Electrics/Machiner | High Sensitivity | Low Thermal Resistance | High Voltage Robustness

Heat Generation amount Measurement of Electronic Components

References: Measure the heat generation value of a mounted electronic component
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Goal

① Measure the heat generation value of a mounted electronic component
② Measure the heat generation amount through a stable and accurate measurement

Measurement Method

A method of simply attaching a water or air-cooled heat sink to the upper surface of the part to be measured and estimating the heat value from the temperature rise is a method in which the amount of heat dissipation to the substrate side, which is difficult to directly measure, is characterized by speculation, high versatility.
As shown on Fig.1, we are going to measure the heat generation value by using our heat flux sensor mounted together with a heat sink on the upper surface of the electronic component to be measured. Actually, since part of the heat generation moves toward the substrate side, it does not fully correlate to the heat generation value. Therefore, a certain correction factor needs to be taken into account. Please consider the thermal network shown on Fig.2.
The following heat generation equation is constructed

$$Qt = Qf + Qb \quad (1)$$

where Qt is the total heat generation quantity of the electronic component, Qf is the heat quantity towards the heatsink and Qb is the heat quantity towards the substrate. Even though Qf can be directly measured, the thermal resistance Rb differs depending on the substrate and thus Qb cannot be obtained. Therefore, without directly measuring Rb, we will change the rotation speed of the fan, thus intentionally changing the thermal resistance Rf. As Qf changes, we will then estimate Rb.
If we try to represent equation (1) in terms of temperature and thermal resistance, then we would obtain the following:

$$Qt = Qf + Qb = (T1 - T0)/Rf + (T1-T0)/Rb \quad (2)$$

with the unknowns being two: Qt and Rb. Here we change the fan RPM and obtain a change in Rf, which in turn produces a change in T1 giving us:

$$Qt = Q'f + Q'b = (T'1 - T0)/R'f + (T'1-T0)/Rb \quad (3).$$

However, since the temperature change as a result of changing the fan RPM is very small, we assume there is no temperature dependency with the electronic parts heat generation and the thermal resistance from substrate to atmosphere. From this result, solving algebraically is possible.

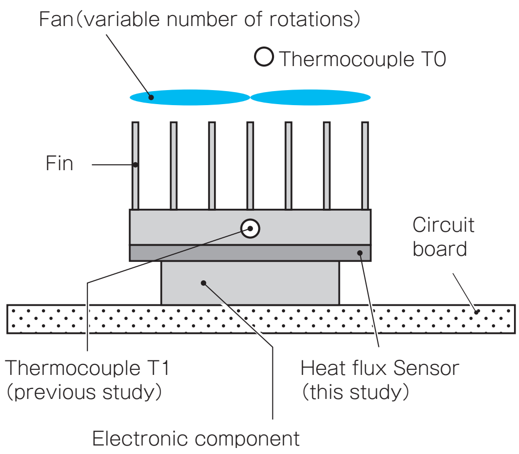

Fig.1 Measurement principle

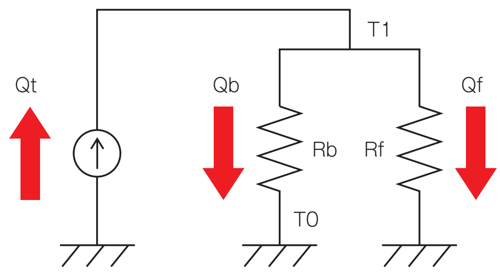

Fig.2 Thermal network of the measurement system

Results

By using a heat flux sensor and mounting these measurement systems on the product board used in the market, the heat generation value of the IC was determined to be 0.54 W and 0.93 W. As a result of the thermal analysis using these measurement results, the rising temperature could be successfully reproduced. From this fact, it is presumed that the heat generation value was accurately obtained. Since the heat flux sensor can be measure the output stably, a smaller heat generation value can be obtained.

Considerations

From this result, it can be said that a method to measure the heat generation value of electronic components using a heat flux sensor could be devised. The heat flux sensor has a fast response time and confirmed the advantage that stable measurement can be performed without being influenced by room temperature or the like. It can be said that this sensor can become a tool to improve the precision of heat of electronic parts and the accuracy of simulation by precisely determining the heat generation value of electronic parts.

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