PCB layout for Econo boards

Conduction losses in copper PCB traces

The conduction losses in the PCB can be estimated by

$$P_{av} \approx I_{rms}{}^{2} \circ \sum_i \frac{\rho_i \circ l_i}{A_i}$$

with A: cross section of copper, l: length of conductor and ρ: resistance constant of copper. These losses are the main factor for the rise inf PCB temperature. The dependency between conduction losses and PCB temperature was investigated. Under constant conditions a correlation was found. Figure 1 shows the increase in PCB temperature under natural convection conditions versus cross section dimensioning with different DC currents as parameter. The graph is an example based on certain operating conditions and therefore should only be used for first rough estimates of thermal conditions.

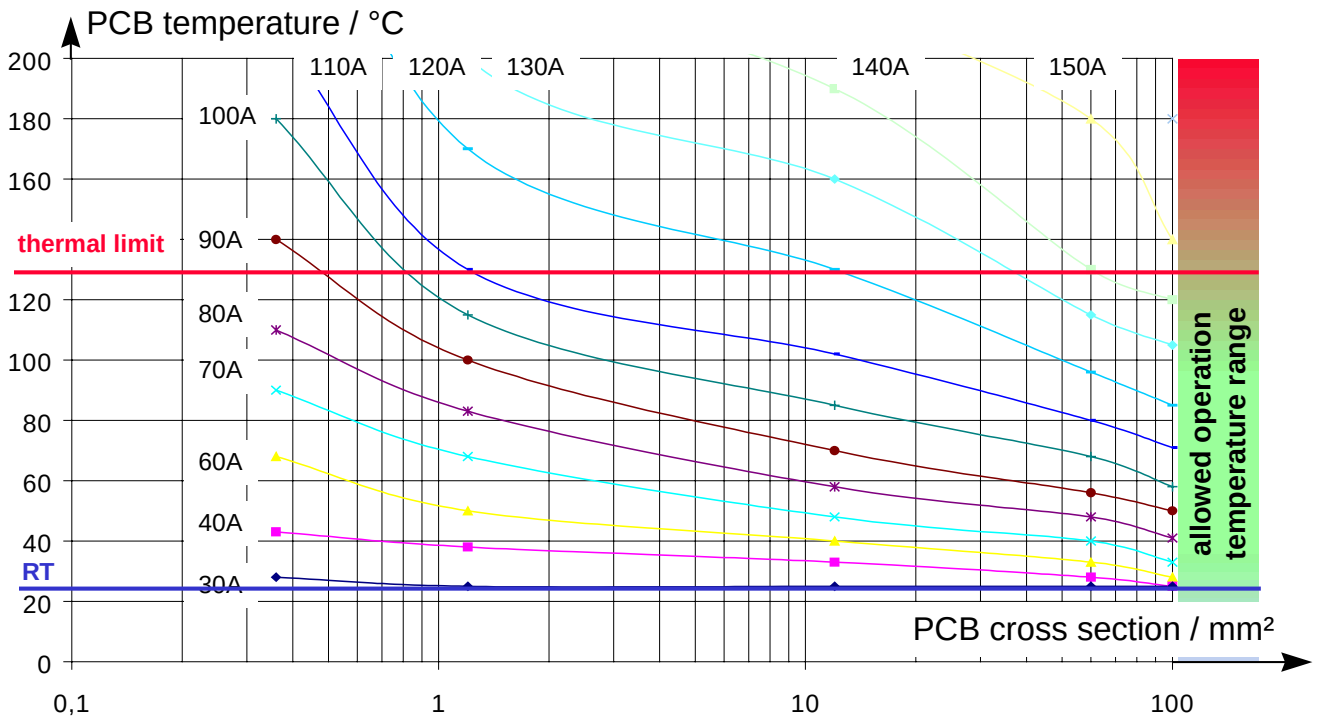

Figure 1: Temperature raise vs. cross section dimensioning for different currents

The room temperature (RT) and the thermal limit are shown in the graph.

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The investigation was done without forced air cooling. The use of advanced cooling systems would lead to higher utilization of the same cross sections.

Simulation of temperature distribution between defined thermal potentials

Figure 2 shows an example for a simulation of thermal distribution between defined potentials at both ends of the PCB traces. The most critical temperature was found between the defined thermal potentials. A larger cross section reduces the maximum temperature significantly.

