

SYSTEM AND METHOD FOR RAPID TEMPERATURE TRANSITIONS FOR DEVICES UNDER TEST

Field of the Invention

[0001] The present invention generally relates to temperature control systems for devices under test. In particular, the invention relates to a temperature control system and method for rapid temperature transitions for a device under test using hot and cold fluids.

Background of the Invention

[0002] Integrated Circuits or sometimes referred to as IC-Chips are widely used in virtually every electronic device conceivable. During manufacturing of IC-chips, they undergo some form of testing to ensure that the internal circuitry has been wired properly. This test is sometime referred to as the “burn-in” test.

[0003] During testing, the IC-chip is often referred to as a Device under Test (DUT). The DUT is mounted onto a PCB having a predetermined testing algorithm and setting. While undergoing testing, the DUT may further be maintained at a few predetermined temperature settings, whereby the performance of the DUT is further being monitored and recorded.

[0004] There have been various ways for maintaining such DUTs at these predetermined temperatures. The DUTs when undergoing testing are inherently generating heat and may heat up to relatively high temperatures. Heat exchangers have been used to dissipate the heat from the DUTs to help maintain them at certain temperature levels. In addition, there has also been use of thermoelectric coolers coupled to the DUTs for providing temperature variations and controlling the rate of heat transfer. Sometimes the thermoelectric coolers are used more as a thermal valve than a heat pump.

[0005] However, many of these methods require relatively great lengths of time when changing from one temperature of the DUT to another. Furthermore, some of these methods are further limited by the self-heating of the DUT.

[0006] It can thus be seen that there exists a need for a simple and low cost method for a system and method for rapid temperature transitions for a device under test that can overcome or at least alleviate the disadvantages of the existing prior art.

Summary of the Invention

[0007] The present invention seeks a system and method for rapid temperature transitions for a device under test.

[0008] Accordingly, in one aspect, the present embodiment provides, a temperature control system for providing rapid temperature transitions for a plurality of electronic devices under test, the temperature control system comprising: a hot fluid subsystem for providing a hot fluid at a first temperature; a cold fluid subsystem for providing a cold fluid at a second temperature; a plurality of test heads each for maintaining one of the plurality of electronic devices under test close to at least one highest temperature and at least one lowest temperature; each of the plurality of test heads further comprising: a mixer valve for mixing the hot fluid and the cold fluid to produce a pre-mix fluid having a third temperature; a fluid jacket for coupling to the one of the plurality of electronic devices under test, thereby maintaining temperature of the one of the plurality of electronic devices under test by thermal exchange between the pre-mix fluid in the fluid jacket, the pre-mix fluid further being continuously circulated between the fluid jacket and the hot fluid subsystem or the cold fluid subsystem; and at least one temperature sensor for measuring temperature of the pre-mix fluid and for providing at least one temperature signal; a controller for receiving the at least one temperature signal from each of the plurality of test heads and for sending at least one control signal to the mixer valve of each of the plurality of test heads; wherein the at least one control

signal may be used change the temperature of the pre-mix fluid by controlling the mixer valve of each of the plurality of test heads, thereby rapidly changing the temperature of the plurality of electronic devices under test.

[0009] In another aspect, the present embodiment provides, a method for providing rapid temperature transitions for a plurality of electronic devices under test, the method comprising the steps: providing a temperature control system having a plurality of test heads each for maintaining one of the plurality of electronic devices under test close to at least one highest temperature and at least one lowest temperature; providing a hot fluid at a first temperature and a second cold fluid at a second temperature; mixing the hot fluid and the cold fluid in a mixer valve of each of the plurality of test heads to produce a pre-mix fluid having a third temperature; running the pre-mixed fluid in a fluid jacket of each of the plurality of test heads resulting in thermal exchange between the pre-mix fluid and the plurality of electronic devices under test; providing at least one temperature signal from each of the plurality of test heads; and providing at least one control signal to each of the plurality of test heads; wherein the at least one control signal is for instructing one of the mixer valves of each of the plurality of test heads to change the pre-mix fluid temperature which in turn changes the temperature of one of the plurality of electronic devices under test.

