15. Package Information for Cyclone II Devices

CII51015-2.3

Introduction

This chapter provides package information for Altera® Cyclone® II devices, including:

- Device and package cross reference
- Thermal resistance values
- Package outlines

Table 15–1 shows Cyclone II device package options.

Table 15–1. Cyclone II Device Package Options

Device	Package	Pins
EP2C5	Plastic Thin Quad Flat Pack (TQFP) – Wirebond	144
	Plastic Quad Flat Pack (PQFP) – Wirebond	208
	Low profile FineLine BGA® – Wirebond	256
EP2C8	TQFP – Wirebond	144
	PQFP – Wirebond	208
	Low profile FineLine BGA – Wirebond	256
EP2C15	Low profile FineLine BGA, Option 2 – Wirebond	256
	FineLine BGA, Option 3– Wirebond	484
EP2C20	PQFP – Wirebond	240
	Low profile FineLine BGA, Option 2 – Wirebond	256
	FineLine BGA, Option 3– Wirebond	484
EP2C35	FineLine BGA, Option 3 – Wirebond	484
	Ultra FineLine BGA – Wirebond	484
	FineLine BGA, Option 3 – Wirebond	672
EP2C50	FineLine BGA, Option 3 – Wirebond	484
	Ultra FineLine BGA – Wirebond	484
	FineLine BGA, Option 3 – Wirebond	672
EP2C70	FineLine BGA, Option 3 – Wirebond	672
	FineLine BGA – Wirebond	896

Thermal Resistance

Thermal resistance values for Cyclone II devices are provided for a board meeting JEDEC specifications and for a typical board. The values provided are as follows:

- θ_{JA} (° C/W) Still Air—Junction-to-ambient thermal resistance with no airflow when a heat sink is not being used.
- θ_{JA} (° C/W) 100 ft./minute—Junction-to-ambient thermal resistance with 100 ft./minute airflow when a heat sink is not being used.
- θ_{JA} (° C/W) 200 ft./minute—Junction-to-ambient thermal resistance with 200 ft./minute airflow when a heat sink is not being used.
- θ_{JA} (° C/W) 400 ft./minute—Junction-to-ambient thermal resistance with 400 ft./minute airflow when a heat sink is not being used.
- θ_{JC} (° C/W)—Junction-to-case thermal resistance for device.
- θ_{JB} (° C/W)—Junction-to-board thermal resistance for specific board being used.

Table 15–2 provides θ_{JA} (junction-to-ambient thermal resistance) values and θ_{JC} (junction-to-case thermal resistance) values for Cyclone II devices on a board meeting JEDEC specifications for thermal resistance calculation. The JEDEC board specifications require two signal and two power/ground planes and are available at **www.jedec.org**.

Table 15–2. Thermal Resistance of Cyclone II Devices for Board Meeting JEDEC Specifications (Part 1 of 2)

Device	Pin Count	Package	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.	θ_{JC} (° C/W)
EP2C5	144	TQFP	31	29.3	27.9	25.5	10
	208	PQFP	30.4	29.2	27.3	22.3	5.5
	256	FineLine BGA	30.2	26.1	23.6	21.7	8.7
EP2C8	144	TQFP	29.8	28.3	26.9	24.9	9.9
	208	PQFP	30.2	28.8	26.9	21.7	5.4
	256	FineLine BGA	27	23	20.5	18.5	7.1
EP2C15	256	FineLine BGA	24.2	20	17.8	16	5.5
	484	FineLine BGA	21	17	14.8	13.1	4.2
EP2C20	240	PQFP	26.6	24	21.4	17.4	4.2
	256	FineLine BGA	24.2	20	17.8	16	5.5
	484	FineLine BGA	21	17	14.8	13.1	4.2
EP2C35	484	FineLine BGA	19.4	15.4	13.3	11.7	3.3
	484	Ultra FineLine BGA	20.6	16.6	14.5	12.8	5
	672	FineLine BGA	18.6	14.6	12.6	11.1	3.1

Table 15–2. Thermal Resistance of Cyclone II Devices for Board Meeting JEDEC Specifications (Part 2 of 2)

Device	Pin Count	Package	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.	θ_{JC} (° C/W)
EP2C50	484	FineLine BGA	18.4	14.4	12.4	10.9	2.8
	484	Ultra FineLine BGA	19.6	15.6	13.6	11.9	4.4
	672	FineLine BGA	17.7	13.7	11.8	10.2	2.6
EP2C70	672	FineLine BGA	16.9	13	11.1	9.7	2.2
	896	FineLine BGA	16.3	11.9	10.5	9.1	2.1

Table 15–3 provides board dimension information for each package.

