# *Micro*LeadFrame®

Amkor's *Micro*LeadFrame® (MLF®/QFN/SON/DFN) package is a near CSP plastic encapsulated package with a copper leadframe substrate. This package uses perimeter lands on the bottom of the package to provide electrical contact to the Printed Wiring Board (PWB).

The package also offers Amkor's ExposedPad technology as a thermal enhancement. Having the die attach paddle exposed on the bottom of the package surface provides an efficient heat path when soldered directly to the PWB. This enhancement also enables stable ground using down bonds or by electrical connection through a conductive die attach material.

## MLF® OFFERINGS

- Chip-on-Lead (CoL)
- Thin *Micro*LeadFrame®
- Flip chip MLF® (fcMLF®)
- Routable MLF® (rtMLF®)
- Single row (up to 108 I/O)
  - Punch and saw formats
- Dual row (up to 180 I/O)
  - Punch and saw formats
- Multi-Chip Package (MCP)
- Stacked die
- Non-exposed pad
- PPF (NiPd) punch & saw *Micro*LeadFrame®
- Small MLF® (less than 2 x 2 body size)
- Non-magnetic leadframes for sensors
- Split pad designs for increased flexibility and I/O count
- Wettable flanks (PEL)
- Edge Protection™ technology

## Applications

The small size and weight along with excellent thermal and electrical performance make the *Micro*LeadFrame® package an ideal choice for handheld portable applications such as smartphones and tablets or any other application where size, weight and package performance are required.

## Thermal Performance

### Multi-Layer PCB

| Package | Body Size (mm) | # Board Vias | Exposed Pad (mm) | Die (mm) | ΘJA (°C/W) |
|---|---|---|---|---|---|
| 12 Ld | 3 x 3 | 1 | 1.25 | 1.25 | 61.1 |
| 28 Ld | 5 x 5 | 9 | 2.7 | 2.54 | 34.8 |
| 44 Ld | 7 x 7 | 16 | 4.8 | 3.81 | 24.4 |
| 52 Ld | 8 x 8 | 25 | 6.1 | 5.08 | 20.9 |
| 64 Ld | 10 x 10 | 36 | 7.1 | 2.79 | 29.4 |
| 124 Ld | 10 x 10 | 36 | 7.1 | 2.79 | 30.0 |

JEDEC standard test boards
Modeled data @ air flow

## Electrical Performance

### Simulated Results @ 2 GHz

| Package | Body Size (mm) | Lead | Inductance (nH) | Capacitance (pF) | Resistance (mΩ) |
|---|---|---|---|---|---|
| 12 Ld | 3 x 3 | Longest<br>Shortest | 0.564<br>0.531 | 0.203<br>0.220 | 141.8<br>138.9 |
| 44 Ld | 7 x 7 | Longest<br>Shortest | 1.766<br>1.194 | 0.326<br>0.289 | 315.1<br>234.5 |
| 64 Ld | 10 x 10 | Longest<br>Shortest | 2.179<br>1.475 | 0.518<br>0.409 | 337.5<br>250.8 |

Values dependent on specific die and wire configurations

Amkor Technology®

# *Micro*LeadFrame®

## Features

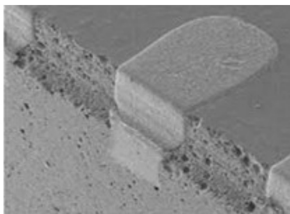
- Small size (reduce package footprint by 50% or more and improved RF performance) and weight
- Standard leadframe process flow and equipment
- Excellent thermal and electrical performance
- 0.35 mm to 1.45 mm maximum height
- I/O count range: 1-180 available with conventional MLF®; >200 possible with rtMLF®
- 1-13 mm body size
- Thin profile and superior die-to-body size ratio
- Pb-free/Green
- Flexible designs and high yields
- Saw and punch versions available

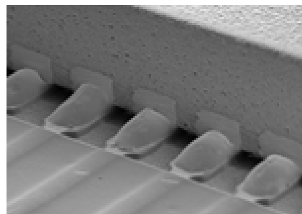
## Dual Row MLF® Package

An MLF® package with two rows of leads offers a cost effective, high-performance solution for devices requiring up to 180 I/O. Typical applications include hard disk drives, USB controllers and wireless LAN.

