

## Introduction

This chapter provides package information for Altera’s MAX® II devices, and includes these sections:

- “Board Decoupling Guidelines” on page 7-1
- “Device and Package Cross Reference” on page 7-1
- “Thermal Resistance” on page 7-2
- “Package Outlines” on page 7-3

In this chapter, packages are listed in order of ascending pin count. See [Figure 7-1](#) through [7-17](#).

## Board Decoupling Guidelines

Decoupling requirements are based on the amount of logic used in the device and the output switching requirements. As the number of I/O pins and the capacitive load on the pins increase, more decoupling capacitance is required. As many as possible 0.1-mF power-supply decoupling capacitors should be connected to the VCC and GND pins or the VCC and GND planes. These capacitors should be located as close as possible to the MAX II device. Each VCCINT/GNDINT and VCCIO/GNDIO pair should be decoupled with a 0.1-mF capacitor. When using high-density packages, such as ball-grid array (BGA) packages, it may not be possible to use one decoupling capacitor per VCC/GND pair. In this case, you should use as many decoupling capacitors as possible. For less dense designs, a reduction in the number of capacitors may be acceptable. Decoupling capacitors should have a good frequency response, such as monolithic-ceramic capacitors.

## Device and Package Cross Reference

[Table 7-1](#) shows which Altera® MAX II devices are available in thin quad flat pack (TQFP), FineLine BGA (FBGA), and Micro FineLine BGA (MBGA) packages.

**Table 7-1.** MAX II Devices in TQFP, FineLine BGA, and Micro FineLine BGA Packages (Part 1 of 2)

Device	Package	Pin
EPM240Z	MBGA (1)	68
EPM240 EPM240G	FBGA (1)	100
EPM240 EPM240G EPM240Z	MBGA (1)	100
EPM240 EPM240G	TQFP	100

**Table 7-1.** MAX II Devices in TQFP, FineLine BGA, and Micro FineLine BGA Packages (Part 2 of 2)

Device	Package	Pin
EPM570 EPM570G	FBGA (1)	100
EPM570 EPM570G EPM570Z	MBGA (1)	100
EPM570 EPM570G	TQFP	100
EPM570Z	MBGA (1)	144
EPM570 EPM570G	TQFP	144
EPM570 EPM570G	FBGA	256
EPM570 EPM570G EPM570Z	MBGA (1)	256
EPM1270 EPM1270G	TQFP	144
	FBGA	256
	MBGA (1)	256
EPM2210 EPM2210G	FBGA	256
	FBGA	324

**Note to Table 7-1:**

(1) Packages available in lead-free versions only.

## Thermal Resistance

Table 7-2 provides  $\theta_{JA}$  (junction-to-ambient thermal resistance) and  $\theta_{JC}$  (junction-to-case thermal resistance) values for Altera MAX II devices.

**Table 7-2.** Thermal Resistance of MAX II Devices (Part 1 of 2)

Device	Pin Count	Package	$\theta_{JC}$ (°C/W)	$\theta_{JA}$ (°C/W) Still Air	$\theta_{JA}$ (°C/W) 100 ft./min.	$\theta_{JA}$ (°C/W) 200 ft./min.	$\theta_{JA}$ (°C/W) 400 ft./min.
EPM240Z	68	MBGA	35.5	68.7	63.0	60.9	59.2
EPM240 EPM240G	100	FBGA	20.8	51.2	45.2	43.2	41.5
EPM240 EPM240G EPM240Z	100	MBGA	32.1	53.8	47.7	45.7	44.0
EPM240 EPM240G	100	TQFP	12.0	39.5	37.5	35.5	31.6
EPM570 EPM570G	100	FBGA	14.8	42.8	36.8	34.9	33.3

**Table 7-2.** Thermal Resistance of MAX II Devices (Part 2 of 2)

Device	Pin Count	Package	$\theta_{JC}$ (°C/W)	$\theta_{JA}$ (°C/W) Still Air	$\theta_{JA}$ (°C/W) 100 ft./min.	$\theta_{JA}$ (°C/W) 200 ft./min.	$\theta_{JA}$ (°C/W) 400 ft./min.
EPM570 EPM570G EPM570Z	100	MBGA	25.0	46.5	40.4	38.4	36.8
EPM570 EPM570G	100	TQFP	11.2	38.7	36.6	34.6	30.8
EPM570Z	144	MBGA	20.2	51.8	45.1	43.2	41.5
EPM570 EPM570G	144	TQFP	10.5	32.1	30.3	28.7	26.1
EPM570 EPM570G	256	FBGA	13.0	37.4	33.1	30.5	28.4
EPM570 EPM570G EPM570Z	256	MBGA	12.9	39.5	33.6	31.6	30.1
EPM1270	144	TQFP	10.5	31.4	29.7	28.2	25.8
EPM1270G	256	FBGA	10.4	33.5	29.3	26.8	24.7
	256	MBGA	10.6	36.1	30.2	28.3	26.8
EPM2210	256	FBGA	8.7	30.2	26.1	23.6	21.7
EPM2210G	324	FBGA	8.2	29.8	25.7	23.3	21.3

## Package Outlines

The package outlines on the following pages are listed in order of ascending pin count. Altera package outlines meet the requirements of JEDEC Publication No. 95.

