

TOSHIBA

SYSTEM CATALOG

System LSI Packaging

Efficiency = 92%
Efficiency = 84%

bioplast
bioplast

Efficiency = 97%
Efficiency = 57%

bioplast
bioplast

Packaging Solutions

To meet the ever-increasing demands for higher levels of system integration, semiconductor packages have evolved from through-hole to surface mount types, and from peripheral-led to area array formats. Additionally, the growing and diversifying system requirements have continued to drive the development of a variety of new package styles and configurations.

In this circumstance, Toshiba has defined five categories of enabling technologies and assigned relative importance to each of them in satisfying various customer needs. The objective is to draw up specifications on which to base the development of packaging solutions tailored to particular applications.

1 Small-form-factor and lightweight technology

We are working to develop packages for space-constrained devices such as cell phones and media cards where reduced size and weight are absolute necessities. Our packaging portfolio offers a wide range of area array and multi-chip module packages that meet such customer needs.

Toshiba will continue to enhance its small-form-factor package offerings, based on innovations of interconnect, substrate and testing technologies. The ball/lead pitch will eventually drop to 0.8 mm, 0.65 mm or 0.5 mm, and 3-D die stacking will be further improved.

2 Low-profile technology

To support slim electronics, including cell phones and media cards, Toshiba is heavily involved in providing low-profile packaging solutions. At present, packages with a 1.2-mm thickness are the mainstay, and 0.5-mm-thick packages are available for particular applications. Our efforts encompass a wide range of projects, including interconnect, substrate, encapsulation and testing. The goal is to reduce the thickness of the most widely used packages to 0.65 mm.

3 High-pin-count technology

Networking is one of the most demanding areas requiring high-pin-count packages. Packages with 1000+ pins are currently available. Toshiba will develop ultra-high-pin-count packages with more than 2000 pins.

4 High-speed technology

High-speed packages are designed to meet the requirements of cell phone and networking applications. Toshiba's package offerings include 16- and 24-pin packages for 1.5-GHz cell phone applications and >1000-pin packages for >500-MHz networking applications. To support 2.0- and 5.0-GHz bands, Toshiba is focused on ways to reduce signal loss through improvements in interconnect and substrate technologies.

5 Thermal dissipation technology

Superior thermal dissipation is essential for networking and automotive applications. Currently, Toshiba offers packages with 1 W/mm²-class thermal performance. For electronics cooling, system-level thermal design is expected to become increasingly important; thus Toshiba is preparing thermal models and data for its packages.

■ Packaging Solutions

Optimal packaging solutions for various end-use products

System Requirements	Cell Phones / Pagers	Media Cards	Mobile Devices (PCs, PDAs, DSCs)	Digital Broadcasting (Digital TVs, DVDs)	Networking	Gate Consoles	Automotive Electronics
Small Form Factor	★★★★★	★★★★	★★★★★				★★★
Low Profile	★★★★★	★★★★★	★★★★★				
High Pin Count			★★★	★★★	★★★★★	★★★★★	
High Speed	★★★★★		★★★★	★★★	★★★★	★★★★	
Thermal Performance	★★★		★★★★★		★★★★	★★★★★	★★★★★
Packaging Solutions	QON/TQON/VQON				FCBGA/PBGA[FC]		
	PFBGA	PFBGA	PFBGA				PFBGA
	Stacked MCP		Stacked MCP			EBGA	
	FLGA	FLGA	FLGA				
	TCP/COG		TBGA	TBGA	TBGA		
			TCP/COG				
			PBGA	PBGA	PBGA		
	CCD/CMOS		CCD/CMOS				High Power QFP

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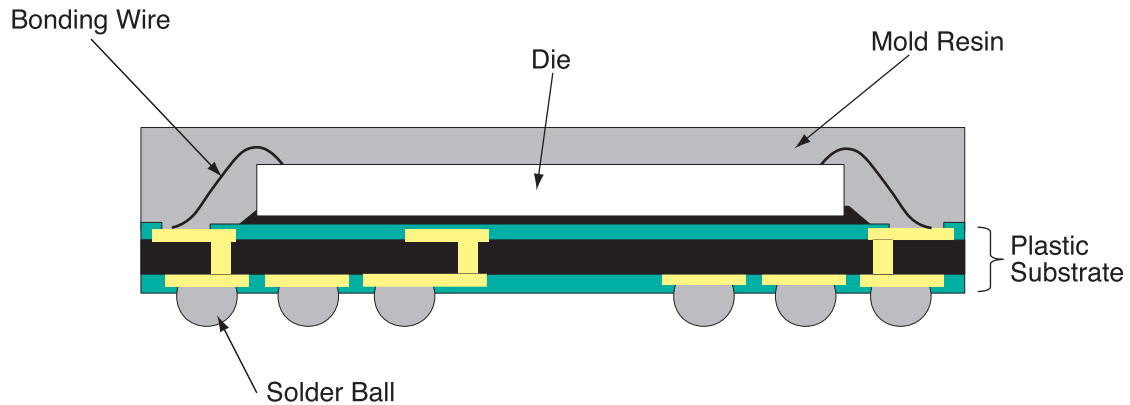
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Packaging Overview

