Altera Device Package Information

April 2002, ver. 10.2 Data Sheet

Introduction

This data sheet provides package information for Altera® devices. It includes these sections:

- Device & Package Cross Reference (below)
- Thermal Resistance (starting on page 8)
- Package Outlines (starting on page 21)

In this data sheet, packages are listed in order of ascending pin count.

Device & Package Cross Reference

Tables 1 through 17 show which Altera Stratix™, APEX™ II, Mercury™, ARM®-based Excalibur™, APEX 20KC, APEX 20KE, APEX 20K, and ACEX® 1K, FLEX 10KA, FLEX® 10KS, FLEX 10KE, FLEX 10KV, FLEX 10K®, FLEX 6000, MAX® 9000, MAX 7000B, MAX 7000AE, MAX 7000A, and enhanced configuration devices are available in BGA, FineLine BGA and Ultra FineLine BGA packages.

Table 1. Stratix Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages (Part 1 of 2)

Device	Package	Pins
EP1S10	Non-Thermally Enhanced Cavity Up	672
	Non-Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	780
EP1S20	Non-Thermally Enhanced Cavity Up	672
	Non-Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	780
EP1S25	Non-Thermally Enhanced Cavity Up	672
	Non-Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	780
	Thermally Enhanced FineLine BGA	1,020
EP1S30	Thermally Enhanced FineLine BGA	780
	Thermally Enhanced BGA Cavity Up	956
	Thermally Enhanced FineLine BGA	1,020

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Table 1. Stratix Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages (Part 2 of 2)

Device	Package	Pins
EP1S40	Thermally Enhanced BGA Cavity up	956
	Thermally Enhanced FineLine BGA	1,020
	Thermally Enhanced FineLine BGA	1,508
EP1S60	Thermally Enhanced BGA Cavity Up	956
	Thermally Enhanced FineLine BGA	1,020
	Thermally Enhanced FineLine BGA	1,508
EP1S80	Thermally Enhanced BGA Cavity Up	956
	Thermally Enhanced FineLine BGA	1,508
EP1S120	Thermally Enhanced FineLine BGA	1,923

Table 2. APEX II Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EP2A15	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced BGA Cavity Up	724
EP2A25	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced BGA Cavity Up	724
	Thermally Enhanced FineLine BGA	1,020
EP2A40	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced BGA Cavity Up	724
	Thermally Enhanced FineLine BGA	1,020
EP2A70	Thermally Enhanced BGA Cavity Up	724
	Thermally Enhanced FineLine BGA	1,508

Table 3. Mercury Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EP1M120	Thermally Enhanced FineLine BGA	484
EP1M350	Thermally Enhanced FineLine BGA	780

Table 4. ARM-Based Excalibur Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EPXA1	Non-Thermally Enhanced FineLine BGA	484
	Thermally Enhanced FineLine BGA	672
EPXA4	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	1,020
EPXA10	Thermally Enhanced FineLine BGA	1,020

Table 5. APEX 20KE Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EP20K30E	Non-Thermally Enhanced FineLine BGA	144
	Non-Thermally Enhanced FineLine BGA	324
EP20K60E	Non-Thermally Enhanced FineLine BGA	144
	Non-Thermally Enhanced FineLine BGA	324
	Thermally Enhanced BGA Cavity Down	356
EP20K100E	Non-Thermally Enhanced FineLine BGA	144
	Non-Thermally Enhanced FineLine BGA	324
	Thermally Enhanced BGA Cavity Down	356
EP20K160E	Thermally Enhanced BGA Cavity Down	356
	Non-Thermally Enhanced FineLine BGA	484
EP20K200E	Thermally Enhanced BGA Cavity Down	356
	Non-Thermally Enhanced FBGA	484
	Non-Thermally Enhanced BGA Cavity Up	652
	Non-Thermally Enhanced FBGA	672
EP20K300E	Non-Thermally Enhanced BGA Cavity Up	652
	Non-Thermally Enhanced FBGA	672
EP20K400E	Thermally Enhanced BGA Cavity Down	652
	Thermally Enhanced FineLine BGA	672
EP20K600E	Thermally Enhanced BGA Cavity Down	652
	Thermally Enhanced FBGA	672
	Thermally Enhanced FBGA	1,020
EP20K1000E	Thermally Enhanced BGA Cavity Up	652
	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	1,020
EP20K1500E	Thermally Enhanced BGA Cavity Up	652
	Thermally Enhanced FineLine BGA	1,020

Table 6. APEX 20KC Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EP20K200C	Thermally Enhanced BGA Cavity Down	356
	Non-Thermally Enhanced FineLine BGA	484
EP20K400C	Thermally Enhanced BGA Cavity Down	652
	Thermally Enhanced FineLine BGA	672
EP20K600C	Thermally Enhanced BGA Cavity Down	652
	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	1,020
EP20K1000C	Thermally Enhanced BGA Cavity Up	652
	Thermally Enhanced FineLine BGA	672
	Thermally Enhanced FineLine BGA	1,020

Table 7. APEX 20K Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EP20K100	Non-Thermally Enhanced FineLine BGA	324
	Thermally Enhanced BGA Cavity Down	356
EP20K200	Thermally Enhanced BGA Cavity Down	356
	Non-Thermally Enhanced FineLine BGA	484
EP20K400	Thermally Enhanced BGA Cavity Down	652
	Thermally Enhanced FineLine BGA	672

Table 8. ACEX 1K Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EP1K10	Non-Thermally Enhanced FineLine BGA	256
EP1K30	Non-Thermally Enhanced FineLine BGA	256
EP1K50 EP1K50S	Non-Thermally Enhanced FineLine BGA	256
EP1K50 EP1K50S	Non-Thermally Enhanced FineLine BGA	484
EP1K100	Non-Thermally Enhanced FineLine BGA	256
	Non-Thermally Enhanced FineLine BGA	484

Table 9. FLEX 10KA & FLEX 10KS Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPF10K10A	Non-Thermally Enhanced FineLine BGA	256
EPF10K30A	Non-Thermally Enhanced FineLine BGA	256
EPF10K30A	Thermally Enhanced BGA Cavity Down	356
EPF10K30A	Non-Thermally Enhanced FineLine BGA	484
EPF10K50S	Non-Thermally Enhanced FineLine BGA	256
EPF10K50S	Thermally Enhanced BGA Cavity Down	356
EPF10K50S	Non-Thermally Enhanced FineLine BGA	484
EPF10K100A	Thermally Enhanced BGA Cavity Down	356
EPF10K100A	Non-Thermally Enhanced FineLine BGA	484
EPF10K100A	Thermally Enhanced BGA Cavity Down	600
EPF10K200S	Thermally Enhanced BGA Cavity Down	356
EPF10K200S	Non-Thermally Enhanced FineLine BGA	484
EPF10K200S	Thermally Enhanced BGA Cavity Down	600
EPF10K200S	Non-Thermally Enhanced FineLine BGA	672
EPF10K250A	Thermally Enhanced BGA Cavity Down	600

Table 10. FLEX 10KE Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPF10K30E	Non-Thermally Enhanced FineLine BGA	256
EPF10K30E	Non-Thermally Enhanced FineLine BGA	484
EPF10K50E	Non-Thermally Enhanced FineLine BGA	256
EPF10K50E	Non-Thermally Enhanced FineLine BGA	484
EPF10K100E	Non-Thermally Enhanced FineLine BGA	256
EPF10K100E	Thermally Enhanced BGA Cavity Down	356
EPF10K100E	Non-Thermally Enhanced FineLine BGA	484
EPF10K130E	Thermally Enhanced BGA Cavity Down	356
EPF10K130E	Non-Thermally Enhanced FineLine BGA	484
EPF10K130E	Thermally Enhanced BGA Cavity Down	600
EPF10K130E	Non-Thermally Enhanced FineLine BGA	672
EPF10K200E	Thermally Enhanced BGA Cavity Down	600
EPF10K200E	Non-Thermally Enhanced FineLine BGA	672

Table 11. FLEX 10K & FLEX 10KV Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPF10K30	Thermally Enhanced BGA Cavity Down	356
EPF10K50	Thermally Enhanced BGA Cavity Down	356
EPF10K50V	Thermally Enhanced BGA Cavity Down	356
EPF10K50V	Non-Thermally Enhanced FineLine BGA	484
EPF10K130V	Thermally Enhanced BGA Cavity Down	600

Table 12. FLEX 6000 Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPF6016	Non-Thermally Enhanced BGA Cavity Up	256
EPF6016A	Non-Thermally Enhanced FineLine BGA	100
EPF6016A	Non-Thermally Enhanced BGA	256
EPF6024A	Non-Thermally Enhanced BGA Cavity Up	256
EPF6024A	Non-Thermally Enhanced FineLine BGA	256

Table 13. MAX 9000 Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPM9320	Thermally Enhanced BGA Cavity Down	356
EPM9320A	Thermally Enhanced BGA Cavity Down	356
EPM9560	Thermally Enhanced BGA Cavity Down	356

Table 14. MAX 7000B Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EPM7032B	Ultra FineLine BGA	49
EPM7064B	Ultra FineLine BGA	49
EPM7064B	Non-Thermally Enhanced FineLine BGA	100
EPM7128B	Ultra FineLine BGA	49
EPM7128B	Non-Thermally Enhanced FineLine BGA	100
	Non-Thermally Enhanced BGA	100
EPM7128B	Ultra FineLine BGA	169
EPM7128B	Non-Thermally Enhanced FineLine BGA	256
EPM7256B	Ultra FineLine BGA	169
EPM7256B	Non-Thermally Enhanced FineLine BGA	256
EPM7512B	Ultra FineLine BGA	169
EPM7512B	Non-Thermally Enhanced FineLine BGA	256
EPM7512B	Thermally Enhanced BGA Cavity Down	256

Table 15. MAX 7000AE Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EPM7064AE	Ultra FineLine BGA	49
	Non-Thermally Enhanced FineLine BGA	100
EPM7128AE	Non-Thermally Enhanced FineLine BGA	100
	Ultra FineLine BGA	169
	Non-Thermally Enhanced FineLine BGA	256
EPM7256AE	Thermally Enhanced BGA Cavity Down	256
EPM7256AE	Non-Thermally Enhanced FineLine BGA	256
EPM7512AE	Thermally Enhanced BGA Cavity Down	256

Table 16. MAX 7000A Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages

Device	Package	Pins
EPM7128A	Non-Thermally Enhanced FineLine BGA	100
	Non-Thermally Enhanced FineLine BGA	256
EPM7256A	Non-Thermally Enhanced FineLine BGA	256

Table 17. Enhanced Configuration Devices in BGA, FineLine BGA & Ultra FineLine BGA Packages		
Device	**Package**	**Pins**
EPC16	Ultra FineLine BGA	88

Thermal Resistance

Tables 18 through 31 provide θ_{JA} (junction-to-ambient thermal resistance) and θ_{JC} (junction-to-case thermal resistance) values for Altera Stratix, APEX II, Mercury, ARM-based Excalibur, APEX 20K and APEX 20KE, ACEX 1K, FLEX® 10K and FLEX 10KE, FLEX 8000, FLEX 6000, MAX® 9000, MAX 7000, MAX 3000A, Classic™, and configuration devices.

Table 18. Thermal Resistance of Stratix Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP1S10	672	BGA	3.2	16.8	13.7	11.9	10.5
	672	FBGA	3.4	17.2	14	12.2	10.8
	780	FBGA	0.2	11.2	9.1	7.6	6.4
EP1S20	672	BGA	2.5	15.5	12.4	10.7	9.3
	672	FBGA	2.7	16	12.8	11	9.6
	780	FBGA	0.2	11	8.9	7.4	6.2
EP1S25	672	BGA	2.2	14.8	11.7	10.0	8.7
	672	FBGA	2.3	15.3	12	10.4	9
	780	FBGA	0.2	10.8	8.8	7.2	6.1
	1020	FBGA	0.15	10.3	8.7	6.7	5.6
EP1S30	780	FBGA	0.2	10.7	8.6	7.1	5.9
	1020	FBGA	0.15	10.1	8.1	6.5	5.5
	956	BGA	0.1	9.3	7.3	6.0	4.9
EP1S40	956	BGA	0.1	9.3	7.2	5.9	4.8
	1020	FBGA	0.15	10.1	8.0	6.5	5.4
	1508	FBGA	0.1	9.3	7.3	5.9	4.8
EP1S60	956	BGA	0.1	9.2	7.1	5.8	4.7
	1020	FBGA	0.15	9.9	7.9	6.4	5.3
	1508	FBGA	0.1	9.2	7.1	5.8	4.7
EP1S80	956	BGA	0.1	9.1	7.0	5.6	4.6
	1508	FBGA	0.1	9.1	7.0	5.6	4.6

Table 19. Thermal Resistance of APEX II Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP2A15	672	FineLine BGA	0.1	11.6	9.6	8.0	6.6
	724	BGA	0.1	10.0	8.2	6.6	5.4
EP2A25 EP2A40	672	FineLine BGA	0.1	11.5	9.6	8.6	6.6
	724	BGA	0.1	10.0	8.2	6.6	5.4
	1,020	FineLine BGA	0.1	10.4	8.5	6.9	5.7
EP2A70	724	BGA	0.1	9.7	7.8	6.2	5.0
	1,508	FineLine BGA	0.1	9.4	7.3	5.8	4.7

Table 20. Thermal Resistance of Mercury Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP1M120	484	FineLine BGA	0.3	13.0	11.1	9.3	7.9
EP1M350	780	FineLine BGA	0.1	11.0	9.2	7.6	6.3

Table 21. Thermal Resistance of Excalibur Embedded Processor Solutions

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPXA1	484	FineLine BGA	4.0	20.0	18.3	15.8	13.9
	672	FineLine BGA	0.3	12.2	10.2	8.6	7.2
EPXA4	672	FineLine BGA	0.1	11.6	9.6	7.9	6.6
	1,020	FineLine BGA	0.1	10.4	8.5	6.9	5.7
EPXA10	1,020	FineLine BGA	0.1	10.0	8.0	6.4	5.2

Table 22. Thermal Resistance of APEX 20K & APEX 20KE Devices (Part 1 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP20K30E	144	TQFP	8.0	29.0	28.0	26.0	25.0
	208	PQFP	5.0	30.0	29.0	27.0	22.0
	144	FineLine BGA	14.0	36.0	34.0	32.0	29.0
	324	FineLine BGA	9.0	31.0	29.0	28.0	25.0

Table 22. Thermal Resistance of APEX 20K & APEX 20KE Devices (Part 2 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP20K60E	144	TQFP	7.0	28.0	26.0	25.0	24.0
	144	FineLine BGA	11.0	33.0	32.0	30.0	27.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	240	PQFP	4.0	26.0	24.0	21.0	17.0
	324	Fineline BGA	7.0	29.0	28.0	26.0	24.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EP20K100	144	TQFP	7.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	240	PQFP	4.0	25.0	23.0	20.0	17.0
	324	FineLine BGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EP20K100E	144	TQFP	7.0	26.0	25.0	24.0	23.0
	144	FineLine BGA	9.0	32.0	30.0	29.0	26.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	240	PQFP	4.0	25.0	23.0	20.0	17.0
	324	FineLine BGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EP20K160E	144	TQFP	6.0	25.0	24.0	23.0	22.0
	208	PQFP	5.0	28.0	26.0	23.0	19.0
	240	PQFP	4.0	24.0	21.0	19.0	16.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	24.0	23.0	22.0	21.0
EP20K200	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	21.0	19.0	17.0	15.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	22.0	21.0	20.0	19.0
EP20K200E	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	22.0	19.0	18.0	16.0
	356	BGA	2.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	23.0	22.0	21.0	20.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FineLine BGA	5.0	21.0	20.0	19.0	18.0
EP20K200C	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	22.0	19.0	18.0	16.0
	356	BGA	2.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0

Table 22. Thermal Resistance of APEX 20K & APEX 20KE Devices (Part 3 of 3)							
Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP20K300E	240	PQFP	3.0	19.0	18.0	16.0	15.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FineLine BGA	5.0	20.0	19.0	18.0	17.0
EP20K400	652	BGA	0.5	9.0	8.0	7.0	6.0
	655	PGA	1.0	8.0	7.0	6.0	4.0
	672	FineLine BGA	0.1	11.6	9.6	7.9	6.5
	672	FineLine BGA w/ fin *(1)*	0.5	7.0	4.0	3.0	2.6
EP20K400E EP20K400C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FineLine BGA	0.2	11.7	9.7	8.0	6.7
	672	FineLine BGA w/ fin *(1)*	0.5	7.0	4.0	3.0	2.6
EP20K600E EP20K600C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FineLine BGA	0.1	11.6	9.6	7.9	6.5
	672	FineLine BGA w/ fin *(1)*	0.5	5.0	3.0	3.0	2.0
	1,020	FineLine BGA	0.1	10.4	8.4	6.8	5.6
	1,020	FineLine BGA w/ fin *(1)*	0.5	5.0	3.0	3.0	2.0
EP20K1000E EP20K1000C	652	FineLine BGA	0.1	9.3	7.4	6.0	4.9
	652	FineLine BGA w/ fin *(1)*	0.5	4.0	3.0	3.0	2.0
	672	FineLine BGA	0.1	11.4	9.4	7.7	6.3
	672	FineLine BGA w/ fin *(1)*	0.5	6.0	4.0	3.0	2.0
	1,020	FineLine BGA	0.1	10.1	8.2	6.6	5.4
	1,020	FineLine BGA w/ fin	0.5	5.0	3.0	2.0	2.0
EP20K1500E	652	FineLine BGA	0.1	9.2	7.3	5.8	4.8
	652	FineLine BGA w/ fin *(1)*	0.5	4.0	3.0	2.5	2.0
	1,020	FineLine BGA	0.1	10.1	8.1	6.4	5.3
	1,020	FineLine BGA w/ fin *(1)*	0.5	5.0	3.0	2.5	2.0

Notes to Table 22:

(1) "fin" is an extra heat sink that customers can add to the device. Several vendors make heat sinks, and they all have different sizes. Altera performed the thermal calculations in Table 22 using the following fin specifications: width: 0.25 mm; height: 7.0 mm; pitch: 1.5 mm; base thickness: 0.5 mm.