Brief Description of the Drawings

[0010] A present embodiment of the present invention will now be more fully described, with reference to the drawings of which:

[0011] FIG. 1 illustrates a block diagram of a system in accordance with the present embodiment;

[0012] FIG. 2 illustrates a flowchart for a method in accordance with the present embodiment;

[0013] FIG. 3A, FIG. 3B and FIG. 3C illustrates a test jig system in accordance with the present embodiment; and

[0014] FIG. 4 illustrates a kinetic mount of a test head in accordance with the present embodiment.

Detailed description of the Drawings

[0015] A system and method for rapid temperature transitions for a plurality of electronic devices under test is described. In the following description, details are provided to describe the preferred embodiment. It shall be apparent to one skilled in the art, however that the invention may be practiced without such details. Some of the details may not be described at length so as not to obscure the invention.

[0016] The present embodiment utilizes a test head coupled to each of the electronic devices under test (hereinafter referred to as DUT) for maintaining the DUT at a desired temperature. Furthermore, the present embodiment allows for rapid transitions of temperatures in the test head from one temperature to another. This is achieved by advantageously mixing a hot fluid and a cold fluid to achieve a desired temperature and by continuously running this pre-mixed fluid into a fluid jacket of the test head. Thermal exchange occurs rapidly through the fluid jacket to the DUT, changing the temperature of the pre-mixed fluid. However, by running the pre-mixed fluid at a high flow rate through the fluid jacket, the temperature of the fluid jacket is maintained closely to the desired temperature. In particular, the flow rate refers to the volume of fluid flowing across the DUT, and is used to determine the minimum change in temperature (ΔT) during the time duration where the fluid enters and exits the fluid jacket. The minimum ΔT is preferably maintained across the DUT. Generally, it is desirable to minimize ΔT so that the flow rate is generally maximized for the application.

[0017] Each test head further has a mixer valve for controlling the ratio of the mixing of the hot and cold fluid thereby changing the temperature of the pre-mix

fluid. Rapid temperature changes may be achieved by controlling the mixer valve. Citing the mixer valve as a control mechanism is in no way intended to limit the scope of the invention but is included for completeness. Furthermore, the mixer valve can be controlled by a dual rod air cylinder that produces good controllability at a low cost. The dual rod cylinder typically uses one regulator, which makes the control more cost effective.

[0018] The hot fluid and the cold fluid are further maintained at pre-set temperatures separately in their respective hot and cold tanks. The hot fluid and the cold fluid are pre-mixed in a mixer valve and run continuously through the fluid jacket at the desired temperature. The pre-mixed fluids exit the fluid jacket and are returned to an arrangement of hot reservoir tanks and cold reservoir tanks to be later returned to the hot and cold tanks. The arrangement aims to keep hot fluids separated from cold fluids, such that less energy is consumed in bringing the temperatures of the fluids either up to or down to the level of the hot tanks and cold tanks. In a preferred embodiment, the fluid flows through the system by differential air pressure. In this system, there is a minimum of two hot reservoir tanks and two cold reservoir tanks so that when one of the reservoir tanks fills up, there is an empty one to switch the flow to. If there is no change in the fluid temperature, then one reservoir tank is filling while the other reservoir tanks are draining. It is required that the drain time be shorter than the fill time so that there will always be an empty tank when needed.

[0019] The temperature of the hot and cold tanks are further selectively chosen based on the known temperature profiles required for the testing of the DUTs. This allows a rapid transition of temperatures from one predetermined temperature to another predetermined temperature.

[0020] The present embodiment further advantageously uses an improved test jig that minimizes human errors during the mounting of the DUTs to the fluid jackets of the temperature control systems during the “burn-in” testing.