Table 15–3. PCB Dimensions Notes (1), (2)

2.5 mm Thick	Signal Layers	Power/Ground Layers	Package Dimension (mm)	Board Dimension (mm)
F896	10	10	31	91
F672	8	8	27	87
F672	7	7	27	87
F484	7	7	23	83
F484	6	6	23	83
U484	7	7	19	79
U484	6	6	19	79
F256	6	6	17	77

Notes to Table 15–3:

(1) Power layer Cu thickness 35 um, Cu 90%

(2) Signal layer Cu thickness 17 um, Cu 15%

Table 15–4 provides θ_{JA} (junction-to-ambient thermal resistance) values, θ_{JC} (junction-to-case thermal resistance) values, θ_{JB} (junction-to-board thermal resistance) values for Cyclone II devices on a typical board.

Table 15–4. Thermal Resistance of Cyclone II Devices for Typical Board

Device	Pin Count	Package	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.	θ_{JC} (° C/W)	θ_{JB} (° C/W)
EP2C5	256	FineLine BGA	30.2	25.8	22.9	20.6	8.7	14.8
EP2C8	256	FineLine BGA	27.9	23.2	20.5	18.4	7.1	12.3
EP2C15	256	FineLine BGA	24.7	20.1	17.5	15.3	5.5	9.1
	484	FineLine BGA	20.5	16.2	13.9	12.2	4.2	7.2
EP2C20	256	FineLine BGA	24.7	20.1	17.5	15.3	5.5	9.1
	484	FineLine BGA	20.5	16.2	13.9	12.2	4.2	7.2
EP2C35	484	FineLine BGA	18.8	14.5	12.3	10.6	3.3	5.7
	484	Ultra FineLine BGA	20	15.5	13.2	11.3	5	5.3
	672	FineLine BGA	17.4	13.3	11.3	9.8	3.1	5.5
EP2C50	484	FineLine BGA	17.7	13.5	11.4	9.8	2.8	4.5
	484	FineLine BGA	18.1	13.8	11.7	10.1	2.8	4.6
	484	Ultra FineLine BGA	19	14.6	12.3	10.6	4.4	4.4
	484	Ultra FineLine BGA	19.4	15	12.7	10.9	4.4	4.6
	672	FineLine BGA	16.5	12.4	10.5	9	2.6	4.6
EP2C70	672	FineLine BGA	15.7	11.7	9.8	8.3	2.2	3.8
	672	FineLine BGA	15.9	11.9	9.9	8.4	2.2	3.9
	896	FineLine BGA	14.6	10.7	8.9	7.6	2.1	3.7

Package Outlines

The package outlines on the following pages are listed in order of ascending pin count.

144-Pin Plastic Thin Quad Flat Pack (TQFP) – Wirebond

- All dimensions and tolerances conform to ASME 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.

Tables 15–5 and 15–6 show the package information and package outline figure references, respectively, for the 144-pin TQFP package.

