



## MicroLeadFrame® Quad Flat No-Lead Package (MLF®/QFN/SON/DFN)

Amkor's *MicroLeadFrame*® QFN 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 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 by use of down bonds or by electrical connection through a conductive die attach material.

### MLF Offerings

- Chip-on-Lead (COL)
- Single Row (Up to 108 I/O)
- Dual Row (Up to 180 I/O)
- Multi Chip Package
- Non-Exposed Pad
- PPF (NiPd) Punch & Saw MLF
- Small MLF (Less than 2 x 2 body size)
- Stacked Die
- Thin *MicroLeadFrame*®
- Top Exposed Pad (TEP)
- Inframe Cavity MLF
- Flipchip MLF

### 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.

### Applications

The small size and weight along with excellent thermal and electrical performance make the *MicroLeadFrame* package an ideal choice for handheld portable applications such as cell phones and PDAs or any other application where size, weight and package performance are required.

Visit [Amkor Technology](http://www.amkor.com) online for locations and to view the most current product information.

## MicroLeadFrame® MLF®/QFN/SON/DFN

### Features

- Small size (reduce package footprint by 50% or more and improved RF performance) and weight
- Standard leadframe process flow and equipment
- 0.4 mm to 2.03 mm maximum height
- 4 to 180 I/O
- 1-13 mm body size
- Thin profile and superior die-to-body size ratio
- Pb-free/Green
- Flexible designs for optimal electrical and thermal performance
- Saw and punch versions available

### Thermal Performance

#### Multi-layer PCB

Pkg	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 @ 0 air flow

### Electrical Performance

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

Simulated Results @ 2 GHz  
Values dependent on specific die and wire configurations

### 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 body size



## MicroLeadFrame® MLF®/QFN/SON/DFN

### Process Highlights

- Die thickness .20 ± .05 mm nominal, thinner for special applications
- Plating Matte Sn, NiPdAuAg
- Marking Laser

### Standard Materials

- Leadframe Copper alloy, dual gauge
- Die attach Conductive epoxy
- Wire 0.8 mil Au, 1% PD doped, 0.8 mil Cu
- Mold compound Pb-free/Green capable

### Test Services

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

### Shipping

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

### Configuration Options

#### MLF Package Family (mm)

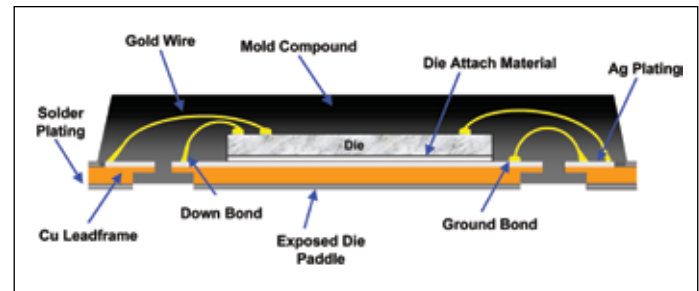
Body Size (mm)	QFN/SON/DFN Lead Counts 0.8, 0.65, 0.5, 0.4, 0.35, 0.3 mm Pitch	Dual Row Lead Counts 0.5 mm Pitch
<2 x 2 (saw only)	-	-
2 x 3	-	-
3 x 3	4/8/10/12/16/20/24	-
4 x 4	12/16/20/24/28/32/40	-
5 x 5	16/20/28/32/36/40/44/52	44/52
6 x 5	18/24/36/42	-
6 x 6	20/24/28/36/40/48/56/64	60/68
7 x 7	28/32/36/44/48/56/68/80	76/84
8 x 8	32/36/40/52/56/68/76/88	92/100
9 x 9	36/44/48/60/64/76/88/104	108/116
10 x 10	44/52/56/68/72/88/100/116	124/132
11 x 11	-	140/148
12 x 12	48/60/84/88/100/108/124/144	156/164
13 x 13	-	164/180