### 68-Pin Micro FineLine Ball-Grid Array (MBGA) – Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M – 1994
- Controlling dimension is in millimeters
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

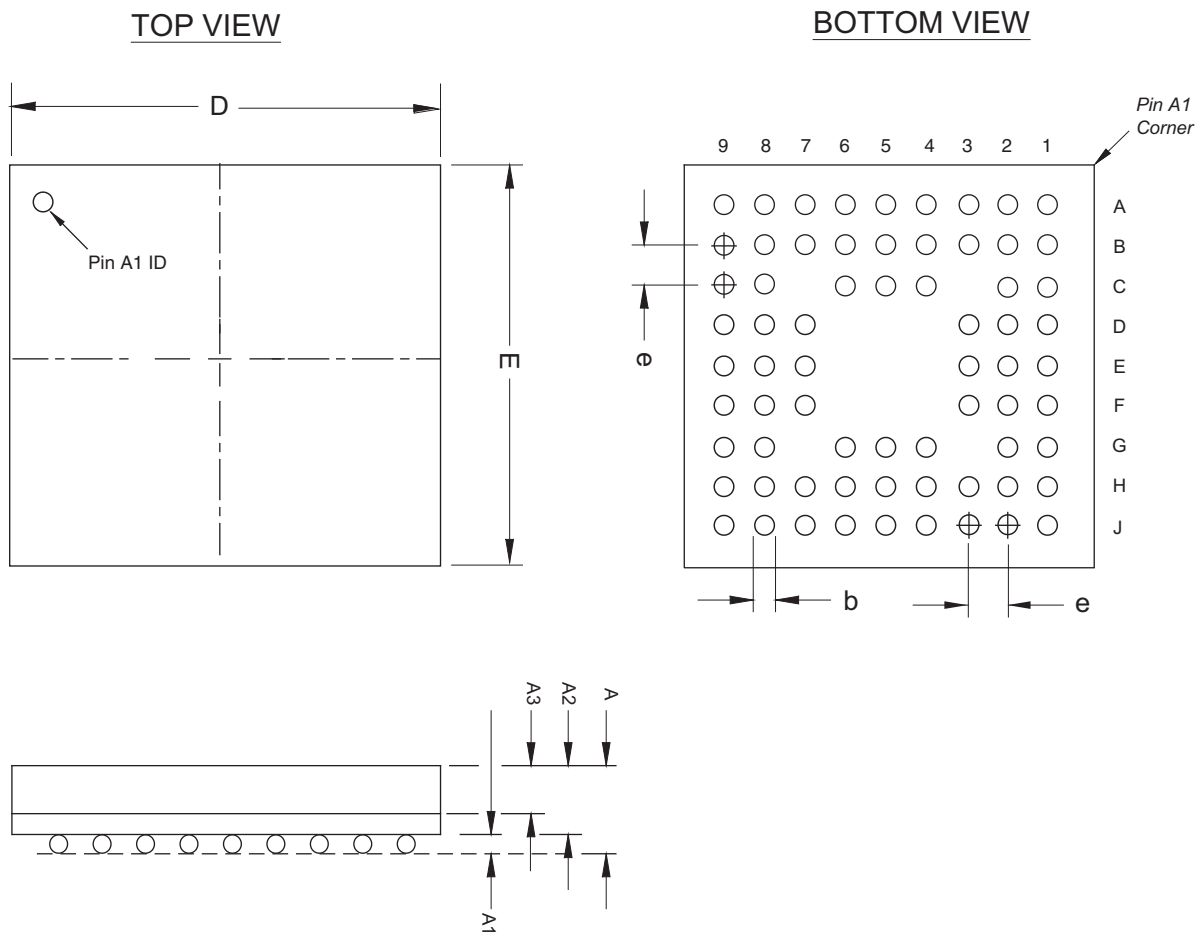
<b>Package Information (Part 1 of 2)</b>	
Description	Specification
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-195 Variation: AB

<b>Package Outline Dimension Table (Part 1 of 2)</b>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	1.20
A1	0.15	—	—
A2	—	—	1.00
A3	0.60 REF		

<b>Package Information (Part 2 of 2)</b>	
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	0.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<b>Package Outline Dimension Table (Part 2 of 2)</b>			
D	5.00 BSC		
E	5.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

