

# General Guide for Assembly Services

*Integra Technologies*

*Single-Source Turnkey Solution From Wafer Processing To Final Test*



# GENERAL GUIDE

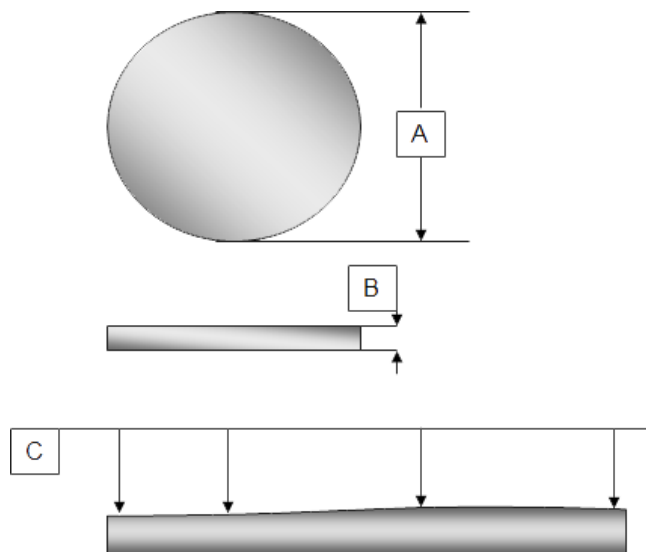
- Integra Capabilities exceed general guidelines
- Guidelines are provided to assist customers in making their products more manufacturable and thus assist in achieving maximum yields.

# GENERAL ASSEMBLY GUIDELINE

- Wafer Thinning / Individual Die Thinning
- Wafer Dicing / Dice Before Grind (DBG)
- Die Pick-n-Place
- Automated Visual Inspection
- Die Attach
- Flip Chip Assembly
- Wirebond Assembly
- Die Tape & Reel Capability
- Chip-on-Board (COB) Assembly
- Quad Flat No-Lead (QFN) and BGA Assembly

# WAFER THINNING

Materials	[A] Wafer Diameter	[B] Final Thickness (FT) Deviation (um)	[B <sub>1</sub> ] Special FT Deviation(um)	[C] Total Thickness Variation (TTV) (um)	[C <sub>1</sub> ] Special TTV (um)
Si / SiGe	All (up to 12")	+/-12	12" = +/- 6      8" = +/- 3 6" = +/- 2	≤ 6	≤ 3
GaAs / InP / III-V	All (3, 5, 6, 8")	+/-12	+/-6	≤ 6	
Sapphire	All sizes	+/-12		≤ 6	
Glass	All sizes and shapes	+/-12		≤ 6	



Bumped Wafer Guidelines (Si wafer)	
Maximum Bump Height:	.5x Si Thickness



## Notes:

1. Typical FT Deviation = +/- 5um
2. Min. standard FT = 50um
3. Bumped wafers depend on planarity of the bumps

**Capability:** Thinning between 15 – 20um

# BACKSIDE FINISH

Wheel	Material	Grit	Spindle
Metal Removal	Gold, oxide layers, various metals	270	Z1 (rough grind)
1200	Silicon	1200	Z2 (fine grind)
2000	Silicon	2000	Z2 (fine grind)
Polygrind	Silicon	4000+	Z2 (fine grind)
Polish	Silicon	8000+	Polisher
GaAs	GaAs	4000	Z2 (fine grind)
InP	InP / III-V	4000	Z2 (fine grind)
Glass	Glass	1500	Z2 (fine grind)
Sapphire	Sapphire	600	Z2 (fine grind)

# BACKGRIND GUIDELINES

	<u>DFG840</u>	<u>DFG 850</u>	<u>8540 Mini-Beast</u>	<u>DAG810</u>	<u>Dry Polisher</u>
Wafer Size	3" - 6"	4" - 8"	8" only	Die - 12"	3"- 5" manual 6"- 8" full auto
Materials	GaAs, Silicon, Quartz, InP, etc.	GaAs, Silicon, Quartz, InP, etc.	Silicon Only	Silicon, Quartz, InP etc.	Silicon Only
Minimum Thickness **	100 um	50 um std. 10-40 um engr.	50 um	50 um 10-40 um engr.	50 um
<b>** Required finish to achieve Min Thickness</b>	Micro/Poly Grind	Micro/Poly Grind	Micro/Poly Grind	Micro/Poly Grind	Polish

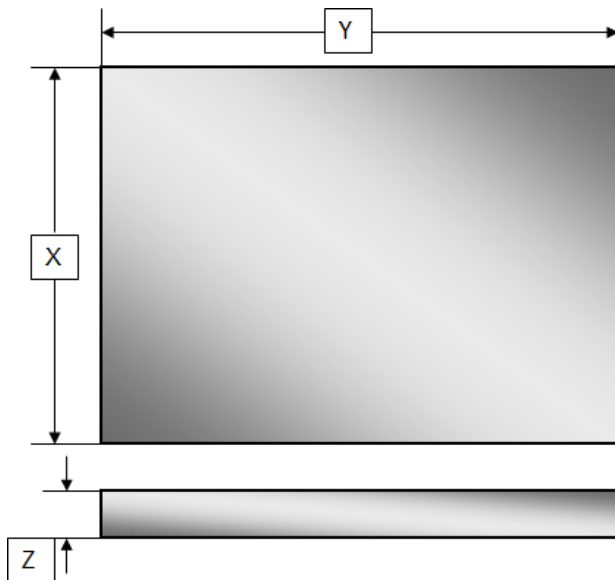
	<u>2000 Grit</u>	<u>Microgrind</u> Recommended when thinning to <= 200um	<u>Dry Polish</u>
Roughness	Ra = 150 A Rmax = 810 A	Ra = 90 A Rmax = 650 A	Ra = 3 A Rmax = 17 A

<u>TTV (Total Thickness Variation)</u>	<u>Spec: &lt;6um</u>	<u>Internal: &lt;3um</u>	<u>Comments</u>
Bump Height Ratio	Bump Height < Base Thickness		Maximum bump height = 0.5 * Material Base Thickness
Individual Die Thinning	Min Die Thickness: 100um Min Die Size: 2.5mm x 2.5mm		<b>***Non-standard process requiring Engineering review***</b>

*Note: All inquiries outside of the stated design guidelines require Engineering review*

# INDIVIDUAL DIE THINNING

Material	[X/Y] Die Size (mm)	[Z] Minimum Thickness (um)	Surface Finish	Bumped Die
Si / SiGe	> 1.27	> 50	Polygrind	Yes
GaAs / InP / III-V	> 1.27	> 100	4000	Yes
Sapphire	> 1.27	> 100	600	
Glass	> 1.27	> 100	1500	



- Dimensions listed above are a general guideline for individual die thinning
- Individual die thinning is a non-standard process that requires Engineering review for all inquiries
- Die loss and edge chipping are potential quality concerns for individual die thinning

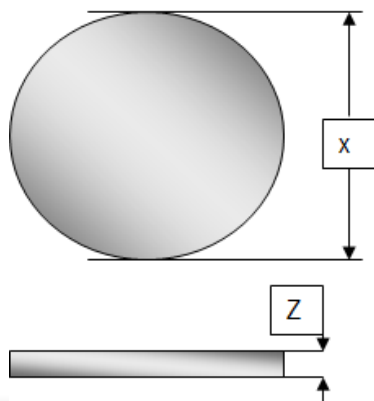
## Diced Material Experience

- Silicon, SiGe
- LowK & Ultra LowK dielectric products down to 28nm
  - Mechanical Dicing of Ultra LowK products recommended for Prototypes Only
- Glass (Pyrex/Borosilicate glass; Quartz)
- Gallium Nitride, SiC
- Sapphire, Zirconia
- Compound material semiconductors (GaAs; InP)
- SAW crystals (Lithium Niobate; Lithium Tantalate)
- Metal foils (Au; SS; Ti; Cu)
- Resin (molded packages)
- Ceramic Substrate (Alumina; SiC; AlN)
- Organic Substrate (BT, FR4, PI)
- Magnetic materials (Ferrite)
- PZT (Barium titanate; Calcium titanate)
- Waveguides (Polycarbonate)



# DICING GUIDELINES

<u>Material</u>	<u>Minimum Street Width (um)</u>	<u>Maximum Wafer Thickness (um)</u>
Silicon/SiGe	25-35*	Contact Engineering
	40	400
	60	725
	80	890 *
	100	1020 *
GaAs / III-V	70	510
Sapphire	170	2000 *
Glass	170	2000 *
QFN/BGA	290	2000 *



## Production Min/Max Die Size Per Wafer

Minimum	0.500 mm (0.020") L or W/ die (> 100K die/wafer)
Maximum	1 die/wafer

\* Stacked Wafers

## Prototype/Engineering Min/Max Die Size Per Wafer

Minimum	L or W of die should be 2x of the wafer thickness
Example:	10 mil thick wafer shall have die size $\geq 20$ mils W and/or L

Consult engineering for all street widths below the standard minimum for the various thicknesses

Consult engineering for all wafer thicknesses above the stated limits

**Capability:** *Dicing wafers thinned to 15 – 20um*

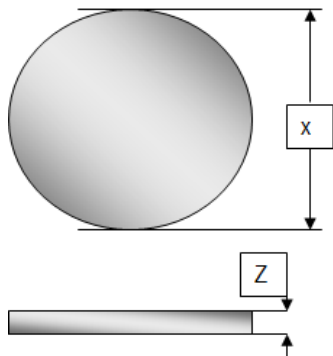
# DICE BEFORE GRIND GUIDELINES

<u>Material</u>	<u>Wafer Diameter</u>	<u>Max Final Thickness</u>	<u>Min Final Thickness</u>	<u>Minimum Die Size</u>	<u>Process Mode</u>	<u>Process Equipment</u>
Si / SiGe	8"	400 um	100 um	600 um	Full-Auto	Saw #9 Mini-Beast
Si / SiGe	3" - 6"	400 um	100 um	600 um	Semi-Auto Manual frame mount	B/G #1, #3
Si / SiGe	12"	400 um	100 um	600 um	Manual	Saw #6, Saw #8 B/G #3

