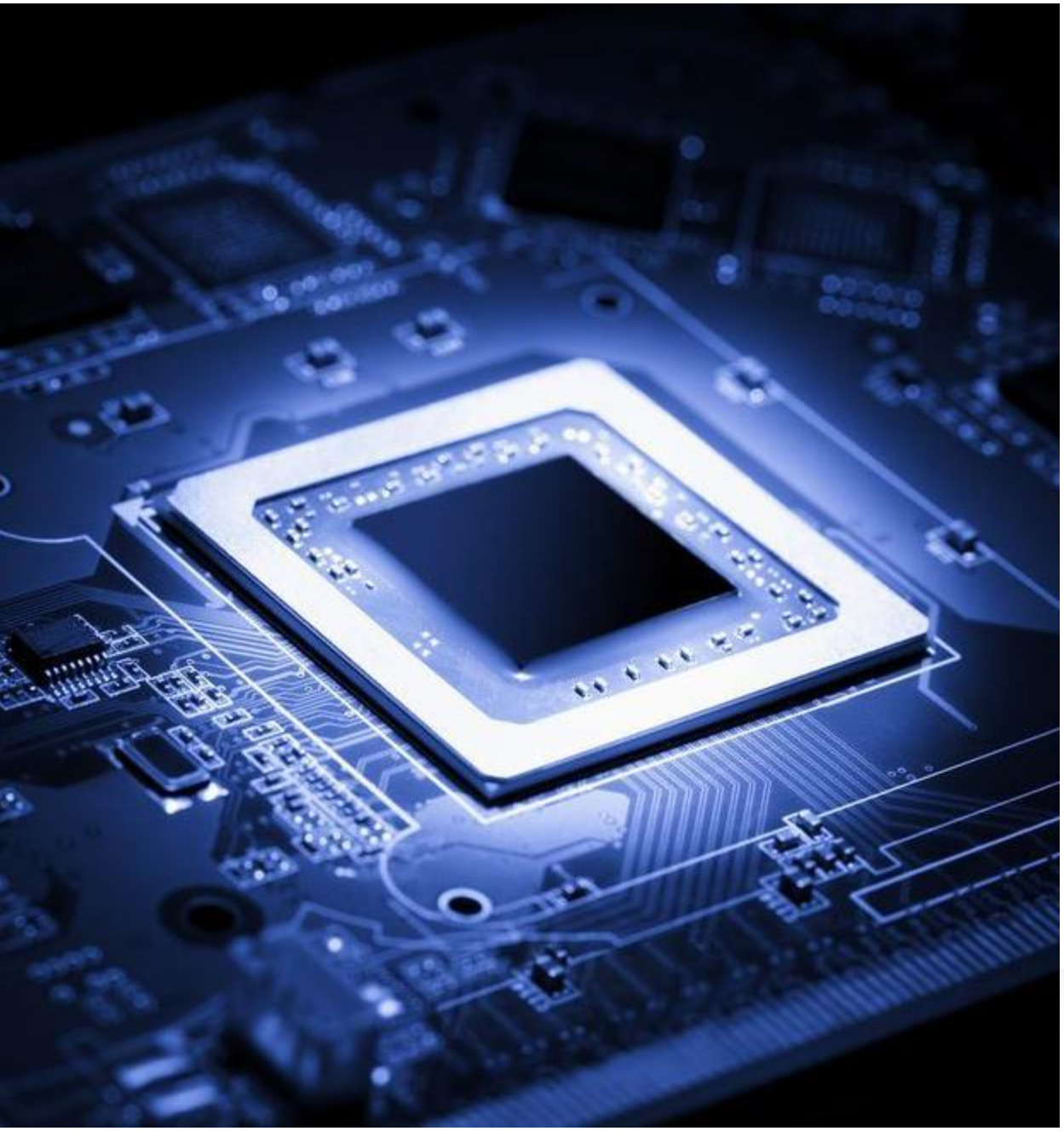
INTEGRA TECHNOLOGIES

GENERAL GUIDE FOR ASSEMBLY SERVICES

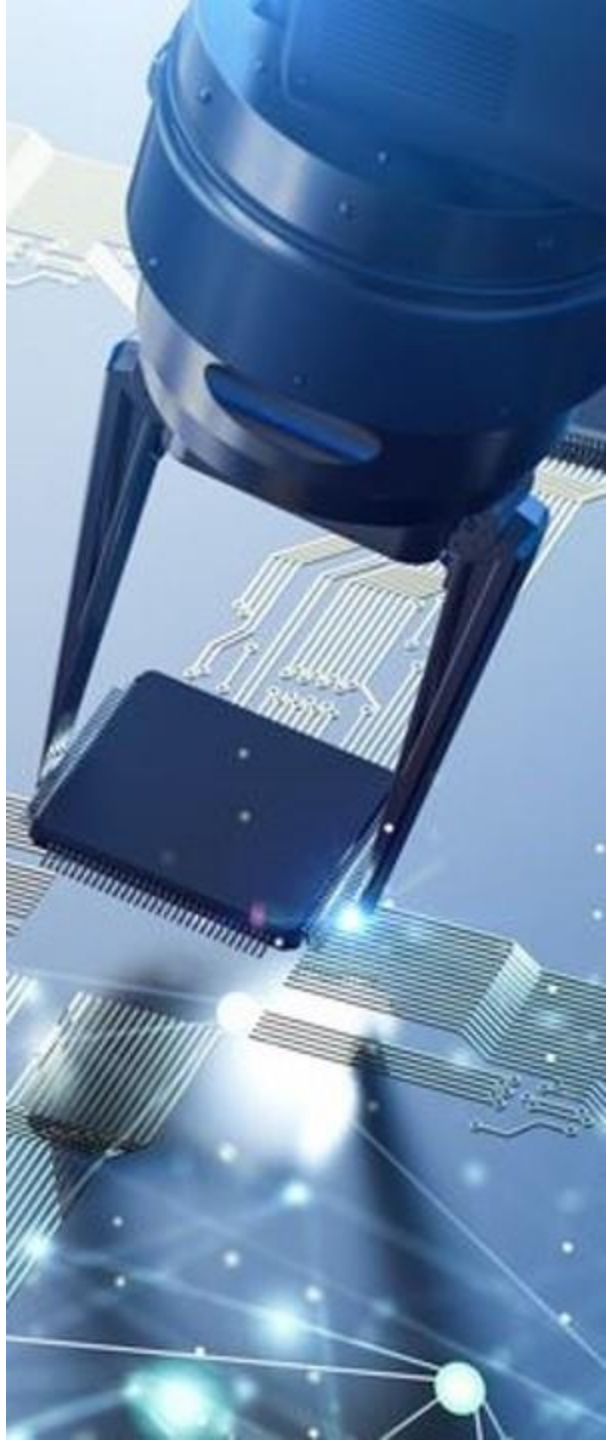
Single-Source Turnkey Solution From Wafer Processing To Final Test

September 2024



GENERAL GUIDE

- Integra’s capabilities exceed general guidelines
- The following guidelines are provided to assist customers in making their products more manufacturable and thus assist in achieving maximum yields.



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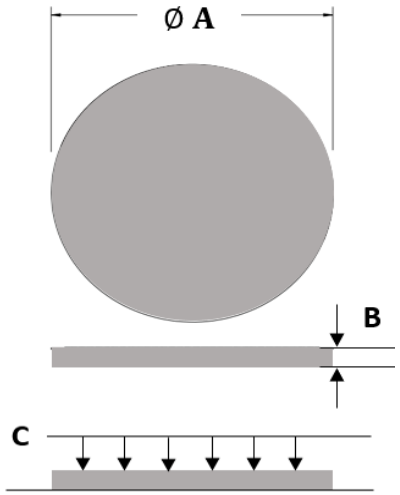
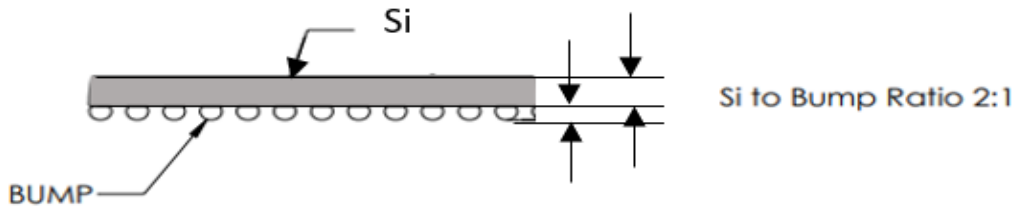
WAFER THINNING

Standard Materials	[A] Wafer Diameter	[B] Final Thickness (FT) Deviation (µm)	[B1]Special FT Deviation(µm)	[C] Total Thickness Variation (TTV) (µm)	[C1]Special TTV (µm)
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: 0.5 x Si Thickness



Notes:

- All non-standard materials – inquire
- Typical FT Deviation = +/-5 um Min. standard FT = 50um
- Bumped wafers depend on planarity of the bumps

INTEGRA TECHNOLOGIES

BACKSIDE FINISH

Wheel	Material	Grit	Spindle
Metal Removal	Gold, oxide layers, various metals	270	Z1 (rough grind)
GaN	GaN	600	Z2 (fine grind)
2000	Silicon	2000	Z2 (fine grind)
Polygrind	Silicon	4000+	Z2 (fine grind)
Polish	Silicon	8000+	Z3 (dry polish)
GaAs/InP/III-V	GaAs/InP/III-V	4000	Z2 (fine grind)
SiC	SiC		Z2 (fine grind)
Glass	Glass	1500	Z2 (fine grind)
Sapphire	Sapphire	600	Z2 (fine grind)

BACKGRIND GUIDE

	HRG 300	DFG 850 & 840	8540 Mini-Beast	DAG810	Dry Polisher
Materials	GaAs, Silicon, Quartz, InP, SiC, GaN, Sapphire	GaAs, Silicon, Quartz, InP, etc.	Silicon Only	Silicon, Quartz, InP etc.	Silicon Only
Minimum Thickness **	100 µm	100 um std. **20-75 µm Eng Control**	100 µm	100 um **20-75 µm Eng Control**	100 µm
** Required finish to achieve Min Thickness	Varies by Material	Varies by Material	Micro/Poly Grind	Varies by Material	Polish

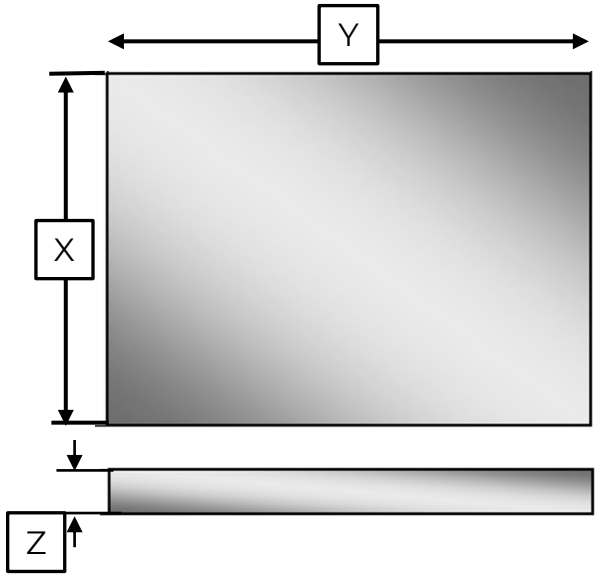
	2000 Grit	Microgrind Recommended when thinning to <= 200um	Dry Polish
Roughness	Ra = 150 - 240 A Rmax = 810 A	Ra = 90 - 140 A Rmax = 650 A	Ra = 3 A Rmax = 17 A

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

INTEGRA TECHNOLOGIES

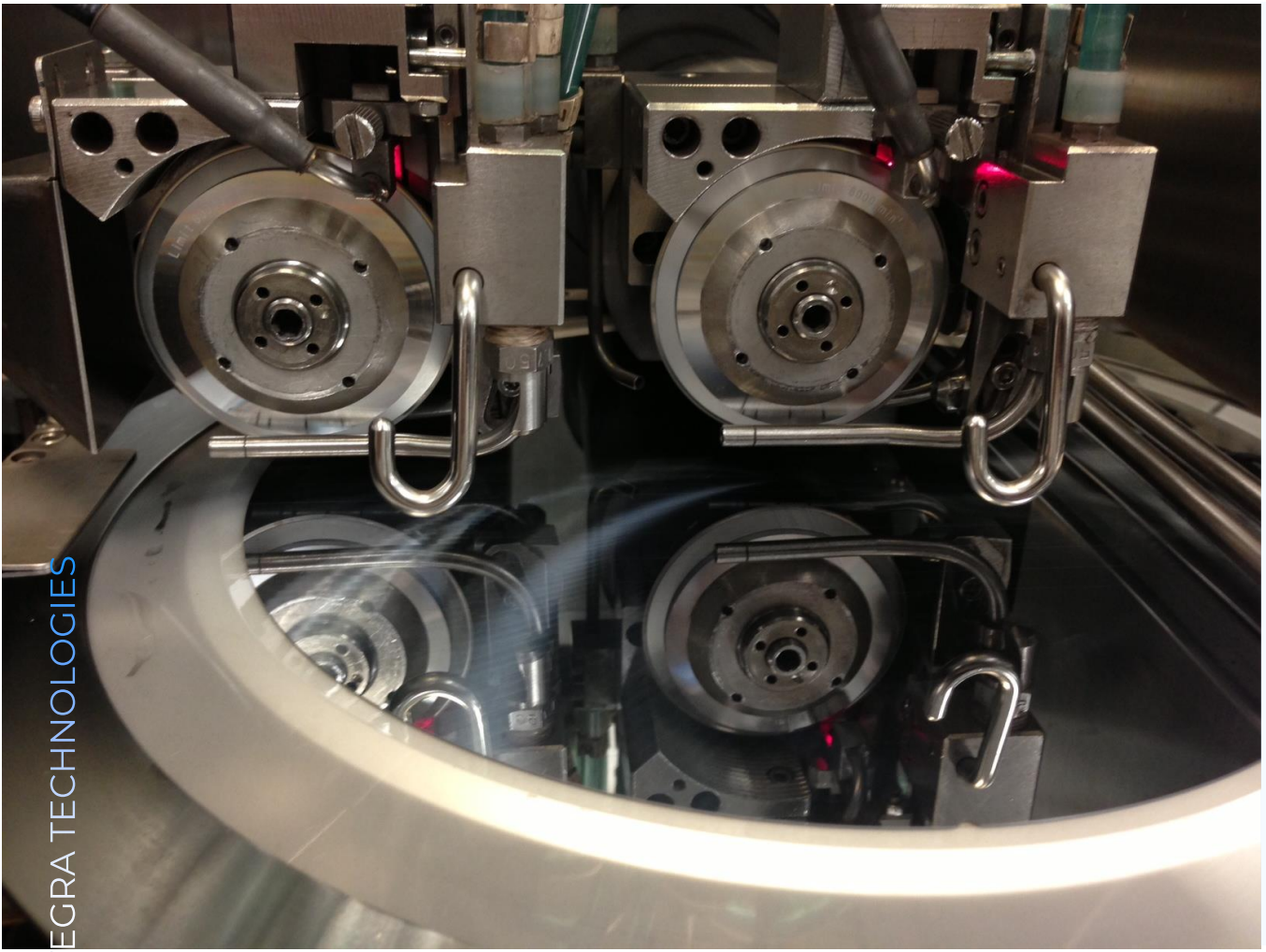
INDIVIDUAL DIE THINNING

Material	[X/Y] Die Size (mm)	[Z] Minimum Thickness (µm)	Surface Finish	Bumped Die 40
Si / SiGe	> 2.5	> 50	Polygrind	Yes
GaAs/InP/III-V	> 2.5	> 100	4000	Yes
Sapphire	> 2.5	> 100	600	-
Glass	> 2.5	> 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