[0021] Referring to FIG. 1, the temperature control system 10 in accordance with the present embodiment comprises a hot fluid subsystem, a cold fluid subsystem, and a plurality of test heads 20 for maintaining or changing temperatures of the plurality of DUTs 15.

[0022] Each of the test heads 20 comprises a mixer valve 22 in communication with a fluid jacket 25. The fluid jacket 25 may be coupled directly to the DUT 15 or may be coupled via a layer of Thermal Interface Material. The mixer valve 22 receives a hot fluid having a first temperature and a cold fluid having a second temperature and mixes them in to produce a pre-mix fluid having a third temperature. The pre-mix fluid is then received by the fluid jacket 25 which results in thermal exchange of the pre-mix fluid in the fluid jacket 25 with the coupled DUT 15.

[0023] By controlling the mixer valve 22 of each of the test heads 20, different temperatures within the fluid jackets 25 may be obtained. This is advantageous as not all DUTs 15 have the same characteristics. Some DUTs 15 heat up faster than others, some perform better at certain temperatures as well. As such, being able to control the temperature of each of the fluid jackets 25 independently advantageously allows each DUT 15 to be tested depending on its responses.

[0024] The hot fluid subsystem of the temperature control system 10 comprises a hot tank 30 for storing and maintaining the hot fluid at the first temperature. The hot tank 30 is further equipped with a heater unit 31 and a hot tank temperature sensor 32.

[0025] The pre-mix fluid is running continuously into the fluid jackets 25 and exit the fluid jackets 25 to be circulated back to the hot fluid subsystem or the cold fluid subsystem.

[0026] If the pre-mix fluid is above a threshold temperature, the pre-mix fluid is circulated back to the hot fluid subsystem. The hot fluid system further comprises a first hot reservoir tank 33 and a second hot reservoir tank 34. The first and

second hot reservoir tanks 33, 34 serves to receive the circulated pre-mix fluid from the test heads 20.

[0027] Similarly, the cold fluid subsystem comprises a cold tank 40 for storing and maintaining a cold fluid at the second temperature. The cold tank 40 is further equipped with a chiller unit 41 and a cold tank temperature sensor 42. The cold fluid subsystem further comprises a first cold reservoir tank 43 and a second cold reservoir tank 44.

[0028] When the circulated pre-mix fluid is below the threshold temperature, the pre-mix fluid is directed to the cold fluid subsystem. The first and second cold reservoir tanks 43 and 44 serve to receive this pre-mix fluid from the fluid jackets 25.

[0029] Referring to the hot fluid subsystem, having the first and the second hot reservoir tanks 33, 34 advantageously allows for example the first hot reservoir tank 33 to be filled from the pre-mix fluid after the test heads 20, while the second hot reservoir tank 34 is draining pre-mix fluid already in the second hot reservoir tank into the hot tank 30.

[0030] As the pre-mix fluid is added into the hot tank 30, the temperature of the contents of the hot tank 30 may vary depending on the temperature of the pre-mix fluid added. The hot tank temperature sensor 32 then serves to monitor the temperature within the hot tank 30. If the temperature varies too greatly, the heater unit 31 may be activated to heat the fluid in the hot tank 30 to the first temperature.

[0031] Referring to the cold fluid subsystem, having the first and the second cold reservoir tanks 43, 44 advantageously allows for example the first cold reservoir tank 43 to be filled from the pre-mix fluid after the test heads, while the second hot reservoir tank 44 is draining pre-mix fluid already in the second hot reservoir tank into the cold tank 40.

[0032] As the pre-mix fluid is added into the cold tank 40, the temperature of the contents of the cold tank 40 may vary depending on the temperature of the pre-mix fluid added. The cold tank temperature sensor 42 then serves to monitor the

temperature within the cold tank 40. If the temperature varies too greatly, the chiller unit 41 may be activated to cool the fluid in the cold tank 40 to the second temperature.