PFBGA / PTFBGA / PVFBGA

PFBGA: Plastic Fine-Pitch Ball Grid Array

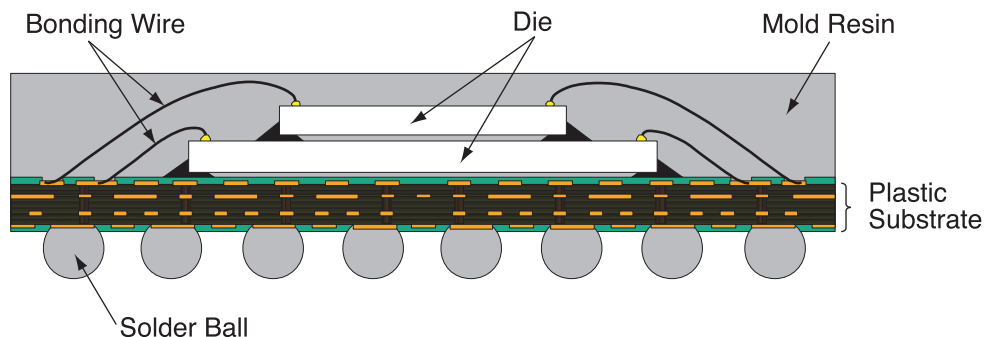
- **Features:** Small form factor and low profile
- **Structure:** The die is wire-bonded to a plastic substrate in an overmolded package body.
- **Intended Use:** PCs, DVD players/recorders, cell phones, etc.



Stacked PFBGA / PTFBGA

Stacked PFBGA: Stacked Die Plastic Fine-Pitch Ball Grid Array

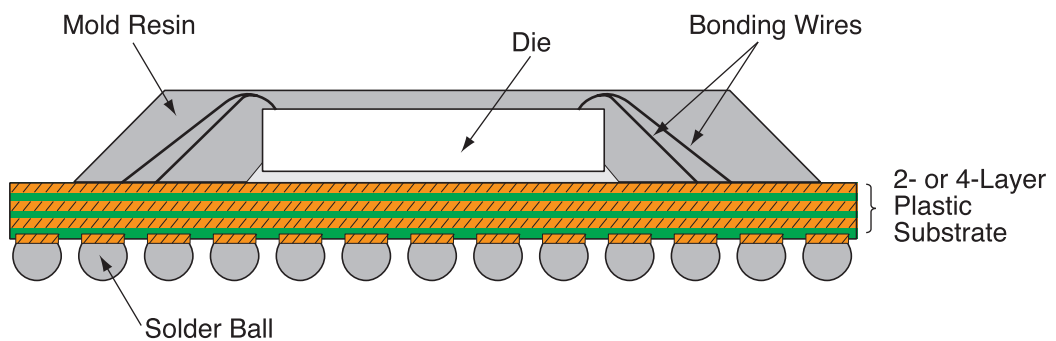
- **Features:** Multi-chip packaging provides substantial board space savings.
- **Structure:** Multiple die are stacked on top of each other and wire-bonded to a plastic substrate in an overmolded package body.
- **Intended Use:** Cell phones, mobile devices, etc.



PBGA/PBGA[4L]

PBGA: Plastic Ball Grid Array

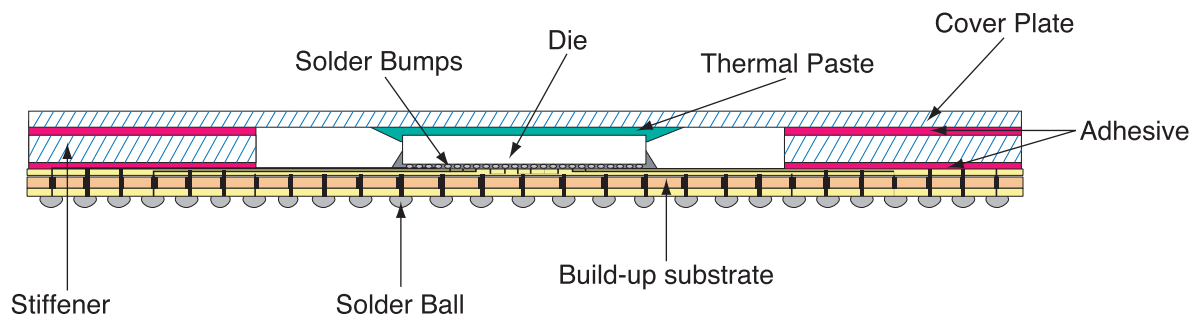
- **Features:** Small form factor and high pin count
- **Structure:** The die is wire-bonded to a plastic substrate in an overmolded package body.
- **Intended Use:** PCs, mobile devices, etc.



PBGA[FC]

PBGA[FC]: Flip-Chip Plastic Ball Grid Array

- **Features:** High pin count (>1,000 pins)
- **Structure:** The die is flipped over so that solder bumps on the active surface of the die are soldered to the package substrate.
- **Intended Use:** Networking applications, etc.

