



Packaging Cost and Price Model – Assembly Options

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Version 2019 model

Introduction

The Assembly and Test Cost and Price Model is a bottoms-up simulator of Assembly and Test operations. This document will outline the major assembly options covered by the model.

Date range

Supported years are 2015 to 2030

Assembly location/provider

The following assembly locations/providers are pre-defined in the model. Users can also override/modify the configuration for any of the options.

- Amkor
- ASE Group
- Chipbond
- ChipMOS
- Intel - China
- Intel - Malaysia
- Internal - China
- Internal - France
- Internal - Germany
- Internal - Israel
- Internal - Italy
- Internal - Japan
- Internal - Malaysia
- Internal - Mexico
- Internal - Philippines
- Internal - Singapore
- Internal - South Korea
- Internal - Taiwan
- Internal - United Kingdom
- Internal - United States
- Powertech Technology (PTI)
- Silicon Precision Industries (SPIL)
- STATS ChipPac
- TSMC
- United Test and Assembly Center Ltd. (UTAC)

Internal operations do not include a gross margin. OSAT providers have pre-defined margins that depend on the year and the volume and can be overridden by the user.

Input wafers

The model supports up to 6 user-defined input wafers and up to 5 pre-defined wafers. For each wafer any number of die may be used as inputs into the packaging process.

The pre-defined wafers are:

- Bridge die wafer – used for the Intel EMIB process
- InFO – used for the TSMC InFO process
- Integrated Passive Device (IPD) – some OSATs now fabricate their own IPD wafers for use in the assembly process
- Silicon Interposers – 2 to 4 layers with and without TSV and 5 layers with capacitors and with and without TSV
- Organic Interposers – 2 to 4 layers

Wafer level assembly options

The following wafer level assembly options are supported:

- Backgrind
- Redistribution layers – up to 4 supported
- Front side wafer bumping either solder or copper bumps
- Front or backside solder balls
- Wafer coating
- Wafer sawing – either single or dual pass
- Reconstructed wafers – often used for image sensors, a wafer on a frame is created from only good die
- Backside laser marking
- Tape and reel
- Visual inspect
- InFO with configurable copper pillars (yes/no), build up layers (up to 8), wafer mold, planarize and carrier removal

Leadframe based packages

The following leadframes are currently supported:

- D2PAK - 2 lead - 10 x 15 x 4.4 mm
- DIP - 8 lead - 300 x 365 x 130 mils
- DIP - 14 lead - 300 x 750 x 130 mils
- DIP - 16 lead - 300 x 750 x 130 mils
- DIP - 18 lead - 300 x 900 x 130 mils
- DIP - 20 lead - 300 x 1030 x 130 mils
- DIP - 24 lead - 300 x 1250 x 130 mils
- DIP - 24 lead - 600 x 1250 x 150 mils
- DIP - 28 lead - 300 x 1450 x 130 mils
- DIP - 28 lead - 600 x 1450 x 150 mils
- DIP - 40 lead - 600 x 2060 x 150 mils