**Figure 7-1.** 68-Pin Micro FineLine BGA Package Outline



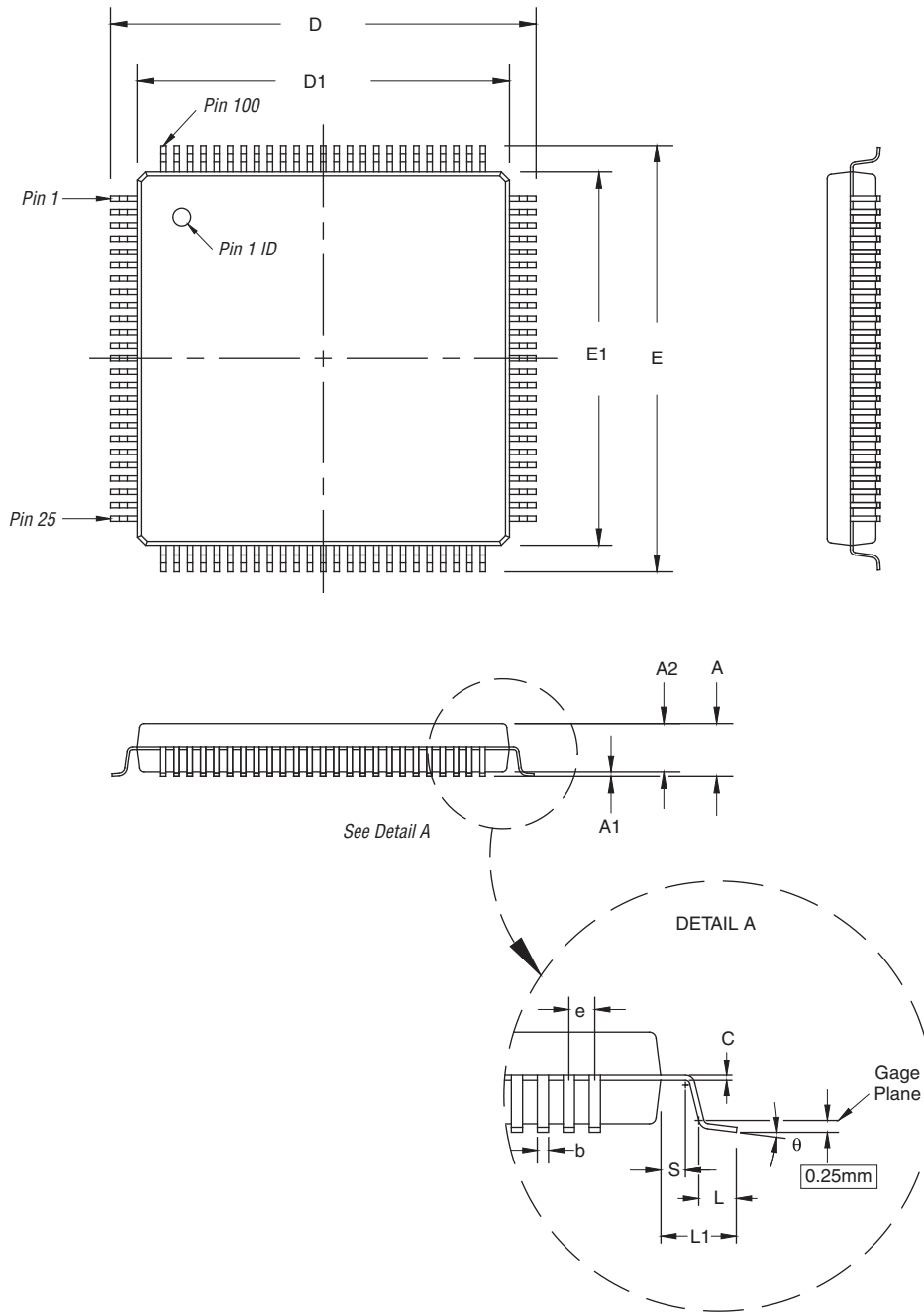
## 100-Pin Plastic Thin Quad Flat Pack (TQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994
- Controlling dimension is in millimeters
- Pin 1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	T
Package Acronym	TQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: AED
Maximum Lead Coplanarity	0.003 inches (0.08mm)
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	1.20
A1	0.05	—	0.15
A2	0.95	1.00	1.05
D	16.00 BSC		
D1	14.00 BSC		
E	16.00 BSC		
E1	14.00 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
S	0.20	—	—
b	0.17	0.22	0.27
c	0.09	—	0.20
e	0.50 BSC		
θ	0°	3.5°	7°

