

COOLING SYSTEM AND METHOD FOR SEMICONDUCTOR RELIABILITY, FUNCTIONALITIES AND BURN-IN TEST

Field of the Invention

[0001] The present invention relates to cooling system. In particular, the invention relates to a system and method for cooling a reliability, functionalities and burn-in test apparatus for device under test.

Background

[0002] In the field of reliability, functionality and burn-in test for semiconductors in batches, such as micro-processors, the test equipment is built in a form of cabinets with trays where the electronic equipments are mounted thereon for performing the semiconductor batch testing. These cabinets are built with cooling systems or thermal management systems for cooling the devices under test (DUT) in operation. The common available cooling systems or thermal management systems, for example, either air-cooling enclosure, fluid-cooling head, or Peltier cooling are widely used in the semiconductor batch testing.

[0003] For air-cooling enclosure, the cabinets are built in a form of concealed cabin for housing the test equipment and DUT. Cooled air is supplied therein to provide cooling. Such cooling enclosure generally requires a centralized cooling apparatus and in some cases, a centralized cooling system is built to supply cooled air to more than one testing cabinets. Such cooling system is however not efficient as the air is flowed free within the cabinets and heat may potentially be accumulated at close proximity of the heat sources, i.e. the DUT, if the air flow within the cabin is not sufficiently good. Further, not all components within the cabinets required cooling, therefore, wastage of cooling resources.

[0004] For fluid-cooling system, the cabinet for holding the test board and the DUT does not require to be concealed. A cooling head is provided for each of the

DUT. Fluid runs through the cooling head helps to carry away the heat generated by the DUT. The fluid-cooling system also uses centralized compressor where a compressor is operable to supply fluid flow to one or more cabinets of DUT.

[0005] A centralized compressor is generally bulky and has high power consumption. It is therefore not scalable with increased power density requirement for the DUT. When the compressor fails to operate, the DUT test will have to be shut down until the compressor is fixed/replaced. However, fixing/replacing a centralized compressor can be tedious due to the large size. Further, big compressor produces a lot of noise when operating.

[0006] Thermoelectric cooler, or Peltier cooler is a solid state cooling device designed for some specific applications. The Peltier cooler is substantially noiseless cooling system and it is generally maintenance free. The effectiveness of the Peltier depends on the amount of current provider and how well the heat on the hot side can be removed. It is known that the efficiency of the Peltier cooler is far lower than conventional compression cycle system.

Summary

[0007] In accordance with one aspect of the present invention, there is provided a modular cooling system for a reliability, functionality and burn-in test equipment having more than one tray, each tray is mounted with a plurality of devices under test (DUT) for testing, the modular cooling system comprises a plurality of cooling heads, each for cooling one DUT on one tray; and a modular unit adapted to removably mount on each tray, wherein the modular unit is connected to the plurality of cooling heads in a close loop to provide a refrigeration cycle for cooling the DUT.

[0008] In accordance with one embodiment, the cooling head may comprise a multiple-tiers compartment for allowing a fluid flow therein. Each tier of the multiple-tiers compartment may also comprise channels for providing a fluid flow path.

[0009] In accordance with another embodiment, each tier of the cooling head may comprise concentrically aligned circular channels fluidly connecting with each other via diffusing channels. The fluid path may allow fluid to spread from the center of the multiple-tiers compartment.

[0010] In accordance with yet another embodiment, the multiple-tiers compartment may comprise pins projecting from an inner bottom surface of the multiple-tier compartment. The pins may be hollow tubes.

[0011] In accordance with a further embodiment, the cooling head may further comprise a fluid inlet adapted to inject fluid into the multi-tiers compartments from a center of the multiple-tiers compartment. It is possible that the fluid inlet is adapted to extend into a bottom most tier of the multiple-tiers compartment. The fluid inlet may further define a plurality of orifices for diffusing fluid.