\* Other Material types are also possible but require engineering review

# WAFER SCRIBE & BREAK GUIDELINES

<u>Material</u>	<u>Max Wafer Thickness</u>	<u>Minimum Die Size</u>	<u>Minimum Street Width **</u>	<u>Diamond Scribe Width</u>	<u>Crystalline Orientation</u>
Si	200 $\mu$ m	0.8 mm	20 $\mu$ m	5 $\mu$ m	100, 110
SiGe	200 $\mu$ m	0.8 mm	20 $\mu$ m	5 $\mu$ m	100, 110
InP	200 $\mu$ m	0.8 mm	20 $\mu$ m	5 $\mu$ m	100
GaAs	200 $\mu$ m	0.8 mm	20 $\mu$ m	5 $\mu$ m	100
Sapphire	125 $\mu$ m	1.5 mm	20 $\mu$ m	7 $\mu$ m	100
GaN	125 $\mu$ m	1.5 mm	20 $\mu$ m	7 $\mu$ m	100
SiC	125 $\mu$ m	1.5 mm	20 $\mu$ m	7 $\mu$ m	100, 110



- Thicknesses greater than the specified optimal conditions will be evaluated by Integra Engineering
- Street widths narrower than specified will be evaluated by Integra Engineering
- **Maximum wafer size is 5"**
- Irregular shapes and wafer fragments and portions can be processed

**\*\* Minimum Street Width results optimal without process structures in the Scribe street. Can be done with process structures but with yield impact.**

# DICING GUIDELINES

## Wafer Reticle Map Guidelines:

- Reference points or datum should be in DICING STREET JUNCTIONS or uniquely patterned fiducials. **Wafer dicing maps with datum at the center of the wafer or at the edge of the wafer are NOT accepted. Y coordinates of dicing locations are NOT accepted.**
- A cross pattern centered at the X-Y dicing street junctions are preferred.

## Wafer / Die Fiducial Guidelines:

- Vertical or horizontal features only. No circular features.
- High contrast materials such as Al or Au against semiconductor background.
- Needs to be in the exact location on each die.

## Other Requirements:

- Dicing lanes WITHOUT metals such as Sn, Pb, Ag, Cu, Au and Al are preferred. **Dicing lanes with Ni and Cr are not accepted.**
- All wafers must be capable of withstanding high water flow to the surface.
- Sensitive surfaces like MEMS or air bridges require Engineering evaluation

# AUTO PICK-N-PLATE/PLACE GUIDE

Descriptions	Material	Production/Standard
Max Input Wafer Size	All	12" / 300mm
Min Input Wafer Size	All	no minimum
Max Die Size	Si / SiGe	25 mm <sup>2</sup>
	GaAs / InP / III-V	25 mm <sup>2</sup>
Min Die Size	Si / SiGe	250 um <sup>2</sup> / 10 mils <sup>2</sup> (standard production)
	GaAs / InP / III-V	250 um <sup>2</sup> / 10 mils <sup>2</sup> (standard production)
Input Options	All	Film Frame
	All	Stretch Ring - requires transfer of wafer to film frame.
Output Options	All	Waffle Pack, Gel Pak, Film Frame, Tape & Reel
	All	Custom outputs are available upon request.
Die Surface	Si / SiGe / GaAs / InP / III-V	Bumped die can be plated as long as no bumps are present in the center of the die. Die with bumps in the center require custom pick collets that must be designed and ordered. <b><i>**Non-contact surfaces may require custom pick collets**</i></b>
Small Die Handling	<b>All die &lt; 20 mils<sup>2</sup> or thinner than 4 mils require engineering evaluation.</b> <b><i>**Gel Paks are recommended for die smaller than 20 mils.</i></b>	

**E-Map Format:** *SINF (Simplified Integrator Nested Format)* is Integra's standard format. All other formats require evaluation and/or conversion.

# AUTOMATED VISUAL INSPECTION

<u>Descriptions</u>	<u>Details</u>
Max Input Wafer Size	12"
Min Input Wafer Size	no minimum
Max Die Size	No maximum
Min Die Size	no minimum
Input Options	Film Frame - preferred Diced, Scribed and Broken, Unsawn Stretch Ring - requires transfer of wafer to film frame.
Inspection Magnification	20X, 50X, and 100X
Die Reference	"Golden Die" for defect detection.
Wafer Material	No limitations on wafer material
Defect Detection	~ 98% accurate in detection of defects 4 pixels in size or greater. ~ Minimum defect size detectable with accuracy is 8 um (~ 4 pixels). ~ Black and white inspection - does not detect color variation defects. ~ AVI is performed using standard commercial inspection criteria.

## ***E-Map Format:***

*SINF (Simplified INF) is Integra's standard format. All other formats require evaluation and/or conversion.*

*\*\*\*MIL-STD inspection cannot officially be performed on machine due to the MIL-STD spec. not defining automated inspection as a means of inspection. Wafers can be inspected to the MIL-STD on the machine with the caveat that it is an unofficial MIL inspection\*\*\**

# TAPE & REEL OF BARE DIE

## Design Rules:

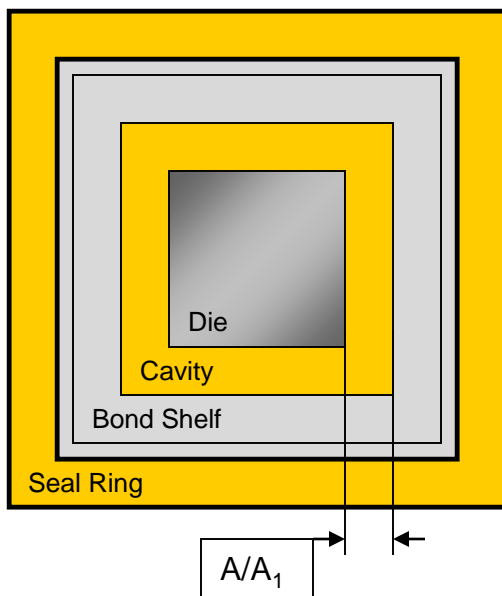
- Maximum wafer size: 300mm
- Minimum die size: 10 x 10 mils or 0.25 x 0.25 mm
- Minimum pocket pitch: 4 mm
- Minimum carrier tape width: 8 mm
- Maximum carrier tape width: 24 mm
- Bumped wafers should provide adequate clearance in the center of the die to allow a pick collet to pull vacuum
- Integra does not carry any stock of tape and reel materials
- Integra strongly recommends that all tape and reel materials be customer supplied
- Tape and reel material that is not customer supplied will be special ordered
- Typical lead times for special orders of tape are 6-8 weeks
- ***All inquiries outside of the stated design rules must be reviewed by Engineering***

- Die Attach Processes Available
  - Die attach using various conductive, non-conductive epoxy and DAF ( Die-Attach- Film)
  - Die attach of ceramic, hybrid packages using silver glass adhesive
  - Eutectic die attach using Au98/Si2 & Au80/Sn20 preforms
    - Integra will need to verify availability of preform sizes vs. die size
- Die Attach Capability:
  - Placement Accuracy
    - X/Y placement M
      - AT-6400 die bonder : +/- 5um @ 3sigma – Application dependent  
(+/- 10 um after die attach cure)
      - Data-con 2200 APM die bonder : +/- 10 um (+/- 15 um after die attach cure)
      - Manual die attach : +/- 75um
    - Theta rotation
      - MAT -6400 die bonder : +/- 0.5 degree
      - Data-con 2200 APM die bonder : +/- 1 degree
      - Manual die attach : +/- 5 degrees

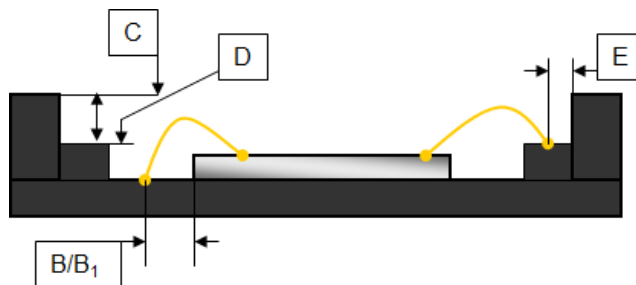


- **Die Attach Capability:**
  - Bond Line Thickness (BLT) control
    - Pressure and time control (for epoxy) : Target BLT +/- 5 um
    - Height or distance control ( for silver glass) : Target BLT +/- 7 um
    - Manual die attach, recommend the use of glass bead spacers for BLT control
  - Fillet and Epoxy coverage
    - Guarantee to meet or exceed MIL-STD-883, Methods 2010, 2012 and 2030.

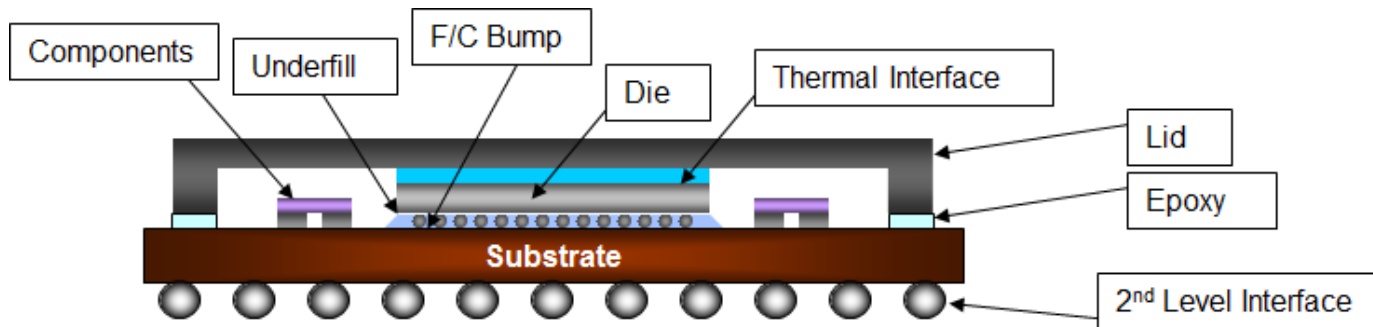
# DIE CLEARANCE CAVITY PACKAGES



Description	QMI-2569 Silver Glass	Epoxy	Eutectic AuSn, AuSi
[A] Die Clearance ( <i>Wedge Bond</i> )	min. 0.5 mm	min 0.5 mm	min 1.0 mm
[A <sub>1</sub> ] Die Clearance ( <i>Ball Bond</i> )	min. 0.5 mm	min 0.5 mm	min 1.0 mm
[B] Die Clearance w/down bonds ( <i>Wedge Bond</i> )	min 1.0 mm	min 0.75 mm	min 1.5 mm
[B <sub>1</sub> ] Die Placement w/down bonds ( <i>Ball Bond</i> )	min 1.0 mm	min 0.75 mm	min 1.5 mm
[C] Substrate Cavity Depth	< 2.0 mm	< 2.0 mm	< 2.0 mm
S/R height to bond shelf	< 1.0 mm	< 1.0 mm	< 1.0 mm
[D] Shelf Height	< 1.0 mm	< 1.0 mm	< 1.0 mm
Distance between top of die to pkg S/R	> 0.25 mm	> 0.25 mm	> 0.25 mm
[E] Clearance Between Pkg Lead Shelf and S/R	min. 0.75 mm	min. 0.75 mm	min. 0.75 mm
Preform Size	na	na	90% of Die Size