## Saw MLF® Wettable Flanks Package

This package meets customer requirements for the automotive industry including: fine lead pitch (0.50 mm, 0.65 mm), higher solder filled height on the side of lead area; similar or better BLR performance than standard design; and elimination of need for X-ray monitoring after SMD. Amkor has released this process to High Volume Manufacturing (HVM).





## rtMLF® (Routable Molded Leadframe) Package

The rtMLF® is an MLF® package with resin filled traces for small form factor driven structures. This offers a low-cost, high thermal performance device in a smaller footprint. It has internal routing traces with limited line width/space capability and this package adapts easily to flip chip configurations. rtMLF® provides higher pin count and more flexible internal trace routing with resin filled leadframe.

## Reliability Qualification

Amkor devices are assembled in optimized package designs with proven reliable semiconductor materials.

- Moisture sensitivity characterization: JEDEC level 1*, 85°C/85% RH, 168 hrs
- uHAST: 130°C/85% RH, 96 hrs
- Temp/Humidity: 85°C/85% RH, 1000 hours
- Temp cycle: -65°C/+150°C, 1000 cycles
- High temp storage: 150°C, 1000 hours

*Depending on BOM, body size and design

## Process Highlights

- Die thickness: .20 ± .05 mm nominal, thinner for special applications
- Marking: Laser
- IPD: Integrated passive device
- Stacked die: Multiple die, pyramid or side by side combination

## Standard Materials

- Leadframe: Copper alloy, dual gauge, PPF
- Die attach: Conductive epoxy or DAF, non-conductive epoxy or DAF
- Wire: Au, Cu, Au PCC, Ag
- Mold compound: Pb-free/Green capable
- Plating: Matte Sn, NiPdAu, Ag

## Test Services

- Program generation/conversion
- Product engineering
- Available test/handling technology
- Burn-in capabilities
- Tape and reel services
- Film frame

## Shipping

- Clear anti-static tubes, bakable trays or metal canisters

# *Micro*LeadFrame®

## Edge Protection™ Technology

Since its inception in the late 1990's, Amkor's *Micro*LeadFrame® package has seen accelerated adoption by the automotive industry as a result of its size advantages, robust performance qualities and the integration of wettable flanks. Amkor offers the MLF® package in punch and saw formats to meet the demanding needs of the automotive industry and is recognized as the premiere supplier of this QFN package.

To further improve the strength of the MLF® package design, Amkor has developed Edge Protection™ technology that protects the edges of the device during handling operations, such as test and surface mount assembly (SMA). By strengthening the edges of the punch MLF® package, test induced damage has been significantly reduced. Amkor now offers its punch MLF® package with Edge Protection™ technology in a variety of body sizes.

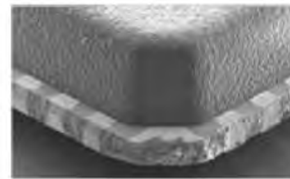
This innovative enhancement is rapidly growing in acceptance, particularly in the area of test, as Amkor's Edge Protection™ technology improves the robustness of package design. Additionally, Amkor has continued to develop enhancements to extend the capabilities of the MLF® package. With the proven implementation of dimple end leads, the punch MLF® continues to be the package format of choice for automotive applications.

### Edge Protection™ Considerations

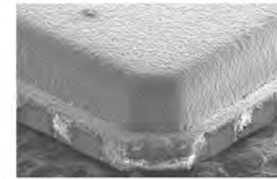
Amkor's package enhancement protects the edges of MLF® packaging during handling, test and assembly process operations.

### Advantages

- Package corners and edges strengthened by ≥2x
- Elimination of test induced damage
- Elimination of common handling damage
- No change to package footprint