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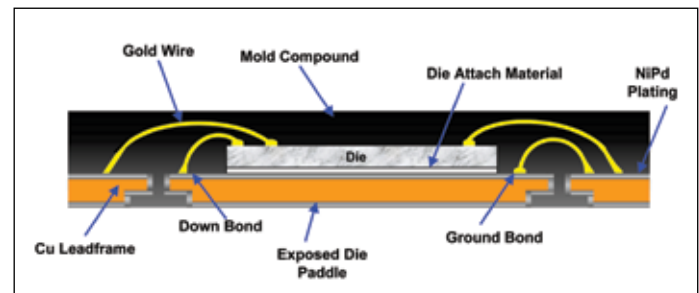
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### Cross-sections MLF

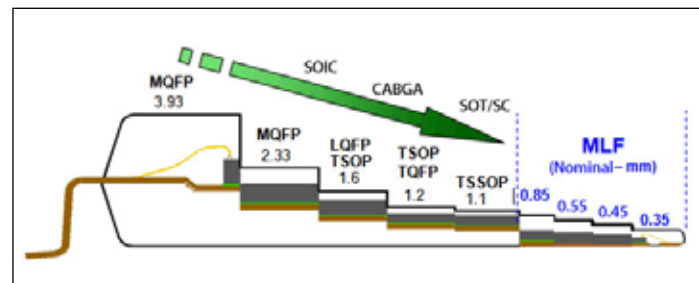
#### Individual Unit Design "Punch"



#### Map Design "Saw"



### Package Height Comparison



Save valuable board space with MLF!





## Low Profile Quad Flat Pack Packages (LQFP)

Amkor offers a broad line of LQFP IC packages designed to provide the same great benefits as MQFP packaging with a 1.4 mm body thickness. These packages allow IC packaging engineers, component specifiers and systems designers to solve issues such as increasing board density, die shrink programs, thin end-product profile and portability.

### Applications

Amkor's LQFPs are an ideal package for most IC semiconductor technologies such as Digital Signal Processors (DSP), PLDs, microprocessors, microcontrollers, high-speed logic/FPGAs, ASICs, SRAMs and PC chip sets.

LQFP packages are particularly well suited for light weight, portable electronics requiring broad performance characteristics. Such applications include: laptop PCs, video/audio, telecom, cordless/RF, data acquisition, office equipment, disc-drives and communication boards.

### Features

- 7 x 7 mm to 28 x 28 mm body size
- 32-256 lead counts
- Broad selection of die pad sizes
- Copper leadframes
- 1.4 mm body thickness
- Custom leadframe design available
- Low stress BOM for stress sensitive products
- Pb-free RoHs compliant materials

Visit [Amkor Technology](http://www.amkor.com) online for locations and to view the most current product information.

## LQFP

### Thermal Resistance

Single-layer PCB, JEDEC Standard Test Boards

Pkg	Body Size (mm)	Pad Size (mm)	ΘJA (°C/W) by Velocity (LFPM)		
			0	200	500
32 ld	7 x 7	5 x 5	67.8	55.9	50.1
100 ld	14 x 14	8 x 8	41.5	33.4	29.5
100 ld	14 x 20	9.5 x 9.5	39.7	31.8	28.3
144 ld	20 x 20	8.5 x 8.5	38.0	31.2	28.1
176 ld	24 x 24	8 x 8	38.3	31.9	29.0

JEDEC Standard Test Boards

Multi-layer PCB, JEDEC Standard Test Boards

Pkg	Body Size (mm)	Pad Size (mm)	ΘJA (°C/W) by Velocity (LFPM)		
			0	200	500
32 ld	7 x 7	5 x 5	47.9	42.1	39.4
100 ld	14 x 14	8 x 8	31.7	26.8	24.7
100 ld	14 x 20	9.5 x 9.5	30.0	25.1	23.0
144 ld	20 x 20	8.5 x 8.5	31.7	26.9	24.9
176 ld	24 x 24	8 x 8	31.9	27.3	25.4
208 ld*	28 x 28	16 x 16	18.1	15.3	14.4

