PRODUCTION TEST METHODS

NPI AND PRODUCTION LEVEL TESTS
NPI TEST OVERVIEW

- NPI (New Product Introduction)
- Low production quantities, many changes possible to design, quick timeline
- Limited customer test resources available
- Product mostly to be used for internal design verification
- Most production test includes AOI, Flying Probe, X-Ray, Benchtop Boundary Scan
PRODUCTION TEST OVERVIEW

- Standard production level quantities being built
  – limited/none ECO changes
- Production process fully developed
- All required customer test resources available
- Product must be tested to verify operation for customer use
- Most production test includes AOI, X-Ray, ICT, ESS, board level/system level F/T
AOI

- Visually test specific components for placement and value – includes passives and active components
- Uses special optical cameras/software for visual recognition
- Development time – 1 to 2 days depending on the number of devices to be tested
- Test time in the minutes range
XRAY

- 2D, 3D
- Used to detect solder defects with all packages types
- Specifically accurate for BGA and non-pin lead package styles
- Non-electrical method to detect open and shorted solder defects
- Development time can be from 1 – 2 days
- Test time is in the minutes and requires an experienced technician to decode the results of some tests
FLYING PROBE

- Used for manufacturing defect detection for NPI and low production run quantities
- Detect wrong value passive components and adjacent pin shorts of IC device pins
- Long test times depending on number of connections being tested – from 10 – 45 minutes or more.
- Program can be written and debugged in 2 days or less
- No special fixture required for each board design being tested
BOUNDARY SCAN

- Quick method for checking connectivity of devices on the board – 1 to 2 week development, 1 minute test time

- Benchtop test

- Utilize the boundary scan chain(s) on the board to test large clusters of devices

- Capabilities must be designed in for best coverage results
BOARD LEVEL F/T

- Test board on benchtop or in ‘GOLD’ system to verify board level functions
- Can be used to test memory banks, CPU BIST operations, data traffic tests, program board level specific information, and test circuits not tested by other methods
- Development time can be 1 - 6 months depending on board complexity and required functions to be tested
- A fixture may/may not be required
- External stimulus and measurement equipment is required to complete the test
SYSTEM TEST

- Racks of systems running operation test code
- Monitoring stations to detect faults in system
- May require external cabling to simulate ‘real’ world operation
- Development time can be months
- Test time can be in the hours
- Isolation of faults difficult based on failure
ESS TEST

- Board or system level test
- Stresses the unit under test with extremes of temperature, humidity, or combination
- Utilizes a ESS chamber to produce the extremes required – hot/cold and ramp rates
- Running system level test code during the testing to detect failures
- Development time can be in the months
- Test time depends on many variables – typically 24 hours.
ICT

- Most comprehensive manufacturing defects test available in the factory environment
- Test strategy of checking each piece to determine that the whole is good
- Used to detect shorts across entire board, measure passive device values, power up the board and run powered analog and digital tests on ICs
- Detects faults that may not be detected at other test steps
- Incorporates un-powered test methods to detect open pins of ICs and connectors
ICT

- Uses boundary scan capabilities to detect open pins of ICs – including powered opens testing
- Able to program memory and other programmable devices (CPLDs, CPUs, etc.)
- Development times range from 3 to 8 weeks – depending on board complexity
- Does require a fixture specific to board being tested
- Standard test time is typically in the 1 – 2 minute range
ICT

- Coverage based on probe access to board nets – capability must be designed into the PCB layout.
- DFT guidelines must be followed for test pad size and spacing – based on current probe technologies.
- Circuit control/disabling must be designed in for best coverage/stability – clock control, device disable, etc.
- Fixture probe force must be controlled to prevent PCB or device damage.
ICT MACHINES

- AGILENT 3070 Family
- TERADYNE L-Series
- Other low level MDA manufacturers
ICT

ADVANTAGES
- Full shorts detection before board power up
- Failure isolation to device/pin
- Un-powered/powered test capabilities
- Boundary scan capabilities
- Memory/device programming capability
- Short test time

DISADVANTAGES
- Lead time/cost
- Fixture required – ECO change issue
- Limited ICT probe access to all nets on PCB
- Circuit disable issues
- Parallel device test coverage (bypass caps)
- Possible probe force damage to PCB/devices
FUTURE PRODUCTION TEST

- AOI, Flying probe, and X-RAY will continue to be used for NPI
- ICT and F/T (board and system) will be used for production level quantities – but the percent usage may change
- System level and ESS will be utilized where required by the product
- BenchTop Boundary Scan fits in at any stage in the test process to enhance test coverage
FUTURE ICT

- Using current capabilities, ICT will continue to be used for many customer’s PCB test requirements
- Incorporate more F/T requirements at ICT
- Smaller PCB form factors, signal speed/integrity, and device package types will lead to NO ICT probe access to nets
- New fixture and test techniques will be needed to maintain current coverage levels
CONCLUSION

- Production test methods can be selected based on NPI/production quantities, lead time, required coverage, and cost
- Utilization of all or some of the test methods described can enhance production quality
- Customer requirements can drive what types of tests are necessary
- ICT remains a viable test solution
THANK YOU

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APPENDIX
EXAMPLE AOI MACHINE
2D and 3D EXAMPLE MACHINES
BOARD LEVEL F/T

- Test times can range from 10 minutes to many hours, depending on the tests being run.
- A skilled technician is typically needed to isolate the failures detected during this test.
- Typically used for production build quantities.
BOARD LEVEL F/T

- Scopes, cables, meters, and other external hardware are used in a typical setup
- AXI, LabView – possible F/T control software packages
SYSTEM TEST