

(C-023-D) DC-DC LLC Half-Bridge Buck Converter (Discrete)

Simulation Parameters (Dialog)

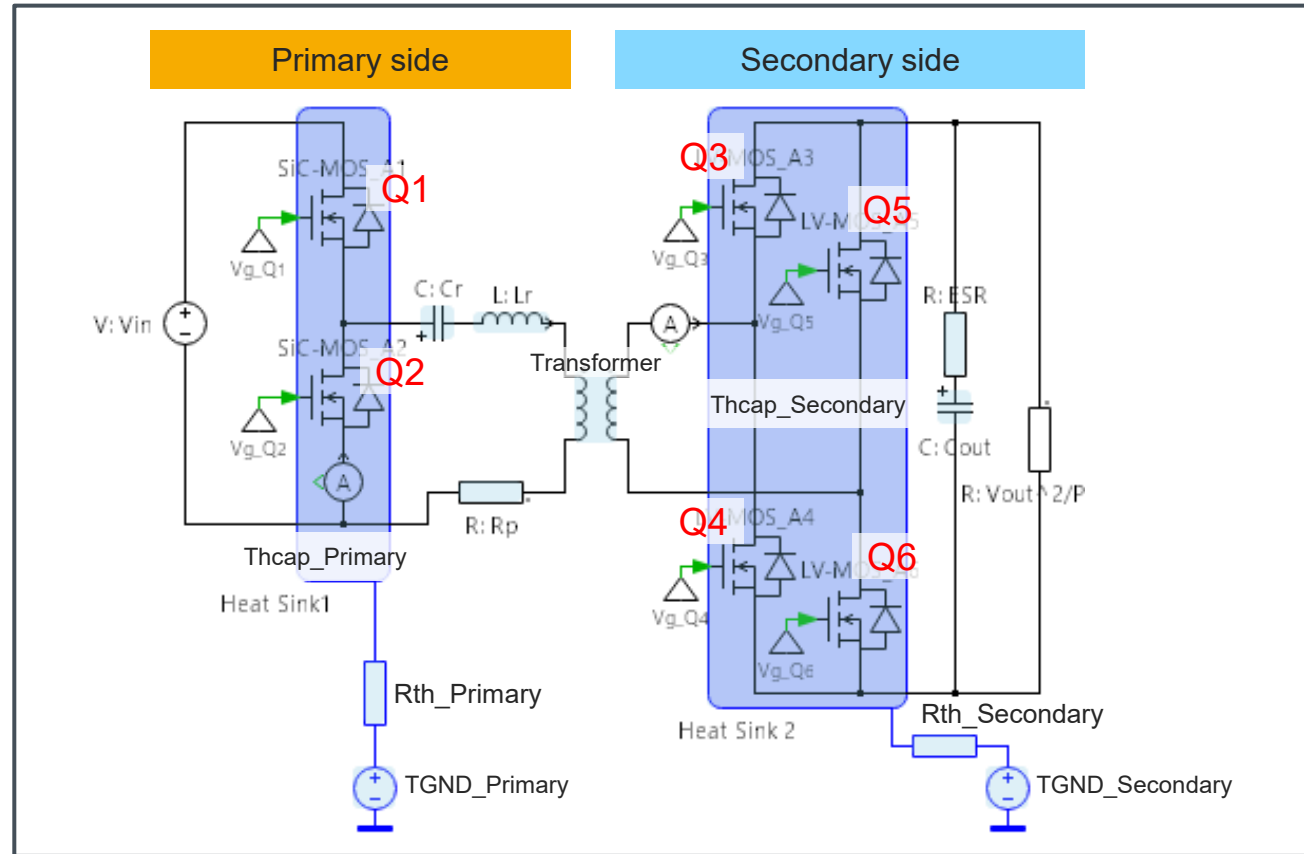
Name	Content	unit	Default Value	Variable Range
Transformer	Np: Primary-turns	turns	9	1 ~ 1,000
	Ns: Secondary-turns	turns	1	1 ~ 1,000
	Lm: Magnetizing Inductance	H	60u	1n~1
Rp	Transformer Resistance	Ω	2m	1m ~ 1
Lr	Resonant Inductance	H	12u	1n ~ 1
Cr	Resonant Capacitance	F	100n	1n ~ 1
Cout	Output Capacitance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

Simulation Parameters (Table)

