− Fuji IGBT Module −

Calculation of power cycle life when there are multiple different temperature rise peaks

The power cycle lifeof the IGBT module depends on the temperature swing (and maximum temperature) during power cycle. Therefore, when there is only one temperature swing of the IGBT module in one particular operation cycle of the inverters/converters, the number of times calculated from the power cycle life curve is the life cycle of the IGBT module.

However, when there are multiple temperature rise peaks in one operation cycle of the inverter, the life cycle becomes shorter because the module is influenced by the multiple temperature rises. The calculation method of power cycle life when there are multiple different temperature rise peaks is shown below.

When there are n times of temperature rises for one operation cycle of inverter, the combined power cycle life can be expressed in the following formula, where PC(k) is the power cycle life for the k-th (k=1, 2, 3, …., n) temperature rise.

$$PC = 1 \Big/ \left(\sum_{k=1}^{n} \frac{1}{PC(k)} \right)$$

For example, when n=4 and the power cycle numbers for the respective power rise peaks are 3.8×10^6, 1.2×10^6, 7.6×10^5 and 4.6×10^5, calculation is made as follows:

$$PC = 1 \Big/ \left(\frac{1}{3.8 \times 10^6} + \frac{1}{1.2 \times 10^6} + \frac{1}{7.6 \times 10^5} + \frac{1}{4.6 \times 10^5} \right) = 2.2 \times 10^5$$

Therefore, the power cycle lifetime can be obtained from the product of the power cycle life calculated in this way and one cycle (time) of operation mode.

For example, when one cycle of the above operation mode is 1800sec (30min), the lifetime is calculated as follows:

$2.2 \times 10^5 \times 1800 / (60 \times 60 \times 24 \times 365) = 12.55 \approx$ 12 years and 6 months.

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