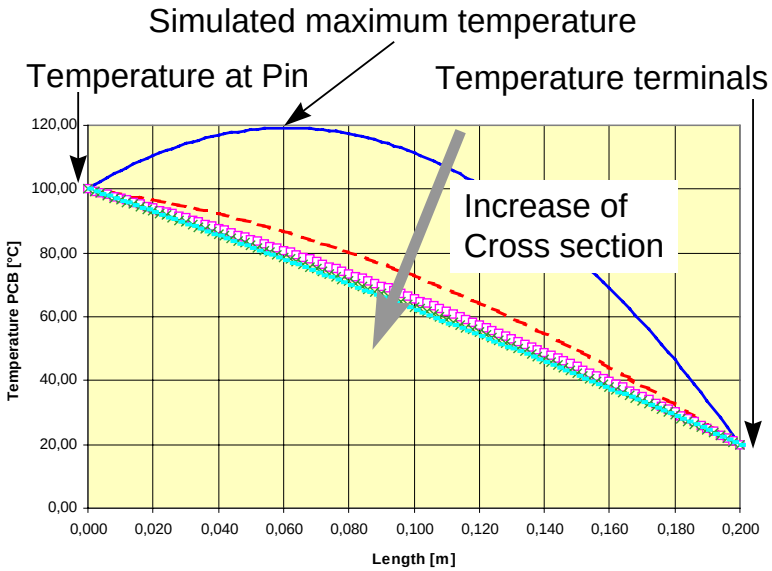

Figure 2: Example of temperature profil in strip conductor

It is useful to test worst-case conditions with a prototype PCB. The use of thermal camera equipment is recommended for this investigation.

Simulations for thermal loss dissipation out of Econo pins

Calculations were done for Econo II and Econo III for thermal dissipation of conducting losses out of the Econo pins. The PCB temperature was kept constant. Since the thermal dissipation through the module is negligible, the calculations assume that all losses have to be dissipated totally through the traces. Figure 3 summarizes the result of this calculation for Econo II and figure 4 for Econo III. The calcualtions were done for different PCB temperatures.

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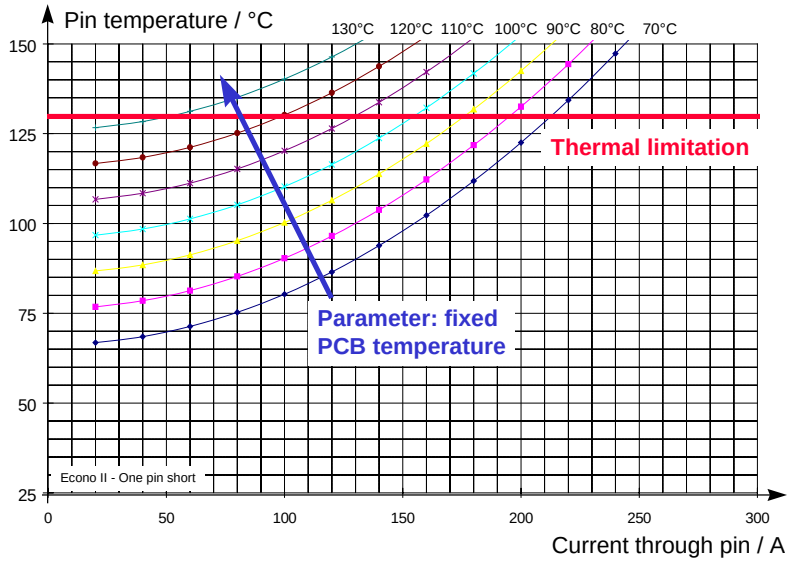

Figure 3: Pin temperature vs. Pin current for Econo II

The difference in the rise of temperature is caused by the number of pins used in Econo II and III types. The calculation was made for constant PCB temperature conditions. The thermal limitation is given by the used materials, e.g. plastic, and solder reliability.

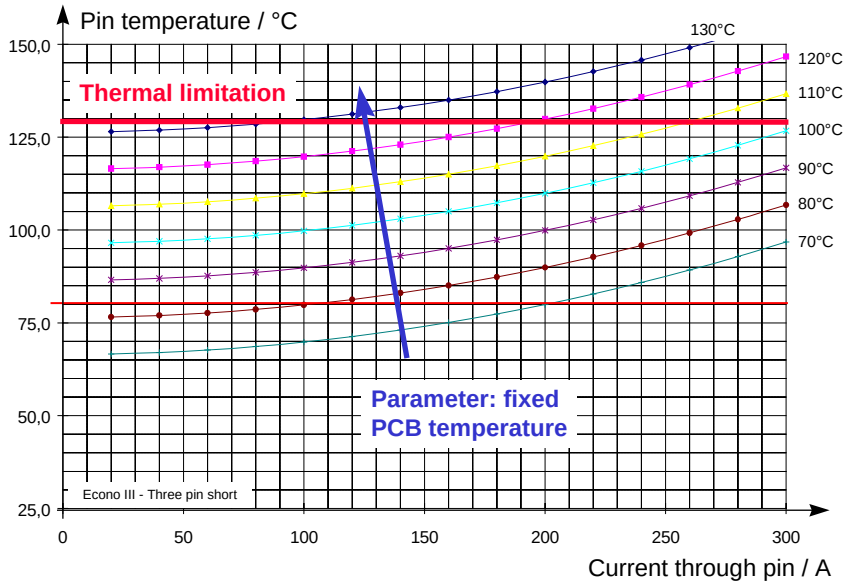

Figure 4: Pin temperature vs. Pin current for Econo III

It should always be kept in mind that these values are only valid for certain conditions. The interdependence of the whole thermal system is too complex and depends on various application restraints to make any general statement.

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