

# (C-019-D) DC-DC Phase-Shift Full-Bridge Buck Converter (Discrete)

## Simulation Parameters (Dialog)

Name	Content	unit	Default Value	Variable Range
Transformer	Np: Primary-turns	turns	10	1 ~ 1000
	Ns: Secondary-turns	turns	9	1 ~ 1000
	Lm: Magnetizing Inductance	H	1m	1n~1
Lr	Leakage Inductance	H	6.8u	1n ~ 1
Lout	Output Inductance	H	330u	1n ~ 1
Cout	Output Capacitance	F	47u	1n ~ 1
Vc_init	Initial Voltage of Cout	V	300	0 ~ 1200
Rp	Parasitic Resistance (Primary)	ohm	5m	1n ~ 100
Rs	Parasitic Resistance (Secondary)	ohm	5m	1n ~ 100
Primary	Thcap_Primary	Thermal Capacitance	J/K	0.1 ~ 100
	Rth_Primary	Thermal Resistance	K/W	0.3 ~ 100
	TGND_Primary	Thermal GND Temperature	°C	-40 ~ 175
Secondary	Thcap_Secondary	Thermal Capacitance	J/K	0.1 ~ 100
	Rth_Secondary	Thermal Resistance	K/W	0.3 ~ 100
	TGND_Secondary	Thermal GND Temperature	°C	-40 ~ 175

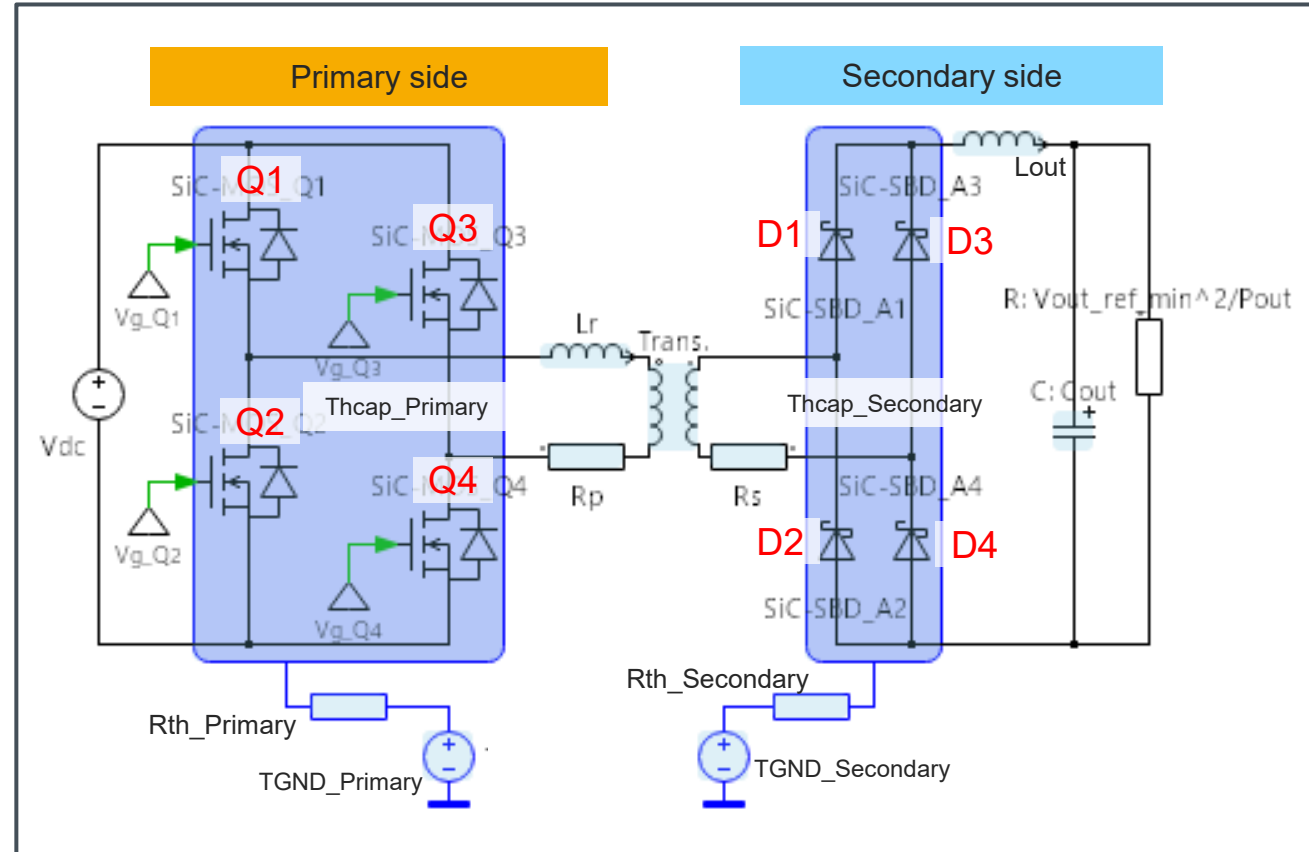
## Simulation Parameters (Table)