JEDEC Standard Test Boards

\*Pre-JEDEC Standard Test Boards, Tested @ 1W

### Electrical Performance

Pkg	Body Size (mm)	Pad Size (mm)	Lead	Inductance (nH)	Capacitance (pF)	Resistance (mΩ)
32 ld	7 x 7	5 x 5	Longest	0.904	0.211	9.2
			Shortest	0.799	0.202	7.8
48 ld	7 x 7	5 x 5	Longest	1.110	0.225	13.8
			Shortest	0.962	0.200	12.0
100 ld	14 x 14	8 x 8	Longest	2.300	0.419	26.3
			Shortest	1.520	0.322	17.8
144 ld	20 x 20	8.5 x 8.5	Longest	6.430	1.100	62.9
			Shortest	4.230	1.070	52.6
176 ld	24 x 24	8 x 8	Longest	9.510	1.270	89.0
			Shortest	5.200	1.340	64.0
208 ld	28 x 28	11 x 11	Longest	9.670	1.380	86.2
			Shortest	6.190	1.210	64.8

Simulated Results @ 100 MHz

### Reliability Qualification

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

- Moisture Sensitivity Characterization JEDEC Level 3, 30°C/60% RH, 192 hrs
- PCT 121°C, 100% RH, 2 atm, 504 hours
- Temp Cycle -55°C/+125°C, 1000 cycles
- Temp/Humidity 85°C/85% RH, 1000 hours
- High Temp Storage 150°C, 1000 hours

## LQFP

### Process Highlights

- Die thickness 14.5 ± .5 mil
- Strip solder plating Matte Sn and pre-plated package options, i.e. Ni/Pd frames
- Marking Laser
- Lead inspection Laser/optical
- Pack/ship options Bar code, dry pack
- Wafer backgrinding Available

### Test Services

- Program generation/conversion
- Product engineering
- Wafer sort
- 256 pin x 20 MHz test system available
- -55°C to +165°C test available
- Burn-in capabilities

### Shipping

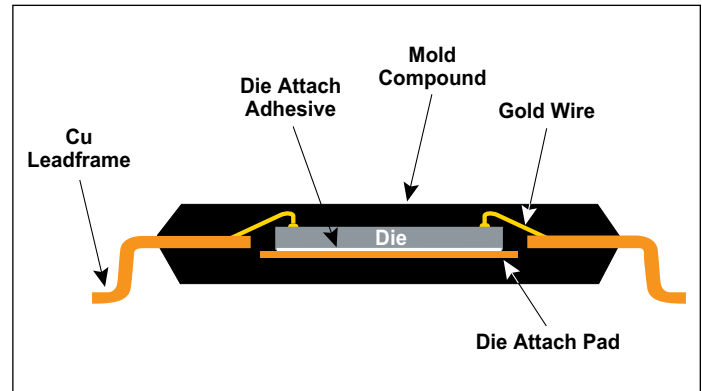
- JEDEC outline CO-124 low profile tray

### Configuration Options

#### LQFP Nominal Package Dimensions (mm)

Lead Count	Body Size	Body Thickness	Lead Form	Standoff	Foot Length	Tip-to-Tip	JEDEC	Tray Matrix	Units Per Tray
32/48/64	7 x 7	1.40	1.00	0.10	0.60	9.0	MS-026	10 x 25	250
44/52/64/80	10 x 10	1.40	1.00	0.10	0.60	12.0	MS-026	8 x 20	160
80	12 x 12	1.40	1.00	0.10	0.60	14.0	MS-026	7 x 17	119
44/64/80/100/120/128	14 x 14	1.40	1.00	0.10	0.60	16.0	MS-026	6 x 15	90
100/128	14 x 20	1.40	1.00	0.10	0.60	16.0 x 22.0	MS-026	6 x 12	72
128/144/176	20 x 20	1.40	1.00	0.10	0.60	22.0	MS-026	5 x 12	60
160/176/216	24 x 24	1.40	1.00	0.10	0.60	26.0	MS-026	4 x 10	40
208/256	28 x 28	1.40	1.00	0.10	0.60	30.0	MS-026	4 x 9	36

### Cross-section LQFP



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DS232D  
Rev Date: 1/13



## Thin Quad Flat Pack Packages (TQFP)

Amkor offers a broad line of TQFP IC packages. These packages allow IC packaging engineers, component specifiers and systems designers to solve issues such as increasing board density, die shrink programs, thin end-product profile and portability.

### Applications

Amkor's TQFPs are an ideal package for most IC semiconductor technologies such as Digital Signal Processors (DSP), PLDs, microprocessors, microcontrollers, high-speed logic/FPGAs, ASICs, SRAMs and PC chip sets.

