"LOOKING FOR AN ORIGINAL SOLUTION WHEN PROBING BECOMES A NIGHTMARE"

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JUNE 14, 2000 **SOUTHWEST TEST WORKSHOP**

LET'S SKIP AND WIN

ALTIS Semiconductor

- **A Company built from the IBM Microelectronics Corbeil-Essonnes site**
- **50 / 50 IBM / Infineon Joint Venture (07 / 99)**
- **A conversion from DRAM centric focused product mix to Logic centrix focused mix**
  - ✓ LOGIC : Aluminium 0.35µ / 0.25µ / 0.18µ Copper / 0.13µ Copper Low K
  - ✓ MEMORY : 64 / 256 Mb DRAM 0.20µ / 0.17 µ / 0.15µ
- **World class customers leaders in Telecoms and Computer peripherals**
- **Shared management IBM / Infineon**
- **Capacity sharing 50 / 50 based on normalized capacity**
- **Investment plan : above 500 M$ over 3 years**

LET'S SKIP AND WIN

NEW CHALLENGE

NEW PROBE-CARDS

NEW PRODUCTS : LOGIC

A NEW COMPANY

A CHALLENGE FOR PROBE-CARDS

WHY ?
THE PRODUCT...

	DRAM	LOGIC
LIFE	**LONG (up to 30 months)**	**SHORT (below 6 months)**
PAD NUMBER	**LOW (from 70 to 80...)**	**HIGH (up to 250...)**
PAD LAYOUT	**SIMPLE (1 to 2 row...)**	**COMPLEX (on 4 sides...)**
PAD PITCH	**HIGH (around 120µm...)**	**LOW (down to 60µm...)**
PAD SIZE	**LARGE (around 100x100µm)**	**SMALL (down to 52x95µm)**
MIXED TEST	**DIGITAL (memory)**	**DIGITAL (memory + logic) / ANALOGIC**

A CHALLENGE FOR PROBE-CARDS

WHY ?

THE PROBE-CARD...

	DRAM	LOGIC
PCB DESIGN	**OFTEN RE-USABLE**	**CUSTOMIZED**
DELIVERY	**NOT AS CRITICAL**	**FROM 10 days to 8 weeks**
PART NUMBER QTY	**FEW PRODUCTS**	**MANY PRODUCTS**
PC QTY PER PRODUCT	**MANY PER PRODUCTS**	**FEW PER PRODUCTS**
PC EXTRA COMPONENTS	**NO**	**MANY (relays, ICs,Tx,etc...)**
TESTER TYPE	**FEW (J995-J996)**	**MANY (J971-J750-ADV6671-ADV6672-CATALYST)**
CLEANING FREQUENCY	**LOW**	

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1999 : WHEN COMES THE PROBING NIGHTMARE...

PRODUCTS CHARACTERISTICS :

- LOGIC PRODUCT (0.25µm)
- PITCH ~90µm
- NUMBER OF PADS ~150
- PAD SIZE 72X72µm
- Alu PAD THICKNESS (half)

TEST CONDITION

- TESTER TERADYNE J971 (later J750)
- PROBER TSK UF200
- TEST TEMPERATURE 87°C
- PRODUCTION FABs : DRESDEN, REGENSBURG (Germany), ESSONNES (France)

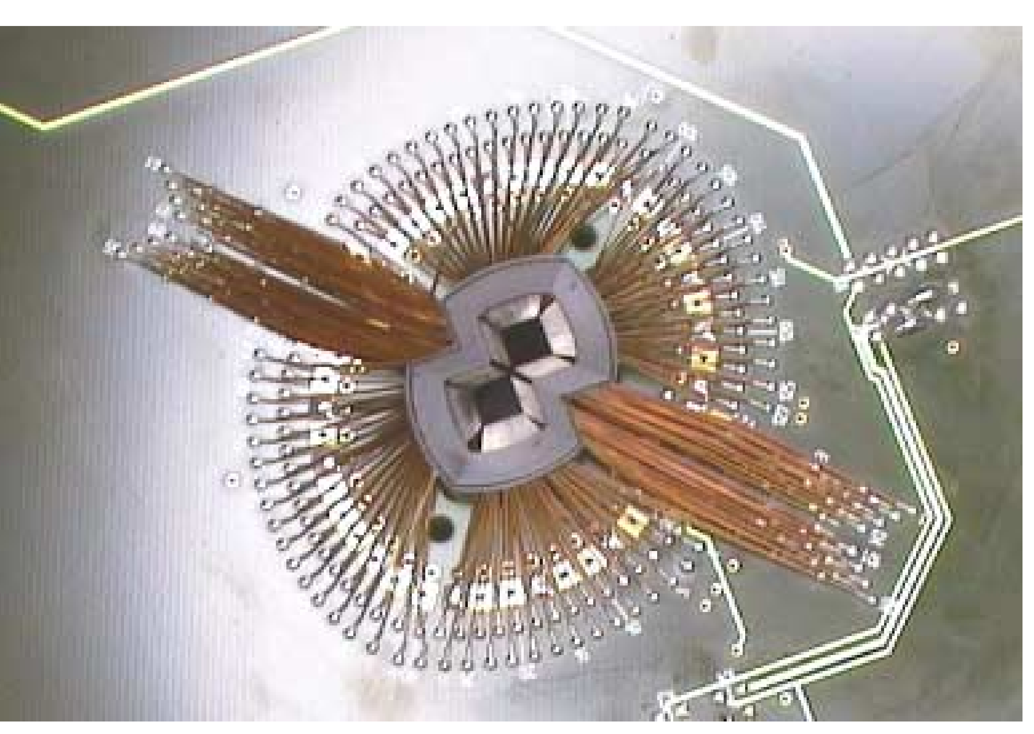
IT COULD HAVE BEEN AN EASY STORY, BUT...