Name	Content	unit	Default Value	Variable Range
Test_time	Test time in simulation	s	0.2	100u ~ 0.5
fs	Switching Frequency	Hz	30k	10k ~ 100k
Vin	Input Voltage	V	400	100 ~ 1200
Vout_ref_min	Output Voltage	V	300	10 ~ 1200
Vout_ref_max			320	
Pout	Output Power	W	5000	100 ~ 10000
Rg_on*	Gate Resistance (Source)	Ω	6.8	0.1 ~ 100
Rg_off*	Gate Resistance (Sink)	Ω	6.8	0.1 ~ 100
DT	Dead Time	s	100n	0 ~ 1m
T_init**	Initial Junction Temp.	°C	25	-40 ~ 175

\*Common for all MOSFETs

\*\*Common for all devices

## Simulation Circuit



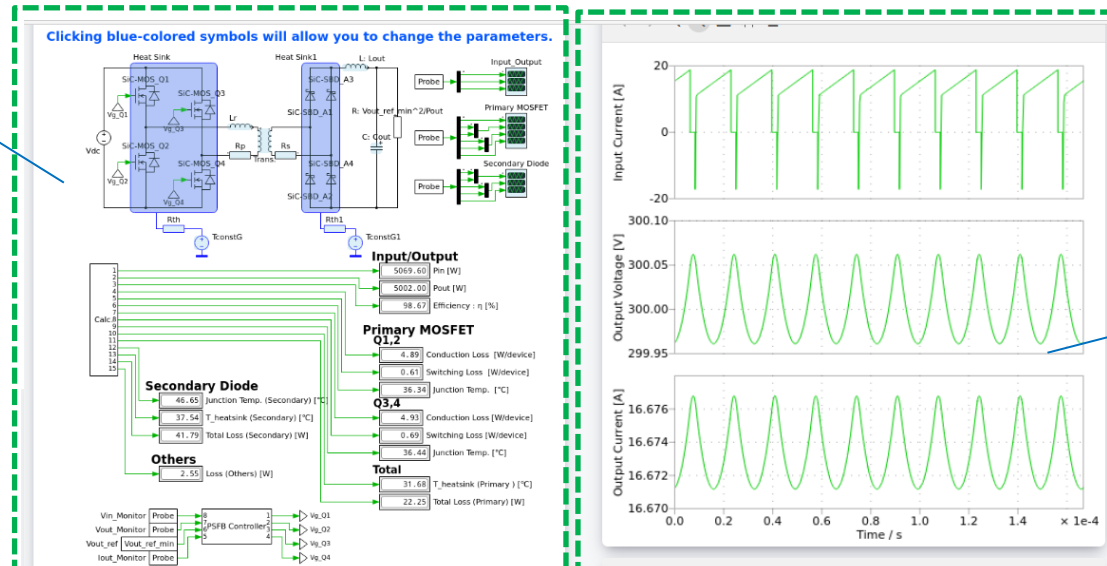
## Power Devices

Name	Device Type	Part No.	Specification
Q1~4	SiC MOSFET	SCT4036DR	750V/ 42A/ 13mΩ/ TO-247-4L
D1~4	SiC SBD***	SCS320AG	650V/ 20A/ TO-220ACGE