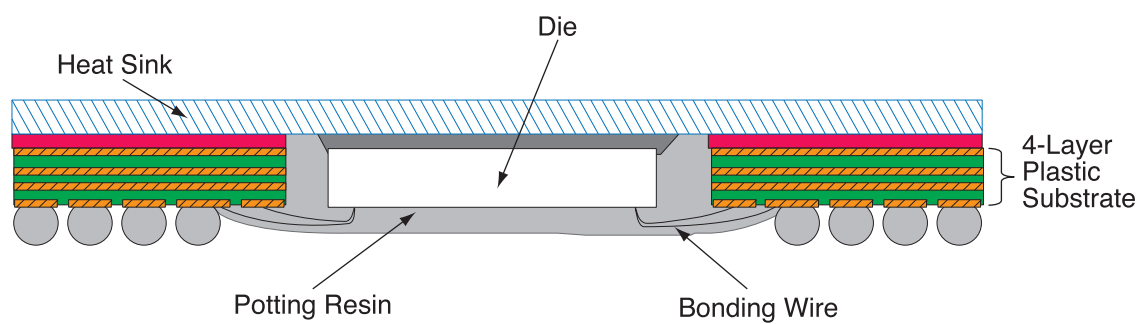


Packaging Overview

EBGA[4L]

EBGA[4L]: 4-Layer Enhanced Ball Grid Array

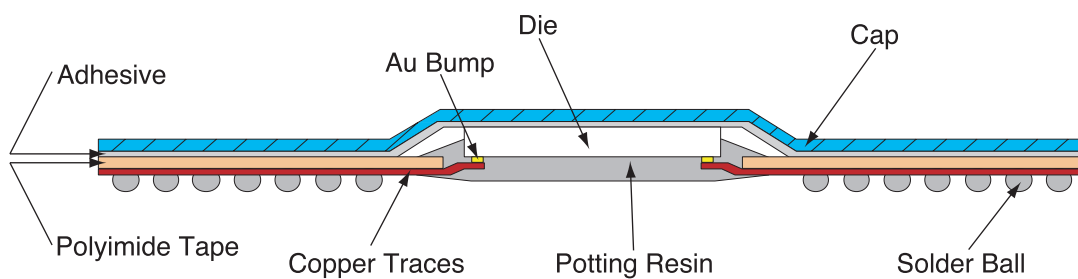
- **Features:** Enhanced thermal and electrical performance
- **Structure:** The die is directly attached, face down, to an integral heat sink.
- **Intended Use:** PCs, game consoles, etc.



TBGA

TBGA: Tape Ball Grid Array

- **Features:** Low profile and high pin count
- **Structure:** An adhesively attached cap covers the die that is bonded to a polyimide film using TAB technology.
- **Intended Use:** PCs, networking applications, etc.



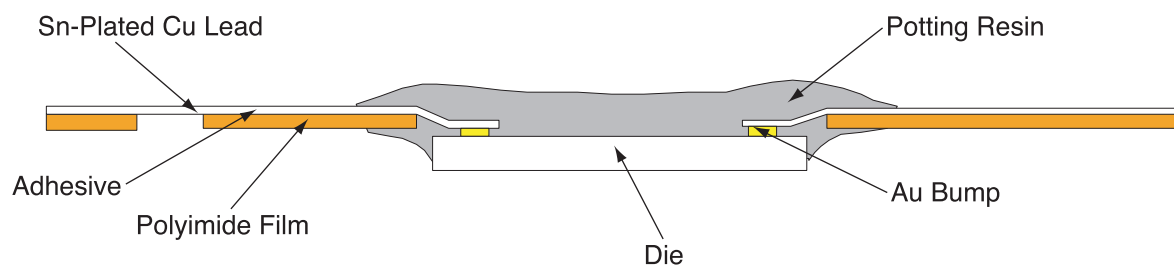
TCP/COF

TCP: Tape Carrier Package

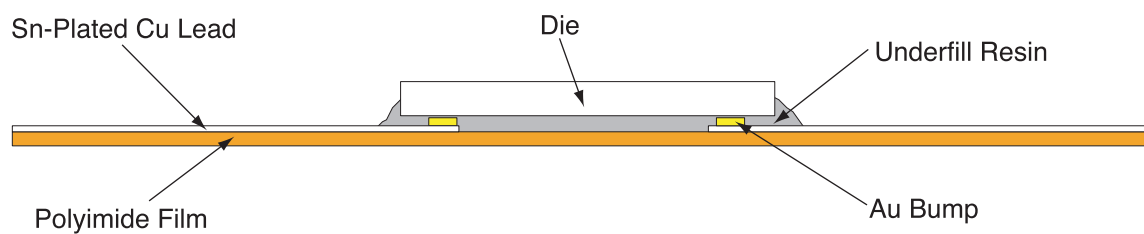
COF: Chip-On-Film

- **Features:** High pin count, small form factor and low profile
- **Structure:** The die is attached to a polyimide film using Au-Sn inner lead bonding (ILB).
- **Intended Use:** LCD drivers, etc.

