ASIC Packaging

Overview

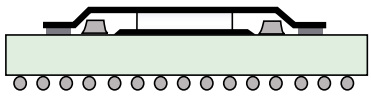
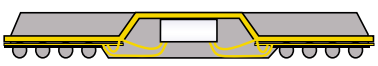
Fujitsu, a world leader in packaging and interconnect technology, offers an extensive range of packages from the industry-standard Quad Flat Pack (QFP) to a wide variety of Ball Grid Array (BGA) configurations. Fujitsu owns and operates several ISO-level package manufacturing and assembly facilities in Japan, shipping millions of packages per month to meet the needs of its customers.

For its ASIC customers, Fujitsu offers "one-stop shopping" for all their packaging needs. In addition to a robust set of off-the-shelf standard packages, Fujitsu offers complete in-house turnkey package design, as well as assembly and test services. Fujitsu's ASIC packaging solutions range from lead insertion matrix-type PGAs to surface mount Flat Quad Lead types (QFP, LQFP, TQFP, HQFP) and Matrix types (BGAs and LGAs).

Fujitsu's BGA packages are ideally suited for communication and computation ASIC applications and are offered in the following categories:

- Flip-chip Ball Grid Arrays (FC-BGA) – Providing GHz range packaging solutions
- Tape-automated-bonding Ball Grid Arrays (TAB-BGA) – Providing thermal-enhanced packaging solutions
- Enhanced Ball Grid Arrays (EBGA) – Providing Electrical and thermal-enhanced packaging solutions
- Fine-pitch Ball Grid Arrays (FBGA) – Providing Chip-Scale Packaging (CSP) solutions
- Face-down Heat-enhanced Ball Grid Arrays (FDH-BGA) – A cost-effective thermal enhanced packaging solution

Fujitsu's Diversified ASIC BGA Packages

	Configuration	Pin Counts	Clock Frequency	Thermal Resistance	Application
FC-BGA		450 ~ 2116	~ 2.5GHz	9°C/W (0m/s)	Internet Router Server, Workstation Public Transmission
TAB-BGA		352 ~ 800	~ 150MHz	16°C/W (0m/s)	Internet Router PC Graphics
EBGA		352 ~ 700	~ 800MHz	13°C/W (0m/s)	Internet Router Server, Workstation Public Transmission
FDH-BGA		256 ~ 500	~ 250MHz	13°C/W (0m/s)	Internet Router PC Graphics
PBGA		256 ~ 420	~ 150MHz	21°C/W (0m/s)	PC, Cellular Phones DVC, DSC
FBGA		40 ~ 460	~ 500MHz	30°C/W (0m/s)	Cellular Phones DVC, DSC

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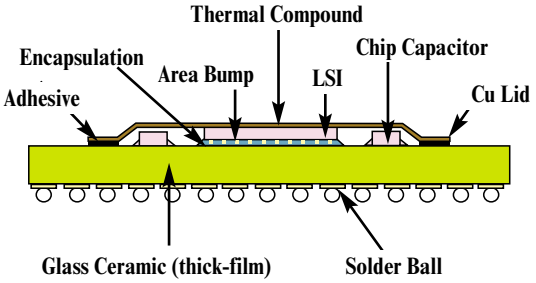
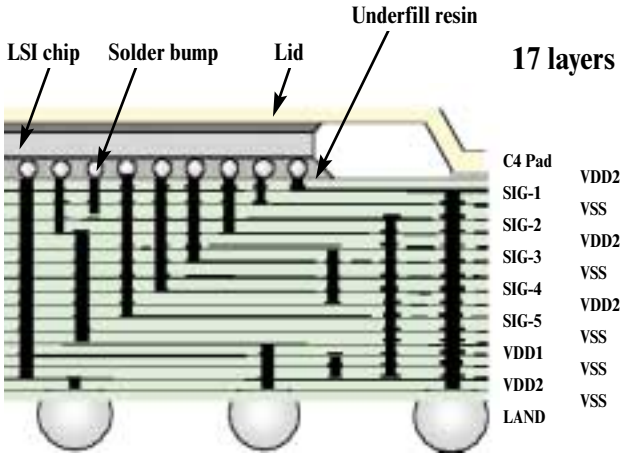
FC-BGA Packages