ORIGINAL PROBE-CARD ORDER

- PCB : CUSTOMIZE, LOCAL VENDOR
- PROBE-CARD ASSEMBLY : MAJOR WORLDWIDE VENDOR
- PROBE-LAYOUT : DIAGONAL
- SPECIFICATION : TUNGSTEN-RHENIUM NEEDLES, HSD

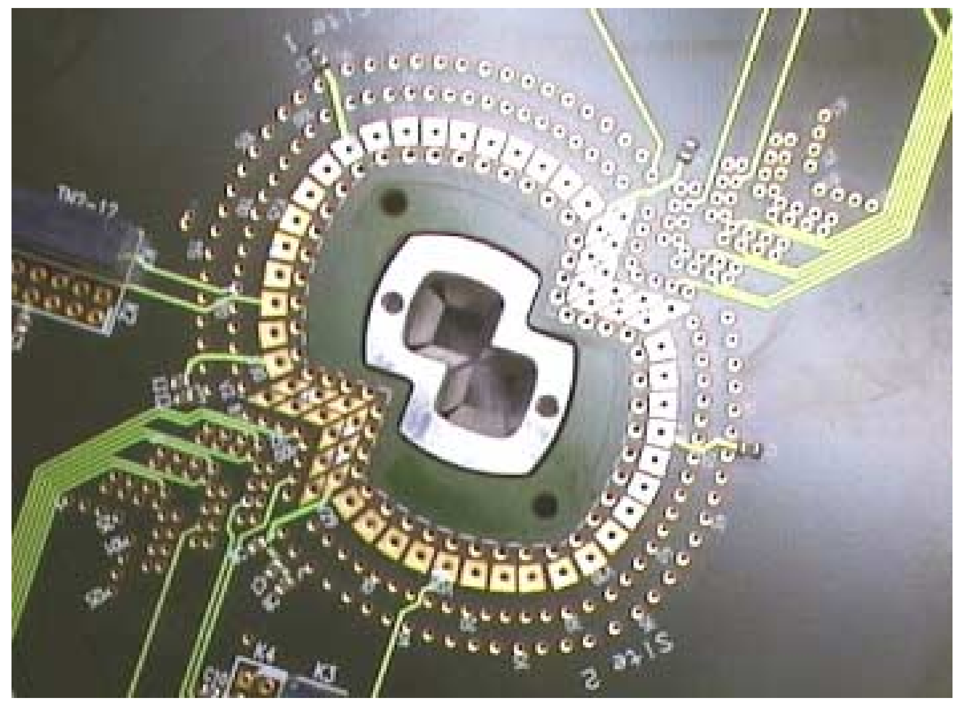
IT SHOULD HAVE WORKED LIKE FOR 95 % OF THE PRODUCTS BUT...

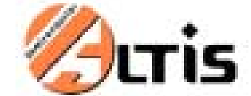
THE ORIGINAL PROBE-CARD DIAGONAL



WAFER SIDE

TESTER SIDE





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WHEN THE PROBLEMS APPEAR...

- DAMAGED VIA
- LOSS OF YIELD BETWEEN DUTS
- FREQUENT OFF LINE CLEANING
- ALUMINIUM FLAG BUILD UP
- CRACKS IN THE VIA

PRELIMINARY INVESTIGATION

USING THE SAME CUSTOMIZED PCB :

- CHANGE THE GRAM FORCE (from 3gr to 1.5gr)
- CHANGE THE NEEDLE TIP SHAPE (from semi-radius to asymetric, to different vendors shapes)
- CHANGE THE VENDOR FOR ASSEMBLY

TRY 2 DIFFERENT TECHNOLOGIES :

- AN ADVANCED EPOXY (with standart PCB)
- A VERTICAL PROBE-CARD

VARIATION OF THE CHUCK SPEED (3 speeds on UF200)

→ ***NO MAJOR IMPROVEMENTS***

LET'S SKIP AND WIN

TRYING TO UNDERSTAND THE PROBLEMS IN ESSONNES...