TCP



COF

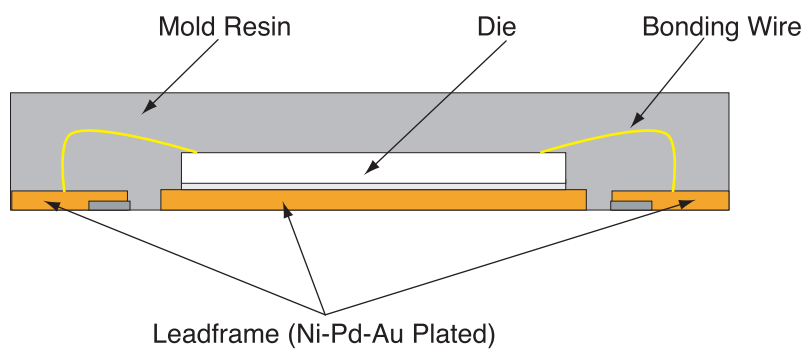


Packaging Overview

VQON

VQON: Very Small Quad Outline Non-Leaded

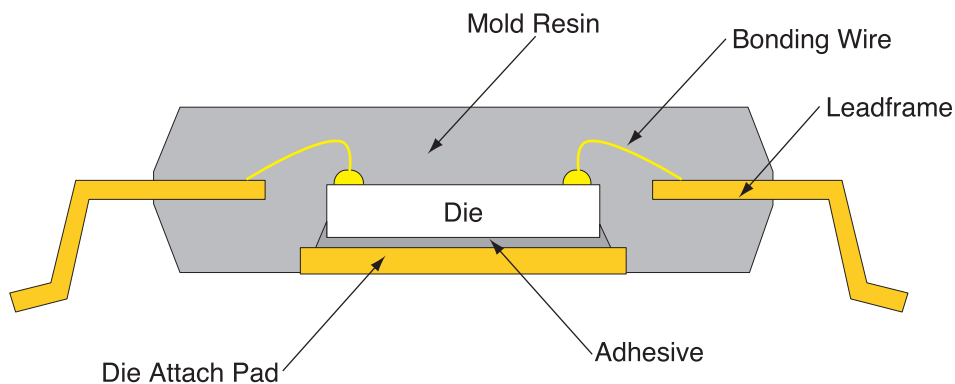
- **Features:** Small form factor, low profile, lightweight and superior electrical performance
- **Structure:** Only the topside of the package is molded, so the leadframe is exposed on the underside of the package.
- **Intended Use:** Cell phones, etc.



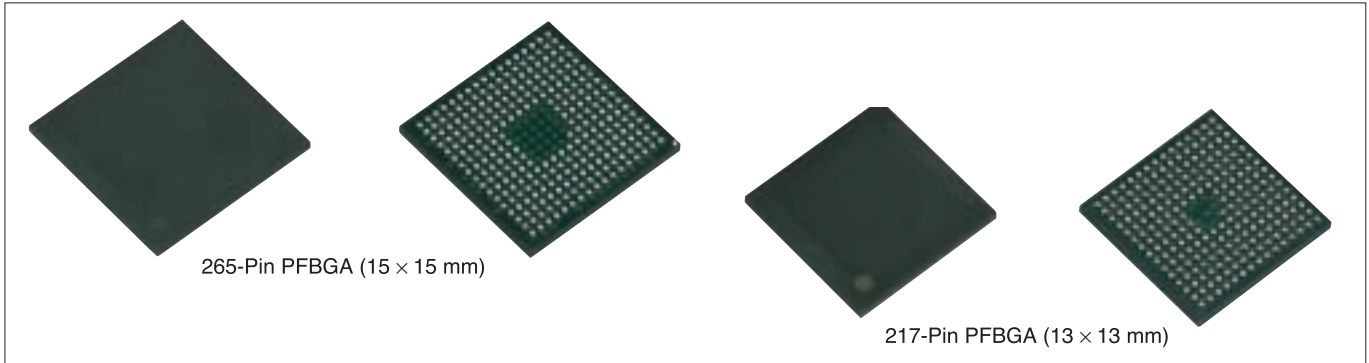
HQFP

HQFP: Heatsink Quad Flat Package

- **Features:** Low profile and superior thermal dissipation
- **Structure:** The die attach pad is exposed on the underside of the package to provide an efficient heat path.
- **Intended Use:** Consumer electronics, etc.



PBGA/PFBGA/PTFBGA/PVFGA



Package Type	PBGA	
Body Size (mm)	15 × 15	17 × 17
Ball Pitch (mm)	1.00	1.00
Total Ball Count	196	256
Ball Rows	7	Full Array
L (nH)	2.82 - 8.57	2.82 - 9.47
C (pF)	0.13 - 1.29	0.13 - 1.47
R (mΩ)	160 - 495	160 - 547
θ _{ja} (°C/W)	38.1	TBD
θ _{jc} (°C/W)	4.46	TBD
Photo		

Note: All characteristics data in the table are simulated values.

Package Type	PFBGA												
Body Size (mm)	9 × 9	10 × 10	11 × 11	13 × 13			15 × 15		16 × 16	17 × 17	13 × 13	15 × 15	
Ball Pitch (mm)	0.8												
Total Ball Count	97	121	141	145	177	217	209	265	361	400	281	321	361
Ball Rows	4	Full Array	5	3	4	6	4	6	Full Array		5		6
L (nH)	2.82 - 5.86	2.82 - 6.31	2.82 - 6.76	2.82 - 7.66			2.82 - 8.57		2.82 - 9.02	2.82 - 9.47	2.82 - 7.66	2.82 - 8.57	
C (pF)	0.13 - 0.74	0.13 - 0.83	0.13 - 0.92	0.13 - 1.11			0.13 - 1.29		0.13 - 1.38	0.13 - 1.47	0.13 - 1.11	0.13 - 1.29	
R (mΩ)	160 - 337	160 - 363	160 - 389	160 - 442			160 - 495		160 - 521	160 - 547	160 - 442	160 - 495	
θ _{ja} (°C/W)	55.8	49.3	44.1	37.0			38.1		37.6	TBD	37.0	38.1	
θ _{jc} (°C/W)	7.32	6.24	5.34	4.24			4.46		4.53	TBD	4.24	4.46	
Photo						Y		Y					

Notes: Package height of 1.4 mm or less

All characteristics data in the table are simulated values.