[0033] In terms of each of the hot and cold fluid subsystems having two reservoir tanks. The two reservoir tank arrangement advantageously allows the first reservoir tank to be filled up before switching to the second reservoir tank, while the first reservoir tank then drains to the hot or cold tank 30, 40. At any one time, only one reservoir tank is allowed to be filled up. At least one of the reservoir tanks must either be draining or empty.

[0034] As mentioned previously, if the fluid does not change temperature appreciably in the time it takes to fill the reservoir tank, there is a second empty receiver tank to switch the flow to while the previous tanks is being emptied. Furthermore, there may be a scenario when the total volume of fluids in one subsystem exceeds the volume that the subsystem is intended to handle. The excess fluid may then be drained to the other subsystem. It can be appreciated by one skilled in the art that other types of recirculation schemes may be utilized.

[0035] The first temperature, the second temperature, the third temperature and the threshold temperature may be predetermined and selected based on the temperature testing profile that is desired for the DUTs. The temperature testing profiles for the DUTs usually comprises a few set temperatures within a range of temperatures. There are usually at least two predetermined set temperatures corresponding to a highest set temperature and a lowest set temperature.

[0036] The second temperature is the temperature of the cold fluid coming from the cold tank 40. The second temperature is selected to be similar to the lowest set temperature of the temperature testing profile. This way, the cold fluid from the cold tank 40 is always ready for lowering the DUTs to their lowest set temperature in the temperature testing profile. This is desirable as the time and power required for further lowering the temperature of a cold fluid is much more than that for heating of a hot fluid. As such, the cold fluid is always kept at the lowest set

temperature so that no additional cooling is required when the cold fluid from the cold tank 40 is being used.

[0037] The first temperature is the temperature of the hot fluid coming from the hot tank 30. This is selected to be not more than 10°C above the highest set temperature. As such, whenever the hot fluid is in use, it would be mixed with lesser amounts of cold fluid to bring the hot fluid to a lower temperature for use. This overall results in less cold fluid being used, which results in less time and power consumed in cooling the cold fluid.

[0038] As compared to the cold fluid, the hot fluid is more easily heated up to a higher temperature for use. In addition to the heater unit 31 in the hot tank 30, a flash heater 50 may be installed in the hot fluid subsystem for further providing rapid heating to the hot fluid being sent to the plurality of test heads 20. This may be desirable particularly when pre-mix fluid having lower temperatures have been added into the hot tank 30. In an alternative embodiment, a plurality of flash heaters may be utilized. Specifically, if the plurality of test heads 20 operates independently, then a flash heater 50 may be coupled to each of the plurality of test heads 20.

[0039] . The advantage of the flash heater 50 is that it solves the problem of sudden increases in temperature over the current temperature of the hot tank 30. In one mode of operation, the flash heater 50 allows the hot tank 30 to be run below the highest temperature required for the test, and up to maximum temperature of the fluid that the flash heater 50 can raise to. For example, suppose that the test procedure requires running at 60°C for 20min and 90°C for 10min. Instead of having to run the hot tank 30 at 90°C throughout the whole test procedure by mixing the hot flow with large amounts of cold flow to achieve the 60°C working temperature, the hot tank 30 can be run at 65°C for 20min by mixing a small amount of cold fluid to produce the desired working temperature, and then warmed to 90°C for the last 10min. During the transition from 65°C to 90°C the flash

heater 50 is used to raise the temperature of the hot fluid. A flash heater capable of at least raising the temperature of the fluid passing through by 30°C is then used.

[0040] The threshold temperature is used mainly for deciding whether the pre-mix fluid after the test heads 20 will be circulated back to the hot fluid subsystem or the hot fluid subsystem. The threshold temperature may be a temperature selected between the highest set temperature and the lowest set temperature. More particularly, the threshold temperature may be selected to be about 10°C above the lowest set temperature if the threshold temperature at this selection does not go above midway between the highest set temperature and the lowest set temperature.