DAMAGED VIA
WHY ?

- NEEDLES VARIOUS ANGLES TO THE RING (LAYOUT)
- HEAT SINK TOO SMALL
- PROBE DEPTH TOO SMALL (PCB WORPING)

DIFFERENCE OF YIELD BETWEEN DUTs
WHY ?

- NEEDLES TOO LONG
- NEEDLE LENGTH DIFFERENCES (UNBALANCED)
- DECOUPLING UNSYMETRIC
- PCB POWER PLANES UNSYMETRIC
- VS SENSE UNCORRECT (TOO FAR FROM DUT)

FREQUENT CLEANING
WHY ?

- TOO MUCH OVERDRIVE
- VOLTAGE DROPS (NEEDLES TOO LONG)

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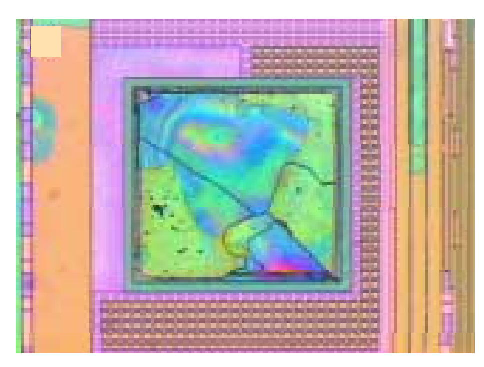
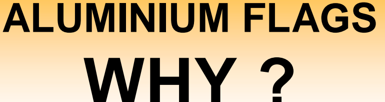
TRYING TO UNDERSTAND THE PROBLEMS IN ESSONNES...

PAD CRACKS

WHY ?

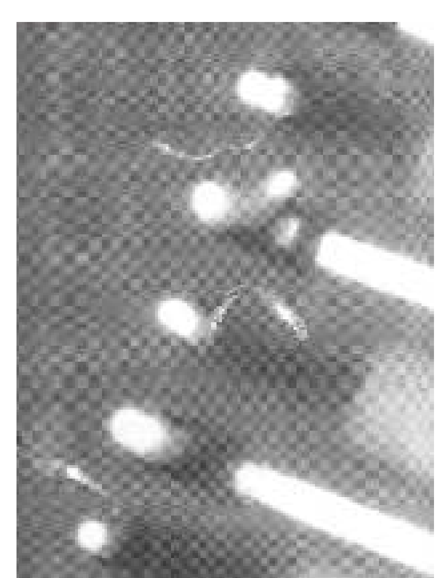




ALUMINIUM FLAGS

WHY ?

- LOW GRAM FORCE NEEDLES (NO EFFECT...)
- CHUCK SPEED (SMALL INFLUENCE...)
- PROBE-CARD OR PRODUCT DEPENDANT ?
- PAD STRUCTURE
- PAD THICKNESS



- TOO MUCH OVERDRIVE
- PAD MATERIAL ?
- PROBE TIP SHAPE (NO INFLUENCE...)
- NEEDLES DEPENDANT ? (LAYER, TIP DIAMETER...)

LET'S SKIP AND WIN

GO FOR A NEW PROBE-CARD
WITH A NEW PCB

CERPROBE EUROPE

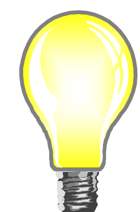
PCB VENDOR

- 150 EMPLOYEES
- NICE (FRANCE)
- QUALITY: EXPERTISE
- GOOD REPUTATION

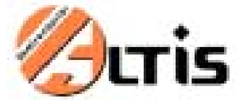
PROBE-CARD ASSEMBLY VENDOR

- 35 EMPLOYEES
- MEYREUIL (FRANCE)
- QUALITY : DELAY, REACTIVENESS, PRICE, EXPERIENCE

CUSTOMER SPECIFICATIONS + PB ANALYSIS → BRAINSTORMING WITH BOTH VENDORS → IMPROVEMENTS DECISION LAYOUT + PROJECT FLOW



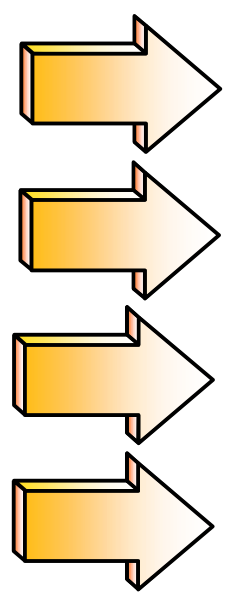
THE GOAL : TO FIND A SOLUTION IN LESS THAN 8 WEEKS...