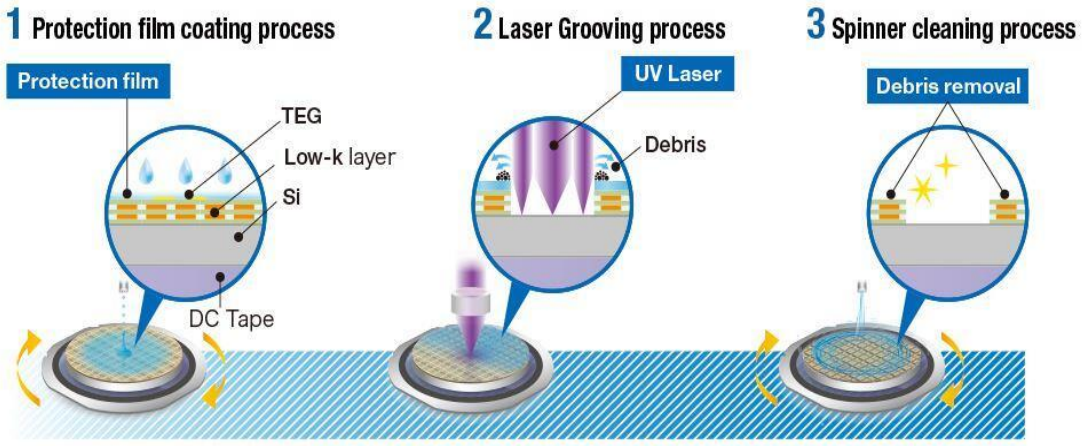
WAFER DICING GUIDE



- Diced Material Experience
- Silicon, SiGe,
- Dicing of Low-k and Ultra Low-k products
- Glass - including Pyrex/Borosilicate glass; Quartz; Fused Silica
- Galium Nitride, SiC
- Sapphire, Zirconia, Quartz
- Compound material semiconductors (GaAs; InP & others)
- 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)
- Others

LASER GROOVING

Recommended Uses	[A] Wafer Diameter
Low-k and Ultra Low-k Wafers at manufacturers recommendation	All (up to 300mm)
At Customer/Fab Request	All (up to 300mm)



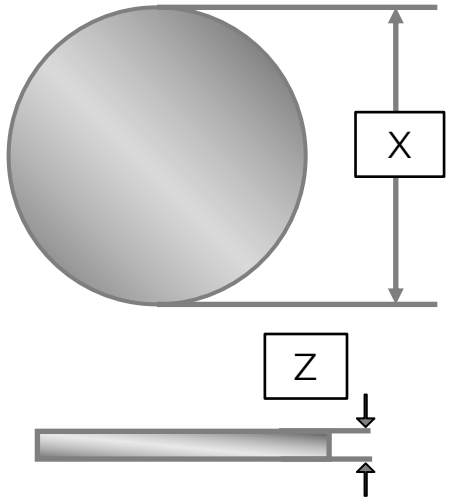
Integra's **Accretech AL3000**, fully automated laser grooving machine:

- Achieves both high quality processing and high throughput with a unique laser engine mechanism
- 300 mm wafer compatible, fully automatic laser grooving machine
- Automatically supports a series of processes from water-soluble protective film distribution to laser dicing and cleaning.
- The optical design is ideal for low-k grouping and removal of TEG from above the street.
- Processing distortion and damage due to heat are kept to a minimum, and a stable processing groove is formed.

DICING GUIDE

Material	Minimum Street Width (µm)	Maximum Wafer Thickness (µm)
Silicon/SiGe	25-35*	Contact Engineering
	40	400
	60	725
GaAs / III-V	80	890*
Sapphire	250	1020*
Glass	250	510
QFN/BGA/	300	2000*
GaN & SiC	250	1020
Organic/LCP/Alumina	125	2000*

* Stacked Wafers



Production Min/Max Die Size Per Wafer	
Minimum	0.500 mm (0.020") L or W/ die (> 100K die/wafer)
Maximum	1 die/wafer

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 ≥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 - 20µm*

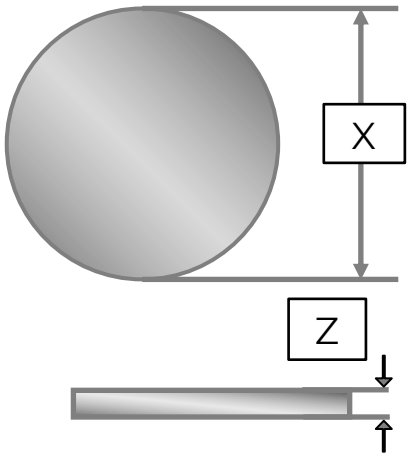
DICE BEFORE GRIND GUIDE

Material	Wafer Diameter	Max Final Thickness*	Min Final Thickness*	Minimum Die Size*	Process Mode	Process Equipment
Si / SiGe	8"	300 µm	100 µm	2.5 mm	Full-Auto	Mini-Beast
Si / SiGe	3" - 6"	300 µm	100 µm	2.5 mm	Semi-Auto Manual frame mount	B/G #1, #3
Si / SiGe	12"	300 µm	100 µm	2.5 mm	Manual	Saw #6, Saw #8 B/G #5

*All requirements outside of above Min/Max under engineering control

WAFER SCRIBE & BREAK GUIDE (NON-CONTACT)

Material	Max Wafer Thickness	Minimum Die Size	Minimum Street Width **	Diamond Scribe Width	Crystalline Orientation
Si (BTO)	200 µm	0.8 mm	20 µm	5 µm	100, 110
SiGe	200 µm	0.8 mm	20 µm	5 µm	100, 110
InP	200 µm	0.8 mm	20 µm	5 µm	100
GaAs	200 µm	0.8 mm	20 µm	5 µm	100
Sapphire	125 µm	1.5 mm	20 µm	5 µm	100
GaN	125 µm	1.5 mm	20 µm	5 µm	100
SiC	125 µm	1.5 mm	20 µm	5 µm	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

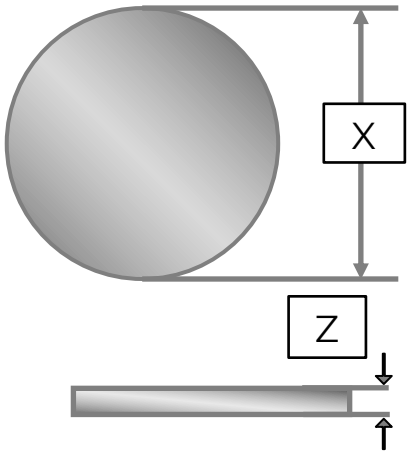
Maximum wafer size is 5”

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.**

WAFER SCRIBE & BREAK GUIDE (CONTACT)

Material	[Z] Min Wafer Thickness	Max Wafer Thickness	Minimum Die Size	Minimum Street Width **	Diamond Scribe Width	Crystalline Orientation
SiBTO	125 µm	225 µm	1.2 mm	35 µm	5 µm	100, 110
SiLiN	125 µm	225 µm	1.2 mm	35 µm	5 µm	100, 110
InP	125 µm	225 µm	1.2 mm	35 µm	5 µm	100
GaAs	125 µm	225 µm	1.2 mm	35 µm	5 µm	100



- Above materials are based on POR. We believe other materials such as SiC, GaN, Sapphire, and SiGe are doable as well.
- Thicknesses greater than the specified optimal conditions will be evaluated by Integra Engineering
- Street widths narrower than specified will be evaluated by Integra Engineering
- **[X] Maximum wafer size is 6".**
- 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 GUIDE

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 ,Al and passivation 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 ²*
	GaAs / InP / III-V	*25 mm ²*
Min Die Size	Si / SiGe	500 µm ² / 10 mils ² (standard production)
	GaAs / InP / III-V	500 µm ² / 10 mils ² (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. Multi binning and die tracking are capable.
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. **Non-contact surfaces may require custom pick collets**
Small Die Handling	All die < 20 mils or thinner than 4 mils require engineering evaluation. **Gel Paks are recommended for die smaller than 20 mils.	

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

- Range of systems
  - Muhlbauer (ecoLINE)
  - Mi10
  - Royce AP+ & RoyceMP300 (AOI is not available)

AOI & Automated Die Sorter

Production / Standard:

- Maximum wafer size: 300mm
- Minimum die size: 0.5 mm (below 0.5 µm2 and 150 µm thick requires evaluation
- Maximum die size: 15 mm
- Ink dot size: 100um to 350 um
- Emap format: SINF (Simplified Integrator Nested Format). All other formats require evaluation and/or conversion.
- Input option: Film Frame / Stretch Ring (8” Maximum)
- Output option: Waffle Pack, Gel Pak, Film Frame
- Die sorting : Multi binning and X,Y die tracking
- AOI: Detect any defect size > 10 microns on front / back of the die
- Bumped wafers should provide adequate clearance in the center of the die to allow a pick collet to pull (** Bumps or Non-contact surfaces may require custom pick collets**)

AUTOMATED VISUAL INSPECTION

Descriptions	Details
Max Input Wafer Size	12"/300mm
Min Input Wafer Size	No mininimum
Max Die Size	No maximum **(NOTE – must be single die size)**
Min Die Size	No minimum
	Film Frame - preferred
Input Options	Diced, Scribed and Broken, Unsawn Stretch Ring - requires transfer of wafer to film frame.
Inspection Magnification	20X, 50X, and 100X 2D surface Inspection and 2D Bump Metrology.
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 4 µm (~ 2 pixels). Black and white inspection - does not detect color variation defects. AVI is performed using standard commercial inspection criteria.

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

E-Map Format & Conversion:

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

NOTE:
We Can convert an e-map to an Inked Wafer.

Eagle System

MANUAL INSPECTION

MILITARY

- A high-power microscope with illumination and magnification of 75X to 150X for Class B (Integra uses 50X to 100X) and 100X to 200X for Class S. Refer to MIL-STD-883, Method 2010.
- When using Low power (usually for sidewall and backside inspection), use Binocular low power microscope with illumination and magnification of minimum 30X. Refer to MIL-STD-883, Method 2010.
- CDA (Clean Dry Air). Pressure is not to exceed 20 psig.
- Anti-static finger cots or gloves.
- Vacuum wand with rubber tip.
- Tweezers.
- ESD Wrist strap with 1 Mega-Ohm, 1/4-Watt resistor.
- Grounded workstation with laminar flow hood.
- Conductive rubber bands and lint-free filter paper.
- Tyvek paper over the plated die after inspection.

COMMERCIAL

- A high-power microscope with a magnification range of 40X to 150X. (Integra uses 50X)
- Vacuum wand with rubber tip.
- Anti-static finger cots or gloves.
- Tweezers (conductive plastic).
- ESD Wrist strap with 1mega ohm 1/4-Watt resistor.
- Grounded workstation with laminar flow hood.
- Conductive rubber bands and lint-free filter paper.
- Tyvek paper over the plated die after inspection.