Table 15–5. 144-Pin TQFP Package Information

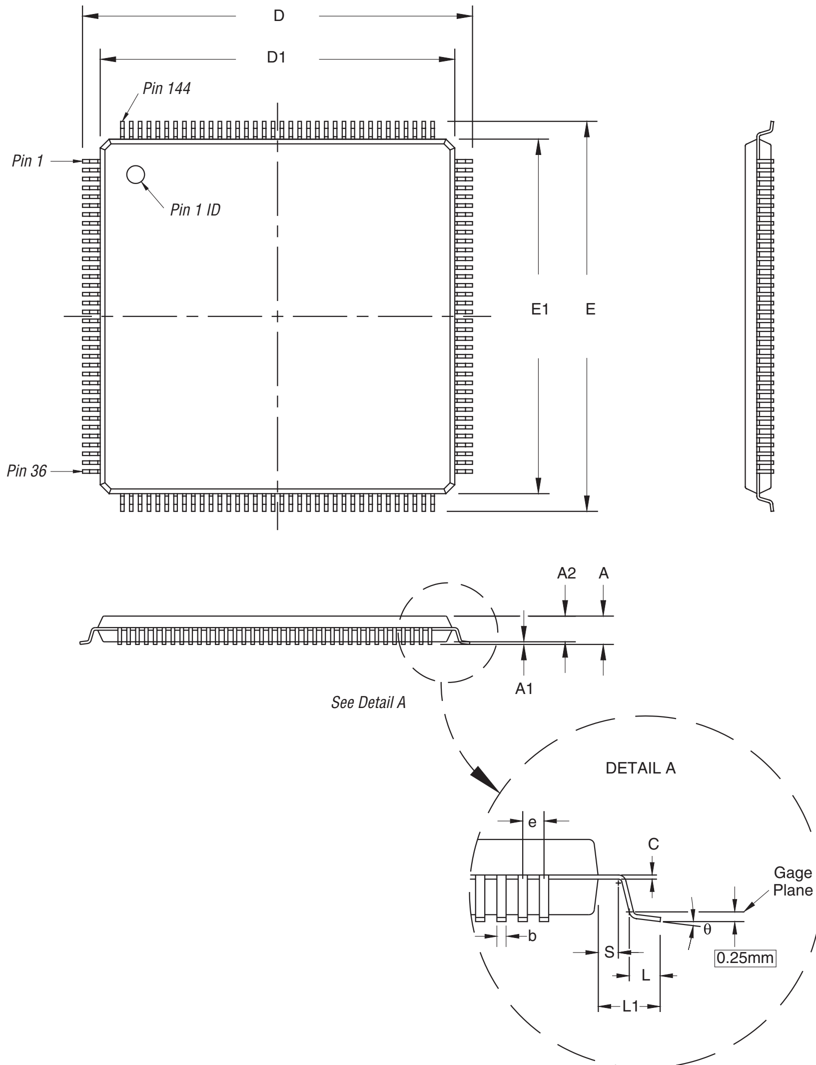
Description	Specification
Ordering code reference	T
Package acronym	TQFP
Lead frame material	Copper
Lead finish (plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: BFB
Maximum lead coplanarity	0.003 inches (0.08mm)
Weight	1.3 g
Moisture sensitivity level	Printed on moisture barrier bag

Table 15–6. 144-Pin TQFP Package Outline Dimensions

Symbol	Millimeter		
	Min.	Nom.	Max.
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 15–1 shows a 144-pin TQFP package outline.

Figure 15–1. 144-Pin TQFP Package Outline



208-Pin Plastic Quad Flat Pack (PQFP) – Wirebond

- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin 1 may be indicated by an ID dot in its proximity on package surface.

Tables 15–7 and 15–8 show the package information and package outline figure references, respectively, for the 208-pin PQFP package.

Table 15–7. 208-Pin PQFP Package Information

Description	Specification
Ordering code reference	Q
Package acronym	PQFP
Lead material	Copper
Lead finish (plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-029 Variation: FA-1
Maximum lead coplanarity	0.003 inches (0.08 mm)
Weight	5.7 g
Moisture sensitivity level	Printed on moisture barrier bag

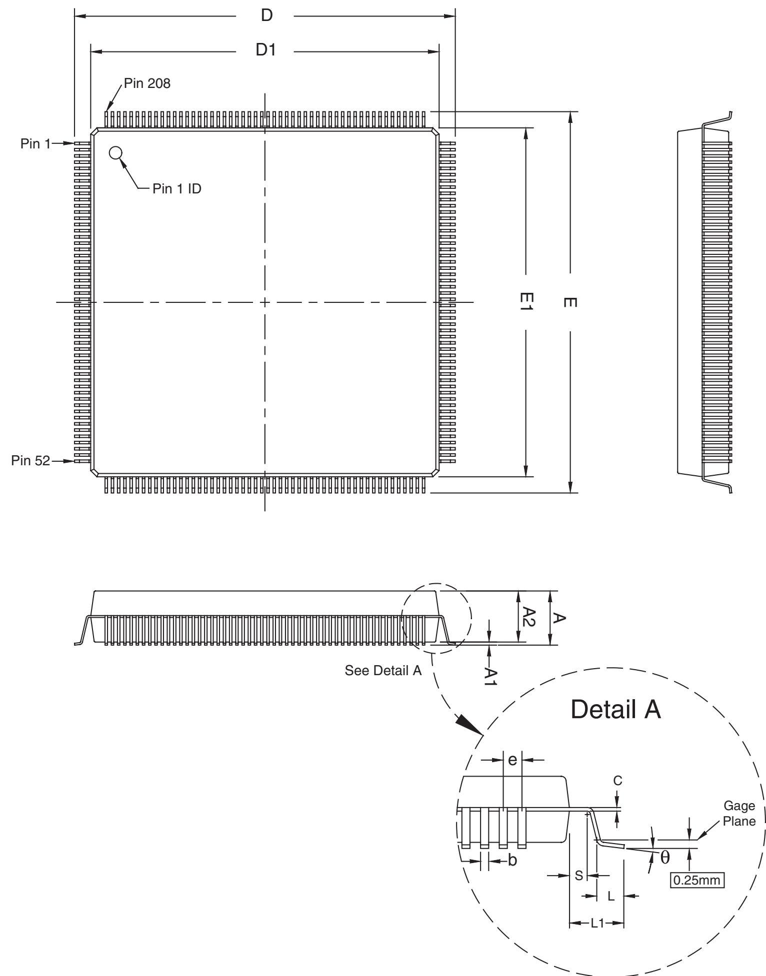
Table 15–8. 208-Pin PQFP Package Outline Dimensions (Part 1 of 2)