Table 23. Thermal Resistance of ACEX 1K Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EP1K10	100	TQFP	11.0	37.0	35.0	33.0	29.0
	144	TQFP	8.0	31.0	29.0	28.0	25.0
	208	PQFP	6.0	30.0	29.0	27.0	22.0
	256	FineLine BGA	12.0	37.0	35.0	33.0	30.0
EP1K30	144	TQFP	8.0	28.0	27.0	26.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	256	FineLine BGA	9.0	31.0	29.0	28.0	25.0
EP1K50	144	TQFP	7.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	28.0	25.0	20.0
	256	FineLine BGA	7.0	30.0	28.0	27.0	24.0
	484	FineLine BGA	5.0	25.0	24.0	23.0	22.0
EP1K100	208	PQFP	5.0	28.0	26.0	23.0	18.0
	256	FineLine BGA	6.0	28.0	26.0	25.0	23.0
	484	FineLine BGA	5.0	24.0	23.0	22.0	21.0

Table 24. Thermal Resistance of FLEX 10K Devices (Part 1 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPF10K10	84	PLCC	9.0	28.0	26.0	24.0	22.0
	144	TQFP	7.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
EPF10K10A	100	TQFP	10.0	35.0	33.0	31.0	28.0
	144	TQFP	7.0	29.0	28.0	26.0	25.0
	208	PQFP	5.0	30.0	29.0	27.0	21.0
	256	FineLine BGA	7.0	33.0	30.0	28.0	26.0
EPF10K20	144	TQFP	6.0	24.0	23.0	22.0	21.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPF10K30	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	356	BGA	1.0	12.0	11.0	10.0	9.0

Table 24. Thermal Resistance of FLEX 10K Devices (Part 2 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPF10K30A	144	TQFP	7.0	25.0	24.0	23.0	22.0
	208	PQFP	5.0	29.0	27.0	24.0	19.0
	240	PQFP	4.0	25.0	22.0	20.0	17.0
	256	FineLine BGA	6.0	28.0	26.0	24.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	24.0	22.0	21.0	20.0
EPF10K30E	144	TQFP	9.0	28.0	27.0	26.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	256	FineLine BGA	9.0	31.0	29.0	28.0	25.0
	484	FineLine BGA	6.0	26.0	25.0	24.0	22.0
EPF10K40	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
EPF10K50	240	RQFP	1.0	12.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	403	PGA	3.0	12.0	10.0	9.0	8.0
		PGA *(1)*	3.0	10.0	8.0	7.0	6.0
EPF10K50V	240	PQFP	4.0	25.0	22.0	20.0	17.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	23.0	22.0	21.0	20.0
EPF10K50E	144	TQFP	9.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	27.0	24.0	19.0
	240	PQFP	4.0	25.0	22.0	20.0	17.0
	256	FineLine BGA	6.0	29.0	27.0	26.0	24.0
	484	FineLine BGA	5.0	25.0	24.0	23.0	21.0
EPF10K50S	144	TQFP	9.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	28.0	25.0	20.0
	240	PQFP	4.0	26.0	23.0	20.0	17.0
	256	FineLine BGA	7.0	30.0	28.0	27.0	24.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	25.0	24.0	23.0	22.0
EPF10K70	240	RQFP	1.0	12.0	11.0	10.0	9.0
	503	PGA	1.0	8.0	7.0	6.0	4.0
EPF10K100	503	PGA	1.0	8.0	7.0	6.0	4.0
		PGA *(1)*	1.0	6.0	5.0	4.0	3.0
		PGA *(2)*	–	2.0	–	–	–

Table 24. Thermal Resistance of FLEX 10K Devices (Part 3 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPF10K100A	240	RQFP	1.0	13.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	22.0	21.0	20.0	18.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
EPF10K100E	208	PQFP	5.0	28.0	26.0	23.0	18.0
	240	PQFP	4.0	23.0	21.0	19.0	16.0
	256	FineLine BGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	24.0	23.0	22.0	21.0
EPF10K130V	599	PGA	1.0	8.0	7.0	6.0	4.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
EPF10K130E	240	PQFP	4.0	21.0	19.0	17.0	15.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	23.0	22.0	21.0	20.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FineLine BGA	5.0	21.0	20.0	19.0	18.0
EPF10K200E	599	PGA	1.0	8.0	7.0	6.0	4.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FineLine BGA	5.0	20.0	19.0	18.0	17.0
EPF10K200S	240	RQFP	1.0	13.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FineLine BGA	5.0	22.0	21.0	20.0	19.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FineLine BGA	5.0	21.0	20.0	19.0	18.0
EPF10K250A	599	PGA	1.0	8.0	7.0	6.0	4.0
	600	BGA	0.5	10.0	9.0	8.0	7.0

Notes to Table 24:

(1) With attached pin-fin heat sink.
(2) With attached motor-driven fan heat sink.

Table 25. Thermal Resistance of FLEX 8000 Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPF8282A	84	PLCC	10.0	30.0	28.0	26.0	23.0
	100	TQFP	11.0	36.0	34.0	32.0	29.0
EPF8452A	84	PLCC	10.0	30.0	28.0	26.0	23.0
	100	TQFP	11.0	35.0	33.0	31.0	28.0
	160	PQFP	6.0	32.0	31.0	30.0	28.0
	160	PGA	6.0	20.0	13.0	10.0	8.0
EPF8636A	84	PLCC	10.0	29.0	28.0	26.0	23.0
	160	PQFP	6.0	32.0	31.0	30.0	27.0
	192	PGA	6.0	16.0	11.0	8.0	6.0
	208	PQFP	5.0	30.0	38.0	26.0	20.0
	208	RQFP	1.0	17.0	16.0	15.0	14.0
EPF8820A	144	TQFP	9.0	26.0	25.0	24.0	23.0
	160	PQFP	6.0	32.0	31.0	30.0	27.0
	192	PGA	6.0	16.0	11.0	8.0	6.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	208	RQFP	1.0	17.0	16.0	15.0	14.0
	225	BGA	6.0	28.0	19.0	14.0	11.0
EPF81188A	208	PQFP	5.0	28.0	26.0	24.0	19.0
	232	PGA	2.0	14.0	10.0	7.0	5.0
	240	PQFP	4.0	24.0	21.0	19.0	16.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPF81500A	240	PQFP	4.0	22.0	20.0	19.0	16.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	280	PGA	2.0	14.0	10.0	7.0	5.0
	304	RQFP	1.0	11.0	10.0	9.0	8.0

Table 26. Thermal Resistance of FLEX 6000 Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPF6010A	100	TQFP	11.0	35.0	33.0	31.0	28.0
	144	TQFP	10.0	28.0	26.0	25.0	24.0
EPF6016	144	TQFP	10.0	28.0	26.0	25.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	240	PQFP	4.0	26.0	24.0	21.0	17.0
	256	BGA	6.0	28.0	22.0	20.0	19.0
EPF6016A	100	TQFP	11.0	35.0	33.0	31.0	28.0
		FineLine BGA	14.0	36.0	34.0	32.0	29.0
	144	TQFP	10.0	29.0	28.0	26.0	24.0
	208	PQFP	5.0	30.0	29.0	26.0	21.0
	256	FineLine BGA	10.0	32.0	30.0	29.0	26.0
EPF6024A	144	TQFP	10.0	27.0	26.0	25.0	24.0
	208	PQFP	5.0	29.0	28.0	26.0	20.0
	240	PQFP	4.0	26.0	23.0	21.0	17.0
	256	BGA	6.0	28.0	22.0	20.0	19.0
		FineLine BGA	8.0	30.0	29.0	27.0	25.0

Table 27. Thermal Resistance of MAX 9000 Devices (Part 1 of 2)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPM9320	84	PLCC	9.0	29.0	27.0	25.0	23.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	280	PGA	2.0	14.0	10.0	7.0	5.0
	356	BGA	2.0	14.0	12.0	11.0	10.0
EPM9320A	84	PLCC	9.0	29.0	27.0	26.0	23.0
	208	RQFP	2.0	17.0	16.0	15.0	13.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EPM9400	84	PLCC	9.0	29.0	27.0	25.0	23.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPM9480	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	12.0	11.0	10.0	9.0

Table 27. Thermal Resistance of MAX 9000 Devices (Part 2 of 2)							
Device	**Pin Count**	**Package**	**θ_{JC} (° C/W)**	**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.**
EPM9560	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	12.0	11.0	10.0	9.0
	280	PGA	2.0	14.0	10.0	7.0	5.0
	304	RQFP	1.0	12.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EPM9560A	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	11.0	10.0	9.0	8.0
	356	BGA	1.0	12.0	11.0	10.0	9.0

Table 28. Thermal Resistance of MAX 7000 Devices (Part 1 of 3)							
Device	**Pin Count**	**Package**	**θ_{JC} (° C/W)**	**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.**
EPM7032	44	PLCC	10.0	33.0	31.0	30.0	27.0
		PQFP	15.0	48.0	46.0	45.0	42.0
		TQFP	14.0	46.0	44.0	43.0	40.0
EPM7032B	44	PLCC	10.0	33.0	31.0	30.0	27.0
		TQFP	14.0	46.0	44.0	43.0	40.0
	49	Ultra FineLine BGA	23.0	69.0	67.0	66.0	62.0
EPM7032S	44	PLCC	10.0	33.0	31.0	30.0	27.0
		TQFP	14.0	46.0	44.0	43.0	40.0
EPM7032V	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	45.0	44.0	42.0	39.0
EPM7032AE	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	45.0	43.0	40.0
EPM7064S	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	44.0	43.0	40.0
	84	PLCC	9.0	28.0	26.0	25.0	23.0
	100	TQFP	11.0	39.0	37.0	35.0	32.0
EPM7064	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	13.0	44.0	43.0	41.0	38.0
	68	PLCC	9.0	29.0	28.0	26.0	23.0
	84	PLCC	9.0	28.0	26.0	25.0	22.0
	100	PQFP	6.0	33.0	32.0	31.0	30.0

Table 28. Thermal Resistance of MAX 7000 Devices (Part 2 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPM7064AE EPM7064B	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	45.0	43.0	40.0
	49	Ultra FineLine BGA	23.0	56.0	53.0	51.0	47.0
	100	TQFP	12.0	39.0	37.0	35.0	31.0
		FineLine BGA	21.0	49.0	47.0	44.0	40.0
EPM7096	68	PLCC	9.0	29.0	27.0	26.0	23.0
	84	PLCC	9.0	28.0	26.0	24.0	22.0
	100	PQFP	6.0	32.0	31.0	30.0	29.0
EPM7128A	84	PLCC	9.0	28.0	26.0	25.0	22.0
	100	TQFP	11.0	37.0	35.0	33.0	30.0
		FineLine BGA	18.0	44.0	42.0	39.0	35.0
	144	TQFP	9.0	31.0	29.0	28.0	25.0
	256	FineLine BGA	12.0	38.0	36.0	34.0	31.0
EPM7128B	49	Ultra FineLine BGA	22.0	53.0	50.0	48.0	44.0
	100	TQFP	11.0	38.0	36.0	34.0	31.0
		FineLine BGA	19.0	46.0	44.0	41.0	37.0
	144	TQFP	9.0	32.0	30.0	29.0	26.0
	169	Ultra FineLine BGA	16.0	44.0	42.0	39.0	35.0
	256	FineLine BGA	13.0	40.0	38.0	36.0	33.0
EPM7128E	84	PLCC	10.0	29.0	28.0	26.0	23.0
	100	PQFP	6.0	32.0	31.0	30.0	29.0
	160	PQFP	6.0	32.0	31.0	30.0	28.0
EPM7128S	84	PLCC	10.0	30.0	28.0	26.0	23.0
	100	TQFP	12.0	38.0	36.0	34.0	30.0
		PQFP	10.0	35.0	34.0	33.0	32.0
	160	PQFP	7.0	33.0	32.0	31.0	30.0
EPM7128AE	84	PLCC	11.0	30.0	28.0	26.0	23.0
	100	TQFP	12.0	38.0	36.0	34.0	30.0
		FineLine BGA	14.0	43.0	40.0	38.0	37.0
	144	TQFP	11.0	33.0	30.0	28.0	26.0
	169	Ultra FineLine BGA	14.0	42.0	40.0	38.0	36.0
	256	FineLine BGA	12.0	39.0	37.0	35.0	31.0
EPM7160E	84	PLCC	10.0	29.0	28.0	26.0	23.0
	100	PQFP	6.0	32.0	31.0	30.0	29.0
	160	PQFP	6.0	33.0	32.0	31.0	30.0

Table 28. Thermal Resistance of MAX 7000 Devices (Part 3 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPM7160S	84	PLCC	10.0	35.0	28.0	26.0	23.0
	100	TQFP	12.0	37.0	35.0	33.0	30.0
	160	PQFP	6.0	33.0	32.0	31.0	30.0
EPM7192S	160	PQFP	6.0	32.0	31.0	30.0	29.0
EPM7192E	160	PGA	6.0	20.0	13.0	10.0	8.0
		PQFP	6.0	32.0	31.0	30.0	26.0
EPM7256A	100	TQFP	9.0	36.0	34.0	32.0	30.0
	144	TQFP	8.0	32.0	27.0	25.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	256	FineLine BGA	12.0	34.0	32.0	29.0	28.0
EPM7256B	100	TQFP	12.0	37.0	35.0	33.0	30.0
	144	TQFP	9.0	33.0	29.0	27.0	25.0
	169	Ultra FineLine BGA	13.0	40.0	38.0	36.0	34.0
	208	PQFP	5.0	31.0	29.0	27.0	22.0
	256	FineLine BGA	9.0	34.0	32.0	30.0	28.0
EPM7256E	192	PGA	6.0	20.0	13.0	10.0	8.0
	160	PQFP	6.0	31.0	30.0	29.0	25.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
EPM7256S	208	PQFP	5.0	30.0	29.0	26.0	21.0
		RQFP	1.0	18.0	17.0	16.0	15.0
EPM7256AE	100	FBGA	13.0	42.0	39.0	37.0	36.0
	100	TQFP	12.0	37.0	35.0	33.0	30.0
	144	TQFP	9.0	33.0	29.0	27.0	25.0
	208	PQFP	5.0	31.0	29.0	27.0	22.0
	256	FineLine BGA	9.0	34.0	32.0	30.0	28.0
EPM7512AE	144	TQFP	10.0	32.0	27.0	25.0	23.0
	208	PQFP	5.0	30.0	28.0	25.0	21.0
	256	BGA	1.2	14.0	12.0	11.0	10.0
		FineLine BGA	11.0	32.0	30.0	28.0	22.0
EPM7512B	144	TQFP	10.0	32.0	27.0	25.0	24.0
	169	Ultra FineLine BGA	12.0	35.0	33.0	31.0	30.0
	208	PQFP	5.0	30.0	28.0	25.0	21.0
	256	BGA	1.2	14.0	12.0	11.0	10.0
	256	FineLine BGA	11.0	32.0	30.0	28.0	27.0