LET'S SKIP AND WIN

IMPROVEMENTS REQUIRED

- NEEDLES AS SHORT AS POSSIBLE
- NEEDLES EQUAL LENGTH
- NEEDLES 90° TO RING
- 2 NEEDLES LAYERS MAXIMUM



- BETTER DECOUPLING, Z MATCHING
- NO DIFFERENCE OF YIELD BETWEEN DUTs
- BETTER PROBE MARKS
- PRECISE GRAM FORCE

LET'S SKIP

DUT0

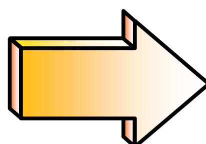
DUT1

LET'S SKIP AND WIN

IMPROVEMENTS REQUIRED

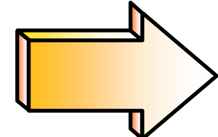
AND WIN !!

- INCREASE OF HSD SIZE
- CERAMIC SCREWED ON HSD
- HSD SCREWED TO HARD CORE
- INCREASE 1.5 mm PROBE DEPTH
- METAL HARD CORE INSERTED IN PCB



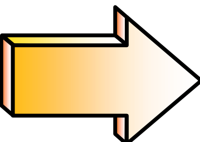
REDUCE PCB WARPING AT 87°C

- 2 VS MAXIMUM PER PC PLANE
- POWER and SENSE CONNECTED CLOSE TO DUT
- POWER PLANES SYMETRIC



BETTER POWER DISTRIBUTION

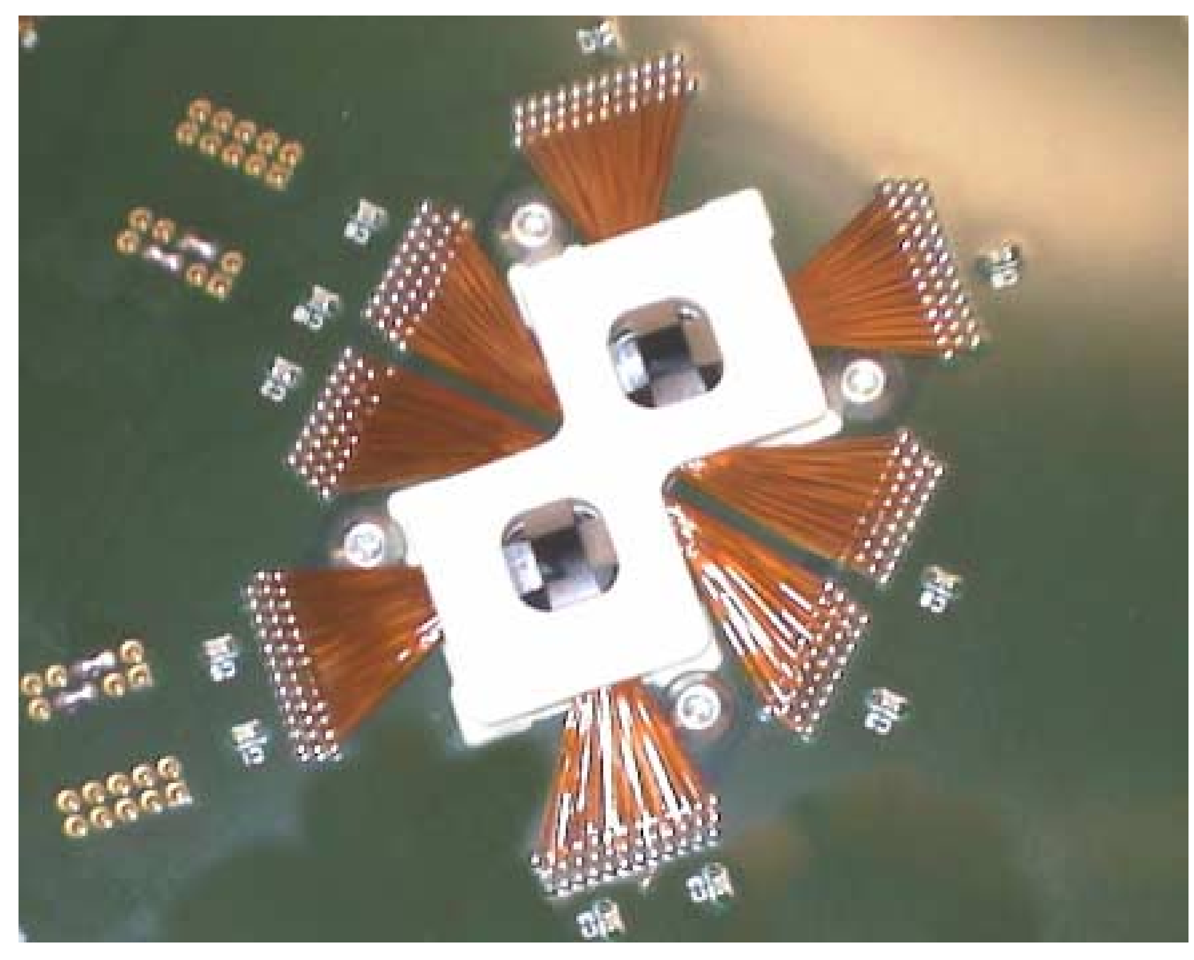
- INCREASE AND OPTIMIZATION OF DISTANCE BETWEEN TRACES



