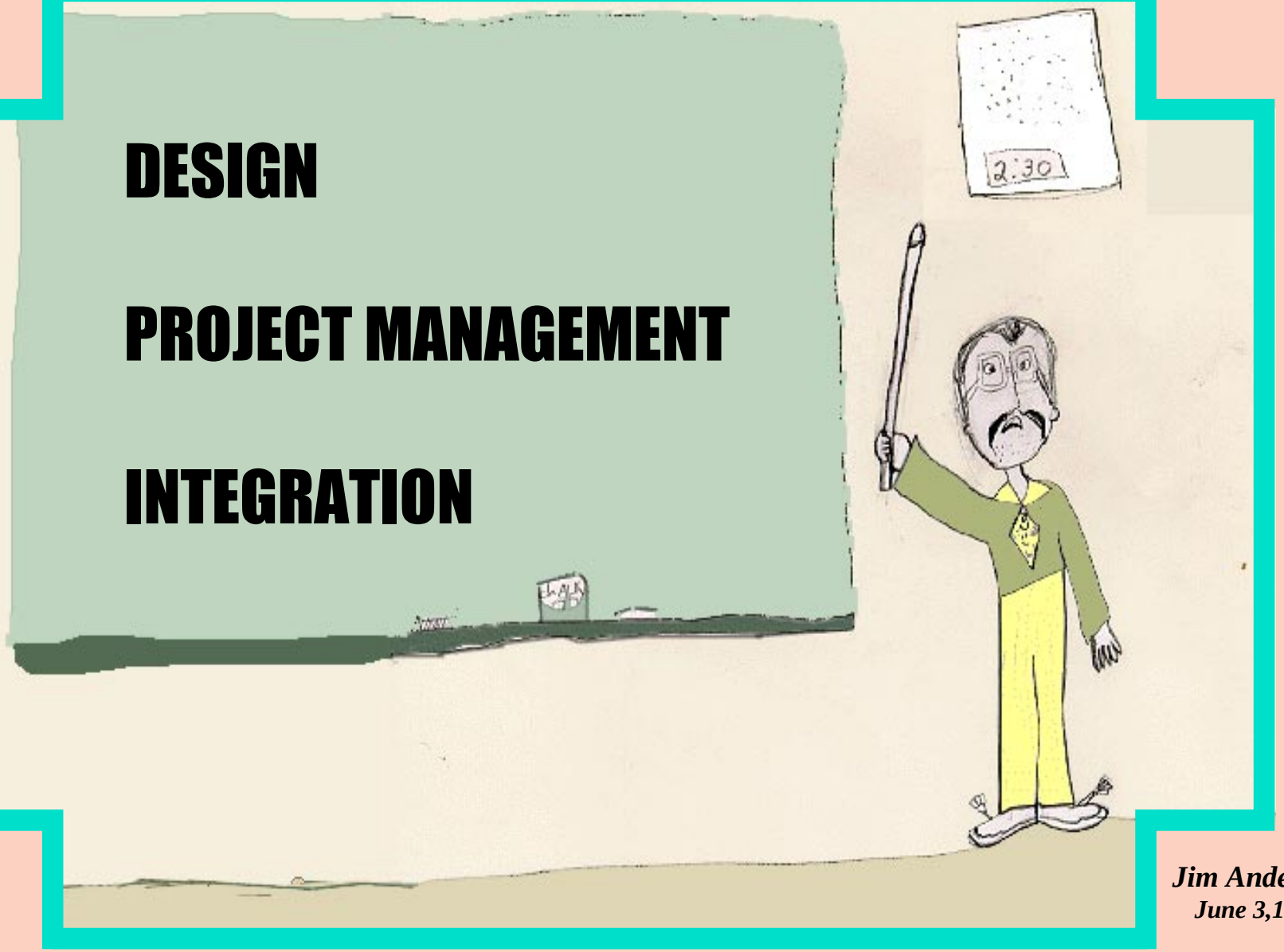
Design Concepts For A Total Integrated Solution

