

Junction Temperature Definitions

1. Definitions

The international standard IEC 60747-9 requires device manufacturers to specify junction temperatures. In this application note, the definitions of the virtual junction temperature, the operating junction temperature and the maximum junction temperature are clarified.

A) Virtual junction temperature, T_{vj}

A junction temperature basically means the temperature in the junction area of an IGBT or a diode chip. In reality the temperature is not uniform across the chip. Where multiple chips are mounted in an IGBT module, the temperature may also differ from chip to chip. Therefore, the idea of a virtual junction temperature T_{vj} is introduced to define a thermal resistance or impedance junction to case. The virtual junction temperature does not precisely coincide with the junction temperature of each chip but it is useful for the estimation of a junction temperature. Since the temperature is measured indirectly and does not have a precise value, it is appropriate to use the term “virtual junction temperature”. The measuring method of the temperature is presented in the international standard IEC 60747-9.

B) Operating junction temperature, $T_{vj(op)}$

The operating junction temperature $T_{vj(op)}$ is the junction temperature to ensure the safe and continuous operation of the semiconductor under practical operating conditions including switching mode. The temperature $T_{vj(op)}$ has a minimum and maximum value, where the maximum value is identical to the maximum temperature specified in the SOA diagram. In designing application systems with a switching operation, the allowable range of the operation temperature $T_{vj(op)}$ is the term to be considered.

C) Maximum junction temperature, $T_{vj(max)}$

The maximum junction temperature, $T_{vj(max)}$, is specified to determine the maximum permissible power dissipation of an IGBT or a diode under a continuous ON-state of the device.

2. $T_{vj(op)}$ and $T_{vj(max)}$ for each HITACHI chip generation

V _{CES}	Chip generation	$T_{vj(op).max}$	$T_{vj(max)}$
1700V	D version	125 °C	150 °C
	E version	125 °C	150 °C
	F version	150 °C	175 °C
3300V	D version	125 °C	150 °C
	E version	125 °C	150 °C
	E2/E3 version	150 °C	175 °C
	F version	150 °C	175 °C
4500V	A version	125 °C	150 °C
	E2/E2-H version	125 °C	150 °C
6500V	E2 version	125 °C	150 °C