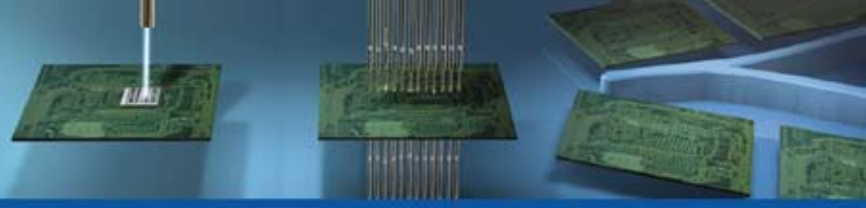


Environmental Stress Screening Using PTM Modules

A new and efficient handling concept for hot/cold testing in high volume production lines, using Thermoboxes as carriers for PCBs and electronic assemblies.

Within a few minutes, PCBs and assemblies are brought to temperatures from -40 °C to +150 °C (-40 °F to +302 °F) for Functional Test (FCT), Run In, Burn In, Life Test or Stress Screening. Environmental Stress Screening with PTM modules was designed for In Line handling or handling with loading/unloading units. The concept is modular and expandable.

Environmental Stress Screening for Each Test Concept

Due to the handling of the material in sealed *Thermoboxes*, the temperature conditioned area of the system is reduced to a minimum. This allows the efficient use of all kind of test strategies, such as:

- Temp. cycle Run In (ambient only or ambient/hot/cold), followed by a FCT.
- Ambient test, followed by a max./min. hot/cold test.
- Temp. cycles under power on condition, followed by a max./min. hot/cold test.
- Permanent monitoring during Burn In.

- **Modular concept: adaptable for every production volume**
- **Temperature range from -40 °C to +150 °C (-40 °F to +302 °F)**
- **Dynamic, fast temperature setting**
- **Passive, Power-On and Functional Test**
- **No icing or condensation**
- **Changeover and service at every temperature and ongoing production**
- **Energy saving**
- **For PCBs and assemblies**

Fast and Dynamic Temperature Settling

The system is suitable for all kinds of PCBs, with and without case. The temperature slope may be adjusted to avoid additional thermal stress of the device.

PCBs will reach the test temperature within 3…4 minutes. Assemblies in a case need about 10…13 minutes to reach the required temperature inside.

A temperature range from -40 °C to +130 °C (-40 °F to +266 °F may be reached within 6…7 minutes

Typical System Setup with one PTM Temperature Conditioning Module and one Test Stage Module

Only the Thermobox with the D.U.T. inside will be brought to the required test temperature.

Thermoboxes are suitable for automatic loading/unloading.

Device style conversion is possible "on-the-fly", without prolonging heat up or cool down to ambient. No LN_2 is required for cooling!

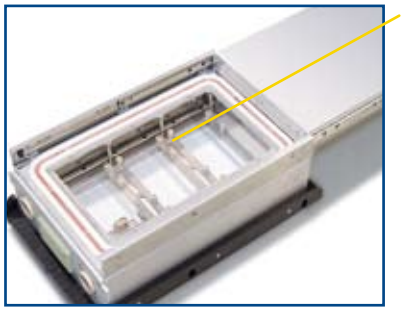
Patents: PCT/EP2008/000296 and DE 10 207 007 529.6

The Thermobox: a Carrier for PCBs and Electronic Assemblies

A hatec© *Thermobox* is the ideal temperature chamber. The size and profile of the integrated board carrier is adaptable to the current PCB or assembly. Depending on the size of the PCB or the assembly, a box provides multiple use.

Thermoboxes are suitable for PCBs with or without cases. Opposite to tunnel furnaces, only a very small volume is brought to the required test temperature. The special design provides a homogenous air flow inside. Integrated temperature sensors take care of fast, efficient and precise temperature setting.

hatec© *Thermoboxes* use a common footprint. The height can be adapted to the size of the D.U.T. For FCT, contacting is possible from both sides. For this purpose, another slider will be mounted on the bottom side of the box.