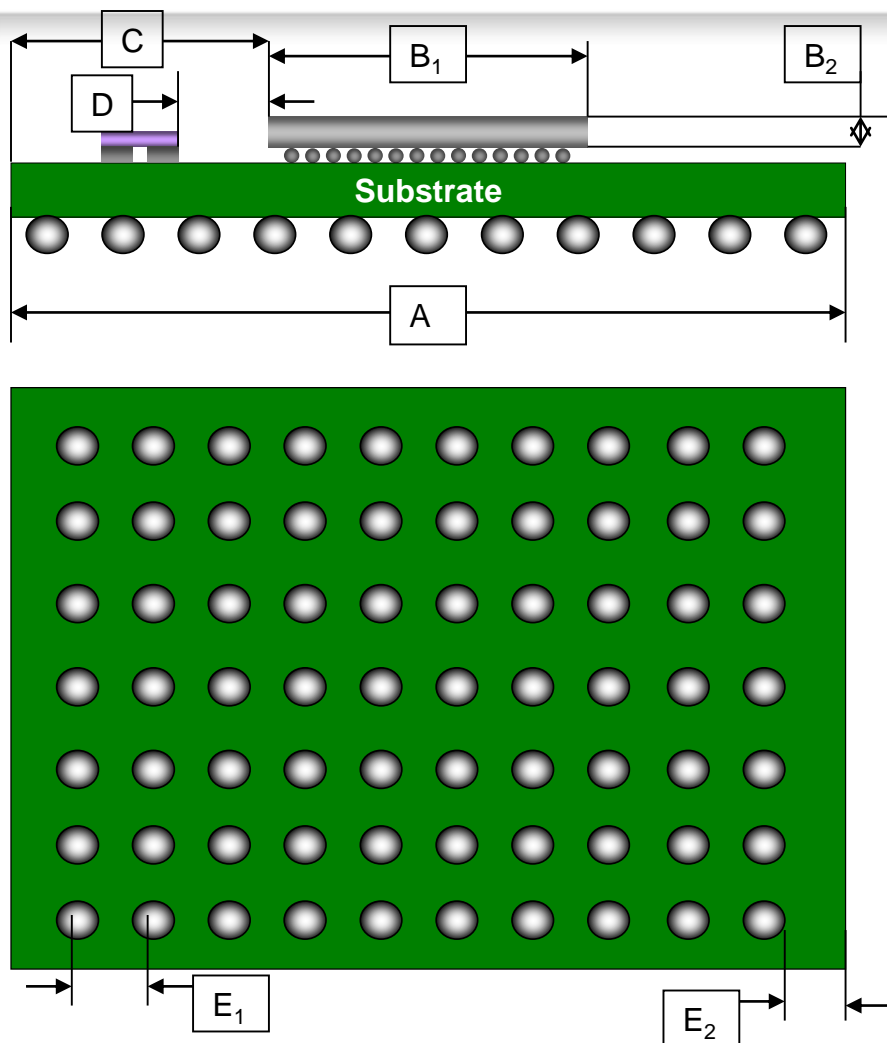
# FLIP CHIP ASSEMBLY GUIDE



Description	Options	Details / Experience
Substrate	Ceramic, Organic laminate, Flex Circuit, PCB	
Die	Si / SiGe / GaAs / Low K	I/O = 3 min to ~ X (bumps)
Lid / Heat Spreader	Ceramic / Aluminum / Cu Lid Stiffner / No lid	
Thermal Interface	Grease / Gel / Adhesive	
Underfill	Namics 8439-1 / Other(s)	
SMT Components	Resistors, Capacitors, etc. ( <i>high quantities are subject to review</i> )	Conductive epoxy / Solder
F/C Bump	Eutectic PbSn: 37/63	Pitch = 125um min
	SAC or other Pb-free	Pitch = 125um min
	High Pb: 90/10, 95/5, 97/3	Pitch = 125um min
2nd Level Interface	LGA	Pitch = 0.4 mm min
	BGA [Eutectic / Pb-free]	Pitch = 0.4 mm min
Substrate Metalization	Ceramic	Ni/Au
	Organic	Solder on Pad (SOP) / ENiG

RoHS  
Compliant

# FLIP CHIP ASSEMBLY GUIDE



Description	Production/Standard
[A] Substrate O.D.	50 mm Sq. Max.
[B <sub>1</sub> ] Die Size	0.5 to 30 mm
[B <sub>2</sub> ] Die Thickness	0.15 to 1.0 mm
[C] F/C to Edge Proximity	0.50 mm min.
[D] F/C to Component Proximity	0.50 mm nom.
[E <sub>1</sub> ] BGA/LGA Pitch	0.4 mm min.
[E <sub>2</sub> ] BGA/LGA Edge Proximity	0.4 mm min.

**Note:** Requirements outside of the production standards are subject to engineering review.

# Au STUD BUMP DESIGN GUIDE

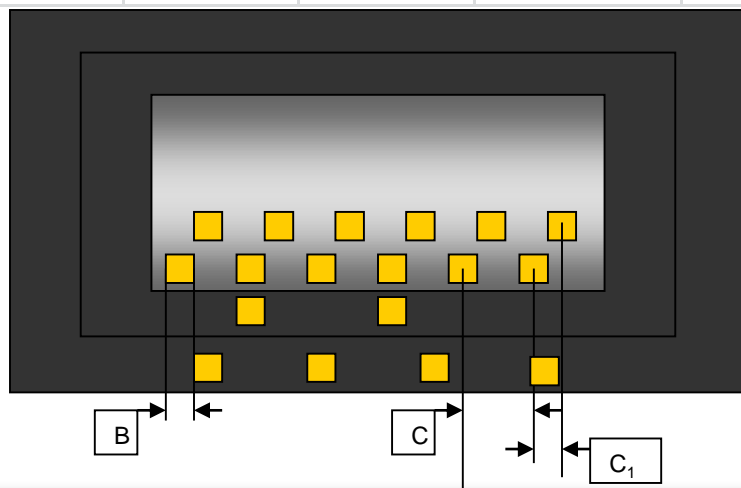
- Integra Stud bumping capability is limited as follows:
  - Equipment limitations do not allow us to stud bump the die while in wafer form.
  - Candidate wafers must first be cut into manageable sized tiles of multiple die from a minimum of 8 x 8 mm to a maximum of 50 x 50 mm
  - Individual die can be stud bumped if they are at least 5 x 5 mm, but special wire bond fixtures with clamps are required.
  - Stud bumping of individual die also requires engineering review to determine if the bumping pattern will work with the custom fixtures.
  - Stud bumping of individual die or wafer sections should typically be done on silicon that is at least 300um thick.
  - Minimum thickness of individual die for stud bumping must be at least 200um.
  - When stud bumping individual die the customer should expect 10 to 20 % yield loss due to handling during the stud bump and coin process.

# Au STUD BUMP DESIGN GUIDE

Wire Diameter (mils)	[B] Die Pad Opening (um)	[C] Inline Die Pad Pitch (um)	[C <sub>1</sub> ] Staggered Die Pad Pitch (um)	[D] Coined Stud Bump Height (um)	[D] Uncoined Stud Bump Height (um)	[B] Bond Pad Opening (um)	[C] Inline Bond Pad Pitch (um)	[C <sub>1</sub> ] Staggered Bond Pad Pitch (um)
0.60						> 30	> 37	18.5 / 37
0.70						> 35	> 40	20 / 40
0.80	> 45	> 55	27.5 / 55	20-30	40-50	> 40	> 50	25 / 50
1.00	> 60	> 70	35 / 70	30-40	55-65	> 50	> 60	30 / 60
1.25	> 75	> 90	45 / 90	45-55	70-80	> 70	> 80	40 / 80
Multiple stud bump stacks are subject to engineering review. Other wire diameter stud bumps are subject to engineering review.						<b>LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO acceptance.</b>		

Production

Prototype



# WIRE BOND DESIGN GUIDE

## Al Wedge Bond

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)
0.70	> 0.3 < 8	> 55	> 65	37.5 / 75	> 100	> 50	> 60	35/70	>80
1.00	> 0.3 < 10	> 70	> 85	43 / 85	> 100	> 65	> 80	40/80	>90
1.25	> 0.5 < 14	> 80	> 95	50 / 100	> 125	> 75	> 85	45/90	> 100
1.50***	> 0.5 < 14	> 100	> 140	70 / 140	> 200	>90	>120	60/120	>150
2.00***	> 0.5 < 14	> 120	> 140	70 / 140	> 200	>100	>130	65/130	>150

