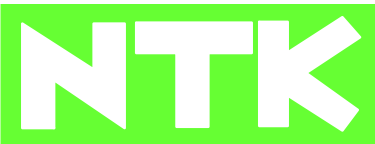

NGK SPARK PLUG CO.,LTD
2808,IWASAKI,KOMAKI,AICHI,485,JAPAN

Rev. H / Oct.2005

- Alumina Cofired Ceramic Flip Chip Package -

General Design Guide

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NGK SPARK PLUG CO.,LTD
2808,IWASAKI,KOMAKI,AICHI,485,JAPAN

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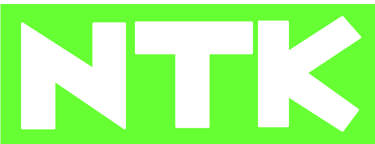


1. General

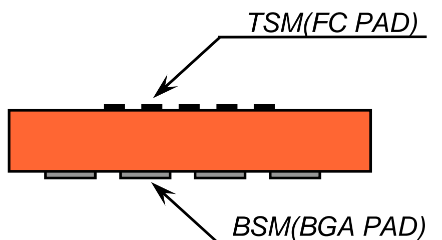
1-1 Out Line

UNIT:mm

Item	Standard	Special
Size	≤ 50 sq.	≤ 94 x 100
Layer Thickness	0.127 0.152 0.203 0.254 0.381 0.508 0.635	0.040 (2mil tape) 0.102
Substrate Thickness	≤ 3.30	≤ 5.08
Layer Count (reference)	20 Max.	30 Max.

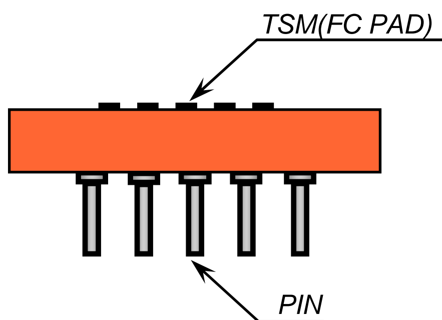
1-2 Plating Condition

1-2-1 Flip Chip BGA



TSM	BSM
Electroless Ni (3.2μm Min.) +Electroless Au(0.03~0.10μm)	Electroless Ni (3.2μm Min.) +Electroless Au(0.03~0.10μm)

1-2-2 Flip Chip PGA



TSM	PIN (BSM)
Electroless Ni (3.2μm Min.) +Electroless Au(0.03~0.10μm)	Electrolytic Ni (2.0μm Min.) +Electrolytic Au(1.27μm Min.) (with Pin Through Plating)

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1-3 Applicable Layer Thickness

(A) Ability of Via Filling

THK / Via Dia (µm)	Special Sheet		STD. Sheet						
	0.040 mm (2 mil)	0.102mm (4 mil)	0.127mm (5 mil)	0.152mm (6 mil)	0.203mm (8 mil)	0.254mm (10 mil)	0.381mm (15 mil)	0.508mm (20 mil)	0.635mm (25 mil)
70 µm	✓	✓	✓	✓					
95, 100 µm	✓	✓	✓	✓	✓	✓	Need divide into some thinner sheets		
130, 150 µm	✓	✓	✓	✓	✓	✓	✓		
200 µm	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note 1. NTK recommends to use 6 mil sheet for a top (F/C pad) layer.
2. Use of special sheet thickness should be discussed with the NTK engineering.