[0041] An example of such a selection of threshold temperature may be when the highest set temperature is 100°C and the lowest set temperature is 10°C. The threshold temperature is then selected to be 20°C. For example, a pre-mix fluid having a temperature of 25°C would then be sent to either the first or second hot reservoir tanks 43, 44.

[0042] In another example, if the highest set temperature is 40°C and the lowest set temperature is 25°C, the midway between the highest set temperature and the lowest set temperature would be 32.5°C. As such, selecting the threshold temperature to 10°C above the lowest set temperature would bring the threshold temperature to 35°C which is above the midway between the highest set temperature and the lowest set temperature. In this case, the threshold temperature with a lower level of 32.5°C is selected.

[0043] The system 10 according to the present embodiment may further comprise of at least one controller (not shown in FIG. 1) for controlling the circulation of the hot fluids and for controlling a plurality of valves (not shown in FIG. 1) for directing the flow of the fluids inside the system. The heater units 31 and the chiller units 41 may also be controlled by this controller. The controller is further adapted to receive inputs from the plurality of temperature sensors that may be installed at various locations in the system 10. Two such examples are the hot tank

temperature sensor 32 and the cold tank temperature sensor 42. Temperature sensors would also be installed to monitor the temperature of the pre-mix fluids before and after the individual fluid jackets 25, such that the control of the individual mixer valves 22 for each test head 20 would also be controlled by the controller.

[0044] The controller would then control each of the mixer valves by sending out at least one control signal to each of the mixer valves to control the temperature of the pre-mix fluids, which would then affect the temperature of the DUTs the fluid jackets are coupled to. The control signal provides instructions for the mixer valve to mix the hot fluid and the cold fluid at a predetermined ratio that would be produce the pre-mix fluid having the third temperature.

[0045] The system 10 may further comprise a plurality of pipelines or means for transporting the fluids around the system. Driving means such as motor and variety of pumps will also be required for driving the fluids through these pipelines. Use of compressed air may also be used for such driving means and the use of valves and regulator will also need to be considered. It would be apparent to one skilled in the art that the present invention may be practiced without further description to such details.

[0046] Referring to FIG. 2, a method 200 in accordance with the present embodiment may further start with the step of providing 210 the hot fluid at the first temperature and the cold fluid at the second temperature. Next the step of mixing 215 the hot fluid and the cold fluid to form the pre-mix fluid is performed. The mixer valve 22 of the test heads 20 would receive instructions from the controller to mix the hot and cold fluids at a predetermined ratio to produce the pre-mix fluid having a third temperature.

[0047] The pre-mix fluid is then run 220 continuously into the fluid jackets 25 which are coupled to the DUTs 15. The continuous flow of the pre-mix fluid into the fluid jackets 25 result in thermal exchange between the pre-mix fluid and the DUTs 15. This way the temperature of the DUTs 15 may be maintained according

to the third temperature of the pre-mix fluids or may be changed by changing the third temperature.

[0048] The plurality of test heads 20 may further be equipped with temperature sensors for detecting and providing temperature signals of the pre-mix fluids and the DUTs 15. The step of providing 225 at least one temperature signal from each of the test heads 20 is then performed.

[0049] The controller of the system 10 then processes these temperature signals to provide control instructions to each of the mixer valves 22 of the test heads 20. The step of providing 230 the at least one control signal to each of the test heads 20 is then performed. The at least one control signal may be to instruct one of the test heads 20 to adjust or change the pre-mix fluid temperature to maintain or change the temperature of the DUT 15.

[0050] In another embodiment, the present implementation may be further improved by utilizing a test jig system that minimizes human errors during mounting of the DUTs to the fluid jackets of the temperature control system 10 during the “burn-in” testing.