- LQFP - 32 lead - 7 x 7 x 1.4 mm
- LQFP - 44 lead - 10 x 10 x 1.4 mm
- LQFP - 44 lead - 14 x 14 x 1.4 mm
- LQFP - 48 lead - 7 x 7 x 1.4 mm
- LQFP - 52 lead - 10 x 10 x 1.4 mm
- LQFP - 64 lead - 7 x 7 x 1.4 mm
- LQFP - 64 lead - 10 x 10 x 1.4 mm
- LQFP - 64 lead - 14 x 14 x 1.4 mm
- LQFP - 80 lead - 10 x 10 x 1.4 mm
- LQFP - 80 lead - 12 x 12 x 1.4 mm
- LQFP - 80 lead - 14 x 14 x 1.4 mm
- LQFP - 100 lead - 14 x 14 x 1.4 mm
- LQFP - 100 lead - 14 x 20 x 1.4 mm
- LQFP - 120 lead - 14 x 14 x 1.4 mm
- LQFP - 128 lead - 14 x 14 x 1.4 mm
- LQFP - 128 lead - 14 x 20 x 1.4 mm
- LQFP - 128 lead - 20 x 20 x 1.4 mm
- LQFP - 144 lead - 20 x 20 x 1.4 mm
- LQFP - 160 lead - 24 x 24 x 1.4 mm
- LQFP - 176 lead - 20 x 20 x 1.4 mm
- LQFP - 176 lead - 24 x 24 x 1.4 mm
- LQFP - 216 lead - 24 x 24 x 1.4 mm
- LQFP - 208 lead - 28 x 28 x 1.4 mm
- LQFP - 256 lead - 28 x 28 x 1.4 mm
- MLF/MLP/QFN - 4 lead - 2 x 2 x 0.35 mm
- MLF/MLP/QFN - 4 lead - 2 x 2 x 0.55 mm
- MLF/MLP/QFN - 4 lead - 2 x 2 x 0.85 mm
- MLF/MLP/QFN - 4 lead - 2 x 2 x 1 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2 x 0.35 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2 x 0.55 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2 x 0.85 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2 x 1 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2.5 x 0.35 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2.5 x 0.55 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2.5 x 0.85 mm
- MLF/MLP/QFN - 4 lead - 2.5 x 2.5 x 1 mm
- MLF/MLP/QFN - 4 lead - 3 x 3 x 0.35 mm
- MLF/MLP/QFN - 4 lead - 3 x 3 x 0.55 mm
- MLF/MLP/QFN - 4 lead - 3 x 3 x 0.85 mm
- MLF/MLP/QFN - 4 lead - 3 x 3 x 1 mm
- MLF/MLP/QFN - 4 lead - 5 x 2.5 x 0.35 mm
- MLF/MLP/QFN - 4 lead - 5 x 2.5 x 0.55 mm
- MLF/MLP/QFN - 4 lead - 5 x 2.5 x 0.85 mm
- MLF/MLP/QFN - 4 lead - 5 x 2.5 x 1 mm
- MLF/MLP/QFN - 6 lead - 2 x 2 x 0.35 mm
- MLF/MLP/QFN - 6 lead - 2 x 2 x 0.55 mm