(B) Ability of Via Punching

THK / Via Pitch	Special Sheet		STD Sheet			
	0.040 mm (2 mil)	0.102mm (4 mil)	0.127mm (5 mil)	0.152mm (6 mil)	0.203mm (8 mil)	0.254mm (10 mil)
250µm *(100µm dia.)*						
225µm *(95µm dia.)*	Gang Punching					
200µm *(95µm dia.)*						
180µm *(70/95µm dia.)*			Block (Semi-hard) Punching			

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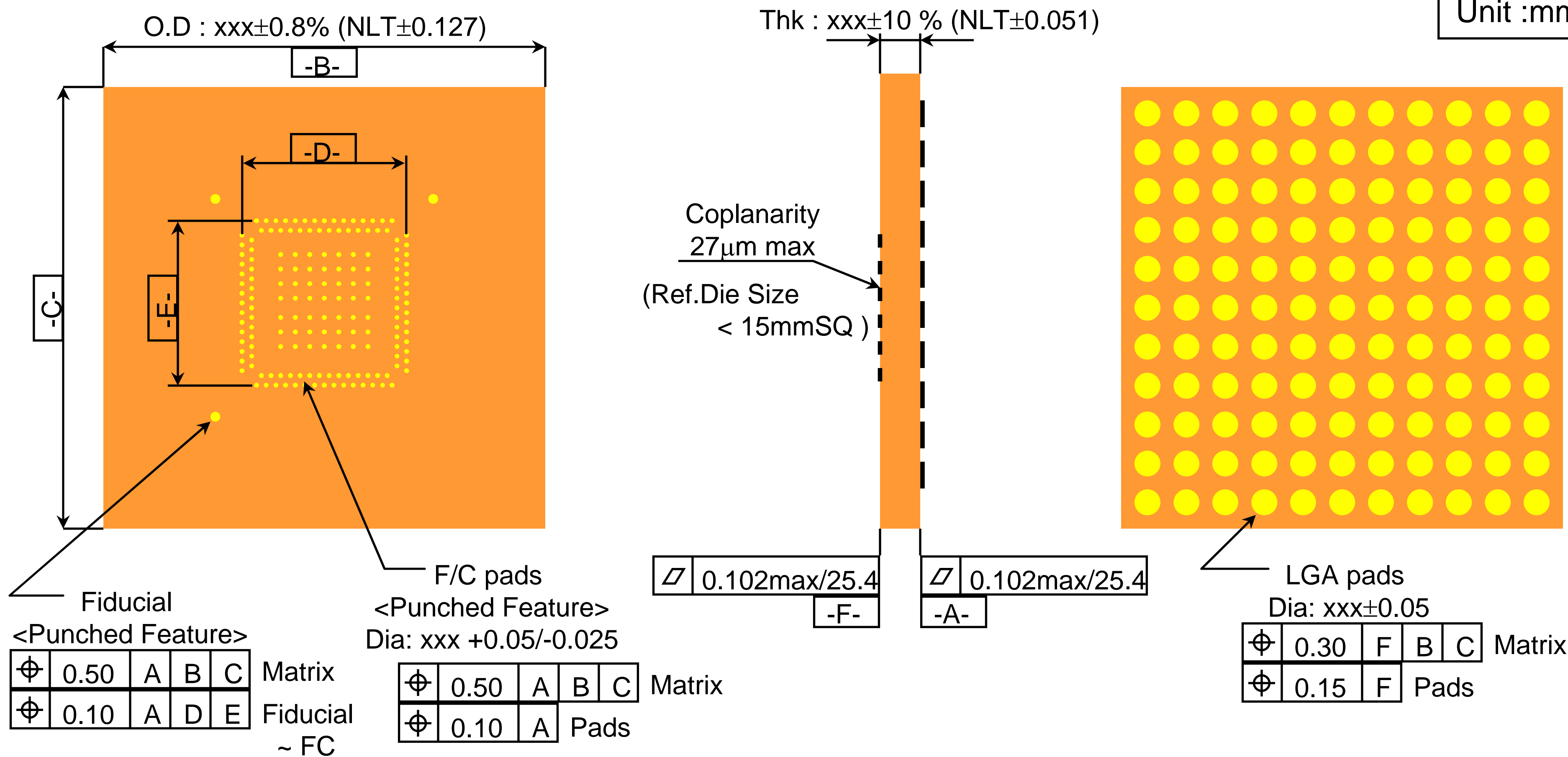
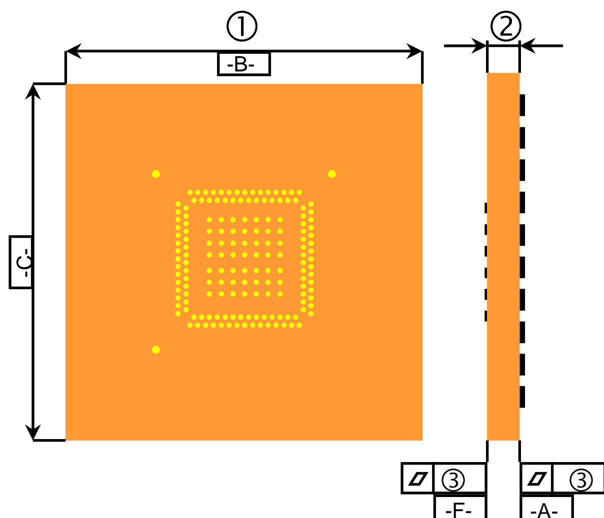
1-4 Properties