PRESENTED BY
JIM ANDERSON

SOUTHWEST TEST WORKSHOP

SAN DIEGO, CALIFORNIA
JUNE 1997

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION



Jim Anderson
June 3,1997

DESIGN

SYSTEM DESIGN

» CUSTOMER INITIATIVE - CONCEPT SPECIFICATION

» SYSTEM PERFORMANCE

- SINGLE SPECIFICATION
  - Pulse Rise Time
  - Round Trip Delay
  - System Impedance
  - System Capacitance
  - Bandwidth

- RESPONSIBILITY OF SUPPLIER

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

SYSTEM DESIGN

» COMMUNICATION

INTERFACE PROJECT

- CERPROBE
  - PROBER COMPANY
  - TESTER COMPANY
  - MANIPULATOR COMPANY

INTERFACE PROJECT

- CUSTOMER
  - LOAD BOARD MFG.
  - POGO STACK MFG.
  - PROBE CARD MFG.
  - PROBER COMPANY
  - TESTER COMPANY
  - MANIPULATOR COMPANY

Jim Anderson
June 3,1997

SIGNAL TRANSMISSION

» SYSTEM PERFORMANCE SPEC DRIVES DESIGN

- CONTROL IMPEDANCE
  - Maintain constant width lines
  - Maintain constant distance from signal path to reference path or plane
  - Minimize vias and other discontinuities in the line
  - Relieve ground planes around those necessary vias
  - Provide a ground current return path of same length as signal path

SIGNAL TRANSMISSION

» SYSTEM PERFORMANCE SPEC DRIVES DESIGN

MINIMIZE CROSSTALK

- Reference signal lines to low inductance ground plane
- Maximize the distance between lines-maintain minimum of 2.5X dielectric
- Separate critical paths on to separate layers
- Place well grounded guards on either side of more critical lines as shields
- Separate analog and digital grounds
- Where necessary, route signals over fully shielded lines such as semi-rigid coax

SIGNAL TRANSMISSION

» SYSTEM PERFORMANCE SPEC DRIVES DESIGN

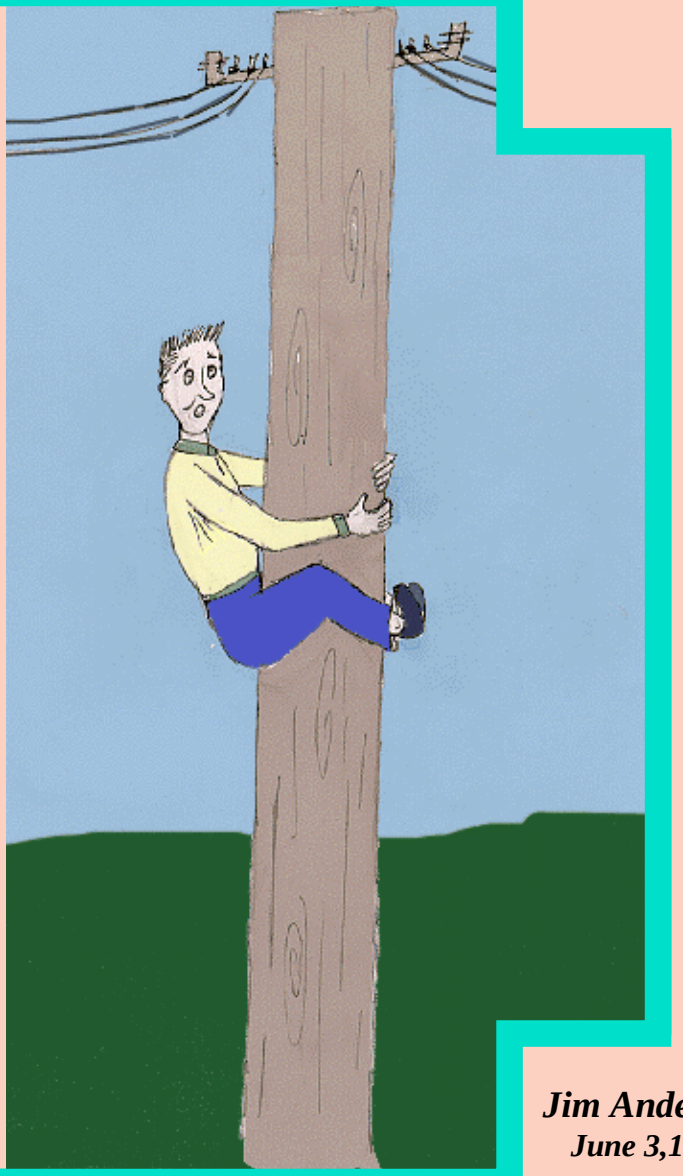
- MINIMIZE GROUND BOUNCE
  - Provide low inductance power and ground planes
  - Provide sites for bypass capacitors close to the DUT
  - Tie ground lines on top and bottom surfaces to the ground plane at frequent intervals
  - Isolate AC signals from critical areas of the board using inductors, in those cases where both areas need to be at the same DC level.