Table 29. Thermal Resistance of MAX 3000A Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	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.
EPM3032A	44	TQFP	19.0	64.0	56.0	50.0	45.0
		PLCC	9.0	52.0	45.0	41.0	36.0
EPM3064A	44	TQFP	10.0	44.0	38.0	34.0	31.0
		PLCC	11.0	35.0	23.0	18.0	14.0
	100	TQFP	10.0	44.0	38.0	34.0	31.0
EPM3128A	100	TQFP	10.0	44.0	38.0	34.0	31.0
	144	TQFP	9.0	33.0	26.0	22.0	20.0
EPM3256A	144	TQFP	9.0	33.0	26.0	22.0	20.0
	208	PQFP	7.0	35.0	24.0	18.0	14.0

Table 30. Thermal Resistance of Classic Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W)
EP600I	24	PDIP	22.0	67.0
		CerDIP	18.0	60.0
	28	PLCC	16.0	64.0
EP610	24	CerDIP	10.0	60.0
		PDIP	18.0	55.0
		SOIC	17.0	77.0
	28	PLCC	13.0	74.0
EP610I	24	CerDIP	18.0	60.0
		PDIP	22.0	67.0
	28	PLCC	16.0	64.0
EP900I	40	PDIP	23.0	49.0
	44	PLCC	10.0	58.0
EP910	40	CerDIP	12.0	40.0
		PDIP	23.0	49.0
	44	PLCC	10.0	58.0
EP910I	40	CerDIP	17.0	44.0
		PDIP	29.0	51.0
	44	PLCC	16.0	55.0
EP1800I	68	PLCC	13.0	44.0
EP1810	68	JLCC	12.0	47.0
		PLCC	13.0	44.0
		PGA	6.0	38.0

Table 31. Thermal Resistance of Configuration Devices				
Device	**Pin Count**	**Package**	θ_{JC} (° C/W)	θ_{JA} (° C/W)
EPC1064 EPC1064V	8	PDIP	19	48
	20	PLCC	18	80
	32	TQFP	17	75
EPC1213	8	PDIP	19	48
	20	PLCC	18	80
	32	TQFP	17	75
EPC1441	8	PDIP	19	48
	20	PLCC	18	80
	32	TQFP	17	75
EPC1	8	PDIP	16	70
	20	PLCC	18	80
EPC2	20	PLCC	18	80
	32	TQFP	17	75
EPC4	100	PQFP	7	32
EPC8	100	PQFP	7	32
EPC16	88	Ultra FineLine BGA	18	45
	100	PQFP	7	32

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*.

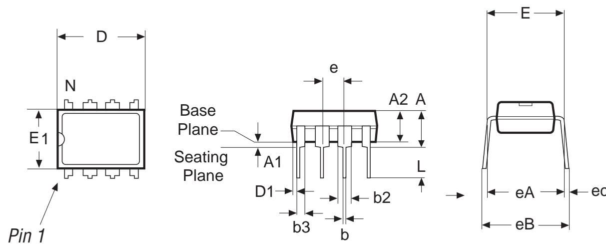
8-Pin Plastic Dual In-Line Package (PDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	P
Package Acronym	PDIP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-001
JEDEC Option	BA
Maximum Lead Coplanarity	N/A
Weight	0.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	–	–	0.17
A1	.015	–	–
A2	–	.130	–
b	.016	–	.020
b2	.055	–	.065
b3	.030	.039	.045
c	.008	.010	.014
D	.360	–	.380
D1	.005	–	–
E	.300	–	.325
E1	.240	–	.260
e	.100 BSC		
eA	.300 BSC		
eB	–	–	.430
eC	0°	–	15°
L	.125	–	.135
N	8		

Package Outline



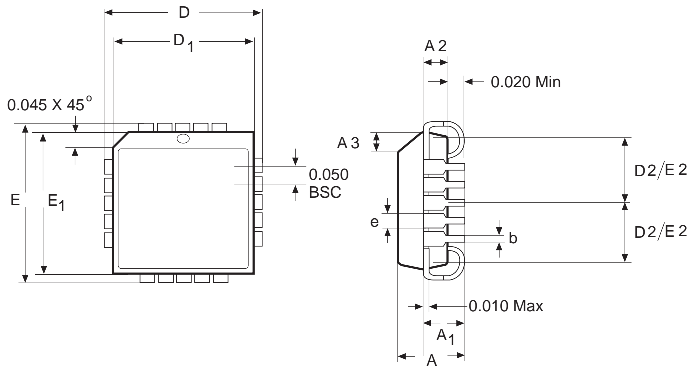
20-Pin Plastic J-Lead Chip Carrier (PLCC)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-018
JEDEC Option	AA
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	Inches		
	Min.	Nom.	Max.
A	.165	.172	.180
A1	.090	.105	.120
A2	.062	–	.083
A3	.042	–	.048
D	.385	.390	.395
D1	.350	.353	.356
D2	.141	.155	.169
E	.385	.390	.395
E1	.350	.353	.356
E2	.141	.155	.169
b	.013	–	.021
e	.026	–	.032
N	20		

Package Outline



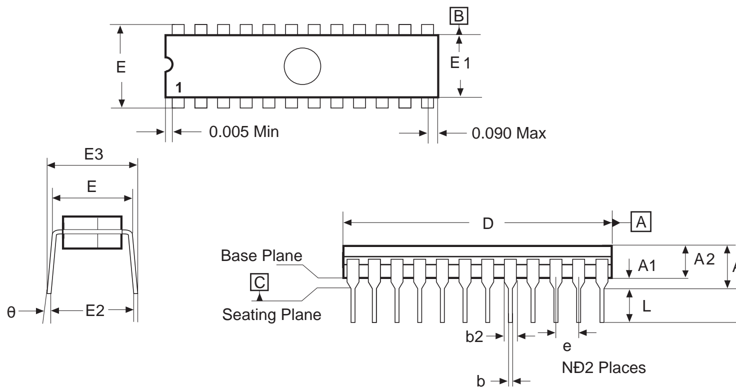
24-Pin Ceramic Dual In-Line Package (CerDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	D
Package Acronym	CerDIP
Lead Material	Alloy 42
Lead Finish	Solder dip (60/40 typical)
JEDEC Outline	MS-030
JEDEC Option	AF
Maximum Lead Coplanarity	N/A
Weight	4.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	–	–	0.200
A1	0.015	0.028	0.041
A2	0.140	–	0.175
b	0.015	0.018	0.021
b2	0.049	0.057	0.065
E2	0.365	0.380	0.395
e	0.100 BSC		
L	0.125	–	–
θ	0°	–	15°
D	1.240	1.260	1.280
E	0.290	0.305	0.320
E1	0.280	0.295	0.310
E3	0.325	–	0.410
N	24		

Package Outline



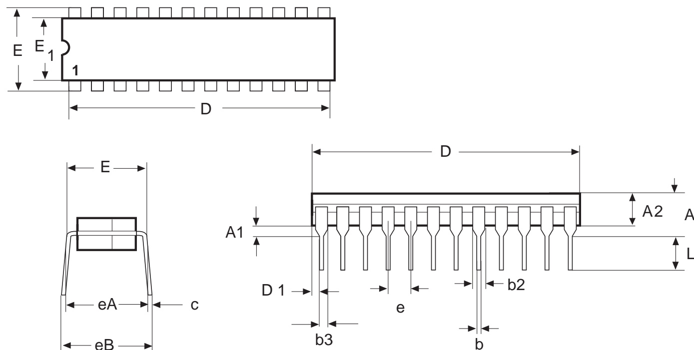
24-Pin Plastic Dual In-Line Package (PDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	P
Package Acronym	PDIP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-001
JEDEC Option	AF
Maximum Lead Coplanarity	N/A
Weight	1.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.140	–	0.170
A1	0.015	–	–
A2	0.125	–	0.145
b	0.016	–	0.020
b2	0.045	0.060	0.070
b3	0.030	0.039	0.045
c	0.008	0.010	0.012
D	0.124	–	1.255
D1	0.020	–	–
E	0.295	–	0.325
E1	0.245	–	0.270
e	0.100 BSC		
eA	0.310	–	0.360
eB	–	–	0.430
L	0.125	–	0.135
N	24		

Package Outline



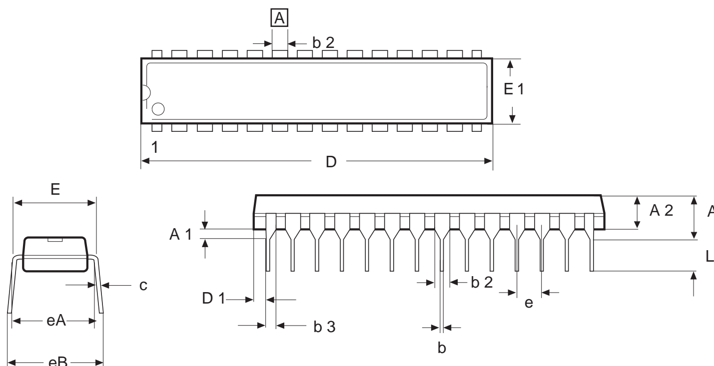
28-Pin Plastic Dual In-Line Package (PDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	P
Package Acronym	PDIP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-001
JEDEC Option	AG
Maximum Lead Coplanarity	N/A
Weight	1.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.140	–	0.180
A1	0.020	–	–
A2	0.125	–	0.145
b	0.015	–	0.021
b2	0.045	–	0.055
b3	0.030	0.039	0.045
c	0.008	0.010	0.012
D	1.345	–	1.370
D1	0.028	–	–
E	0.295	–	0.325
E1	0.270	–	0.295
e	0.100 BSC		
eA	0.310	–	0.360
eB	–	–	0.430
L	0.125	–	0.135
N	28		

Package Outline



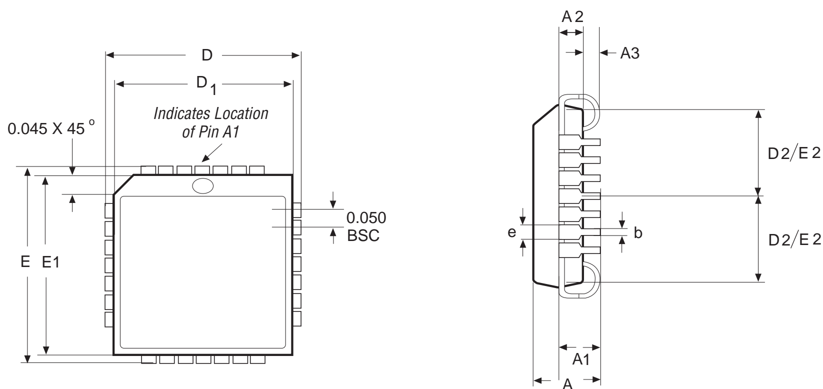
28-Pin Plastic J-Lead Chip Carrier (PLCC)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-018
JEDEC Option	AB
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	1.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.155	–	0.180
A1	0.090	0.105	0.120
A2	0.062	–	0.083
A3	0.030	–	0.042
D	0.485	0.490	0.495
D1	0.442	–	0.458
D2	0.191	0.205	0.219
E	0.485	0.490	0.495
E1	0.442	–	0.458
E2	0.191	0.205	0.219
e	0.026	–	0.032
b	0.017	–	0.043
N	28		

Package Outline



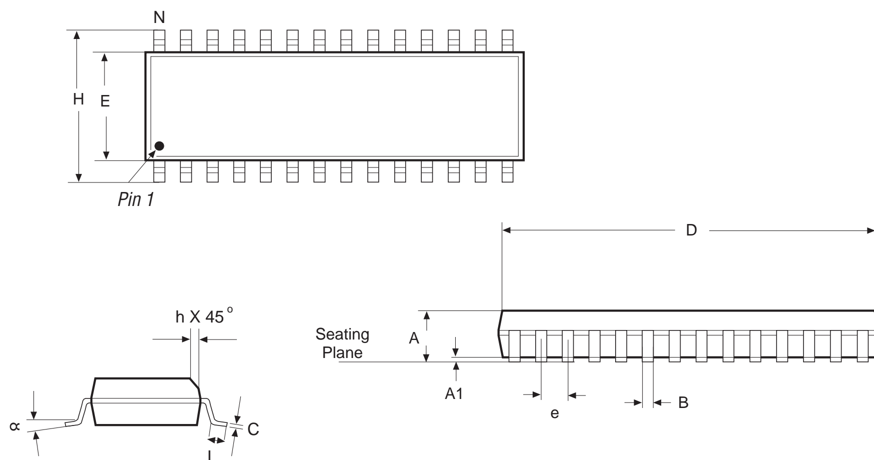
28-Pin Small-Outline Integrated Circuit (SOIC)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	S
Package Acronym	SOIC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-013
JEDEC Option	AE
Maximum Lead Coplanarity	N/A
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.35	–	2.65
A1	0.10	–	0.30
B	0.33	–	0.51
C	0.23	–	0.32
D	17.70	–	18.10
E	7.40	–	7.60
e	1.27 BSC		
H	10.00	–	10.65
h	.25	–	.75
L	.40	–	1.27
α	0°	–	8°
N	28		

Package Outline



32-Pin Plastic Thin Quad Flat Pack (TQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	T
Package Acronym	TQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-026
JEDEC Option	BBA
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.27
A1	0.05	–	0.15
b	0.30	0.37	0.45
D	9.00 BSC		
D1	7.00 BSC		
e	0.80 BSC		
E	9.00 BSC		
E1	7.00 BSC		
θ	0°	3.5°	7°
θ1	0°	–	–
θ2	11°	12°	13°
θ3	11°	12°	13°
L	0.45	0.60	0.75
L1	1.00 REF		
R1	0.08	–	–
R2	0.08	–	0.20
S	0.20	–	–
N	32		

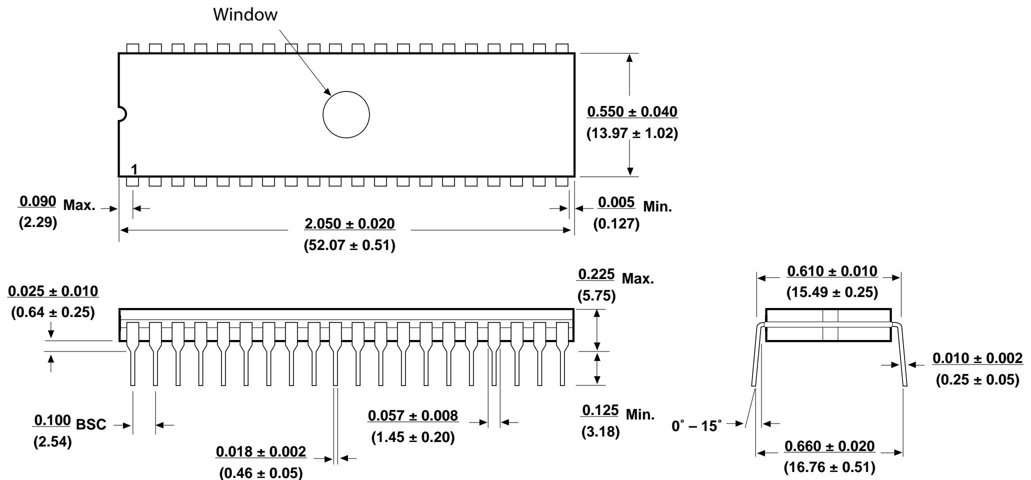
Package Outline

40-Pin Ceramic Dual In-Line Package (CerDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.