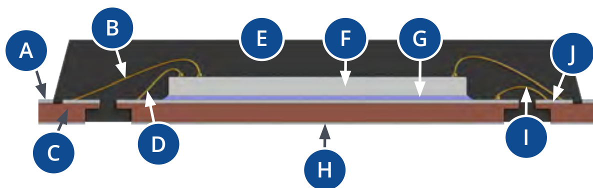
**Without Edge Protection™**



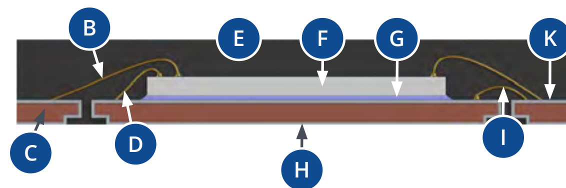
**With Edge Protection™**

## Cross Section *Micro*LeadFrame®

### Individual Unit Design "Punch"

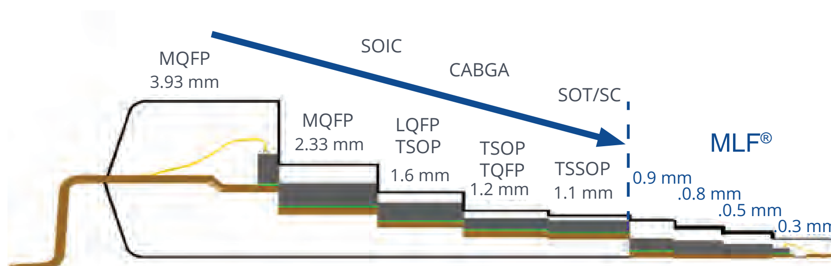



### Map Design "Saw"




- **A** EPT
- **B** Gold wire
- **C** Cu leadframe
- **D** Down bond
- **E** Mold compound
- **F** Die
- **G** Die attach adhesive
- **H** Exposed die paddle
- **I** Ground bond
- **J** Ag plating
- **K** NiPd plating

## Package Height Comparison



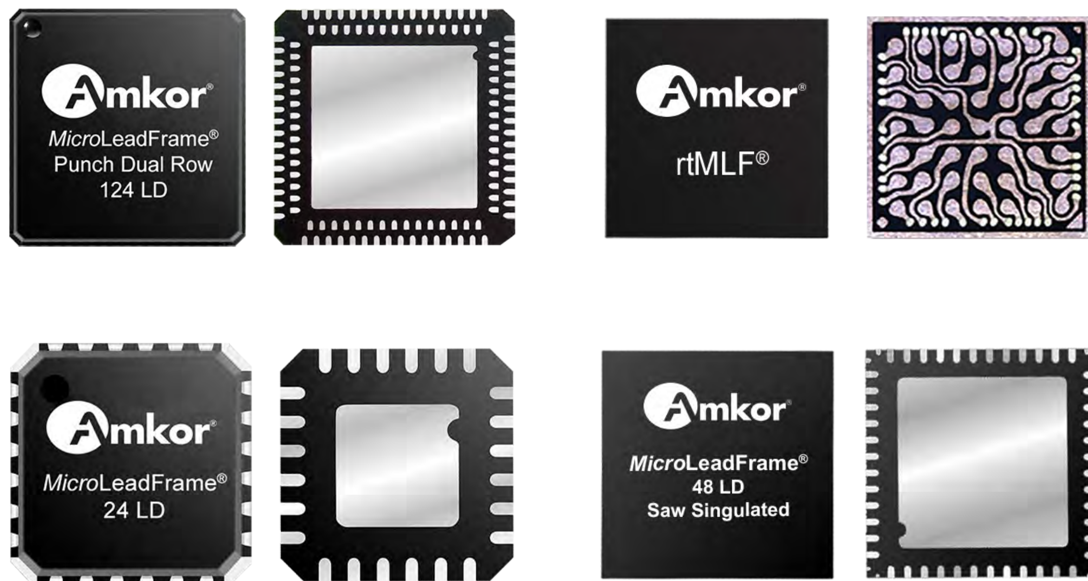
# *Micro*LeadFrame®

## Configuration Options For Dual Row MLF®

### MLF® Package Family (mm)

| Package Type | Body Size | Single Row Lead Counts | | Dual Row Lead Counts | |
|---|---|---|---|---|---|
| | | 0.50 mm Pitch | 0.40 mm Pitch | 0.65 mm Pitch | 0.50 mm Pitch |
| Saw | 5 x 5 | 32 | 40 | 36 | 52 |
| Saw | 6 x 6 | 40 | 48 | 44 | 68 |
| Saw | 7 x 7 | 48 | 60 | 60 | 84 |
| Saw/Punch | 8 x 8 | 56 | 68 | 76 | 100 |
| Punch | 9 x 9 | 64 | 76 | 84 | 116 |
| Punch | 10 x 10 | 72 | 88 | 100 | 132 |
| Punch | 11 x 11 | N/A | N/A | 108 | 148 |
| Punch | 12 x 12 | 88 | 108 | 116 | 164 |
| Punch | 13 x 13 | N/A | N/A | 124 | 180 |

**Note:** Various package sizes available between 1 x 1 through 3 x 3. For example: 2.5 x 2.5, 2 x 1 or 1.5 x 1.5



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