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

SIGNAL TRANSMISSION

» START AT THE BOTTOM - WORK UP

- PROBE CARD
- POGO STACK
- PERFORMANCE BOARD



Jim Anderson
June 3,1997

SIGNAL TRANSMISSION

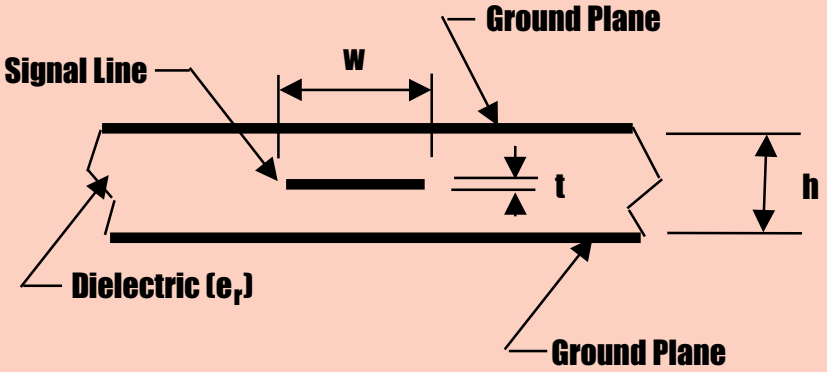
» START AT THE BOTTOM - WORK UP

- PROBE CARD
  - The DUT drives the design
    - Size of DUT
    - Parallel testing
    - Direction of array
    - Tester site layout
    - Area for device mounting

SIGNAL TRANSMISSION

» START AT THE BOTTOM - WORK UP

- PROBE CARD
  - Stripline
    - Efficient for frequencies up to 4-5 GHz
    - Can increase layer count

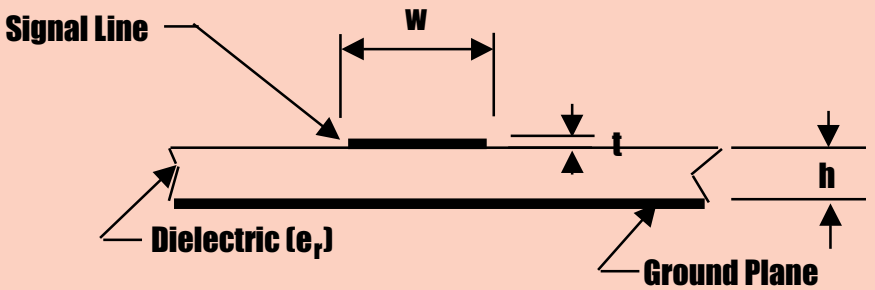


$$Z_o = \frac{60}{\sqrt{e_r}} \ln\left(\frac{4h}{0.67\pi w (0.8 + t/w)}\right)$$

SIGNAL TRANSMISSION

» START AT THE BOTTOM - WORK UP

- PROBE CARD
  - Microstrip
    - Efficient for frequencies up to 2-3 GHz
    - Easy to add matching resistors or other components to the signal path



$$Z_o = \frac{87}{\sqrt{e_r + 1.41}} \ln\left(\frac{5.98h}{0.8w + t}\right)$$

SIGNAL TRANSMISSION

- START AT THE BOTTOM - WORK UP
  - PROBE CARD
    - Combination
      - Watch out for the difference in propagation delay
      - Adjust physical line lengths to equalize electrical line lengths and minimize signal skew