Package Information	
Description	**Specification**
Ordering Code Reference	D
Package Acronym	CerDIP
Lead Material	Alloy 42
Lead Finish	Solder dip (60/40 typical)
JEDEC Outline	MS-103
JEDEC Option	N/A
Maximum Lead Coplanarity	N/A
Weight	13.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



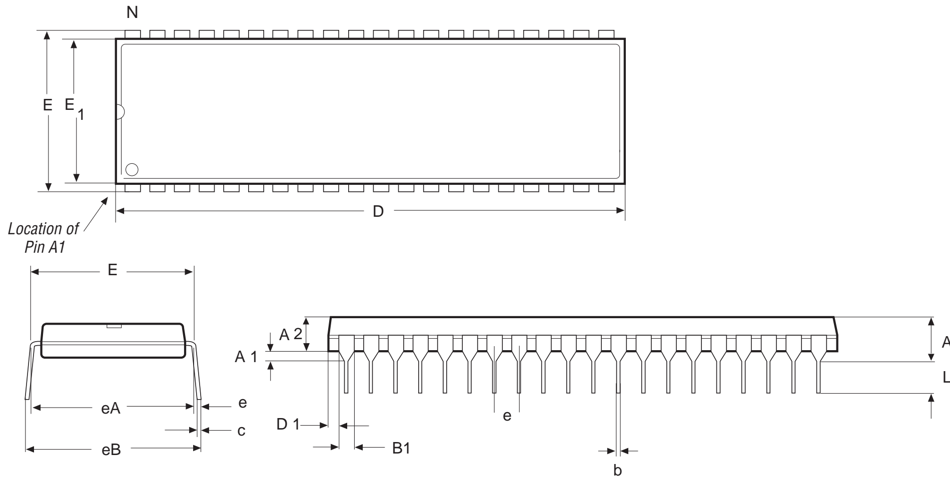
40-Pin Plastic Dual In-Line Package (PDIP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	P
Package Acronym	PDIP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-011
JEDEC Option	AC
Maximum Lead Coplanarity	N/A
Weight	6.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.165	–	0.190
A1	–	0.020	–
A2	0.145	–	0.155
b	0.015	–	0.020
B1	0.049	–	0.065
C	0.008	–	0.012
D	2.030	2.050	2.070
D1	0.005	–	–
E	0.600	–	0.620
E1	0.485	–	0.580
e	0.100 BSC		
eA	0.600 BSC		
eB	0.640	0.660	0.680
L	0.120	–	0.130
N	40		

Package Outline



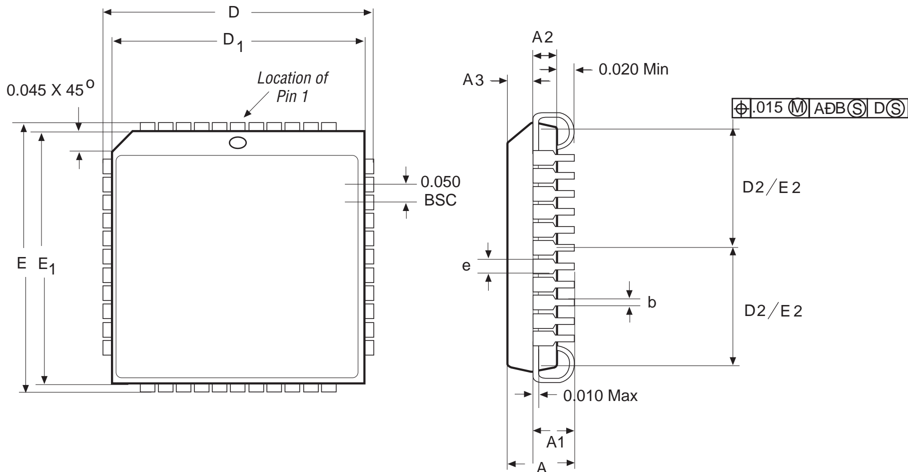
44-Pin Plastic J-Lead Chip Carrier (PLCC)

- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-018
JEDEC Option	AC
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	2.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.165	0.172	0.180
A1	0.090	0.105	0.120
A2	0.062	–	0.083
A3	0.042	–	0.048
D	0.685	0.690	0.695
D1	0.650	0.653	0.656
D2	0.590	–	0.630
E	0.685	0.690	0.695
E1	0.650	0.653	0.656
E2	0.590	–	0.630
b	0.013	–	0.032
e	0.026	–	0.032
N	44		

Package Outline



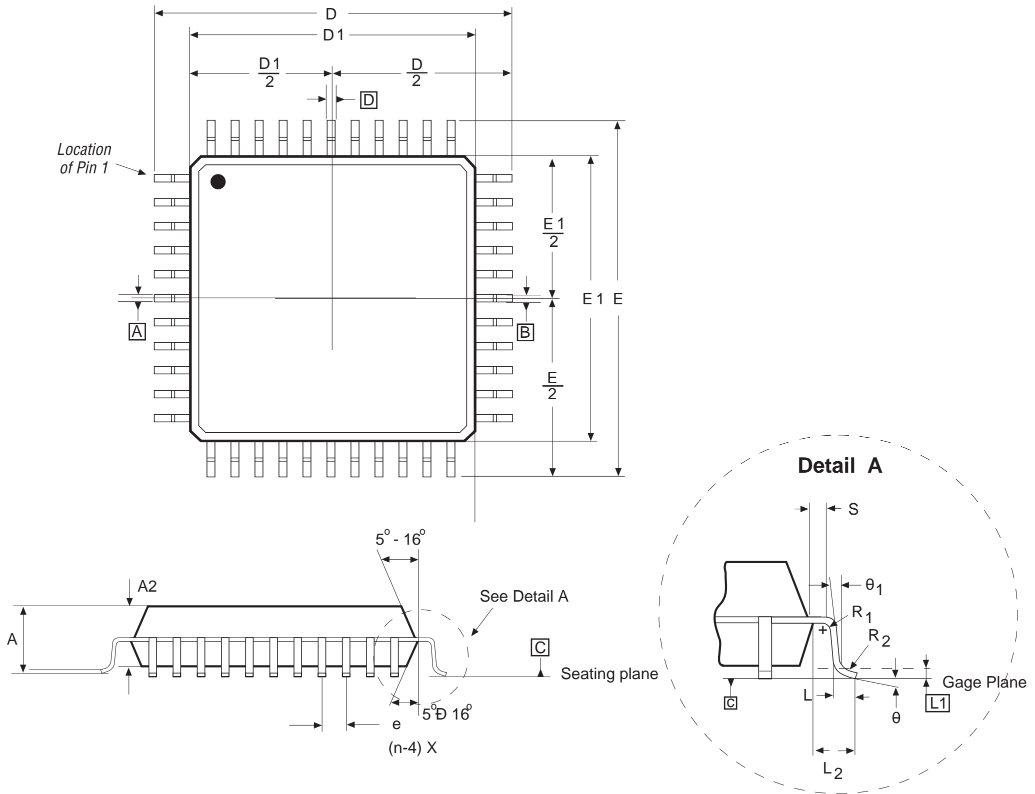
44-Pin Plastic Quad Flat Pack (PQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-022
JEDEC Option	AB
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	2.45
A2	1.95	–	2.10
b	0.30	–	0.45
D	12.95	–	13.45
D1	9.90	–	10.10
E	12.95	–	13.45
E1	9.90	–	10.10
e	0.80 BSC		
c	0.11	–	0.23
L	0.65	0.80	0.95
L1	0.25 BSC		
L2	1.40	1.60	1.80
R1	0.13	–	–
R2	0.13	–	0.30
S	0.20	–	–
θ	0°	–	70°
θ1	0°	–	–
N	44		

Package Outline



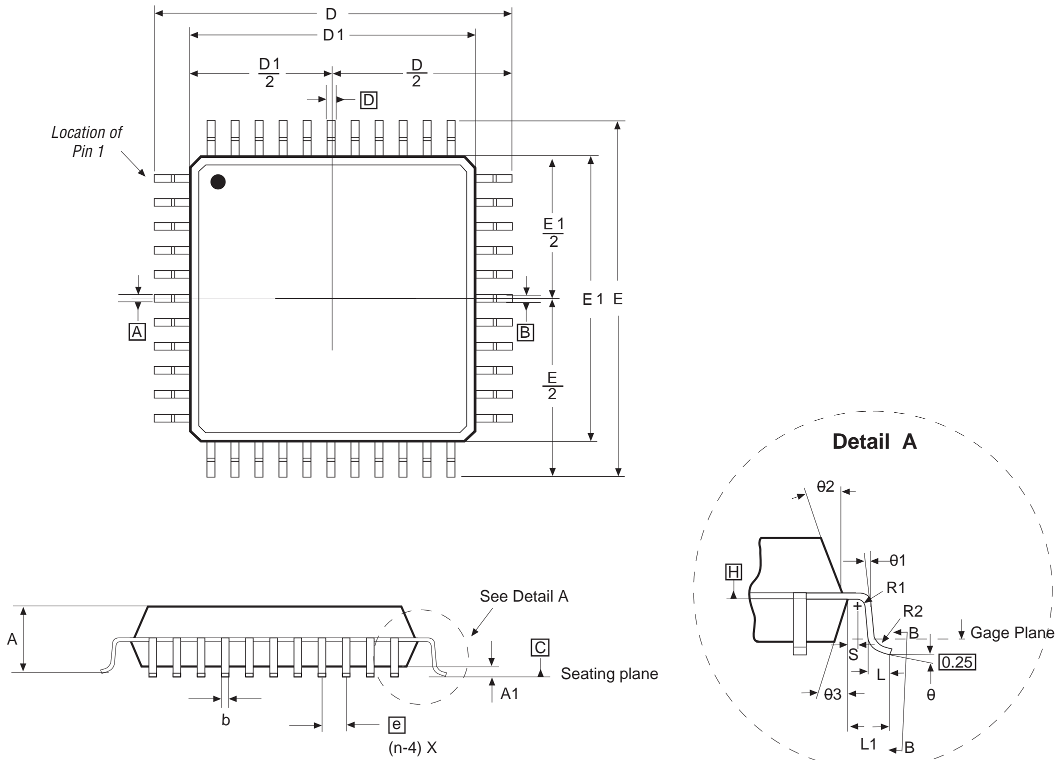
44-Pin Plastic Thin Quad Flat Pack (TQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	T
Package Acronym	TQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-026
JEDEC Option	BCB
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.27
A1	0.05	–	–
b	0.30	0.37	0.45
D	11.75	–	12.25
D1	9.90	–	10.10
e	0.80 BSC		
E	11.75	–	12.25
E1	9.90	–	10.10
θ	0°	3.5°	7°
θ1	0°	–	–
θ2	11°	12°	13°
θ3	11°	12°	13°
L	0.45	0.60	0.75
L1	1.00 REF		
R1	0.08	–	–
R2	0.08	–	0.20
S	0.20	–	–
N	44		

Package Outline



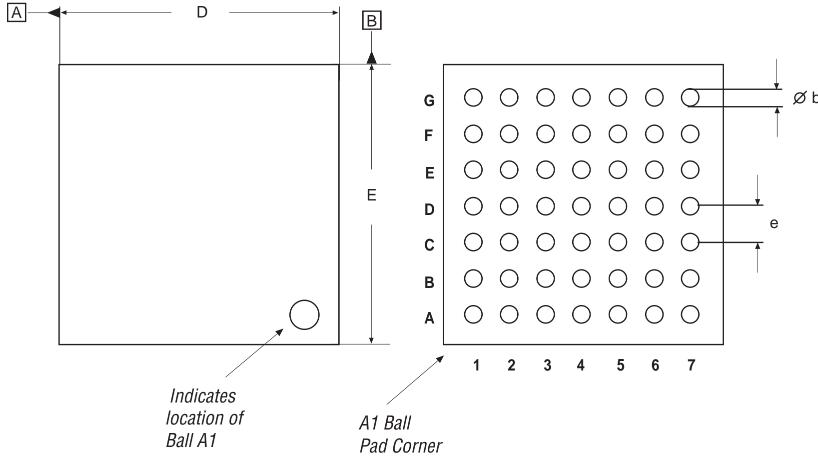
49-Pin Ultra FineLine Ball-Grid Array (UBGA)

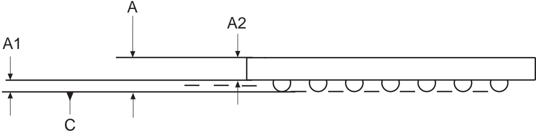
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	U
Package Acronym	UBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-216
JEDEC Option	BAB-2
Maximum Lead Coplanarity	0.005 inches (0.12 mm)
Weight	0.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.30	–	1.55
A1	0.30	0.40	0.45
A2	0.65	0.70	0.75
b	0.50	0.55	0.60
e	0.80		
D/E	7		
N	49		

Package Outline



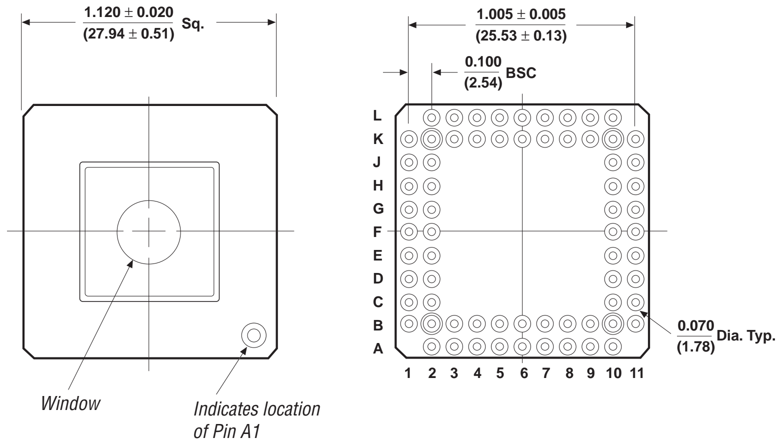


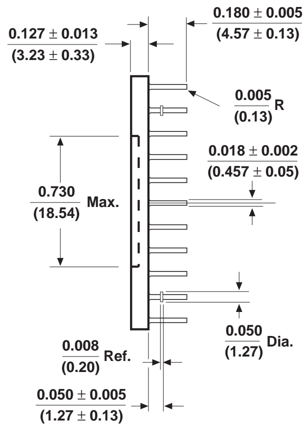
68-Pin Small Outline Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-066
JEDEC Option	AC
Maximum Lead Coplanarity	N/A
Weight	10.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline





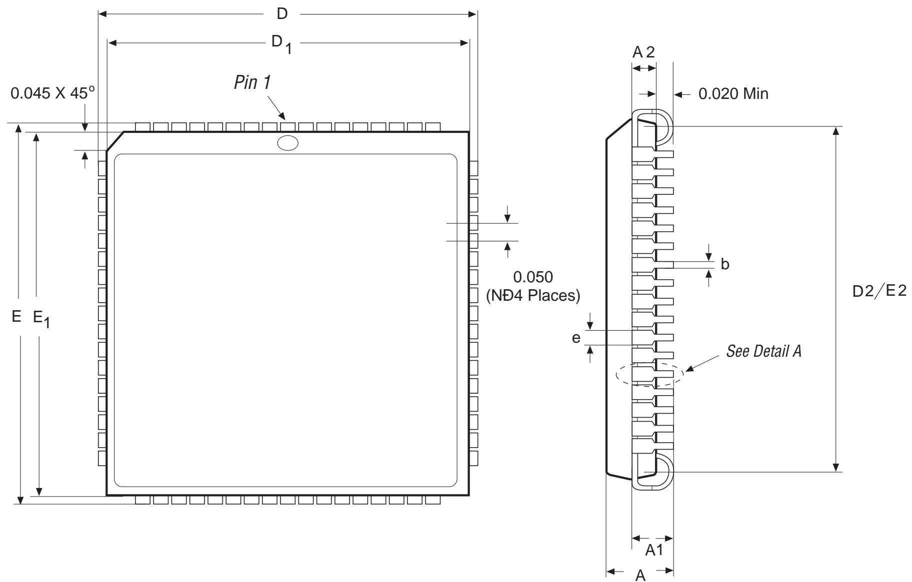
68-Pin Plastic J-Lead Chip Carrier (PLCC)

