IXAN0058

Parallel Operation of IGBT Discrete Devices

As applications for IGBT components have continued to expand rapidly, semiconductor manufacturers have responded by providing IGBTs in both discrete and modular packages to meet the needs of their customers. Discrete IGBTs span the voltage range of 250V to 1400V and are available up to 75A (DC), which is the maximum current limit for both the TO-247 and TO-264 terminals. IGBT modules cover the same voltage range but, due to their construction, can control currents up to 1000A today. However, on an Ampere per dollar basis, the IGBT module is more expensive so that for cost-sensitive applications, e.g. welding, low voltage motor control, small UPS, etc., designs engineers would like to parallel discrete IGBT devices.

The parallel operation of MOSFETs has proven to be successful. Now experience has shown that it is possible to achieve similarly satisfactory performance in paralleling IGBT devices, as long as certain guidelines are followed. Remember that all high current IGBT and MOSFET modules consist of paralleled IGBT dice and, while it is easier for a semiconductor manufacturer to select dice for paralleling, an OEM manufacturer can obtain similar results.

The following is a list of guidelines for paralleling IGBT discretes, which in many ways parallels those for paralleling MOSFETs:

1. Each IGBT device must have its own gate resistor.
2. Arrange lay-out of devices so that the current paths are symmetrical.
3. Mount the parallel parts next to each other on the same heatsink so that they are thermally coupled.
4. All the paralleled parts within "one switch group“ should have the following characteristics:
    a. Be made from silicon dice from the same wafer lot (see below).
    b. Threshold voltages should be matched to + 0.10V
    c. Saturation voltages at normal operating current level should be matched to + 0.05 V.

5. If the IGBT component contains an anti-parallel diode, match the forward voltage drop of the diode to within + 0.1 V.

6. If it proves impractical to perform the matching outlined in step 4, then insert a resistor in series with each emitter to force current sharing. Pick a standard value for the resistor that is closest to 0.2V divided by the nominal current per IGBT. Resistor tolerance should not be greater than + 1%.