SIGNAL TRANSMISSION

» START AT THE BOTTOM - WORK UP

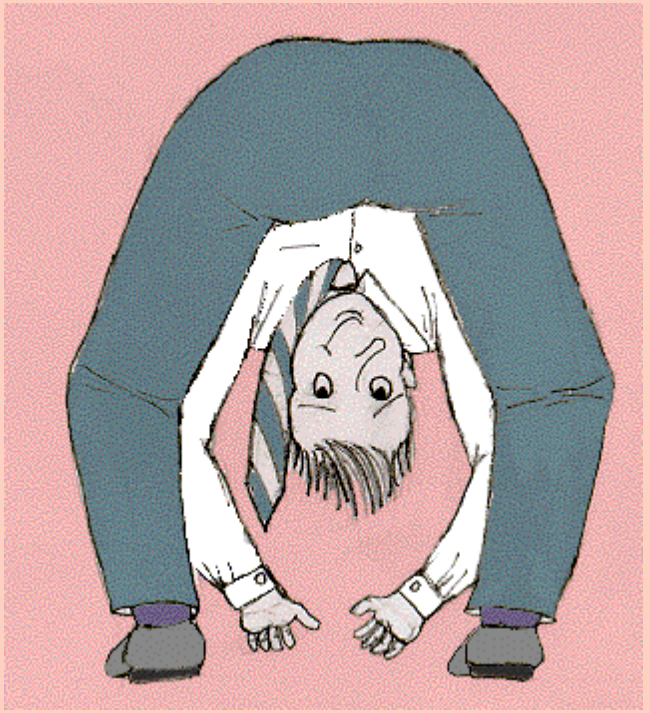
- POGO STACK
  - Choosing the pogo pattern
    - Two wire array
    - Co-planar array
    - 5 wire array
    - Coaxial
  - Isolate signals
  - Isolate signal grounds from power grounds

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

SIGNAL TRANSMISSION

» BOTTOMS UP

- PERFORMANCE BOARD
  - Translation
    - Tester Pin Out Pattern
    - Probe Card/Pogo Pattern
  - Equal Line Length
  - Device Population
  - Connector City



Jim Anderson
June 3,1997

MECHANICAL DESIGN

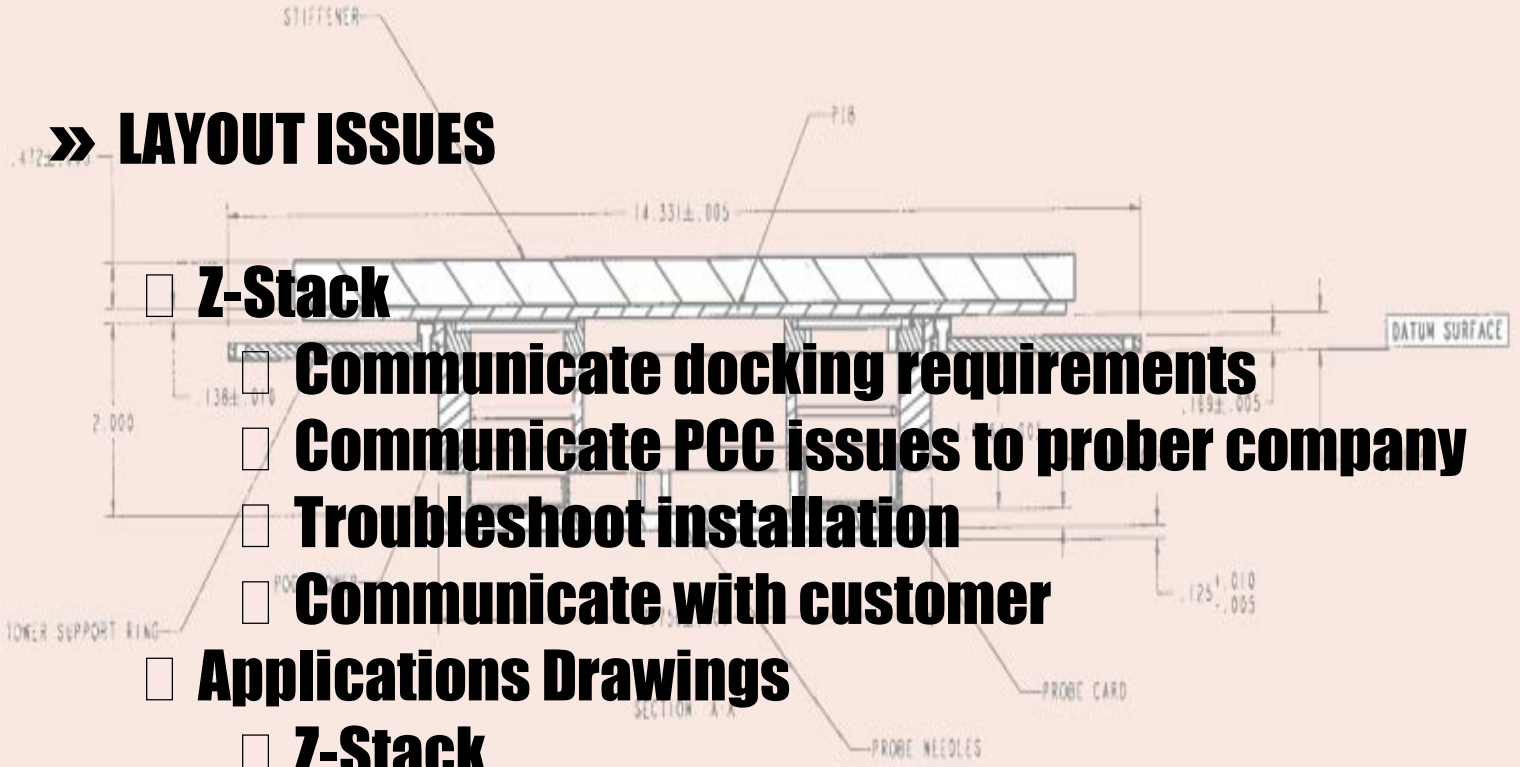
- PCC vs. NON-PCC METHODOLOGY
  - PCC
    - Probe card/ carrier
    - Pogo stack/ adapter (or insert) ring
    - Load board/ stiffener
    - Docking

