

IEEE SW Test Workshop
Semiconductor Wafer Test Workshop



Mark McLaren
Integrated Technology Corporation

Metrology Solutions for Very Large Probe Cards

20th 2-0-1-0
ANNIVERSARY



June 6 to 9, 2010
San Diego, CA USA

CONTENT

- INTRODUCTION
- BACKGROUND
- HISTORY
- NEW DEVELOPMENTS
- METROLOGY TOOL CHALLENGES
- FUTURE?
- ACKNOWLEDGEMENTS



Introduction

- Large format probe cards have traditionally been seen in memory arena – one touch 300mm
- Last 18 months Advantest, Teradyne and Verigy (presented in alphabetical order throughout presentation) all moved to large format cards in the non-memory arena
- Different approaches taken but in each case the goals appear to be improved signal integrity and increased applications space
- This presentation does not attempt to assess the merits of each approach but is an attempt to outline the probe card metrology challenges



Background

- **Wafer test goals**
 - Process feedback
 - Improve yield at final test
 - KGD
- **The industry has constantly tried to put more test capability at the wafer level, for example**
 - One touch memory probe cards
 - Multi-DUT logic/SOC/processor/mixed signal
 - Dynamic testing of power devices



Background

- **Push toward “at speed” testing on logic/SOC/processor/mixed signal applications at the wafer level**
 - Requires more “local” test resources close to the DUT’s
 - Improved signal integrity
- **All this requires more real estate**
- **SOLUTION – Make the probe card bigger**



Background

- **Cost/Performance trade off**
 - Downside
 - Bigger probe cards = higher initial card cost
 - Higher replacement cost
 - Metrology solution cost
 - Upside
 - Improved testing at wafer level
 - Replaceable head probe technologies help with replacement costs



History

- **More detailed look at previous interfaces and the metrology solutions on Probit**
- **Advantest**
 - T2000 round probe card
- **Teradyne**
 - 300mm Tiger/FLEX probe card
- **Verigy**
 - 9.5” and 12” 93K probe cards



ITC's Design Guidelines

- **Emulate Tester Mechanical Conditions**
 - Same Forces on Probe Card
 - Same Connector Control Methods
- **Emulate Wafer Prober Card Holding Conditions**
 - Same Forces on Probe Card
 - Maintain Same Reference Surface
- **Requires detailed information from test system manufacturer and custom hardware**



