APPLICATION NOTE

Recommendations for switching times

1) Maximum short-circuit duration

Under „hard short circuit" conditions (SC1) the short circuit current rises to a - voltage class depended - value of several times the nominal current while the collector-emitter voltage remains on the level of the DC-link voltage. Excessive power losses are generated in the IGBTs during this period of time, which has to be limited to a maximum of 10µs within which the SC has to be detected and turned off. Under SC2 conditions, the turn-off command has to be delayed, until the current has reached a level, where the IGBT gets into desaturation. At that point, the IGBT should be turned off immediately.

2) Dead times

To prevent any short circuit conditions within a phase leg during normal switching operation, both devices have to be in an inter-mediate off-state during the transition from upper arm „on" to „off" and lower arm „off" to „on" (or vice versa). Due to the short duration of potential „shoot throughs", they are hardly to detect but may be destructive to the modules due to excessive losses or SC stress.

As a minimum, this dead time should exceed the difference between minimum turn-on delay plus rise time and maximum turn-off delay plus fall time. It has to be considered, that dead times have further to be increased when using higher gate resistors or operating at lower gate voltages compared to the data sheet values.

3) Minimum turn-on times

When turning on an IGBT or a diode, charges start to spread across the chip with a certain velocity. When turning off an IGBT or a diode during this transient state, the resulting di/dt is drastically increased compared to a device which is already fully flooded. Due to the high di/dt an IGBT will show an increased turn-off overvoltage while a diode will „snap off", which may result in inadmissible dv/dts and oszillations across the device. To prevent getting into such critical operation, minimum turn-on times for IGBTs and diodes should be limited to 10µs by the controller.

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