Board Carrier

Low weight board carrier with and without edge connector contacting. For dual side contacting, another slider will be mounted on the bottom side of the box.

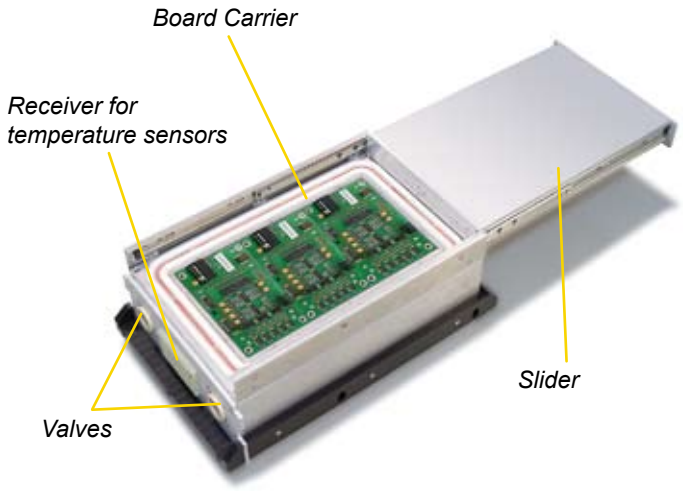
Reliable Contacting at Each Temperature

At the front side, each *Thermobox* provides two valves for the air flush and a receiver for the connection of the temperature sensors. For the functional test of the PCBs, the top cover slider will be opened (sealed) and exchanged into a test receiver connector.

Signal paths are short, therefore temperature screening of RF-devices or high power boards is possible. The temperature distribution is homogenous and the performance exceeds the commonly used tunnel furnaces.

Safe Test Handling Procedure

Each *Thermobox* uses an RFID Tag. It stores the required testing procedure, the system configuration and the current condition of the D.U.T. This ensures the integrity of the testing procedure under all conditions, even in case of a system error. It allows save assignment of PASS/FAIL test results for each device. Storing individual test schedules of the D.U.T.s by means of an RFID Tag in each *Thermobox*, allows easy and trouble-free configuration of large PTM-units, consisting of several modules for high volume production lines, even for various individual test conditions.



The hatec® Thermobox with Integrated Board Carrier

The box provides valves for air connection and a receiver for the connection of the temperature sensors and internal supplies. The picture shows an example wit 3 D.U.T.s. The number of boards in one box depends on the board size.
The size of a standard box is 410 mm x 215 mm x 235 mm (16.14" x 8.47" x 9.25").

Dry Air for Temperature Conditioning

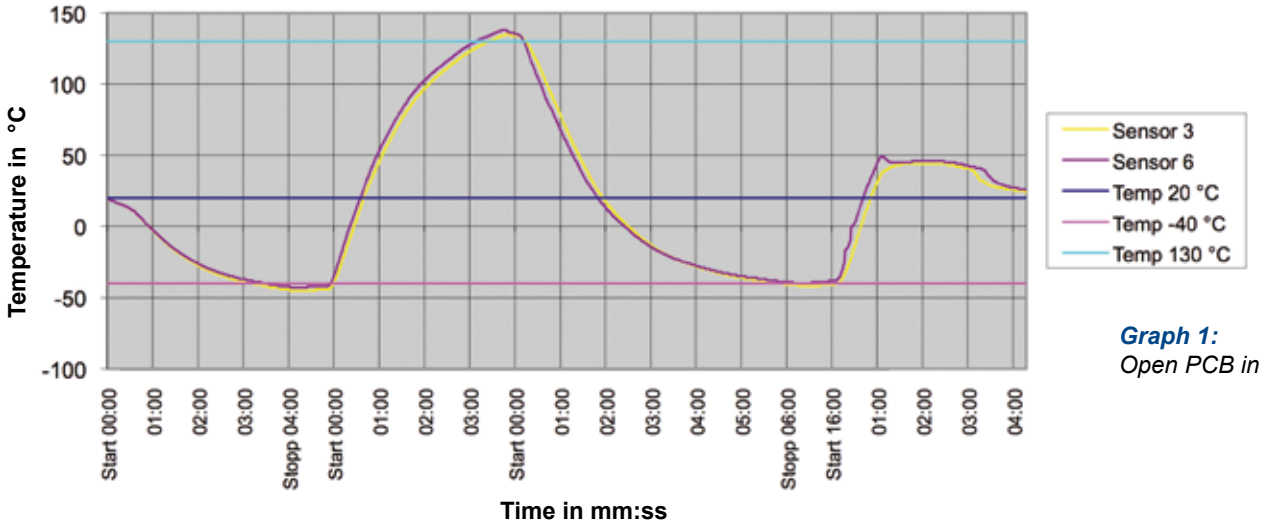
Hot and dry circulating air is used for conditioning, only. Due to the small volume of the box, liquid Nitrogen is not necessary for cooling. After cold testing, the boards will be brought back to ambient or at least above dew point, to avoid any problems with condensate or icing.