Name	Content	unit	Default Value	Variable Range
Test_time	Test time in simulation	s	0.3	100u ~ 1
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
Rg_on 1*	Gate Resistance (Source)	Ω	2	0.1 ~ 100
Rg_off 1*	Gate Resistance (Sink)	Ω	1	0.1 ~ 100
DT1	Dead Time	s	200n	0 ~ 1m
Rg_on 2*	Gate Resistance (Source)	Ω	10	0.1 ~ 100
Rg_off 2*	Gate Resistance (Sink)	Ω	10	0.1 ~ 100
DT2	Dead Time	s	200n	0 ~ 1m
T_init**	Initial Junction Temp.	°C	25	-40 ~ 175

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

Simulation Circuit



Default 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

Schematic window

- Dialog parameters setting
- Results display

The screenshot displays the ROHM PLECS Simulator interface, which is divided into several functional areas:

- Schematic Window (Top):** Shows a power electronic circuit diagram with components like MOSFETs, diodes, and thermal nodes. Below the schematic is an 'Input/Output' table and a 'Secondary MOSFET' parameter table.
- Device Selection (Middle-Left):** A table listing various MOSFET models for selection.

Parameter	Value
[Primary] SIC-MOSFET	SCT4018KR (1200V/18mD/TO-247-4L)
	SCT4036KR (1200V/36mD/TO-247-4L)
	SCT4050KR (1200V/50mD/TO-247-4L)
	SCT4062KR (1200V/62mD/TO-247-4L)
	SCT4090KR (1200V/90mD/TO-247-4L)
	SCT4018KE (1200V/18mD/TO-247N)
	SCT4036KE (1200V/36mD/TO-247N)
	SCT4050KE (1200V/50mD/TO-247N)
	SCT4062KE (1200V/62mD/TO-247N)
	SCT4090KE (1200V/90mD/TO-247N)
	SCT4018KWA (1200V/18mD/TO-263-7LA)
	SCT4036KWA (1200V/36mD/TO-263-7LA)
	SCT4050KWA (1200V/50mD/TO-263-7LA)
	SCT4062KWA (1200V/62mD/TO-263-7LA)
	SCT4090KWA (1200V/90mD/TO-263-7LA)
- Table Parameters Setting (Middle-Left):** A table for setting device conditions.

Parameter	Value	Unit
[Primary] Rg_on1	2	ohm
[Primary] Rg_off1	1	ohm
[Primary] Dead Time1	2e-7	sec
[Secondary] Rg_on2	10	ohm
[Secondary] Rg_off2	10	ohm
- Simulation Control (Bottom-Left):** Includes buttons for 'Startup', 'Steady-state', and 'Hold Result'. The status shows 'Simulation Completed'.
- Trace Selection (Bottom-Left):** A list of simulation traces, including '[He]SCT4050KR', 'RSN200GH (88V/1.7mQ/DFN-8S)', and 'Trace 1'.
- Waveforms (Right):** A series of plots showing simulation results over time (0.00 to 0.30 s). The top plots show Input Current [A] and Inductor Current [A] as green horizontal bars. The middle plots show Output Voltage [V] and Output Current [A] as green horizontal bars. The bottom plots show MOSFET Primary and Diode Saturated Current [A] as red horizontal bars. The bottom-most plot shows Junction Temperature [degC] as a green curve that rises from approximately 25°C to 35°C.