- Range of systems
  - Muhlbauer
  - Mi30 (2)
  - Semi-auto

TAPE & REEL OF BARE DIE

Design Rules:

- Maximum wafer size: 300mm
- Minimum die size: below 500 µm2 and 150 µm thick requires evaluation
- Minimum pocket pitch: 4 mm
- Minimum carrier tape width: 8 mm
- Maximum carrier tape width: 24 mm (some tooling required)
- Bumped wafers should provide adequate clearance in the center of the die to allow a pick collet to pull
- Integra does not carry any stock of tape and reel materials
- 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

LASER MARKING OF WAFERS

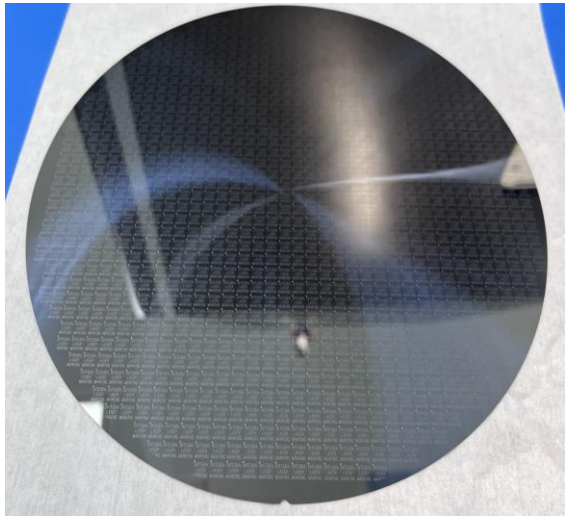
Machine Model: EO Technics - CSM2000 Fully Automate Wafer Level CSP Marker

Wafer Marking:

- Laser wavelength 532nm (Green)
- Laser source: Diode Pumped Laser Nd:YVO4
- Marking accuracy +/-75µm
- Scanning speed: 3000mm/sec
- Wafer material: Bare Silicon Wafer or Wafer with backside Black Tape Lamination
- Wafer size: 6- and 8-inch single die size
- Wafer Handler: Cassette to Cassette
- Minimum Wafer thickness: > 400µm
- Minimum Character Size: > 200µm
- Minimum Die Size: > 1.0mm x 1.0mm

Individual Die/Package Marking:

- Engineering review or Package system (pg. 52)



DIE ATTACH

Die Attach Processes Available

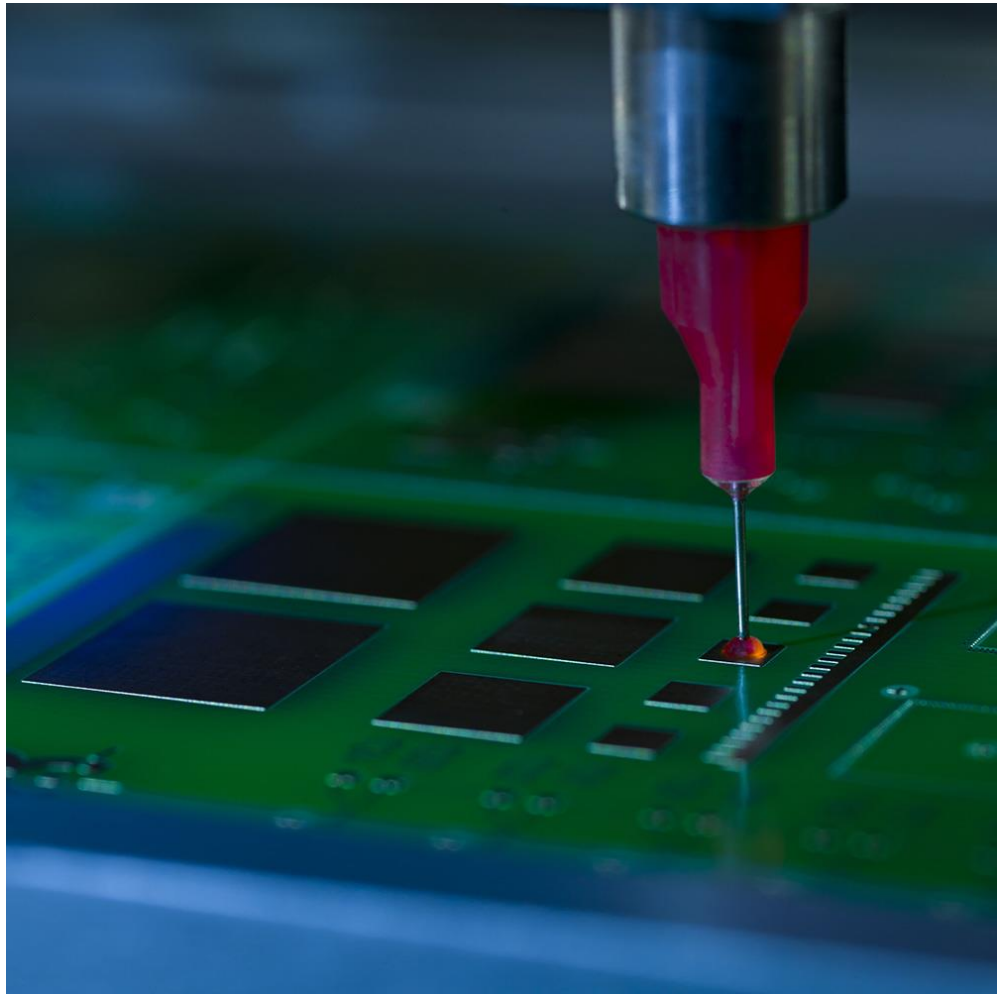
Die attach using various conductive, non-conductive epoxy and DAF (Die-Attach-Film)

Die attach of ceramic, hybrid packages using silver glass adhesive

Eutectic die attach (see page 22)

Integra will need to verify availability of preform sizes vs. die size

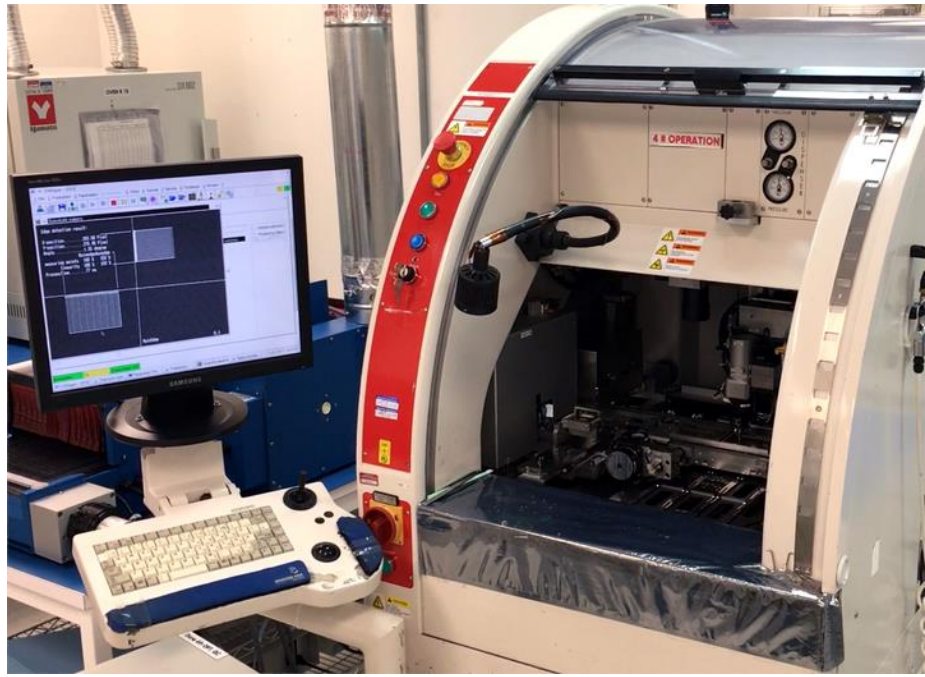
Sintered Silver also available under Engineering Control

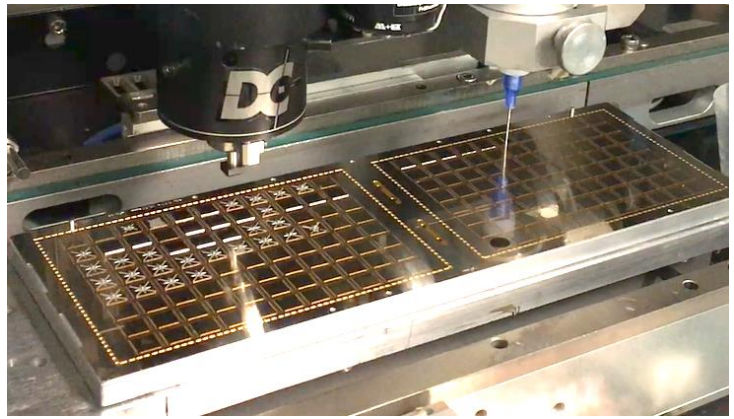


DIE ATTACH – Standard equipment

Die Attach Capability:

X/Y placement M	
MAT- 6400 die bonder	+/-5um @ 3sigma - Application dependent (+/- 10 µm after die attach cure)
Datacon 2200 APM die bonder	+/- 10 µm (+/- 15 µm after die attach cure)
Manual die attach :	+/- 75 µm
Theta rotation	
MAT- 6400 die bonder :	+/- 0.5 degree
Datacon 2200 APM die bonder	+/- 1 degree
Manual die attach :	+/- 5 degrees
Die Size – Production Standard	
Minimum 750um – 40mm***	
Bond Line Thickness (BLT) control	
Pressure and time control (for epoxy) : Target BLT +/- 12.5 µm (die size dependent) Height or distance control (for silver glass) : Target BLT +/- 12.5 µm	
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.	





***Larger or smaller needs engineering review

INTEGRA TECHNOLOGIES

Eutectic DIE ATTACH

TOOL AND OUTLINE

- SST Vacuum Reflow Systems
- High Vacuum MEMs Packaging, Hermetic Package Sealing, Solder Paste Reflow Attach
- Fluxless Eutectic Solder Attach
- Tooling required per different die

FEATURES:

- Programmable vacuum/pressure furnace
- Creates void-free solder joints without the use of flux,
- High reliability electronic components.
- This system allows for heating up to 500°C and cooling in an inert gas environment from vacuum levels below 50 millitorrs to pressures up to 40 psig.
- Process heating is provided over the entire work area by a close-coupled planar infrared heating element.

SET-NA 150 Bonding (includes FC)

Benefits:

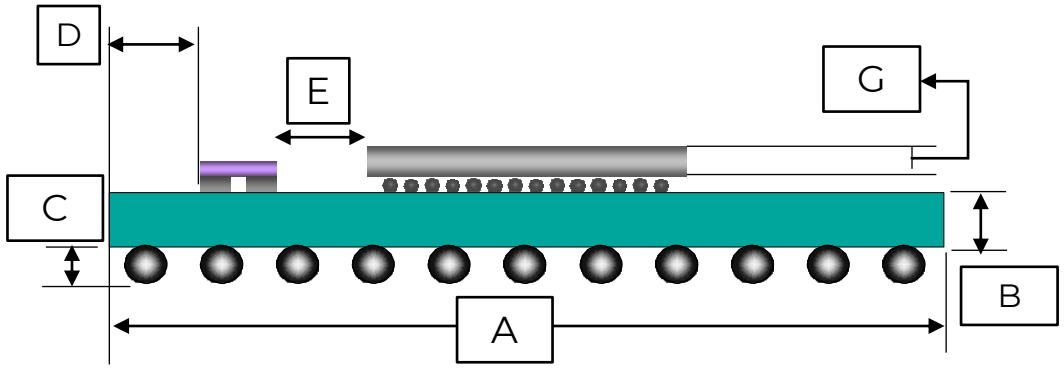
- ± 1 µm post-bond accuracy and 20 µradian leveling guarantee high yields on the most advanced products
- Semi-Open Confinement Chamber for Oxide Reduction (option)
- Air bearing construction on a granite structure ensures long-term stability and reliability
- Compression, Z-control and temperature profiling, together with process monitoring, maximize process control
- Optical automatic leveling and alignment enables hands-off operation for production applications
- Nanoimprint Lithography option with Hot Embossing or UV-NIL process without compromising the bonding capability

Process Capabilities:

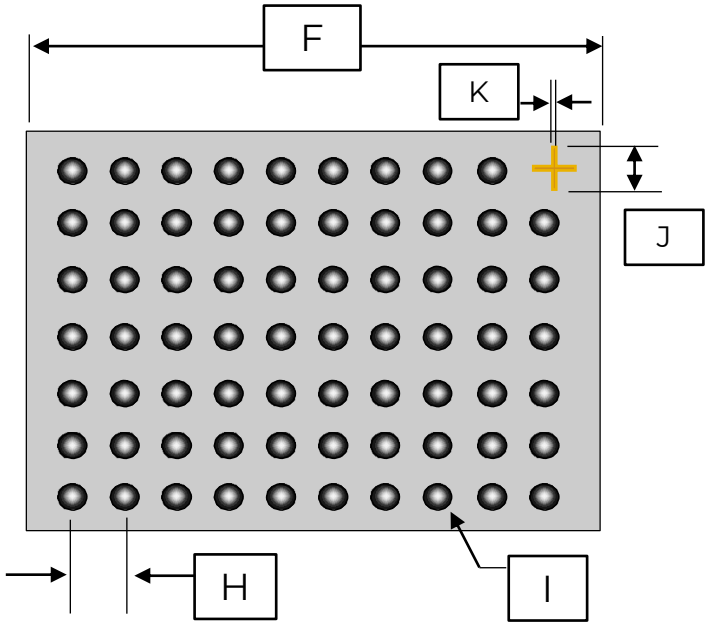
- The FC150 accommodates a wide variety of materials, including extremely fragile materials such as GaAs and HgCdTe and processes:
- Die Bonding, Flip Chip Bonding
- Mass Reflow, In-Situ Reflow, Fluxless Eutectic Bonding
- Thermocompression, Ultrasonic and Adhesive Bonding
- Gold, Gold/Tin, Indium, UV or Thermal Cure Adhesive, Polymers
- Fragile Material Compatibility: InP, GaAs, MCT
- Bond process changes are easily achieved

SET-NA 150 Bonding

SUBSTRATE



DIE



Parameter	Unit	Solder Reflow (min / max)	Conventional Die Attach (min / max)	Ultrasonic (min / max)
Bump Material	--	Cu Pillar, Indium, Solder Alloys	Cu Pillar, Indium, Solder Alloys	Cu Pillar, Indium, Solder Alloys
[A] Substrate Size	mm	3 / 100 sq.	3 / 100 sq.	3 / 100 sq.
[B] Substrate+Die Thickness	mm	6 max	6 max	6 max
Substrate warpage	µm	5 max @ full thickness	5 max @ full thickness	5 max @ full thickness
[C] Substrate underside structure	µm	200 max	200 max	200 max
[D] Die to Substrate Edge Proximity	µm	50 min	50 min	50 min
[E] Die to Component Proximity	µm	100 min	100 min	100 min
[F] Die Size	mm	3 / 50 sq.	3 / 50 sq.	3 / 50 sq.
[G] Die Thickness	µm	125 min	125 min	125 min
[H] Bump Pitch	µm	8 min	8 min	8 min
[I] Bump Diameter	µm	3 min	4 min	5 min
[J] Fiducial Size	µm	100 min	100 min	100 min
[K] Fiducial Line Width	µm	5 min	5 min	5 min
Bonding Force	N	2,000 max	2,000 max	2,000 max
Temperature (Substrate)	°C	Room temp / 400	Room temp / 400	Room temp / 400
Temperature (Die)	°C	Room temp / 400	Room temp / 400	Room temp / 400
Input Handler (Die)	--	2x2 in. WafflePak	2x2 in. WafflePak	2x2 in. WafflePak
Input Handler (Substrate)	--	4x4 in. WafflePak	4x4 in. WafflePak	4x4 in. WafflePak
Dispenser	--	--	Epoxy	--
Placement Tolerance	µm	+/-1	+/-3	+/-5

DIE-TO-WAFER DIRECT BONDING GUIDE

Machine type : BESI 2200 Evo Plus

- Focuses on Silicon Photonics technology.
- Class 1k cleanroom / Class 100 equipment.
- Bonding capability up to 500 dies per hour.
- Programmable bond force up to 7500 grams.
- Placement accuracy <XY>: +/- 7µm
- (35µm w/o pattern on die/wafer)
- Placement accuracy <theta>: +/- 0.3 ^{o}deg.
- AOI prior to die placement = higher yield.
- Optional Laser mark for die traceability.
- Uses atmospheric type instead of the conventional vacuum type plasma.
- FA Metrology: CSAM / Pull Test / *Surface Roughness / *SEM. (*) = Outsourced.