TO AVOID CROSS TALKING

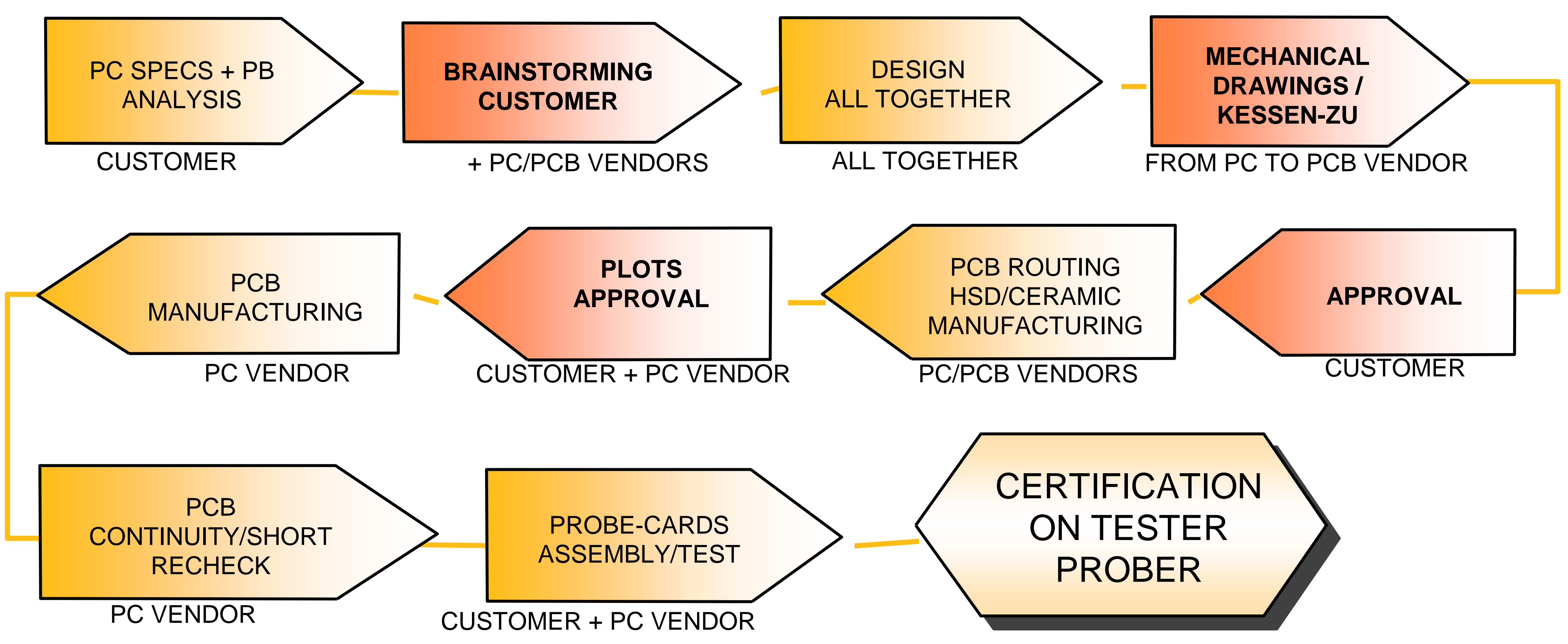
LET'S SKIP AND WIN

THE NEW PROBE-CARD :
DIAGONAL SKIPPED



LET'S SKIP AND WIN

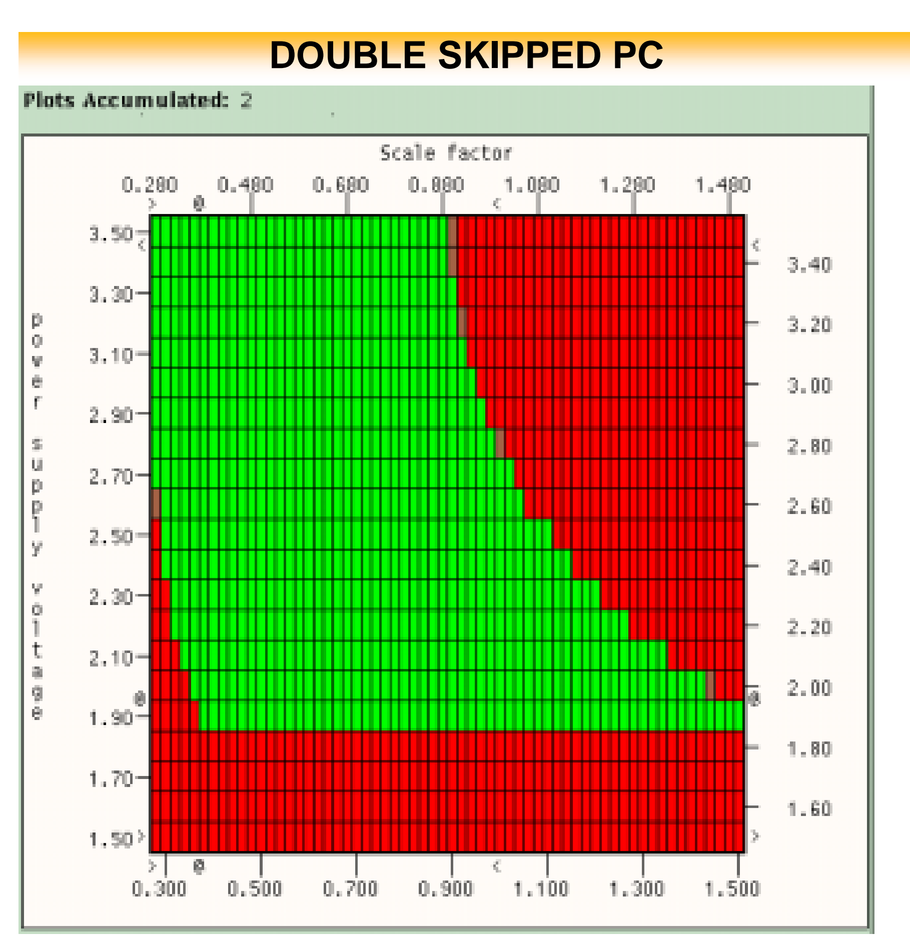
A STEP BY STEP PROCESS



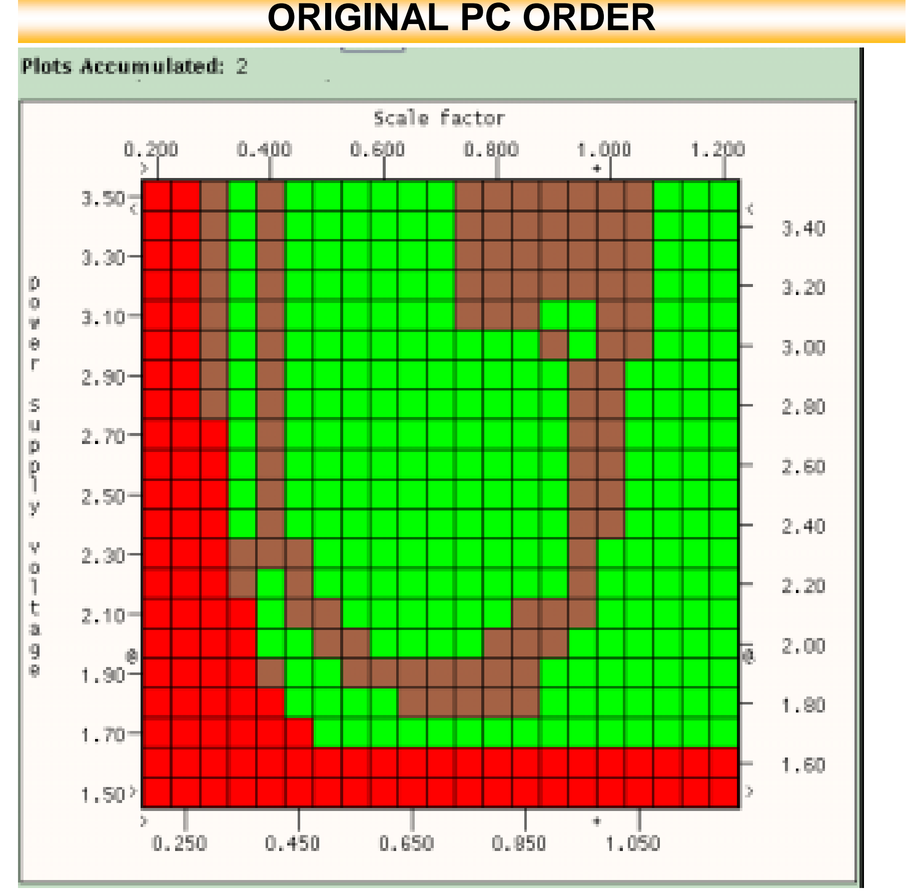
LET'S SKIP : THE RESULTS

DIFFERENCE OF YIELD BETWEEN DUTs
ELECTRICAL CHARACTERIZATION : DUT 0 VS DUT 1

DOUBLE SKIPPED PC



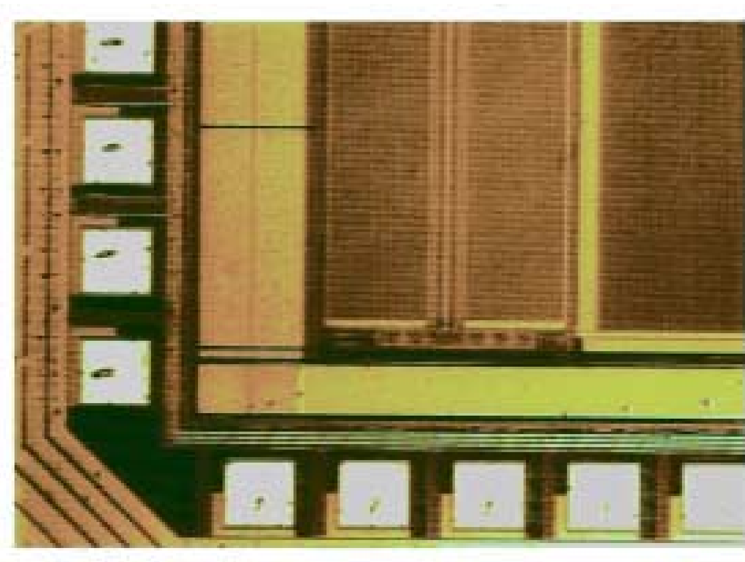