[0012] In yet a further embodiment, the modular unit may comprise a compressor, a heat exchanger, and fluid piping. In yet a further embodiment, each tray of the test equipment may be mounted with one or more modular unit

[0013] In accordance with another aspect of the present invention, there is provided a reliability, functionality and burn-in test apparatus for semiconductors, the apparatus comprises a cabinet having more than one tray, each tray is adapted for mounting a plurality of devices under test (DUT); a modular unit adapted to removably mount on each tray; and a cooling head for attaching with each of the DUT. The modular unit is connected to the plurality of cooling head in a close loop to provide a refrigeration cycle for cooling the DUT.

[0014] In accordance with one embodiment, the cooling head may comprise a multiple-tiers compartment for allowing a fluid flow therein. Each tier of the multiple-tiers compartment may also comprise channels for providing a fluid flow path.

[0015] In accordance with another embodiment, each tier of the cooling head may comprise concentrically aligned circular channels fluidly connecting with each

other via diffusing channels. The fluid path may allow fluid to spread from the center of the multiple-tiers compartment.

[0016] In accordance with yet another embodiment, the multiple-tiers compartment may comprise pins projecting from an inner bottom surface of the multiple-tier compartment. The pins may be hollow tubes.

[0017] In accordance with a further embodiment, the cooling head may further comprise a fluid inlet adapted to inject fluid into the multi-tiers compartments from a center of the multiple-tiers compartment. It is possible that the fluid inlet is adapted to extend into a bottom most tier of the multiple-tiers compartment. The fluid inlet may further define a plurality of orifices for diffusing fluid.

[0018] In yet a further embodiment, the modular unit may comprise a compressor, a heat exchanger, and fluid piping. In yet a further embodiment, each tray of the test equipment is mounted with one or more modular unit.

Brief Description of the Drawings

[0019] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0020] **FIG. 1** illustrates a semiconductors reliability, functionality and burn-in test system having a modular cooling system in accordance with one embodiment of the present invention;

[0021] **FIG. 2A** illustrates a schematic diagram of the modular unit in accordance with one embodiment of the present invention;

[0022] **FIG. 2B** illustrates a schematic diagram of the modular unit in accordance with an alternative embodiment of the present invention;

[0023] FIG. 2C illustrates a schematic diagram of the modular unit in accordance with a further embodiment of the present invention;

[0024] FIG. 3A illustrates a partially explored view of the cooling head in accordance with one embodiment of the present invention;

[0025] FIG. 3B illustrates a top plan view of a base plate of the cooling head of FIG. 3A;

[0026] FIG. 3C illustrates a top plan view of the middle plate of the cooling head of FIG. 3A in accordance with one embodiment of the present invention;

[0027] FIG. 3D illustrates a top plan view of the middle plate of the cooling head of FIG. 3A in accordance with another embodiment of the present invention;

[0028] FIG. 3E illustrates a cross section view of the top plate of FIG. 3A;

[0029] FIG. 4A illustrates a perspective cross sectional view of a cooling head in accordance with another embodiment of the present invention;

[0030] FIG. 4B shows the flow of fluid within the cooling head of FIG. 4A;
and

[0031] FIG. 5 illustrates a cross sectional view of a cooling head in accordance with a further embodiment of the present invention.

Detailed Description

[0032] In line with the above summary, the following description of a number of specific and alternative embodiments are provided to understand the inventive features of the present invention. It shall be apparent to one skilled in the art, however that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0033] **FIG. 1** illustrates a semiconductors reliability, functionality and burn-in test system **150** having a modular cooling system **100** in accordance with one embodiment of the present invention. The semiconductors devices to be tested are herein referred to as devices under test (DUT) **158**. The test system **150** comprises a cabinet rack **152** having a plurality of trays **154**. Each tray **154** is mounted with a test board **156** and each test board **156** is loaded with a plurality of DUT **158**. Each tray **154** further has a modular cooling system **100** mounted thereon for cooling the DUT **158** on that tray **154**. The modular cooling system **100** comprises a modular unit **102**, cooling heads **104**, and fluid pipes **106**. The modular cooling system **100** is a small size cooling system adapted to be easily removable/replaceable from each tray. The modular unit **102** is a compression type refrigerator that provides heat transfer cycle to remove heat from the heat source, i.e. DUT **158**. The modular unit **102** is connected with a plurality of cooling head **104** via the fluid pipes **106**. Each of the DUT **158** has one cooling head **104** for removably attaching thereto to withdraw heat generated by the DUT **158**. The cooling head **104** is profiled to provide channels (not show in **FIG. 1**) that allows refrigerant to flow therein to transmit heat. The refrigerant is cycling from the modular unit **102** to the fluid pipes **106** to the cooling head **104** and back to the modular unit **102** via the fluid pipes **106**.