Figure 7-2. 100-Pin TQFP Package Outline

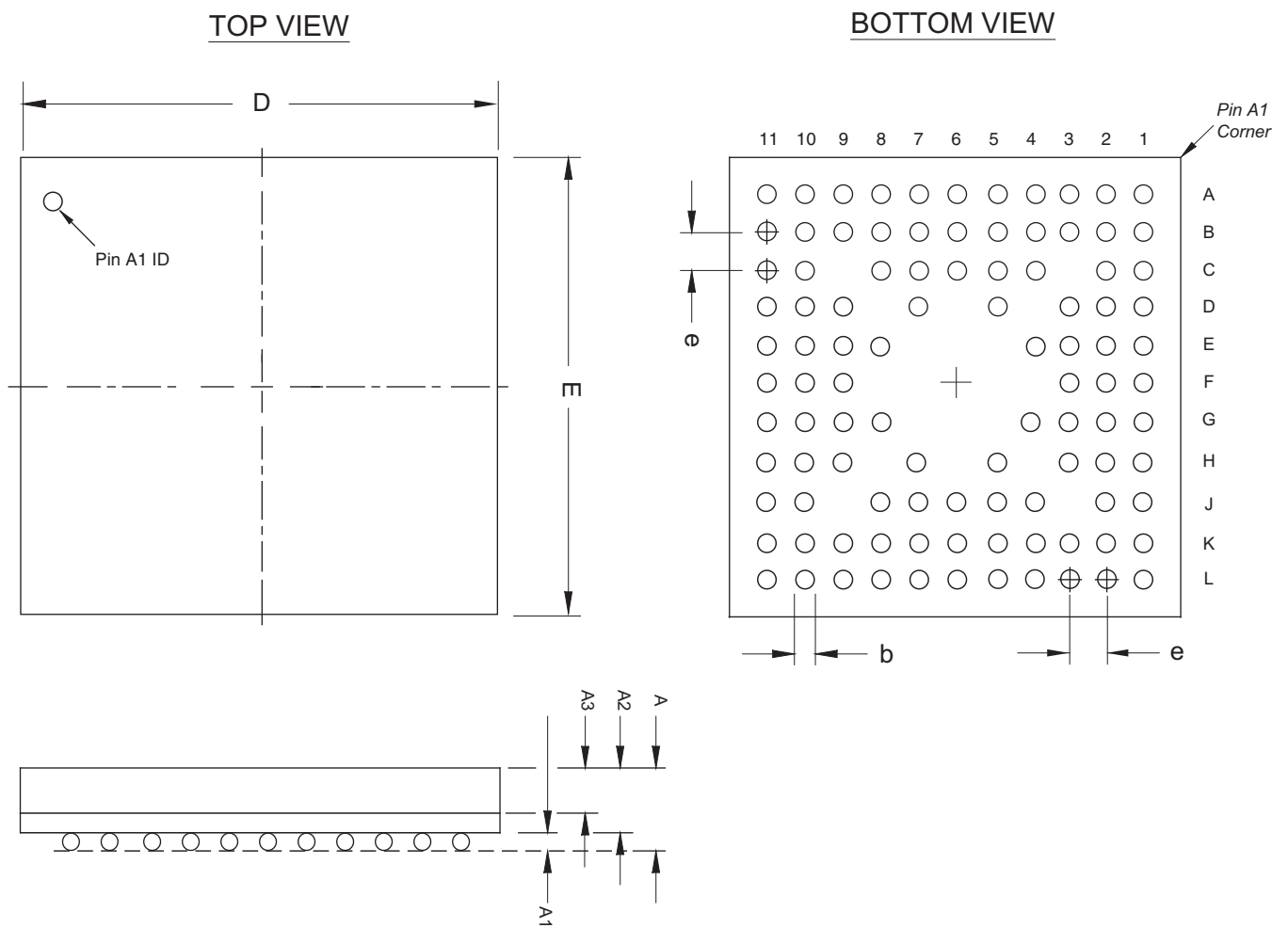


## 100-Pin Micro FineLine Ball-Grid Array (MBGA)

- All dimensions and tolerances conform to ASME Y14.5 – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-195 Variation: AC
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	0.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	1.20
A1	0.15	—	—
A2	—	—	1.00
A3	0.60 REF		
D	6.00 BSC		
E	6.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

**Figure 7-3.** 100-Pin Micro FineLine BGA Package Outline

### 100-Pin FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ASME Y14.5 – 1994
- Controlling dimension is in millimeters
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

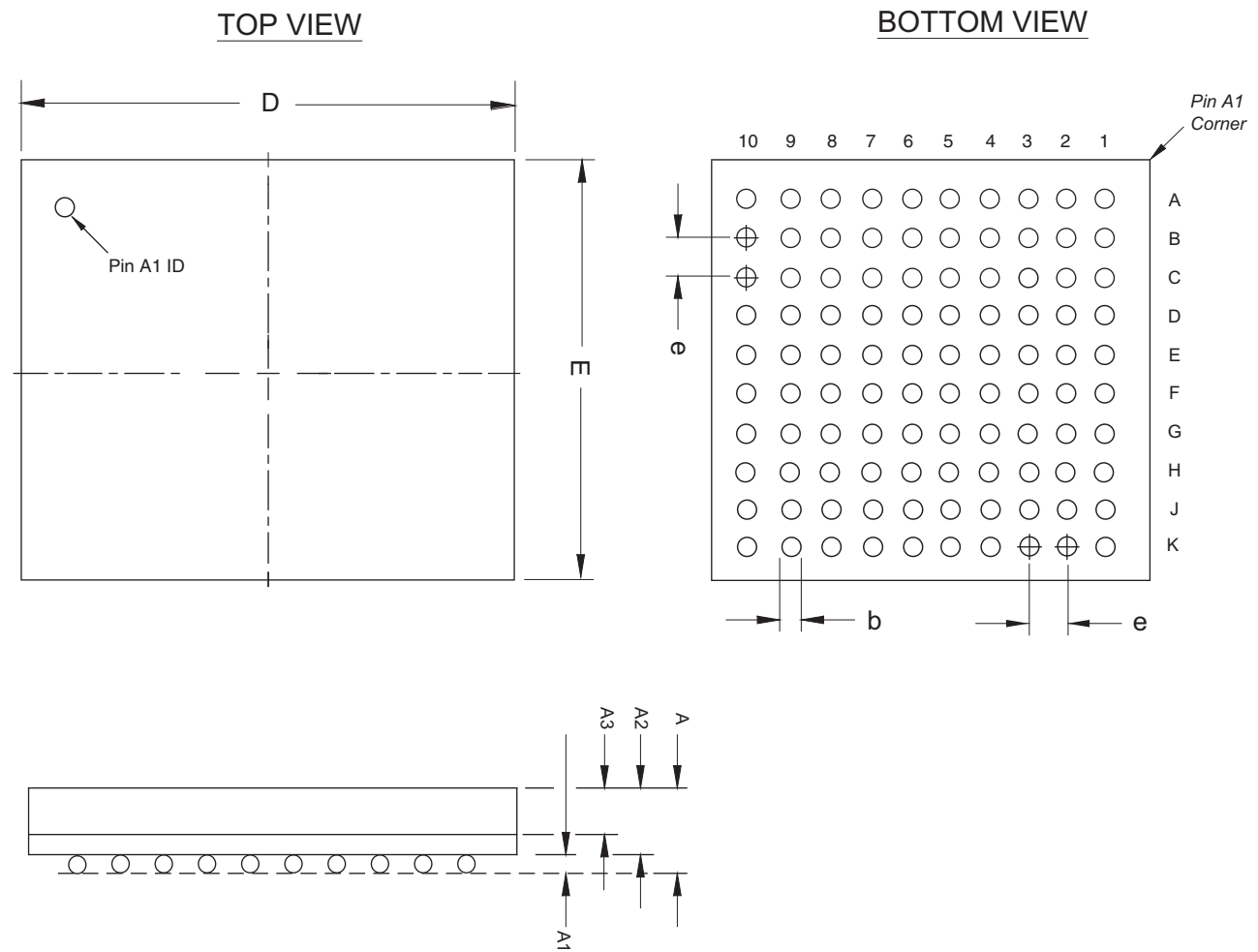
<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	1.55
A1	0.25	—	—