Package Type	PTFBGA																
Body Size (mm)	8 × 8				9 × 9	11 × 11		12 × 12			5 × 5	6 × 6	7 × 7	9 × 9	12 × 12		
Ball Pitch (mm)	0.65																
Total Ball Count	72	112	113	121	141	177	241	168	209	241	48	81	84	80	201	345	
Ball Rows	2	4		Full Array	5	4	6	3	4	5	2	Full Array	3	2	5	7	
L (nH)	2.82 - 5.40				2.82 - 5.86		2.82 - 6.76		2.82 - 7.21			TBD	TBD	TBD	2.82 - 4.95	2.82 - 5.86	2.82 - 7.21
C (pF)	0.13 - 0.65				0.13 - 0.74		0.13 - 0.92		0.13 - 1.02			TBD	TBD	TBD	0.13 - 0.60	0.13 - 0.74	0.13 - 1.02
R (mΩ)	160 - 310				160 - 337		160 - 389		160 - 416			TBD	TBD	TBD	160 - 284	160 - 337	160 - 416
θ _{ja} (°C/W)	65.7				55.8		44.1		39.7			TBD	TBD	TBD	TBD	55.8	39.7
θ _{jc} (°C/W)	9.53				7.32		5.34		4.59			TBD	TBD	TBD	TBD	7.32	4.59
Photo																	

Notes: Package height of 1.2 mm or less

All characteristics data in the table are simulated values.

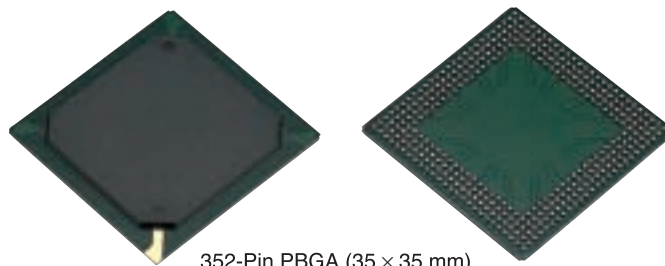
Package Type	PVFBGA	
Body Size (mm)	5 × 5	7 × 7
Ball Pitch (mm)	0.5	
Total Ball Count	61	80
Ball Rows	3	2
L (nH)	TBD	2.82 - 4.95
C (pF)	TBD	0.13 - 0.60
R (mΩ)	TBD	160 - 284
θ _{ja} (°C/W)	TBD	
θ _{jc} (°C/W)	TBD	
Photo		

Notes: Package height of 1.0 mm or less

All characteristics data in the table are simulated values.

Packaging Overview

PBGA[4L]



352-Pin PBGA (35 × 35 mm)

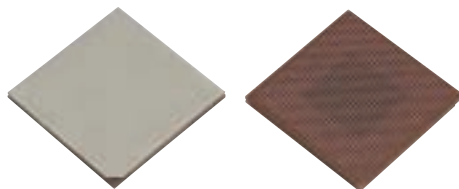
Package Type	PBGA[4L]															
Body Size (mm)	27 × 27				31 × 31				35 × 35				40 × 40			
Ball Pitch (mm)	1.27															
Total Ball Count	256	272	300	336	304	360	408	352	388	420	480	484	544	500	564	576
Ball Rows	4	4 + (4*4)	5	6	4	5	6	4	4 + (6*6)	5	6	5 + (8*8)	6 + (8*8)	5	5 + (8*8)	6
L (nH)	4.0 – 9.3				4.0 – 10.6				4.1 – 12.0				5.3 – 13.6			
C (pF)	0.4 – 0.9				0.4 – 1.1				0.4 – 1.2				0.4 – 1.4			
R (mΩ)	370 – 696				370 – 777				377 – 857				447 – 957			
θ _{ja} (°C/W)	19	18	TBD		18	TBD		17	16	TBD		16	TBD			
θ _{jc} (°C/W)	5 – 6 (Typ.)															
Photo								Y								

Note: All characteristics data in the table are simulated values.

Package Type	PBGA[4L]														
Body Size (mm)	27 × 27					31 × 31					35 × 35			40 × 40	
Ball Pitch (mm)	1.00														
Total Ball Count	352	388	420	456	480	416	500	564	576	464	560	648	768	868	
Ball Rows	4	4 + (6*6)	5	5 + (6*6)	6	4	5	5 + (8*8)	6	4	5	6	6	7	
L (nH)	4.0 – 9.3					4.0 – 10.6					4.1 – 12.0			5.3 – 13.6	
C (pF)	0.4 – 0.9					0.4 – 1.1					0.4 – 1.2			0.4 – 1.4	
R (mΩ)	370 – 696					370 – 777					377 – 857			447 – 957	
θ _{ja} (°C/W)	TBD					18	TBD								
θ _{jc} (°C/W)	5 – 6 (Typ.)														
Photo															

Note: All characteristics data in the table are simulated values.