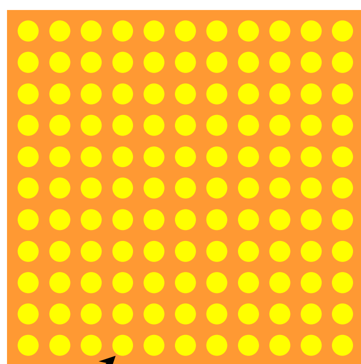
Item	Unit	Value
TCE (RT~800deg.C) (RT~400deg.C)	[ppm/deg.C] [ppm/deg.C]	7.6 6.8
Thermal conductivity	[W/m deg.C]	17
Dielectric constant		9.8(@1MHz) 9.0(@10GHz)
Dielectric loss		0.0004(@1MHz) 0.0010(@10GHz)
Volume Resistivity	[ohm·m]	$>10^{12}$
Young Modulus	[GPa]	280
Bending Strength	[MPa]	350
Conductor Resistance (100μm w trace : Mo)	[mohm/sq.]	8

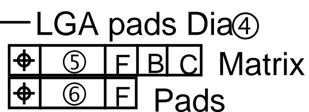
2. Dimensional Specifications



2-1 Out Line



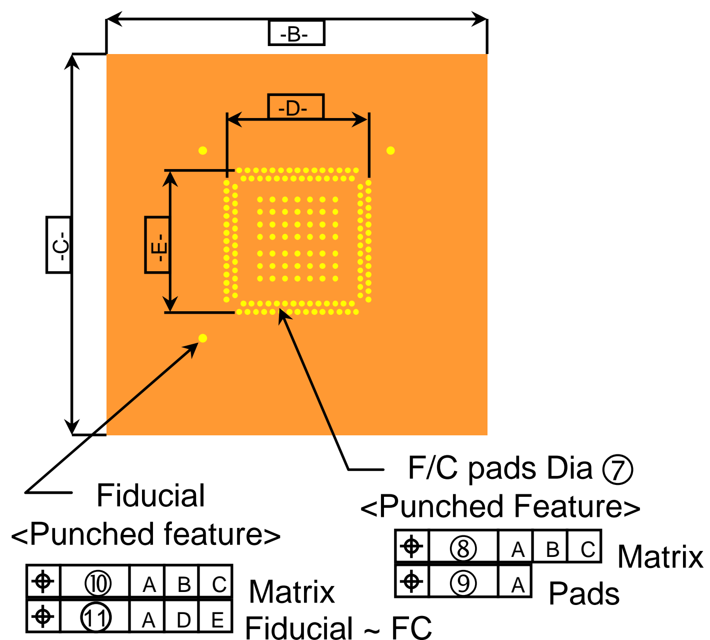




Unit : mm

	Std.	Special
① O.D	+/- 0.8% NLT 0.127	+/- 0.5% NLT 0.10
② Thk.	+/- 10% NLT 0.05	+/- 5% NLT 0.04
③ Flatness	0.102 Max /25.4	0.051 Max /25.4
④ LGA Pad Dia.	+/- 0.05	
⑤ Matrix True Position (PKG center ~ LGA center)	0.30 (+/- 0.15)	0.20 (+/- 0.10)
⑥ Pad ~ Pad True Position (Total Pitch)	0.15 (Total P : +/-0.15)	0.10 (Total P : +/-0.10)