- MLF/MLP/QFN - 6 lead - 2 x 2 x 0.85 mm
- MLF/MLP/QFN - 6 lead - 2 x 2 x 1 mm
- MLF/MLP/QFN - 6 lead - 2.5 x 2.5 x 0.35 mm
- MLF/MLP/QFN - 6 lead - 2.5 x 2.5 x 0.55 mm
- MLF/MLP/QFN - 6 lead - 2.5 x 2.5 x 0.85 mm
- MLF/MLP/QFN - 6 lead - 2.5 x 2.5 x 1 mm
- MLF/MLP/QFN - 8 lead - 2.5 x 2.5 x 0.35 mm
- MLF/MLP/QFN - 8 lead - 2.5 x 2.5 x 0.55 mm
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- MLF/MLP/QFN - 8 lead - 3 x 3 x 0.35 mm
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- MLF/MLP/QFN - 8 lead - 3 x 3 x 0.85 mm
- MLF/MLP/QFN - 8 lead - 3 x 3 x 1 mm
- MLF/MLP/QFN - 10 lead - 3 x 3 x 0.35 mm
- MLF/MLP/QFN - 10 lead - 3 x 3 x 0.55 mm
- MLF/MLP/QFN - 10 lead - 3 x 3 x 0.85 mm
- MLF/MLP/QFN - 10 lead - 3 x 3 x 1 mm
- MLF/MLP/QFN - 12 lead - 3 x 3 x 0.35 mm
- MLF/MLP/QFN - 12 lead - 3 x 3 x 0.55 mm
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- MLF/MLP/QFN - 42 lead - 6 x 5 x 0.35 mm
- MLF/MLP/QFN - 42 lead - 6 x 5 x 0.55 mm
- MLF/MLP/QFN - 42 lead - 6 x 5 x 0.85 mm
- MLF/MLP/QFN - 42 lead - 6 x 5 x 1 mm
- MLF/MLP/QFN - 44 lead - 10 x 10 x 0.35 mm
- MLF/MLP/QFN - 44 lead - 10 x 10 x 0.55 mm
- MLF/MLP/QFN - 44 lead - 10 x 10 x 0.85 mm
- MLF/MLP/QFN - 44 lead - 10 x 10 x 1 mm
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- MLF/MLP/QFN - 44 lead - 9 x 9 x 0.85 mm
- MLF/MLP/QFN - 44 lead - 9 x 9 x 1 mm
- MLF/MLP/QFN - 48 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 48 lead - 12 x 12 x 0.55 mm
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- MLF/MLP/QFN - 48 lead - 12 x 12 x 1 mm
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- MLF/MLP/QFN - 48 lead - 9 x 9 x 0.85 mm
- MLF/MLP/QFN - 48 lead - 9 x 9 x 1 mm
- MLF/MLP/QFN - 52 lead - 10 x 10 x 0.35 mm
- MLF/MLP/QFN - 52 lead - 10 x 10 x 0.55 mm
- MLF/MLP/QFN - 52 lead - 10 x 10 x 0.85 mm
- MLF/MLP/QFN - 52 lead - 10 x 10 x 1 mm
- MLF/MLP/QFN - 52 lead - 5 x 5 x 0.35 mm
- MLF/MLP/QFN - 52 lead - 5 x 5 x 0.55 mm
- MLF/MLP/QFN - 52 lead - 5 x 5 x 0.85 mm
- MLF/MLP/QFN - 52 lead - 5 x 5 x 1 mm
- MLF/MLP/QFN - 52 lead - 8 x 8 x 0.35 mm
- MLF/MLP/QFN - 52 lead - 8 x 8 x 0.55 mm
- MLF/MLP/QFN - 52 lead - 8 x 8 x 0.85 mm
- MLF/MLP/QFN - 52 lead - 8 x 8 x 1 mm
- MLF/MLP/QFN - 56 lead - 10 x 10 x 0.35 mm
- MLF/MLP/QFN - 56 lead - 10 x 10 x 0.55 mm
- MLF/MLP/QFN - 56 lead - 10 x 10 x 0.85 mm
- MLF/MLP/QFN - 56 lead - 10 x 10 x 1 mm
- MLF/MLP/QFN - 56 lead - 6 x 6 x 0.35 mm
- MLF/MLP/QFN - 56 lead - 6 x 6 x 0.55 mm
- MLF/MLP/QFN - 56 lead - 6 x 6 x 0.85 mm
- MLF/MLP/QFN - 56 lead - 6 x 6 x 1 mm
- MLF/MLP/QFN - 56 lead - 7 x 7 x 0.35 mm
- MLF/MLP/QFN - 56 lead - 7 x 7 x 0.55 mm
- MLF/MLP/QFN - 56 lead - 7 x 7 x 0.85 mm
- MLF/MLP/QFN - 56 lead - 7 x 7 x 1 mm
- MLF/MLP/QFN - 56 lead - 8 x 8 x 0.35 mm
- MLF/MLP/QFN - 56 lead - 8 x 8 x 0.55 mm
- MLF/MLP/QFN - 56 lead - 8 x 8 x 0.85 mm
- MLF/MLP/QFN - 56 lead - 8 x 8 x 1 mm
- MLF/MLP/QFN - 60 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 60 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 60 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 60 lead - 12 x 12 x 1 mm
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- MLF/MLP/QFN - 68 lead - 10 x 10 x 0.35 mm
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- MLF/MLP/QFN - 68 lead - 8 x 8 x 1 mm
- MLF/MLP/QFN - 72 lead - 10 x 10 x 0.35 mm
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- MLF/MLP/QFN - 72 lead - 10 x 10 x 1 mm
- MLF/MLP/QFN - 76 lead - 8 x 8 x 0.35 mm
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- MLF/MLP/QFN - 84 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 84 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 84 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 84 lead - 12 x 12 x 1 mm
- MLF/MLP/QFN - 88 lead - 10 x 10 x 0.35 mm
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- MLF/MLP/QFN - 100 lead - 10 x 10 x 0.35 mm
- MLF/MLP/QFN - 100 lead - 10 x 10 x 0.55 mm
- MLF/MLP/QFN - 100 lead - 10 x 10 x 0.85 mm
- MLF/MLP/QFN - 100 lead - 10 x 10 x 1 mm
- MLF/MLP/QFN - 100 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 100 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 100 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 100 lead - 12 x 12 x 1 mm
- MLF/MLP/QFN - 104 lead - 9 x 9 x 0.35 mm
- MLF/MLP/QFN - 104 lead - 9 x 9 x 0.55 mm
- MLF/MLP/QFN - 104 lead - 9 x 9 x 0.85 mm
- MLF/MLP/QFN - 104 lead - 9 x 9 x 1 mm
- MLF/MLP/QFN - 108 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 108 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 108 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 108 lead - 12 x 12 x 1 mm
- MLF/MLP/QFN - 116 lead - 10 x 10 x 0.35 mm
- MLF/MLP/QFN - 116 lead - 10 x 10 x 0.55 mm
- MLF/MLP/QFN - 116 lead - 10 x 10 x 0.85 mm
- MLF/MLP/QFN - 116 lead - 10 x 10 x 1 mm
- MLF/MLP/QFN - 124 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 124 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 124 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 124 lead - 12 x 12 x 1 mm
- MLF/MLP/QFN - 144 lead - 12 x 12 x 0.35 mm
- MLF/MLP/QFN - 144 lead - 12 x 12 x 0.55 mm
- MLF/MLP/QFN - 144 lead - 12 x 12 x 0.85 mm
- MLF/MLP/QFN - 144 lead - 12 x 12 x 1 mm
- MLF/MLP/QFN - 172 lead - 11.2 x 10 x 0.74 mm
- MQFP - 44 lead - 10 x 10 x 2 mm
- MQFP - 52 lead - 10 x 10 x 2 mm
- MQFP - 52 lead - 14 x 14 x 2 mm
- MQFP - 52 lead - 14 x 14 x 2.67 mm
- MQFP - 64 lead - 10 x 10 x 2 mm
- MQFP - 64 lead - 14 x 14 x 2 mm
- MQFP - 64 lead - 14 x 14 x 2.67 mm
- MQFP - 64 lead - 14 x 20 x 2.71 mm
- MQFP - 80 lead - 14 x 14 x 2 mm
- MQFP - 80 lead - 14 x 14 x 2.67 mm
- MQFP - 80 lead - 14 x 20 x 2.71 mm
- MQFP - 100 lead - 14 x 14 x 2 mm
- MQFP - 100 lead - 14 x 14 x 2.67 mm
- MQFP - 100 lead - 14 x 20 x 2.71 mm
- MQFP - 120 lead - 28 x 28 x 3.37 mm