Package Information		Package Outline Dimension Table		
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)	A2	1.05 REF	
JEDEC Outline Reference	MO-192 Variation: DAC-1	A3	—	0.80
Maximum Lead Coplanarity	0.008 inches (0.20 mm)	D	11.00 BSC	
Weight	0.6 g	E	11.00 BSC	
Moisture Sensitivity Level	Printed on moisture barrier bag	b	0.45	0.50
		e	1.00 BSC	

Figure 7-4. 100-Pin FineLine BGA Package Outline



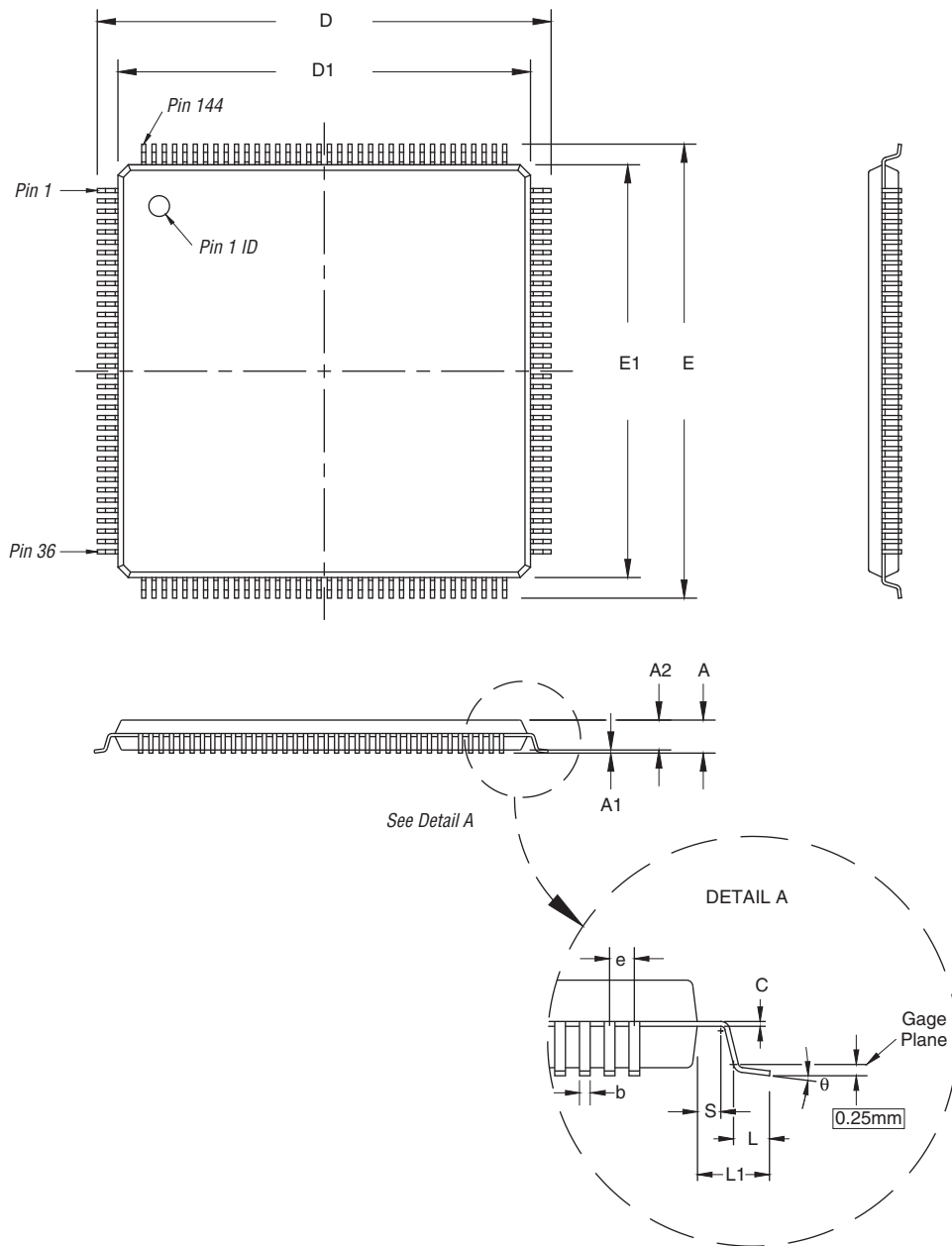
**144-Pin Plastic Thin Quad Flat Pack (TQFP)**