\*\*\* SBD: Schottky Barrier Diode

Schematic window

- Dialog parameters setting
- Results display



Simulation control

Simulation Control

Start-Up    Steady-state    Hold Result    Simulation Completed

Powered by PLECS

Trace selection

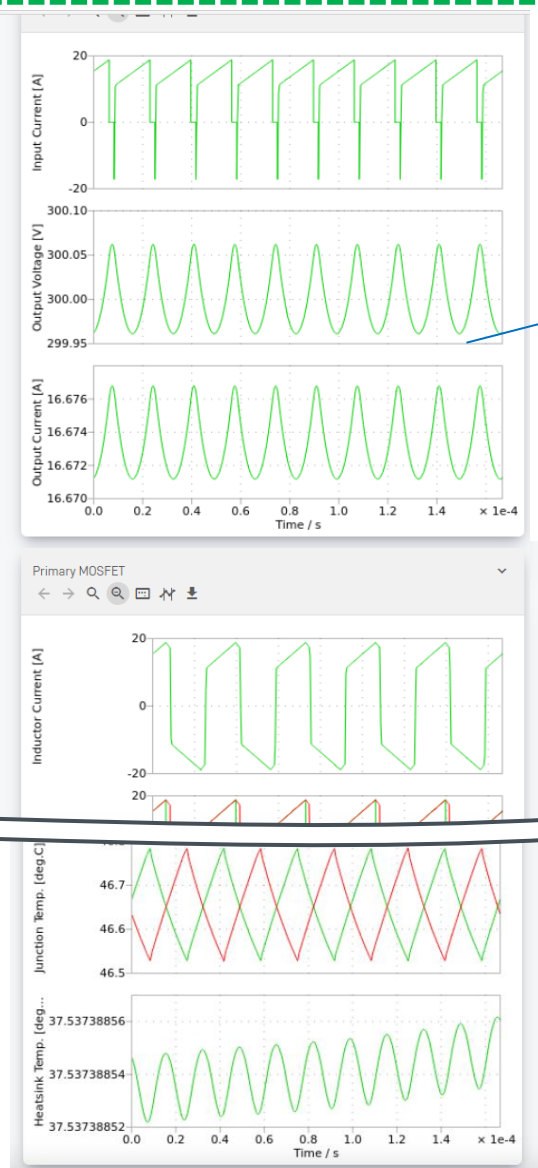
Traces

[file:SCT4036DR], SCS320AG (650V/20A/TO-220ACGE), Trace 1

Table parameters setting

Switching Frequency	30000	Hz
Vin_dc	400	V
Vout_dc (Min.limit)	300	V
Vout_dc (Max.limit)	320	V
Pout	5002	W