MUX to Motherboard Connections



- Rugged, reliable connections

- Simple MB installation

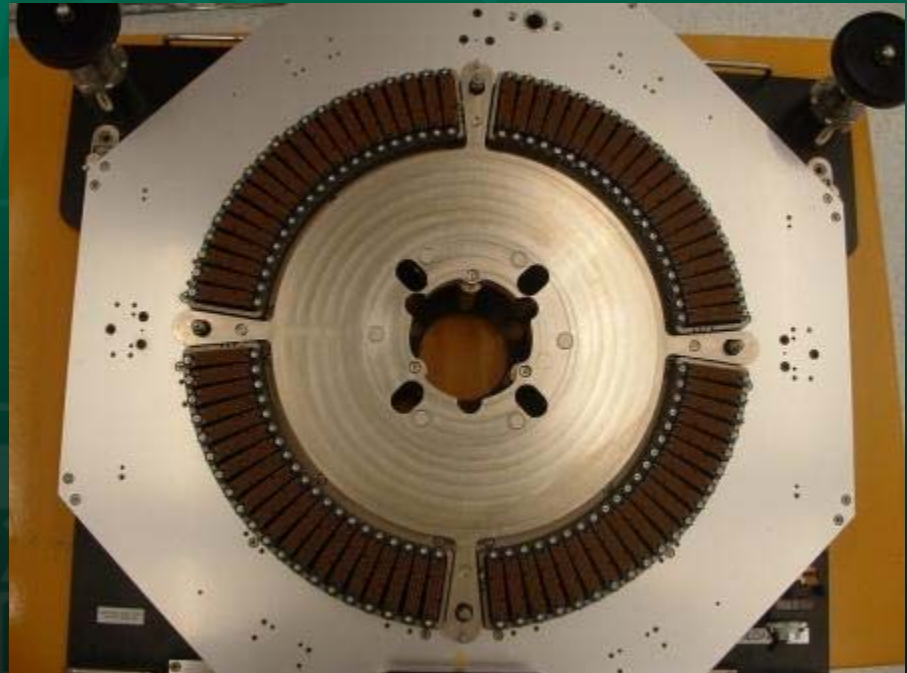


- Gold pads on MB are connection to ITC test channels



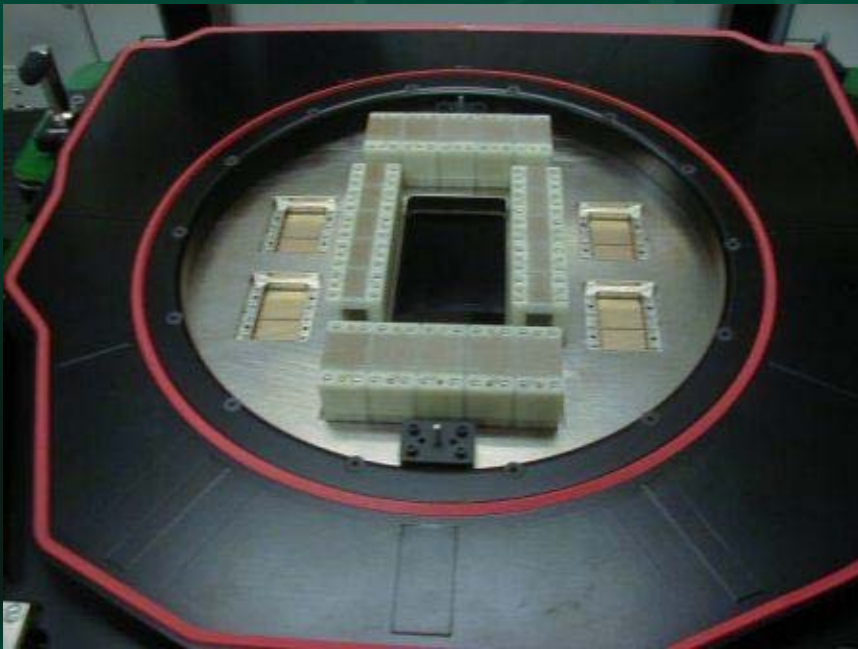
History

Advantest T2000 round probe card



History

Teradyne 300mm probe card Tiger/Flex



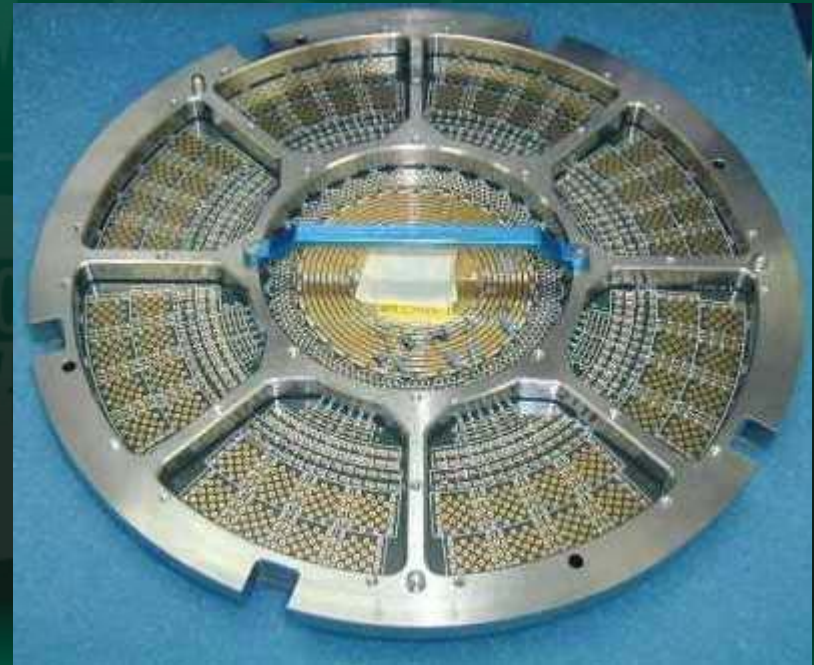
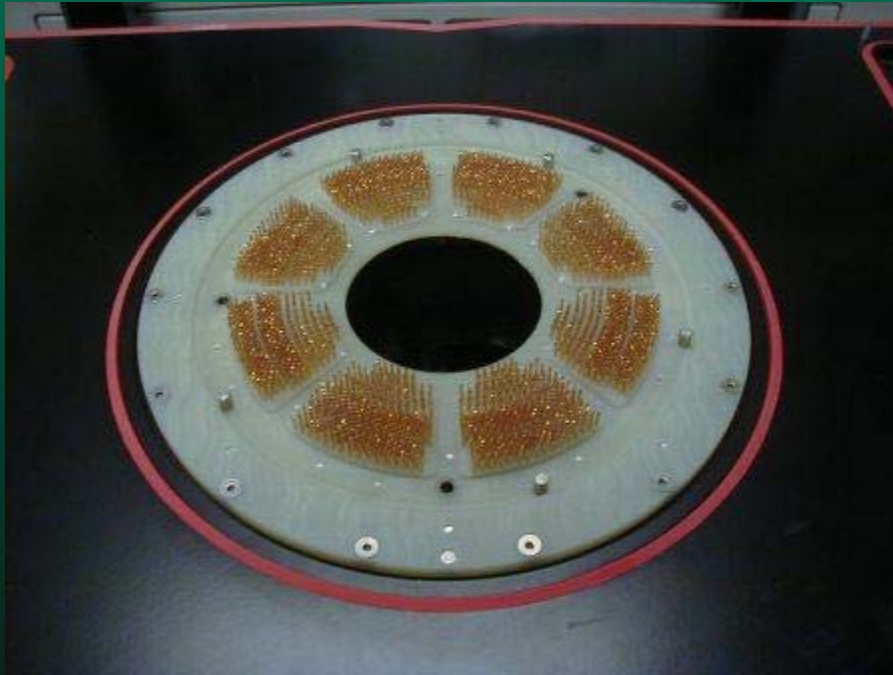
June 6 to 9, 2010