PBGA[FC]

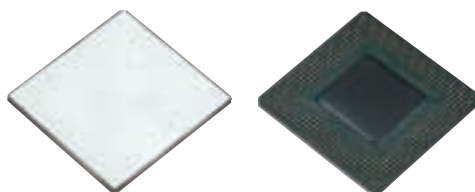


1444-Pin PBGA[FC]

Package Type	PBGA[FC]				
Body Size (mm)	27 × 27	31 × 31	35 × 35	40 × 40	45 × 45
Ball Pitch (mm)	1.00				
Total Ball Count	625	841	1089	1444	1849
Ball Rows	Full Array				
L (nH)	0.4 – 7.7	0.4 – 9.9	0.2 – 11.5	0.2 – 13.7	0.4 – 16.5
C (pF)	0.1 – 1.4	0.1 – 1.7	0.2 – 2.0	0.23 – 2.4	0.1 – 2.9
R (mΩ)	34 – 720	34 – 925	20 – 1100	18 – 1250	34 – 1539
θ _{ja} (°C/W)	13.7	12.2	11.1	9.9	8.4
θ _{jc} (°C/W)	0.2 (Typ.)				
Photo				Y	

Note: All characteristics data in the table are simulated values.

EBGA[4L]



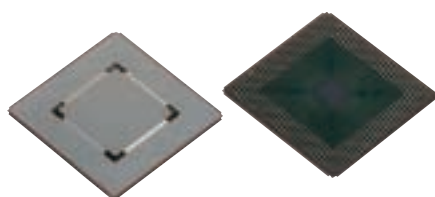
540-Pin EBGA[4L]

Package Type	EBGA[4L]	
Body Size (mm)	35 × 35	42.5 × 42.5
Ball Pitch (mm)	1.27	
Total Ball Count	352	540
Ball Rows	4	5
L (nH)	4.6 – 8.4	4.2 – 9.5
C (pF)	0.33 – 1.14	0.25 – 1.38
R (mΩ)	332 – 567	308 – 638
θ _{ja} (°C/W)	13.5	10.5
θ _{jc} (°C/W)	0.3 (Typ.)	
Photo		Y

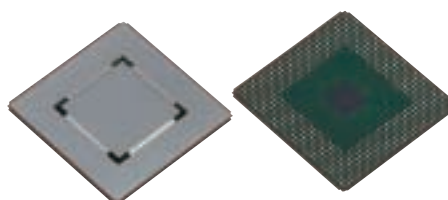
Note: All characteristics data in the table are simulated values.

Packaging Overview

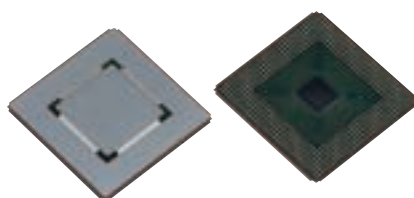
TBGA



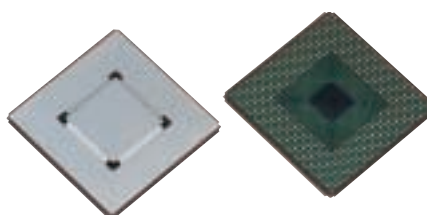
768-Pin TBGA (40 × 40 mm)



576-Pin TBGA (40 × 40 mm)



648-Pin TBGA (35 × 35 mm)



480-Pin TBGA (35 × 35 mm)

Package Type	TBGA								
	27 × 27		31 × 31		35 × 35			40 × 40	
Body Size (mm)	27 × 27		31 × 31		35 × 35			40 × 40	
Ball Pitch (mm)	1.27				1.00		1.27	1.00	
Total Ball Count	256	304	352	480	560	648	576	768	868
Ball Rows	4			6	5	6		7	
Die Size for Package Simulation (mm)	7.09	9.16	10.4			12.06			
L (nH)	3.4 – 9.0	4.1 – 9.9	4.8 – 10.9	3.3 – 11.3	3.7 – 11.0	3.4 – 9.9	4.4 – 13.5	4.8 – 12.8	5.4 – 12.5
C (pF)	0.5 – 1.5	0.7 – 1.6	0.8 – 1.8	0.5 – 1.9	0.6 – 1.8	0.5 – 1.7	0.7 – 2.2	0.8 – 2.1	0.9 – 2.1
R (mΩ)	249 – 516	316 – 572	329 – 627	256 – 685	279 – 674	269 – 614	335 – 816	373 – 787	423 – 761
θ _{ja} (°C/W)	16.1	16.3	14.9	14.4	14.8	14.3	13.8	13.5	13.3
θ _{jc} (°C/W)	3.3								
Photo	Y	Y	Y	Y		Y	Y	Y	

Note: All characteristics data in the table are simulated values.