MECHANICAL DESIGN

- PCC vs. NON-PCC METHODOLOGY
  - Non-PCC
    - Probe card/ stiffener
    - Pogo stack
    - Insert/ clamp ring assembly
    - Load board/ stiffener
    - Docking

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

MECHANICAL DESIGN

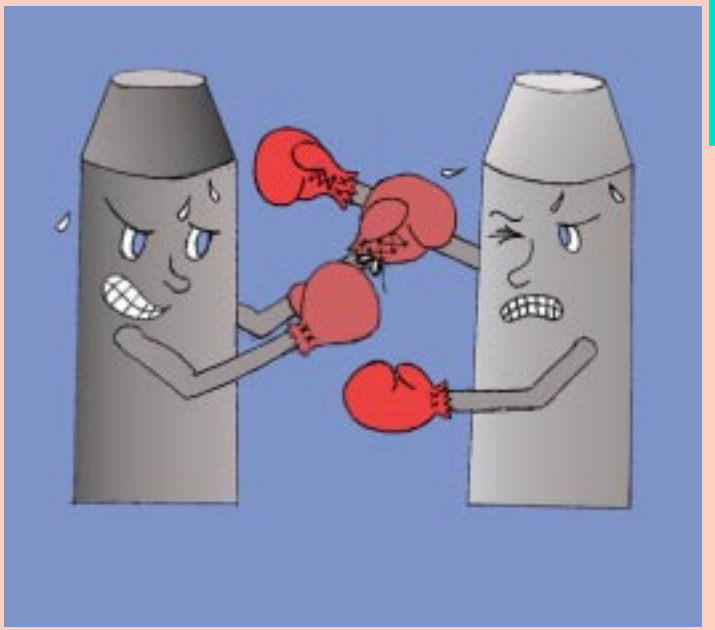


- » LAYOUT ISSUES
  - Z-Stack
    - Communicate docking requirements
    - Communicate PCC issues to prober company
    - Troubleshoot installation
    - Communicate with customer
  - Applications Drawings
    - Z-Stack
    - Outline

Jim Anderson
June 3,1997

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

MECHANICAL DESIGN



» LAYOUT ISSUES

- The pin fights
  - Why we need alignment pins
  - PCC
    - Probe card carrier - to insert ring
    - Pogo stack - to- same pin in insert ring
    - Load board/ stiffener to same pin in insert ring
  - Non-PCC
    - Probe Card/ stiffener to pogo stack
    - Load board to same pin in pogo stack

