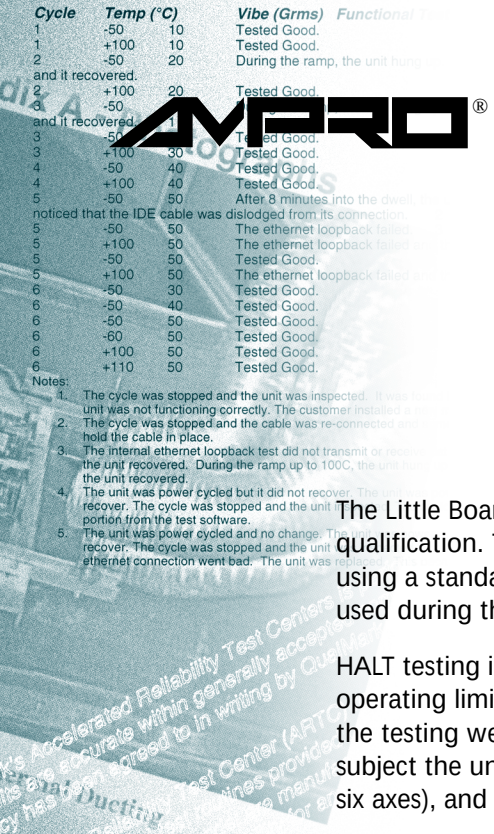

Highly Accelerated Life Testing (HALT) Results for the Little Board™/P5x

The Little Board/P5*x* was subjected to Highly Accelerated Life Testing as a part if its engineering qualification. Testing was performed by Qualmark Corporation at an Accelerated Reliability Test Center, using a standardized procedure. Products representing the production release level Little Board/P5*x* were used during the testing.

HALT testing is used during the development of a product to identify the temperature and vibration operating limits and destruct limits of the product. The stresses applied to the Little Board/P5*x* during the testing were well beyond those expected during normal operation. The intent of the test is to subject the unit to progressively greater extremes of temperature, rapid thermal transitions, vibration (in six axes), and combined temperature and vibration until the unit fails, and then, is ultimately destroyed.

The results of the test identify the elements of the design that are the weakest, and at what level of environmental stress the elements fail or are destroyed. This information is then used to improve the design of the product. The official test report from Qualmark details the test process, the specific stresses applied, and the observations of the Qualmark Test Engineer. The Engineer noted the levels of stress where anomalies were detected during the test process. In addition, an Ampro design engineer was present to identify the root cause of the failure and to devise improvements to the design.

During the course of the test, the Little Board/P5*x* was executing a test loop by exercising its subsystems. The CPU, serial ports, floppy port, ethernet subsystem, video subsystem, and IDE interface were all exercised. Anomalies during the testing process were identified by a failure detected by the test software or by physical damage to the board that did not cause a failure of the test software.

The Little Board/P5*x* was found to operate flawlessly outside of its published standard and extended operating environment. The environmental limits of the test equipment were achieved during several of the tests.

The temperature lower operating limit and lower destruct Limit were found to be -100°C or better (the limit of the equipment was reached). The temperature upper operating Limit was +140°C and the temperature Upper Destruct Limit was greater than +150°C. In addition to the temperature stress, the voltage supply to the board was successfully margined at ±5% at the lower and upper operating limits.

No failures were encountered during the rapid thermal transition test. This test subjected the Little Board/P5*x* to five temperature cycles from -50°C to +100°C at a rate of 70°C per minute. The unit was held at the temperature extremes for five minutes before the next transition was started. Again, the voltage supply was margined ±5% at the temperature extremes.

During the Vibration testing, several issues surfaced. The unit under test did not have the connector latches (available in the Clip Kit, ACC-CLP-Q-03) installed and some of the cables were dislodged. This will not happen when the latches are installed.

At 50 Grms the battery came off the board. Although this is an extreme amount of vibration, the performance of the battery under these conditions can be improved by adding RTV or other such material to better secure it to the PCB.

Continued

Other failures encountered during the vibration test and the combined vibration and temperature test were traced to the DIMM memory socket. (In the test report, some of these failures were erroneously attributed to the Ethernet Subsystem.) The DIMM memory was being dislodged from the socket during extreme vibration conditions. It was found that applying a tie-wrap around the memory socket such that it compresses the socket latches against the DIMM corrected this condition. The test was re-run, and the Little Board/P5*x* operated at 50 Grms with no errors. 50 Grms random vibration is the environmental limit of the test equipment.

The extra measures applied to the test sample (RTV on the battery and the Tie-Wrap on the memory socket) can be used to extend the environmental limits of the Little Board/P5*x*. However, this is not required for products operating within published limits. The unit performed flawlessly well beyond the operating vibration and temperature limits without these added measures.

Unfortunately, one objective of the test process was not met. Testing to the maximum stresses the test equipment could deliver failed to destroy any Little Board/P5*x* test samples. With the extra measures mentioned for the battery and the DIMM socket applied, Ampro is unable to provide any data on the upper and lower destruct limits of the Little Board/P5*x* as they exceed the capability of the equipment.

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