

3-D TSV: INSIGHT ON CRITICAL ISSUES AND MARKET ANALYSES

Table of Contents

Chapter 1	Introduction	1-1
Chapter 2	Insight Into Critical Issues	2-1
2.1	Driving Forces In 3-D TSV	2-1
2.2	Benefits of 3-D ICs With TSVs	2-2
2.3	Requirements For A Cost Effective 3-D Die Stacking Technology	2-3
2.4	TSV Technology Challenges	2-4
2.5	TSV Supply Chain Challenge	2-13
2.6	Limitations of 3-D Packaging Technology	2-14
2.6.1	Thermal Management	2-14
2.6.2	Cost	2-16
2.6.3	Design Complexity	2-16
2.6.4	Time to Delivery	2-17
Chapter 3	Cost Structure	3-1
3.1	Cost Structure of 3-D chip Stacks	3-1
3.2	Cost of Ownership	3-5
Chapter 4	Critical Processing Technologies	4-1
4.1	Introduction	4-1
4.2	Cu Plating	4-3
4.3	Lithography	4-5
4.3.1	Optical Lithography	4-5
4.3.2	Imprint Lithography	4-6
4.3.3	Resist Coat	4-7
4.4	Plasma Etch Technology	4-8
4.5	Stripping/Cleaning	4-12
4.6	Thin Wafer Bonding	4-14
4.7	Wafer Thinning/CMP	4-19
4.8	Stacking	4-20
4.9	Metrology/Inspection	4-22
Chapter 5	Evaluation Of Critical Development Segments	5-1
5.1	Introduction	5-1

5.2	Via-first	5-3
5.2.1	Equipment Requirements	5-5
5.2.2	Material Requirements	5-7
5.3	Via-Middle	5-8
5.3.1	Equipment Requirements	5-10
5.3.2	Material Requirements	5-11
5.4	Via-Last	5-14
5.4.1	Equipment Requirements	5-14
5.4.2	Material Requirements	5-15
5.5	Interposers	5-17
Chapter 6	Profiles Of Participants	6-1
6.1	Chip Manufacturers/Packaging Houses/Services	6-1
6.2	Equipment Suppliers	6-18
6.3	Material Suppliers	6-24
6.4	R&D	6-29
Chapter 7	Market Analysis	7-1
7.1	TSV Device Roadmap	7-1
7.2	TSV Device Forecast	7-3
7.3	Equipment Forecast	7-8
7.4	Material Forecast	7-11
List of Tables		
1.1	3-D Mass Memory Volume Comparison Between Other Technologies And TI's 3-D Technology	1-8
1.2	3-D Mass Memory Weight Comparison Between Other Technologies And TI's 3-D Technology	1-9
3.1	Cost Of Ownership Comparison	3-15
4.1	Via Middle Metrology/Inspection Requirements	4-24
4.2	Via Last Metrology/Inspection Requirements	4-26
7.1	Forecast Of TSV Devices By Units	7-4
7.2	Forecast Of TSV Devices By Wafers	7-6
7.3	Forecast Of TSV Equipment by Type	7-9
List of Figures		
1.1	3-D Technology On Dram Density	1-2
1.2	3-D Through-Silicon Via (TSV)	1-6

1.3	Graphical Illustration Of The Silicon Efficiency Between MCMs And 3-D Technology	1-10
1.4	Silicon Efficiency Comparison Between 3D Packaging Technology and Other Conventional Packaging Technologies	1-11
2.1	TSV Fabrication Process Challenges	2-6
2.2	TSV Fabrication Process Challenge – Cu Protrusion	2-7
2.3	TSV Reliability Challenges	2-10
2.4	Via Middle Process Integration Challenges	2-11
2.5	Via Middle Process Integration Challenges	2-12
3.1	Cost Structure of D2W and W2W	3-2
3.2	Assembly Cost Analysis	3-4
3.2	Cost Structure Of Different Vias And Tools	3-4
3.3	Cost Of Ownership For 5 X 50 TSV VIA Middle	3-6
3.4	Cost Of CMP For TSV VIA Middle Process	3-7
3.5	Cost Of Ownership For 10 X 100 TSV Via Middle	3-8
3.6	Cost Structure Of TSVs 5 X 50 μm	3-10
3.7	Interposer TSV: Upscaling To 10 X 100 μm	3-11
3.8	TSV Downscaling To 3x50 μm	3-12
3.9	Cost Structure Of Different Vias And Tools	3-14
3.10	Via First Cost Of Ownership	3-16
3.11	Via First Cost Of Ownership Front And Back Side	3-18
3.12	Via First Process Flow	3-19
3.13	iTSV Versus pTSV Cost Of Ownership	3-21
3.14	Effect Of TSV Depth And Diameter On Cost	3-22
4.1	Illustration Of Bosch Process	4-10
4.2	Key Via Middle TSV Process Steps	4-23
4.3	Key Last TSC Process Steps	4-25
5.1	VIA First, Middle, And Last Process Flows	5-2
5,2	VIA First TSV Process Flow	5-4
5.3	VIA Middle TSV Process Flow	5-9
5.4	Soft Reveal Process	5-13
5.5	VIA Last TSV Process Flow	5-15
5.6	Comparison Between 2.5D And 3D	5-18
5.7	TSV Interposer Cross Sectional Schematic With RDL Layer	5-20
5.8	Process Flow For RDL And UBM	5-21
7.1	Leading Edge TSV Roadmap	7-2
7.2	Forecast Of TSV Devices By Units	7-5
7.3	Forecast Of TSV Devices By Wafers	7-7
7.4	Forecast Of TSV Equipment by Type	7-10
7.5	Forecast Of TSV Materials	7-12