

## Focus on: Electrical test procedures

### Flying probe test (FPT)

- Examination for correctness of processing and in part examination of the parameters and function of the components on a device. Essentially corresponds to an MDA (Manufacturing Defect Analyzer) to identify manufacturing defects
  - short circuit test: between grids in the device
  - analog ICT: for passive components and analog ICs
  - capacitive opens test and current scan: for ICs that can otherwise not be tested (with reasonable effort)
  - optical inspection: inspection using a camera to verify the presence of components
  - functional test: limited function testing capacity with the assistance of the "fixed pins"
- Error coverage: typ. 80 – 90 % of potential pin errors and misassembled components (short circuit or outage)
- Requirements: all grids to be examined must be contactable from one side. Test points are not stringently required but expedient
- Measuring channels: 4 flying probes + 56 fixed pins
- Speed: up to 25 measurements per second
- Measurement accuracy: up to 0.1 % accuracy
- Area of application:
  - pilot runs
  - low volume production typ. up to about 100 pieces p. a.
  - devices that cannot be tested via ICT due to the lack of test points

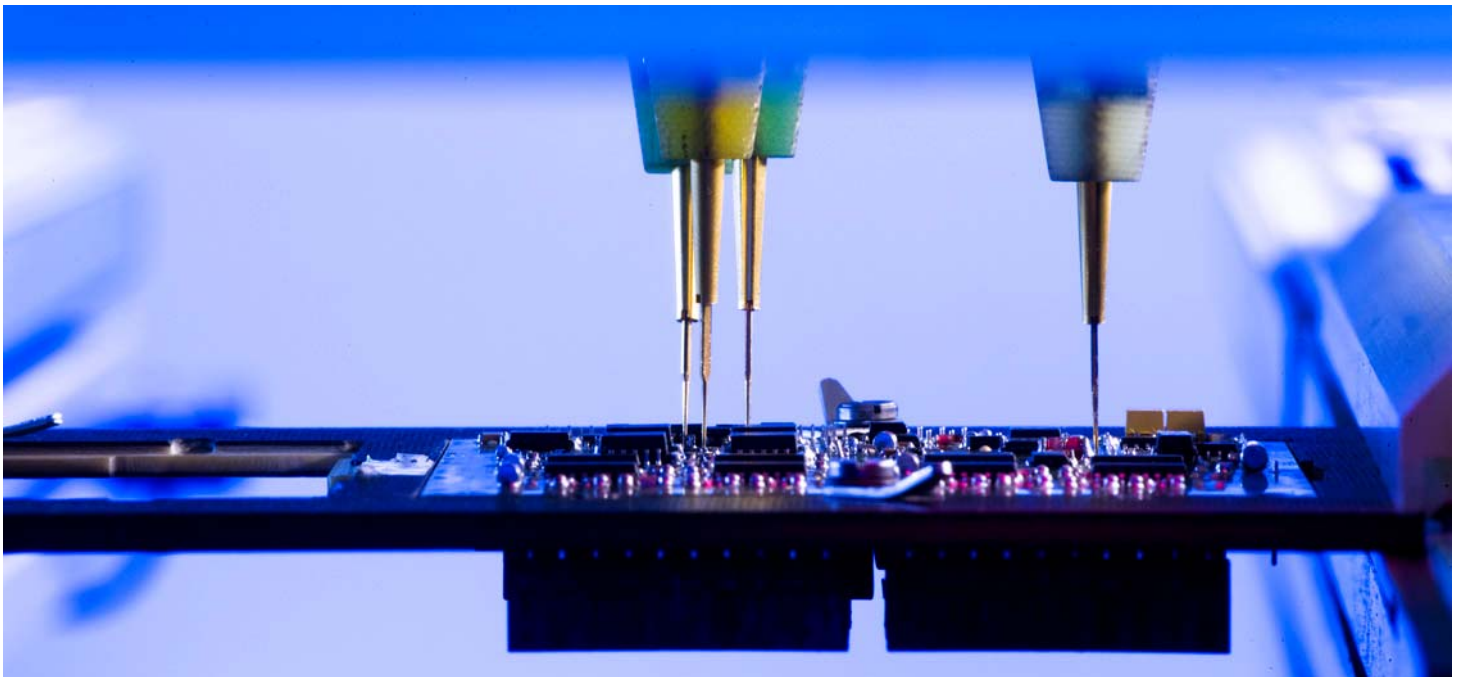
### In-circuit test (ICT)

