

Future Challenges and Requirements to Productive Test Equipment

VDE/VDI GMM Fachgruppe 1.1.4
„Testequipment und -verfahren“

GMM Fachgruppe 1.1.4 „Testequipment und -verfahren“ is a group of experts from semiconductor companies and universities dealing with all aspects of semiconductor test with a special focus on productive volume test on wafer and package level. Currently the group consists of 15 semiconductor companies and two universities.

One major working topic of the group is the discussion of future challenges and requirements to productive semiconductor test equipment.

As products are getting more and more complex regarding electrical functionality, but also regarding used technology, i. e. advanced packaging technologies, volume testing gets more and more a critical parameter to meet cost per die targets. In addition to that, quality requirements are continuously increasing driven by a zero defect approach, especially in the automotive world.

All this sums up in a need for new test equipment with a wider feature specification regarding different aspects of test equipment hardware, software and interfacing.

This paper provides a summary collection of challenges and requirements that will be essential for future test equipment. It is a superset of aspects out of the different applications represented by the group members. It can be used as an add-on to the actually used target specifications for future test equipment investments. It should also be a source of ideas for future research and development in the testing area to develop and improve functionality and features of future test equipment.

Overview of Challenges and Requirements

General Goals of Future Productive Test

- Optimization of overall equipment efficiency (OEE)
- Optimization of cost of ownership (COO)
- Continuous improvement (CIP)
- Zero defect quality operation (no impact of test on product quality)
- Full user guidance for productive usage and maintenance
- Automation (Industry 4.0, IoT)
- Full remote access and real time information about test operations and equipment status
- Traceability of tested devices (input, material in process, output) test process and auxiliaries, e. g. sockets by identification and tracking

Human Machine Interface

- Access by touchscreen as Graphical User Interface
- Remote Access via Terminal
- Local access of all events and internal calculations or graphics
- Alternate access to cell controller or MES
- Recipe download via Host
- Information about all installed modules and parts
- All changeable parts and consumables to be automatically detected by
 - Part number
 - Serial number
 - Revision number
 - Detection method to be shared with 3rd party vendors
- Full status of operation with indication of additional lamp set
 - Operation, Engineering, Setup, Maintenance
- Selectable privilege levels
 - at least Operator, Shift Leader, Maintenance, Engineering, Admin

Factory Integration of Test Equipment

- A complete integration of a test cell in CAM/ MES system should be possible and easy to implement
- Test equipment should have an integrated data server or a data interface for easy access of test data, equipment data and traceability data

Information Access from Test Equipment

- Test equipment data should be provided in a database oriented structure, based on raw data, using clear identifiers/tags
- Quick and easy user access to all detailed information and event log data
- Data access and selection should be possible in a user defined structure and format by transparent interface and event handling
- All necessary data to establish internal and external closed loops can be defined individually by the equipment user (customer)
- Structured logging of all events with time stamp and references and additional context information
- Raw data handling and interface should be secure with guaranteed data integrity

Test Equipment Data Interfaces

- Flexible availability of data interface protocols
 - SECS / GEM compliance
 - (favored future protocol)
 - Ethernet TCP / IP protocol
- Possibility of additional hardware interfaces (individually selectable by the customer)
- Multiple interface to a server independent test cell controller, the MES and other equipment, connections using a flexible, configurable variety of data interfaces
 - RJ 45
 - WLAN
 - IEEE 488.2
 - Parallelport
 - RS232 / RS485
 - CAN Bus
 - High Speed Optical Interface

What we foresee for the Future of Productive Test

Documentation

- Complete electrical and mechanical drawings (STEP, PDF, HTML)
- Scalable Block Diagrams
- Highlighted location of defect or error causing part in different views (diagram, location)
- First aid procedures for frequent occurring events (machine guided failure repair)
- Self learning and teachable system (event based learning)
- Online help (PDF or browser based), remote debugging and repair functionality
- Hints according to theoretical lifetime of affected parts (lifetime goal versus actual state)
 - Part number
 - Serial number
 - Revision
 - Time stamps for start stop usage
 - Number of cycles and time of usage
 - Time to preventive maintenance
- Internal and customer buy off report
- Calibration evidence

Operations Reporting (configurable, automated)

- OEE: to be defined by customer according to factory standard
- Time / Event logs
 - Life time report
 - MTBPF (Mean Time between Part Failure)
 - MTBF (Mean Time between Failure)
 - MTBA (Mean Time between Assist)
 - MTTA (Mean Time to Assist – i.e. Restart)
 - MTTR (Mean Time to Repair)
 - Total Time for Repair
 - Total Time for Calibration
 - Total Time for Preventive Maintenance
 - Engineering Time
 - Jam rate
 - System Uptime
 - Time based
 - User Defined: Number of tested Good Parts × Theoretical Throughput Time
- Reports based on fixed or rolling time (Hour, Shift, Day, Week, Month) or Events (Batch, Type, Error type)
- Basic report at each end of operation, batch or engineering, including throughput (UPH) and events occurred

Hook-up and Facilities

- All media supply and consumption measured and checked against specification or specific configuration, logged and reported
- Lock of operation possible, if any value out of spec with detailed info on panel
- Electrical power consumption (average, peak, interference)
- Noise level according to regulatory requirements
- Water Cooling or Liquid Nitrogen LN2 if applicable
 - Actual pressure against nominal pressure (user defined) with alarm
 - Consumption against source quantity (user defined) with graphical plot
 - Humidity
- Compressed Dry Air Supply
 - Actual pressure against nominal pressure (user defined) with alarm
 - Consumption with graphical plot
- Dimensions and weight info at sticker / label
- Robust and safe setup at production floor (e. g. measures to avoid vibration resonance, Vibration Supression)

**Test equipment will be embedded in high automated fabs (I4.0, IoT)
and have to have the necessary capabilities and interfaces**

The Members:

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Opto Semiconductors • OTH Regensburg • RoodMicrotec • TDK Micronas GmbH • Texas Instruments • Xfab



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