IGBT losses in hard switching

Energy Saving Products BU
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International
IOR Rectifier

The IGBT Selector calculates the losses

IGBTs are ranked by junction temperature

Switching and conduction losses

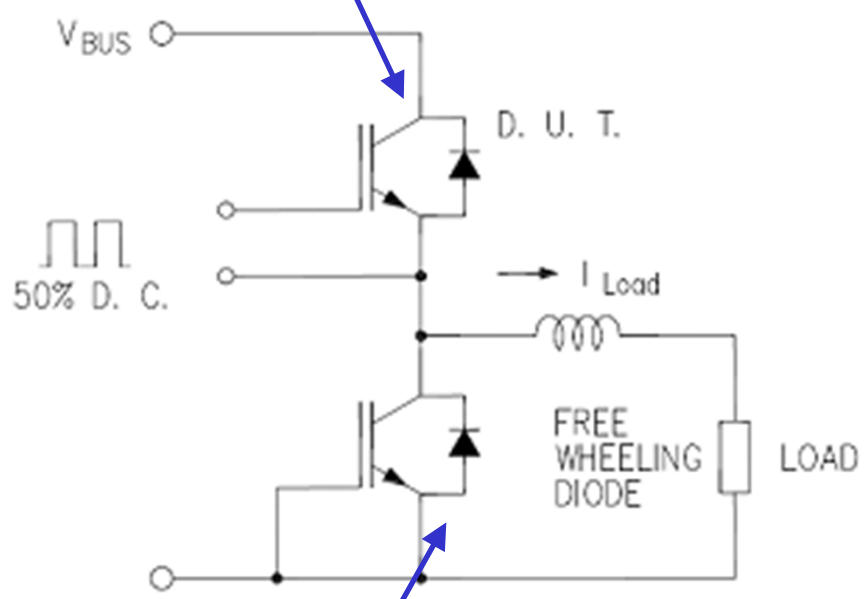
LISTED BELOW ARE THE IGBTs THAT MEET YOUR APPLICATION PARAMETERS

	Part Number	Junct. Temp., °C	Total Pd, W	Switch. Pd, W	Cond. Pd, W
☑	IRGB4056DPBF	105.6	13.41	4.76	8.65
☑	IRGB4064DPbF	111.6	13.51	3.83	9.68
☑	IRGB4060DPbF	116.8	14.69	4.17	10.52
☑	IRGB10B60KDPBF	116.2	17.48	7.12	10.36
☐	IRGB4045DPbF	142.4	18.84	5.06	13.78

For detailed conditions, see next page

Circuit and conditions – 1

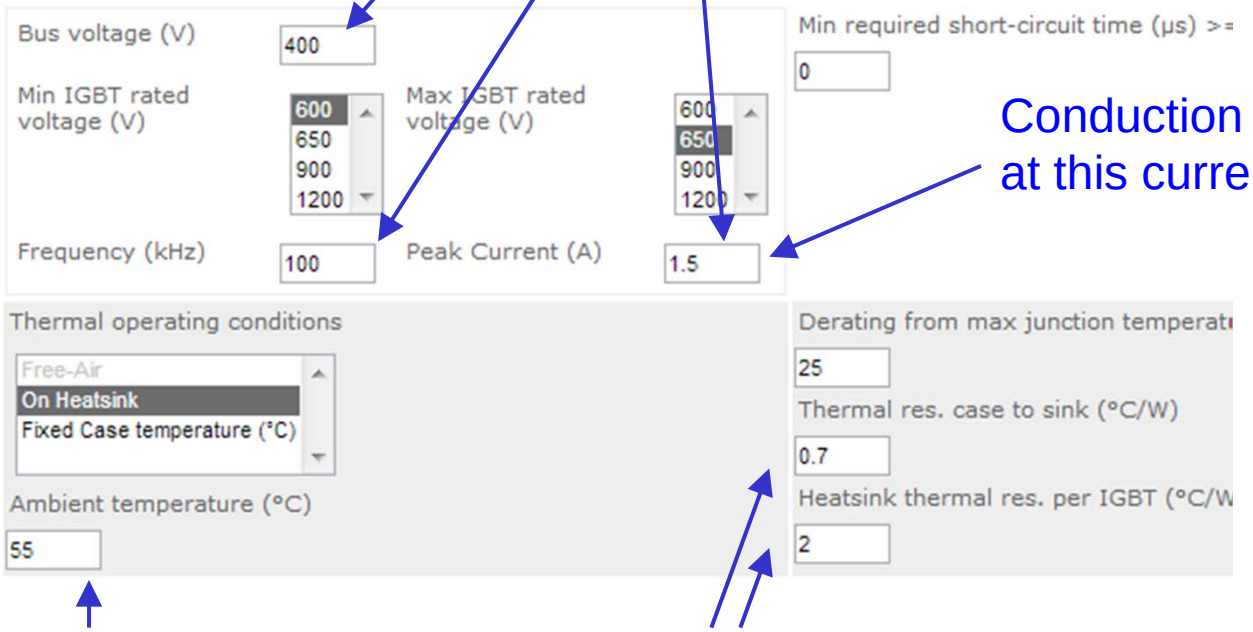
1. Buck (or Boost) converter operating at 50% duty cycle, single switch
2 Losses are calculated for the operating temperature indicated in the results
3. Hard switching. IGBT turn-on losses due to diode reverse recovery are included in the switching losses