Waveforms

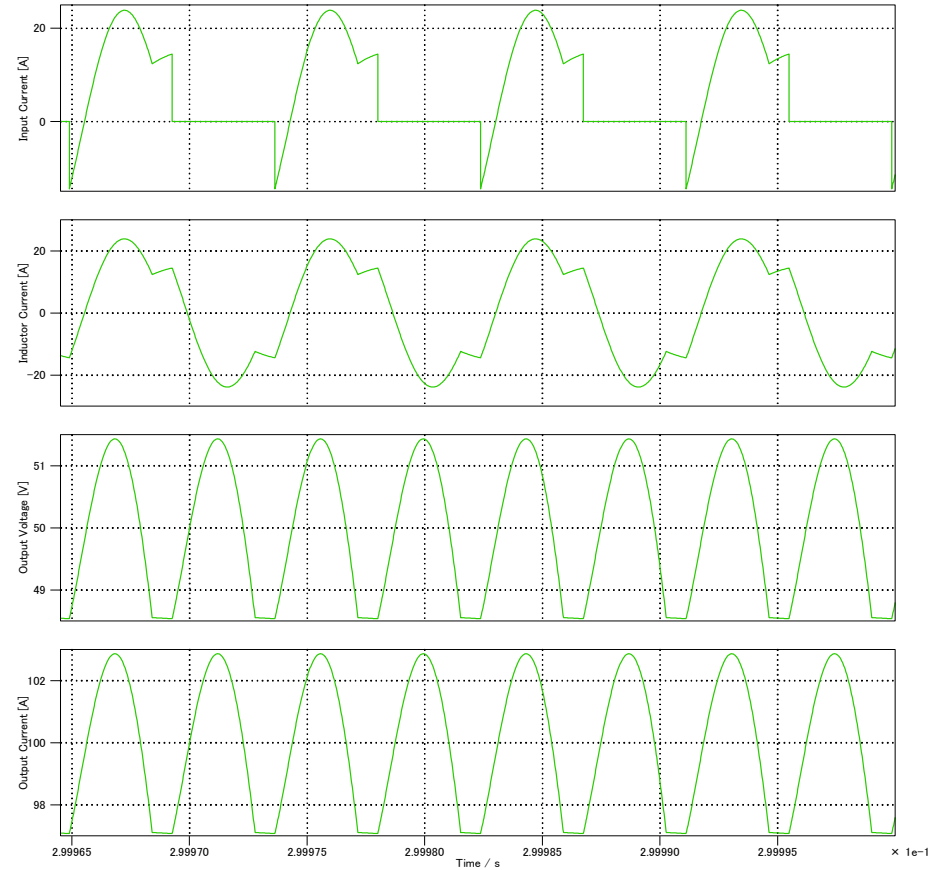
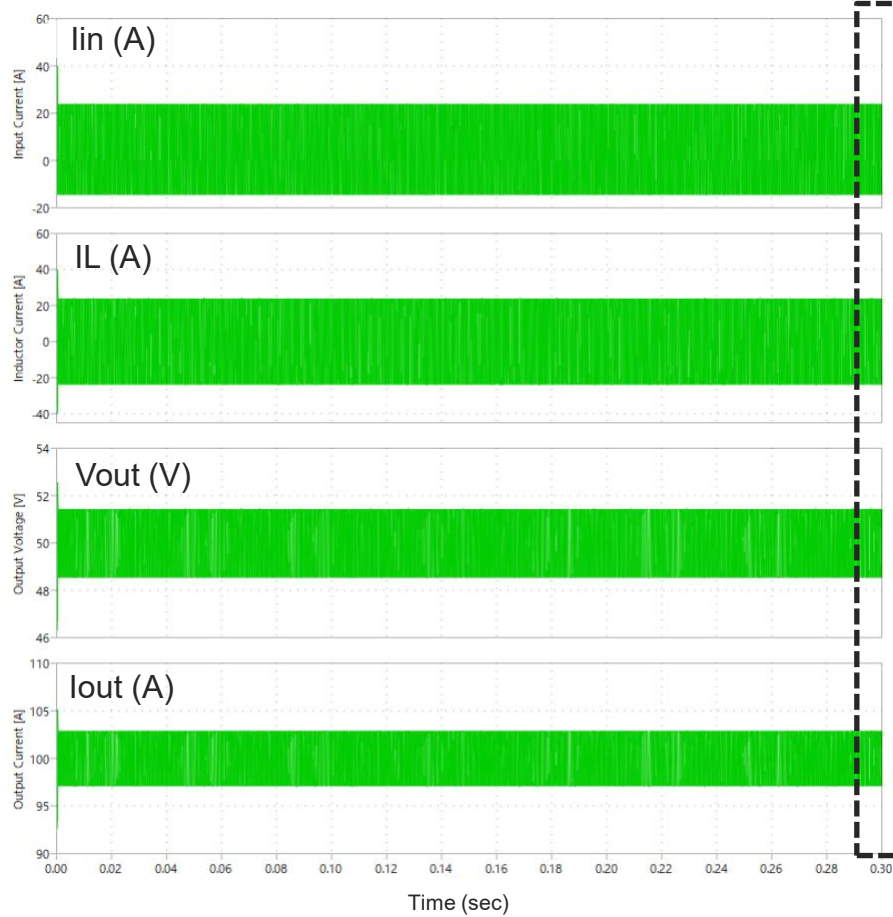
Device selection