[F] Loop heights dependent on die placement, pkg style & wire size

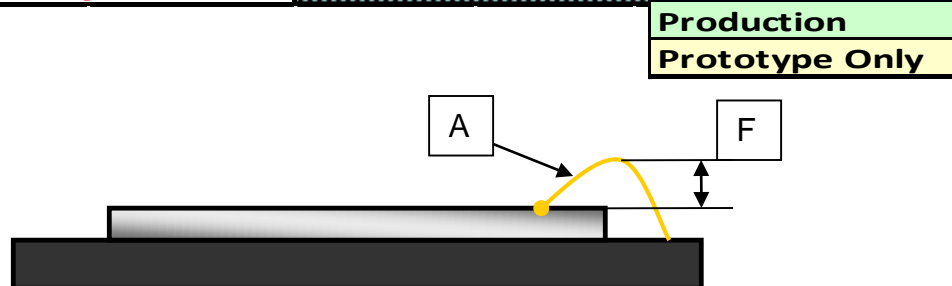
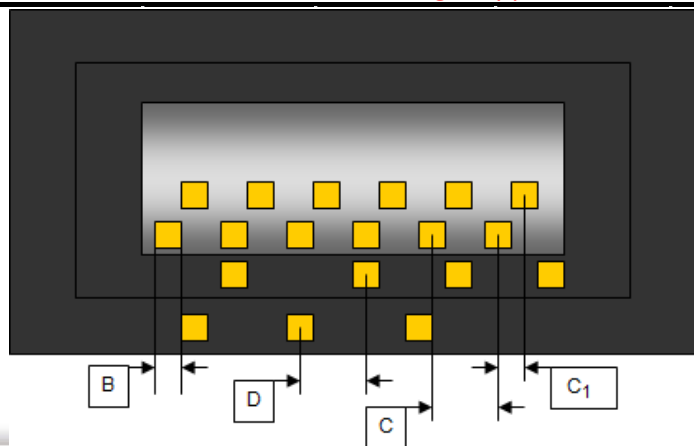
\* Minimum Wire Lengths Subject to Die Edge Clearance.

\*\* Shorter or Longer Lengths Subject to Engineering Review

\*\*\* 1.50 & 2.00 mil wire available with special wire order.

# Maximum Wire Length applies to Non Molded Packages

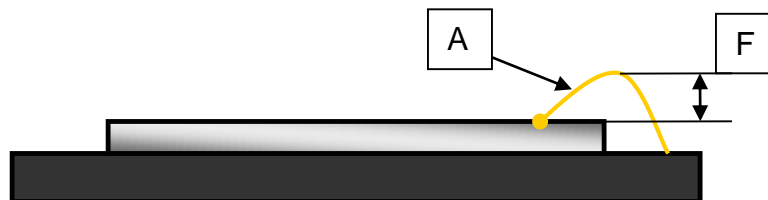
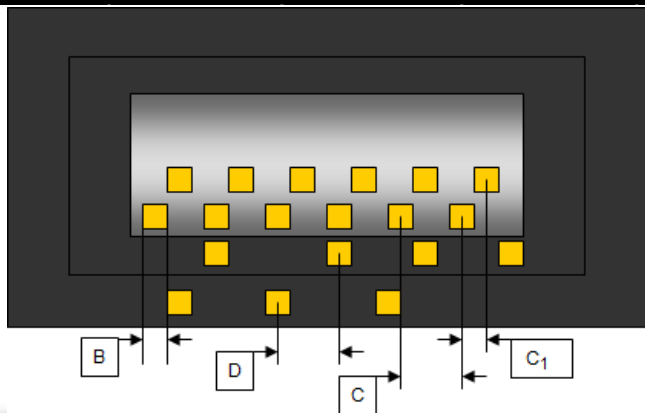
**LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO acceptance.**



# WIRE BOND DESIGN GUIDE

## Au Wedge Bond – Non Molded Packages

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (um)	[C] Die Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)
0.70	> 0.3 < 7	> 55	> 65	37.5 / 75	> 100	> 50	> 60	35/70	> 80
1.00	> 0.3 < 9	> 70	> 85	43 / 85	> 100	> 65	> 80	40/80	> 90
1.25	> 0.5 < 10	> 80	> 95	50 / 100	> 125	> 75	> 85	45/90	> 100
1.50***	> 0.5 < 10	> 100	> 140	70 / 140	> 200	> 90	> 120	60/120	> 150
2.00***	> 0.5 < 10	> 120	> 140	70 / 140	> 200	> 100	> 130	65/130	> 175
[F] Loop heights dependent on die placement, pkg style & wire size * Minimum Wire Lengths Subject to Die Edge Clearance. ** Shorter or Longer Lengths Subject to Engineering Review *** 1.50 & 2.00 mil wire available with special wire order.						<b>LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO acceptance.</b>			
h applies to Non Molded Packages						<div>Production</div> <div>Prototype Only</div>			

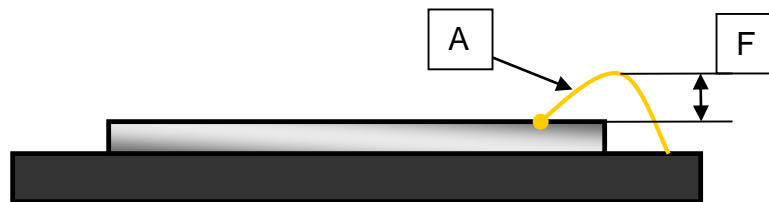
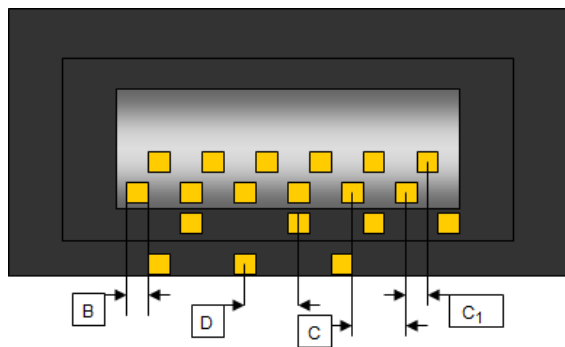




# WIRE BOND DESIGN GUIDE

## Au Ball Bond

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C1] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)	[A] Wire Length (mm)	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C1] Bond Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)
0.50						> 0.2 < 4.0	> 30	> 38	19/38	> 45
0.60	> 0.2 < 3.2	> 36	> 44	22/44	> 75	> 0.2 < 4.0	> 33	> 41	20.5/41	> 55
0.70	> 0.2 < 3.7	> 40	> 48	24/48	> 75	> 0.2 < 4.5	> 36	> 44	22/44	> 65
0.80	> 0.2 < 5.0	> 43	> 53	26.5/53	> 75	> 0.2 < 6.0	> 40	> 48	24/48	> 70
0.90	> 0.2 < 5.0	> 45	> 55	28 / 55	> 75	> 0.2 < 6.5	> 43	> 51	25.5/51	> 70
1.00	> 0.2 < 6.5	> 50	> 60	30 / 60	> 80	> 0.2 < 7.0	> 45	> 55	28.5/55	> 75
1.25	> 0.5 < 7.0	> 65	> 80	40 / 80	> 100	> 0.5 < 8.0	> 60	> 70	35/70	> 90
1.50***	> 0.5 < 7.0	> 75	> 100	60 / 120	> 120	> 0.5 < 8.0	> 70	> 90	45/90	> 100
2.00***	> 0.5 < 7.0	> 100	> 120	70 / 140	> 150	> 0.5 < 8.0	> 85	> 100	50/100	> 120
[F] Loop heights dependent on die placement, pkg style & wire size * Minimum Wire Lengths Subject to Die Edge Clearance. ** Shorter or Longer Lengths Subject to Engineering Review *** 1.50 & 2.00 mil wire available with special wire order. # Maximum Wire Length applies to Non Molded Packages						<b>LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO acceptance.</b>				
						<div>Production</div> <div>Prototype Only</div>				



# WIRE BOND DESIGN GUIDE

## Au Ball Bond – Pyramid / Stair Case Stacked Die

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min Lead Pitch Flat Area (um)	[E] Stacked Die Height (mm)	[F] Die Thickness (mils)	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Bond Pad Staggered Pitch (um)	[D] Substrate min Lead Pitch Flat Area (um)	[E] Stacked Die Height (mm)	[F] Die Thickness (mils)
0.50								> 30	> 38	19/38	> 45	< 2.8	> 2.0 < 35
0.60	> 0.2 < 3.2	> 36	> 43	20/40	> 75	< 2.3	> 3.0 < 20	> 33	> 41	20.5/41	> 55	< 2.8	> 2.0 < 35
0.70	> 0.2 < 3.2	> 40	> 48	22.5/45	> 75	< 2.3	> 3.0 < 20	> 36	> 44	22/44	> 65	< 2.8	> 2.0 < 35
0.80	> 0.2 < 4.5	> 43	> 53	26.5/53	> 75	< 2.3	> 3.0 < 20	> 40	> 48	24/48	> 70	< 2.8	> 2.0 < 35
0.90	> 0.2 < 4.5	> 45	> 55	28 / 55	> 75	< 2.3	> 3.0 < 20	> 43	> 51	25.5/51	> 70	< 2.8	> 2.0 < 35
1.00	> 0.2 < 6.0	> 50	> 60	30 / 60	> 80	< 2.3	> 3.0 < 20	> 45	> 55	28.5/55	> 75	< 2.8	> 2.0 < 35
1.25	> 0.5 < 7.0	> 65	> 80	40 / 80	> 100	< 2.3	> 3.0 < 20	> 60	> 70	35/70	> 90	< 2.8	> 2.0 < 35
1.50***	> 0.5 < 7.0	> 75	> 100	60 / 120	> 120	< 2.3	> 3.0 < 20	> 70	> 90	45/90	> 100	< 2.8	> 2.0 < 35
2.00***	> 0.5 < 7.0	> 100	> 120	70 / 140	> 150	< 2.3	> 3.0 < 20	> 85	> 100	50/100	> 120	< 2.8	> 2.0 < 35

[G] Loop heights are dependent on die placement and package style

\* Minimum Wire Lengths Subject to Die Edge Clearance.