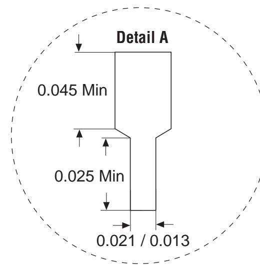
- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-018
JEDEC Option	AE
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	4.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.165	0.172	0.200
A1	0.090	0.105	0.130
b	0.013	–	0.021
D	0.985	0.990	0.995
D1	0.950	0.954	0.958
D2	0.441	0.455	0.469
E	0.985	0.990	0.995
E1	0.950	0.954	0.958
E2	0.441	0.455	0.469
e	0.026	–	0.032
D2/E2	0.890	–	0.930
N	68		

Package Outline





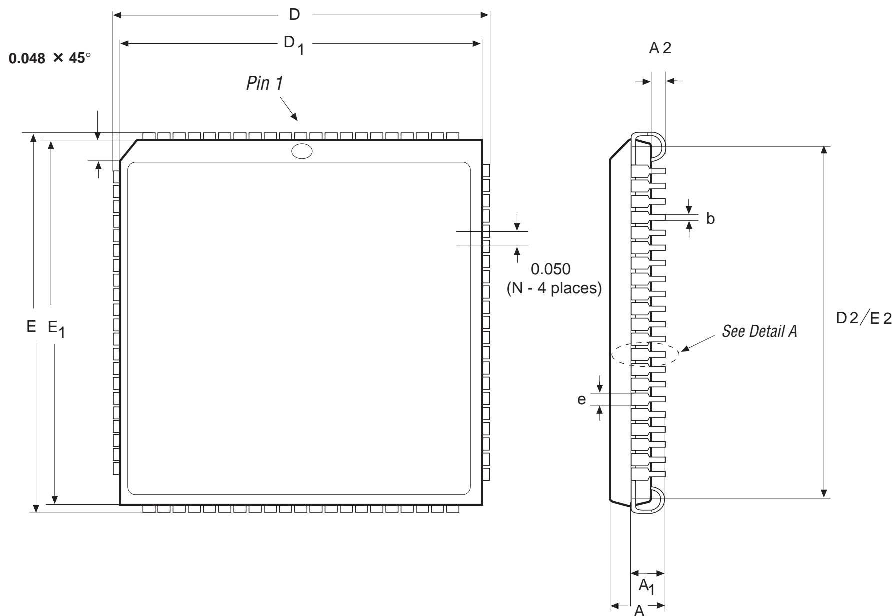
84-Pin Plastic J-Lead Chip Carrier (PLCC)

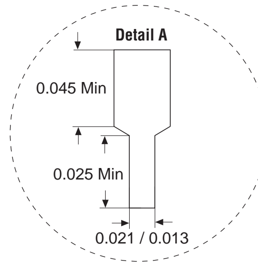
- All dimensions and tolerances conform to ANSI Y14.5M – 1982.
- Controlling dimension is in inches.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-018
JEDEC Option	AF
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	6.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Inches**		
	Min.	**Nom.**	**Max.**
A	0.155	–	0.200
A1	0.090	0.105	0.120
A2	0.030	–	0.040
b	0.017	–	0.023
D	1.185	1.190	1.195
D1	1.142	–	1.158
E	1.185	1.190	1.195
E1	1.142	–	1.158
e	0.260	–	0.320
D2/E2	1.090	–	1.130
N	84		

Package Outline





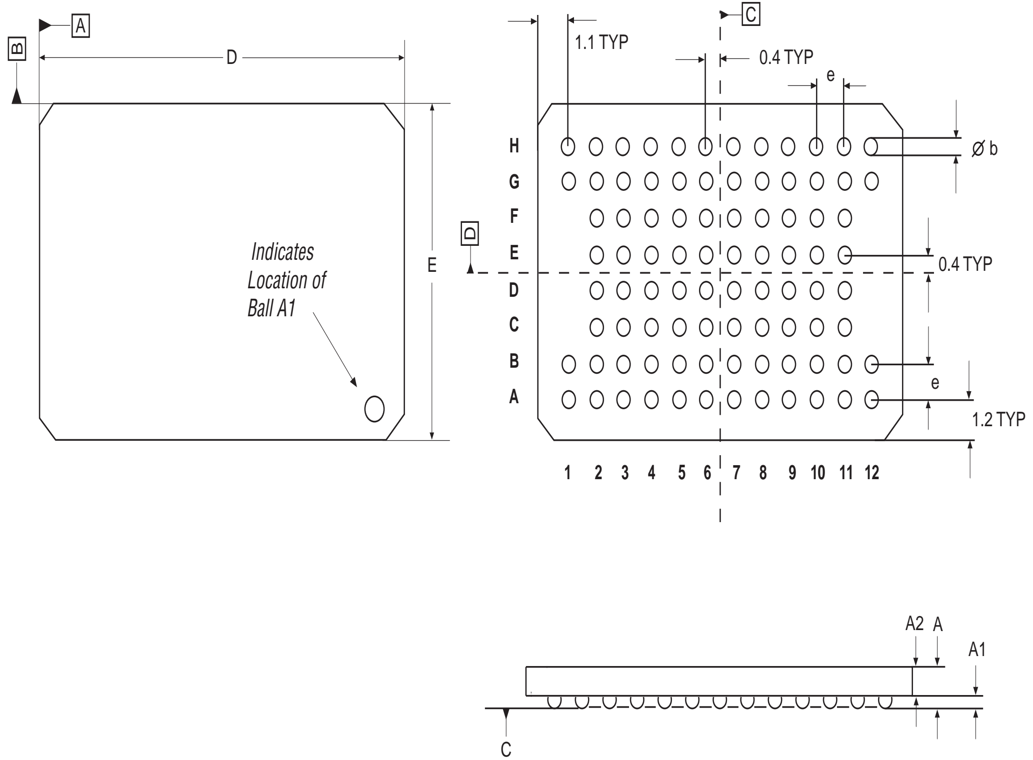
88-Pin Ultra FineLine Ball-Grid Array (UBGA)

- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	U
Package Acronym	UBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	Contact Altera Application at www.altera.com/mysupport.
JEDEC Outline	N/A
JEDEC Option	N/A
Maximum Lead Coplanarity	0.005 inches (0.12 mm)
Weight	Contact Altera Application at www.altera.com/mysupport.
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.4
A1	0.30	–	0.40
A2	0.65	–	–
b	0.40	0.45	0.50
D	11.00	–	11.20
E	8.00	–	8.20
e	0.8 BSC		
N	88		

Package Outline



100-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

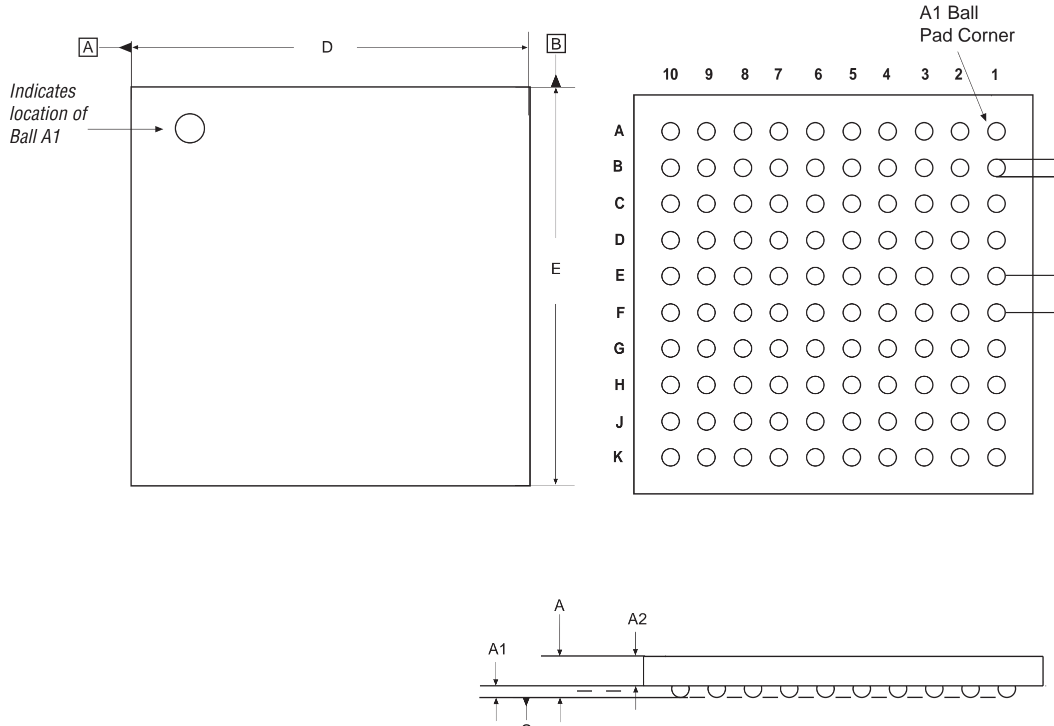
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAC-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	1.70
A1	0.30	–	–
A2	0.25	–	1.10
D/E	11.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
M	10		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



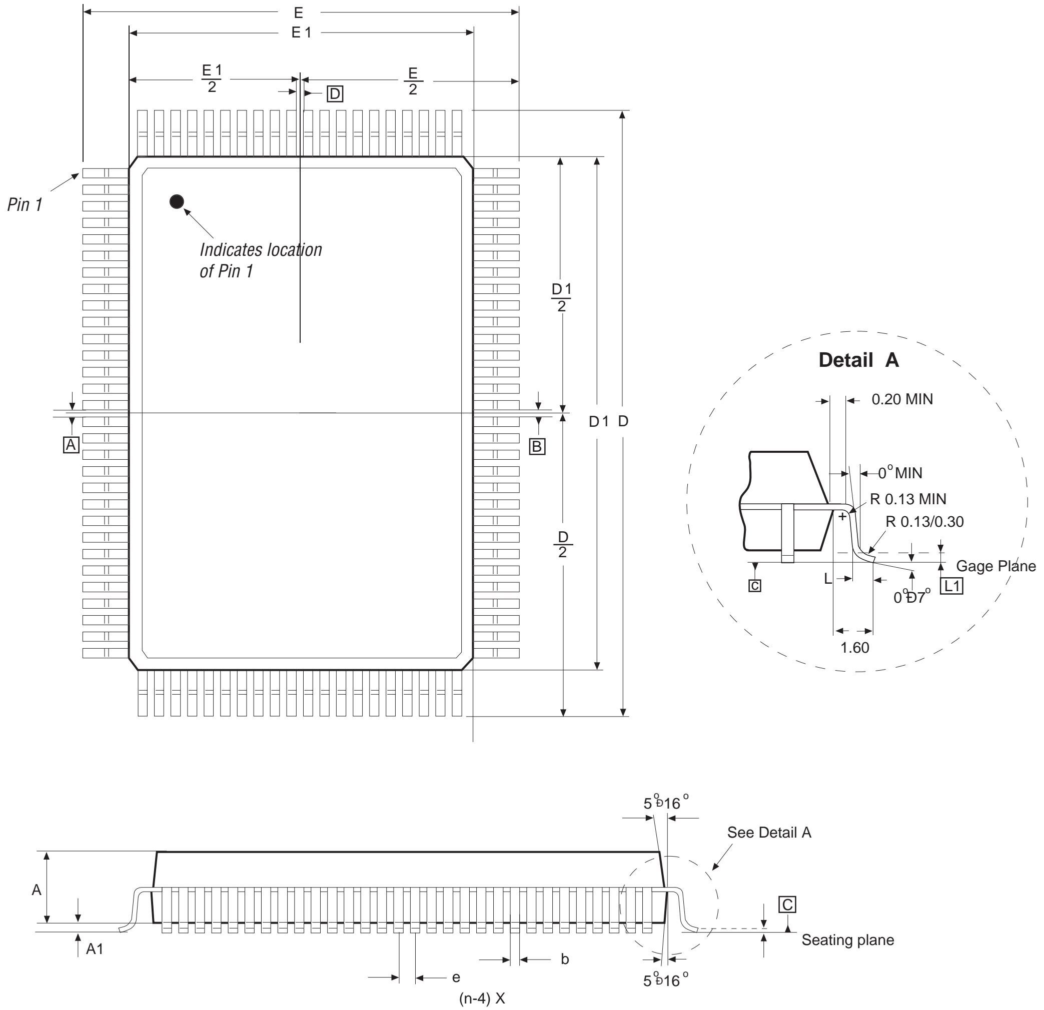
100-Pin Plastic Quad Flat Pack (PQFP) Option 1

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- These dimensions support all 100-pin PQFP devices, including EPC4, except EPC8 and EPC16 devices. See 100-Pin Plastic Quad Flat Pack (PQFP) Option 2 for more information.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-022
JEDEC Option	GC-1
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.40
A1	0.25	–	0.50
b	0.22	–	0.38
D	22.95	–	23.45
D1	19.90	–	20.10
E	16.95	–	17.44
E1	13.90	–	14.10
e	0.65 BSC		
L	0.65	–	0.95
L1	0.25 BSC		
N	100		

Package Outline



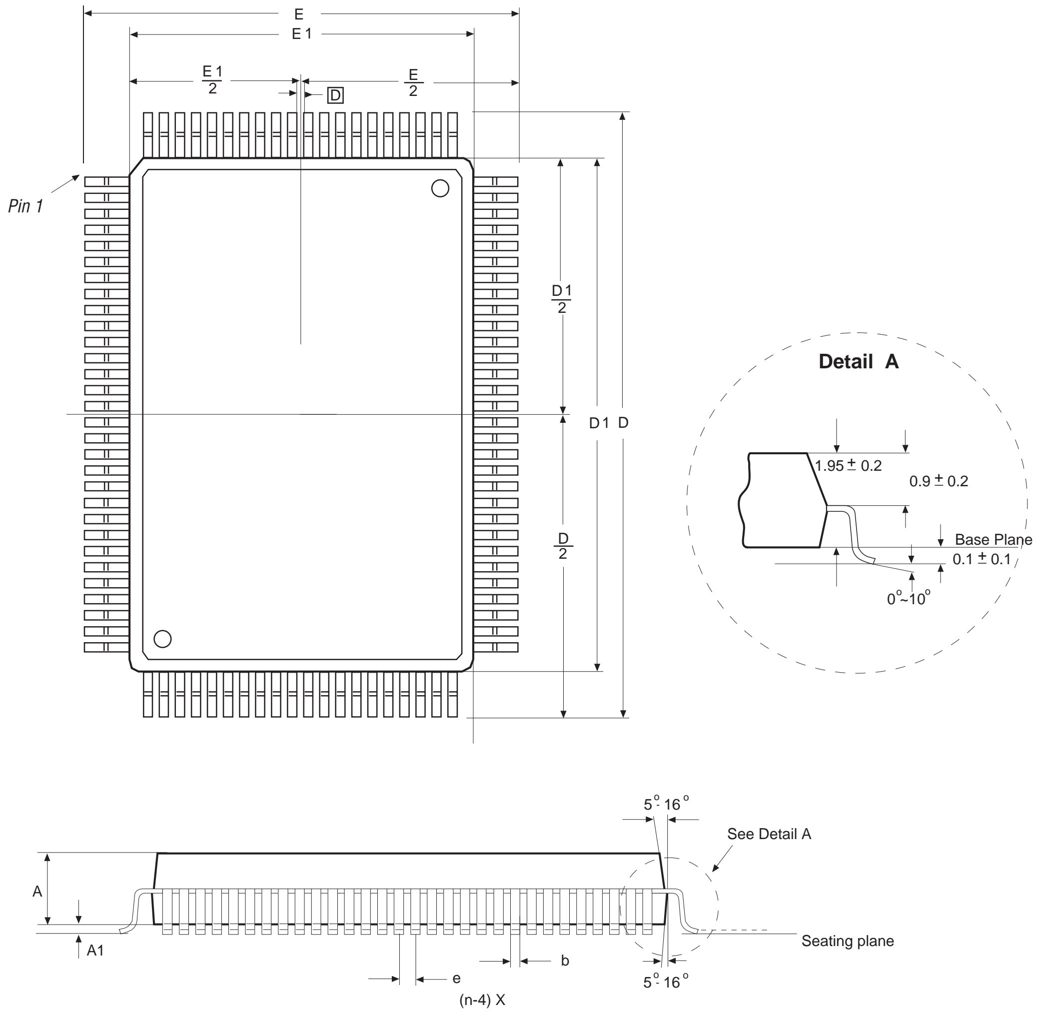
100-Pin Plastic Quad Flat Pack (PQFP) Option 2