[0034] **FIG. 2A** illustrates a schematic diagram of a modular cooling system **200** in accordance with one embodiment of the present invention. The modular cooling system **200** comprises a modular unit **202**, an expansion valve **203** and a cooling head **204**. The modular unit **202** comprises a housing **205**, a compressor **206**, a solenoid

valve **207**, a heat exchanger **208** and inner pipes **209**. The housing **205** is adapted to removably mount onto the tray **154** and sized to contain the modular unit's components. The modular unit **202** has an in-port **216** and an out-port **218**. The in-port **216** is connected to the compressor **206** directly. The compressor **206** is a miniature-sized compressor with an outlet **212** and an inlet **214**. The inlet **214** of the compressor **206** is connected to the in-port **216** directly. The outlet **212** of the compressor **206** is extended to run through the heat exchanger **208** via the inner pipe **209**. Beyond the heat exchanger **208**, the inner pipe **209** is connected to the solenoid valve **207** before it ends with the out-port **218**. The solenoid valve **207** is provided to regulate the amount of fluid passing through.

[0035] Still referring to **FIG. 2A**, the out-port **218** is connected to the cooling head **204** via the expansion valve **203** and looped back to the in-ports **216**. When in used, the modular cooling system **200** is filled with refrigerant for the refrigeration cycle. In operation, the refrigerant is compressed in the compressor **206** and discharged through the outlet **212**. The pressurized refrigerant is condensed in the heat exchanger **208**. The refrigerant is then injected into to the cooling head. The heat generated by the DUT is absorbed by cooling head **204** and the refrigerant in the cooling head **204** carries the heat along the fluid pipes **209** back to the compressor **202**. During the refrigeration cycle, by controlling the refrigerant flow with the solenoid valve **207**, the temperature of the DUT can be controlled and maintained at a desired level.

[0036] **FIG. 2B** illustrates a schematic diagram of a modular cooling system **220** in accordance with an alternative embodiment of the present invention. The modular cooling system **220** comprises a modular unit **222**, two expansion valves **223** and two cooling heads **224**. To support the two cooling heads **224**, the modular unit **222** is adapted to provide two in-ports **238** and two out-ports **236**. The modular unit **222** comprises a housing **225**, two compressors **226**, two solenoid valves **227**, a heat exchanger **228** and inner pipes **229**. The housing **225** is adapted to removably mount the tray **154** and sized to contain the module unit's components. In this embodiment, each of the compressors **226** is used for supporting one cooling head **224**. The expansion valves **223**, the solenoid valves **227** are connected to the compressors **226** in

a similar manner as the aforesaid embodiment. The outlets of each compressor 226 are extending through the heat exchanger for dissipating heat.

[0037] FIG. 2C illustrates a schematic diagram of a modular cooling system 240 in accordance with a further embodiment of the present invention. The modular cooling system 240 comprises a modular unit 242, a plurality of expansion valves 243 and a plurality of cooling heads 244. The modular unit 242 comprises a compressor 246 for supporting the plurality of cooling heads 244. The compressor 246 comprises an inlet 248 and an outlet 249. To support the plurality of cooling heads 244, the inlet 248 is channeled into corresponding number of in-ports. Similarly, the outlet 249 is channeled into corresponding number of out-ports after passing through the heat exchanger of the modular unit 242.