Symbol	Millimeter		
	Min.	Nom.	Max.
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	30.60 BSC		
D1	28.00 BSC		
E	30.60 BSC		
E1	28.00 BSC		
L	0.50	0.60	0.75
L1	1.30 REF		
S	0.20	–	–
b	0.17	–	0.27
c	0.09	–	0.20

Table 15–8. 208-Pin PQFP Package Outline Dimensions (Part 2 of 2)			
Symbol	**Millimeter**		
	Min.	**Nom.**	**Max.**
e	0.50 BSC		
q	0°	3.5°	8°

Figure 15–2 shows a 208-pin PQFP package outline.

Figure 15–2. 208-pin PQFP Package Outline



240-Pin Plastic Quad Flat Pack (PQFP)

- All dimensions and tolerances conform to ASME 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.

Tables 15–9 and 15–10 show the package information and package outline figure references, respectively, for the 240-pin PQFP package.

Table 15–9. 240-Pin PQFP Package Information

Description	Specification
Ordering Code Reference	Q
Package Acronym	PQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-029 Variation: GA
Maximum Lead Coplanarity	0.003 inches (0.08mm)
Weight	7.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

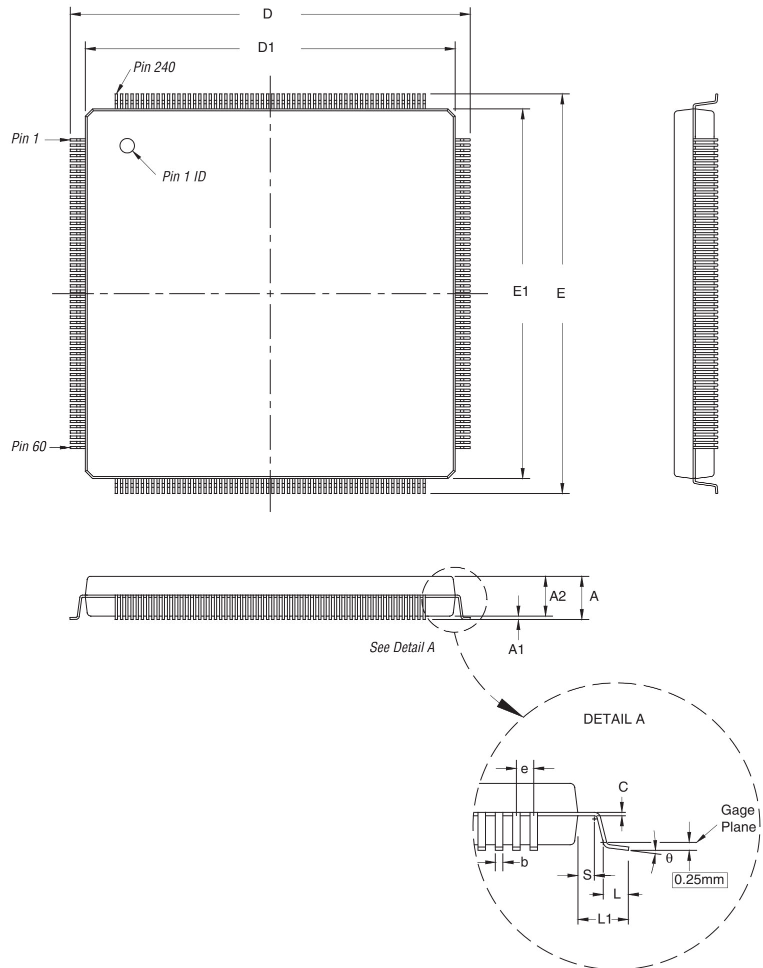
Table 15–10. 240-Pin PQFP Package Outline Dimensions (Part 1 of 2)

