

## < IGBT Modules >

# Note the following points when using IGBT modules: About Isolation voltage and LTDS

Please note the following points when using IGBT modules:

### ■ Isolation voltage

Our IGBT modules are assumed their use below an altitude of 2000meters and designed their isolation voltage based on UL840. When using IGBT modules over altitude of 2000meters, please note that electrical discharge is easily generated by lower pressure generally.

Reference data for relationship between altitude and required clearance.

\* When 1 to 2000meters (Referrer: IEC60664-1)

Altitude	Ratio
2000m	1.00
3000m	1.14
4000m	1.29
5000m	1.48

### ■ LTDS

LTDS, Long Term DC Stability, means accidental failure tolerance due to cosmic rays.

Cosmic ray is generic name of the radiation drenched to Earth from space, and not only flying through space, but also includes secondary cosmic rays generated by interference with the atmosphere. It is said that the neutron in the radiation can cause failure. Failure rate due to cosmic rays changes by its using conditions --voltage and temperature-- and by its radiation dose --installed state / latitude / longitude / altitude--.

- Voltage-dependence;

Failure rate due to cosmic rays increases as higher voltage applied between the collector and the emitter.

- Temperature-dependence;

Failure rate due to cosmic rays decreases at higher temperature.

- Latitude and longitude-dependence;

Failure rate due to cosmic rays depends at the site of use. It is said in general that the neutron beam of near-surface is mostly secondary radiation, and neutron dose are different by its latitude and its longitude.

- Altitude-dependence;

Failure rate due to cosmic rays increases at high altitude. It is said in general that neutron dose are also different by its altitude. Please refer following data from Japan Atomic Energy Agency, regarding the relationship between the altitude and neutron dose.

At Tokyo, on 1st January 2013

Altitude [m]	Neutron dose [cm <sup>2</sup> /s/(MeV/n)]	Ratio * When 1 to 0meters
0	13241	1
1000	29669	2.24
2000	60843	4.6
4000	200950	15.18

\* EXPACS from Japan Atomic Energy Agency,

Please contact us in the case you required to estimate the failure rate due to cosmic rays, when our product will be used in high applied voltage and high altitude.

Regards,