- MQFP - 128 lead - 14 x 20 x 2.71 mm
- MQFP - 128 lead - 28 x 28 x 3.37 mm
- MQFP - 144 lead - 28 x 28 x 3.37 mm
- MQFP - 160 lead - 28 x 28 x 3.37 mm
- MQFP - 208 lead - 28 x 28 x 3.37 mm
- MQFP - 240 lead - 32 x 32 x 3.4 mm
- MQFP - 256 lead - 28 x 28 x 3.37 mm
- PLCC - 20 lead - 352 x 352 x 152 mils
- PLCC - 28 lead - 452 x 452 x 152 mils
- PLCC - 32 lead - 452 x 552 x 109 mils
- PLCC - 44 lead - 652 x 652 x 152 mils
- PLCC - 52 lead - 752 x 752 x 152 mils
- PLCC - 68 lead - 952 x 952 x 150 mils
- PLCC - 84 lead - 1152 x 1152 x 150 mils
- PowerPak - 3 lead - 8 x 8 x 1.9 mm
- SOIC - 8 lead - 150 x 194 x 58 mils
- SOIC - 8 lead - 208 x 208 x 71 mils
- SOIC - 14 lead - 150 x 342 x 58 mils
- SOIC - 16 lead - 150 x 391 x 58 mils
- SOIC - 16 lead - 300 x 407 x 92 mils
- SOIC - 18 lead - 300 x 456 x 92 mils
- SOIC - 20 lead - 300 x 505 x 92 mils
- SOIC - 24 lead - 300 x 607 x 92 mils
- SOIC - 28 lead - 300 x 706 x 92 mils
- SOIC - 32 lead - 445 x 802 x 118 mils
- SOIC - 36 lead - 430 x 902 x 118 mils
- SOIC - 44 lead - 430 x 1130 x 118 mils
- SOIC - 54 lead - 430 x 1387 x 118 mils
- SOT1235 (LFPK88) - 4 lead - 8 x 6.3 x 1.7 mm
- sTOLL - 3 lead - 7 x 8 x 2.3 mm
- TO220 - 3 lead - 10 x 15 x 4.6 mm
- TOLL - 8 lead - 11.7 x 9.9 x 2.3 mm
- TQFP - 32 lead - 5 x 5 x 1 mm
- TQFP - 32 lead - 7 x 7 x 1 mm
- TQFP - 40 lead - 5 x 5 x 1 mm
- TQFP - 44 lead - 10 x 10 x 1 mm
- TQFP - 48 lead - 7 x 7 x 1 mm
- TQFP - 52 lead - 10 x 10 x 1 mm
- TQFP - 64 lead - 7 x 7 x 1 mm
- TQFP - 64 lead - 10 x 10 x 1 mm
- TQFP - 64 lead - 14 x 14 x 1 mm
- TQFP - 80 lead - 12 x 12 x 1 mm
- TQFP - 80 lead - 14 x 14 x 1 mm
- TQFP - 100 lead - 14 x 14 x 1 mm
- TQFP - 120 lead - 14 x 14 x 1 mm
- TQFP - 128 lead - 14 x 14 x 1 mm

