Gate driving technology for multi-chip Insulated Gate Bipolar Transistors (IGBT) power devices

Ravi Nath Tripathi[a], I. Omura[a,b]

[a] *Next Generation Power Electronics Research Center, Kyushu Institute of Technology, 2-4 Hibikino, Wakamatsu-ku, Kitakyushu-shi, Fukuoka, 808-0196, Japan*
[b] *Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, 2-4 Hibikino, Wakamatsu-ku, Kitakyushu-shi, Fukuoka, 808-0196, Japan*

Abstract

The multi-chip power devices are imperative for high-power system, to provide requisite current/voltage. Nevertheless, the multi-chip power devices connected in parallel/series have to deal amongst the devices due to unceratinities of the parameters that are non-identical. Insulate Gate Bipolar Transistor (IGBT) is one of the major player to fulfil requirement high power system by paralleling of multi-chip modules for many applications such as wind as well as photovoltaic power converters and motor drive systems.

The paralleling of IGBT power devices are prone to non-homogenous current sharing due to alteration in device paramaeters, gate driving parameters and connection parameters. The effect of parameters ultimately results in asynchronous switching of devices. Therefore, the control is required to compensate the delay in swithing amonsgst the device.

The delay compensation controls have been presented based on the current edge detection method and emiiter sense voltage method. Emitter sense voltage method is an indirect way of control and current edge detection method require quite a complex circuitary. The direct method that is to assess the current corresponding to delay compensation does not require addition calibration amongst the parameters.

We present a current peak detection methodology based delay compensation control that is a direct method and does not require a complicated circuitary for measurement. In addition, it can be implemented using analog circuit as well as digital implementation. The device currents are measured using PCB Rogowski coil and peak detection method is perfectly suitable to it as it provides dynamic peak signal corresponding change in current.

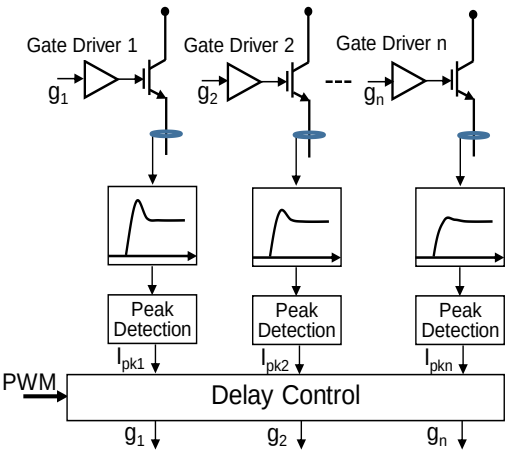

Fig. 1. Gate delay compensation control

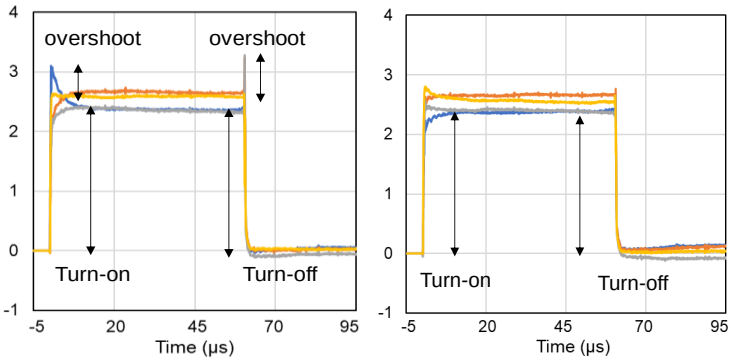

Fig. 2. Current waveforms of four parallel-connected IGBT system measured using PCB Rogowski coil current sensor (a) unbalanced condition : no delay control (b) balanced condition : after delay control iterations.

References

[1] Ravi Nath Tripathi, Masanori Tsukuda and Ichiro Omura, "Dynamic Current Balancing of Parallel Connected IGBT Devices using PCB Sensors for Integration in Power Modules", IEEE-CIPS, Berlin, Germany, 2020.