2-2 Flip Chip Area



Unit : mm

	Std.	Special
⑦ F/C Pad Dia.	+ 0.051 - 0.025	+/- 0.025
⑧ Matrix True Position (PKG center ~ F/C center)	0.50 (+/- 0.25)	0.25 (+/- 0.127)
⑨ Pad ~ Pad True Position (Total Pitch)	0.10 (Total P : +/-0.10)	+/- 0.3% NLT 0.04
⑩ Matrix True Position (PKG center ~ Fiducial center)	0.50 (+/- 0.25)	0.25 (+/- 0.127)
⑪ Fiducial ~ FC True Position (F/C Matrix center ~ Fiducial)	0.10 (+/- 0.05)	

2-3 Coplanarity < Least Square Method >

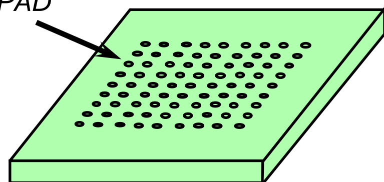
Standard Coplanarity Specification for reference

CHIP SIZE	≦ 10mmSQ.	≦ 15mmSQ.	≦ 20mmSQ.
Standard Coplanarity Specification	20μm MAX.	27μm MAX.	38μm MAX.

<DEFINITION OF COPLANARITY>

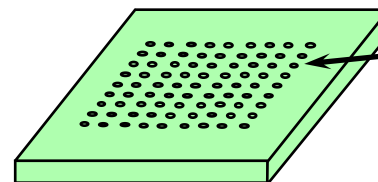
Step 1 Making Imaginary Plane

MEASUREMENT PAD
(25 PADS)



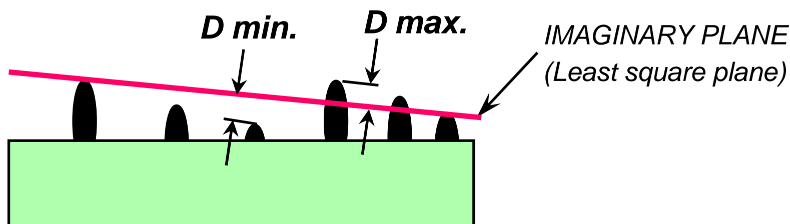
* Make the imaginary plane by using
25 F/C pads position (x,y,z).
< Imaginary plane is defined by least square plane method
using 25 points. >

Step 2 Measurement of Coplanarity



MEASUREMENT PAD
(25 PADS)

* Calculate the distance between
imaginary plane (Least square plane) and
25 F/C pads (D1 ~ D25).