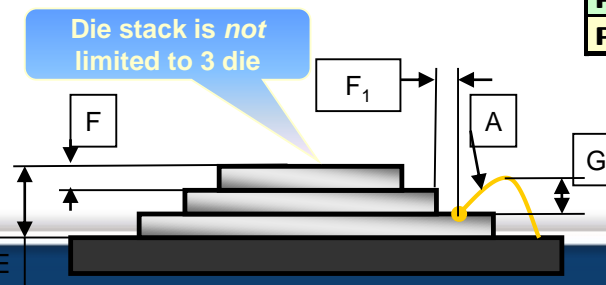
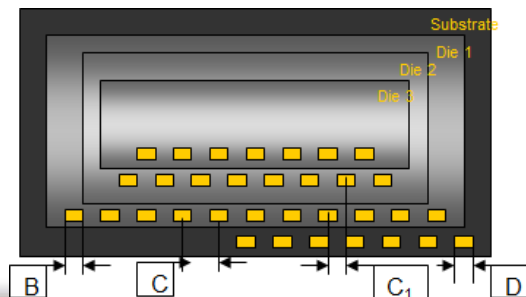
\*\* Shorter or Longer Lengths Subject to Engineering Review

Available with special wire order.

Applies to Non Molded Packages

[F<sub>1</sub>] If die is > 0.500mm (20 mils) thick, the clearance from the die edge to the die pad area of any lower die in a “pyramid-type die stack” must be > 0.750mm.

[F<sub>1</sub>] If the die is < 0.500mm (20 mils) thick, the clearance from the die edge to the die pad area of any lower die in a “pyramid-type die stack” must be > 0.400mm.



**Production**  
**Prototype Only**

# WIRE BOND DESIGN GUIDE

## Au Ball Bond – Stacked Die (same size die)

Wire Diameter (mils)	[A] Die 1 Wire Length (mm) #	[B] Die to Bond Shelf with / without down bonds (mm)	[C] Cavity Wall Height (mm)	[D <sub>1</sub> ] Die 1 Loop Height (mm)	[D <sub>2</sub> ] Die 2 Loop Height (mm)	[E] Die 2 Wire Length (mm)	[F <sub>1,2</sub> ] From bond to cavity wall (mm)	[G] Spacer Thickness (mm)
0.60	> 0.2 < 3.2	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 3.2	0.500	> 0.200 < 0.500
0.70	> 0.2 < 3.2	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 3.2	0.500	> 0.200 < 0.500
0.80	> 0.2 < 4.5	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 4.5	0.500	> 0.200 < 0.500
0.90	> 0.2 < 4.5	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 4.5	0.500	> 0.200 < 0.500
1.00	> 0.2 < 6.0	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 6.0	0.500	> 0.200 < 0.500
1.25	> 0.5 < 7.0	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.5 < 7.0	0.500	> 0.200 < 0.500
1.50***	> 0.5 < 7.0	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.5 < 7.0	0.500	> 0.200 < 0.500
2.00***	> 0.5 < 7.0	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.5 < 7.0	0.500	> 0.200 < 0.500

[D<sub>1,2</sub>] Loop heights are dependent on die placement, package style and die spacer thickness.

\* Minimum Wire Lengths Subject to Die Edge Clearance.

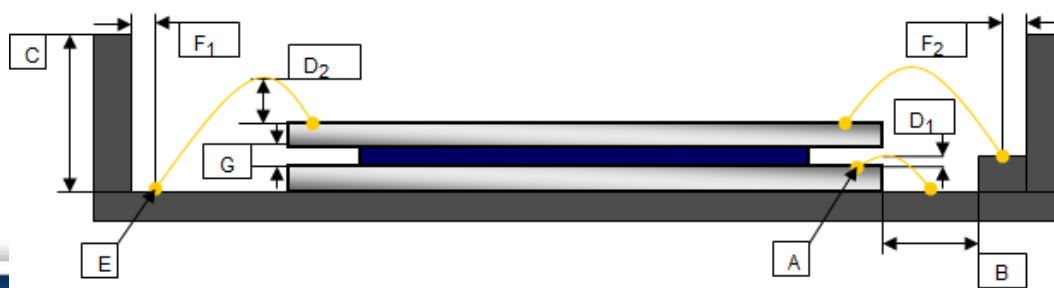
\*\* Shorter or Longer Lengths Subject to Engineering Review

\*\*\* 1.50 & 2.00 mil wire available with special wire order.

# Maximum Wire Length applies to Non Molded Packages

**LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO**

**Special Note: Die Stacks are not limited to two, but are subject to CORWIL Engineering Review**



# WIRE BOND DESIGN GUIDE

## Molded QFN / CSBGA Wire Bond (Au Ball)

Wire Diameter (mils)	[A] Wire Length (mm)	[B] Bond Pad Opening (um)	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Die/Pkg Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)	[E] Down Bond (mm)	[B] Bond Pad Opening	[C] Bond Pad Pitch (um)	[C <sub>1</sub> ] Die/Pkg Pad Staggered Pitch (um)	[D] Substrate min. Lead Pitch (um)
0.80	>0.5 <4.0	>43	>53	26.5 / 53	>75	>0.38	>40	>50	23/45	>45
0.90	>0.5 <4.0	>45	>55	28 / 55	>75	>0.38	>42	>52	25/50	>50
1.00	>0.5 <4.0	>50	>60	30 / 60	>80	>0.38	>45	>55	28/55	>55
1.25	>0.5 <4.0	>65	>80	40 / 80	>100	>0.38	>60	>70	35/70	>60
1.50***	>0.5 <4.0	>75	>100	60 / 120	>120	>0.38	>70	>90	45/90	>75
2.00***	>0.5 <4.0	>100	>120	70 / 140	>150	>0.38	>85	>100	50/100	85

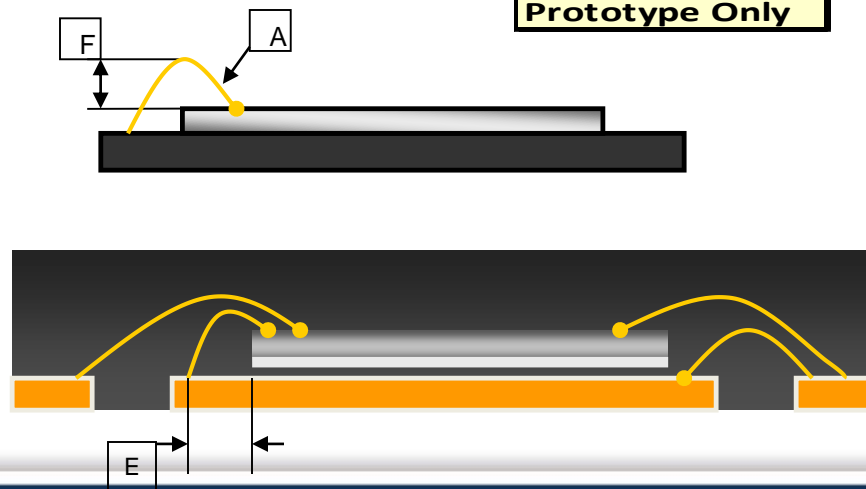
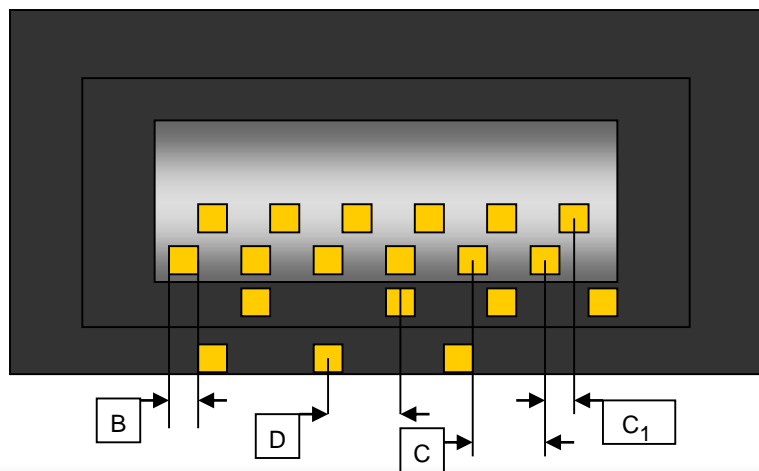
[F] Loop heights are dependent on die placement and package style

\* Minimum Wire Lengths Subject to Die Edge Clearance.

\*\* Shorter or Longer Lengths Subject to Engineering Review

\*\*\* 1.50 & 2.00 mil wire available with special wire order.

**LIMITED RUNS ONLY. All builds using prototype rules require engineering review before PO**



# CORNER PAD DESIGN RULE

## Minimum Bond Pad Size, Pitch, Spacing & Clearances For In-Line Pad Devices

### In-Line Pad Rules (Refer to Figure 1 on the following page)

	<u>Description</u>	<u>(um)</u>	<u>Corner Pad Size (um)</u>
A	Min. Bond Pad Pitch	55	
E	Min. Bond Pad Size (Top Metal, width)	53	76
F	Min. Bond Pad Size (height)	76	76
C	Min. Bond Pad Opening width	49	72
D	Min. Bond Pad Opening height	72	72
G	Min. Passivation enclosure of pads / side	2	
H	Pad to Pad Minimum Spacing	2	

### Special Corner Pad Rules \*

	Bond pads / side of the Die	<= 11	12-25	>= 26
	# of corner pads recommended	0	1	4
M	Corner Dead Zone (measured from the corner)	60um	100um	200um
L	Corner Pad Pitch	0	115um	115um

\* Corner pads [are](#) defined as the pads closest to the corners of the die  
 Corner pad quantities vary by the number of bond pads per side of the die  
 Higher pin count products require more corner pads with wider spaces due to bond wire overlap issues