Symbol	Millimeter		
	Min.	Nom.	Max.
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	34.60 BSC		
D1	32.00 BSC		
E	34.60 BSC		
E1	32.00 BSC		
L	0.45	0.60	0.75
L1	1.30 REF		
S	0.20	–	–
b	0.17	–	0.27
c	0.09	–	0.20

Table 15–10. 240-Pin PQFP Package Outline Dimensions (Part 2 of 2)			
Symbol	Millimeter		
	Min.	Nom.	Max.
e	0.50 BSC		
θ	0°	3.5°	8°

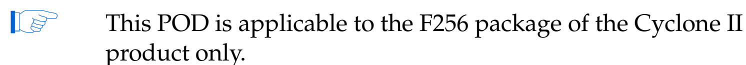
Figure 15–3 shows a 240-pin PQFP package outline.

Figure 15–3. 240-pin PQFP Package Outline



256-Pin FineLine Ball-Grid Array, Option 2 – Wirebond

- 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 the package surface.



This POD is applicable to the F256 package of the Cyclone II product only.

Tables 15–11 and 15–12 show the package information and package outline figure references, respectively, for the 256-pin FineLine BGA package.

Table 15–11. 256-Pin FineLine BGA Package Information

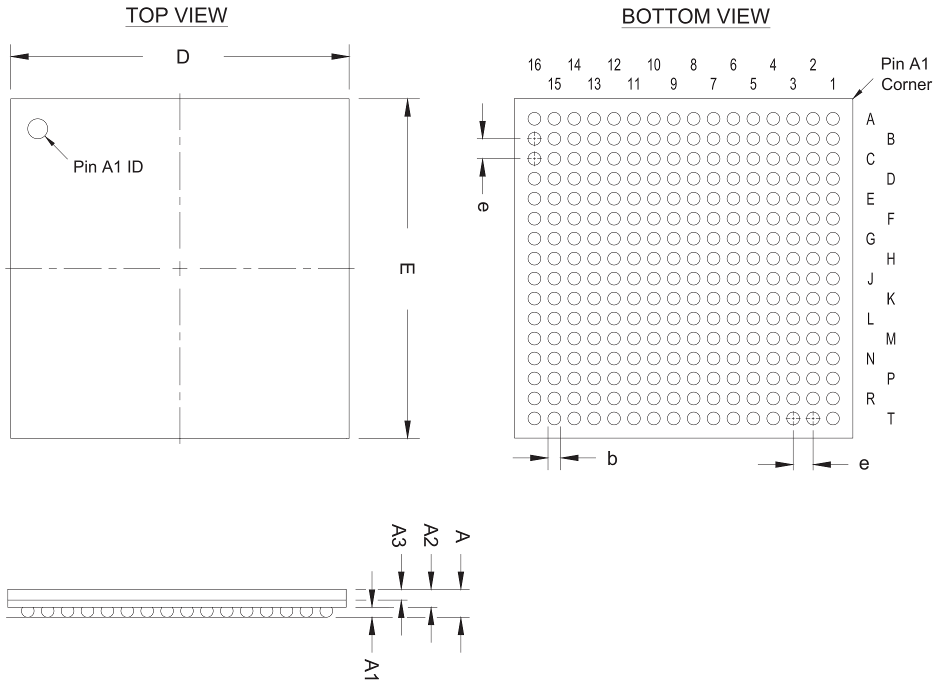
Description	Specification
Ordering code reference	F
Package acronym	FineLine BGA
Substrate material	BT
Solder ball composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: AAF-1
Maximum lead coplanarity	0.008 inches (0.20 mm)
Weight	1.9 g
Moisture sensitivity level	Printed on moisture barrier bag

Table 15–12. 256-Pin FineLine BGA Package Outline Dimensions

Symbol	Millimeter		
	Min.	Nom.	Max.
A	–	–	1.55
A1	0.25	–	–
A2	1.05 REF		
A3	–	–	0.80
D	17.00 BSC		
E	17.00 BSC		
b	0.40	0.50	0.55
e	1.00 BSC		

Figure 15–4 shows a 256-pin FineLine BGA package outline.