- Controlling dimension is in millimeters.
- This information applies to EPC8 andEPC16 devices only. See 100-Pin Plastic Quad Flat Pack (PQFP) Option 1 for more information.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	N/A
JEDEC Option	N/A
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.75	1.95	2.15
A1	0.10	0.15	0.20
b	0.20	0.30	0.40
D	23.90	24.30	24.70
D1	19.80	20.00	20.20
E	17.90	18.30	18.70
E1	13.80	14.00	14.20
e	0.65 BSC		
N	100		

Package Outline



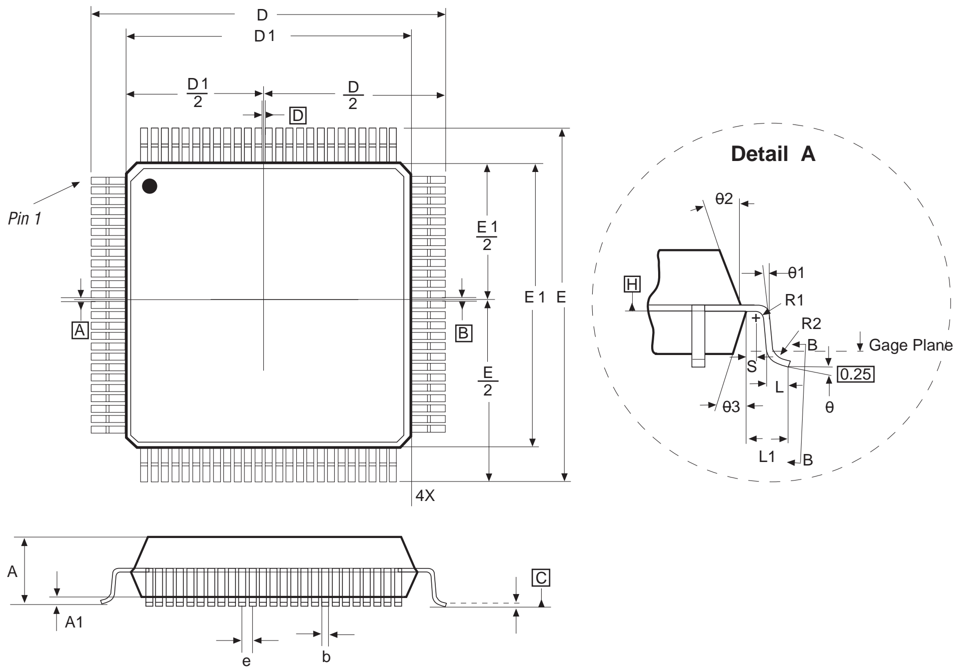
100-Pin Plastic Thin Quad Flat Pack (TQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	T
Package Acronym	TQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-026
JEDEC Option	BDE
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	0.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.27
A1	0.05	–	0.15
b	0.17	0.22	0.27
D	15.80	–	16.20
D1	13.50	–	14.50
E	15.80	–	16.20
E1	13.50	–	14.50
θ	0°	3.5°	7°
θ1	0°	–	–
θ2	11°	12°	13°
θ3	11°	12°	13°
C	0.09	–	0.20
L	0.45	0.60	0.75
L1	1.00 REF		
R1	0.08	–	–
R2	0.08	–	0.20
S	0.20	–	–
e	0.50 BSC		
N	100		

Package Outline



144-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

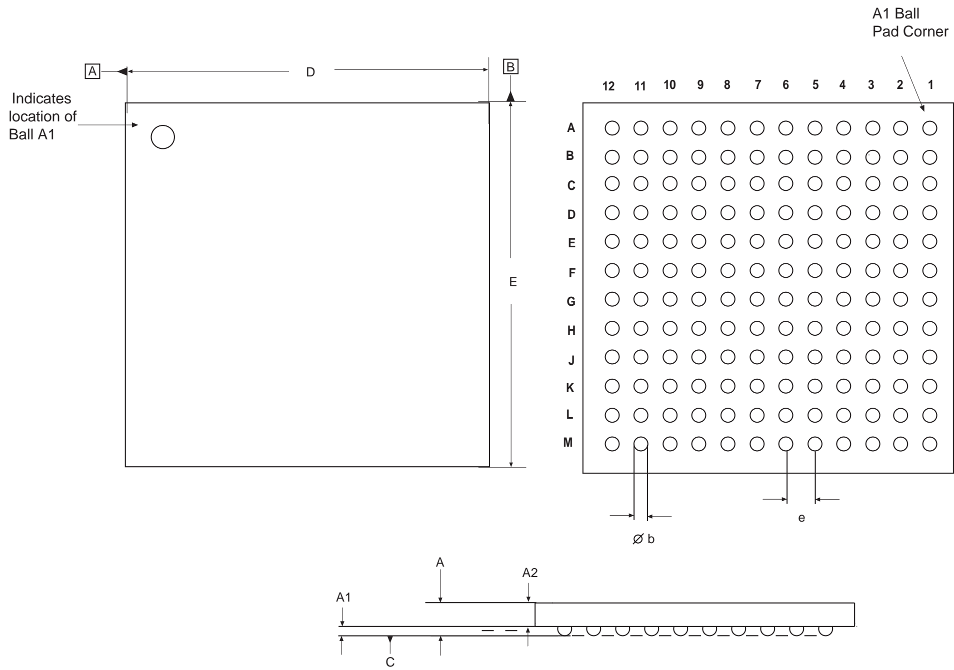
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-192
JEDEC Option	AAD-1, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	1.70
A1	0.30	–	–
A2	0.25	–	1.10
D/E	13.00 BSC		
b	0.50	0.60	0.70
M	12		
e	1.00 BSC		
N	144		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



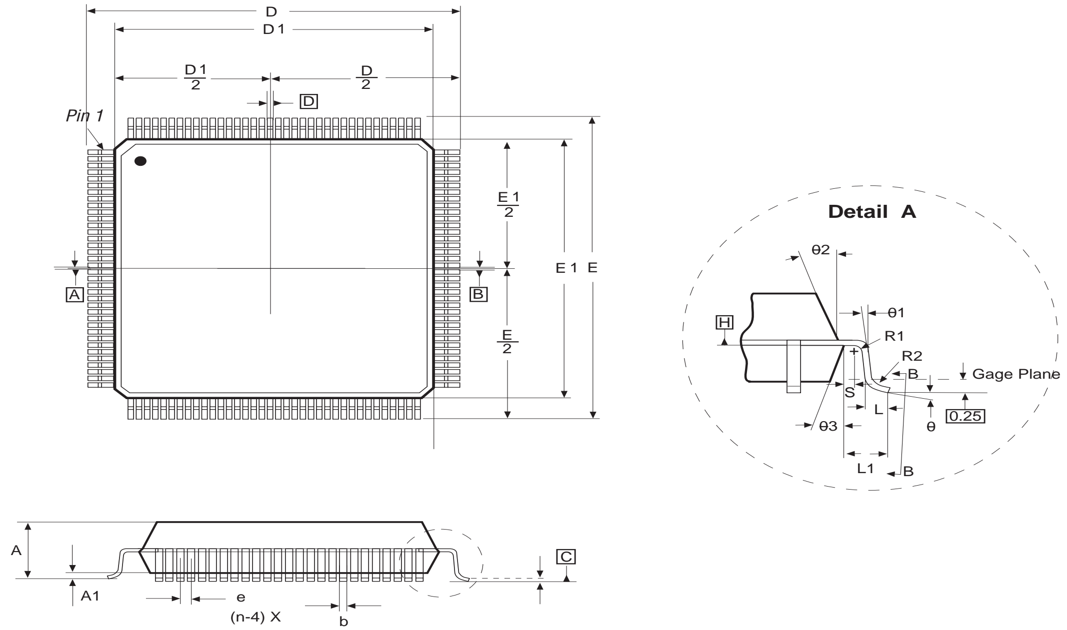
144-Pin Plastic Thin Quad Flat Pack (TQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	T
Package Acronym	TQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-026
JEDEC Option	BFB
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	1.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.60
A1	0.05	–	0.15
b	0.17	0.22	0.27
D	22.00 BSC		
D1	20.00 BSC		
e	0.50 BSC		
E	22.00 BSC		
E1	20.00 BSC		
θ	0°	3.5°	7°
θ1	0°	–	–
θ2	11°	12°	13°
θ3	11°	12°	13°
L	0.45	0.60	0.75
L1	1.00 REF		
R1	0.08	–	–
R2	0.08	–	0.20
S	0.20	–	–
N	144		

Package Outline

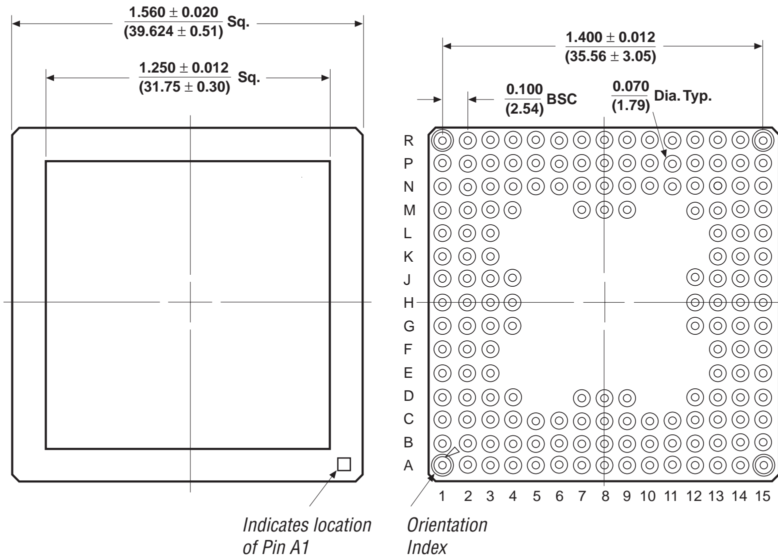


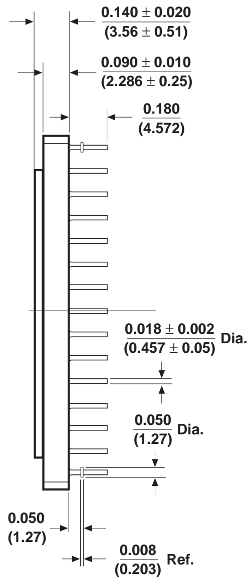
160-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-067
JEDEC Option	AG
Maximum Lead Coplanarity	N/A
Weight	19.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline





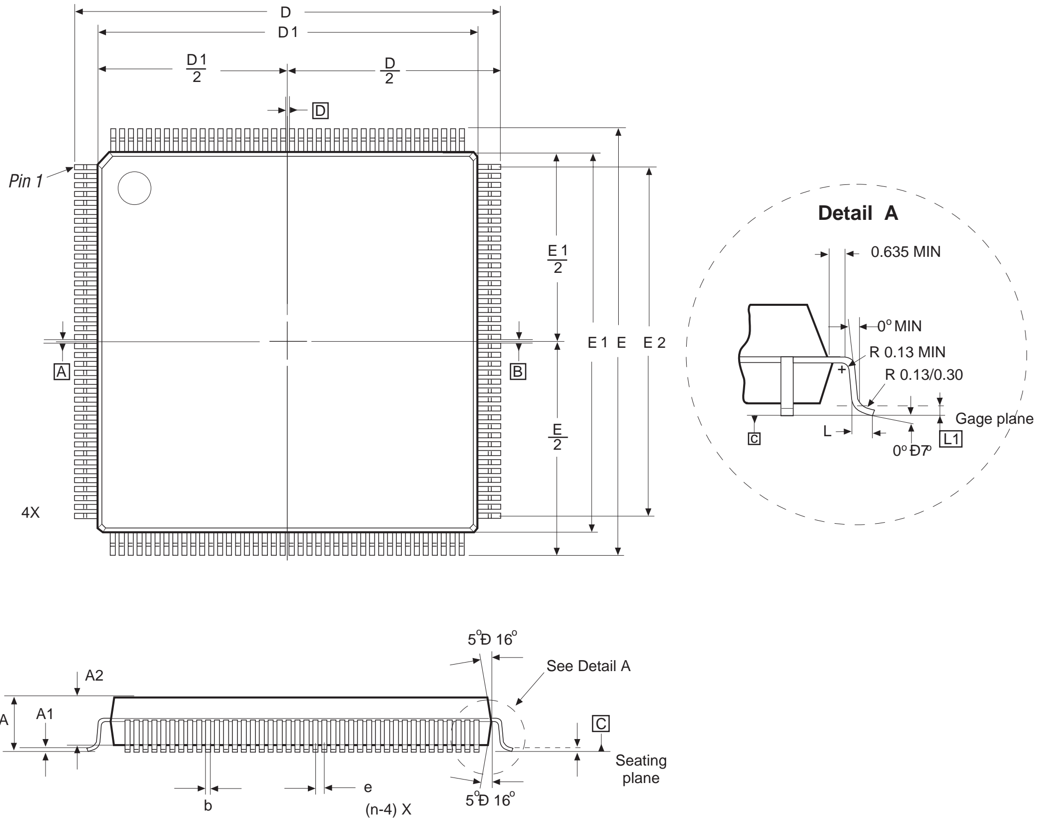
160-Pin Plastic Quad Flat Pack (PQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-022
JEDEC Option	DD-1
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	5.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.07
A1	0.25	–	0.50
A2	3.17	–	3.67
b	0.22	–	0.38
D	30.95	–	31.45
D1	27.90	–	28.10
D2	25.35 REF		
E	30.95	–	31.45
E1	27.90	–	28.10
E2	25.35 REF		
e	0.65 BSC		
L	0.508	–	0.762
L1	0.25 BSC		
N	160		

Package Outline



169-Pin Ultra FineLine Ball-Grid Array (UBGA)

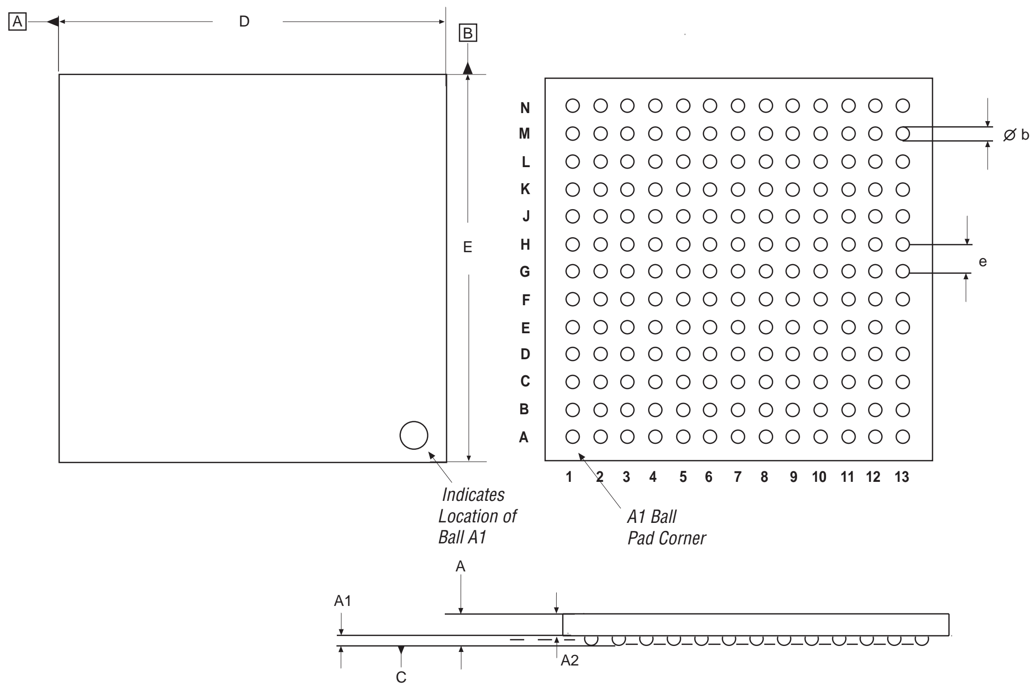
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.
- The EPM7512B uses a thicker version of this package. Package thickness of this EPM7512B device is 1.6 mm typical and total package thickness is 2.2 mm maximum.