- Examination for correctness of processing and in part examination of the parameters and function of the components of a device
  - short circuit test for all contactable grids
  - analog ICT for passive components and analog ICs
  - digital ICT for digital ICs

- capacitive opens test for ICs that can otherwise not be tested (with reasonable effort)
- function test: good function testing capacity by use of built-in generators and measuring instruments. External connectivity for any IEC bus devices
  - programming for programmable memory chips and logic chips
- Error coverage: typ. 80 – 90 % of potential pin errors and misassembled components (short circuit or outage)
- Measuring channels:
  - Teradyne/Genrad GR2284/TS124: 1536
  - Teradyne TS128L: 2816
  - HP/Agilent 3070: 2448
- Speed: up to about 500 measurements / second
- Measurement accuracy: up to 0.1 % accuracy
- Area of application:
  - large quantities
  - exacting analog devices
  - highly complex digital devices
  - programming of components on-board
  - application test

### Functional test (FCT)

- Examination of the function of individual sections as well as of the complete device (similar to its subsequent operating conditions)
- Stimuli facilities: Power and voltage sources, signal / frequency generators. Option of integrating additional stimuli thanks to the flexible bus system (GPIB)
- Error coverage: up to 100 % of device function
- Requirements: test points are helpful to improve testing depth and error localization
- Measuring channels: dependent on the measuring and stimuli devices
- Speed: dependent on the measuring and stimuli devices
- Measurement accuracy: depending on the external measuring devices



- Area of application:
  - final inspection
  - complex functions that cannot be verified using the other testing methods
  - calibration, alignment, adjustment
  - interactions with the existing periphery

### Boundary scan test (BST)

- Examination of a device with the assistance of boundary scan-enabled components on this device
  - interconnection test: for several boundary scan-enabled components on the device, examination of existing connections between these components
  - cluster test: examination of the non-boundary scan-enabled components on the device by means of the boundary scan-enabled components

If there is sufficient access to programmable components via boundary scan cells and if their circuits are programmable as well, these components can also be programmed during the boundary scan test.

- Error coverage: heavily dependent on the number of boundary scan-enabled components
- Requirements: boundary scan-enabled components on the device. Bus must be accessible from the outside.
- Data link: 1 JTAG bus + 64 additional boundary scan cells
- Speed: up to 20MHz digital data transfer
- Measurement accuracy: purely digital test
- Area of application:
  - circuitry specially designed for this testing procedure that have no room for test points
  - adapter-free testing

### Burn-In / Run-In (BI / RI)

- Premature aging and examination of the temperature stability of a device, in particular to reduce early malfunctions
  - static burn-in: heating to constantly high temperature
  - dynamic burn-in: heating and cooling to various temperatures
  - passive burn-in: no supply to devices (devices inactive)
  - active burn-in (standard): supply to devices (devices active), optional function test
  - run-in: operating the devices for a certain period of time, in part under elevated temperatures (active burn-in)
  - climate simulation: climate chambers and climate cabinets
- Error coverage: reduction of early failures, identifying processing defects that lead to malfunction with some delay
- Requirements: burn-in temperature range max. -75°C – 180°C,  $\Delta T/\Delta t$  max. 4°C / min, max. 10 – 95 % rel. humidity (at > 10°C)
- Measuring channels: integrated temperature control, optional external measuring channels
- Speed: usually 8 – 96 h / lot, typically 24 h, gradient max. 4°C / min
- Measurement accuracy: atmospheric temperature +/- 0.5°C, atmospheric humidity +/- 3 % rel. humidity
- Area of application:
  - reducing early malfunctions
  - examining temperature stability
  - reliability testing for new devices
  - combined with humidity, as a climate test for new products to qualify the product

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