IEEE SW Test Workshop

11

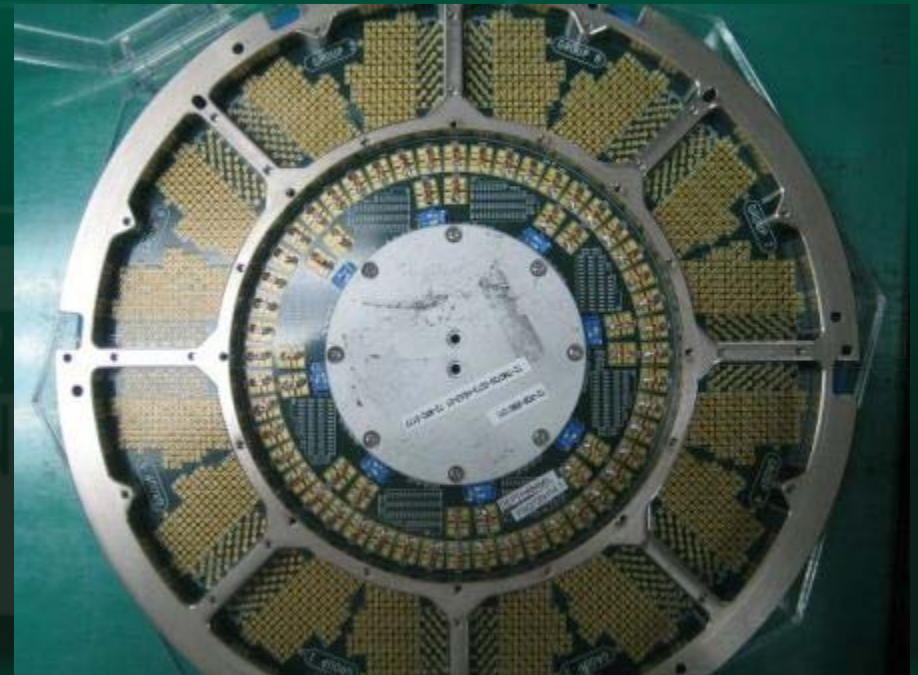
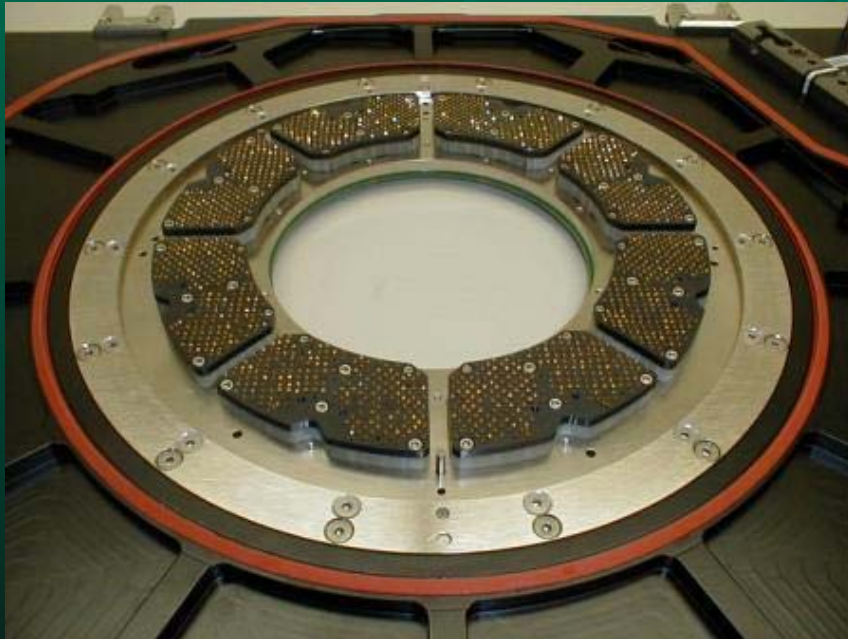
History