[0051] Referring to FIG. 3A, the test jig system 300 comprises a self-contained testing board 305 adapted for mounting multiple DUTs 15 and a system enclosure 350 for housing the temperature control system 10. The self-contained testing board 305 effectively comprises a mother board capable of testing multiple DUTs 15 at any one time. The self-contained testing board 305 is adapted to slide into and out of the system enclosure 350 like a drawer.

[0052] Referring to FIG. 3B, DUTs 15 that need to be tested are mounted onto the self-contained testing board 305 and then slid into the system enclosure 350. Referring to FIG. 3C, compressed air cylinders 320 may be mounted at the bottom of the self contained testing board 305. The compressed air cylinders 320 may be used to raise the self contained testing board 305 such that the DUTs 15 engage with the multiple test heads 20 each corresponding to a DUT 15. While this example uses air cylinders to engage the test head with the DUT, this is in no way

intended to limit the applicability of this design. Motors, solenoids, etc may also be used to raise and lower the mother board. Raising and lowering the DUTs instead of the test heads eliminates the necessity that the test head assembly move appreciably, which makes the design much easier.

[0053] Once the tests are completed, the reverse procedure may be adopted to withdraw the self contained testing board 305 from the system enclosure 350 and the DUTs 15 may then be removed. A handle 310 is attached to the self-contained testing board 305 allowing the removal despite any extreme temperatures that may have been transmitted to the self contained testing board 305.

[0054] The present test jig system 300 advantageously allows for rapid mounting and dismounting of the DUTs 15. Furthermore, force on the DUT 15 is mainly perpendicular to the DUT 15 and the self-contained testing board 305. There is an elimination of operator error when it comes to engaging the DUT 15 to the test heads 20, as the operator does not need to make a decision as to how tightly coupled the DUT 15 must be to the test head 20. There are also less alignment errors since the entire self-contained testing board 305 may be pre-aligned with the location of the DUTs 15 and the test heads 20.

[0055] One further advantage is the vertical motion of the testing board 305 that engages the DUT 15 to the test heads 20 results in minimal wear and tear on any thermal interface material (TIM) that may be used. Compared to the other designs where the test heads or DUTs swing into place to engage each other, the TIM will last many times longer in the vertical engagement between the DUT 15 and the test head 20.

[0056] The test heads 20 within the system enclosure 350 may further be adapted to further comprise a kinetic mount. The kinetic mount comprises of at least a gimbal which results in a consistent application of force and pressure on the DUT 15 when the test heads 20 are engaged and coupled to the DUTs 15. This kinetic mount also reduces the possible planar movements that may be experienced when coupling the test heads 20 to the DUTs 15.

[0057] Referring to FIG. 4, the test head 401 is attached to spring loaded gimbal that rides on a spherical surface 403 such that the center of the sphere is at the bottom of the test head 401 in the vertical direction and in the center of the test head 401 in the horizontal plane. Slight angular misalignment of the DUT 402 and TIM 404 are compensated by the least possible amount of movement. This reduces the wear and tear on the TIM 404.

[0058] It will be appreciated that various modifications and improvements can be made by a person skilled in the art without departing from the scope of the present invention.

Claims

1. A temperature control system for providing rapid temperature transitions for a plurality of electronic devices under test, the temperature control system comprising:
 - a hot fluid subsystem for providing a hot fluid at a first temperature;
 - a cold fluid subsystem for providing a cold fluid at a second temperature;
 - a plurality of test heads each for maintaining one of the plurality of electronic devices under test close to at least one highest temperature and at least one lowest temperature;
 - each of the plurality of test heads further comprising:
 - a mixer valve for mixing the hot fluid and the cold fluid to produce a pre-mix fluid having a third temperature;
 - a fluid jacket for coupling to the one of the plurality of electronic devices under test, thereby maintaining temperature of the one of the plurality of electronic devices under test by thermal exchange between the pre-mix fluid in the fluid jacket, the pre-mix fluid further being continuously circulated between the fluid jacket and the hot fluid subsystem or the cold fluid subsystem; and
 - at least one temperature sensor for measuring temperature of the pre-mix fluid and for providing at least one temperature signal;
 - a controller for receiving the at least one temperature signal from each of the plurality of test heads and for sending at least one control signal to the mixer valve of each of the plurality of test heads;
 - wherein the at least one control signal may be used change the temperature of the pre-mix fluid by controlling the mixer valve of each of the plurality of test heads, thereby rapidly changing the temperature of the plurality of electronic devices under test.