Jim Anderson
June 3,1997

MECHANICAL DESIGN

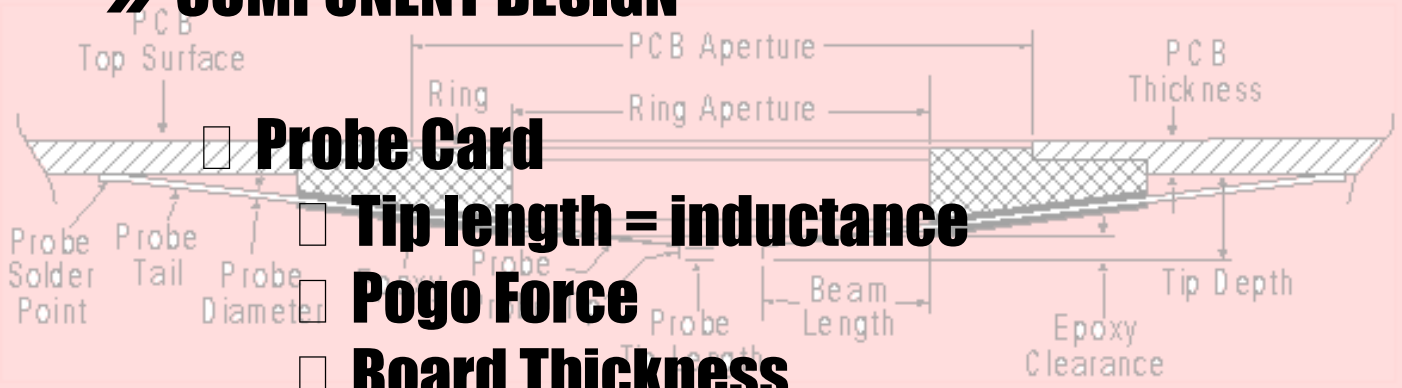
» LAYOUT ISSUES

- Design from the bottom up
  - Prober top plate (ring carrier)
  - Probers optimal probing height
  - Probe tip depth (minimize)
  - Probe card thickness
  - Minimum load board height (from top plate)
  - Choose pogo pin

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

MECHANICAL DESIGN

» COMPONENT DESIGN



- Probe Card
  - Tip length = inductance
  - Pogo Force
  - Board Thickness
  - Stiffener requirements - top and bottom
  - FEA to determine deflection

Jim Anderson
June 3,1997

MECHANICAL DESIGN

» COMPONENT DESIGN

- Pogo Stack
  - Housing should be metal
  - Other materials driven by design of signal transmission
  - Provide pogo overdrive features
  - Pogo's easily removable
  - Flange mount for probers with PCC's
  - Cam followers for clamp mount for probers without PCC's

MECHANICAL DESIGN

» COMPONENT DESIGN

- Load Board
  - Provide stiffener
  - Mount stiffener directly to test head
  - Float load board
  - Do not bolt load board to pogo stack
  - Make sure ‘z’ height sufficient for devices

PROJECT MANAGEMENT

- » ASSUME LEADERSHIP ROLE
- » PROJECT MANAGER/TEAM
- » CONCURRENT DEVELOPMENT
- » GANTT CHARTS
- » DESIGN REVIEWS W/CUSTOMER

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

INTEGRATION

- » INSTALLATION
- » FUNCTIONAL TESTING
- » DEBUG

Jim Anderson
June 3,1997

INSTALLATION

- **INSTALL**
  - Docking 1
  - Insert / Clamp Ring 2
  - Probe Card 3
  - Pogo Stack 5
  - Load Board 8
- **FIT CHECK**
  - Probe card loading 4
  - Probe card to Pogo Stack 6
  - Pogo Stack to Load Board 9
- **CALIBRATE**
  - Probe Card to Pogo Stack 7
  - Pogo Stack F.A. to Docking R.A. 10
  - Docking R.A. to Test Head 11

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

FUNCTIONAL TESTING

- » SHORT OUT SIGNALS ON PROBE CARD
- » WRITE OPENS/SHORTS TEST - ASSIGN CHANNELS
- » PERFORM TEST
- » EVERYTHING IS PERFECT RIGHT?