# CORNER PAD DESIGN RULE

## Minimum Bond Pad Size, Pitch, Spacing & Clearances For In-Line Pad Devices

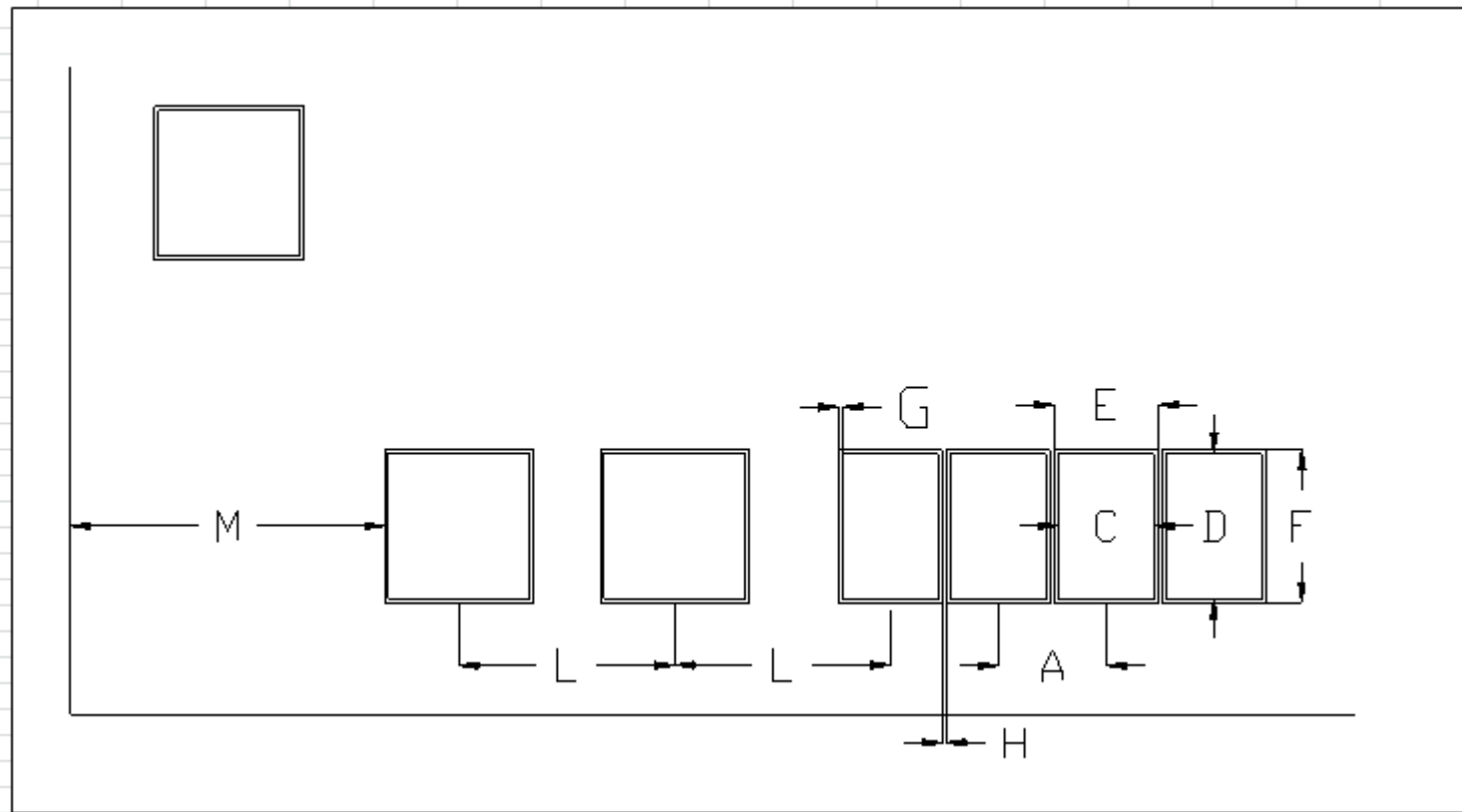
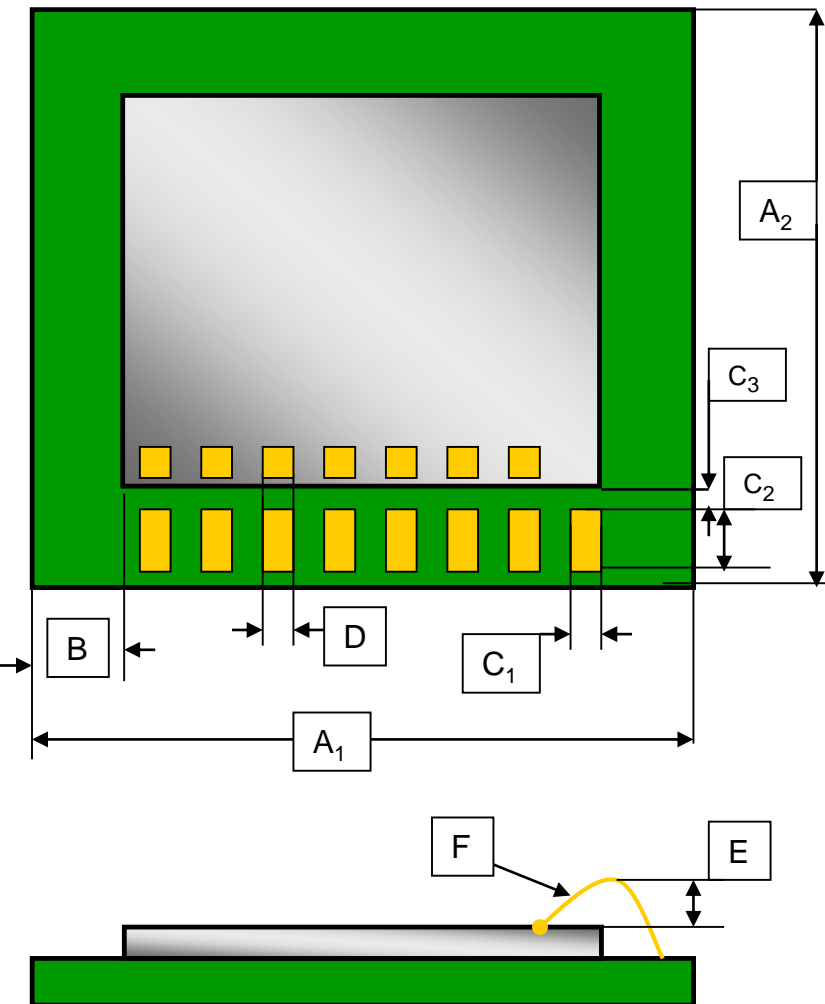


Figure 1

# CHIP-ON-BOARD (COB) GUIDE

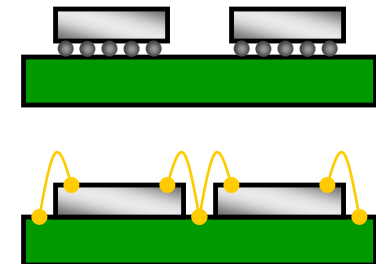
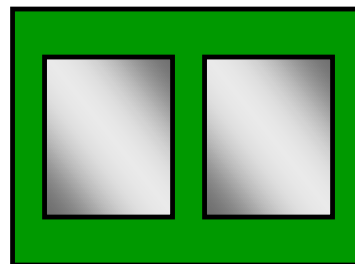


Description	Production/Standard	Prototype/Special
[A <sub>1</sub> ] PCB O.D.	2.5" = Max, for AU ball bond	Die position dependent
[A <sub>2</sub> ] PCB O.D.	2.5" = Max, for AU ball bond	Die position dependent
[B] Die Paddle Size	0.010"/side	0.005"/side
[C <sub>1</sub> ] PCB Pad	> 0.005"	> 0.003"
[C <sub>2</sub> ] PCB Pad	> 0.010"	> 0.004"
[C <sub>3</sub> ] PCB Pad to Die Edge	Die 2-12 mils thick : 0.014" (350um) min Die 12 mils > thick: 0.020" (500um) min	
[D] Die Pad Opening	Refer to pp 22-25	Refer to pp 22-25
Die Placement	Refer to page 17	Refer to page 17
[E] Loop Height	Refer to pp 22-25	Refer to pp 22-25
[F] Wire Length	Refer to pp 22-25	Refer to pp 22-25

## Plating Standards for Copper Clad PCB

- See next page for plating details

Larger substrate may be possible with Gold or Aluminum Wedge bond



# COB, PCB PACKAGE LEAD METALLIZATION FOR GOLD WIRE BOND

## ENEPIG

	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	118.1	275.6	3.000	7.000
Electro less Palladium	5.9	13.8	0.150	0.350
Immersion Gold	3.9	11.8	0.100	0.300

## ENIG + Wire Bondable Gold

	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	150	250	3.810	6.350
Immersion Gold	15	30	0.381	0.762

- Immersion Silver – subject to “daisy chain” lead to lead wire bond test.
- Any new COB / PCB with SMT attach – subject to “daisy chain” lead to lead wire bond test.



# COB, PCB PACKAGE LEAD METALLIZATION FOR ALUMINUM WIRE BOND

## ENEPIG

	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	118.1	275.6	3.000	7.000
Electro less Palladium	5.9	13.8	0.150	0.350
Immersion Gold	3.9	11.8	0.100	0.300

## ENIG + Wire Bondable Gold

	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	150	250	3.810	6.350
Immersion Gold	3	30	0.076	0.762

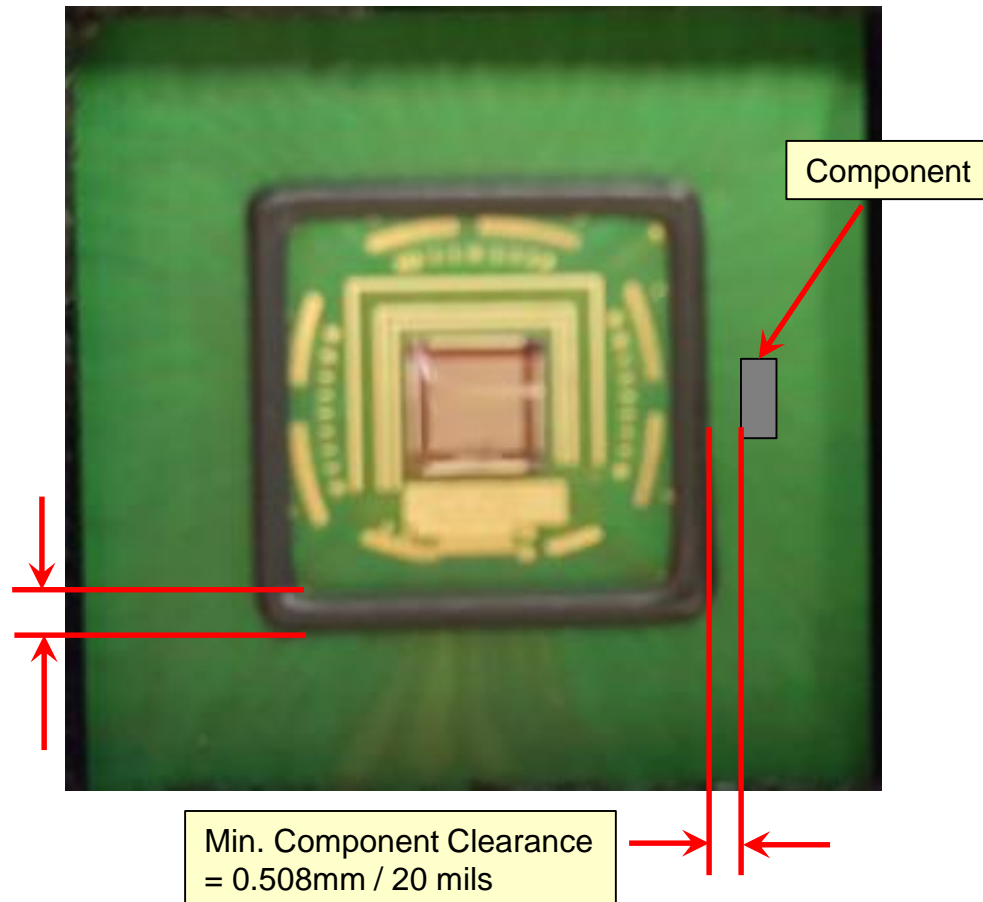
- Immersion Silver – subject to “daisy chain” lead to lead wire bond test.
- Any new COB / PCB with SMT attach – subject to “daisy chain” lead to lead wire bond test.