TQFP packages are particularly well suited for light weight, portable electronics requiring broad performance characteristics. Such applications include: laptop PCs, video/audio, telecom, cordless/RF, data acquisition, office equipment, disc drives and communication boards (Ethernet, ISDN, etc.).

### Features

- 5 x 5 mm to 20 x 20 mm body size
- 32-176 lead counts
- Broad selection of die pad sizes
- Copper leadframes
- 1.0 mm body thickness
- Custom leadframe design available
- Low stress BOM for stress sensitive products
- Pb-free and RoHS compliant materials

Visit [Amkor Technology](http://www.amkor.com) online for locations and to view the most current product information.

## TQFP

### Thermal Performance

#### Single-layer PCB

Pkg	Body Size (mm)	Pad Size (mm)	ΘJA (°C/W) by Velocity (LFPM)		
			0	200	500
32 ld	7 x 7	5 x 5	69.3	57.8	52.1
64 ld	14 x 14	8 x 8	47.0	38.1	33.9
100 ld	14 x 14	8 x 8	43.4	35.5	31.7

JEDEC Standard Test Boards

#### Multi-layer PCB

Pkg	Body Size (mm)	Pad Size (mm)	ΘJA (°C/W) by Velocity (LFPM)		
			0	200	500
32 ld	7 x 7	5 x 5	49.5	43.8	41.3
64 ld	14 x 14	8 x 8	35.1	29.8	27.7
100 ld	14 x 14	8 x 8	33.4	28.5	26.4

JEDEC Standard Test Boards

Tested @ 1W

### Electrical Performance

Pkg	Body Size (mm)	Pad Size (mm)	Lead	Self Inductance (nH)	Bulk Capacitance (pF)	Self Resistance (mF)
176 ld	20 x 20	10 x 10	Longest	4.890	0.871	58.4
-	-	-	Shortest	3.490	0.744	43.9

Simulated Results @ 100 MHz

### Reliability Qualification

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

- Moisture Sensitivity Characterization JEDEC Level 3, 30°C/60% RH, 192 hrs
- PCT 121°C, 100% RH, 2 atm, 504 hours
- Temp Cycle -65°C/+150°C, 1000 cycles
- Temp/Humidity 85°C/85% RH, 1000 hours
- High Temp Storage 150°C, 1000 hours

## TQFP

### Process Highlights

- Die thickness 11.5 ± .5 mils
- Strip solder plating Matte Sn and pre-plated package options, i.e. Ni/Pd frames
- Strip marking Laser
- Lead inspection Laser/optical
- Pack/ship options Bar code, dry pack
- Wafer backgrinding Available

### Test Services

- Program generation/conversion
- Product engineering
- Wafer sort
- 256 pin x 20 MHz test system available
- -55°C to +165°C test available
- Burn-in capabilities