InP-to-Si Direct Bonding

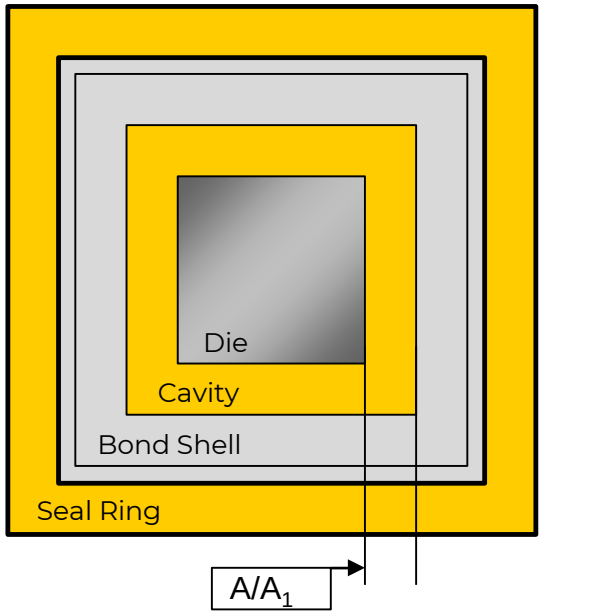
Wafer/Substrate

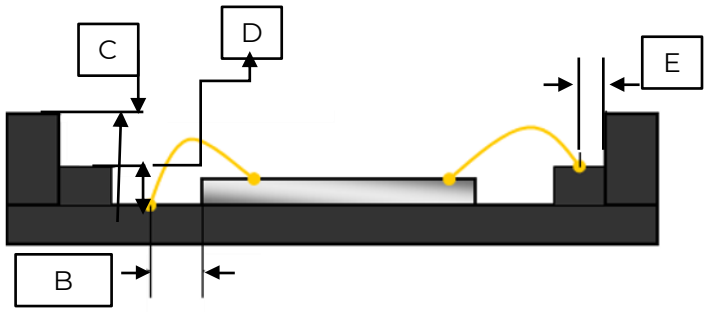
- Material: Si / Silicon-On-Insulator (SOI)
- Wafer size: 50~200mm
- Thickness: 0.4~2.0mm
- Surface roughness: Ra <0.5nm
- Temperature: 200~1000^{o}C. / Nom. 550^{o}C

Die

- Material: InP, GaAs , BTO & TFLN (development)
- Die size: 0.5~50mm
- Thickness: 0.1~7.0mm
- Surface roughness: Ra <0.5nm (CMP req.)
- Edge chipping: <5µm
- Temperature: 200~1000^{o}C. / Nom. 550^{o}C

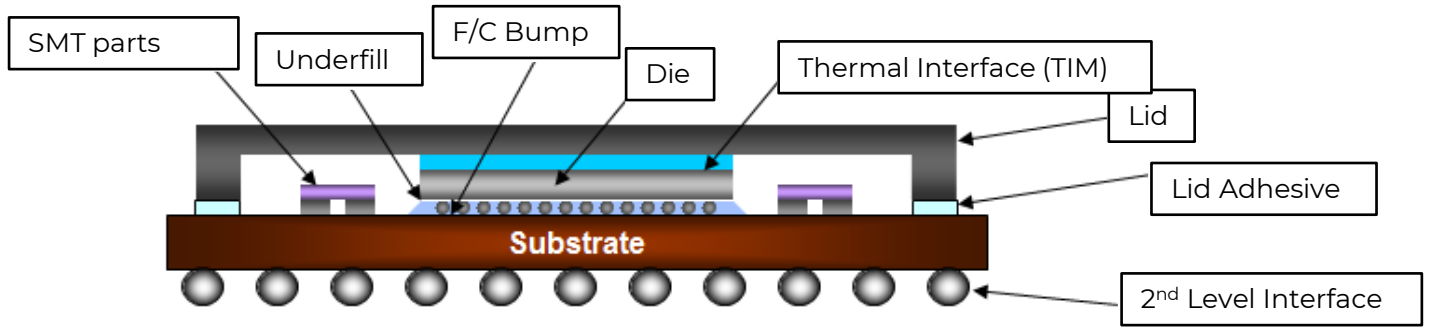
DIE CLEARANCE CAVITY PACKAGES



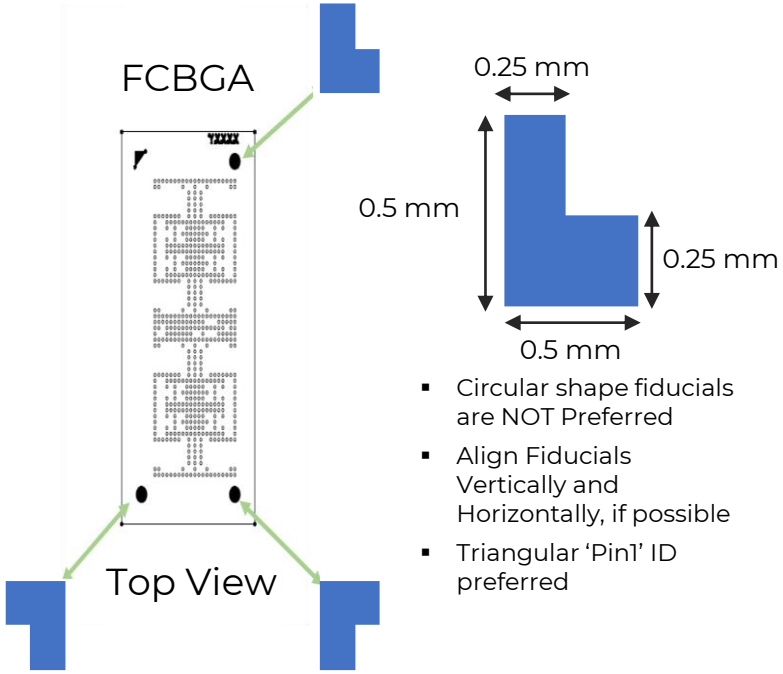


Description	QMI-2569 Silver Glass	Epoxy	Eutectic AuSn, AuSi
[A] Die Clearance *(Wedge Bond)*	min. 0.5 mm	min 0.5 mm	min 1.0 mm
[A_1] Die Clearance *(Ball Bond)*	min. 0.5 mm	min 0.5 mm	min 1.0 mm
[B] Die Clearance w/down bonds *(Wedge Bond/ Ball bond)*	min 1.0 mm	min 0.75 mm	min 1.5 mm
Preform Size	na	na	90% of Die Size
[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 wire bond termination and package	min. 0.75 mm	min. 0.75 mm	min. 0.75 mm

FLIP CHIP ASSEMBLY GUIDE



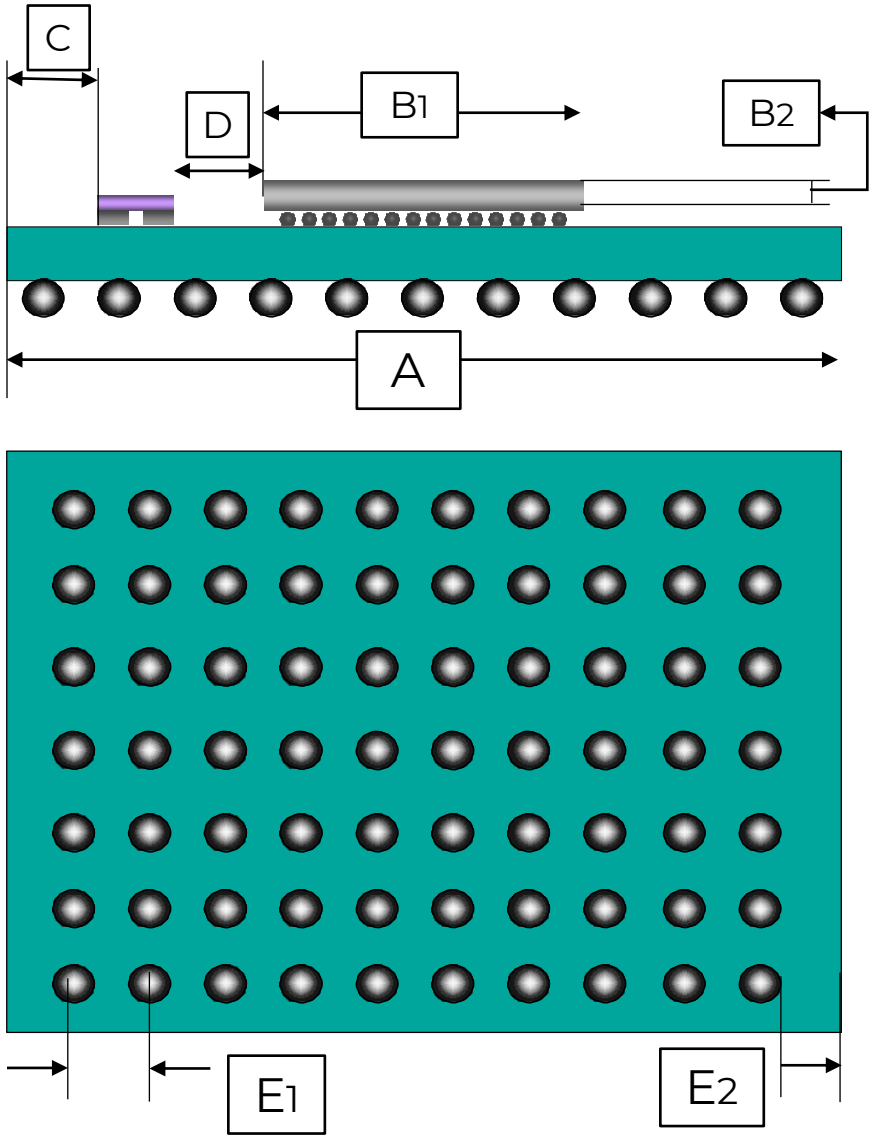
Fiducial preferences



- Circular shape fiducials are NOT Preferred
- Align Fiducials Vertically and Horizontally, if possible
- Triangular 'Pin1' ID preferred

Description	Options	Details / Experience
Substrate	Ceramic, Organic laminate, Flex Circuit, PCB	
Die Lid / Heat	Si / SiGe / GaAs / Low K Ceramic /Aluminum / Cu	I/O = 3 min to ~ X (bumps) -
Spreader	Lid Stiffner / No lid	-
Thermal Interface	Grease / Gel / Adhesive	-
Underfill	Namics 8439-1 / Other(s)	-
SMT Components	Resistors, Capacitors, etc. (high quantities are subject to review)	Conductive epoxy / Solder
F/C Bump	Eutectic PbSn: 37/63 or SAC High Pb: 90/10, 95/5, 97/3 Copper Pillar	Pitch = 50 µm min Pitch = 50 µm min Pitch = 8 µm min
2nd Level Interface	LGA BGA [Eutectic / Pb-free]	Pitch = 0.4 mm min Pitch = 0.4 mm min
Substrate	Ceramic	Ni/Au
Metallization	Organic	Solder on Pad (SOP) / ENiG/ENEPiG

FLIP CHIP ASSEMBLY GUIDE

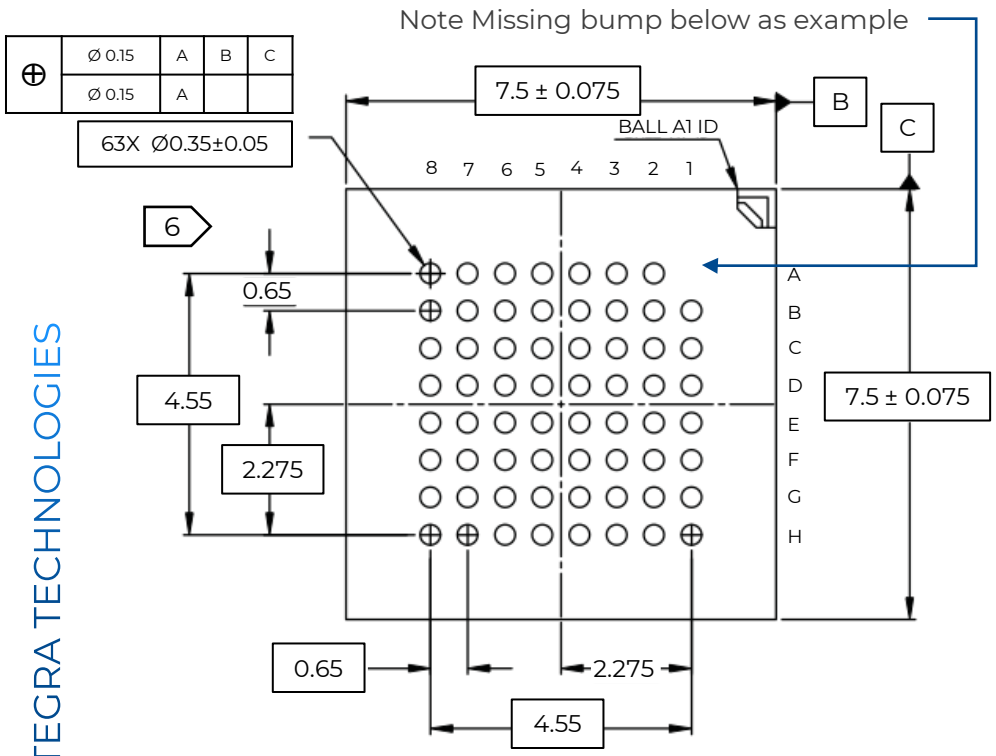


Description	Production/Standard
[A] Substrate O.D.	Job Dependent
[B1] Die Size	Job Dependent
[B2] Die Thickness	0.15 to 1.0 mm
[C] F/C to Edge Proximity	0.50 mm min
[D] F/C to Component Proximity	0.50 mm nom.
[E1] BGA/LGA Pitch	0.4 mm min.
[E2] BGA/LGA Edge Proximity	0.4 mm min.

