Related Products	All Kontron Embedded Modules GmbH products
Subject	Extended temperature range
Document Name	ExtTemp_E112.doc
Usage	Common

1. REVISION HISTORY

Date	Document Name	Subjects added, changed, deleted	Changed by
27-Feb-96	JAP0009.DOC	Initial release of Application Note	H. Mühlbauer
10-May-99	JAP0009.DOC	Revised layout, corrected temperature ranges, replaced example with 233MHz MMX CPU	R. Barth
23-Apr-02	JAP0009.DOC	English proofreading	D. Gunter
23-Aug-02	JAP0009.DOC	Changed to Kontron style	H. Bruhn
20-Nov-02	ExtTemp_E111.DOC	Brought information from JAP0009 to new KEM format	H. Bruhn
20-Nov-02	ExtTemp_E112.DOC	Corrected fault in revision history date	H. Bruhn

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3. BASIC INFORMATION

Many industrial applications require operation and/or storage temperatures above or under the specified temperature range of **Kontron** Embedded Modules GmbH (in the following called Kontron) products. This is generally a complicated issue and cannot be answered easily. The following explanation should give an overview of the problem and what **Kontron** can do to solve this issue for customers. In principle this is not only a matter of the design, it is more or less a general physical problem that affects **Kontron** products as well as any other product available in the market.

4. PROBLEMS

Principally there are two issues someone has to be aware of, when operating electronic components and products at extreme temperatures.

Functionality:
heat and coldness will affect DC and AC parameter of the product and will eventually cause malfunction of a device operating at very low or high temperatures. This problem can sometimes be solved by design techniques.

Lifetime:
higher temperatures in principle cause chemical and physical reactions to speed up (about a factor of two every +10°C). This effect will decrease rapidly the lifetime of modules the higher temperature gets during operation. Furthermore extreme low and high temperatures can cause mechanical stress to components due to different temperature coefficients of used materials.

5. EXPLANATION

Any operating electronic component generates heat according to its power dissipation. Energy can only be transferred to the surrounding by a temperature difference between the components surface and the ambient air. Therefore the semiconductor manufacturers specify in the IC's data sheets the surface temperature and not the ambient air temperature!
All **Kontron** products are based on PC technology chipsets. They are typically specified for 0 to +70°C or 0 to +85°C (for processors).

The necessary temperature difference between component and surrounding depends on the components power dissipation. The temperature differences range from a few degrees up to substantial values like 244,8°C for a 233MHz MMX Pentium from Intel. This means, a 233MHz MMX Pentium CPU cannot run without any additional active cooling (heat sink and fan), which will decrease the surface temperature to specified values like +70°C.

This whole issue is physics and cannot be influenced by manufacturers like **Kontron**. However, all **Kontron** designs are stable above and under the specified temperatures, and will work fine. Because of legal issues we can only guarantee the range 0 to +70°C to our customers, but we can always do temperature tests at extreme temperatures for a specific customer. This will add some testing cost to the product. Our experience with high and low temperatures so far is that from -25°C up to +85°C (most products are frequently tested at -40°C and +100°C) we do not have any technical problems. The only remaining problem is a legal and a lifetime issue.

6. RESULTS:

1. **Kontron defines 0 to +60°C surface temperature to allow the customer a (sometimes necessary) "violation" of about 10°C for "overheating" of components.**

2. **Legally Kontron can only guarantee the reliable function of products between 0 to +70°C surface temperature of components!!!**

3. **Kontron can certainly do temperature testing at extreme temperatures for customers, however Kontron still only guarantees the reliable function of products between 0 to +70°C surface temperature of components.**

4. **Due to physical laws, the lifetime of components generally depends on their operating temperature. Products that work perfectly fine at extreme temperatures can still have a severe "problem" caused by the overheating of components, which leads to a shorter total lifetime of the product itself.**