### Shipping

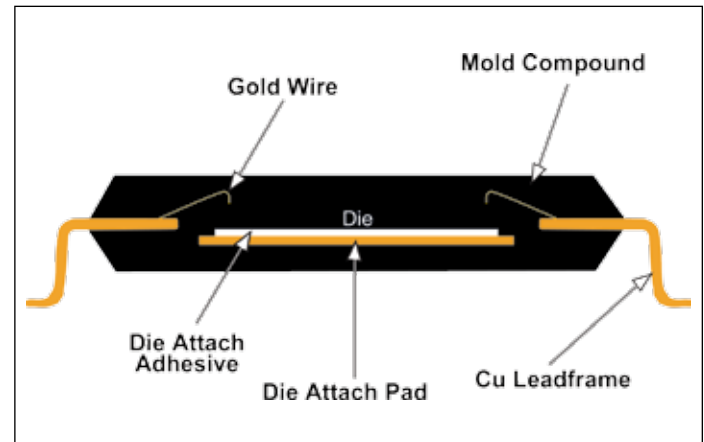
- JEDEC outline CO-124 low profile tray

### Configuration Options

#### TQFP Nominal Package Dimensions (mm)

Lead Count	Body Size	Body Thickness	Lead Form	Standoff	Foot Length	Tip-to-Tip	JEDEC	Tray Matrix	Units Per Tray
32/40	5 x 5	1.00	1.00	0.10	0.60	7.0	MS-026	12 x 30	360
32/48/64	7 x 7	1.00	1.00	0.10	0.60	9.0	MS-026	10 x 25	250
44/52/64	10 x 10	1.00	1.00	0.10	0.60	12.0	MS-026	8 x 20	160
80	12 x 12	1.00	1.00	0.10	0.60	14.0	MS-026	7 x 17	119
64/80/100/120/128	14 x 14	1.00	1.00	0.10	0.60	16.0	MS-026	6 x 15	90
144	16 x 16	1.00	1.00	0.10	0.60	18.0	N/A	6 x 15	90
144/176	20 x 20	1.00	1.00	0.10	0.60	22.0	MS-026	5 x 12	60

### Cross-section TQFP



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Rev Date: 12/12





## ExposedPad LQFP/TQFP Packages

Amkor's ExposedPad LQFP/TQFP family of power IC packages significantly increases the thermal efficiency of power constrained standard LQFP and TQFP packages. These packages can increase heat dissipation by as much as 110% over standard LQFP/TQFP packages, thereby expanding the margin of operating parameters. In addition, the ExposedPad can be connected to ground, thereby reducing loop inductance for high frequency applications. The ExposedPad should be soldered directly to the PCB to realize the thermal and electrical benefits. 3D packaging with die stack process are also provided in this package for MCP solution.

## Applications

As increased end-application densities and shrinking product sizes demand more from IC packages, ExposedPad LQFP/TQFP packages give designers the needed margin for designing and producing high performing products. Applications such as magnetic/optical disk drives, pagers, wireless, CATV/RF modules, LCD/flat panel TVs, radio and telecom benefit from this package. GaAs and high-speed silicon technologies work especially well in ExposedPad LQFP/TQFP packages due to added shielding and grounding capabilities.

## Features

- 5 x 5 mm to 28 x 28 mm body size
- 32-256 lead counts
- Broad selection of die pad sizes
- Double down-set ground bond ring pad
- Copper leadframes
- 1.0 mm body thickness for TQFP
- 1.4 mm body thickness for LQFP
- Custom leadframe design available
- ExposedPad is easily inverted for heat sink attach
- Low Profile – < 1.2 mm max mounted height
- Electrical – very low loop inductance with use of paddle as ground path, more pins available for signal and allows for operating frequencies of up to 2.4 GHz

## ExposedPad LQFP/TQFP

### Thermal Performance

#### Multi-layer PCB

Pkg	Body Size (mm)	Pad Size (mm)	ΘJA (°C/W) by Velocity (LFPM)		
			0	200	500
32 ld	5 x 5	3.4 x 3.4	34.6	29.1	27.2
48 ld	7 x 7	5 x 5	27.6	22.6	20.7
64 ld	10 x 10	7.5 x 7.5	22.3	17.2	15.1
100 ld	14 x 14	10.3 x 10.3	20.6	15.3	13.4
144 ld	20 x 20	7 x 7	20.0	15.4	13.5
176 ld*	24 x 24	10 x 10	19.0	15.4	13.5
208 ld*	28 x 28	11 x 11	18.7	15.5	14.0

\*Estimates

JEDEC Standard Test Boards

Tested @ 1W with die attach pad soldered to PCB

### Electrical Performance

Pkg	Body Size (mm)	Pad Size (mm)	Loop Inductance (nH)	
			Center	Corner
32 ld	5 x 5	3.4 x 3.4	1.97	2.38
48 ld	7 x 7	5 x 5	2.29	2.81
64 ld	10 x 10	7.5 x 7.5	3.04	3.78
100 ld	14 x 14	10.3 x 10.3	2.57	3.32
144 ld	20 x 20	7 x 7	4.00	5.00
176 ld	24 x 24	10 x 10	5.00	6.00
208 ld	28 x 28	11 x 11	6.00	7.00

JEDEC Standard Test Boards

Tested @ 1W with die attach pad soldered to PCB

### Reliability Qualification

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

- Moisture Sensitivity Characterization JEDEC Level 3, 30°C/60% RH, 192 hrs  
3x reflow – SAT
- HAST w/precon 130°C/85% RH, 96 hours
- Temp Cycle w/precon -65°C/+150°C, 1000 cycles
- Temp/Humidity 85°C/85% RH, 1000 hours
- High Temp Storage 150°C, 1000 hours

Visit Amkor Technology online for locations and to view the most current product information.