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

FLIP CHIP: DESIGN/ASSEMBLY CONSIDERATIONS

Having a unique bump pattern will help ensure correct orientation

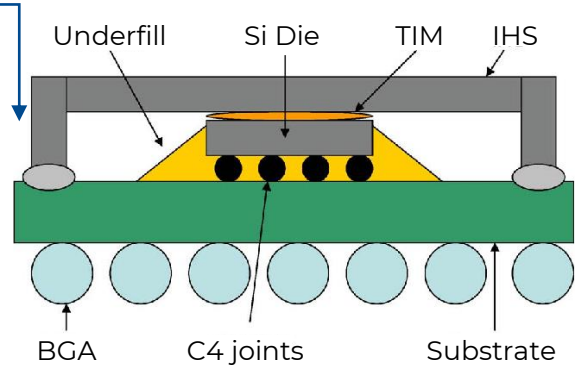


Rules for the Lid and Marking

Lid size should be roughly 2mm smaller than substrate

Lid should have weeping holes on corners

Lid marking should be considered and be executed with a laser.

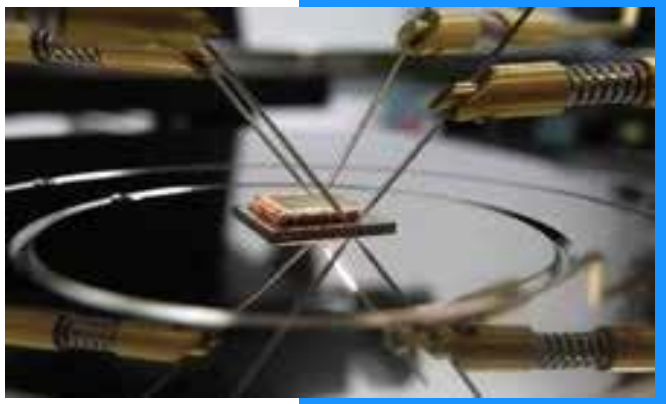


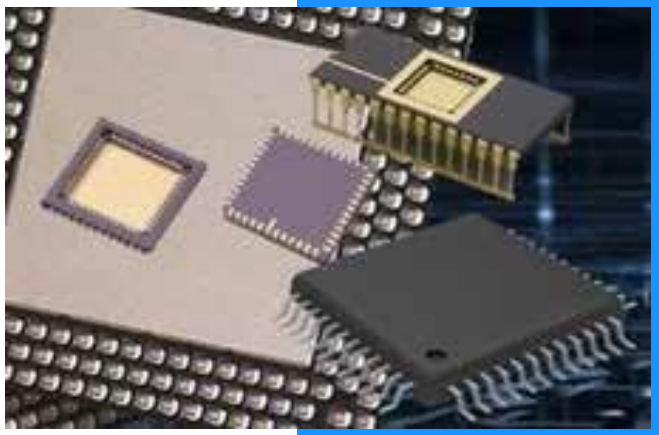
INTEGRA TECHNOLOGIES

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 2 x 2 mm to a maximum of 50 x 50 mm
- Individual die can be stud bumped if they are at least 2 x 2 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 200 µm thick.
- 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)	[C1] 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)	[C1] Staggered Bond Pad Pitch (um)
0.60		> 55	27.5 / 55	20-30	40-50	> 30	> 37	18.5 / 37
0.70		> 70	35 / 70	30-40	55-65	> 35	> 40	20 / 40
0.80	> 45	> 90	45 / 90	45-55	70-80	> 40	> 50	25 / 50
1.00	> 60			25-30		> 50	> 60	30 / 60
1.25	> 75					> 70	> 80	40 / 80

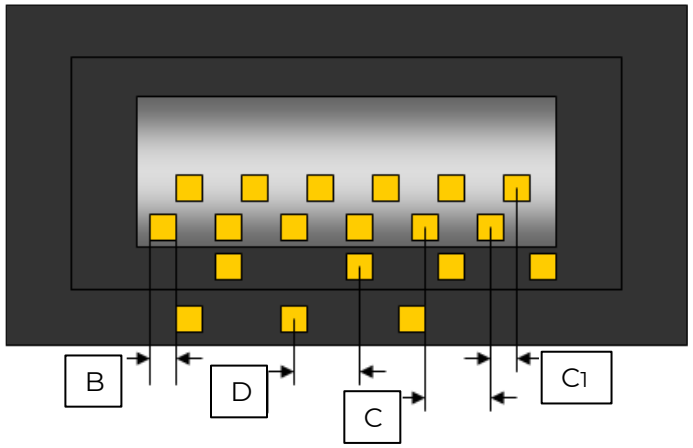
Non-Standard

Multiple stud bump stacks are subject to engineering review. Other wire diameter stud bumps are subject to engineering review.

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

Production

Prototype



INTEGRA TECHNOLOGIES

WIRE BOND DESIGN GUIDE

Al Wedge Bond

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)
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	> 120	> 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	> 100	> 140	70 / 140	> 200	> 100	> 130	65 / 130	>150

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

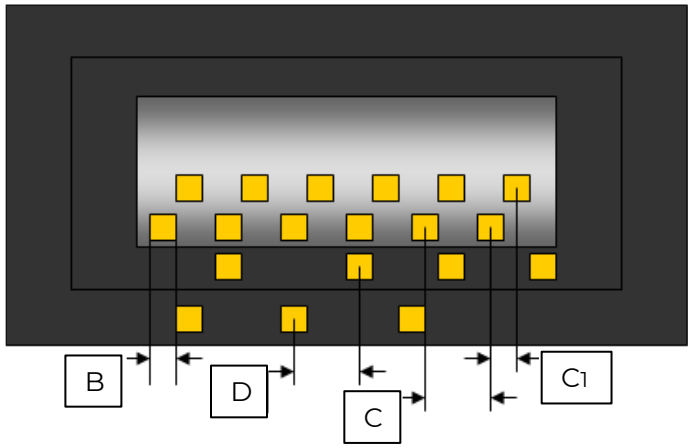
* Minimum Wire Lengths Subject to Die Edge Clearance.

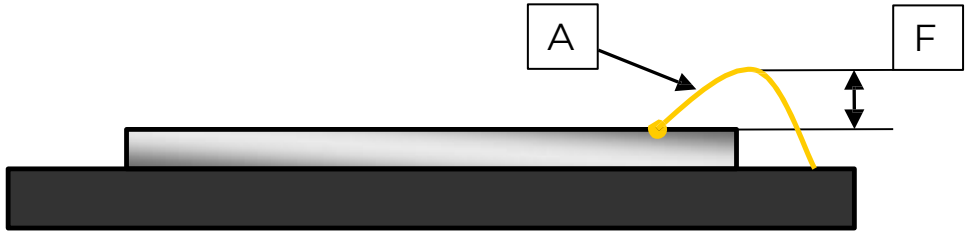
** Shorter or Longer Lengths Subject to Engineering Review

*** 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.





Production

Prototype Only

INTEGRA TECHNOLOGIES

WIRE BOND DESIGN GUIDE

Au Ball Bond

Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)	[A] Wire Length (mm) #	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)
0.50	> 0.2 < 3.2					> 0.2 < 4.0	> 30	> 38	19/38	> 45
0.60	> 0.2 < 3.7	> 36	> 44	22 / 44	> 75	> 0.2 < 4.0	> 33	> 41	20.5/41	> 55
0.70	> 0.2 < 5.0	> 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 < 6.5	> 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 < 6.5	> 65	> 80	40 / 80	> 100	> 0.5 < 6.5	> 60	> 70	35/70	> 90
1.50***	> 0.5 < 6.5	> 75	> 100	60 / 120	>120	> 0.5 < 6.5	> 70	> 90	45/90	> 100
2.00***	> 0.5 < 6.5	>100	>120	70 / 140	>150	> 0.5 < 6.5	> 85	> 100	50/100	> 120

Non-Standard

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

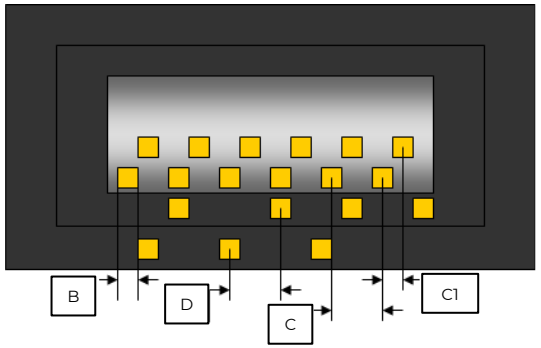
* Minimum Wire Lengths Subject to Die Edge Clearance.

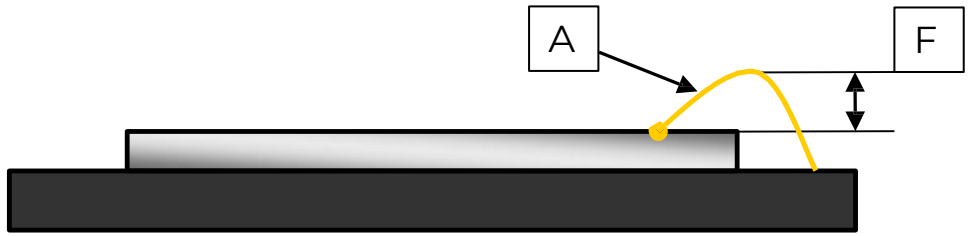
** Shorter or Longer Lengths Subject to Engineering Review

*** 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 and done on a best efforts basis





Production

Prototype

Only

INTEGRA TECHNOLOGIES

WIRE BOND DESIGN GUIDE

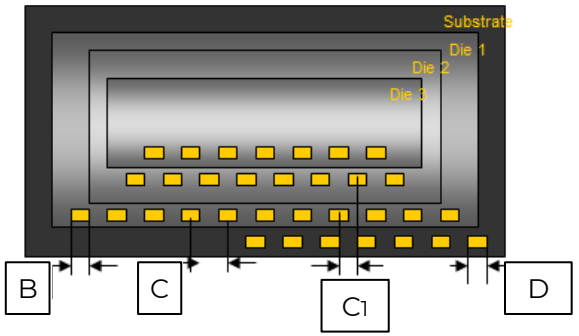
Au Ball Bond - Pyramid / Stair Case Stacked Die

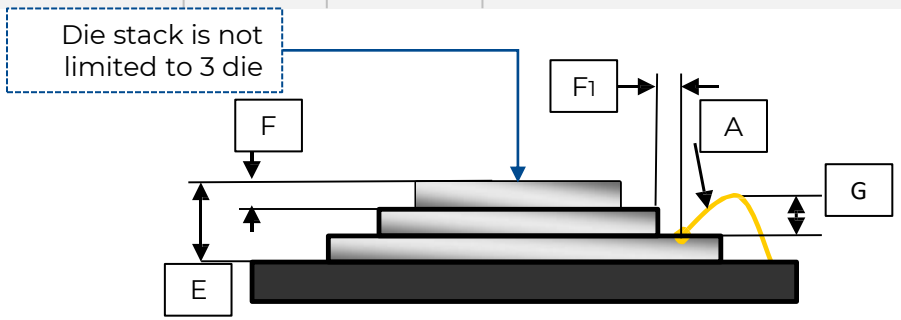
Wire Diameter (mils)	[A] Wire Length (mm) #	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch Flat Area (µm)	[E] Stacked Die Height (mm)	[F] Die Thickness (mils)	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Bond Pad Staggered	[D] Substrate min. Lead Pitch Flat Area (µm)	[E] Stacked Die Height (mm)	[F] Die Thickness (mils)
0.50	> 0.2 < 3.2	> 36	> 43	20 / 40	> 75	< 2.3	> 3.0 < 20	> 30	> 38	19/38	> 45	< 2.8	> 2.0 < 35
0.60								> 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 < 6.5	> 65	> 80	40 / 80	> 100	< 2.3	> 3.0 < 20	> 60	> 70	35/70	> 90	< 2.8	> 2.0 < 35
1.50***	> 0.5 < 6.5	> 75	> 100	60 / 120	>120	< 2.3	> 3.0 < 20	> 70	> 90	45/90	> 100	< 2.8	> 2.0 < 35
2.00***	> 0.5 < 6.5	>100	>120	70 / 140	>150	< 2.3	> 3.0 < 20	> 85	> 100	50/100	> 120	< 2.8	> 2.0 < 35

Non-Standard

[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
*** 1.50 & 2.00 mil wire available with special wire order.
# Maximum Wire Length applies to Non-Molded Packages

[F1] 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 1] 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

INTEGRA TECHNOLOGIES

WIRE BOND DESIGN GUIDE

Au Ball Bond - Stacked Die (same size die)