Diode losses are not calculated
Conduction losses scale with duty cycle, switching losses do not change.

Circuit and conditions – 2

Switching losses are calculated at:
- this voltage
- this current
- this frequency



Conduction losses are calculated at this current

Ambient temperature

Thermal resistances

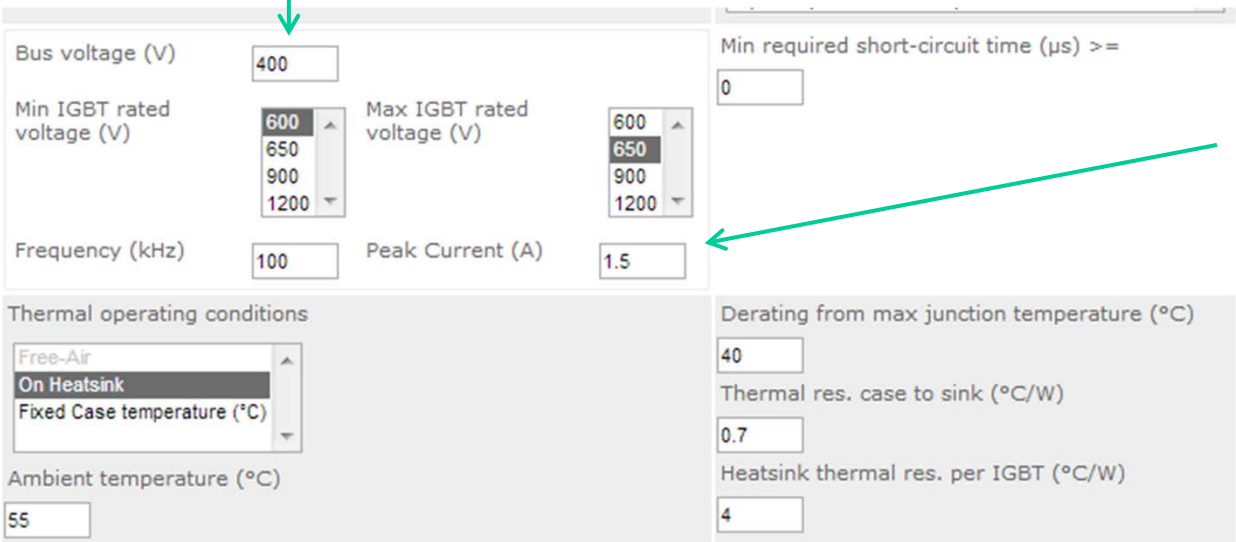
All losses are calculated at the temperature indicated in the results.