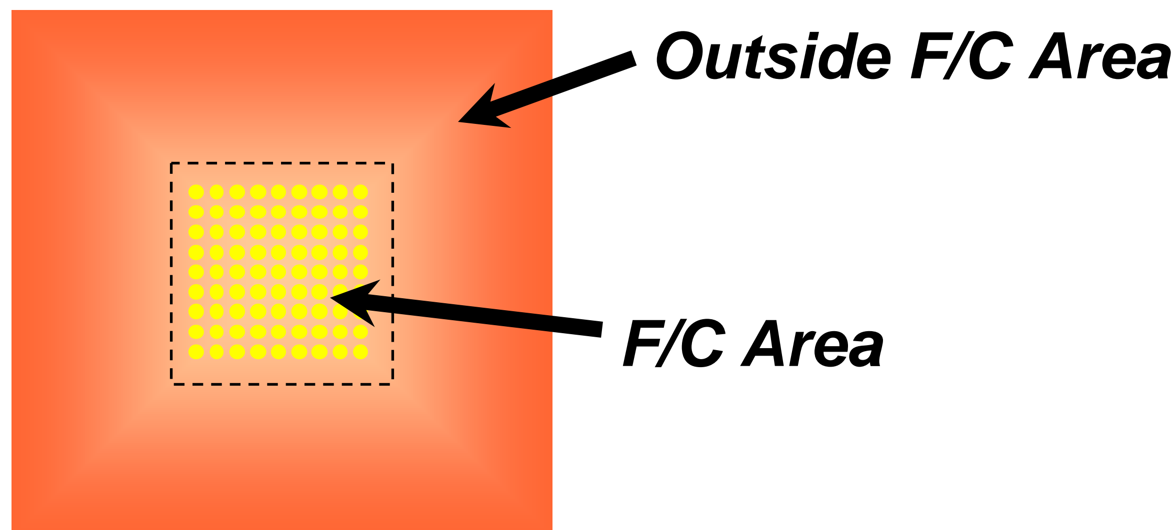


COPLANARITY = Dmax. + Dmin.

3. Internal Design Rule

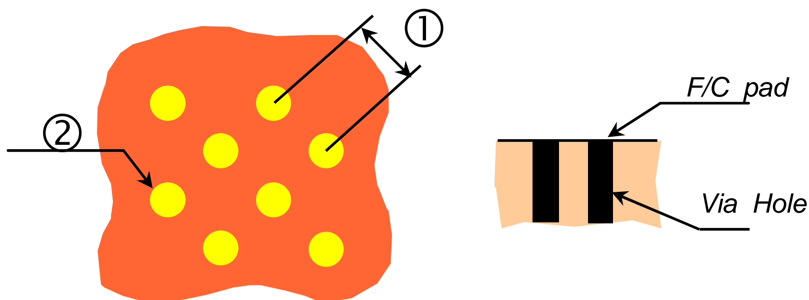
Design Rules are separated into "Fine Rule" Area & "Regular Rule" Area for better productivity.

* *Flip Chip Area : "Fine Rule" Area*
* *Outside Flip Chip Area : "Regular Rule" Area*



3-1 Flip Chip Area (Fine Design Rule Area)

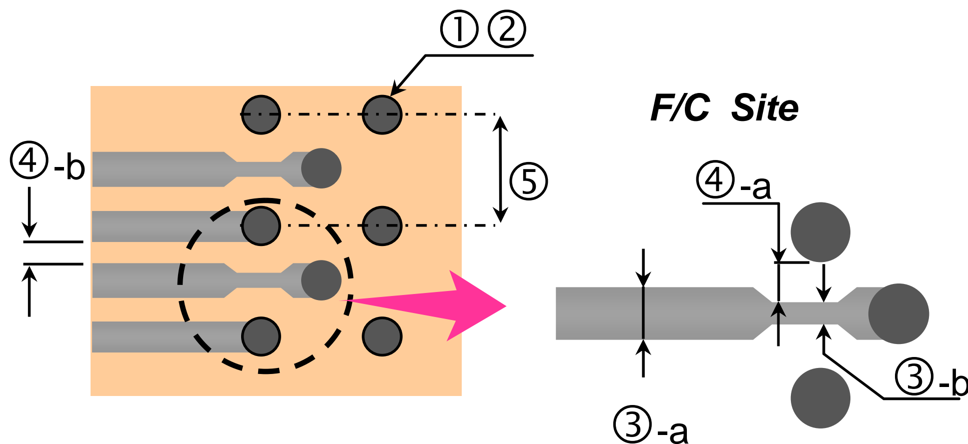
3-1-1 F/C Pad



UNIT:μm

Design Parameter	Production	Pilot
① Pad (Via) Pitch	≥ 180	≥ 150
② Pad (Via) Diameter	≥ 70	≥ 60