[0038] In the above embodiments, the expansion valves, also known as metering device, are coiled up capillary tubes that are used for reducing the pressure of the pressurized refrigerant, with consequential cooling effect for the modular cooling system. It is provided by way of example only, not intended to limit the scope of the present invention. It is understood that any type of expansion valve or the like can be desired for the present invention.

[0039] Further, a small/miniature sized compressor can be used to achieve small size modular cooling system in accordance with one embodiment of the present invention. A compressor disclosed in US publication number US2006/0140791 published on 29 June 2006 entitled "Miniature Rotary Compressor and Method Related Thereto" and the US patent application claiming the benefit of and priority to US provisional patent application serial number 60/827,681 filed on September 29, 2006 entitled "Orientation And Gravity Insensitive In-Casing Oil Management System For Fluid Displacement Devices, And Methods Related Thereto" are suitable for the present invention.

[0040] FIG. 3A illustrates a partially explored view of the cooling head in accordance with one embodiment of the present invention. The cooling head 300 comprises a two tiers compartment form by a base plate 310, a middle plate 320 and a

top plate 330. The three plates 310, 320 and 330 are adapted to stack on each other accordingly to form the two tiers compartment cooling head 300. A bottom surface 319 of the base plate 310 is made flat so that it can have as much surface contact as possible with the DUT. The base plate 310 is substantially a square shaped plate of at least the size of one DUT. Additional thermal interface material or the like (not shown) may be applied on the bottom surface 319 to improve the thermal conduction between the DUT and the base plate 310. The middle plate 320 is adapted to fit onto a top surface of the base plate 310, and when the top plate 330 is covered on the top surface of the base plate 310, the middle plate 320 is sandwiched between the based plate 310 and the top plate 330. The base plate 310 and the middle plate 320 is profiled to provide inner channels for fluid flow there between. The top plate 330 is further configured to provide a head in-port 331 and a head out-port 332 for connecting with the inner channels of the based plate 310 and middle plate 320.

[0041] FIG. 3B illustrates a top plan view of the base plate 310 of the cooling head 300 shown in FIG. 3A. A top surface of the base plate 310 has a circular depression 311 adapted to fit the middle plate 320 thereon. The depth of the circular depression is substantially the thickness of the middle plate 320. The flat surface of the circular depression 311 is profiled to provide concentric circular grooves 312, of which forming circular channels 312 when the middle plate 320 is fitted thereon, to provide fluid flow paths for the refrigerant. Each of the circular grooves 312 is separated from another adjacent circular groove 312 by a pair of opposing orientated semi-circular walls 313. Each pair of opposing semi-circular walls is orientated substantially 90 degrees displaced from the adjacent pair of the semi-circular walls 313 about the center of the circular grooves 312. Each pair of the semi-circular walls 313 further defines two diffusing channel 314 that fluidly connecting each circular grooves 312. When fluid is injecting from the center circular groove 312 (or circular channel) with the middle plate 320 fitted thereon, the fluid flows out from the center circular channel 312 to the outer circular channel 312 via the two diffusing channels 314. The fluid follows along the outer circular channel 312 until it reaches the outer diffusing channels 314 that are 90 degrees displaced and flows out to the next outer circular channel 312. The flow carries on until reaches the outer most circular channel 312 to fill up all the circular channels 312.