QFP

Package Type	QFP											
Body Size (mm)	10 × 10	10 × 14	10 × 10		12 × 12	14 × 14	14 × 20	10 × 14	14 × 14	14 × 20	20 × 20	24 × 24
Lead Pitch (mm)	0.80		0.65	0.50	0.65		0.80	0.50		0.65	0.50	
Lead Count	44	48	52	64		80		84	100		144	176
Body Thickness (mm)	2.7/2.3	2.7	2		2.7							3.6

Package Type	QFP[Pd]							
Body Size (mm)	14 × 14			14 × 20		28 × 28		
Lead Pitch (mm)	0.80		1.00	0.80	0.65		0.50	
Lead Count	44	60	64		80	100	160	208
Body Thickness (mm)	2.7					3.6		

LQFP

Package Type	LQFP								
Body Size (mm)	10 × 10	7 × 7	10 × 10	12 × 12		14 × 14		20 × 20	
Lead Pitch (mm)	0.80	0.50		0.40	0.50	0.40	0.50	0.40	
Lead Count	44	48	64	80	100		128	144	176

Package Type	LQFP[Pd]											
Body Size (mm)	10 × 10	7 × 7	10 × 10	12 × 12		16 × 16	20 × 20		24 × 24	28 × 28	24 × 24	28 × 28
Lead Pitch (mm)	0.80	0.50		0.65	0.50	0.40	0.50	0.40	0.50		0.40	
Lead Count	44	48	64		80	144		176		208	216	256

HQFP

Package Type	HQFP										
Body Size (mm)	10 × 10	7 × 7	12 × 12	14 × 20	14 × 14	28 × 28	32 × 32		28 × 28		32 × 32
Lead Pitch (mm)	1.00	0.50		0.65	0.50	0.65		0.50		0.40	
Lead Count	30	64	80	92	100	160	184	208	240	296	
Body Thickness (mm)	2.3	1		2.7	1	3.6					

TQFP

Package Type	TQFP			
Body Size (mm)	10 × 10	12 × 12	14 × 14	
Lead Pitch (mm)	0.50			0.40
Lead Count	64	80	100	128

DIP/SDIP

Package Type	DIP										
Lead Pitch (mm)	2.54										
Lead Count	8	14	16	18	20	24	28	40	42	48	64

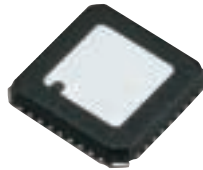
Package Type	SDIP						
Lead Pitch (mm)	1.78						
Lead Count	24	28	30	42	54	56	64

TCP/COF

Package Type	TCP	COF
Body Size (mm)	Flexible	
Lead Pitch (mm)	≥ 0.060	≥ 0.065
Lead Count	≤ 500	≤ 650

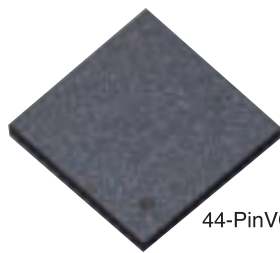
Packaging Overview

QON

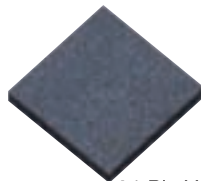
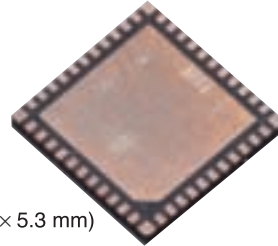


36-Pin QON (6.0 × 6.0 mm)

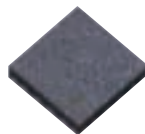
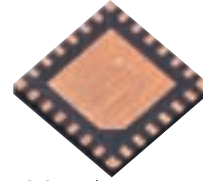
VQON/TQON



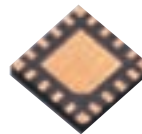
44-Pin VQON (5.3 × 5.3 mm)



24-Pin VQON (3.88 × 3.8 mm)

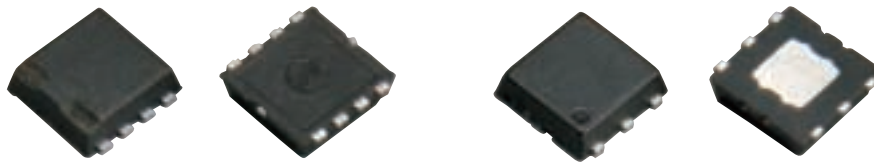


16-Pin VQON (2.7 × 2.7 mm)



Package Type	QON		VQON	
Body Size (mm)	6 × 6	2.7 × 2.7	3.8 × 3.8	5.3 × 5.3
Lead Pitch (mm)	0.5	0.50	0.50	0.40
Lead Count	36	16	24	44
Mounted Height (mm)	0.9	0.6	0.6	0.6
Photo	Y	Y	Y	Y

SON/HSON



8-Pin SON (2.9 × 3.0 mm)

6-Pin HSON (2.9 × 3.0 mm)

Package Type	SON	HSON
Body Size (mm)	2.9 × 3.0	
Lead Pitch (mm)	0.65	0.95
Lead Count	8	6
Photo	Y	Y

SOP/SSOP

Package Type	SOP					SOP[Pa]	
Lead Pitch (mm)	1.27						
Lead Count	8	14	16	18	20	20	28

Package Type	SSOP								
Lead Pitch (mm)	0.65	1.00	0.65	1.00	0.65		1.00	0.65	1.00
Lead Count	10		16		18	20	24	30	

Packaging Overview

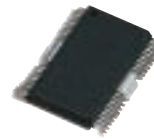
HSOP



16-Pin HSOP
(1.0-mm Pitch)