Table parameters setting

Simulation control

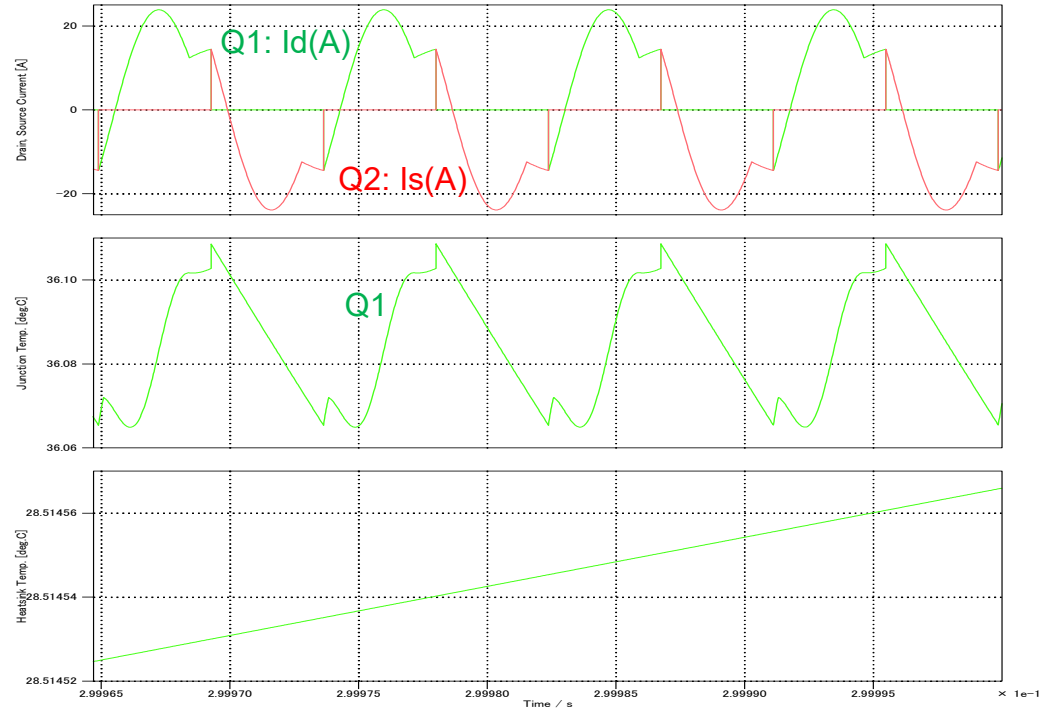
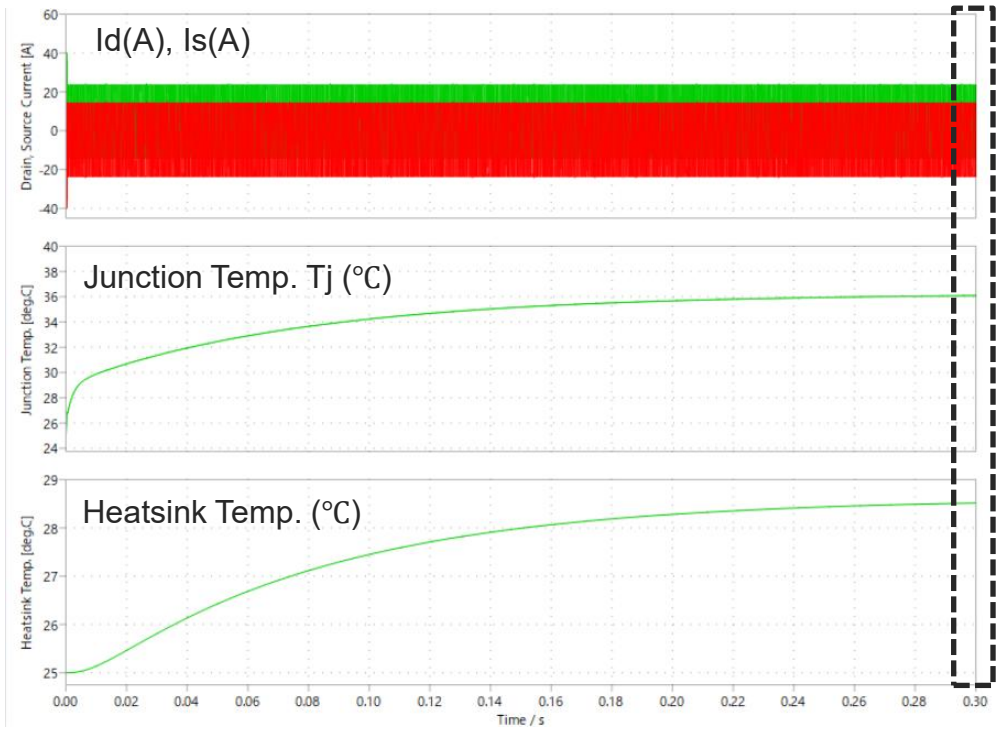
Trace selection