Traditional packaging, with perimeter wire-bonded dies, no longer meets the requirements of today's high pin-count chips, such as those required in GHz-range sustained frequencies. As a result, the more sophisticated, bumped-area flip-chip interconnect technology is preferred, due to the excellent thermal dissipation capability that is inherent in its structure. Inside its Flip-chip BGA packages, Fujitsu's unique wiring strip interconnect technology has further enhanced the thermal and electrical characteristics of these packages. Key features of Fujitsu's FC-BGA technology are:

- Glass Ceramics or Organic (build-up) substrate
- High pin-count – up to 2116 pin in 1.00mm ball-pitch, yet in small sizes and in lighter weights
- Some offerings of FC-BGAs are in 1.27mm ball pitch

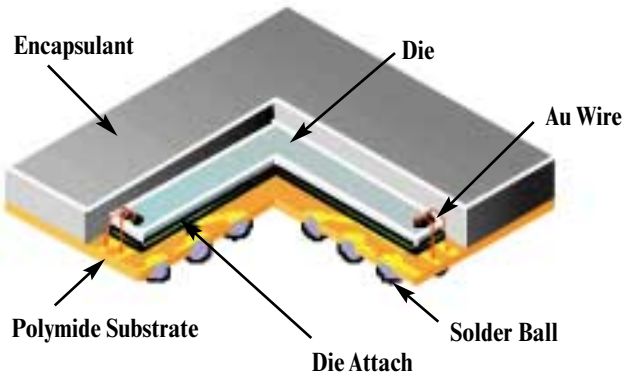
Cross-Section Diagram of FC-BGA



- Excellent electrical properties – low dielectric constant and inductance in multi-layer (10 or 17 layers) build-up substrate technology
- Superb power dissipation – further augmented by the use of thermal vias, thermal compounds, heat spreaders or heat sinks
- Low profile JEDEC-standard packages – easily surface mountable on conventional standard PC boards
- Fujitsu's FC-BGAs are especially suited for highly integrated computing and communication applications
- Ultra-thin profile, including heat spreaders (2.5mm –3mm)
- Moisture resistant (JDEC Level 4)

FBGA Packages

Fine-pitch BGA (FBGA) technology, one of Fujitsu's Chip Scale Packaging (CSP) solutions, provides the benefits of reduced package space and weight. Utilizing a polyamide tape substrate, FBGAs are available in rectangular and



square body size packages.

Features of Fine-pitch BGA packages are:

- Can be low pin count packages – some as low as 112 pins
- JEDEC-approved fine Ball pitch with the lowest pitch at just 0.5mm and the highest at 0.8mm
- Small-outline and Low-profile package
- Provides cost-effective packaging density
- Good replacement candidate for QFP/Shrink-QFP technology

EBGA Packages

Enhanced BGA (EBGA) packages offer cost-effective electrical and thermal solutions for mid-range pin-count chips. The multi-layer substrate provides excellent electrical performance. Fujitsu's EBGAs have built-in ultra-thin heat spreaders for improved CTE characteristics and superb thermal dissipation.

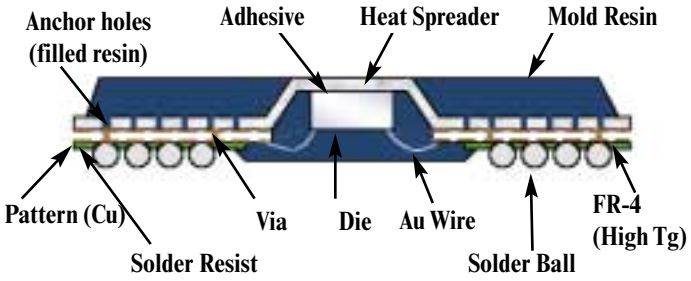
EBGA Packages

Standard Features
- Cavity down with various types of thermal-efficient heat spreaders for high-power design applications
- Square outline
- 1.27mm and 1.00mm ball pitch
- Surface mountable and JEDEC compliant
- Wire (Au-wire) bonding
- Sealed resin in the cavity for high reliability

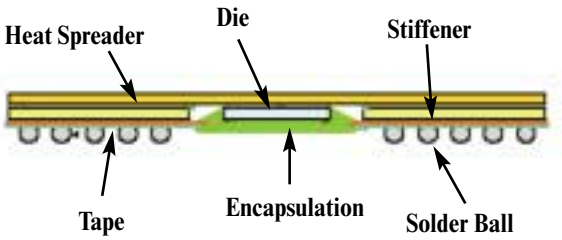
FDH-BGA Packages

Fujitsu's packaging family also includes the Faced-down Heat-spreader BGA (FDH-BGA), which is a cost-effective thermal-enhanced packaging solution.