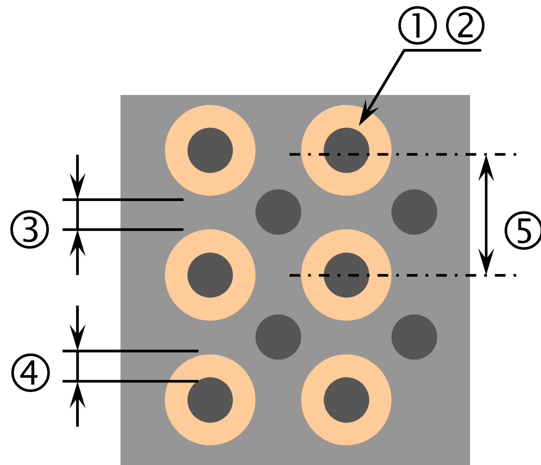
3-1-2 Signal Line



UNIT:μm

Design Parameter	Production	Pilot
① Via Diameter	≥ 70	≥ 60
② Cover Pad	≥ 70	≥ 60
③-a Line Width	≥ 60	≥ 55
③-b Line Width (between vias)	≥ 40	≥ 35
④-a Isolation Gap (via to line)	≥ 60	≥ 55
④-b Isolation Gap (line to line)	≥ 60	≥ 55
⑤ Via Pitch	≥ 230	≥ 205

3-1-3 PWR / GND Plane



UNIT;μm

Design Parameter	Production	Pilot
① Via Diameter	≥ 70	≥ 60
② Cover Pad Diameter	≥ 70	≥ 60
③ Metal Path width	≥ 30	≥ 25
④ Isolation Gap	≥ 60	≥ 55
⑤ Via Pitch with Metal	≥ 220	≥ 195

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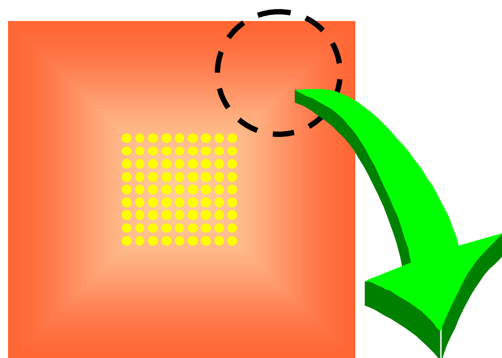
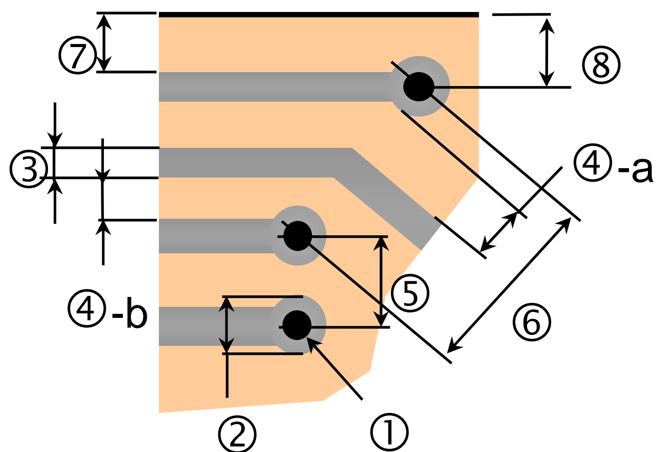
3-2 Outside Flip Chip Area (Regular Design Rule Area)