What if you don't know the thermal resistance of the sink? (see later)

Topologies with variable current and duty cycle

PFC, continuous current

Enter boost voltage



Use the rms value of the line current

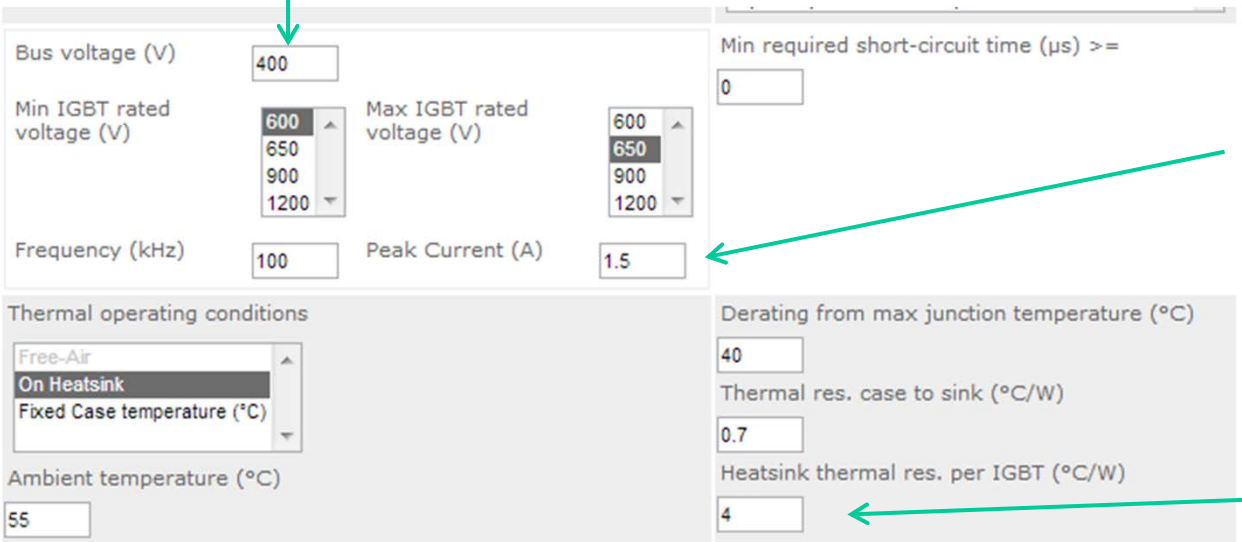
PFCs operate at a duty cycle that is less than 50%.
Scale the conduction losses from 50% to the average duty cycle

Some PFCs operate in discontinuous mode with triangular waveforms. Losses cannot be calculated with this tool

Topologies with variable current and duty cycle

Buss voltage

Motor drives



Use the rms value of the motor current

"per IGBT": heatsink for 6 IGBTs would be 1.3

Results are not accurate because diode losses are not included. They provide a good indication of what they are likely to be and they are very useful to compare alternative IGBTs.
Tools dedicated to motor drives are available. Some are already on the web (follow link below).

https://ec.irf.com/v6/en/US/direct/ir?cmd=dcIpowirHome&action=simConfig.do&appNode=iSine

What if you don't know the heatsink size?

Select "Fixed case temperature"

Enter a reasonable operating temperature for the stated conditions.
A lower temperatures requires a bigger heatsink
For SM applications remember that FR4 is limited to 110-125ºC

LISTED BELOW ARE THE IGBTs THAT MEET YOUR APPLICATION PARAMETERS

	Part Number	Junct. Temp., °C	Total Pd, W	Switch. Pd, W	Cond. Pd, W
☐	IRG4PC50UPbF	102.3	3.59	2.90	0.69
☐	IRG4PC40WPbF	103.1	4.02	3.20	0.83

The losses in the table can be used to calculate a first approximation for the heatsink thermal resistance

$$R_{th} = \frac{(Tjmax - Derating\ \ from\ \ Tjmax\ ) - Tambient}{Total\ \ Pd}$$

Now you can enter the thermal resistance of the heatsink and do a finer selection with a second (and third) iteration