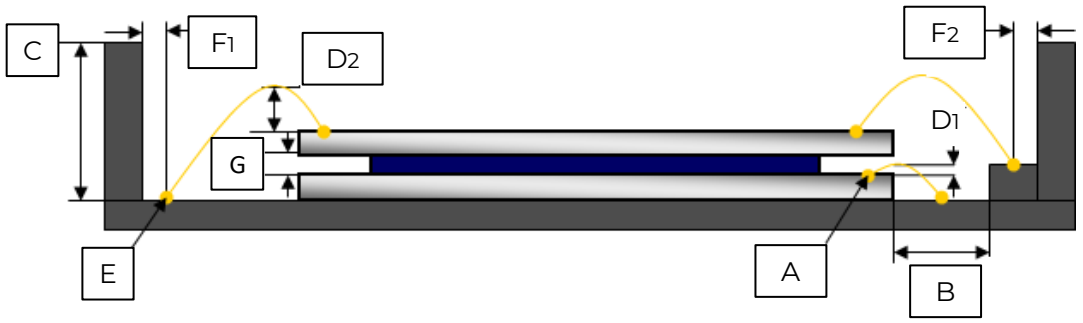
Wire Diameter (mils)	[A] Die 1 Wire Length (mm)	[B] Die to Bond Shelf with / without down bonds (mm)	[C] Cavity Wall Height (mm)	[D1] Die 1 Loop Height (mm)	[D2] Die 2 Loop Height (mm)	[E] Die 2 Wire Length (mm)	[F1,2] From bond to cavity wall (mm)	[G] Spacer Thickness (mm)
0.60	> 0.2 < 3.2	0.5 / 1.0	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	> 0.2 < 7.0	0.5 / 1.0	2.00	> 0.100 < 0.400	> 0.100 < 0.400	> 0.2 < 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	> 0.2 < 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	> 0.2 < 7.0	0.500	> 0.200 < 0.500

← Non-Standard

[D 1,2] 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



INTEGRA TECHNOLOGIES

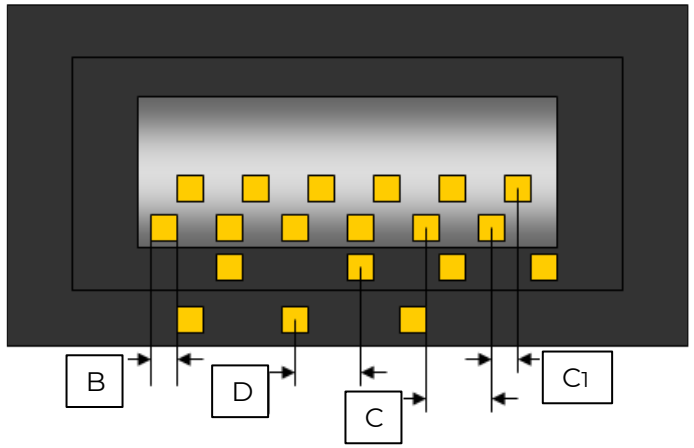
WIRE BOND DESIGN GUIDE

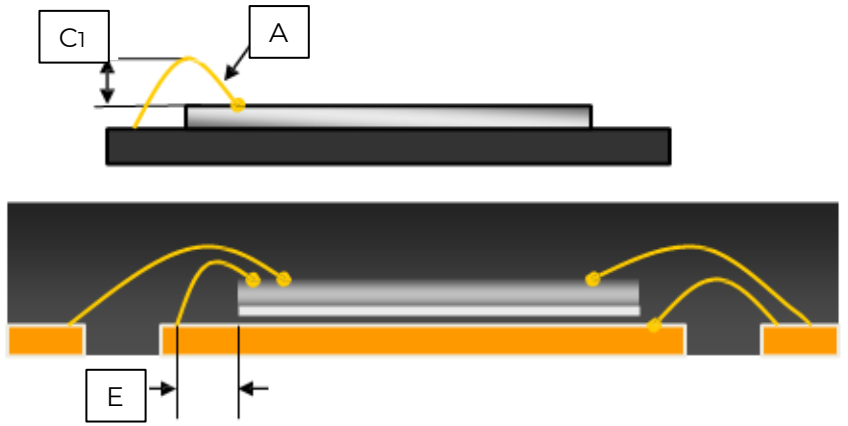
Molded QFN / CSBGA Wire Bond (Au Ball)

Wire Diameter (mils)	[A] Wire Length (mm)	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Die/Pkg Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)	[E] Down Bond (mm)	[B] Bond Pad Opening (µm)	[C] Bond Pad Pitch (µm)	[C1] Die/Pkg Pad Staggered Pitch (µm)	[D] Substrate min. Lead Pitch (µm)
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





INTEGRA TECHNOLOGIES

RIBBON BONDING GUIDE

Machine model : HYBOND 572A Vertical Feed, Deep Access
Wire size capable : up to 1 mil x 10 mils ribbon wire Gold or Aluminum

HYBOND 572A Vertical Feed, Deep Access	
PLL self-tuning, 62.5 KHz (±2.5KHz) nominal	
Ultrasonic Power Range	0-1 watt on Low setting (default), 0-2 watts on High setting
Bond Time Range	10 - 400 mSec
Bond Force Range	15 - 150 grams
Temperature Control	Ambient to 250° C
Bondable Ribbon Dimensions	Up to 1 x 10 mils (25,4 x 254 µm)

1 mil x 10 mils ribbon wire Gold or Aluminum	
Gold and Aluminum	
Bondable Ribbon Dimensions:	Up to 1 x 10 mils (25,4 x 254 µm)
Deep access Wire-In-Tool 90° wire feed	
Bond Actuation	Switch at fixed height, actuated by lever
Z Axis Travel	0.5 in (1,20 cm) maximum
Vertical Bonding Window	60 -100 mils (152-254 µm)

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)

	Description	(µm)	Corner Pad Size (µm)
A	Min. Bond Pad Pitch	55	76
E	Min. Bond Pad Size (Top Metal, width)	53	
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)	60 µm	100 µm	200 µm
L	Corner Pad Pitch	0	115 µm	115 µm

- *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

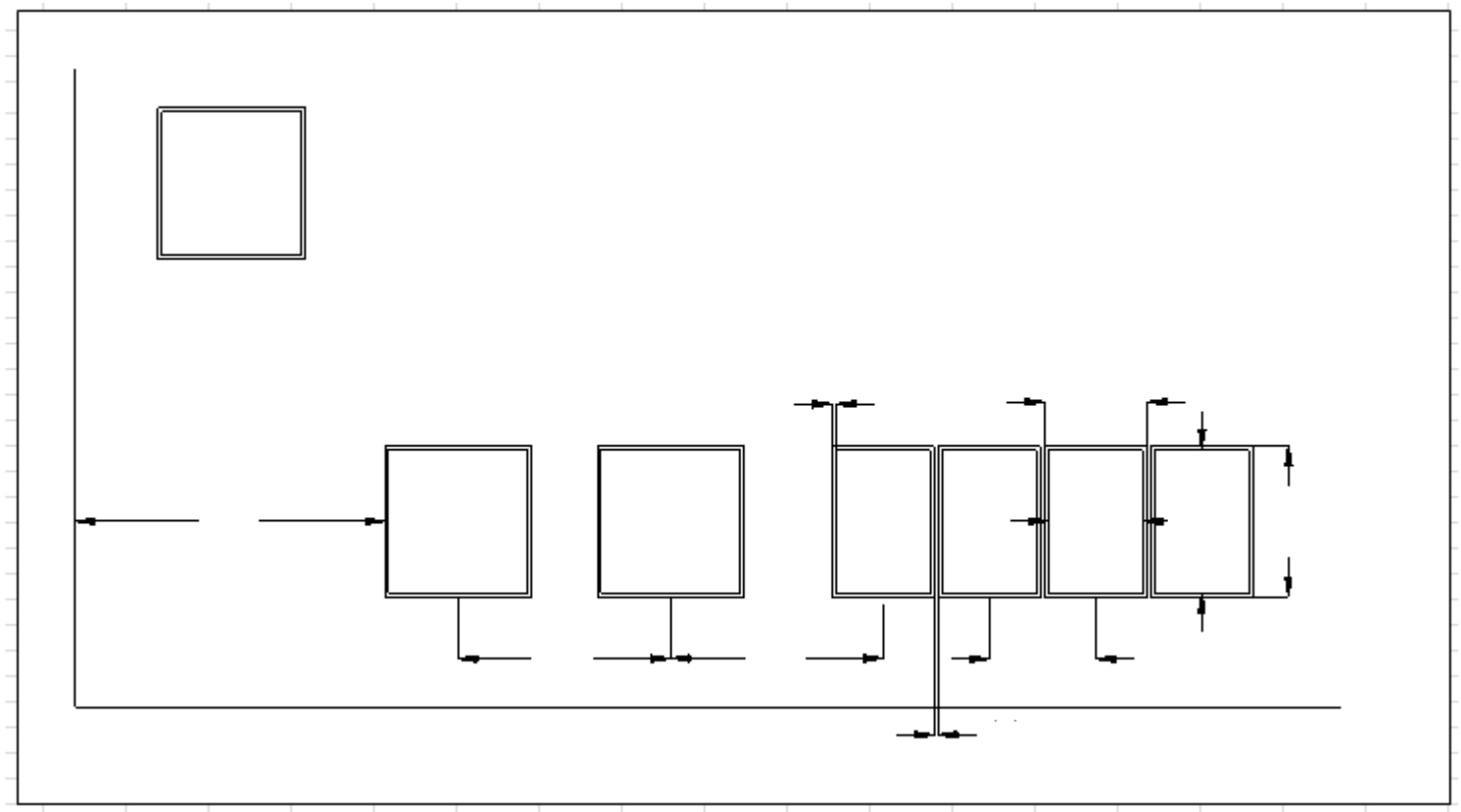
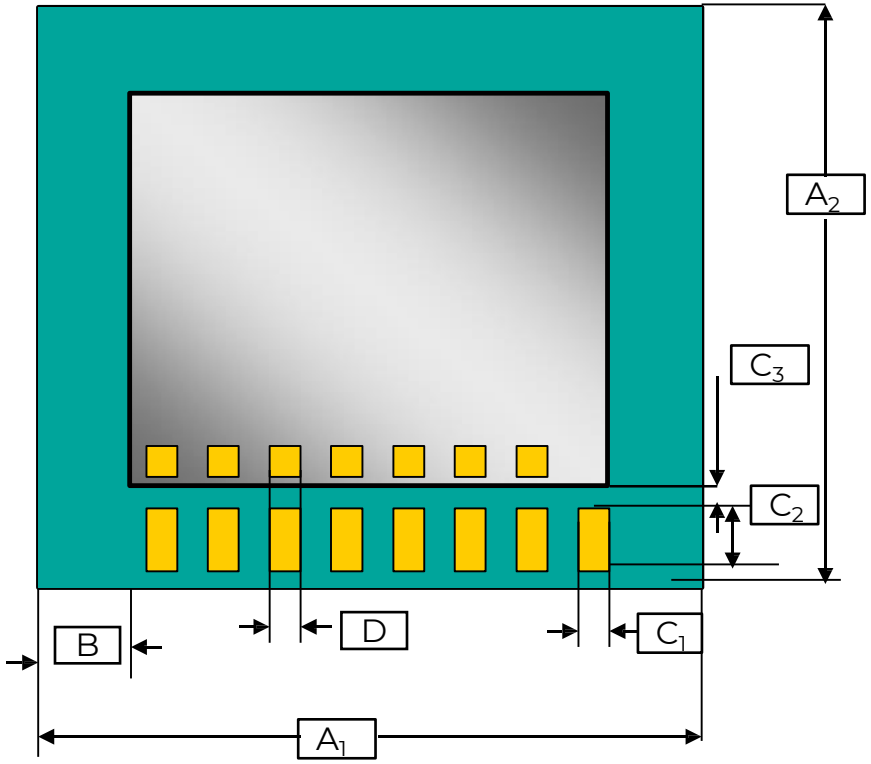


Figure 1

CHIP-ON-BOARD (COB) GUIDE



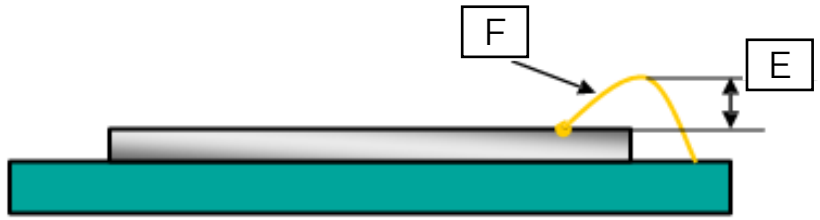
Description	Production/Standard	Prototype/Special
[A1] PCB O.D.	3.5" = Max, for AU ball bond	Die position dependent
[A2] PCB O.D.	8" = Max, for AU ball bond	Die position dependent
[B] Die Paddle Size	0.010"/side	0.005"/side
[C1] PCB Pad	> 0.005"	> 0.003"
[C2] PCB Pad	> 0.010"	> 0.004"
[C3] PCB Pad to Die Edge	Die 2-12 mils thick : 0.014" (350 µm) min	
	Die 12 mils > thick: 0.020" (500 µm) 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

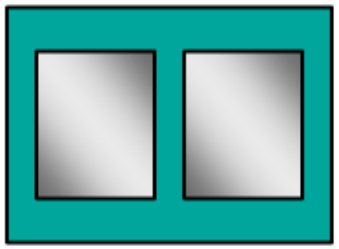
Plating Standards for Copper Clad PCB

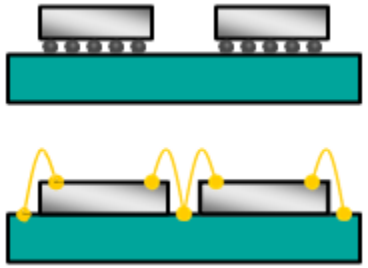
- See next page for plating details

Substrate - Aluminum max size is 12" x 12" / Gold ball = 3.5"x 8"

NOTE: See Flip chip guide for Adjacent component placement guide & size







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

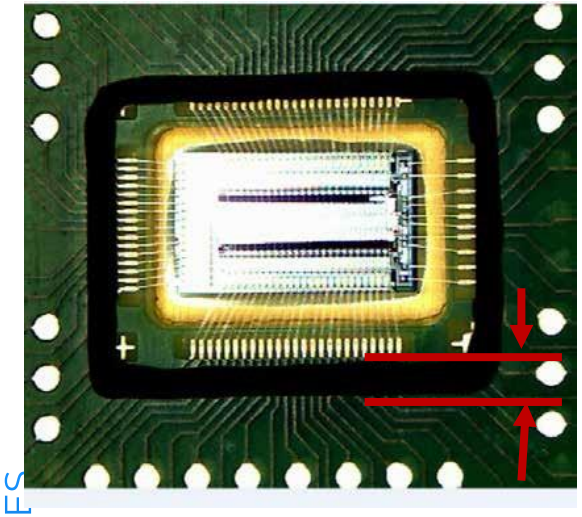
ENEPIG	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	118.1	275.6	3.000	7.000
Electro less Palladium	5.9	13.8	0.150	0.350
Immersion Gold	3.9	11.8	0.100	0.300

