Application Note

European Power-Semiconductor and Electronics Company

Measurement of the circuit stray inductance L_σ

Fig.1 shows the principle circuit of a half-bridge and the resulting voltage and current wave-forms when switching IGBT1. The circuit stray inductance L_σ, shown as a concentrated element, represents all distributed inductances (of capacitors, busbars and IGBT modules) within the commutation loop (striped area).

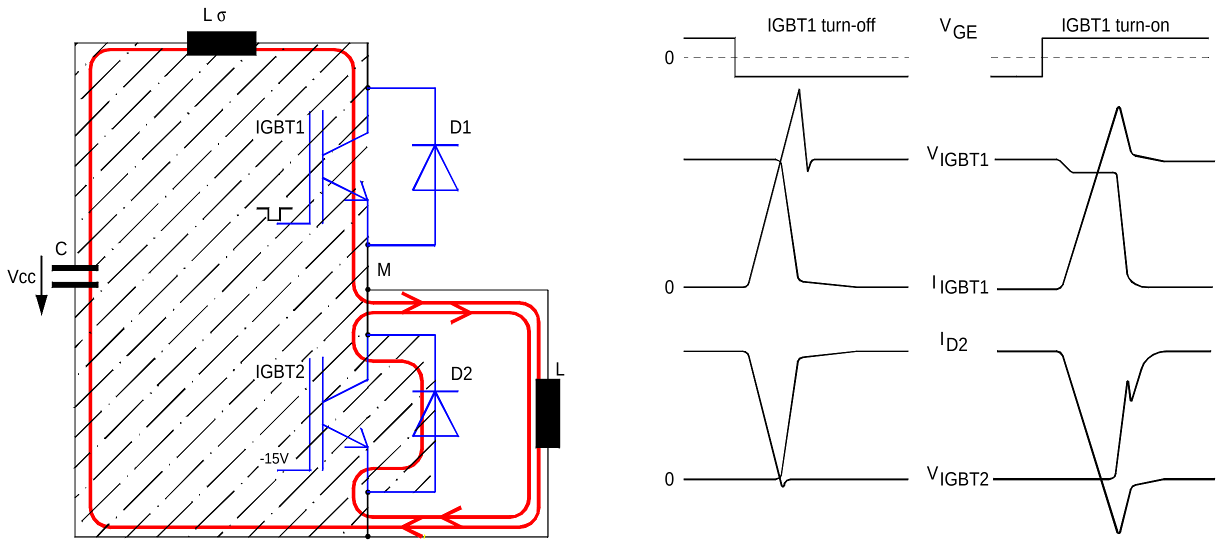

Fig.1: Half-bridge circuit with current and voltage waveforms when switching IGBT1

Due to the changing current a voltage drop of L_σ * di_{off}/dt occurs across the stray inductance L_σ. It is overlayed to the DC link voltage V_{CC} and seen as a voltage spike across the turning-off IGBT1. According to the RBSOA diagram, this spike must be limited to the blocking voltage V_{CES} of the IGBT module (measured at the chip, means measured at the CE auxiliary terminals). Also a derated curve is given in the data-sheet for measurements at the power terminals, taking into account the internal module stray inductance between main and auxiliary terminals of the module.

The stray inductance of the commutation loop can be derived from the voltage drop across IGBT at turn-on: while the IGBT is still blocking and the current is already rising, you can measure di/dt and voltage drop ΔV and calculate the inductance according to

$L\sigma = \Delta V / di/dt$.

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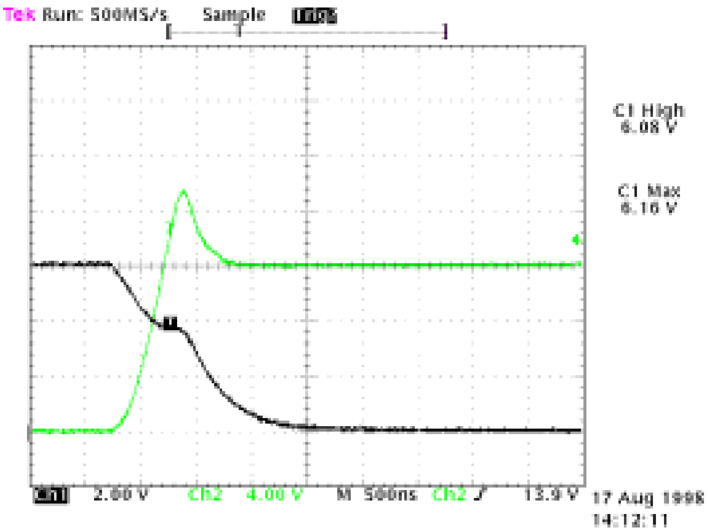

Fig.2: Switching curves of current and voltage when turning on an IGBT

Example:

i: 400A / div (green) v: 200V / div. (black)

The voltage drop happens at a point of time, where the diode still has no blocking capability. Therefore the voltage drop can only be caused be the stray inductances. No other effects have to be considered.

The circuit stray inductance is calculated according to the above shown formula at zero crossing of current. We get the following values:

$\Delta V \approx 230V$

$di/dt \approx 3200A/800ns$

$\rightarrow L\sigma \approx 58nH$

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