Package Information	
Description	**Specification**
Ordering Code Reference	U
Package Acronym	UBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	Contact Altera Application at www.altera.com/mysupport.
JEDEC Outline	MO-216
JEDEC Option	BAF-1
Maximum Lead Coplanarity	0.005 inches (0.12 mm)
Weight	2.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	1.30	–	1.55
A1	0.30	0.40	0.45
A2	0.65	0.70	0.75
b	0.50	0.55	0.60
e	0.80		
D/E	11		
N	169		

† Altera's thickness specification for A is 2.2 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline

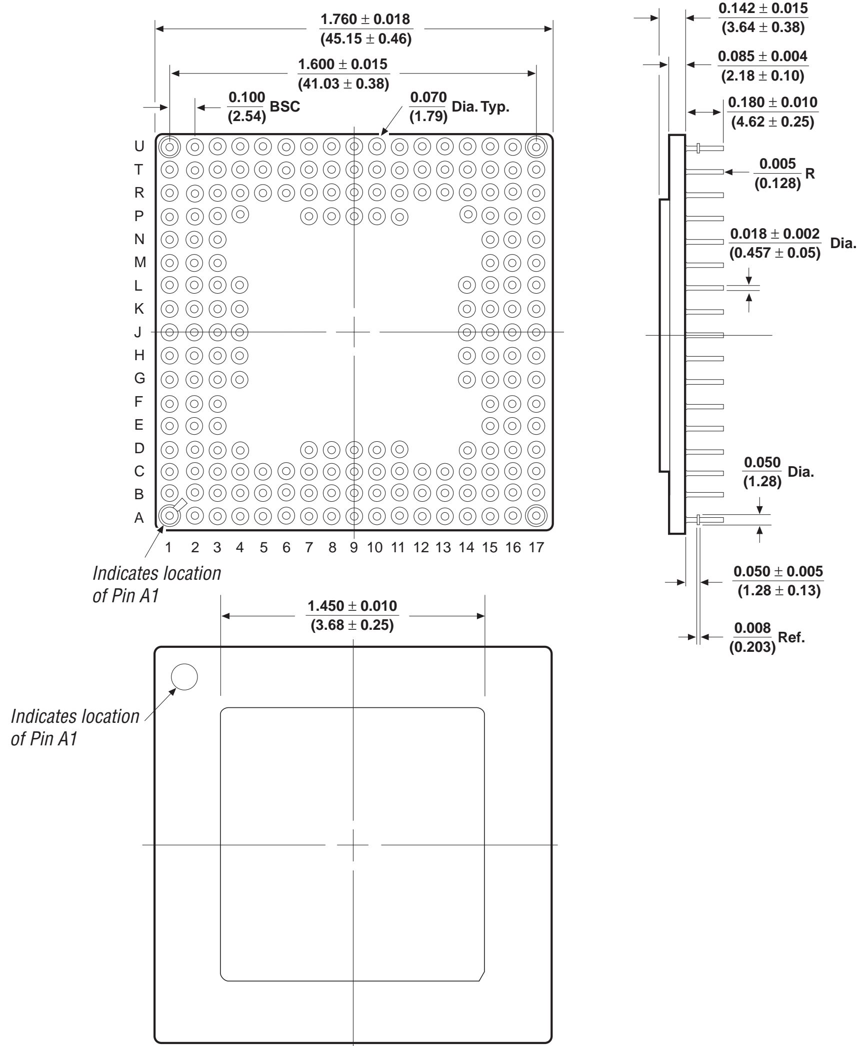


192-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-067
JEDEC Option	AJ
Maximum Lead Coplanarity	N/A
Weight	21.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



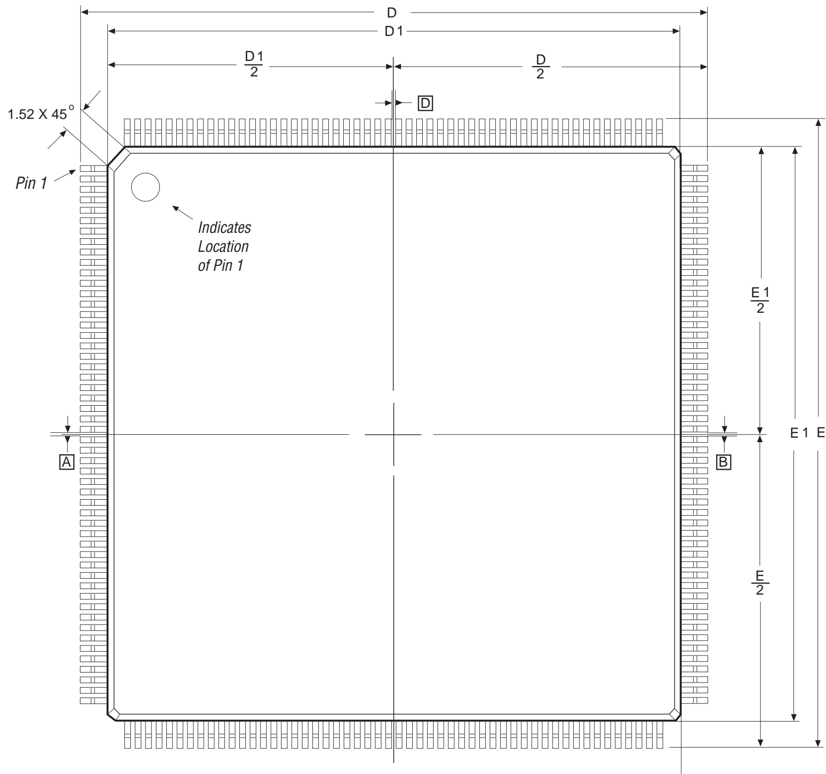
208-Pin Plastic Quad Flat Pack (PQFP)

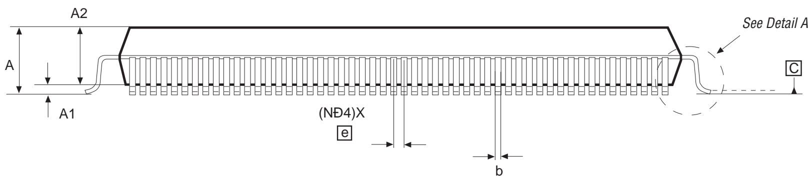
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

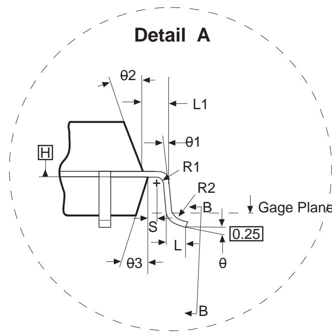
Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-029
JEDEC Option	FA-1
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	5.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	30.35 BSC		
D1	27.90	–	28.10
E	30.35 BSC		
E1	27.90	–	28.10
e	0.50 BSC		
b	0.17	–	0.27
R2	0.08	–	0.25
R1	0.08	–	–
θ	0°	3.5°	8°
θ1	0°	–	–
θ2	5°	–	16°
θ3	5°	–	16°
L	0.46	–	0.66
L1	0.40	–	–
S	0.20	–	–
N	208		

Package Outline







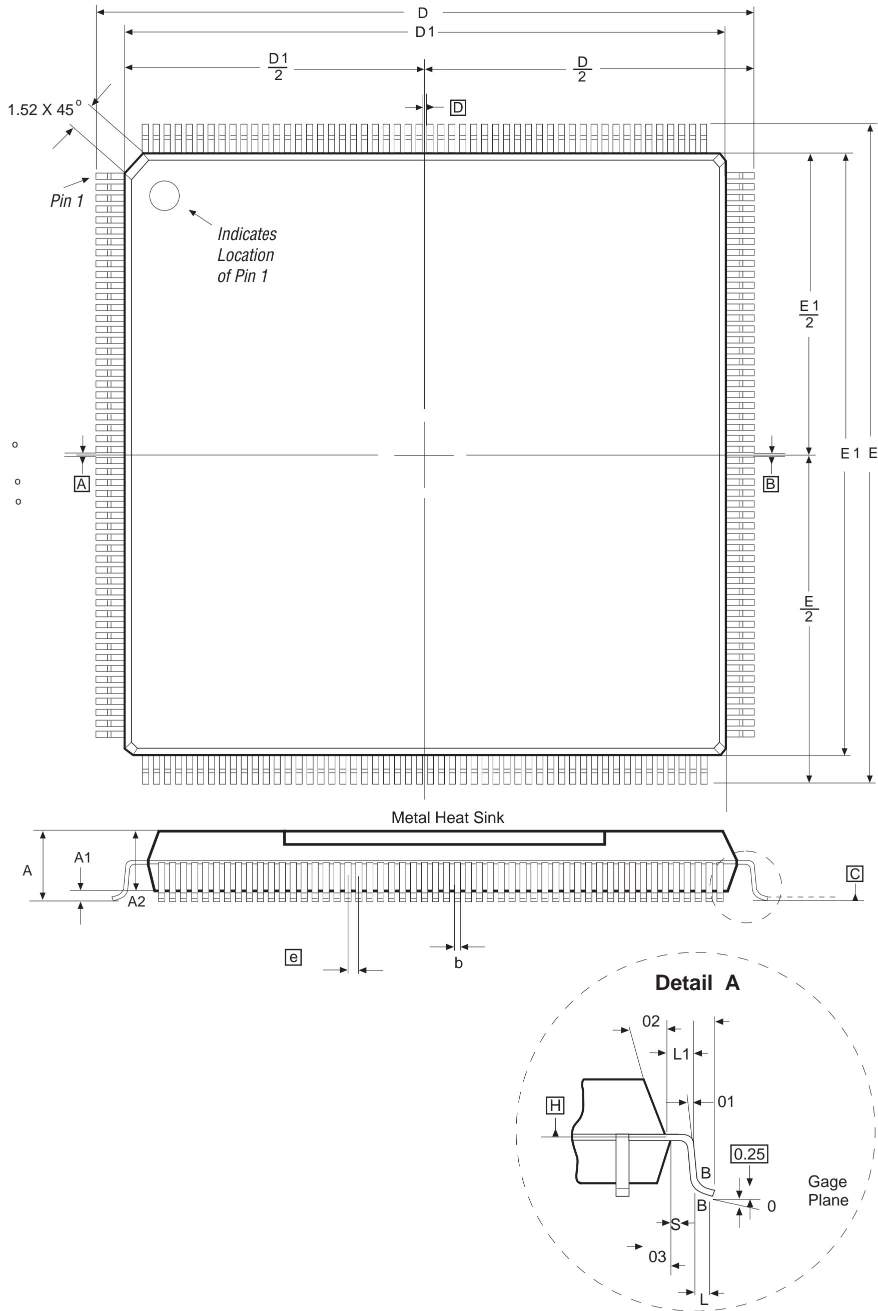
208-Pin Power Quad Flat Pack (RQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	R
Package Acronym	RQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-029
JEDEC Option	FA-1
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	10.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	30.35	–	30.85
D1	27.90	–	28.10
E	30.35	–	30.85
E1	27.90	–	28.10
e	0.50 BSC		
b	0.17	–	0.27
R2	0.08	–	0.25
R1	0.08	–	–
θ	0°	3.5°	8°
θ1	0°	–	–
θ2	5°	–	16°
θ3	5°	–	16°
L	0.46	–	0.66
L1	0.635		
S	0.20	–	–
N	208		

Package Outline

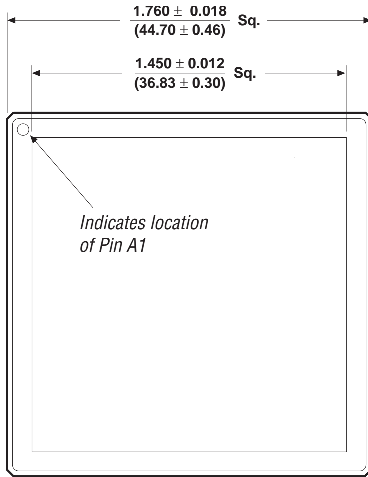


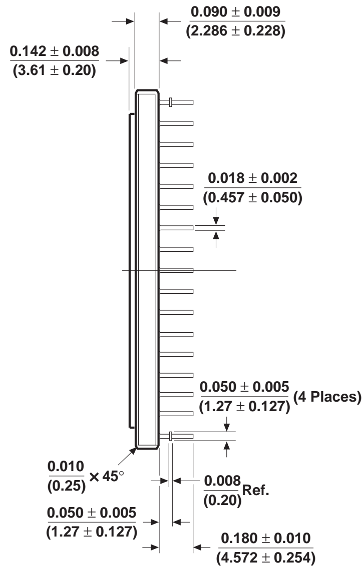
232-Pin Ceramic Pin-Grid Array (PGA)

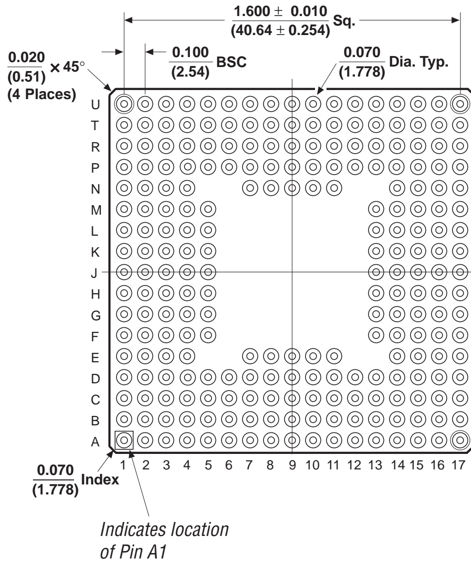
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-067
JEDEC Option	AJ
Maximum Lead Coplanarity	N/A
Weight	25.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline







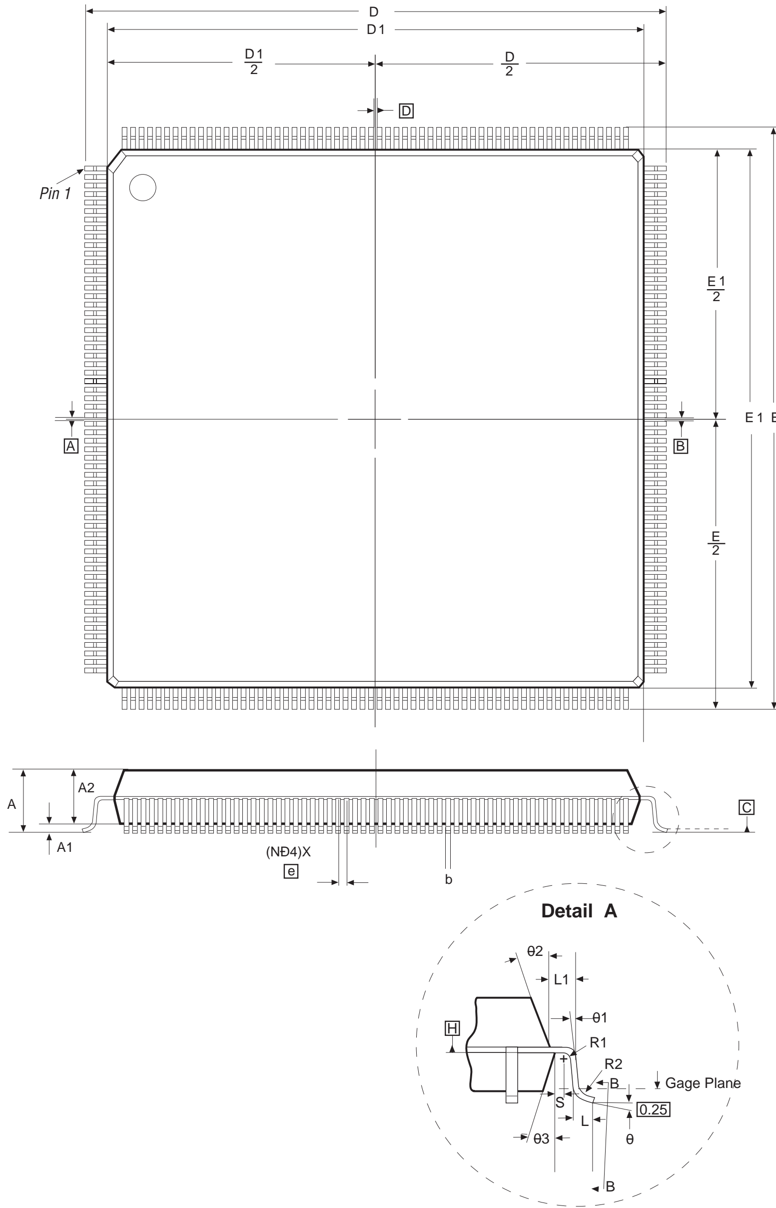
240-Pin Plastic Quad Flat Pack (PQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	Q
Package Acronym	PQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-029
JEDEC Option	GA
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	7.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	34.35	–	34.85
D1	31.90	–	32.10
E	34.35	–	34.85
E1	31.90	–	32.10
e	0.50 BSC		
b	0.17	–	0.27
R2	0.08	–	0.25
R1	0.08	–	–
θ	0°	3.5°	8°
θ1	0°	–	–
θ2	5°	–	16°
θ3	5°	–	16°
L	0.46	–	0.66
L1	0.40	–	–
S	0.20	–	–
N	240		