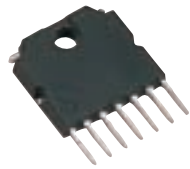
20-Pin HSOP
(1.0-mm Pitch)



36-Pin HSOP
(0.65-mm Pitch)

Package Type	HSOP		
Lead Pitch (mm)	1.00		0.65
Lead Count	16	20	36
Photo	Y	Y	Y

SIP/HSIP



7-Pin HSIP (2.54-mm Pitch)



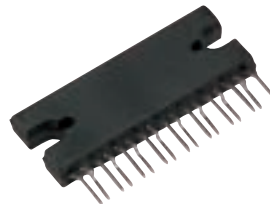
10-Pin HSIP (2.54-mm Pitch)

Package Type	SIP		SSIP	HSIP	
Lead Pitch (mm)	2.54		1.78	2.54	
Lead Count	7	9	12	7	10
Photo				Y	Y

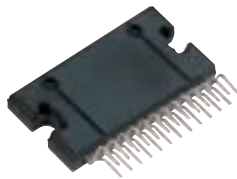
ZIP/HZIP



12-Pin HZIP (1.78-mm Pitch)



17-Pin HZIP (2.00-mm Pitch)



25-Pin HZIP (1.00-mm Pitch)



25-Pin HZIP (1.27-mm Pitch)

Package Type	HZIP					
Lead Pitch (mm)	1.78	1.27	2.00	1.00	1.27	1.00
Lead Count	12	15	17	25		37
Photo	Y		Y	Y	Y	

Toshiba Semiconductor Company Worldwide Support

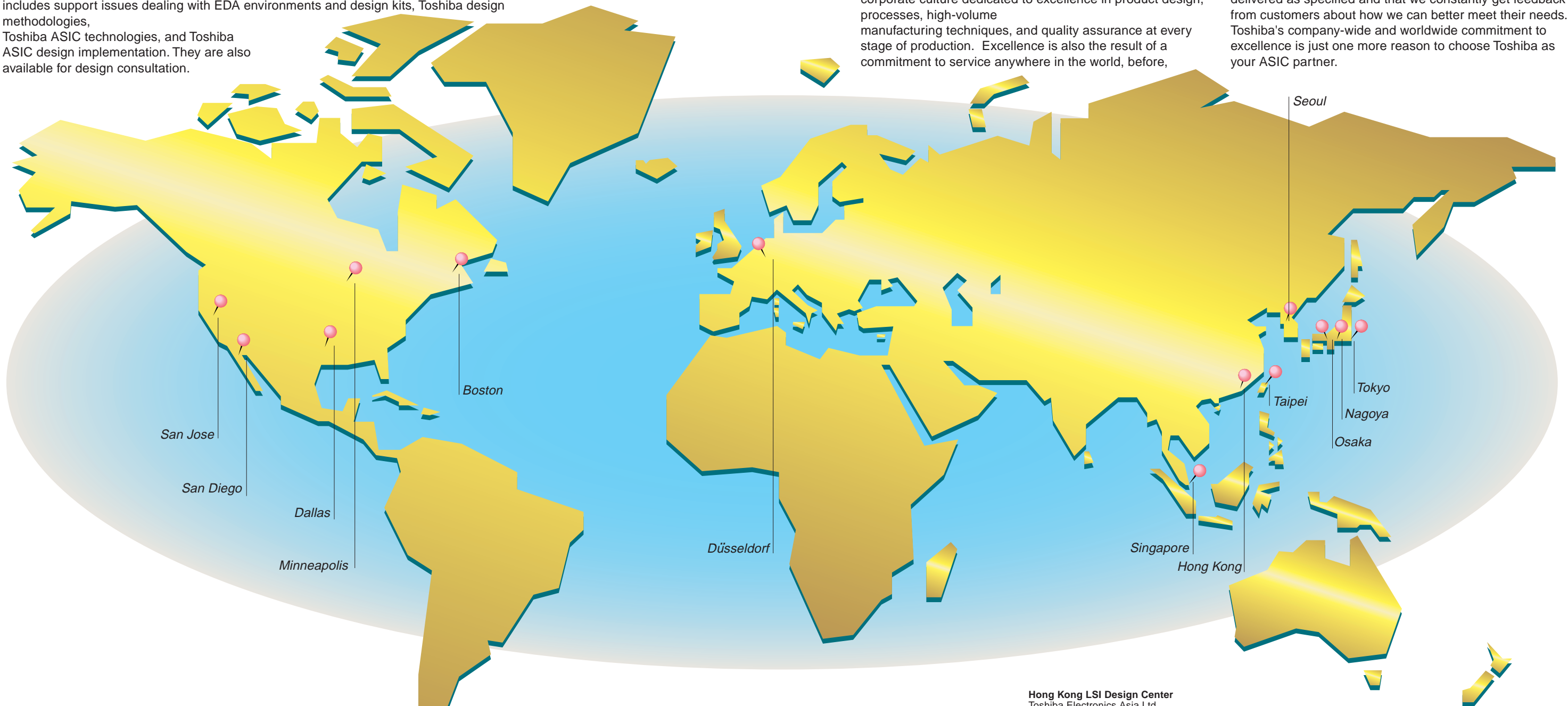
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