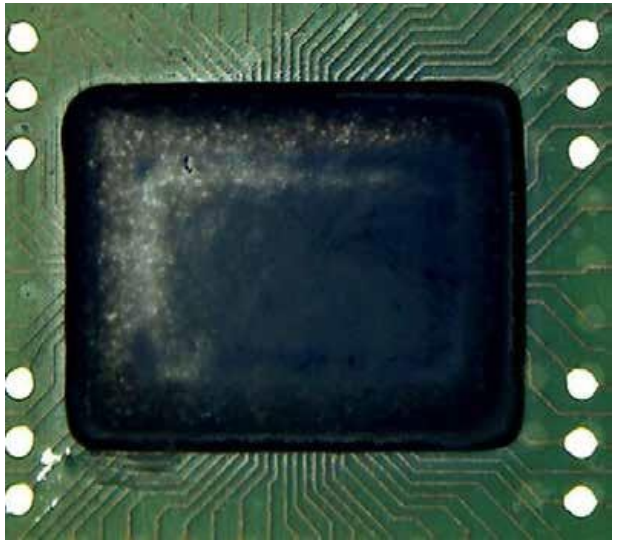
ENIG + Wire Bondable Gold	Min (micro inches)	Max (micro inches)	Min (microns)	Max (microns)
Electro less Nickel	150	250	3.810	6.350
Immersion Gold	3	30	0.076	0.762

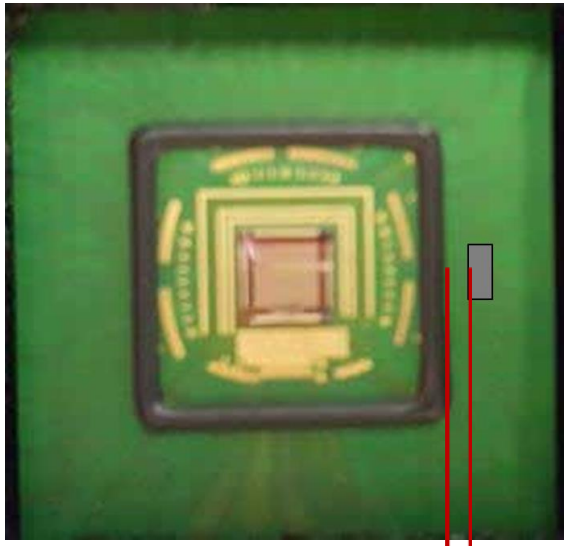
Immersion Silver –subject to “daisy chain” lead to lead wire bond test
Any new COB / PCB with SMT attach –subject to “daisy chain” lead to lead wire bond test.

DAM-N-FILL/GLOBTOP GUIDE

Minimum Dam Width and Placement Tolerance







Component

Min. dam width
= 0.457mm / 18 mils

Std. dam width
= 0.635mm / 25 mils
Height = Job dependent

Accuracy +/- 10mils

Min. Component Clearance
= 0.508mm / 20 mils

INTEGRA TECHNOLOGIES

Molding – FICO / TOWA

Fico – Transfer Molding System:

- Strip size 200 x 70mm
- Pellet form mold compound
- Mold Caps available from 0.6mm – to 1.25mm

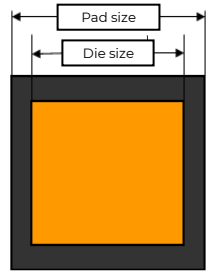
Towa Compression Molding System:

- Standard strip = 200 x 70mm
- Reduced wire sweep and void
- Granular mold compound
- Film assisted
- Mold underfill capable
- Capable of wafer level molding
- Currently tooled for 0.6mm to 0.9mm
- Additional strip sizes / heights available with tooling charge

QFN/DFN STANDARD PACKAGE GUIDE

RoHS Compliant

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 X2.9	0.50	2.4 X 2.4	1.9 X 1.9	QPL-20-QFN-0038 Rv. 0	520	VGGD-5/ WGGD-5
4 X 4	24	LFM-0066	2.85 X 2.85	0.50	2.35 X 2.35	1.85 X 1.85	QPL-24-QFN-0081 Rev. 0	520	-
4X4	28	LFM-0052	2.9X2.9	0.40	2.4X2.4	1.9X1.9	QPL-20-QFN-0067 Rev. 0	520	VGGE
5X5	20	LFM-0048A	3.6 X 3.6	0.65	3.1 X 3.1	2.6 X 2.6	QPL-20-QFN-0040 RV. 1	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
7 X 7	44	LFM-0059	5.6 x 5.6	0.50	5.1 x 5.1	4.6 x 4.6	QPL- 44 -QFN-0019 Rv. 0	176	VKKD-3/WKKD-3
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/ WKKD-6
8X8	52	LFM-0049	6.8 X 6.8	0.50	6.3 X 6.3	5.8 X 5.8	QPL-52-QFN-0004 Rv. 1	140	
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	108	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	72	LFM-0053	8.0x8.0	-	-	-	DWG: QPL-72-QFN-0009 Rev:0	80	-
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	-
12 x 12	80	TBD	9.6 X 9.6	0.50	9.1 X 9.1	8.6 X 8.6	QPL - 80-QFN-0011	56	-
12x12	108	LFM-0051	10.4 X 10.4	0.40	9.90 X 9.90	9.40 X 9.40	QPL-108-QFN-0001 Rv. 0	56	-



Open 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.)
Sumitomo EME-G770HCD Molding compound

INTEGRA TECHNOLOGIES

QFN/DFN CUSTOM PACKAGE GUIDE

RoHS Compliant

Custom Tooled Lead frames Available

Mold Type : Compression or Transfer mold

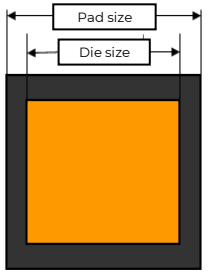
MSL rating : MSL-1 (3x3 –5x5 only) / MSL -3

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

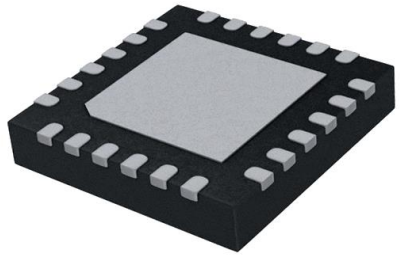


Pkg. size (mm)	Lead Count	CORWIL P/N	Paddle Size (mm)	Lead Pitch (mm)	Max. die size, No-downbonds (mm)	Max. die size, With downbonds (mm)	Lead Frame Vendor DWG. No.	# of units per LF	JEDEC MO-220 Ref.	COMMENTS
3x3	16	LFM-0024A	1.85 X 1.85	0.50	1.35 X 1.35	0.85 X 0.85	DWG: QPL-16-QFN-0092 Rev. 2 (option-2)	884	VEED-4/ WEED-4	fully plated/fully roughened
4x4	16	LFM-0033	2.80 X 2.80	0.80	-	-	QPL-16-QFN-0101 Rv. 0	520	-	some leads tied to the DAP
5X6 DFN	8	LFM-0040	4.45 X 3.81	1.27	-	-	QPL-08-DFN-0109 Rv. 1	288	-	DFN
6X5	36	LFM-0055A	4.25 X 3.25	0.50	-	-	QPL-36-QFN-0032 Rv. 0	288	-	QFN
6X7	44	LFM-0056A	4.32 X 5.46	0.50	-	-	QPL-44-QFN-0016 Rv. 0	224	-	QFN
6X8	48	LFM-0057	4.50 X 6.50	0.50	-	-	QPL-48-QFN-0079 Rv. 1	180	-	QFN
6x6	33	LFM-0031	4.75 X 4.75	0.50	-	-	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. 1	154	-	
8X8	4	LFM-0058	4.55 X 7.40	-	-	-	QPL-04-QFN-0029 Rv. 0	140	-	
8X8	56	LFM-0067	6.9 X 6.9	0.50	6.4 X 6.4	5.9 X 5.9	QPL-56-QFN-0043 Rev,0	140	-	some leads tied to the DAP
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

Final package thicknesses up to 1.45mm – MSL 1 up to 5x5mm

	Standard-1	Standard -2
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= 0.7 –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:

- 0.8–1.25 mils depending on die BPP/BPO

Molding Compound:

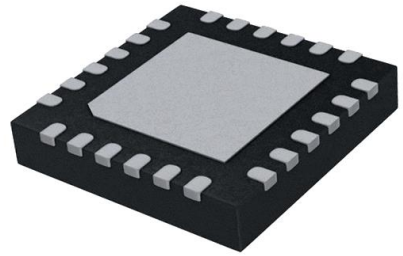
- Sumitomo EME G770HCD (green)

QFN PACKAGE DESIGN GUIDE

Dam and Fill Encapsulation –MSL3

	Standard -1	Standard-2
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	2 - 3	1

Note: New thicknesses available!



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

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- Ni = 20-80 micron inches
- Pd= 0.7 –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 conductive (Pb-free)
- Ablebond 84-3 non-conductive (Pb-free) Die Attach
- Ablebond 2001A conductive Die Attach
- Film (DAF) –non-conductive *Other materials available upon request*

Gold Wire:

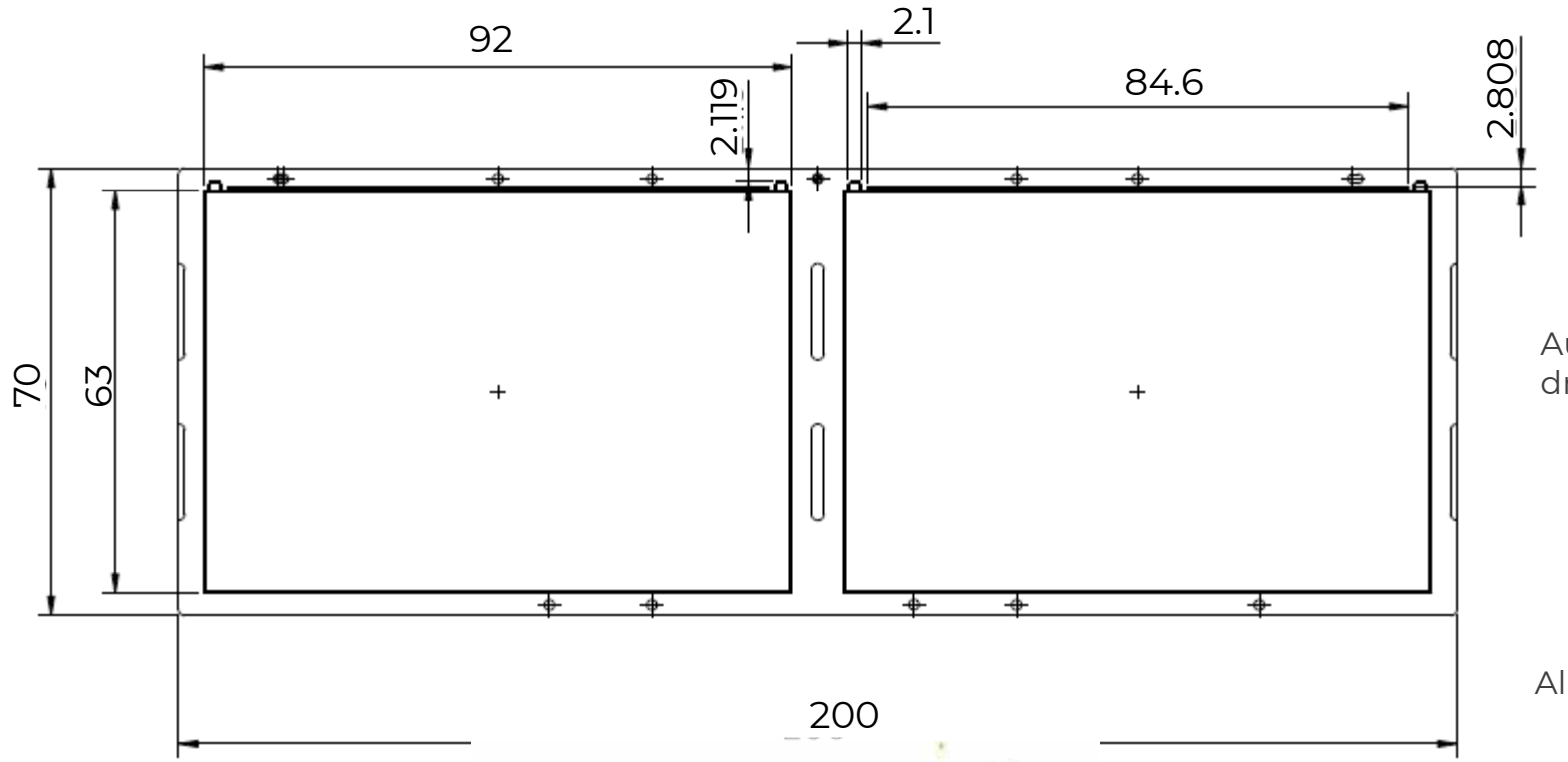
- 0.8–1.25 mils depending on die BPP/BPO

Molding Compound:

- HysolHP4450 / HP4451

QFN/CSBGA PACKAGE DESIGN GUIDE

QFN / CSBGA Strip Outline – Transfer and Compression Mold



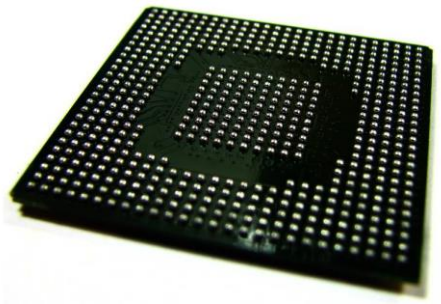
AutoCAD or Solidworks drawing also available

All dimensions in mm

MAP BGA GUIDE

MAP / Saw Singulated Ball Grid Array, Options Available

Package Size (mm)	BGA Pitch (mm)	Standard Solder Ball Size (mm / mils)	Maximum Ball Count	Substrate Thickness (mm)	Mold Cap Thickness Options	Total Pkg Thickness (mm)	Non-Pb Free	Pb-free
3x3 - 32x32 Up to 65x65 Possible but not ideal	*0.40*	*0.25 / 10*	Calculated Based on pkg size and ball pad pitch	0.15 – 1.80 Mold system limited	0.60, 0.80, 1.0 and 1.25	~1.00 to ~2.05	Sn/Pb - 63/37	SAC305 (Sn96.5/Ag3 /Cu0.5) SAC405 (Sn95.5/Ag4 /Cu0.5)
	0.50	0.304 / 12						
	0.80	0.40 - 0.50 / 16-20						
	1.00 1.25	0.50 - 0.635 / 20 - 25						



Other Pb free options available upon request.

