

Bodo's Power Systems®

System Benefits of Using G1 Series Intelligent Power Modules (IPM)

Mitsubishi Electric integrates several key technologies into one power module in order to deliver the best possible overall system performance. The G1 IPM concept addresses three areas crucial for inverter designers – [1] Easy design, [2] High efficiency and [3] High reliability.

Easy design: The G1 IPM is provided with an internal gate drive unit, multiple integrated protection functions and a failure output signal for easy facilitation of failure recognition. The incorporation of these functions into the G1 IPM relieve the inverter designers from extensive verification tests as all functions are fine-tuned to the built-in 7th gen IGBT/FWDi-chip set and which are 100% tested by the module manufacturer. Another feature going in favor of the design process is the busbar design flexibility option: the 'A' package variant (refer Figure 2) offers two possible main terminal positions. One option is where the AC output side is placed in parallel with the DC input terminal and another option is where the DC input terminal is placed at a 90° angle to the AC output terminal (with both variants available in either screw type terminal or solder type terminal).

In combination with this special gate design, this improved IGBT chip is provided with a monolithically integrated current mirror to implement a current sensing scheme. There are two main benefits offered by such a current sensing scheme. Firstly, an effective SC protection can be realized which is based on the instantaneous device current I_c . The trip level of such an SC-protection can be established independent of the IGBT-desaturation, thus being much faster than the conventional desat-protection. Secondly an innovative switching speed control can be established depending on the actual value of the device current I_c . This means - a reduced speed (for Low EMI) turn-on at low I_c values and a high speed turn-on (low turn-on loss) at high I_c values can be achieved (refer Figure 1). These key features ensure a significantly higher inverter efficiency and good EMI performance.

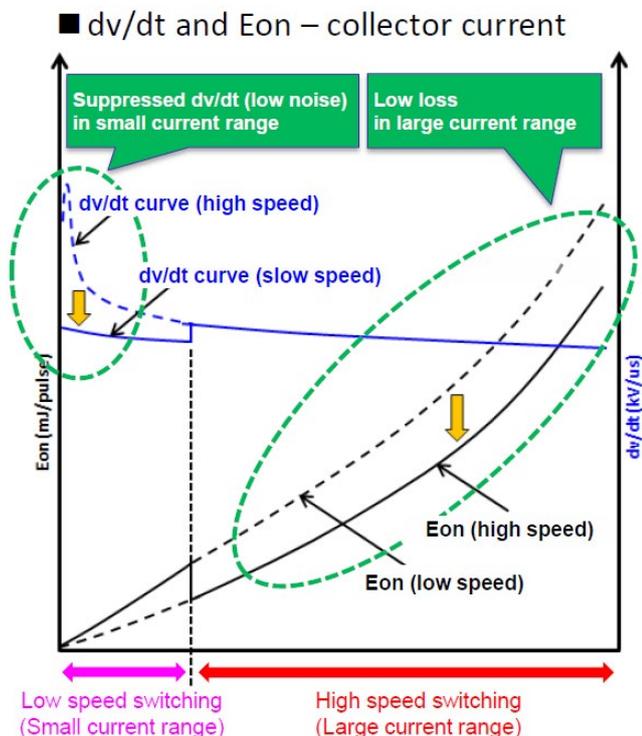


Figure 1: dv/dt and Eon control in G1 IPM

High efficiency: The IGBT chip is based on a special internal gate design optimized for the IPM's 'short circuit capability versus losses' trade-off, and as a result the ON state loss behavior is significantly lower than a conventional IGBT device and the V_{cesat} versus E_{off} characteristic is also superior in comparison with a conventional IGBT

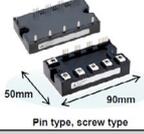
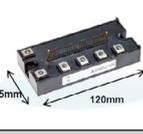
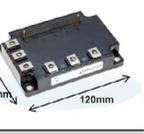
	Small-Pkg. (A-Pkg.)	Middle-Pkg. (B-Pkg.)	Large-Pkg. (C-Pkg.)
Outline of Package			
650V 6in1	50A, 75A, 100A	50A, 75A, 100A, 150A, 200A	200A, 300A, 450A ^{NEW}
650V 7in1	50A, 75A	50A, 75A, 100A, 150A, 200A	200A, 300A, 450A ^{NEW}
1200V 6in1	25A, 50A	25A, 50A, 75A, 100A	100A, 150A, 200A ^{NEW}
1200V 7in1	25A	25A, 50A, 75A, 100A	100A, 150A, 200A ^{NEW}

Figure 2: Line-up of the G1 IPM modules

High reliability: The module packaging design and chip design have been established with 'product reliability' assuming utmost importance. The module consists of built-in functions which aid in failure detection, module's self-protection activation and facilitates failure-type recognition. An important feature is that the IGBT is provided with an on-chip temperature sensor to detect an over temperature directly in the silicon. There is a power supply under-voltage protection system and an innovative short-circuit protection scheme. The G1 module packaging technology aims to improve the withstand capability against stress factors causing degradation/aging of the module. The module employs the SLC (Solid Cover) technology along with an innovative IMB (Insulated Metal Baseplate) structure. As a result, the module exhibits superior thermal cycling behavior while providing lower thermal resistance.

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