Summary

In an aspect, the present disclosure refers to an automated test equipment for testing semiconductor devices, the test equipment comprising

a test handler,

a spare part, in particular a contact socket, and

a semiconductor devices teste,

wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof, and

wherein the test equipment comprises a data buffer unit comprising a data exchange interface which is connected or connectable to the electronic component within the spare part, for buffering data stored therein.

In another aspect, the present disclosure refers to an automated test equipment for testing semiconductor devices, the test equipment comprising

a test handler,

a spare part, in particular a contact socket, and

a semiconductor devices tester,

wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof, in particular according to the above aspect, wherein the test equipment comprises an operator terminal comprising a display or GUI and a data exchange interface which is connected or connectable to the electronic component within the spare part, for at least displaying data stored therein.

In another aspect, the present disclosure refers to an automated test equipment for testing semiconductor devices, the test equipment comprising

a test handler,

a spare part, in particular a contact socket, and

a semiconductor devices tester,

wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof, in particular

according to any one of the above aspects, wherein the test equipment comprises a maintenance planning and control unit comprising a processing unit and a data exchange interface which is connected or connectable to the electronic component within the spare part, for planning and controlling maintenance actions of the test equipment.

In another aspect, the present disclosure refers to an automated test equipment for testing semiconductor devices, the test equipment comprising

a test handler,

a spare part, in particular a contact socket, and

a semiconductor devices tester,

wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof, in particular according to any one of the above aspects, wherein the test equipment comprises a dedicated database residing in a control computer, and a data exchange interface which is connected or connectable to the electronic component within the spare part, for storing data regarding a working setup for the spare part in the database for use by the test handler.

Solutions to this problem are presented in each of the above aspects and appending claims 1-4, alone or in any combination thereof. Further ~~embodiments~~ examples are subject of the dependent claims.

Whereas the appending claims are apparatus claims, the invention can also be carried out as a process of operating and automated test equipment, with process steps which correspond to the apparatus features in the appending claims.

According to an ~~embodiment of the invention~~example an automated test equipment for testing semiconductor devices comprises a test handler, a spare part, in particular a contact socket, and a semiconductor devices tester, wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof, and

wherein the test equipment comprises an operator terminal comprising a display or GUI and a data exchange interface which is connected or connectable to the electronic component within the spare part, for at least displaying data stored therein.

The expression “automated test equipment (ATE)” may denote a system typically including a handler, and a tester for testing semiconductor devises (DUTs). The expression “operator terminal” may denote a portable device, comprising a data exchange interface for receiving data, and a screen for displaying information, in particular the received data. Further, the operator terminal may comprise an independent, also portable power supply. The expression “spare part” may refer to a part of the handler, or a part inside the handler, which wears down upon typical use of the ATE. A spare part may be a contact socket, a lead backer, a contact unit holder, a PCB, a handler part for generating stimuli used in MEMS testing, a plunger, and the like. In addition to its specific purpose and design, the spare part may further comprise a memory, a sensor, and a spare part interface. The spare part interface may exchange data with the data exchange interface of the operator terminal.

According to an example ~~gist of the invention~~ an automated test equipment (ATE), including a handler, and a tester, comprises: a separable (display) terminal, and a spare part comprising an electronic component for storing. Data stored in the electronic component of the spare part, may be submitted to the operator terminal, and data may be submitted from the operator terminal to the spare part, for being stored in the electronic component of the spare part. The operator terminal may comprise a data exchange interface for connecting to the electronic component of the spare part, so that the electronic component of the spare part, and the operator terminal may exchange data. The exchanged data may include data about a previous use of the spare part, and/or instructions for a future use of the spare part. The terminal, or operator terminal may be small enough so that an operator working on a test floor may easily be able to carry the (operator) terminal to a working place where it is needed. The operator may see at the screen, or display of the operator terminal, whether some tasks should be done. The operator terminal may comprise a data exchange interface to connect to various other devices within the devices of the ATE, such as to the tester, the handler, the electronic component of the spare part, and/or a manual maintenance basis.

The spare part may comprise one or more sensors by which a use of the spare part may be captured and the sensor data may include performance data which may be stored in the electronic component to be later submitted towards the operator terminal. The combination of the spare part storing data of its own use and the portable operator terminal, may allow for analysing the use of the spare part for purposes of monitoring and maintenance “on the fly”. The operator terminal having a display may allow for quickly gather information about, e.g. touchdown numbers, and/or maintenance instructions. In particular, displayed information may comprise a sentinel bit, a value for the latest service tag, a slave address. The operator terminal may have a GUI being displayed so that the content on the handheld may be selectable, and/or customizable. An ID tag may be unique for every spare part.

