
- Then, you can change the parameters by entering the value directly ” (e.g. “60kHz” was changed to “20kHz”).

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