- TQFP - 144 lead - 16 x 16 x 1 mm
- TQFP - 144 lead - 20 x 20 x 1 mm
- TQFP - 176 lead - 20 x 20 x 1 mm
- TSOP - 28 lead - 8 x 11.8 x 1 mm
- TSOP - 32 lead - 8 x 11.8 x 1 mm
- TSOP - 32 lead - 8 x 18.4 x 1 mm
- TSOP - 40 lead - 10 x 18.4 x 1 mm
- TSOP - 40 lead - 10.16 x 18.41 x 1 mm
- TSOP - 44 lead - 10.16 x 18.41 x 1 mm
- TSOP - 44 lead - 10.16 x 20.95 x 1 mm
- TSOP - 48 lead - 12 x 18.4 x 1 mm
- TSOP - 50 lead - 10.16 x 20.95 x 1 mm
- TSOP - 54 lead - 10.16 x 22.22 x 1 mm
- TSOP - 56 lead - 14 x 18.4 x 1 mm
- TSSOP - 8 lead - 4.4 x 3 x 0.9 mm
- TSSOP - 14 lead - 4.4 x 5 x 0.9 mm
- TSSOP - 16 lead - 4.4 x 5 x 0.9 mm
- TSSOP - 20 lead - 4.4 x 6.5 x 0.9 mm
- TSSOP - 24 lead - 4.4 x 7.8 x 0.9 mm
- TSSOP - 28 lead - 4.4 x 9.7 x 0.9 mm
- TSSOP - 38 lead - 4.4 x 9.7 x 0.9 mm

Organic substrate-based packages

Organic substrate-based packages are user defined based on body size, core and build up layers, number of I/O and EMIB processing options. Silicon and organic interposers with and without TSVs are also supported.

Common packaging options

The following options may be applied to either leadframe or organic based packages:

- Die attach – Epoxy, Eutectic, Flip Chip or Solder
- Added bypass or power supply capacitors
- Aluminum heat spreader
- Plasma clean
- Wirebond with aluminum, copper or gold wire of varying diameters
- Inspection
- Mold
- Thermal lid
- Singulate
- Laser mark
- Tape & Reel
- Open/short test