Input and Output



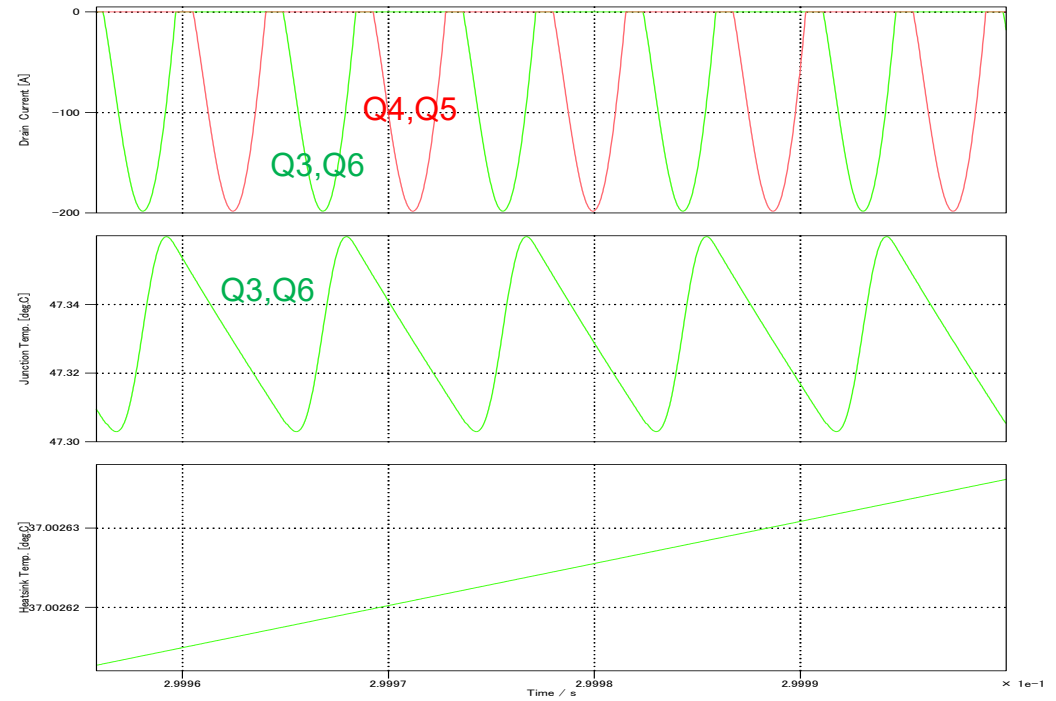
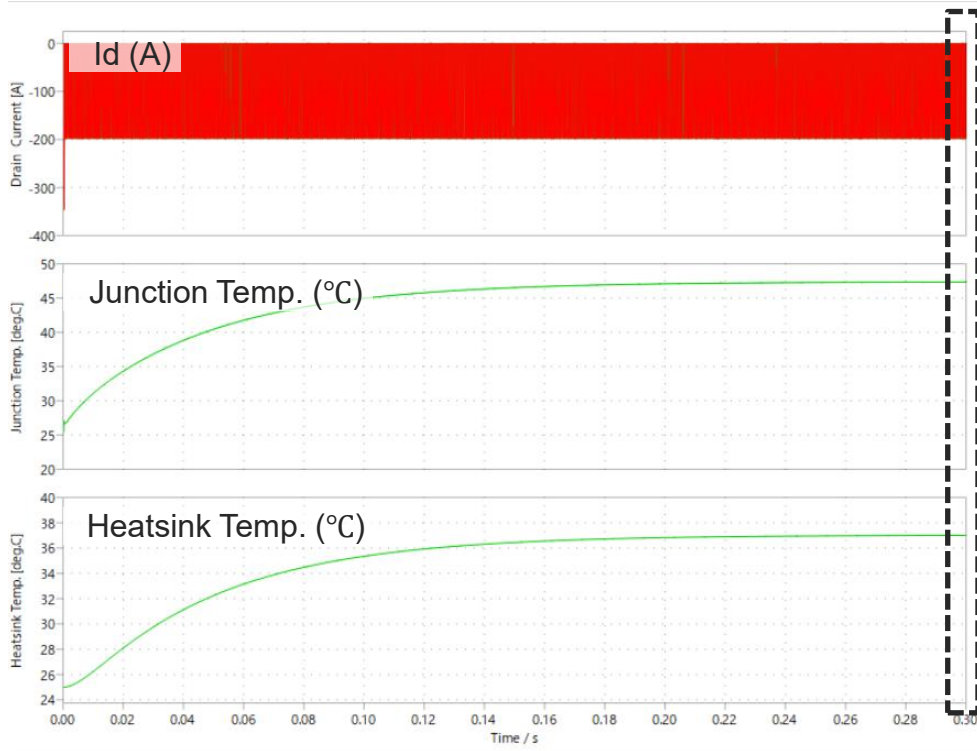
Contents	Results
Input Power : Pin	5.110 (kW)
Output Power: Pout	5.006 (kW)
Efficiency: η	97.98 (%)