# DAM-N-FILL/GLOBTOP GUIDE

## *Minimum Dam Width and Component Clearance*

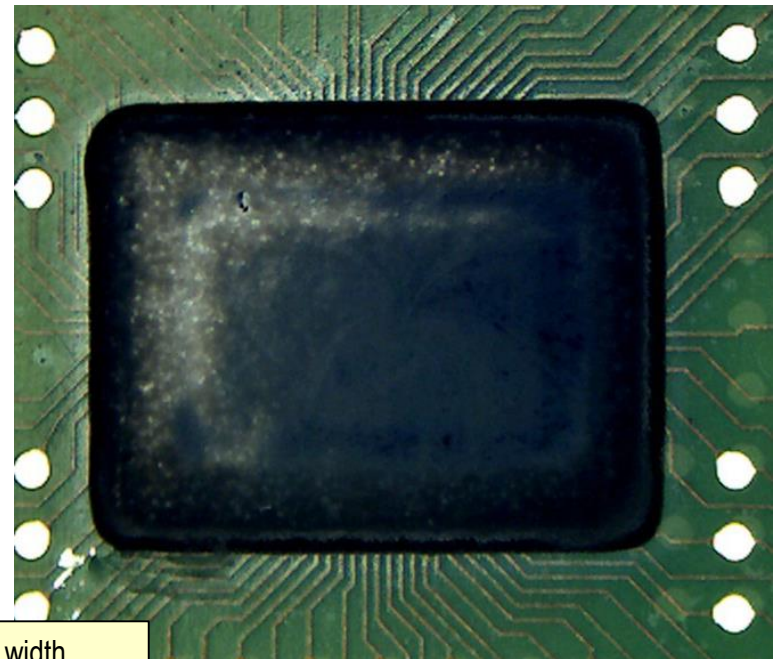
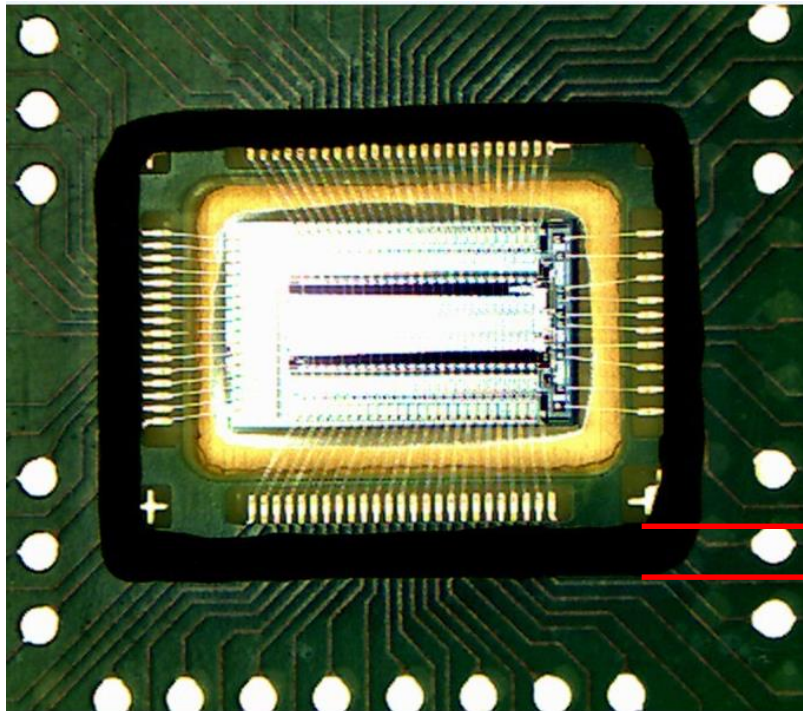
Min. dam width  
= 0.457mm / 18 mils

Std. dam width  
= 0.635mm / 25 mils



# DAM-N-FILL/GLOBTOP GUIDE

## *Minimum Dam Width and Placement Tolerance*



Min. dam width  
= 0.457mm / 18 mils

Std. dam width  
= 0.635mm / 25 mils

# QFN/DFN PACKAGE GUIDE

**RoHS  
Compliant**

*Mold Type : FICO, Multi-plunger, Vacuum Assisted*

**MSL rating : MSL- 1 (3x3 – 5x5 only) / MSL -3**

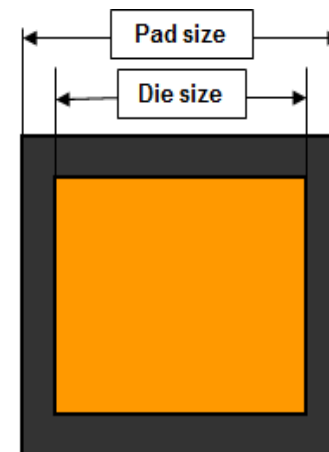
Assembly Materials:

*MSL-1 feature Lead frame design*

*84-1LMI Die attach epoxy (std.) / Hysol QMI-529HT Die Attach epoxy (Alt.)*

*Sumitomo EME-G770HCD Molding compound*

Open Toolled Lead frames Available



Pkg. size (mm)	Lead Count	CORWIL P/N	Paddle Size (mm)	Lead Pitch (mm)	Max. die size, No-downbonds (mm)	Max. die size, With downbonds (mm)	Lead Frame Vendor DWG. No.	# of units per LF	JEDEC MO-220 Ref.
3X3	16	LFM-0024	1.85 X 1.85	0.50	1.35 X 1.35	0.85 X 0.85	QPL-16-QFN-0092 Rv. 1	884	VEED-4/ WEED-4
4X4	20	LFM-0044	2.9 X 2.9	0.50	2.4 X 2.4	1.9 X 1.9	QPL-20-QFN-0038 Rv. 0	520	VGGD-5/ WGGD-5
5X5	20	LFM-0045	3.6 X 3.6	0.65	3.1 X 3.1	2.6 X 2.6	QPL-20-QFN-0040 Rv. 0	352	-
5X5	28	LFM-0042	3.9 X 3.9	0.50	3.4 X 3.4	2.9 X 2.9	QPL-28-QFN-0060 Rv. 2	352	VHHD-4/ WHHD-4
5X5	32	LFM-0023A	4.05 X 4.05	0.50	3.55 X 3.55	3.05 X 3.05	QPL-32-QFN-0071 Rv. 2	352	VHHD-4/ WHHD-4
5X5	32	LFM-0037	3.80 X 3.80	0.50	3.30 X 3.30	2.80 X 2.80	QPL-32-QFN-0081 Rv. 0	352	VHHD-5/ WHHD-5
6X6	40	LFM-0028	4.80 X 4.80	0.50	4.30 X 4.30	3.8 X 3.8	QPL-40-QFN-0074 Rv. 1	234	VJJD-4/ WJJD-4
7X7	48	LFM-0025	5.574 X 5.574	0.50	5.074 X 5.074	4.574 X 4.574	QPL-48-QFN-0062 Rv. 4	176	VKKD-6/ WKD-6
8X8	52	LFM-0026	5.95 X 5.95	0.50	5.45 X 5.45	4.95 X 4.95	QPL-52-QFN-0002 Rv. 0	140	VLLD-6/ WLLD-6
8X8	56	LFM-0032A	6.9 X 6.9	0.50	6.4 X 6.4	5.9 X 5.9	QPL-56-QFN-0029 Rv. 2	140	VLLD-5/ WLLD-5
9X9	64	LFM-0047	7.45 X 7.45	0.50	6.95 X 6.95	6.45 X 6.45	QPL-64-QFN-0018 Rv. 0	96	VMMD-3 /WMMD-3
10x10	68	LFM-0035	7.95 X 7.95	0.50	7.45 X 7.45	6.95 X 6.95	QPL-68-QFN-0013 Rv. 0	80	VNND-2 /WNND-2
10X10	88	LFM-0043	8.6 X 8.6	0.40	8.1 X 8.1	7.6 X 7.6	QPL-88-QFN-0010 Rv. 5	80	-

# QFN/DFN PACKAGE GUIDE

**RoHS  
Compliant**

## Custom Tooled Lead frames Available

*Mold Type : FICO, Multi-plunger, Vacuum Assisted*

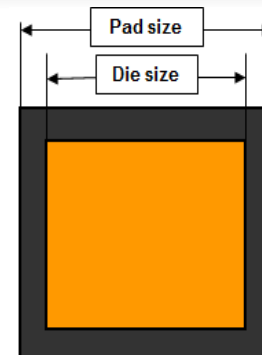
**MSL rating : MSL- 1 (3x3 – 5x5 only) / MSL -3**

