Wafer Translators
An Alternative to Probe Cards

An Introduction

ADVANCED INQUIRY
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Translator Definition

A typical Translator is:

- A thin, but air tight, two-layer-metal substrate
- Large, robust, regularly distributed pads covering the whole tester side
- Laser blind-vias connecting both sides
- Contact points exactly matching the wafer die pads on the wafer side
THE PROBLEM

Wafers Are Difficult To Test Because:

- Die pads are tiny and close together
- Die pads are delicate - 1 micron thick metal
- There are often a lot of them - per die / per wafer
- Die pads can be inconveniently distributed
AN ORGANIC PCB BASED TRANSLATOR
Rogers 4350 Microwave Substrate - .004” Core, 17 Micron Metalization Both Sides Ni & Au – Laser Blind Vias
What does a wafer “Translator” do?

- Translates tiny pads to big pads
  - 65 microns sq. to 800 microns sq. – 150 times the area
- Translates delicate pads to robust pads
  - 1 micron thick Al to 9-20 micron Cu-Ni-Au
- Translates inconvenient to symmetrical
  - Random to square pitch arrays typ. 1 mm x 1 mm
ORGANIC PCB BASED WAFER TRANSLATORS
Conventional two layer metal PCB substrate (.004”) with ½ oz. Cu and laser blind vias

BT Epoxy
CTE of 7 PPM °C

Rogers 4350
PCB core
“Translated Wafer™”

- Translated Wafer™ has giant, tough pads with large pitch arranged for easy, low-cost contact
- Now the wafer die pads are never touched more than once
- Translator takes all the punishment
- If desired, all die pads on wafer appear on top of the Translator
VACUUM MOUNTING OF TRANSLATOR IS CO-CONFORMAL

- Vacuum drawn from nitrogen flood
- No re-oxidation of contact site possible
- 1,400 lb. available at sea level to distribute
- Mated pair very stable – no shifting or lifting
- Test system vibration does not erode CRES
- PCB tech. translator .0025 to .009” thick

Wafer fragment under translator illustrates co-conformal properties
“Translated Wafer™”

- NO OVERDRIVE - Translator is co-conformal with wafer
- CO-PLANARITY between wafer and Translator is inherent
- CRES using translators is equal to or lower than probe cards
“Translated Wafer™”

- EVERY LINE currently supports 56 Giga Bits on two-layer BT Epoxy
- Translator bumps are in a near vacuum drawn from a nitrogen flood
- Chaining die happens on Translator and is easy to design and fabricate
- Cleaning probe cards for example, 3 times per FOUP, is irrelevant
ORGANIC PCB BASED WAFER TRANSLATORS
Conventional two layer metal PCB substrate (.004”) with ½ oz. Cu and laser blind vias
ORGANIC PCB BASED WAFER TRANSLATORS

Conventional two layer metal PCB substrate (.004") with ½ oz. cu and laser blind vias

Wafer Side

Tester Side

1 mm pitch pads
Wafer Translator Facts

- Translators can be manufactured in
  - PCB / HDI Organic technologies - all types, flex or rigid
  - Semiconductor thin-film technologies – BCB, Poly, Oxide
  - WLCSP redistribution metal technologies
  - Ceramic substrate - etched thick film and thin film
  - Glass, ceramic, silicon, organic and most other substrates

- Translated Wafers™ typically fit in FOUPS

- Translated Wafers™ handle just like plain wafers

- Translators can carry relays, switches, caps etc.
TWO LAYER METAL BT-EPOXY TRANSLATOR
½ Oz Cu - Controlled Impedance – 100% of Lines Support 56 Gigabit Data Rate

Organic PCB Fabrication - Contact Height Variation 1.3 Microns Max – Pre-Coin
225,000 Contacts on a 200 mm logic wafer

This project was an ILD damage test

OURS
CHAINING DRAM DIE
Two-layer-metal organic PCB Translator supports DRAM chaining for test-channel reduction
WAFFER TRANSLATORS often use CPW - CoPlanar Wave Guide Circuits

Two-layer metal substrates gain certain advantages from CPW wiring

Some CPW Simulations

12 Micron Air Gap
WAFTER TRANSLATOR
Rigid Aluminum Nitride Translator Used As The Carrier Wafer During Wafer Thinning

A Tiny Fraction of Translator Patent Claims

A. Second patent to establish and claim the concept of a translator plate

1. A method of wafer level testing, comprising: disposing a wafer onto a chuck such that a first major surface of the wafer is adjacent the chuck; disposing an anisotropic conductor onto a second major surface of the wafer, the second major surface of the wafer having a plurality of integrated circuits formed thereon, each of the integrated circuits having a plurality of pads; disposing a first major surface of a translator plate onto the anisotropic conductor, such that an electrical pathway is established between at least one of the plurality of pads of each of at least two of the plurality of integrated circuits, and corresponding electrical contact pads on a second major surface of the translator plate, engaging a clamping ring with the chuck and the translator plate; electrically coupling the corresponding electrical contact pads to a first tester; and applying electrical signals from the first tester to the at least two integrated circuits; wherein applying electrical signal comprises providing power.

B. First establishment and claim that wafer and translator form a portable assembly

C. First establishment and claim of single touchdown on pad even if probed several times

D. First establishment and claim of moving portable assembly from tester to tester

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IEEE Workshop
DESK-TOP TRANSLATOR ALIGNER
Enables engineers to create a Translated Wafer™ on the workbench
A Translated Wafer™ can be probed with a DMM with no risk to the valuable “First Article” parts.
No probe station or probe card required
When combined with the Translator Aligner, an engineer can test every die in a short time without probe cards or a prober.
PRINT-ON, WASH-OFF TRANSLATOR
Conductive Translator pattern is printed on wafer, cured, wafer tested then pattern washed off without marks on pads or residue on wafer
TRANSLATOR AS CARRIER WAFER
Rigid Aluminum Nitride Translator Is Used As The Carrier Wafer During Wafer Thinning

Translator Enables Testing Of Thinned Die Even After Singulation
- 100% Laser Defined Glass Wafer Translator -
Vias in Mirror wafer with passivation cover as start point
- Laser Defined Translator -

Pads Defined, Via Capture Pad Created, Passivation Opened, Sites Labeled, Ready to Test & Ship
**Laser: Reduced Error Budget – Fewer Entries, Tighter Values**

½ Oz Cu - Controlled Impedance CPW – 300 mm Translator takes 20 to 30 min. per side

- Traces
- Via capture pads
- Alignment features
- Labels
- Fold lines
- Footprint pads
- Logos
- Barcodes
- Clearance features
- Cutting out the fixture
- Single insertion - same coordinate system

ALL AT ONCE
- 100% Laser Defined Ceramic Wafer Translator -
Vias in Mirror wafer as start point
- 100% Laser Defined Ceramic Wafer Translator -
Vias in Mirror wafer as start point
Variable Line Width – Constant Impedance
Laser Direct Creation of Wiring on Translator Enables Better Impedance Control +/- 1%

Air Gap dimensions are approximate

Ground Plane

Air Gap
0.001”

Air Gap
0.0008”

Air Gap
0.0015”

Air Gap
0.001”

Variable Line Width – Constant Impedance
Laser Direct Creation of Wiring on Translator Enables Better Impedance Control +/- 1%
Thanks for your attention