## ExposedPad LQFP/TQFP

### Process Highlights

- Die thickness 11.5 ± 0.5 mils for TQFP  
14.5 ± 0.5 mils for LQFP
- Bond pad pitch 0.050 mm
- Wire diameter 0.8 mil standard
- Lead finish 100% matte Sn standard  
Pre-plated leadframe capa is selectively available
- Marking Laser
- Pack/ship options Bar code, dry pack
- Wafer backgrinding Available

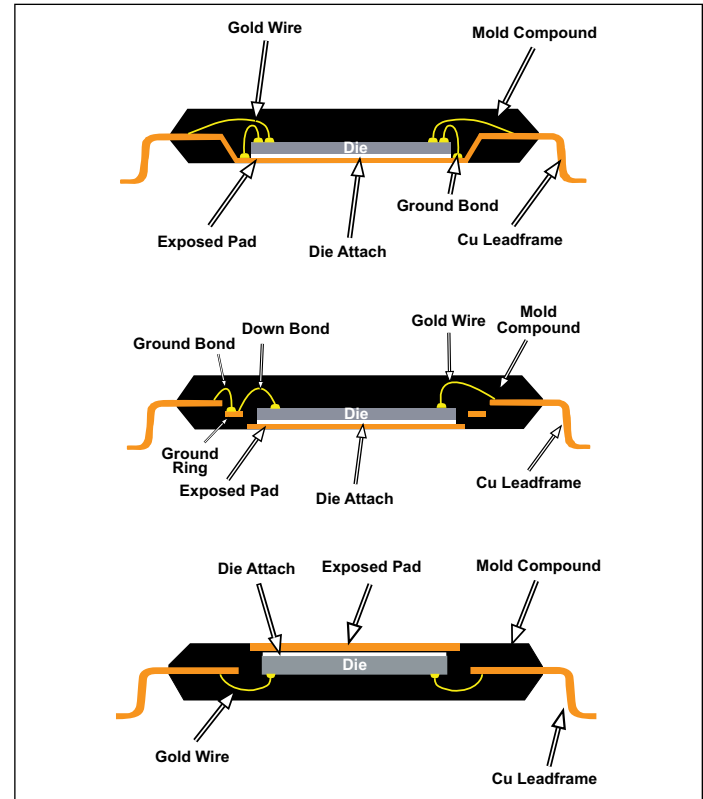
### Test Services

- Program generation/conversion
- Product engineering
- Wafer sort
- 256 pin x 20 MHz test system available
- -55°C to +165°C test available
- Burn-in capabilities
- Tape and reel services

### Shipping

- JEDEC outline CS-007 low profile tray

### Cross-sections ExposedPad LQFP/TQFP



### Configuration Options

#### ExposedPad LQFP/TQFP Nominal Package Dimensions (mm)

Lead Count	Body Size	Body Thickness	Lead Form	Standoff	Foot Length	Tip-to-Tip	Tray Matrix	Units Per Tray
32	5 x 5	1.00	1.00	0.10	0.60	7.0	12 x 30	360
32/48/64	7 x 7	1.00	1.00	0.10	0.60	9.0	10 x 25	250
44/52/64/80	10 x 10	1.0 / 1.4	1.00	0.10	0.60	12.0	8 x 20	160
80	12 x 12	1.0 / 1.4	1.00	0.10	0.60	14.0	7 x 17	119
52/64/80/100/120/128	14 x 14	1.0 / 1.4	1.00	0.10	0.60	16.0	6 x 15	90
144	16 x 16	1.00	1.00	0.10	0.60	18.0	6 x 15	90
100/128	14 x 20	1.40	1.00	0.10	0.60	16.0 x 22.0	6 x 12	72
128/144/176	20 x 20	1.0 / 1.4	1.00	0.10	0.60	22.0	5 x 12	60
160/176/216	24 x 24	1.40	1.00	0.10	0.60	26.0	4 x 10	40
208/256	28 x 28	1.40	1.00	0.10	0.60	30.0	4 x 9	36

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