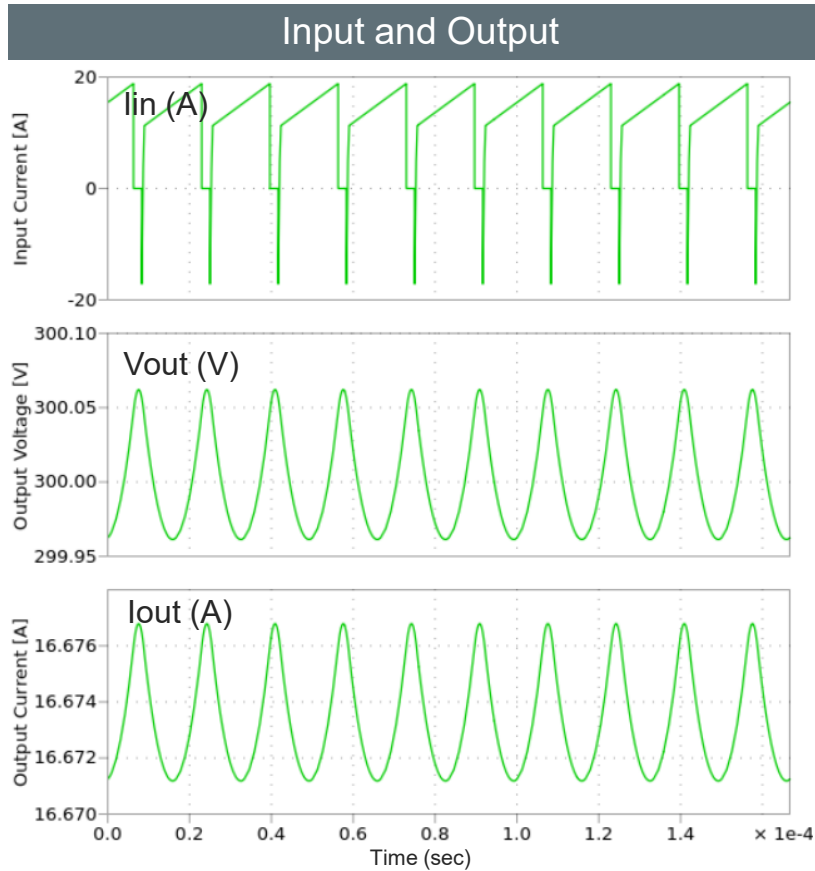
Waveforms



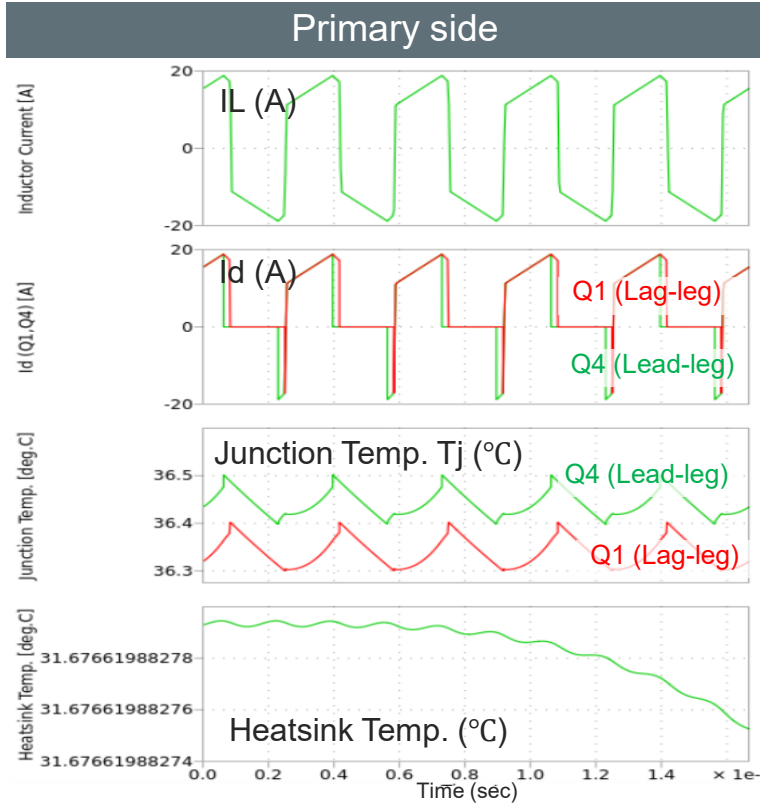
# Simulation Results

Simulation Mode: Steady State

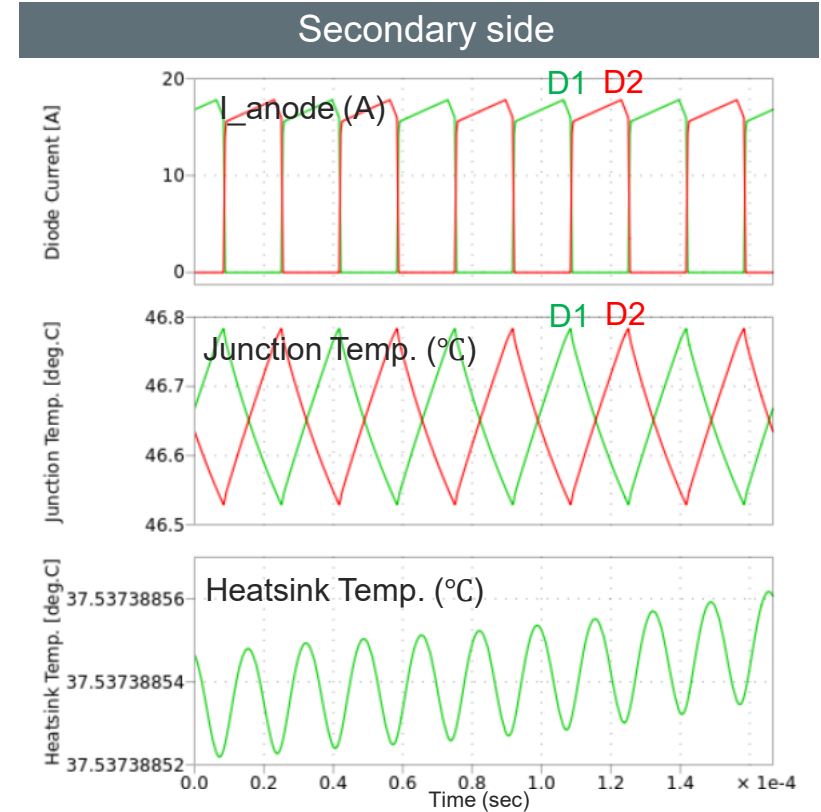
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Contents	Results
Input Power : Pin	5.070 (kW)
Output Power: Pout	5.002 (kW)
Efficiency: $\eta$	98.67 (%)