- All dimensions and tolerances conform to ANSI Y14.5M – 1994
- Controlling dimension is in millimeters
- Pin 1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<b>Package Information</b>	
<b>Description</b>	<b>Specification</b>
Ordering Code Reference	T
Package Acronym	TQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: BFB
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	1.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<b>Package Outline Figure Reference</b>			
<b>Symbol</b>	<b>Millimeters</b>		
	<b>Min.</b>	<b>Nom.</b>	<b>Max.</b>
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
D	22.00 BSC		
D1	20.00 BSC		
E	22.00 BSC		
E1	20.00 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
S	0.20	—	—
b	0.17	0.22	0.27
c	0.09	—	0.20
e	0.50 BSC		
θ	0°	3.5°	7°

Figure 7-5. 144-Pin TQFP Package Outline



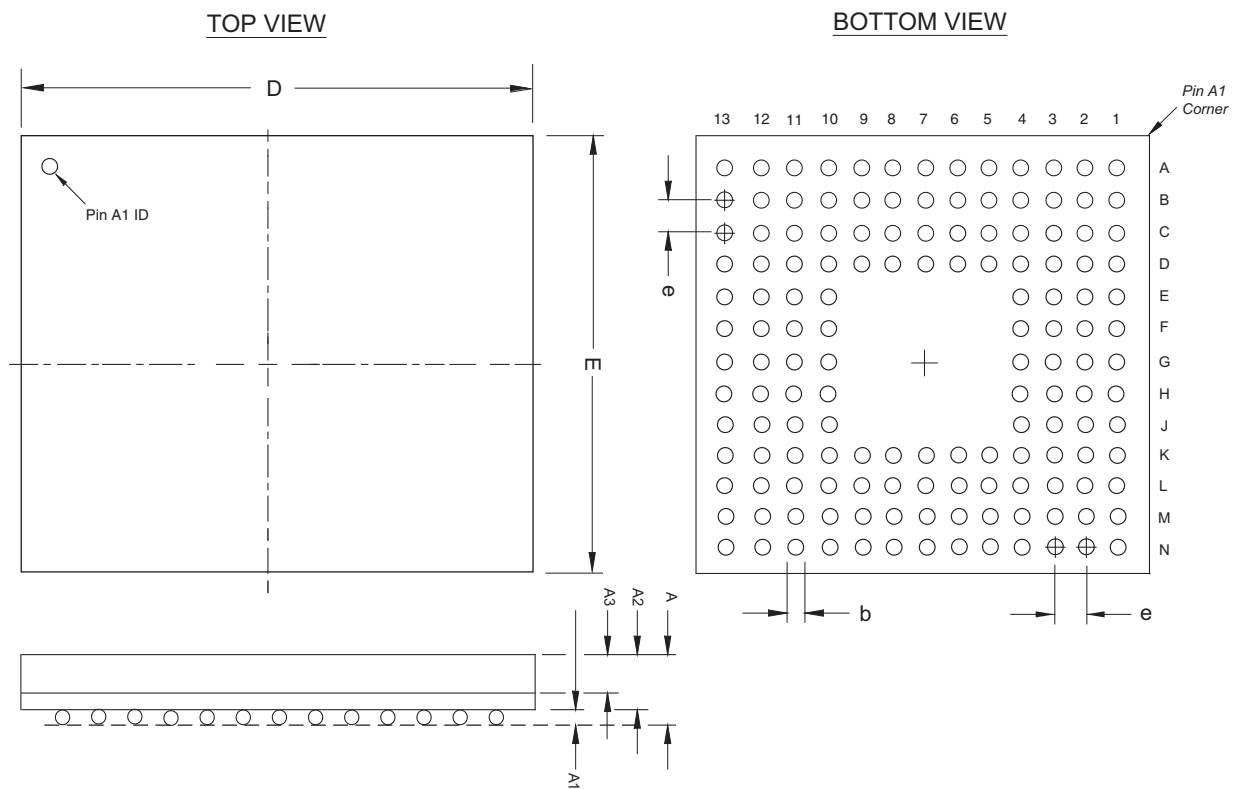
**144-Pin Micro FineLine Ball-Grid Array (MBGA) – Wire Bond**

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<b>Package Information</b>	
<b>Description</b>	<b>Specification</b>
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-195 Variation: AD
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	0.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<b>Package Outline Dimension Table</b>			
<b>Symbol</b>	<b>Millimeters</b>		
	<b>Min.</b>	<b>Nom.</b>	<b>Max.</b>
A	—	—	1.20
A1	0.15	—	—
A2	—	—	1.00
A3	0.60 REF		
D	7.00 BSC		
E	7.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

**Figure 7-6.** 144-Pin Micro FineLine BGA Package Outline



### 256-Pin Micro FineLine Ball-Grid Array (MBGA)

- All dimensions and tolerances conform to ASME Y14.5 – 1994
- Controlling dimension is in millimeters
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