[0042] FIG. 3C illustrates a top plan view of the middle plate 320 of the cooling head 300 in accordance with one embodiment of the present invention. The middle plate 320 is a round shaped plate adapted to fit onto the base plate 310. A bottom surface of the middle plate 320 is flat. When the middle plate 320 is fitted on the base plate 310, the bottom surface of the middle plate and the circular grooves 312 of the base plate 310 form the circular channels 322. A top surface 321 of the middle plate 320 is profiled to provide concentric circular grooves 322 and an inlet channel 325. The inlet channel 325 is a cylindrical channel provided at the center of the middle plate 320. The inlet channel 325 defines an opening 326 that allow fluid to flow to the other side of the middle plate 320 through the inlet channel 325. The inlet channel 325 is adapted to be fluidly separated from the circular grooves 322 in a manner when the top plate 330 is attached thereto, the inlet channel 325 is separated from the circular grooves 322, and the fluid injecting into the inlet channel 325 will flow through the inlet channel 325 without entering the circular grooves 322. The circular grooves 322 are defined in a similar manner as the circular grooves 312 of the base plate 310. Each of the circular grooves 322 is separated from another adjacent circular groove 322 by a pair of opposing semi-circular walls 323. Each pair of opposing semi-circular walls is orientated substantially 90 degrees displaced from the adjacent pair of the semi-circular walls 323 about the center of the circular grooves 322. Each pair of the semi-circular walls 323 further defines two diffusing channels 324 that fluidly connect two adjacent circular grooves 322. The outer most circular groove 322, away from the diffusing channel 324, further provides with through holes 328 allowing a fluid connection with the outer most circular groove 312 of the base plate 310 when fitted thereon. The inner most circular groove 322 that adjacent to the inlet channel 325 is a semi-circular groove.

[0043] FIG. 3D illustrates a top plan view of the middle plate 320 of the cooling head 300 in accordance with one embodiment of the present invention. In the middle plate 320 is provided with a plurality of orifices 329 in place of the opening 326 in FIG. 3C to provide resistance to the fluid flow that results in the backpressure at the inlet channel 325. The fluid exits the inlet channel 325 via the orifices 329 at a lower pressure. In that, the orifices further improves the cooling at the cooling head 300.

[0044] FIG. 3E illustrates a cross sectional view of the top plate 330 shown in FIG. 3A according to one embodiment. The top plate 330 is sized to cover the entire top surface of the based plate 310 and covering the middle plate 320. The top plate 330 is adapted to provide the cooling head in-port 331 and the cooling head out-port 332. The cooling head's in-port 331 is an L-shaped fluid passage having one opening disposed on the side surface of the top plate 330 and the other opening disposed at the center of the bottom surface of the top plate 330. The other end of the in-port 331 is adapted to couple with the inlet channel 325 of the middle plate 320. Similarly, the cooling head out-port 332 is also an L-shaped fluid passage having one opening disposed on the other side surface of top plate 330 opposing the cooling head in-port's 331 opening, where the other opening of the cooling head out-port 332 also disposed on the bottom surface of the top plate 330. The other opening of the cooling head out-port 332 has a shape and location correspond to the inner most semi-circular groove 322 of the middle plate 320. Accordingly, when the top plate 330 is mounted on the middle plate 320, the opening of the cooling head in-port 331 is coupled with the inlet channel 325 and the opening of the cooling head out-port 332 is couple with the inner most semi-circular groove 322.

[0045] In the cooling head 300 assembly, the base plate 310, the middle plate 320 and the top plate 330 are mounted on each other accordingly. An inner fluid path is formed to provide one-way fluid flow from the cooling head in-port 331 to the cooling head out-port 332. When fluid flows into the cooling head 300 via the cooling head in-port 331, the fluid is directed to the inlet channel 325. The fluid further flows through the opening 326 into the inner most circular channel 312. The fluid flows from the inner circular channel 312 outwardly to the outer circular channel 312 via the diffusing channels 314. When the fluid fills up the outer most circular channel 312, the fluid is forced to enter the outer most circular channel 322 of the middle plate 320 via the through holes 328. Once the fluid enters the circular channels 322 of the middle plate 320, it starts filling up the circular channels 322 inwardly until the fluid reaches the semi-circular groove 322 of the middle plate 320. When the semi-circular groove 322 is filled, the fluid flows through the semi-circular opening of the cooling head out-port 332 and exit the cooling head 300.