The main features of the FDH-GBA are:
- Printed circuit board: FR-4 (High Tg type)
- Heat spreader: copper with Ni plating
- Adhesive: silver epoxy paste
- Wire bonding: Au wire
- Mold resin: epoxy type



TAB-BGA Packages



In Tape Automated Bonding BGA (TAB-BGA) packages, Cu leads connect the package lead-frame directly to the pad Au-bumps, thereby eliminating the bond wires and the conventional maximum bond-wire length constraint. In conventional wire-bond technology, the maximum bond wire length and its angle constraints sometimes prevent a small die from fitting into a large cavity package. However, in TAB-BGAs, the package lead-frame is custom designed for each die based on the die size and pin-count. As a result, both the lengths and the angles of the Cu leads are optimized for that particular application. Consequently, this method facilitates the reduction of the PAD pitch as much as possible. Pad-limited designs can decrease/optimize die size through the use of the reduced PAD pitch.

Fujitsu's TAB-BGA packages with metal heat spreaders are excellent for high-power chips requiring high-thermal dissipation. Additional features of the TAB-BGA package are:
- Supports high pin-counts: 272-720 pins
- Provides flexibility in pin assignment
- Square body
- 0.8mm and 1.00mm ball pitch
- Excellent heat dissipation with heat spreader
- Low profile package
- Cost-effective packaging for high pin-count designs

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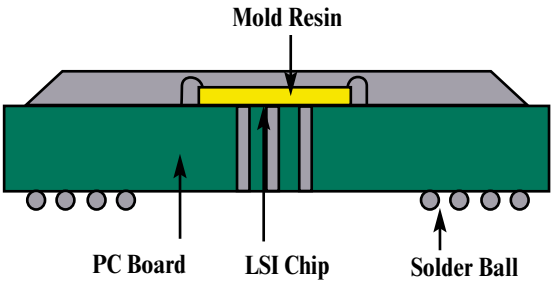
PBGA Packages

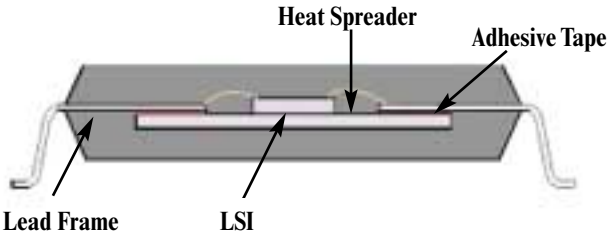
Plastic BGA is an Over Molded Pad Array Carrier (OMPAC) style package designed for low-cost applications. This BGA utilizes a four-layer printed circuit board substrate that provides a high level of electrical performance. PBGA packages provide good thermal performance with moderate power dissipation. Thermal performance can be further enhanced through the use of additional thermal vias and balls placed directly under the die mounting area. Epoxy-filled through holes in the substrate ensure a high level of reliability. For very cost-sensitive designs, a lower performance, two-layer, low-cost printed circuit board version of PBGA is also available.



Key features include:

- 1.27mm ball pitch
- Square body
- Pin-count: 256-480 pins

QFP Packages



Fujitsu offers both plastic and ceramic QFP packages in 1.00, 0.80, 0.65, 0.50 and 0.40 mm lead pitches. The leads of the package, which extend out from four sides, are either gullwing (L-shaped) or straight. These packages conform to industry standards with pin counts ranging from 32 to 304 pins. Lead frames are constructed with either iron/nickel alloy or copper alloy that offers good thermal and electrical performance. The Shrink-QFP (SQFP) uses a 0.5 mm lead pitch in lead counts ranging from 64 to 304. For example, a regular 144-pin QFP package is 28x28 mm in 0.65mm lead pitch. Whereas, the same 144-pin shrink version SQFP is just 20x20 mm in 0.5mm lead pitch.

The Heat-spread QFP (HQFP) package uses a heat-spreader that is attached to the bottom of the die and then attached to the lead-frame with adhesive tape. HQFP offers better thermal performance than traditional QFP packages.

For ASIC applications, two additional types of QFP packages, the Low-profile QFP (LQFP) and Thin QFP (TQFP), are available. The mounting height of the TQFP packages is the thinnest with a maximum height of only 1.27mm. The LQFP packages have a smaller body size than the regular QFP. The lead pitch in both LQFP and TQFP packages is 0.40 and 0.50 mm.

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