ORIGINAL PC ORDER

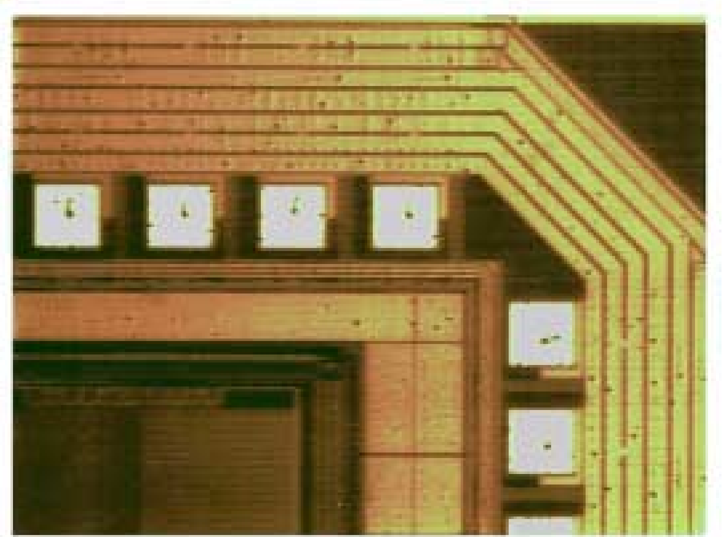


LET'S SKIP AND WIN

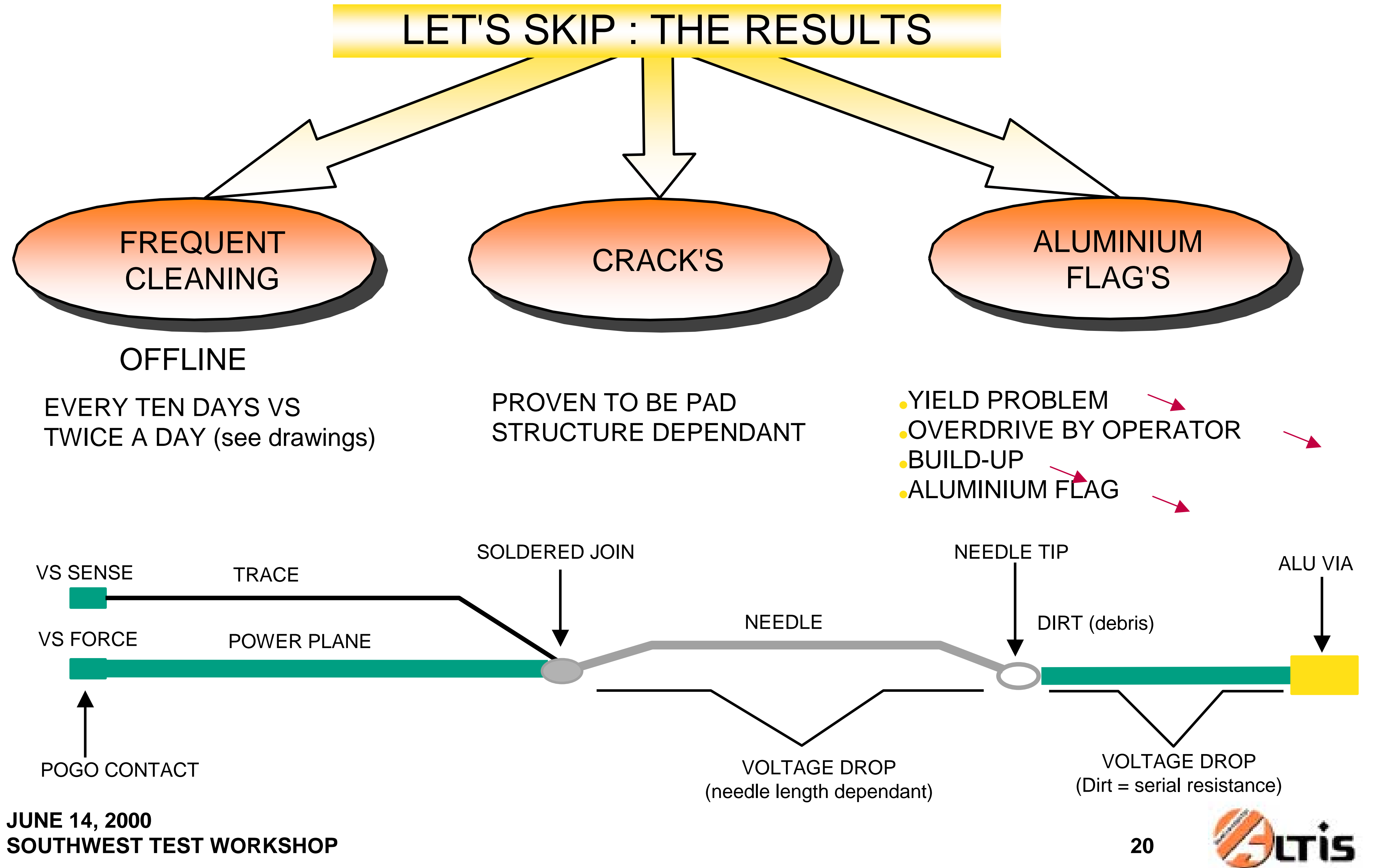
LET'S SKIP : THE RESULTS

LESS THAN 0.1%





LET'S SKIP AND WIN



LEARNING FROM DIFFICULTIES

- **THE PCB CAN BE THE KEY !**

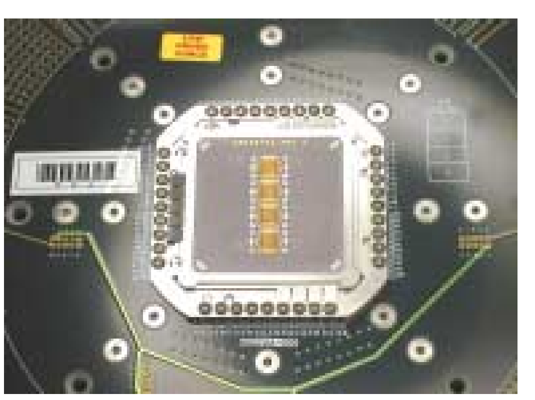
- **PROBE-CARD SHOULD BE GOOD THE FIRST TIME !**
  HOW : ALL POSSIBLE IMPROVEMENTS SHOULD BE IMPLEMENTED
  (DON'T TRY TO SAVE FEW DOLLARS...)