Verigy 93000 9.5" probe card



History

Verigy 93000 12" probe card



June 6 to 9, 2010

IEEE SW Test Workshop

13

Metrology Tool Challenges

- **Three distinct customer types**
 - Probe card manufacturer
 - Needs “universal” solution for all potential customers
 - High channel count needed
 - Test House
 - Needs multiple solutions depending on number of customers supported on a given platform
 - Typically lower “managed” channel count, but may have multiple PIB designs
 - IDM’s
 - More dedicated lower channel count solutions



Metrology Tool Challenges

- **Increasing probe count**
 - Electrical
 - Channel count ok so far even cards with >12K probes are being tested on 1800 channels systems
 - Circuitry on probe card needs to be driven by metrology tool
 - Mechanical
 - Probe forces climbing to >250Kg
 - Metrology tool must handle the force otherwise tests have to be run at decreased overdrive



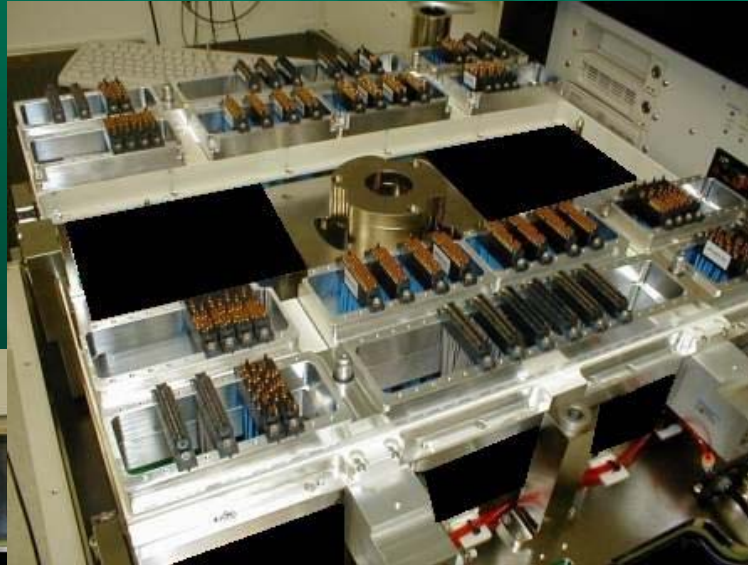
New Developments

- All three companies introduced new large probe card solutions in last 18 months
- **Advantest**
 - T2000 RECT550
- **Teradyne**
 - FLEX 440mm
- **Verigy**
 - V93000 Direct-Probe™



New Developments

Advantest T2000 RECT550



June 6 to 9, 2010

IEEE SW Test Workshop

17

Metrology solution challenges

- **Mechanical/Pneumatic**

- Physical size of probe card

- 550mm x 480mm – flipping to probe repair position
- Increased stroke on elevator

- Outside normal vacuum areas on Probit

- Had to use additional mechanism to secure retainer

- Mechanical Insertion force

- Uses special actuators
- Full population requires motorized actuators
- Reduced population can still use pneumatic actuators