Figure 15–4. 256-Pin FineLine BGA Package Outline



484-Pin FineLine BGA, Option 3 – Wirebond

- 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.

Tables 15–13 and 15–14 show the package information and package outline figure references, respectively, for the 484-pin FineLine BGA package.

Table 15–13. 484-Pin FineLine BGA Package Information

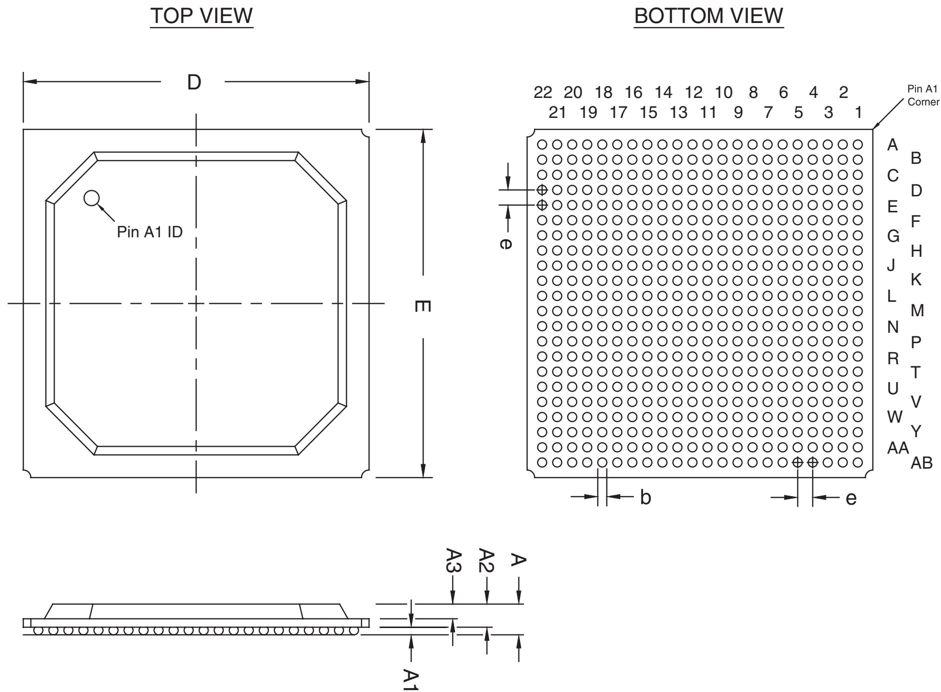
Description	Specification
Ordering code reference	F
Package acronym	FineLine BGA
Substrate material	BT
Solder ball composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAJ-1
Maximum lead coplanarity	0.008 inches (0.20 mm)
Weight	5.7 g
Moisture sensitivity level	Printed on moisture barrier bag

Table 15–14. 484-Pin FineLine BGA Package Outline Dimensions

Symbol	Millimeter		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.30	–	–
A2	–	–	2.20
A3	–	–	1.80
D	23.00 BSC		
E	23.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Figure 15–5 shows a 484-pin FineLine BGA package outline.

Figure 15–5. 484-Pin FineLine BGA Package Outline



484-Pin Ultra FineLine BGA – Wirebond

- 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.

Tables 15–15 and 15–16 show the package information and package outline figure references, respectively, for the 484-pin Ultra FineLine BGA package.