3-2-1 Signal Line



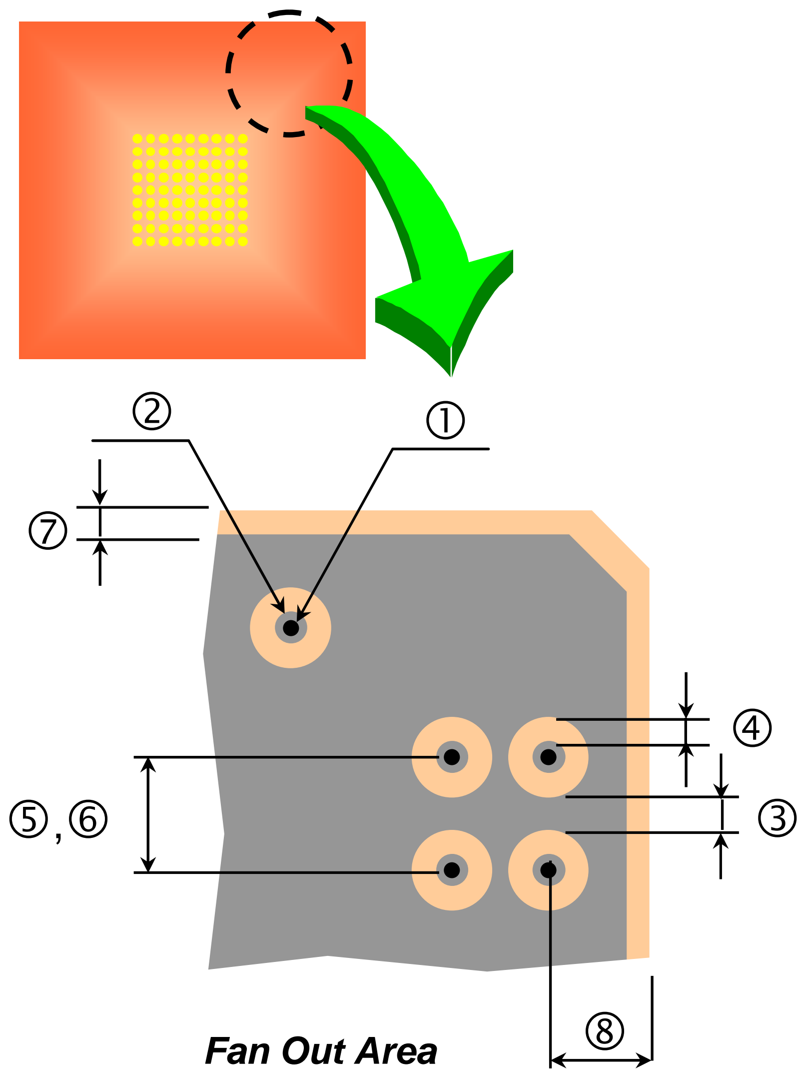


Another Site

UNIT : μm

Design Parameter	Standard	Special
① Via Diameter	≥ 150	≥ 100
② Cover Pad Diameter	≥ 250	≥ 100
③ Line Width	≥ 100	≥ 75
④-a Isolation Gap(pad to line)	≥ 150	≥ 120
④-b Isolation Gap (line to line)	≥ 150	≥ 100
⑤ Via Pitch	≥ 640	≥ 250
⑥ Via Pitch with 1 Line ②+③-b+2 x ④-a	≥ 650	≥ 415
⑦ Ceramic Edge to Line	≥ 640	≥ 300
⑧ Ceramic Edge to Via	≥ 640	≥ 380

3-2-2 PWR / GND Plane



UNIT : μm

Design Parameter		Standard	Special
① Via Diameter		≥ 150	≥100
② Cover Pad Diameter		≥ 250	≥ 100
③ Width of Metal between Vias		≥ 150	≥ 75
④ Isolation Gap (pad to Plane)	STD tape	≥ 225	≥ 150
	Less than 5 mil tape	≥ 300	≥ 225
⑤ Via Pitch		≥ 640	≥ 250
⑥ Via Pitch with Metal ②+③+2 x ④	STD tape	≥ 850	≥ 475
	Less than 5 mil tape	≥ 1000	≥ 625
⑦ Ceramic Edge to Plane		≥ 760	≥ 640
⑧ Ceramic Edge to Via		≥ 640	≥ 380

