

Test & Screening

High Temperature Design

Adapting a Bobcat to Extended Temperature in 3 Steps

A PC/104-Plus single board computer is converted to extended temperature in three steps.

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How does one adapt a board for extended temperature use? Each board differs slightly, but many of the principles used by VersaLogic on the Bobcat PC/104-Plus processor module are similar to those used on other industrial boards to bring them to an extended temperature spec.

The Bobcat utilizes the AMD Elan SC520 CPU and features 10/100 Ethernet, 64 Mbyte SDRAM, DiskOnChip, and four COM ports in addition to the standard peripherals. The board was initially designed for industrial (0° to +60° C) operation, but with the knowledge that it would need to be adapted to extended temperatures (-40° to +85° C) shortly after its debut.

To increase the temperature range, three critical steps were identified: switching to the extended temperature version of the CPU chip, derating the CPU and applying a heatsink to the CPU (see Table). At each step, complete functional testing was performed on the board at temperatures of -45° and +90° C to certify continued operation at -40° to +85° C.

Start with the Right Design

Not just any board can be upgraded to extended temperatures following these methods. Careful selection of components, thorough planning, use of proven technology and adherence to strict design standards are the keys to developing high-reliability

products for use in either industrial or extended temperature environments.

Industrial Components

In the case of this board, only the CPU chip required upgrading to the extended temperature (-40° to +85° C) version. The majority of the components were already rated for extreme temperature operation (and engineers had derated other temperature sensitive components). In other cases, additional components may need upgrading. When selecting components during the initial board design, the designer must factor in the availability of extended temperature versions in order to avoid a major redesign.

Derating

Derating is the practice of running components such as the CPU, CPU support chipset and SDRAM at a lower frequency to allow reliable operation at temperature extremes. To convert from industrial to extended temperature, a component should be run 25% slower. In this case, the BIOS was modified to accommodate the decreased frequency of the CPU chip from 133 to 100 MHz. AMD specifies the 100 MHz rate for its extended temperature version of the SC520 CPU. A faster SDRAM chip (100 MHz) was chosen to allow it to be derated for this 66 MHz system.

Heatsink

Convection thermal management solutions include heat pipes, cold plates, conduction blocks and extruded aluminum



Figure

The Bobcat 586 PC/104-Plus module from VersaLogic. Three steps enabled conversion to extended temperature operation.

heatsinks. In this case, a CPU heatsink was chosen as the least costly convection method. The heatsink was only necessary to allow increasing the temperature range to the margins; in essence it provides a safety buffer. The largest heatsink available was selected that would still fit within a PC/104 stack.

Testing

Rigorous environmental testing was performed, including voltage and temperature margin testing. Board functionality was tested over the entire published temperature range of -40° to +85° C as well as in margin bands of 5° C outside that range. These tests were also performed over the specified power input range of 4.75V to 5.25V, with ±0.25V margin bands.

Application of these three steps to a well-designed board enabled successfully converting the Bobcat from standard industrial to extended temperature operation. ■■

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| Steps | Testing Comments |
|--------------------------|--|
| Extended temperature CPU | Standard CPU actually tested OK at extended ranges |
| Derate | CPU Also passed all tests at 133 MHz |
| CPU heatsink | Allowed CPU to function within the temperature margins |

Table

The three key steps involved in converting the Bobcat PC/104-Plus single board computer to extended temperature.