Table 15–15. 484-Pin Ultra FineLine BGA Package Information

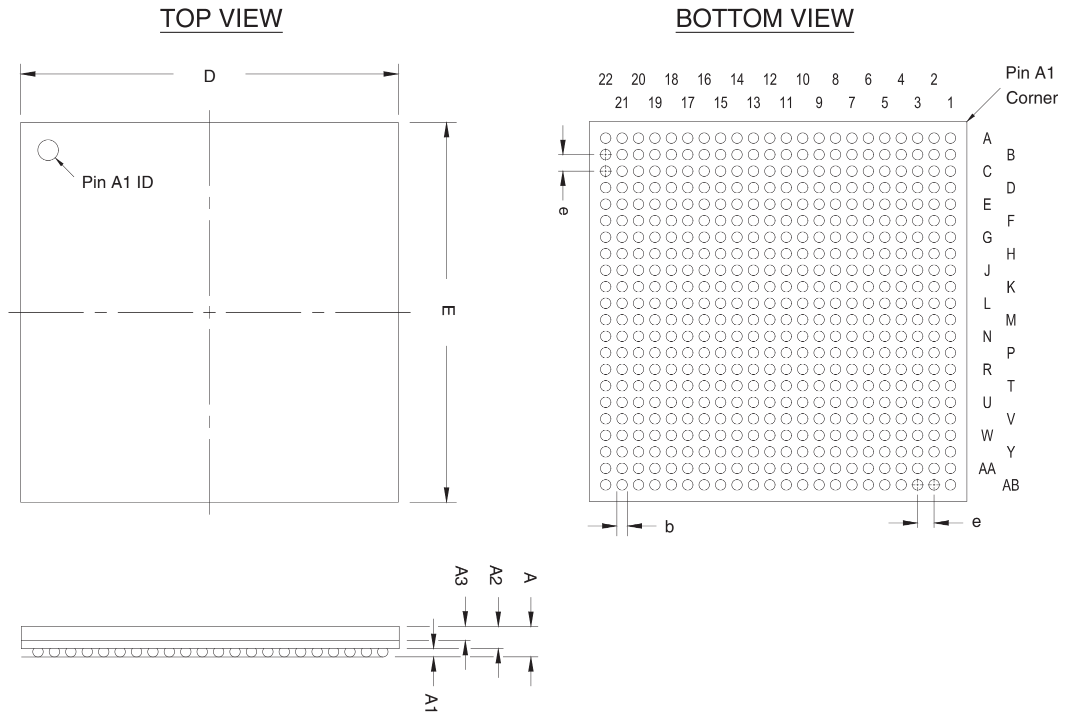
Description	Specification
Ordering Code Reference	U
Package Acronym	UBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-216 Variation: BAP-2
Maximum Lead Coplanarity	0.005 inches (0.12mm)
Weight	1.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Table 15–16. 484-Pin Ultra FineLine BGA Package Outline Dimensions

Symbol	Millimeter		
	Min.	Nom.	Max.
A	–	–	2.20
A1	0.20	–	–
A2	0.65	–	–
A3	0.80 TYP		
D	19.00 BSC		
E	19.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Figure 15–6 shows a 484-pin Ultra FineLine BGA package outline.

Figure 15–6. 484-Pin Ultra FineLine BGA Package Outline



672-Pin FineLine BGA Package, Option 3 – Wirebond

- 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 the package surface.

Tables 15–17 and 15–18 show the package information and package outline figure references, respectively, for the 672-pin FineLine BGA package.

Table 15–17. 672-Pin FineLine BGA Package Information

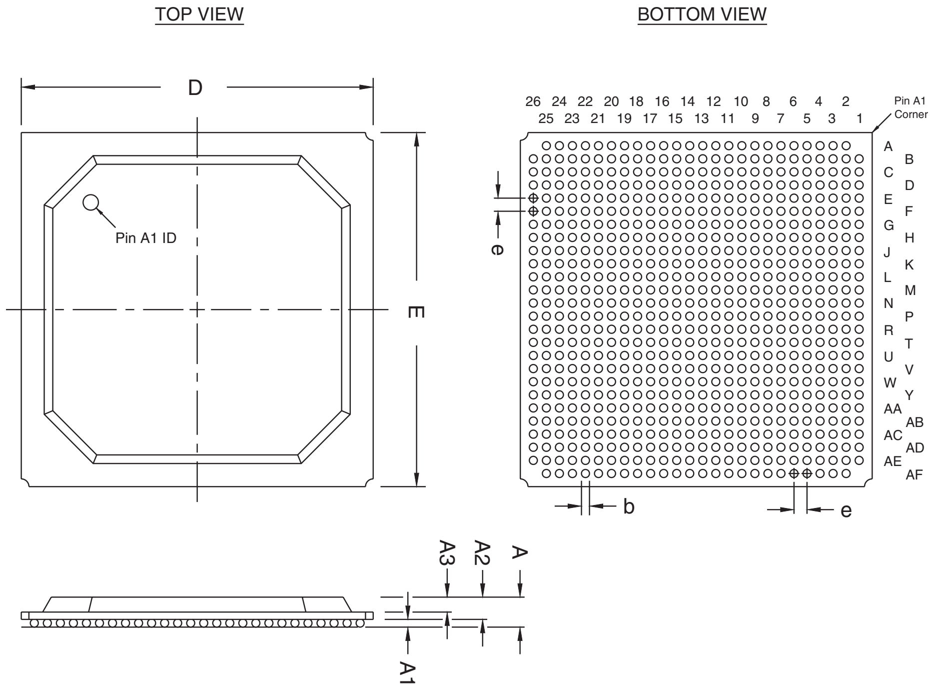
Description	Specification
Ordering code reference	F
Package acronym	FineLine BGA
Substrate material	BT
Solder ball composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAL-1
Maximum lead coplanarity	0.008 inches (0.20 mm)
Weight	7.7 g
Moisture sensitivity level	Printed on moisture barrier bag