PTM System, Loader Module (left)

The D.U.T.s remain in the Thermobox during the whole testing procedure. Loading and unloading of devices maybe done manually or by means of a separate box loader/ unloader or a robot arm.

Temperature Performance of Boards With and Without Case

The graphs below show the performance of temperature conditioned test handling using PTM modules. An assembly was equipped with several temperature sensors. A multi channel line recorder was used to plot the results. The graphs show the results for PCBs with and without case. The check was made on a system, similar to the image on the page before. The PCB was cooled from ambient down to -40 °C and heated up to +130 °C (-40 °F to +266 °F).

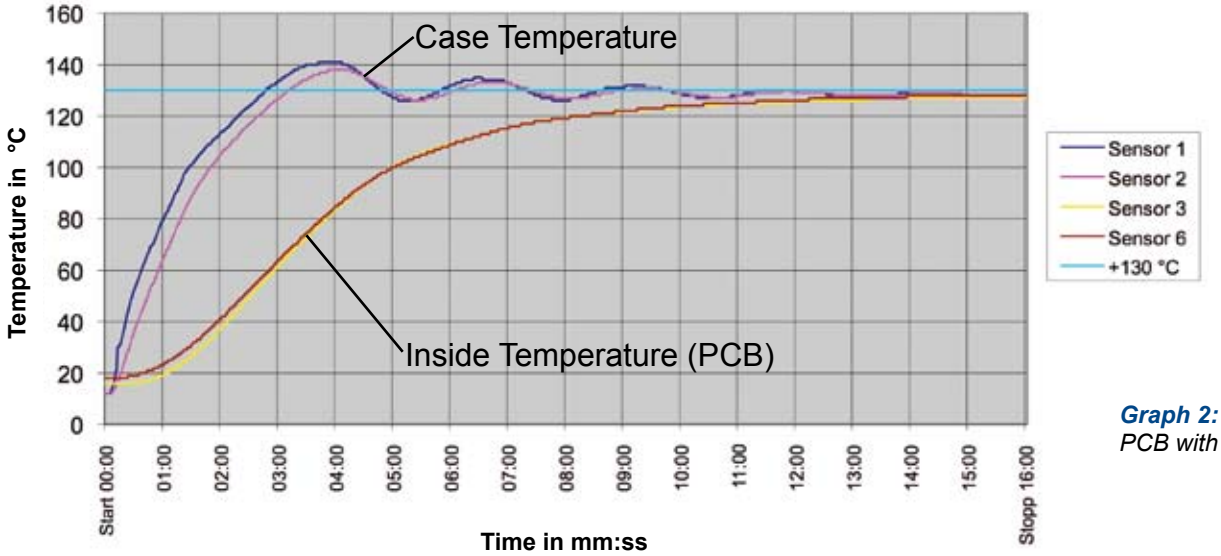


Graph 1:
Open PCB in a Thermobox

Open PCB:

Typical Temperature Conditioning Times

From ambient	to	-40 °C (-40 °F)	3 to 4 minutes
From -40 °C (-40 °F)	to	+130 °C (+266 °F)	3 to 4 minutes
From +130 °C (+266 °F)	to	-40° C (-40 °F)	6 to 7 minutes



Graph 2:
PCB with a case in a Thermobox

PCB in a Case:

- From ambient to +130°C (+266 °F) (case surface temperature): 3 minutes.
- Temperature conditioning of the PCB inside of the closed case: another 13 minutes.