	Contents	Results
Q4 Lead-leg	Conduction Loss: Pcond (Q4)	4.89 (W/device)
	Switching Loss: Psw (Q4)	0.61 (W/device)
	Junction Temp. : Tj (Q4)	36.34 (°C)
Q1 Lag-leg	Conduction Loss: Pcond (Q1)	4.93 (W/device)
	Switching Loss: Psw (Q1)	0.69 (W/device)
	Junction Temp. : Tj (Q1)	36.44 (°C)
	Heatsink Temp.: T_hs (primary)	31.68 (°C)
	Total Loss: Ptot (primary)	22.25 (W)



Contents	Results
Junction Temp. Tj (secondary D1,D2)	46.65 (°C)
Heatsink Temp. T_hs (secondary)	37.54 (°C)
Total Loss: Ptot (secondary)	41.79 (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.

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

**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.

Selected device names are shown here.

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

**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

# 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.

ROHM PLECS Simulator  
Simulation Example

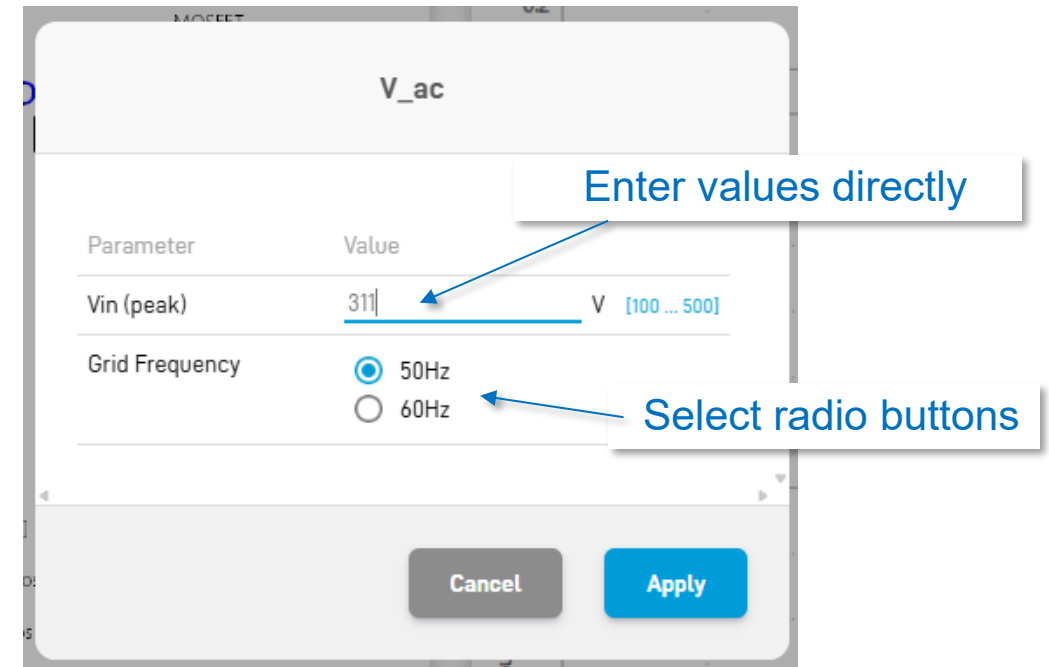


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- Symbols whose parameters can be changed are colored light-blue in the circuit diagram.
- Over your mouse cursor to the symbol that you want to change the parameter and the symbol color is turned to blue (e.g. "V\_ac" symbol in the below).
- Click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

## Table parameters

The diagram illustrates the process of changing a parameter in a table. It shows two screenshots of a parameter table. The top screenshot shows a table with two rows: 'Test\_time' with a value of '1' and unit 'sec', and 'Switching Frequency' with a value of '60000' and unit 'Hz'. A hand cursor is pointing at the '60000' value. A yellow arrow points down to the second screenshot, which shows the same table but with the 'Switching Frequency' value changed to '20000'. The '20000' value is underlined in blue, and a blue range '[10000 ... 100000]' is visible to its right, indicating that the parameter is now interactive and can be changed directly.

Parameter	Value
Test_time	1 sec
Switching Frequency	60000 Hz

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

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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