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Preventive Measure by Gas Sensor for PCB Carbonization (Second Report)

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Sometimes happen abnormal current by electrical component failure. The abnormal current makes PCB track heating and PCB base material carbonization. The typical preventive measure is using fuse. However actual ECUs use other method too combined with fuse. So the preventive design for abnormal is complicated. Especially if the abnormal current is small or heating volume is small, then the detection of abnormal is difficult. Therefor we proposed the new solution by using gas sensor and design scheme. The solution detects to outgas from PCB abnormal heating. In this report, we made clearly the gas sensor response characteristic and how to design the detection margin.

The failure event to theral incident progress is written at Fig.1. The first detection method of the failure event is hardware or software functional faiure detection. If the functional detection can't destect or prevent failure progress, then the abnormal current through wire harness or PCB trucks. Second protection is the current detection method. Most famous measure is to put fuse on the power supply line. If current detection can't abnormal current, then the heating failure is happen. In this phase, we use thermal detection method. For example, It is thermistor or thermal fuse. If the thermal detection can't stop the failure progress, the thermal decomposition is finally started. In this phase, we suggest to use gas detection method. If the organic material is heated, then the outgas occures before organic material carbonization.

In this research, we investigated how to define the margine for the interference gas. We compared the PCB heating gas in ECU case with interference Ethanol gas from out side of ECU case by using variable aperture case. Fig.2 is the test result of the PCB heating and Ethanol gas for each aperture size. If aperture size large, the interference gas intrude faster than PCB heating. On the other hand the aperture size is small, the interference gas is slowly itrude. So we can detect only out gas of the PCB heating to be faster than interference gas intruding. The aperture size is the most important design parameter.

The conclusion of our research is Fig.3 as map of failure current V.S. heating volume. If failure current is large as intense failure, It can be easy detection by current detection. On the other hand, if the heating volume is large, the thermal detection method will much work for abnormal detection. However if heating volume and failure current is both small, the abnormal detection is difficult. So gas detection method is needed to the region, and for the remaining small undetectable region, we need other solution.

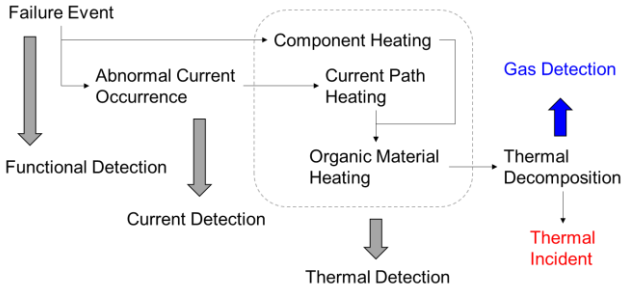

Fig.1 Progress of Thermal Incident

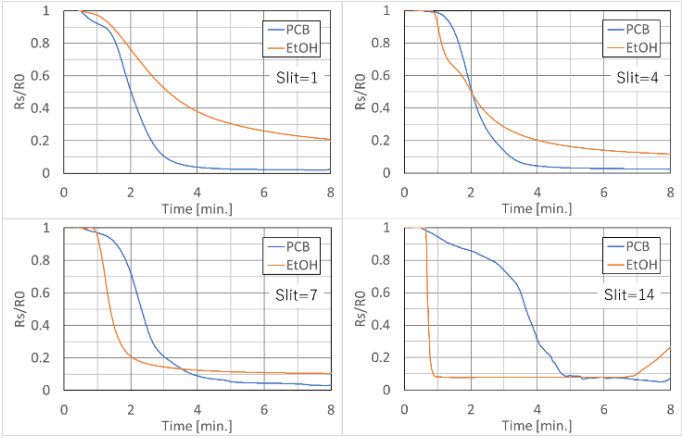

Fig.2 Response Comparing with Ethanol and PCB Heating

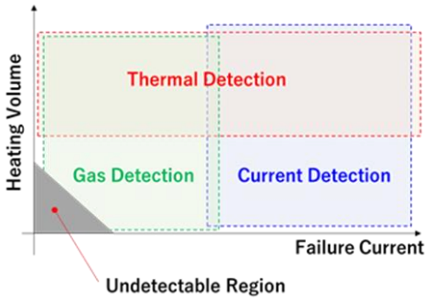

Fig.3 Remaining Undetectable Region