[0046] The cooling head **300** is connected to the modular cooling system in a close loop manner. Therefore, the fluid is cycled through the two tiers channel cooling head **300**. Each tier of the cooling head is provided with connecting channels to control the flow of the fluid. In the two tiers channel cooling head **300**, the fluid diffuses into the inner channels from a center channel of a bottom tier plate through an in-port and spread outwardly. The fluid then flows into the upper tier plate from the side and spread inwardly to the center of the upper tier plate, and then out from the cooling head via an out-port.

[0047] In the above embodiments, the heat exchanger is provided to handle the heat load carried by the inner pipes extended from the outlet of the compressor. The heat exchanger may be any heat exchanger commonly known in the art, which include heat sink, fluid heat exchanger, heat pipe and any of the combinations thereof. For example, in a fluid heat exchanger, a fluid pipe is provided to pass through the heat exchanger to remove heat therefrom.

[0048] FIG. 4A illustrates a perspective cross sectional view of a cooling head **400** in accordance with another embodiment of the present invention. The cooling head comprises a base container **410** and a cover **420**. The base container **410** defines a cylindrical cavity **411** for containing fluid. The cover **420** is configured to fit on top of the base container **410**. The base container **410** comprises pins **412**, **413**, a first partition **414** and a second partition **415**. The pins **412**, **413** are standing vertically on the bottom surface of the cavity **411**. The pins **412**, **413** are lined up in rows and columns with space. The pins **412**, **413** essentially occupy the entire bottom surface of the cavity **411** to increase the surface areas within the cavity **411** for conducting heat. The pins **412** are adapted with a shorter length than the pins **413**. The pins **412** are located at the center of the bottom surface of the cavity **411** and surrounded by the pins **413** resulting a center space **417**. The first partition **414** is a disc shape plate for fitting above the bottom surface of the cavity **411**. The first partition **414** has through holes adapted for fitting with the pins **413** and a diameter smaller than the cavity **411**. When the first partition **414** is fitted within the cavity **411**, it defines an ring-shaped fluid path **421**. The first partition **414** further defined an inlet extension port **416** at the center of

the first partition **414**. The inlet extension port **416** is projected on the first partition **414**. The second partition **415** is a disc shaped plate having a same diameter as the cavity **411**. The second partition **415** also defines through holes adapted for fitting with the pins **413**. A center of the second partition **415** further provides a circular hole **422** having a diameter bigger than the outer diameter of the inlet extension port **416**.

[0049] Still referring to **FIG. 4A**, the cover **420** provides an inlet **431** and an outlet **432** similar to that of the top plate **330** of **FIG. 3**. The cover further defines a circular groove **433** that connected to the outlet of the cover **420**. When the first partition **414** and the second partition **415** are fitted within the cavity **411**, it provides a three-tiers cooling head.

[0050] When a pressurized refrigerant is injected into the cooling head **400** via the inlet **431** as shown in **FIG. 4B**, the refrigerant flow is led to the inlet extension port **416** and injected into a bottom compartment of the cooling head **400**. The refrigerant flow through the pins **412**, **413** from the center and fills up the bottom compartment of the cooling head **400**. The refrigerant then passed through the ring-shaped fluid path **421** and flows into the middle compartment. When the middle compartment is also filled, the refrigerant further flows into the top compartment via the circular hole **422**. Once the third compartment is also filled, the refrigerant flows out from the cavity through the circular groove **433** and out of the cooling head through the outlet **432**. In the present embodiment, the pins **412** and **413** has greatly increases the surface area within the cavity **411**, thereby improve the efficiency of the heat transfer capability of the cooling head **400**.

[0051] In accordance with a further embodiment, the pins **412**, **413** are hollow pins to further increase the surface area of the cavity **411** for heat transfer.

[0052] **FIG. 5** illustrates a cross sectional view of a cooling head **500** in accordance with a further embodiment of the present invention. The cooling head **500** comprises a base container **510**, a middle plate **520** and a top plate **530**. The base container **510** defines a cylindrical cavity **511** having pins **512**. The pins **512** are arranged in rows and columns in space. The middle plate **520** and the top plate **530**

have essentially the same configuration as the middle plate **320** and the top plate **330** of **FIG. 3A**. When in used, the based container **510** is injected with refrigerant to absorb heat conducted from the bottom of the cooling head **500**. When the based container **510** is filled, the refrigerant flows to the middle plate **520** and then out from a outlet **532** of the top plate **530**.