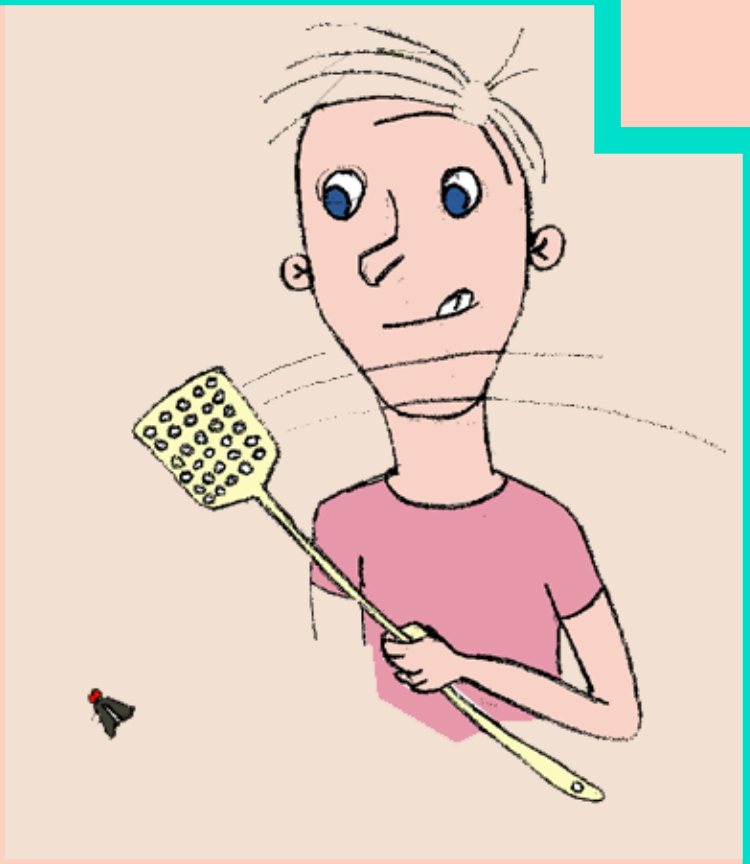
Jim Anderson
June 3,1997

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

DEBUG

LEVEL 1 DEBUG: VERIFY CHANNELS AND CHECK FOR THE OBVIOUS

- » ON PROBE CARD: OHM OUT POGO PIN PAD/VIA TO PROBE LAND
- » TEFLON TAPE ON POGO PAD/VIAS
- » OHM OUT LOAD BOARD PAD FOR TEST HEAD OUTPUT TO PROBE LAND
- » TEFLON TAPE ON LOAD BOARD (BOTH SIDES?)



Jim Anderson
June 3,1997

DEBUG

LEVEL 2 DEBUG: 'Z' HEIGHT ISSUES

- VERIFY FLAT MOUNTING SURFACE FOR POGO STACK
- VERIFY HEIGHT OF POGO (TOP AND BOTTOM) FROM MOUNTING SURFACE
- VERIFY PROBE CARD MOUNTING SURFACE
- VERIFY 'Z' HEIGHT REPEATABILITY OF PROBE CARD LOAD
- OHM OUT POGO PIN
- VERIFY 'Z' HEIGHT ON DOCKING VS. PRINTS

DESIGN CONCEPTS FOR A TOTAL INTEGRATED SOLUTION

DEBUG

LEVEL 3 DEBUG: ITS AN 'X' 'Y' THING

» REMOVE PROBE CARD AND POGO STACK: ✔ ✔ FIT

» ALIGNMENT PINS- P.C. CARRIER -TO-CHANGER CLAMP & PROBE CARD-TO-POGO STACK?

» ALIGNMENT PINS: P.C. CARRIER -TO-CHANGER CLAMP & POGO STACK-TO-INSERT RING /RING CARRIER?

Jim Anderson
June 3,1997

SUMMARY

- TAKE CONTROL
- DRIVE THE SYSTEM CONCEPT AND SPECIFICATION
- ESTABLISH AND MAINTAIN STRUCTURED COMMUNICATION
- ONLY DO BUSINESS WITH AN INTEGRATOR