INTEGRA TECHNOLOGIES

PACKAGE LASER MARK GUIDE

Current Internal Laser Mark

- Machine: EPILOG
- Wavelength: 1062nm (Red)

Capable of marking:

- Molding compound surface
- Dam and fill/ Glob top surface
- Metal surfaces such as Gold/ aluminum plated surface, i.e. combo lids and heat sinks.
- Backside of die after flip chip attach.
- Serialization, 2D Barcoding
- WLCSP tape

SEAM SEAL GUIDE

Machine type : Polaris Venus IV parallel seam sealer

- Seam Seal process for dies that can not tolerate high temperature.
- With in-line vacuum pre-seal bake oven back filled with Nitrogen.
- Glove box purged with 100% Nitrogen.
- Glove box with moisture monitor
- Semi-automatic hermetic sealing and solder reflowing on metal and ceramic packages
- Linear, linear matrix and rotary sealing to MIL SPEC 883
- Seals round, rectangular and square packages from .08" to 5.5" with fixturing available for up to 9" packages
- Self-contained tacking operation in all modes
- Closed loop control of weld force
- Programmable weld speed of 0.5 to 2.0 in/sec
- Maximum power output of 3500 watts
- Moisture and oxygen interlock weld set points
- Low package temperature during sealing process
- Non-volatile memory with storage for up to 25 weld schedules
- Positioning accuracy 0.001" (stepper motor control)
- Programmable welding force of Oto 2500 grams
- Independent stepper motor control of all 6 axes of motion

SiPho FIBER CONNECTION

HexNano Alignment System from Physik Instrumente L.P. (PI).

High accuracy fiber array waveguide attachment system

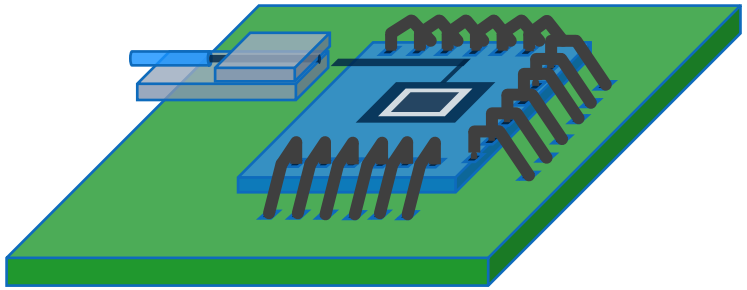
- Non-hermetic
- Integrated scan routines for fiber optic alignment
- Ideal for applications in silicon photonics
- Extensive software package
- Direct detection of the optical signal
- Position sensors for high accuracy and operational reliability
- Automatic alignment of several fibers in <0.2s

Critical Considerations:

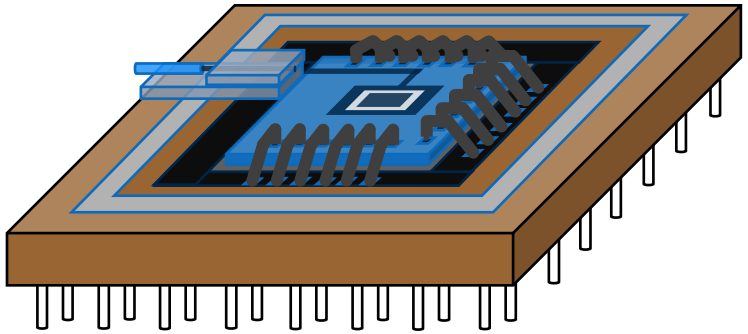
- Package requirement
- Fixturing for fiber attach
- Type of Fiber being connected – polarized or non-polarized
- Contact or Air Gap
- Air Gap encapsulation?
- Refractive index of Epoxy
- Requires multiple fiber? Need tolerance of Fiber Array
- Need maximum temperature

SiPho Package Type

Plastic
(COB, BGA)

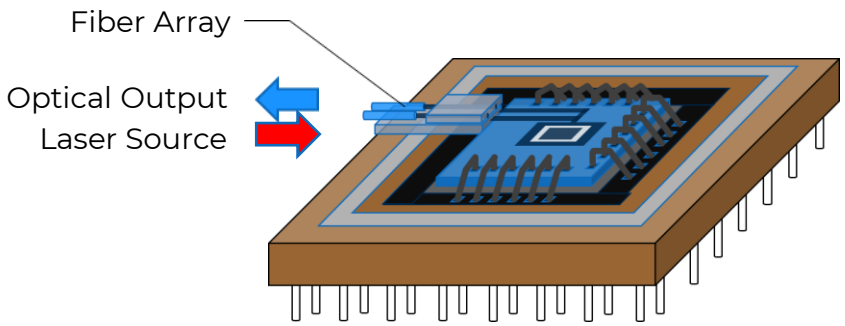


Ceramic
(PGA, LCC)

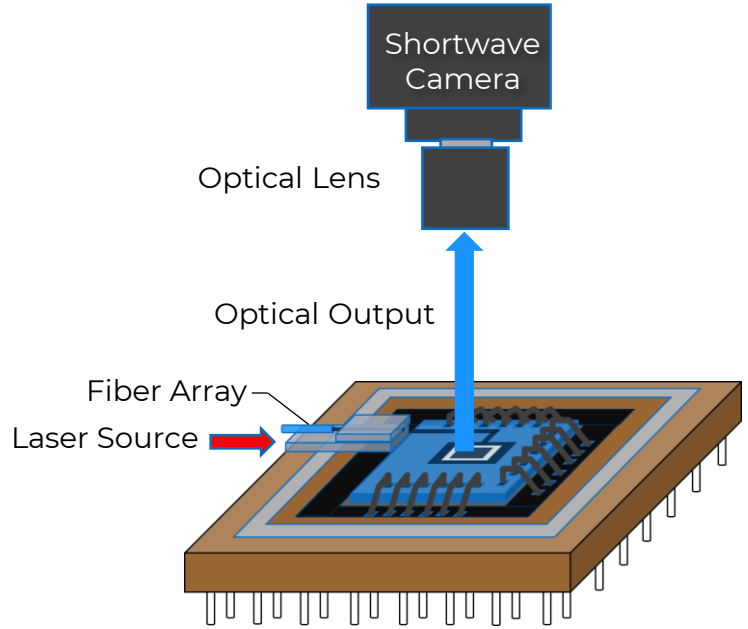


SiPho Methodology

1. Two Fiber Active Alignment Method

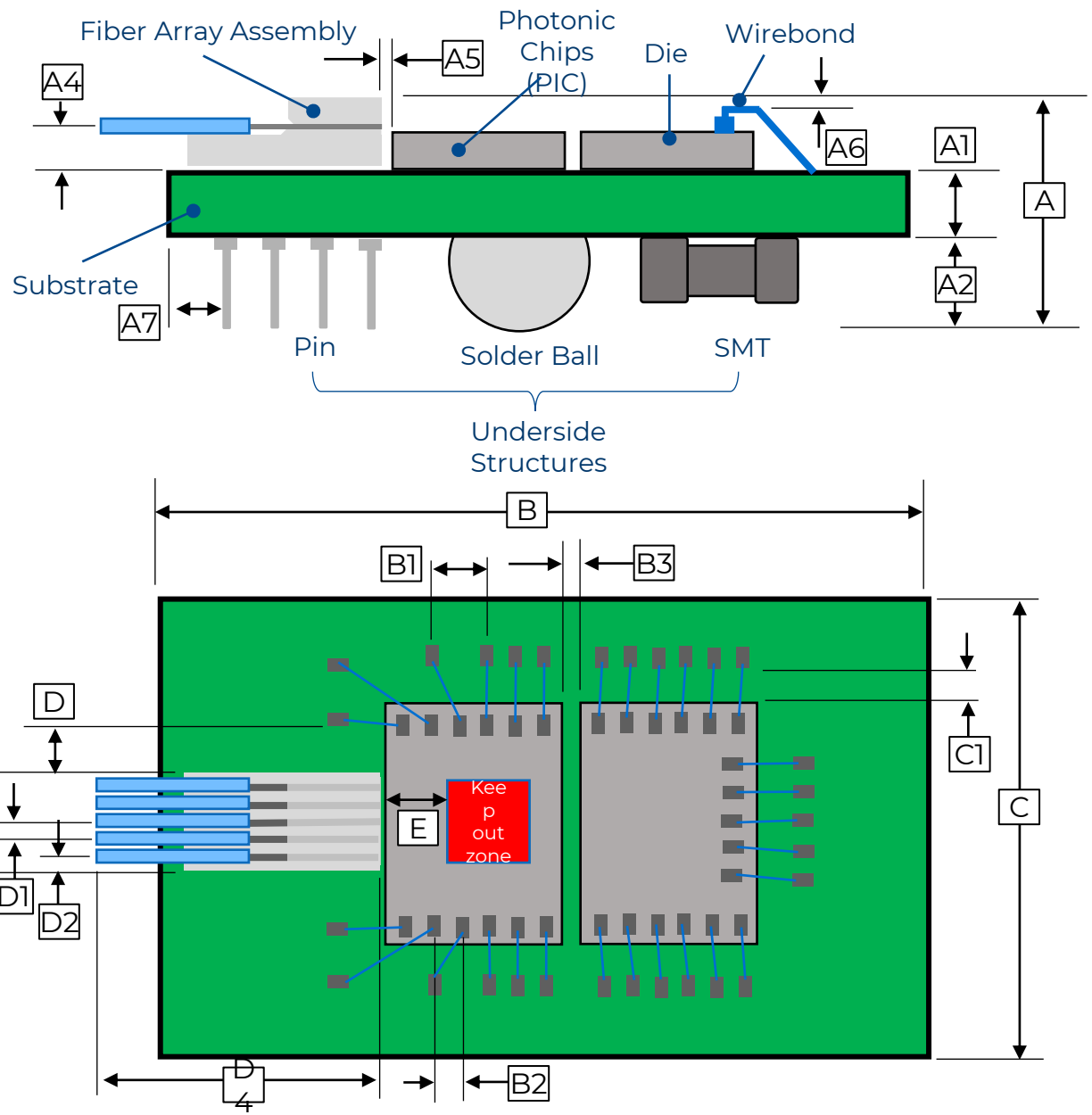


2. Active Alignment via Short-Wave Camera for Optical Phase Array Emitter



Design Guidelines

Description	Min	Max
[A] Overall Substrate Thickness	0.3mm	75mm
[A1] Substrate Thickness	0.3mm	50mm
[A2] Substrate Underside Structures	--	25mm
[A4] Substrate-to-Optical Facet Distance	1.6mm	2.0mm
[A5] Fiber-to-Optical Facet Distance	5um	20um
[A6] Wirebond loop-to-Array Clearance * If wire is close proximity to Array	1.0mm	--
[A7] Underside Structures-to-Edge Clearance.	2.0mm	--
[B] Substrate Length	10.0mm	150mm
[B1] Wirebond Lead Pitch	**(Refer to W/B Design Guideline)**	
[B2] Wirebond Pad Pitch	**(Refer to W/B Design Guideline)**	
[B3] Chip-to-Chip Clearance	**(Refer to D/A Design Guideline)**	
[C] Substrate Width	10.0mm	150mm
[C1] Die-to-Wirebond Lead Clearance	Refer to W/B Design Guideline	
[D] Wirebond-to-Fiber Array Clearance	1.0mm	--
[D1] Fiber Array Pitch	0.127 +/-0.001mm	--
[D2] Fiber-to-Array Edge Clearance	0.3mm	--
[D3] Array Width	2.0mm	
[D4] Fiber Length	0.3m	5m
# of Fiber on Array	1	--
Fiber Type	PM or Non-PM	
Fiber Connectors	FC/APC or FC/PC	
Adhesive Refractive Index	1.52	
Temperature (°C)	-40	85



SHIPPING MEDIA

Die based product

Waffle Packs

Readily available – usually supplied by Integra

Gel-Paks

Readily available – supplied by customer or Integra

Tape and Frame

Metal and Plastic

Wafer Boat

Wafer Container

Tape and Reel

Tooling considerations at times – 6 to 8 week lead times

Packaged Product

Trays

- Standard JEDEC sizes readily available
- Unusual sizes or unencapsulated product require extra time

Tape and Reel

Standard sizes readily available

Tubes

Customer supplied and usually discouraged

Jewel Boxes

Supplied by Integra

Custom

Supplied by the customer

Enhanced Handling

CLEANLINESS

- Integra's Assembly Cleanroom is class 10,000 with hoods where particle count is <250
- Class 1000 cleanroom with hoods where particle count is <100

ESD SENSITIVITY

- Default level 1 ESD standard
- Using additional equipment and processes we can accommodate level 0
  - Additional set-up and cost required

MOISTURE SENSITIVITY (MSL)

- Integra sees multiple programs with moisture sensitivities ranging from 5 to 1
- Material selection, die, and package sizes all play a roll in determining MSL

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.

INTEGRA TECHNOLOGIES

THANK YOU

1635 McCarthy Blvd., Milpitas, CA 95035

(408) 618-8700

Sales_inquiry@integra-tech.com

www.integra-tech.com