

# ICKNOWLEDGE LLC

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## IC Knowledge – Cost and Price Model Product Line Summary

IC Knowledge produces four cost and price models, and, in this document, the four models will be summarized and compared. The four models are:

1. Assembly and Test Cost and Price Model - provides cost and price estimates for most semiconductor assembly and test operations. Assembly supports leadframe, organic substrate packages (BGA, PGA, LGA) including EMIB, ceramic substrate packages and wafer level packages including InFO. The price includes twelve months of updates with support per our support policy. Assembly and test are covered including complex multi die assembly. This model is sold as individual and enterprise licenses.
2. Discrete and Power Products Cost and Price Model - designed to easily calculate the manufacturing cost and selling price of past and current high-power ICs and discrete devices fabricated on silicon, GaAs, GaN and SiC. The price includes twelve months of updates with support per our support policy. Wafer fabrication, test and packaging costs are all covered. This model is sold in individual and enterprise licenses.
3. IC Cost and Price Model - designed to easily calculate the manufacturing cost and selling price of low power silicon ICs (such as microprocessor, ASIC, analog, etc.). The price includes twelve months of updates with support per our support policy. Wafer fabrication, test and packaging costs are all covered. This model is sold in individual and enterprise licenses.
4. Strategic Cost and Price Model – is a fab based model the provides detailed analysis of past 300mm process and forward projects through the end of the decade. The model covers the top three companies of each of four categories, DRAM, Foundry, IDM Logic and NAND Flash. The model presents user editable process, equipment and materials details and has every 300mm fab for the target companies pre-defined (also user editable). Output includes detailed wafer cost and equipment and materials requirements in units and cost. Also includes die counts and die yield projections, margins and selling prices The price includes twelve months of updates with support per our support policy. This model is sold in individual and enterprise licenses.

All of our model run in Microsoft Excel, the Packaging Cost and Price Model and Strategic Cost and Price Model require Excel 2010 or higher, the other models currently run in Excel 2007 or higher but will be transitioning to Excel 2010 or higher.

## Summary and comparison table

Elements	Assembly and Test Cost and Price Model	Discrete and Power Products Cost and Price Model	IC Cost and Price Model	Strategic Cost and Price Model
Model coverage	Wafer sort, semiconductor assembly, class test	High power/voltage integrated circuits and discrete devices fabricated on silicon, GaAs, SiC and GaN	Low powered integrated circuits fabricated on silicon.	Leading edge integrated circuit processes
Difficulty of use	Moderate	Low	Low	High
Cost elements - Wafer cost - Wafer sort - Packaging - Class test	No Yes Yes (detailed) Yes	Yes Yes Yes Yes	Yes Yes Yes Yes	Yes (detailed) No No No
Target customers	Anyone needing detailed assembly and test costs. Ideal for our Strategic Cost and Price Model customers who want a complete front and back-end solution.	Should cost for automotive (widely used), and electronic systems. Benchmarking for IDMs. General usage by analysts and consultants.	Should cost for automotive, electronic systems and fabless companies. Benchmarking for IDMs and foundries. General usage by analysts and consultants. Materials and OEMs.	Preferred model for OEMs and Materials companies. Technology and cost planning for IDMs, Foundries, Fabless, Consultants and Analysts.
Processes	Molded leadframe, organic substrate, ceramic substrate, wafer level, InFO, EMIB.	BCD, HVIC, Power MOSFET, IGBT, Thyristor, diodes, IPD	CMOS, RFCMOS, legacy DRAM, SRAM, 2D NAND, NOR.	Foundry and IDM CMOS logic, DRAM, 2D and 3D Flash, 3D XPoint, Silicon Photonics

Elements	Assembly and Test Cost and Price Model	Discrete and Power Products Cost and Price Model	IC Cost and Price Model	Strategic Cost and Price Model
Typical products	IC and discrete assembly and test including multiple die packages	Power control ICs, high and low side switches, power MOSFETs, IGBTs, high voltage diodes, thyristors	Low power ASICs, FPGAs, microcontrollers, microprocessors, DSP, SOC	Leading edge wafers for logic, 3D NAND, 3D XPoint, advanced DRAM
Companies covered	Top 10 OSATs, user entered	Any relevant to the model	Any relevant to the model	Top 3 foundries, DRAM and 2D NAND, top 6 3D NAND, most advanced logic, Intel-Micron 3D XPoint
Nodes	NA	Past and current	Past and current (as of January 31, 2021 we cover through 5nm)	All 300mm to-date, 3D NAND to 512 layers, logic to 1.5nm, DRAM to 1 $\delta$ , 2D NAND to 1z, 3D XPoint 3 generations
Wafer sizes - 75mm - 100mm - 125mm - 150mm - 200mm - 300mm	Yes Yes Yes Yes Yes Yes	No Yes Yes Yes Yes Yes	No Yes Yes Yes Yes Yes	No No No No No Yes
Packages	Molded leadframe, organic substrate, wafer level, InFO, EMIB. Multiple die	Power and discrete packages such as SOT, DFN, TO, etc. Single die only	Standard IC packages such as QFN, BGA, LGA, QFP, etc. Single die only	None

Elements	Assembly and Test Cost and Price Model	Discrete and Power Products Cost and Price Model	IC Cost and Price Model	Strategic Cost and Price Model
Customizability	Moderate, can activate/deactivate an extensive list of packaging steps. Can modify equipment characteristics and materials prices	Low, can add selected process steps	Low, can add selected process steps	Very high, custom fabs, processes, materials and equipment usage and characteristics
Output details	Assembly and test cost and price including cost per step and detailed material requirements	Wafer, die, test and packaging costs. Approximate fab equipment and materials costs.	Wafer, die, test and packaging costs. Approximate fab equipment and materials costs.	Detailed wafer cost, cost per block and step, equipment set cost and units, material usage and cost
Comments	Detailed ability to define the assembly and test process elements and parameters.	Compound semiconductor coverage. We recommend the assembly and test cost and price model for multi-chip packaging.	We recommend the assembly and test cost and price model for multi-chip packaging.	The fabs, processes, equipment and materials can all be user adjusted.