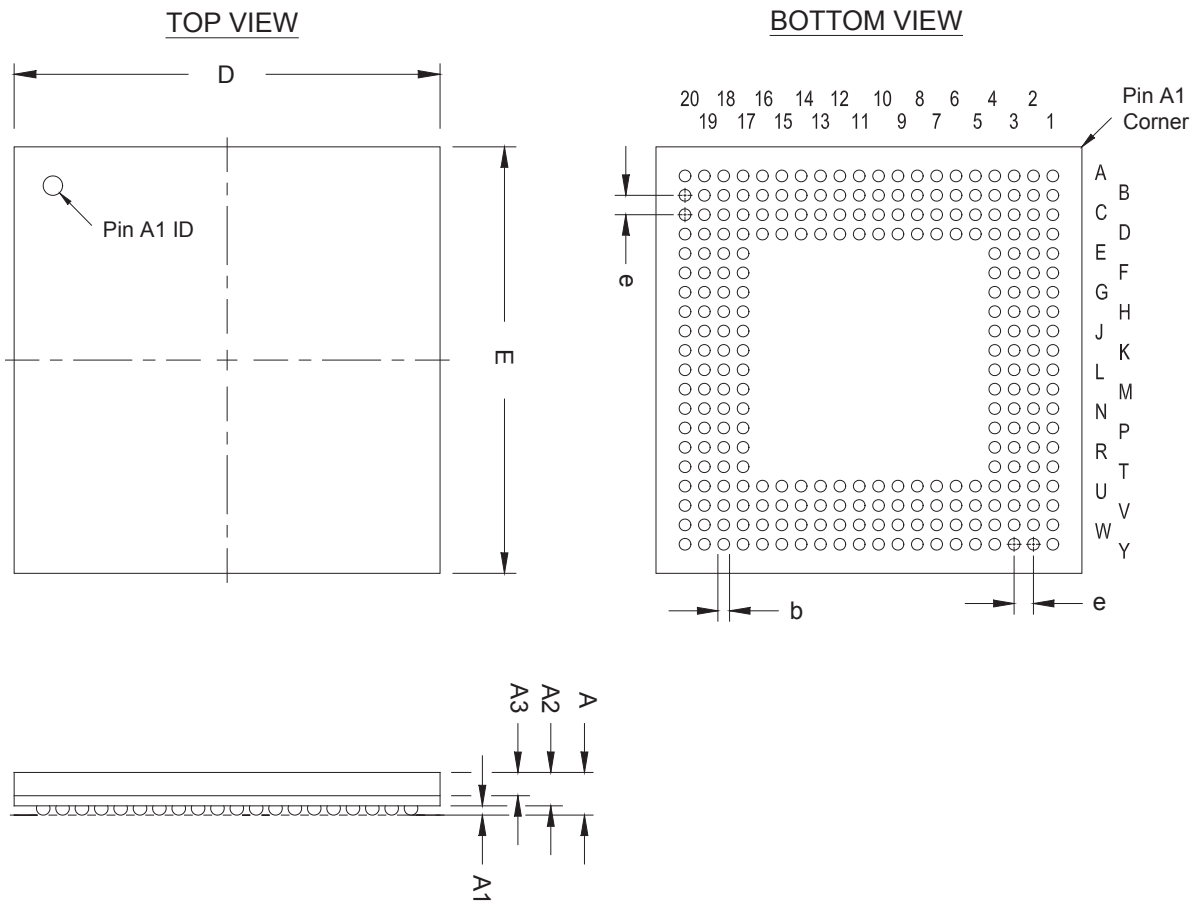
<b>Package Information (Part 1 of 2)</b>	
Description	Specification
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: BH
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	0.3 g

Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	1.20
A1	0.15	—	—
A2	—	—	1.00
A3	0.60 REF		
D	11.00 BSC		
E	11.00 BSC		

Package Information (Part 2 of 2)	
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table (Part 2 of 2)			
b	0.25	0.30	0.35
e	0.50 BSC		

Figure 7-7. 256-Pin Micro FineLine BGA Package Outline

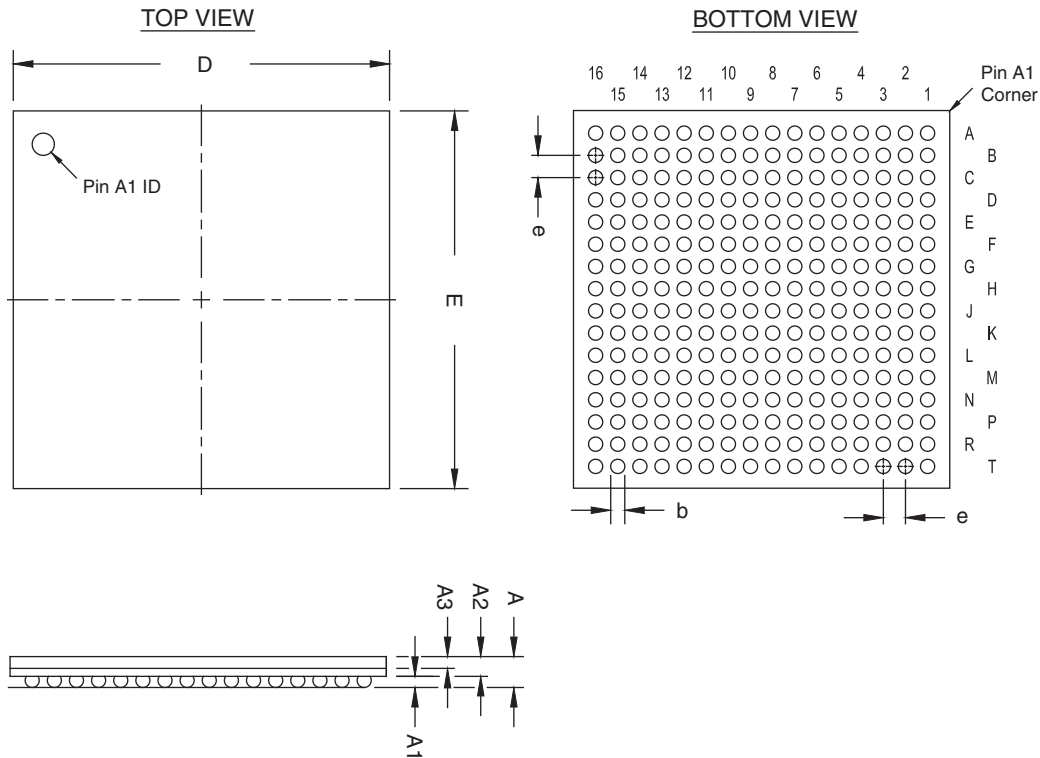


## 256-Pin FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994
- Controlling dimension is in millimeters
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAF-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
	Millimeters		
	Min.	Nom.	Max.
A	—	—	2.20
A1	0.30	—	—
A2	—	—	1.80
A3	0.70 REF		
D	17.00 BSC		
E	17.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