Table 15–18. 672-Pin FineLine BGA Package Outline Dimensions

Symbol	Dimensions (mm)		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.30	–	–
A2	–	–	2.20
A3	–	–	1.80
D	27.00 BSC		
E	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Figure 15–7 shows a 672-pin FineLine BGA package outline.

Figure 15–7. 672-Pin FineLine BGA Package Outline



896-Pin FineLine BGA Package – Wirebond

- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1's location may be indicated by an ID dot in its proximity on the package surface.

Tables 15–19 and 15–20 show the package information and package outline figure references, respectively, for the 896-pin FineLine BGA.

Table 15–19. 896-Pin FineLine BGA Package Information

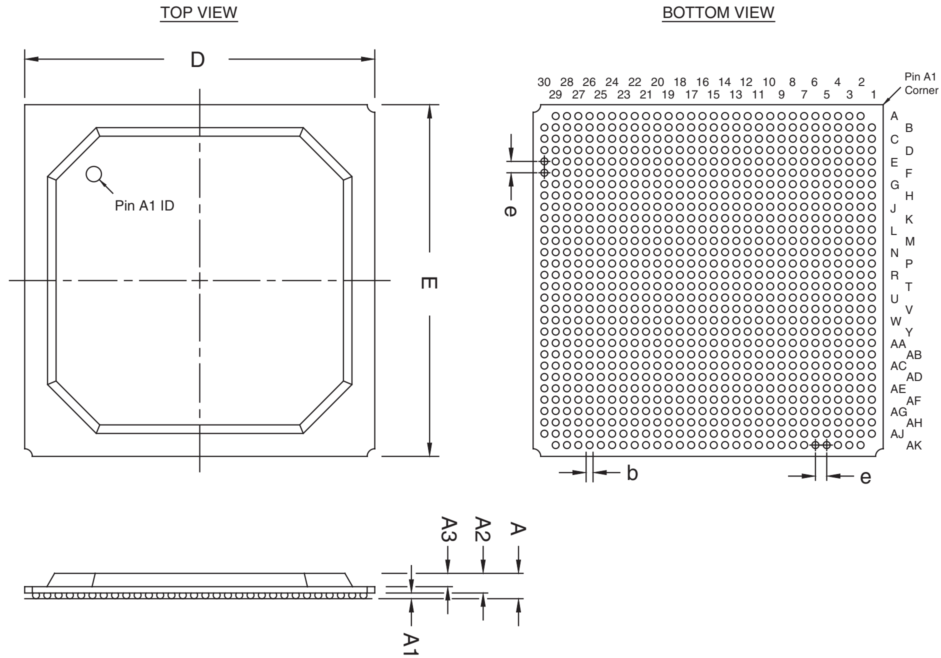
Description	Specification
Ordering code reference	F
Package acronym	FineLine BGA
Substrate material	BT
Solder ball composition	Regular: 63Sn: 37Pb (typical) Pb-free: Sn: 3.0Ag: 0.5Cu (typical)
JEDEC outline reference	MS-034 variation AAN-1
Maximum lead coplanarity	0.008 inches (0.20 mm)
Weight	11.5 g
Moisture sensitivity level	Printed on moisture barrier bag

Table 15–20. 896-Pin FineLine BGA Package Outline Dimensions

Symbol	Dimensions (mm)		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.30	–	–
A2	–	–	2.20
A3	–	–	1.80
D	31.00 BSC		
E	31.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Figure 15–8 shows a 896-pin FineLine BGA package outline.

Figure 15–8. 896-Pin FineLine BGA Package Outline



Document Revision History

Table 15–21 shows the revision history for this document.

Table 15–21. Document Revision History

Date & Document Version	Changes Made	Summary of Changes
February 2007 v2.3	Added document revision history.	
November 2005 v2.1	Updated information throughout.	
July 2005 v2.0	Updated packaging information.	
November 2004 v1.0	Added document to the Cyclone II Device Handbook.	