Primary side



Contents	Results
Conduction Loss: Pcond (primary)	8.00 (W/device)
Switching Loss: Psw (primary)	0.68 (W/device)
Junction Temp. : Tj (primary)	36.17 (°C)
Heatsink Temp.: T_hs (primary)	28.54 (°C)
Total Loss: Ptot (primary)	17.35 (W)

Secondary side



Contents	Results
Conduction Loss: Pcond (secondary)	13.37 (W/device)
Junction Temp. : Tj (secondary)	47.55 (°C)
Heatsink Temp.: T_hs (secondary)	37.11 (°C)
Total Loss: Ptot (secondary)	53.48 (W)

How to change the devices

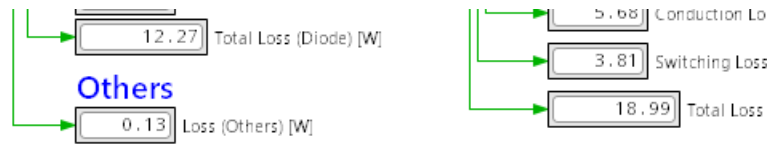
The figure of "(A-011-D) DC-AC Totem-Pole PFC Diode Rectification (Discrete)" is used as an example in this page.

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Circuit Information



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Device Selection



Device Selection	
Parameter	Value
Part No. (SiC-MOSFET)	SCT4065DR (750V/65mΩ/TO-247-3)
Part No. (SiC-Schottky Barrier Diode)	SCS320AG (650V/20A/TO-220-3)



Device Selection	
Parameter	Value
Part No. (SiC-MOSFET)	SCT4065DR (750V/65mΩ/TO-247-3)
Part No. (SiC-Schottky Barrier Diode)	SCS320AG (650V/20A/TO-220-3)

Available Device Lists	
SCT4036DWA (750V/36mΩ/TO-263-7LA)	
SCT4045DWA (750V/45mΩ/TO-263-7LA)	
SCT4065DWA (750V/65mΩ/TO-263-7LA)	
SCT4013DLL (750V/13mΩ/TOLL)	
SCT4026DLL (750V/26mΩ/TOLL)	
SCT4036DLL (750V/36mΩ/TOLL)	
SCT4045DLL (750V/45mΩ/TOLL)	

Over your mouse cursor to the device name that you want to change and click the left button of the mouse.

Available device lists are appeared like the above, and you can select a favorite device from these.