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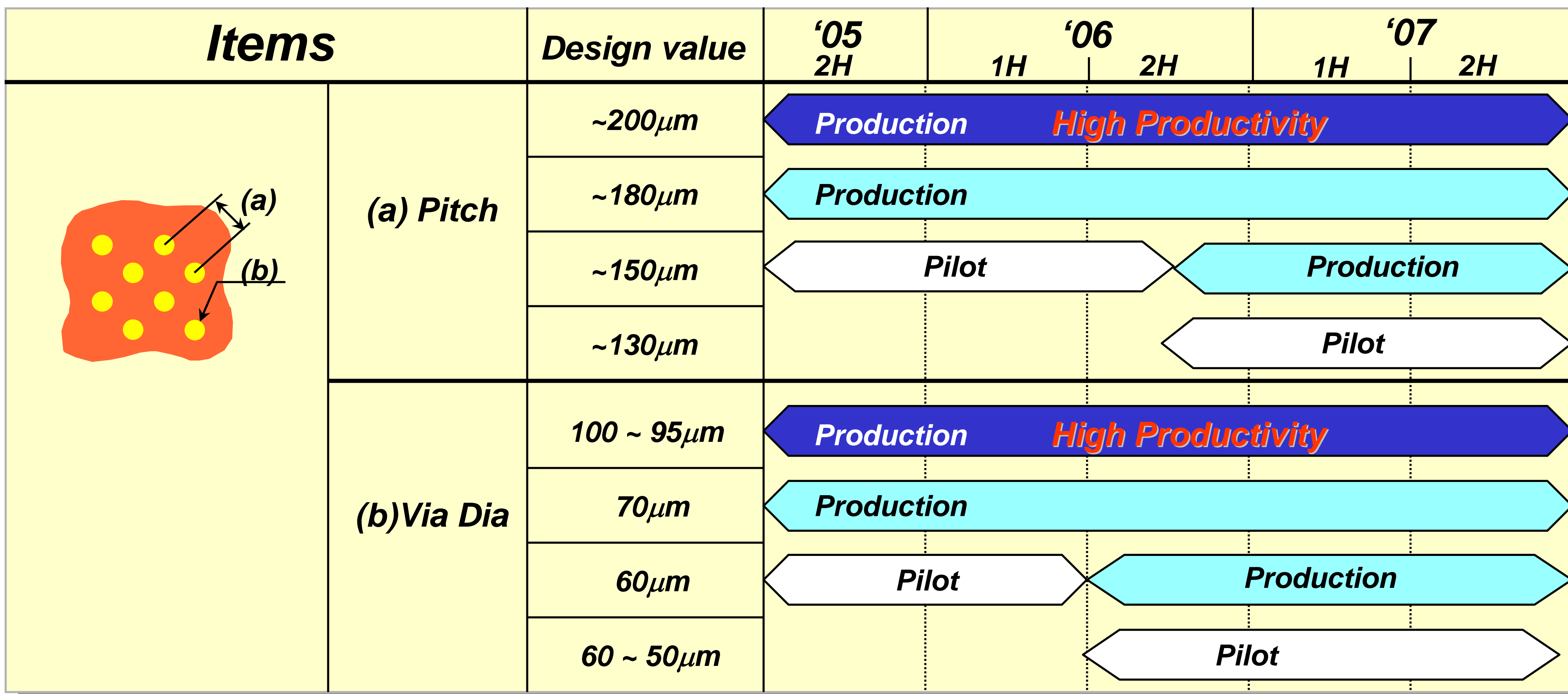
4. Design Rule Road Map

4-1 Flip Chip Pad



4-2 Signal

Items	Design value	'05 2H	'06 1H	'06 2H	'07 1H	'07 2H
(a)Min Gap (Via ~ Line)	≥ 90µm	Production		High Productivity		
	≥ 60µm	Production				
	≥ 55µm	Pilot	Production			
	≥ 50µm		Pilot		Production	
	50~30µm				Pilot	
(b) Line Width (neck down)	≥ 50µm	Production		High Productivity		
	≥ 40µm	Production				
	≥ 35µm	Pilot		Production		
(c) Line Width / (d) Space (routing)	≥ 75 / 75µm	Production		High Productivity		
	≥ 60 / 60µm	Production				
	≥ 55 / 55µm	Pilot	Production			
	≥ 50 / 50µm		Pilot		Production	
	50~30 / 50~30µm				Pilot	

(a) (b) (c) (d)

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4-3 PWR/GND Plane