According to an ~~embodiment of the invention~~example an automated test equipment for testing semiconductor devices comprises a test handler, a spare part, in particular a contactor socket, and a semiconductor devices tester, wherein the spare part comprises an electronic component for storing and/or processing data regarding the space part or a portion thereof,
wherein the test equipment comprises a data buffer unit comprising a data exchange interface which is connected or connectable to the electronic component within the spare part, for buffering data stored therein.

The expression "data buffering unit" may refer to a storage device, in particular, a storage device comprising one or more data exchange interfaces, for storing processing data generating of the ATE. The data buffering unit may be positioned in a moderate temperature area of the ATE system, so that the ID tag, and sensing data generated by the sensing device and exchanged between the data exchange interface (of the data buffer unit) and the data exchange interface of the spare part can be stored in the data buffer unit independently of the operating temperature of the ATE system. The electronic component of the spare part may comprise a microcontroller for processing data from its sensors so that the data buffering unit may store extracted data coming from the spare part. The data buffering unit may use the same memory (e.g. EEPROM), or same type of memory for every connected spare part and may be adapted to address multiple spare parts. Further, the data buffering unit may comprise a micro controller dedicated to one or more spare parts, so that the micro controller of the data buffering unit may address multiple spare parts (e.g. 8 spare parts). E.g. the data buffering unit may store the number and/or the time of the last insertion. The data buffering unit may calculate a (simplified) insertion prediction. The data buffering unit may be adapted to report a setup conclusion and/or may provide a checksum test. Each of the spare parts may comprise a unique service tag number. The spare parts may comprise a temperature stable memory for storing data up to 175°C. In particular, the temperature stable memory may be writable up to a temperature of 150°C. The spare part may be a contact socket. Depending on

sensor, and/or electrical features. The data buffering unit may be upgradable by using the operator terminal.

According to an ~~exemplary embodiment~~example of the automated test equipment, is the electronic component located in a temperature chamber, and the data buffering unit is located outside of the temperature chamber, wherein the data buffering unit comprises a data exchange interface to connect to the operator terminal for at least displaying buffer data stored in the buffer unit.

According to an example ~~embodiment of the invention~~ an automated test equipment for testing semiconductor devices comprises a test handler, a spare part, in particular a contactor socket, and a semiconductor devices tester, wherein the spare part comprises an electronic component for storing and/or processing data regarding the space part or a portion thereof, wherein the test equipment comprises a maintenance planning and control unit comprising a processing unit and a data exchange interface which is connected or connectable to the electronic component within the spare part, for planning and controlling maintenance actions of the test equipment. Originating from the electronic component, and/or via the data exchange interface, the planning and control unit may receive the data originating from the sensor(s), wherein the data include the ID tag from the specific spare part of the specific sensor(s). The planning and control unit may derive maintenance instructions based on the received data from the sensing device and may send these maintenance instructions to the data buffer unit and/or to the socket(s) being specified by the respective ID tag. The type of sensor(s) may include at least one of the group of a touch down counter, a temperature sensor, a pressure sensor, an acceleration sensor, and an ESD sensor. The planning and control unit may be located in the handler, and/or in the device tester.

The maintenance instructions may be based upon a feedback of the sockets, and or based on a database of an external network, including a data analysis, and may in particular be based upon sensing data from the sensor(s) of the

spare part(s), or sockets(s). The database of the external network may comprise data of the equipment health statistics.

The maintenance instructions may comprise periodical monitoring advice, a forecast based on network knowledge, wherein the forecast may include a forecast on equipment availability. The maintenance instructions may inform about a predictive maintenance, including cleaning and replacement recommendation. Further, the maintenance instructions may include recognizing an emergency and generating an emergency stop (e.g. upon temperature discrepancies). The maintenance instructions include data combination and consolidation. The maintenance instructions may preferably result in an improved performance yield, may consider a KPI (key performance indicator), and may include self-learning and/or failure pattern recognition.
According to an example ~~embodiment of the invention~~ an automated test equipment for testing semiconductor devices comprises a test handler, a spare part, in particular a contactor socket, and a semiconductor devices tester, wherein the spare part comprises an electronic component for storing and/or processing data regarding the spare part or a portion thereof,
wherein the test equipment comprises a dedicated database residing in a control computer, and a data exchange interface which is connected or connectable to the electronic component within the spare part, for storing data regarding a working setup for the spare part in the database for use by the test handler.