**Figure 7-8.** 256-Pin FineLine BGA Package Outline

### 324-Pin FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994
- Controlling dimension is in millimeters
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface

<b>Package Information (Part 1 of 2)</b>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAG-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.6 g

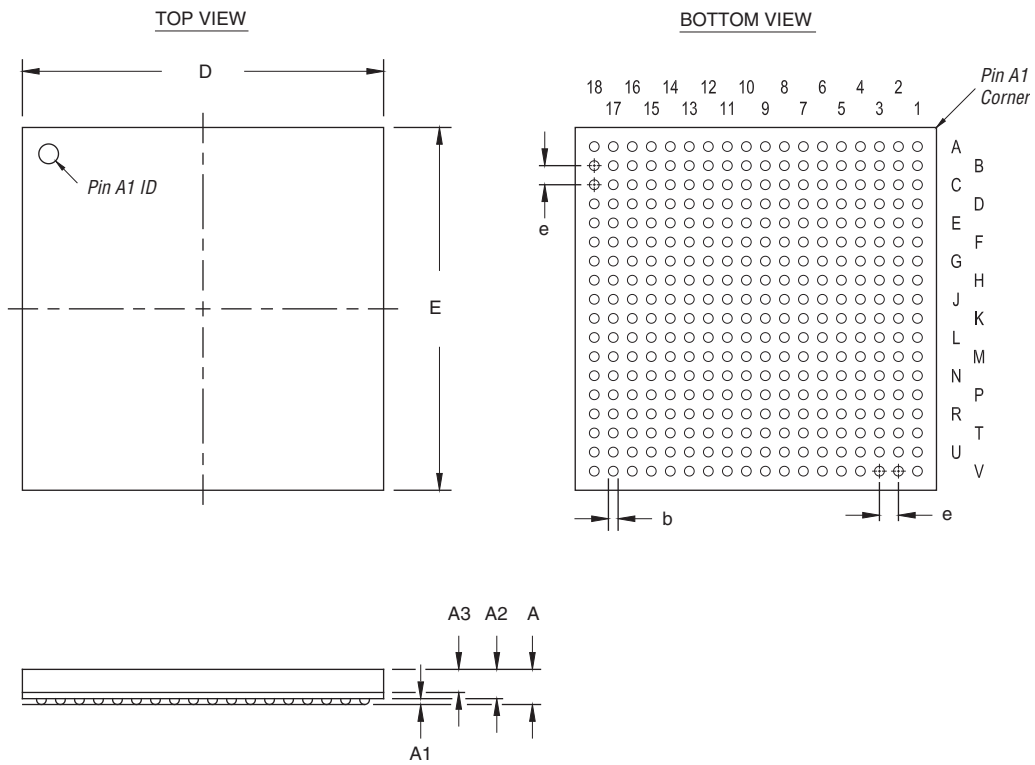
<b>Package Outline Dimension Table (Part 1 of 2)</b>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	—	—	2.20
A1	0.30	—	—
A2	—	—	1.80
A3	0.70 REF		
D	19.00 BSC		
E	19.00 BSC		
b	0.50	0.60	0.70



Package Information (Part 2 of 2)	
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table (Part 2 of 2)	
e	1.00 BSC

Figure 7-9. 324-Pin FineLine BGA Package Outline



## Document Revision History

Table 7-3 shows the revision history for this chapter.

**Table 7-3.** Document Revision History

Date and Revision	Changes Made	Summary of Changes
October 2008, version 2.1	<ul style="list-style-type: none"> <li>■ Updated New Document Format.</li> </ul>	—
December 2007, version 2.0	<ul style="list-style-type: none"> <li>■ Updated Table 7-1 and Table 7-2.</li> <li>■ Added “68-Pin Micro FineLine Ball-Grid Array (MBGA) – Wire Bond” and “144-Pin Micro FineLine Ball-Grid Array (MBGA) – Wire Bond” sections.</li> <li>■ Replaced Figure 7-9 with correct diagram.</li> </ul>	<ul style="list-style-type: none"> <li>■ Updated document with MAX IIZ information.</li> <li>■ Added information about 68-Pin Micro FineLine Ball-Grid Array and 144-Pin Micro FineLine Ball-Grid Array.</li> </ul>
December 2006, version 1.4	<ul style="list-style-type: none"> <li>■ Added document revision history.</li> </ul>	—
July 2006, version 1.3	<ul style="list-style-type: none"> <li>■ Updated packaging information.</li> </ul>	—
August 2005, version 1.2	<ul style="list-style-type: none"> <li>■ Updated the 100-pin plastic thin quad flat pack (TQFP) information.</li> </ul>	—
December 2004, version 1.1	<ul style="list-style-type: none"> <li>■ Updated Board Decoupling Guidelines section (changed the 0.2 value to 0.1.)</li> </ul>	—