CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The following conclusions can be drawn from the present investigations as follows :

PARAMETERS AFFECTING HEAT CONVECTION OF CHIP MODULES

Experimental studies of the parameters affecting convective heat transfer coefficients and temperatures of single row in-line modules, in-line and staggered arrays on electronic printed circuit board (PCB) have been carried out. The parameters considered are air velocity, chip spacing and heat generation. The experimental modules are made of aluminum with electrical heater embedded inside. The module temperatures are monitored directly with an infrared scanner. The conclusions are

a. The heat transfer coefficients of the second and the third modules seems to be the lowest due to a recirculation of air between the module blocks. Higher the air velocity and increase of the module spacing result in better heat transfer.

b. When the modules give different heat generations, the highest one should be positioned closest to the entering air to reduce the hot spot temperature.

c. The staggered arrangement shows better heat transfer than the in-line one.

d. H/B ratio also affects the module temperatures. Higher the ratio results in better cooling.

IMPROVEMENT OF ELECTRONIC AIR COOLING BY COATING CIRCUIT BOARD WITH HIGH THERMAL CONDUCTIVITY MATERIAL

In this part, a technique of coating the circuit board with high thermal conductivity material is proposed thus the areas for heat convection from the modules is greater could be reduced. In the present study, aluminum foil is used as a circuit board coating. The conclusions of the study are:

a. The temperature of electronic module array mounted on circuit board could be reduced by coating high thermal conductivity material on the circuit board since the convective heat transfer area is increased.

b. A model to predict the heat transfer coefficient when the board is coated with aluminum foil is also developed. The module temperatures predicted from this model agree very well with the experimental data.

HEAT TRANSFER ENHANCEMENT IN AIR COOLING WITH VORTEX GENERATOR

The present study investigates the heat transfer enhancement of air cooling and the pressure drop of electronic modules with the presence of delta winglet vortex generator integrated in front of electronic modules. The electronic modules are arranged in in-line and staggered arrays.

a. The delta winglet vortex generators could enhance the adiabatic heat transfer coefficient and reduce the thermal wake function effectively both in-line and staggered arrays. More attack angle results in higher heat transfer augmentation and also the pressure drop in the fluid flow.

b. In case of setting the vortex generators in front of the first row only, the heat transfer enhancement is significant only the first row.

c. The superposition method with the developed adiabatic heat transfer models and the developed thermal wake function models could be used to predict the module temperatures very well for both in-line and staggered arrays.

ALLOCATION OF CHIP MODULES BY SUPERPOSITION OF SELF-HEATING AND THERMAL WAKE EFFECTS FOR CONTROLLING MODULE TEMPERATURES

In this study, the superposition of self-heating and thermal wake effect method is modified to adjust the chip modules mounted on the circuit board for controlling the module temperature not to exceed the required limit. The conclusions are

a. The procedure developed is very effective to allocate the modules both with and without vortex generators.

b. For low temperature limit, the vortex generators have a high potential to control the hot spot.

7.2 RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

a. Different shapes of electronic modules could be considered on the heat transfer coefficients and the thermal wake functions.

b. The method of computational fluid dynamics should be taken to find the flow field and the temperature field of the air flowing through the modules with different shapes on the circuit board.

c. The material having high thermal conductivity and high electrical resistance should be developed and be used as the circuit board. This technique could enhance the heat transfer surface.