[0053] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention.

CLAIMS:

1. A modular cooling system for a reliability, functionality and burn-in test equipment having more than one tray, each tray is mounted with a plurality of devices under test (DUT) for testing, the modular cooling system comprising:
 - a plurality of cooling heads, each for cooling one DUT on one tray; and
 - a modular unit adapted to removably mount on each tray, wherein the modular unit is connected to the plurality of cooling heads in a close loop to provide a refrigeration cycle for cooling the DUT.
2. The modular cooling system according to claim 1, wherein the cooling head comprises a multiple-tiers compartment for allowing a fluid flow therein.
3. The modular cooling system according to claim 2, wherein each tier of the multiple-tiers compartment comprises channels for providing a fluid flow path.
4. The modular cooling system according to claim 2, wherein each tier of the cooling head comprises concentrically aligned circular channels fluidly connecting with each other via diffusing channels,
 - wherein the fluid path allows fluid to spread from the center of the multiple-tiers compartment..
5. The modular cooling system according to claim 2, wherein the multiple-tiers compartment comprises pins projecting from an inner bottom surface of the multiple-tier compartment.
6. The modular cooling system according to claim 5, wherein the pins are hollow tubes.
7. The modular cooling system according to claim 2, wherein the cooling head further comprises a fluid inlet adapted to inject fluid into the multi-tiers compartments from a center of the multiple-tiers compartment.

8. The modular cooling system according to claim 7, wherein the fluid inlet is adapted to extend into a bottom most tier of the multiple-tiers compartment.
9. The modular cooling system according to claim 7, wherein the fluid inlet defines a plurality of orifices for diffusing fluid.
10. The modular cooling system in accordance with claim 1, wherein the modular unit comprises a compressor, a heat exchanger, and fluid piping.
11. The modular cooling system in accordance with claim 1, wherein each tray of the test equipment is mounted with one or more modular unit.
12. A reliability, functionality and burn-in test apparatus for semiconductors, the apparatus comprising:
 - a cabinet having more than one tray, each tray is adapted for mounting a plurality of devices under test (DUT);
 - a modular unit adapted to removably mount on each tray; and
 - a cooling head for attaching with each of the DUT,wherein the modular unit is connected to the plurality of cooling head in a close loop to provide a refrigeration cycle for cooling the DUT.
13. The apparatus according to claim 11, wherein the cooling head comprises a multiple-tiers compartment for allowing a fluid flow therein.
14. The apparatus according to claim 12, wherein each tier of the multiple-tiers compartment comprises channels for providing a fluid flow path.
15. The apparatus according to claim 12, wherein each tier of the cooling head comprises concentrically aligned circular channels fluidly connecting with each other via diffusing channels,
 - wherein the fluid path allows fluid to spread from the center of the multiple-tiers compartment..

16. The apparatus according to claim 12, wherein the multiple-tiers compartment comprises pins projecting from an inner bottom surface of the multiple-tier compartment.

17. The apparatus according to claim 15, wherein the pins are hollow tubes.

18. The apparatus according to claim 12, wherein the cooling head further comprises a fluid inlet adapted to inject fluid into the multi-tiers compartments from a center of the multiple-tiers compartment.

19. The apparatus according to claim 17, wherein the fluid inlet is adapted to extend into a bottom most tier of the multiple-tiers compartment.

20. The apparatus according to claim 17, wherein the fluid inlet defines a plurality of orifices for diffusing fluid.

21. The apparatus in accordance with claim 11, wherein the modular unit comprises a compressor, a heat exchanger, and fluid piping.

22. The apparatus in accordance with claim 12, wherein each tray is mounted with one or more modular unit.

23. A modular unit for the modular cooling system in accordance with any one of the claims 1-11.