How to change Dialog parameters

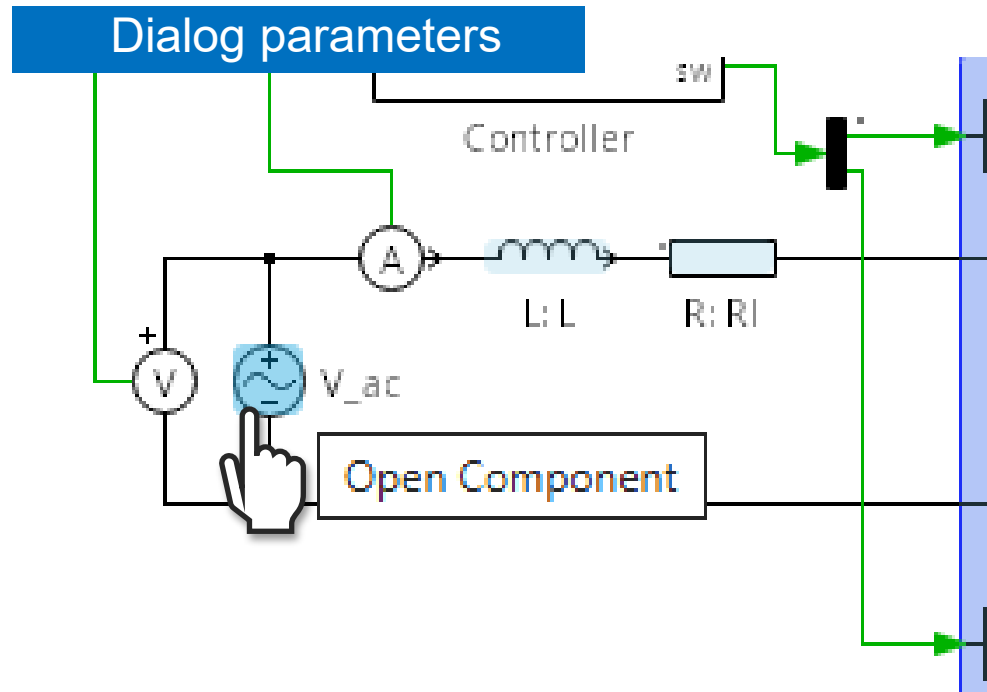
The figure of "(A-011-D) DC-AC Totem-Pole PFC Diode Rectification (Discrete)" is used as an example in this page.

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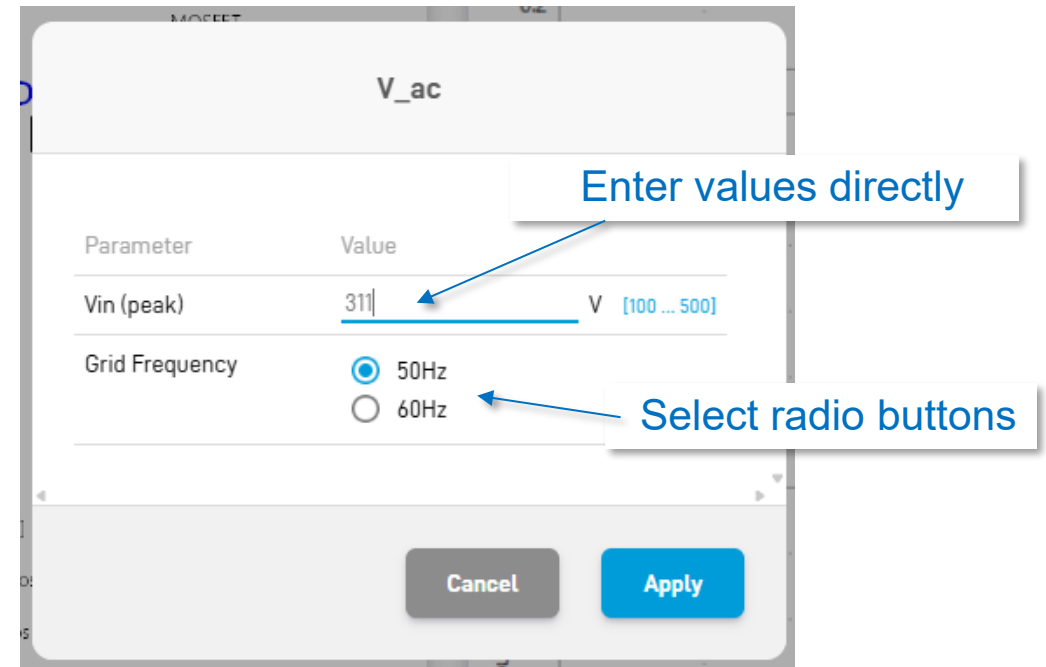


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- Symbols whose parameters can be changed are colored light-blue in the circuit diagram.
- Over your mouse cursor to the symbol that you want to change the parameter and the symbol color is turned to blue (e.g. "V_ac" symbol in the below).
- Click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

General Conditions

Parameter	Value
Test_time	1 sec
Switching Frequency	60000 Hz

Device Conditions

General Conditions

Parameter	Value
Test_time	1 sec
Switching Frequency	<u>20000</u> Hz [10000 ... 100000]

Device Conditions

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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