  WHY : LIMITED ENGINEERING ON TESTER TO FIX PC PROBLEMS
  (NOISE, CROSS-TALKING, VOLTAGE DROPS, ETC...)

- **EPOXY TECHNOLOGY CAN STILL BE PUSHED TO ITS LIMIT (CHEAP PRODUCT, FAST DELIVERY...)**

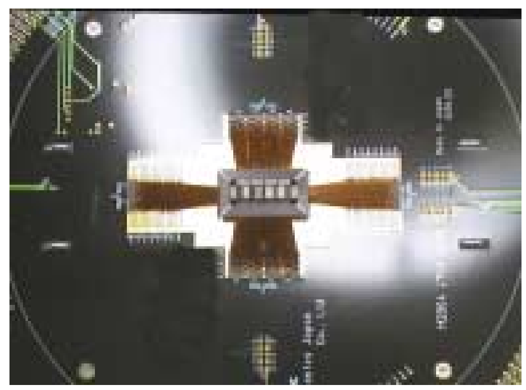
- **DO NOT BLAME THE PROBE-CARD WHEN IT CAN COME FROM THE PRODUCT (VIA CRACKS)**

- **CUSTOMER HAS A VERY IMPORTANT ROLE TO DRIVE THE PROJECT (DIFFERENT PC AND PCB VENDORS)**

LET'S SKIP AND WIN



LOW PITCH UP TO 4 DUT'S



A SUCCESSFULL BENCH MARK...

FORMFACTOR MICROSPRING T2

- LAYOUT 4 INLINE SKIPPED
- FIRST INTRODUCTION WORLDWIDE
- RUN IN PRODUCTION J750

MJC (APS) EPOXY MULTI-SQUARE

- LAYOUT 4 INLINE
- QUAD IN ENGINEERING J750
- DUAL RUN IN PRODUCTION J750

ACKNOWLEDGEMENT

THANKS TO ALL PEOPLE INVOLVED IN THIS PROJECT

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