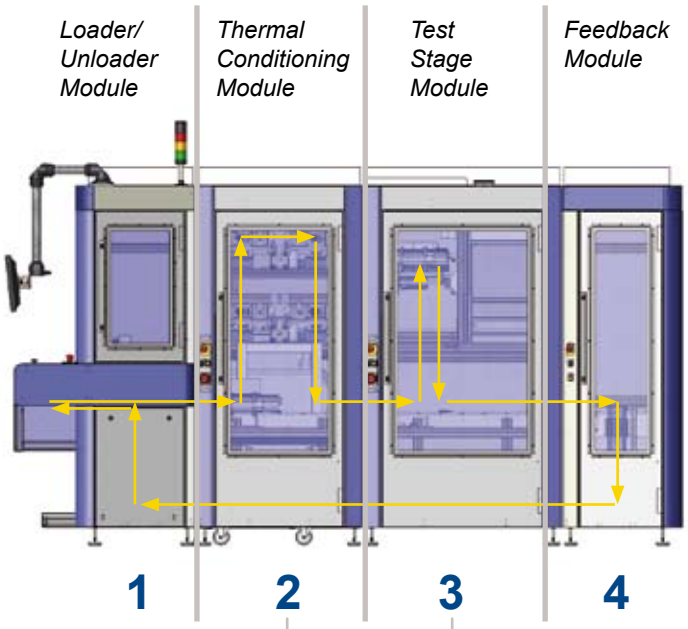
Full temperature conditioning of the complete unit took approx. 16 minutes.

If an on-board temperature sensor is available, it may be used for a dynamic temperature control. In this case the heat up time would be cut in half.

Environmental Stress Screening Using PTM Modules: Modular and Expandable

The system is modular. It consists of PTM Modules (PTM= Paternoster Temperature Module). It may be expanded by subsequent Thermal Conditioning- and Test Stage modules. Subsequent boxes are directly proceeded to the next module, which makes the system expandable for high volume production and individual test strategies.

→ *Box Handling Sequence*

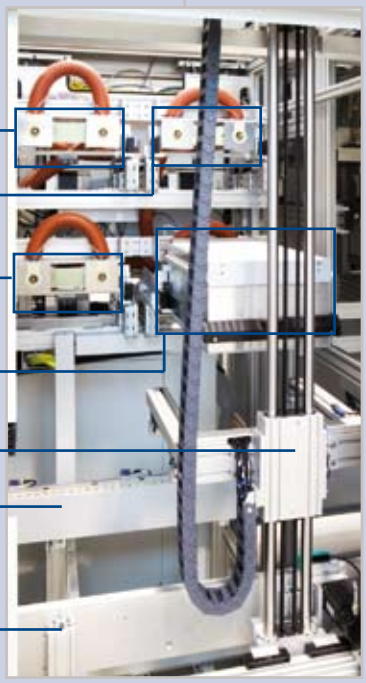


Test Sequence, Using One Thermal Conditioning- and One Test Stage Module

1. **D.U.T. loading and unloading**
2. **Thermal conditioning**
3. **Test stage**
4. **Lowering and feedback of the Thermalboxes**

The Thermal Conditioning Module

Box conditioning in 4 steps:



The Test Stage Module

A System for High Volume Production Lines

A production line may consist of an unlimited number of similar, subsequent Thermal Conditioning- and Test Stage Modules. Therefore, a PTM line is configurable to each required production size, throughput and test strategy.

Each module includes the necessary conveyor for the jam free transport of the boxes.
Due to the RFID Tag in each box, including the current test strategy, device handling is save and easy, even for very large systems.

hatec© is your specialist for backend factory automation and In Line test handling of PCBs and assemblies in electronic production lines.

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Issue 3, 10/2011. Subject to change without notice