The dedicated database residing in the control computer may comprise setup instructions based on the ID tag being submitted via the data exchange interface to the control computer. That is, for a given ID tag there may be an entrance in the dedicated database about the working setup, which in turn may be shown and/or requested via a GUI of the operator terminal and/or via a GUI of the handler. The spare part may comprise an optical alarm device (lamp), if there is an issue or an inappropriate setup detected. In this situation the control computer may trigger an alarm message, in particular, the optical

an amendment of equipment utilization and efficiency. The control computer is adapted to detect or derive sensor deviations, and may make check sum tests. The socket ID and self-checking equipment may avoid a mismatch for the setup.

Further examples~~Aspects of the invention~~ are as follows:

According to an example ~~exemplary embodiment~~ of the automated test equipment, the spare part may comprise a temperature sensor and/or a pressure sensor and/or an acceleration sensor and/or an ESD sensor and/or a touchdown counter, each internally connected to the electronic component.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the electronic component may comprise a programmable microcontroller and/or a memory, in particular an EEPROM, which in particular is temperature-stable up to 175°C.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the spare part may comprise a unique ID tag and the data exchange interface, is adapted to transmit the ID tag to outside the spare part.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the spare part may comprise a spare part interface adapted to be connected to the data exchange interface.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the data exchange interface, is, at least in part, common for the operator terminal and the data buffer unit and/or the maintenance planning and control unit and/or the dedicated database.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the operator terminal may comprise a handheld computer which comprises means

for processing data obtained from the electronic component within the spare part and/or for sending data and/or instructions to the electronic component. The handheld computer may comprise a central processing unit, and a data storage unit, a data exchange interface, according to the spare part, an internet interface, including a wireless, and/or wired internet interface, a power supply interface, and one or more interfaces having a high bandwidth for exchanging data with the data buffer unit. In addition, the handheld may comprise an ADC, an alarm LED, and/or an EPROM.

The handheld computer may be adapted to check a sentinel bit, to determine the slave address, may allow for DDD (double device detection), may allow for check of number of insertions, and may comprise an increment counter. The microcontroller on the spare part may be programmable by the handheld computer.

According to an example ~~exemplary embodiment~~ of the automated test equipment the handheld computer may comprise an internet interface for at least temporarily connecting it to the internet, in particular for upgrading the handheld computer and/or for receiving maintenance instructions and/or firmware updates regarding the test equipment through the internet.

The handheld computer (operator terminal) may be upgradable over the internet. Via the internet, the handheld computer may receive a feedback (changed maintenance instructions) via the internet, or may receive data on firmware updates and/or maintenance updates.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the data buffering unit may be adapted to address multiple spare parts, and in particular comprises a microcontroller which is adapted to process data from multiple spare parts, and/or to derive data and/or instructions for multiple spare parts.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the data buffering unit may be located on a board which is connected or connectable to multiple spare parts, or is located on an interchangeable interface board.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the maintenance planning and control unit may be adapted to derive maintenance instructions based on data regarding and obtained from the spare part and in particular includes a data statistics unit and/or a predictive maintenance triggering unit and/or a failure pattern recognition unit and/or an emergency stop triggering unit.

According to an example ~~exemplary embodiment~~ of the automated test equipment, the dedicated database may comprise information regarding a test floor and/or a site fleet performance and/or sensor data and/or operations data and/or power monitoring data regarding specific tests.

Further examples ~~embodiments of the invention~~ are disclosed in the appending figures.

Brief description of the drawings

Fig. 1A shows an operator terminal and a spare part.

Fig. 1B shows the automated test equipment in a schematic overview.

Fig. 2A shows a spare part or contact socket in perspective views with cross-sectional views.

Fig. 2B shows a perspective and cross-sectional view of the contact socket.

Fig. 3A shows the GUI of the operator terminal.

Fig. 3B shows a handler GUI.

Fig. 4A shows an execution flow diagram of the operator terminal.

Fig. 4B shows a further execution flow diagram of the operator terminal.

Fig. 5A shows a perspective view of a contact unit as a part of the automated test equipment.