Metrology solution challenges

- **Electrical Challenges**

- Tester resources not always in same location
- Each instrument has different connector pin-out
- Shields are not always ground
- Two different types of connector
- PCB routing issues caused by RECT550 connectors sitting almost on top of Probit board to board connections



New Developments

Teradyne 440mm Flex



Picture from SWTW2009 - Daniel Watson, Teradyne Inc



June 6 to 9, 2010

IEEE SW Test Workshop

20

Metrology solution challenges

- **Mechanical**

- More traditional type of interface
- Very large application space requires height clearance for components
- Alignment of tall individual interconnect blocks



Metrology solution challenges

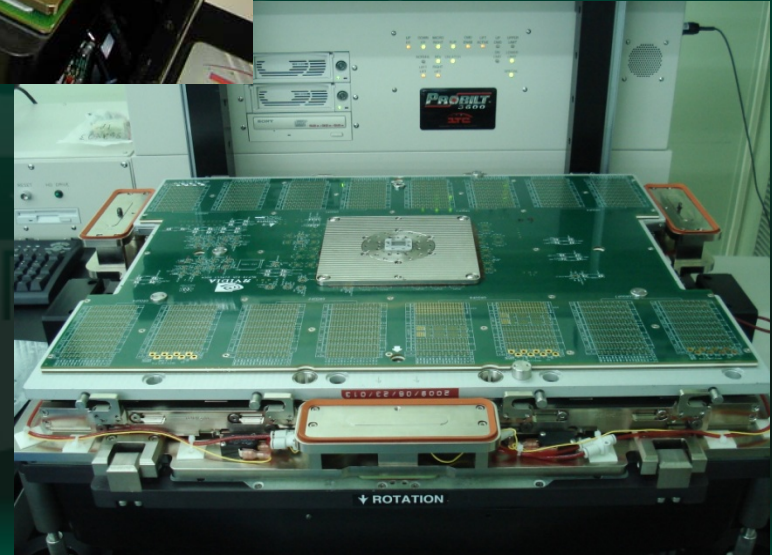
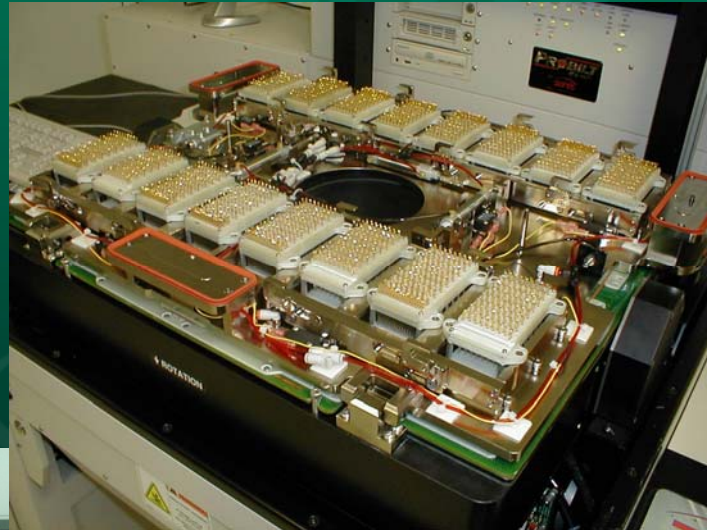
- **Electrical**

- No definition of function of 6400 pins
- Re-designing PIB could change definition of the pins on the interface
- PCB routing issues - very large application space causes interconnect blocks to overlay board to board connectors



New Developments

Verigy V93000 Direct-Probe™



June 6 to 9, 2010

IEEE SW Test Workshop

23

Metrology solution challenges

- **Mechanical**

- Physical size of probe card

- 600mm x 480mm – flipping card to repair position

- Complex docking

- 4 Reference surface locations

- Mechanical force

- Interconnect blocks have to float so no force on outside of probe card. Each block mechanically docks to counteract force.



Future?

- **Higher probe counts**
 - Forces up to 500Kg?
 - Higher analyzer channel counts
- **More circuitry on probe card**
 - Metrology tool needs logic drive capability
- **Probe card manufacturers sell more replacement heads – less complete cards**
 - Need test vehicle and metrology tool that allows heads to be tested



Acknowledgements

- **ITC**
 - Jay Geist, Rod Schwartz
- **Advantest**
 - Dave Komma
- **Teradyne**
 - John Whittaker, Bill Wyckoff
- **Verigy**
 - Daniel Lam, Larry Dibattista