2. The temperature control system of claim 1, wherein the hot fluid subsystem comprises a hot tank having a heater unit, a hot tank temperature sensor and a first hot reservoir tank.
3. The temperature control system of claim 2, wherein the cold fluid subsystem comprises a cold tank having a chiller unit, a cold tank temperature sensor and a first cold reservoir tank.
4. The temperature control system of claim 1, further comprising a flash heater for providing additional rapid heating to the hot fluid before mixing in the mixer valves of each of the plurality of test heads.
5. The temperature control system of claim 3, further comprising a fluid return subsystem for circulating the pre-mix fluid after the plurality of test heads back to the hot fluid subsystem if the pre-mix fluid is above a threshold temperature.
6. The temperature control system of claim 5, wherein the hot fluid subsystem further comprises a second hot reservoir tank.
7. The temperature control system of claim 6, wherein the cold fluid subsystem further comprises a second cold reservoir tank.
8. The temperature control system of claim 5, wherein the threshold temperature is about 10°C above the coldest predetermined temperature.
9. The temperature control system of claim 1, wherein the first temperature is not more than 10°C above the highest predetermined temperature if the highest predetermined temperature is above room temperature.

10. The temperature control system of claim 1, wherein the second temperature is about the same as the lowest predetermined temperature.

11. The temperature control system of claim 1, wherein the plurality of electronic devices under test are mounted on a self contained testing board.

12. The temperature control system of claim 11, wherein the self-contained testing board is adapted to have lifting means to lift the self contained testing board to engage the plurality of electronic devices under test to the plurality of test heads.

13. The temperature control system of claim 12, wherein the lifting means may be compressed air cylinders.

14. The temperature control system of claim 12, wherein each of the plurality of test heads further comprise a kinetic mount having a gimbal.

15. A method for providing rapid temperature transitions for a plurality of electronic devices under test, the method comprising the steps:

- a) providing a temperature control system having a plurality of test heads each for maintaining one of the plurality of electronic devices under test close to at least one highest temperature and at least one lowest temperature;
- b) providing a hot fluid at a first temperature and a second cold fluid at a second temperature;
- c) mixing the hot fluid and the cold fluid in a mixer valve of each of the plurality of test heads to produce a pre-mix fluid having a third temperature;
- d) running the pre-mixed fluid in a fluid jacket of each of the plurality of test heads resulting in thermal exchange between the pre-mix fluid and the plurality of electronic devices under test;

e) providing at least one temperature signal from each of the plurality of test heads; and

f) providing at least one control signal to each of the plurality of test heads;

wherein the at least one control signal is for instructing one of the mixer valves of each of the plurality of test heads to change the pre-mix fluid temperature which in turn changes the temperature of one of the plurality of electronic devices under test.

16. The method of claim 15, wherein the first temperature is not more than 10°C above the highest predetermined temperature if the highest predetermined temperature is above room temperature.

16. The method of claim 15, wherein the second temperature is about the same as the lowest predetermined temperature.

17. The method of claim 15, further comprising the steps:

g) circulating the pre-mix fluid back to a hot fluid subsystem or a cold fluid subsystem of the temperature control system.

18. The method of claim 15, wherein the pre-mix fluid is circulated back to the hot fluid subsystem if the pre-mix fluid is above a threshold temperature.

19. The method of claim 18, wherein the threshold temperature is about 10°C above the coldest predetermined temperature.