### Assembly Materials

*MSL-1 feature Lead frame design*

*84-1LMI Die attach epoxy (std.) / Hysol QMI-529HT Die Attach epoxy (Alt.)*

*Dam: Hysol FP4451, Fill: Hysol FP4450*

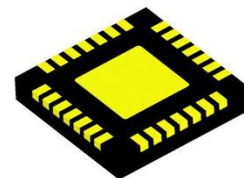


Pkg. size (mm)	Lead Count	Integra P/N	Paddle Size (mm)	Lead Pitch (mm)	Max. die size, No-downbonds (mm)	Max. die size, With downbonds (mm)	Lead Frame Vendor DWG. No.	# of units per LF	JEDEC MO-220 Ref.	COMMENTS
4x4	16	LFM-0033	2.8 X 2.8	0.8	-	-	QPL-16-QFN-0101 Rv. 0	520	-	some leads connected to DAP
5X6	8	LFM-0040	4.45 X 3.81	1.27	-	-	QPL-08-DFN-0109 Rv. 1	288	-	
6x6	33	LFM-0031	4.75 X 4.75	0.5	-	-	QPL-33-QFN-0001 Rv. 0	234	-	de-populated leads
6X6	44	LFM-0029	4.90 X 4.90	0.40	-	-	QPL-44-QFN-0005 Rv. 1	234	-	de-populated leads
7X7	48	LFM-0039	5.574 X 5.574	0.50	-	-	QPL-48-QFN-0070 Rv. 2	176	-	fully ni/pd/au plated
7X8	48	LFM-0027	5.50 X 6.50	0.60/0.442	-	-	QPL-48-QFN-0066 Rv. 0	154	-	
12x12	64	LFM-0038	10 X 10	0.65	9.5 X 9.50	9.00 X 9.00	QPL-64-QFN-0016 Rev. 0	56	-	de-populated leads

# QFN PACKAGE DESIGN GUIDE

## FICO, Multi- Plunger Mold, Vacuum Assisted Mold – MSL1 up to 5x5mm

	<u>OPTION - 1</u>	<u>OPTION - 2</u>
TOTAL PACKAGE THICKNESS, (mm)	1.00	0.80
MOLD CAP THICKNESS, (mm)	0.80	0.60
LEAD FRAME THICKNESS, (mm)	0.203	0.203
MAX. DIE THICKNESS, Single-non-stack (mils)	15.00	10.00
STACK DIE, Number of die stack	2 - 3	2 - 3



**Note:** Consult engineering for maximum individual die thickness on stacked-die efforts

### Leadframe Material & Plating:

**Leadframe Material = Cu C7025** (0.20 mm thick)

#### Leadframe Plating

- Ni/Pd/Au (lead free) ~
  - Ni = 20-80 micron inches
  - Pd= 0.8 – 6.0 micro inches
  - Au = 0.12 – 0.6 micro inches  
→ 0.7 micro inch minimum on newer designs.

### Integra QFN STD BOM:

#### Die Attach Epoxy:

- Ablebond 84-1LMI (std.)
- Hysol, QMI-529HT (for high thermal conductivity)
- *Other materials available upon request*

#### Gold Wire:

- 0.8–1.3 mils depending on die BPP/BPO

#### Molding Compound:

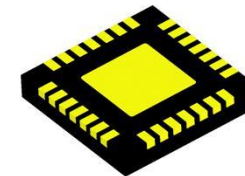
- Sumitomo EME G770HCD (green)



# QFN PACKAGE DESIGN GUIDE

## Dam and Fill Encapsulation – MSL3

	<u>OPTION - 1</u>	<u>Option - 2</u>	
TOTAL PACKAGE THICKNESS, (mm)	1.00	0.55	
MOLD CAP THICKNESS, (mm)	0.80	0.35	
LEAD FRAME THICKNESS, (mm)	0.203	0.203	
MAX. DIE THICKNESS, Single-non-stack (mils)	15.00	8.0	
STACK DIE, Number of die stack, See note *	2 - 3	1	



**Note:** Consult engineering for maximum individual die thickness on stacked-die efforts.

## Leadframe Material & Plating:

Leadframe Material = Cu C7025 (0.20 mm thick)

### Leadframe Plating

- Ni/Pd/Au (lead free) ~
  - Ni = 20-80u"
  - Pd= 0.8 – 6.0u"
  - Au = 0.12 – 0.6u"

## Integra QFN STD BOM:

### Die Attach Epoxy:

- Ablebond 84-1LMI conductive (Pb-free)
- Ablebond 84-3 non-conductive (Pb-free)
- Die Attach Film (DAF) – non-conductive
- Other materials available upon request

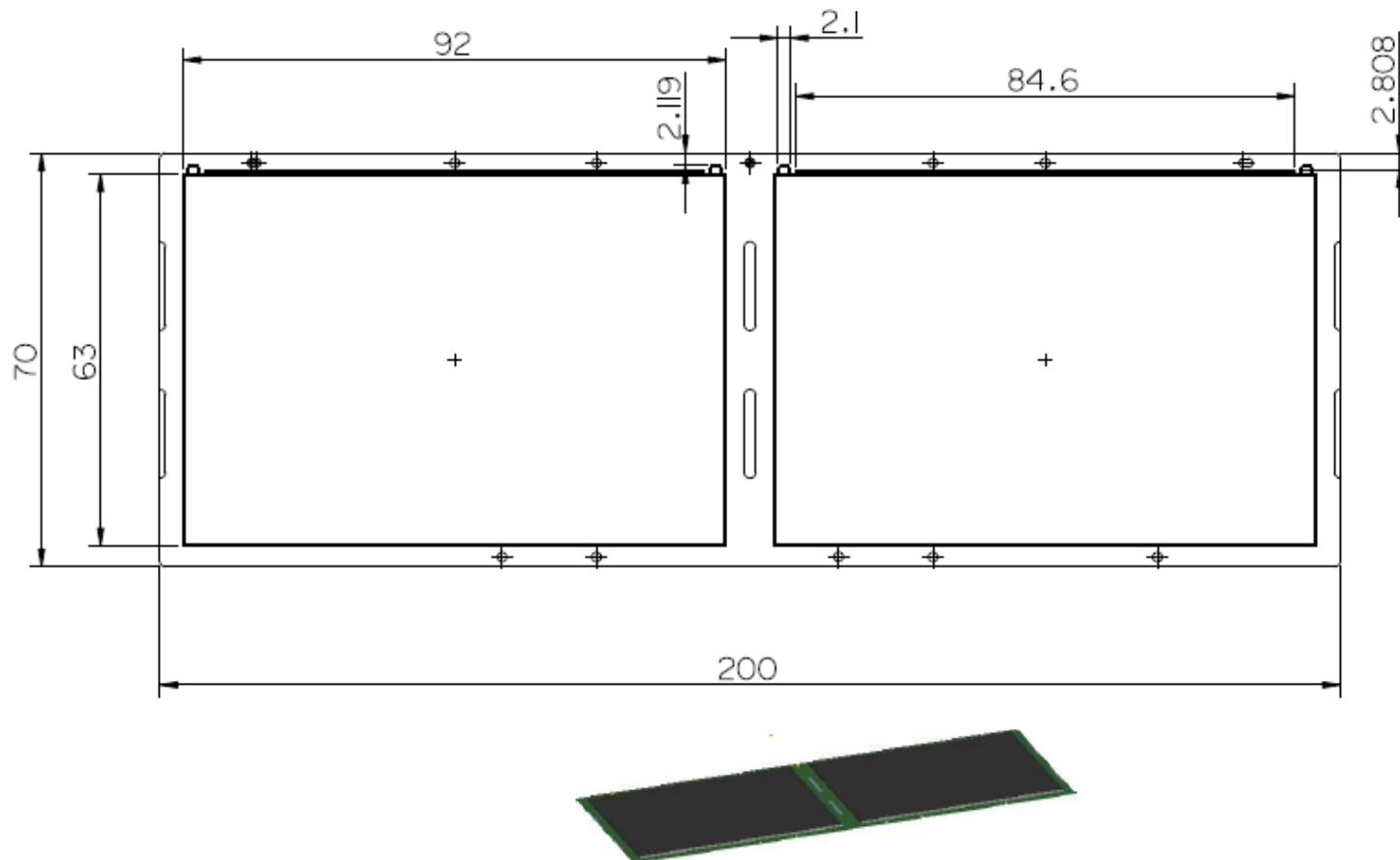
### Gold Wire:

- 0.8–1.3 mils depending on die BPP/BPO

### Dam / Fill Epoxies:

- Hysol HP4450 / HP4451

## QFN / CSBGA Strip Outline – Fico Mold



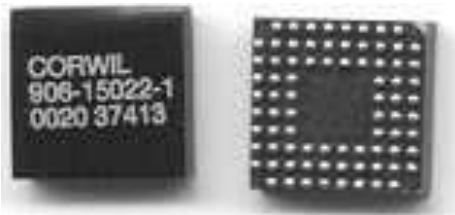
AutoCAD  
drawing also  
available

All dimensions in  
mm



# MAP BGA GUIDELINE

MAP / Saw Singulated Ball Grid Array Options Available								
Package Size (mm)	BGA Pitch (mm)	Standard Solder Ball Size (mm / <i>mils</i> )	Maximum Ball Count	Substrate Thickness (mm)	Mold Cap Thickness Options (mm)	Total Pkg Thickness (mm)	Available Solder Ball	
							Non-Pb Free	Pb-free
3x3 - 23x23  Up to 35x35 Possible but not ideal	0.40	0.25 / 10	Calculated Based on pkg size and ball pad pitch	0.15 - 0.80 Mold system limite	0.60, 0.80, 1.0 and 1.25	~1.00 to ~2.05	Sn/Pb - 63/37	SAC305  (Sn96.5/Ag3 /Cu0.5)
	0.50	0.304 / 12						
	0.80	0.40 - 0.50 / 16-20						SAC405  (Sn95.5/Ag4 /Cu0.5)
	1.00	0.50 - 0.635 / 20 - 25						



*Other Pb-free options  
available upon request.*

# DESIGN/PRODUCT DISCLAIMER

*The Integra Assembly Guide is a summary of process capabilities for Integra services. Integra does not guarantee form, fit, or function of designed customer product. Integra provides assembly services per customer provided specifications.*

# THANK YOU

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