Package Outline



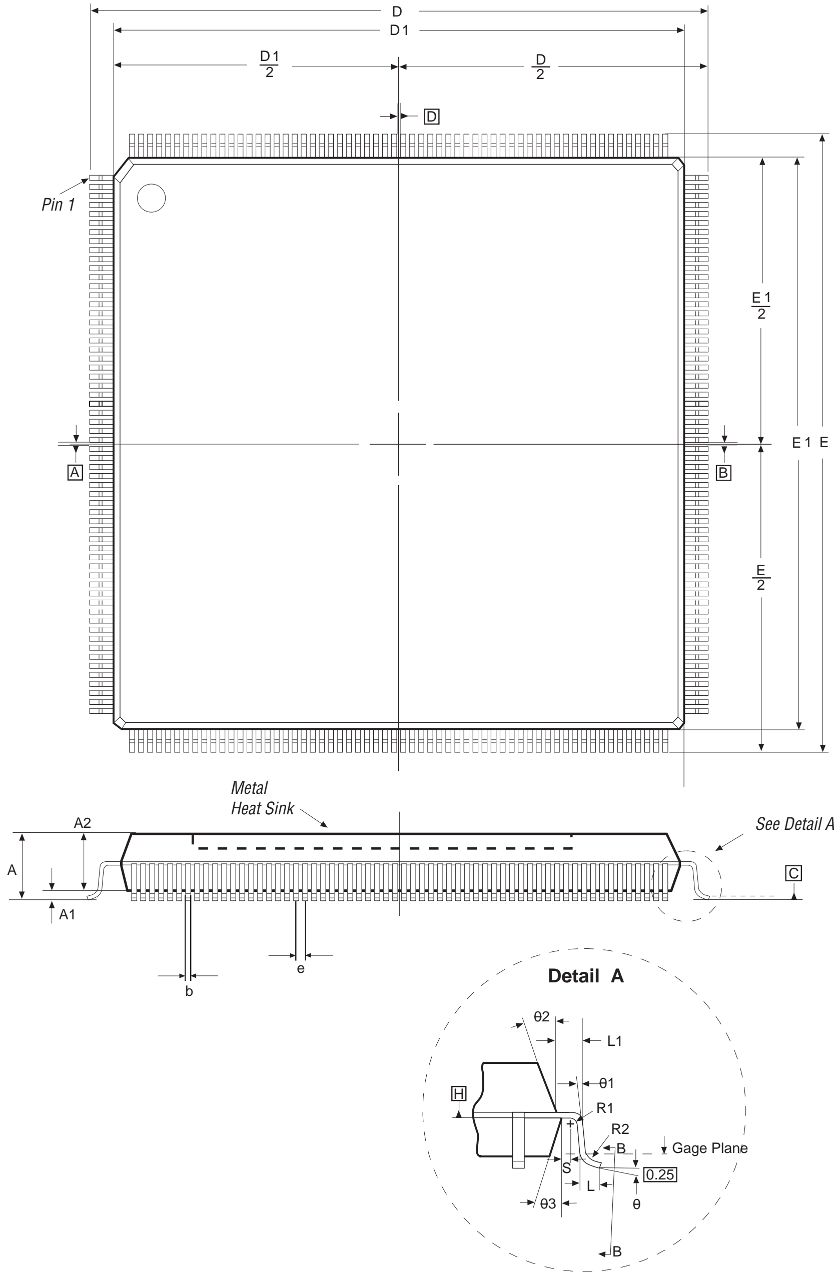
240-Pin Power Quad Flat Pack (RQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	R
Package Acronym	RQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-029
JEDEC Option	GA
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	15.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.10
A1	0.25	–	0.50
A2	3.30	–	3.60
D	34.35	–	34.85
D1	31.90	–	32.10
E	34.35	–	34.85
E1	31.90	–	32.10
e	0.50 BSC		
b	0.17	–	0.27
R2	0.08	–	0.25
R1	0.08	–	–
θ	0°	3.5°	8°
θ1	0°	–	–
θ2	5°	–	16°
θ3	5°	–	16°
L	0.46	–	0.66
L1	0.40	–	–
S	0.20	–	–
N	240		

Package Outline



256-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

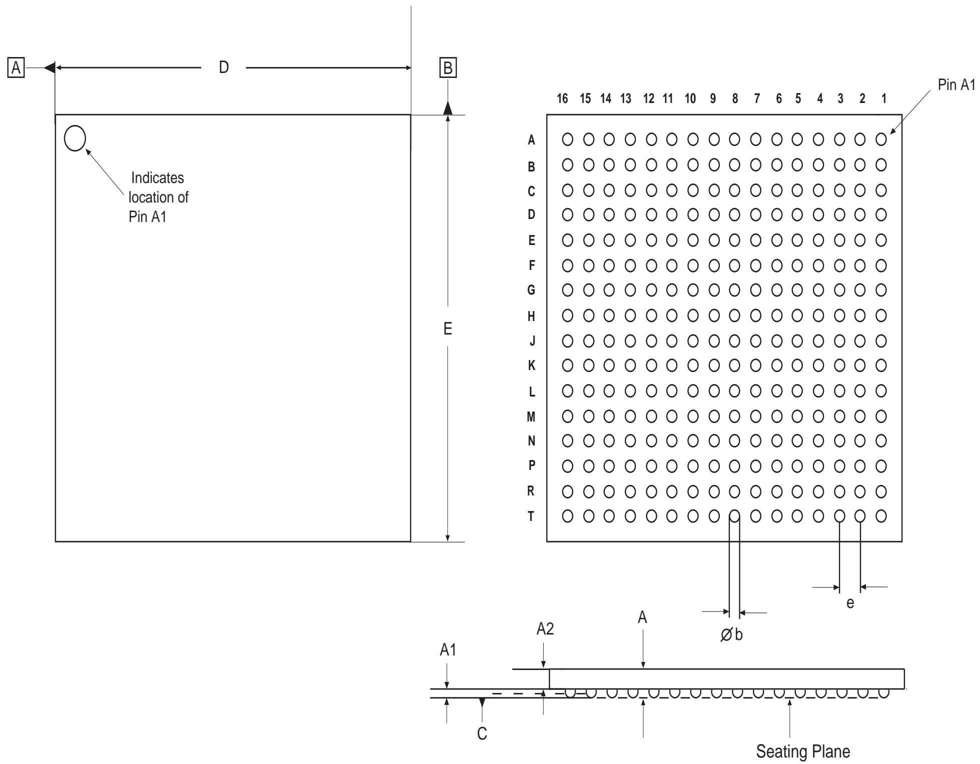
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAF-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.30	–	–
A2	0.25	–	1.10
A3	–	–	2.50
D/E	17.00 BSC		
b	0.50	0.60	0.70
e	1.27 BSC		
M	16		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



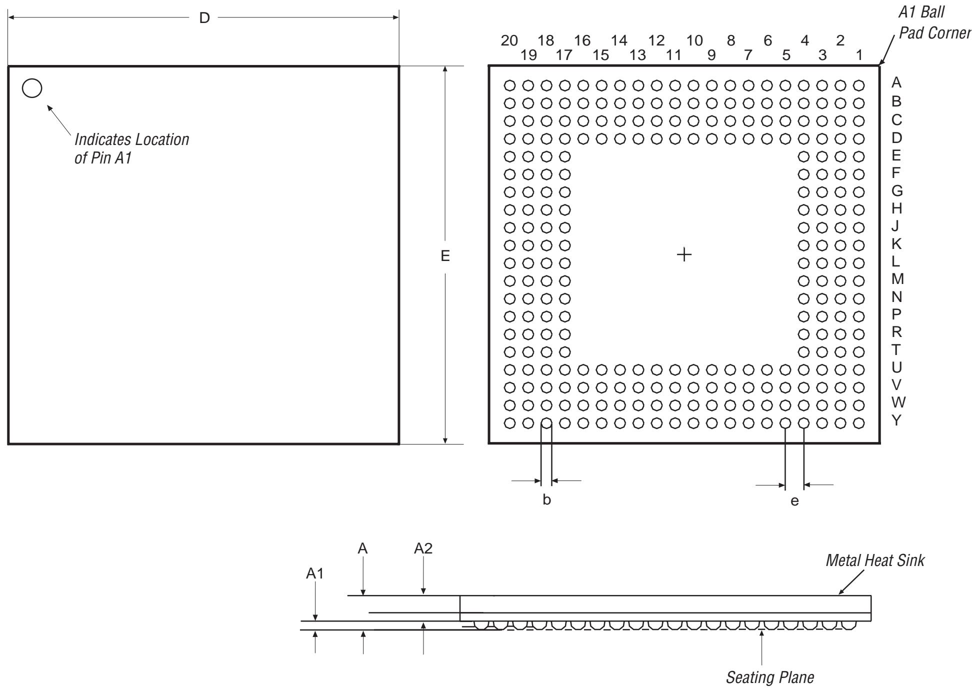
256-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Down

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-192
JEDEC Option	BAL-2, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
b	0.60	0.75	0.90
D/E	27.00 BSC		
e	1.27 BSC		
M	20		

Package Outline



256-Pin Non-Thermally Enhanced Ball-Grid Array (BGA) Cavity Up

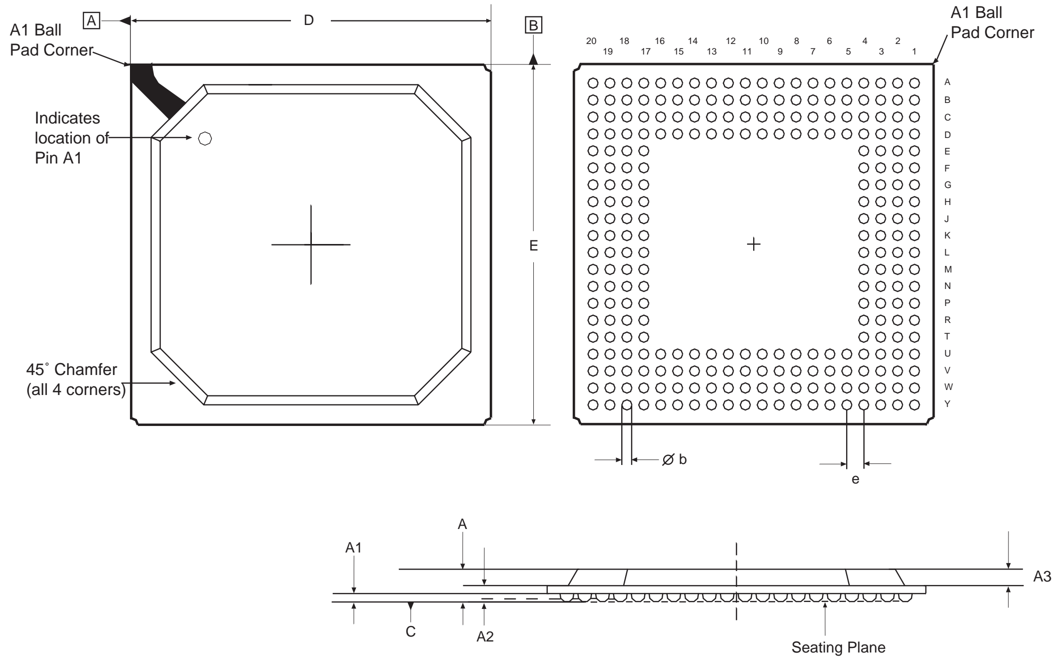
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Sixteen dummy copper pads are visible on the middle of the bottom of some devices. These pads are not connected to the device die.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAL-2, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
b	0.60	0.75	0.90
D/E	27.00 BSC		
e	1.27 BSC		
M	20		

† Altera’s thickness specification for A is 2.7 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline

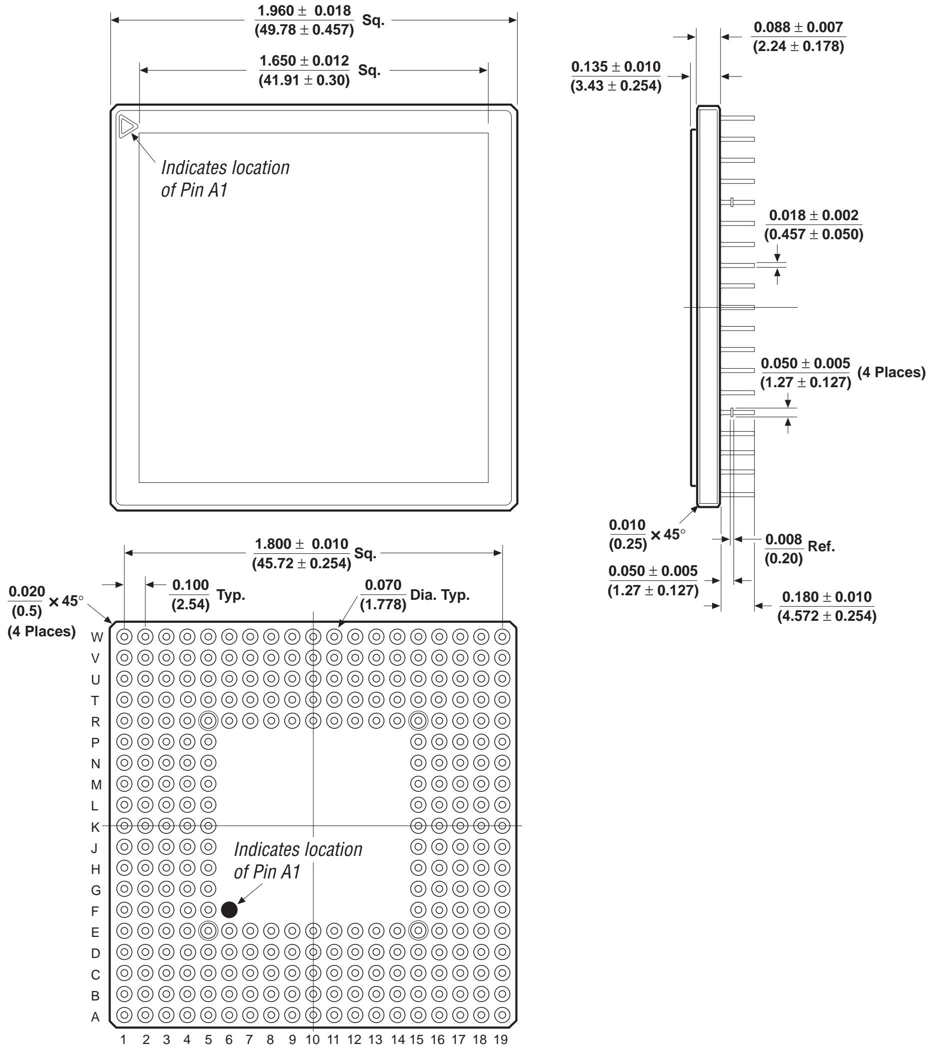


280-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-067
JEDEC Option	AL
Maximum Lead Coplanarity	N/A
Weight	29.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



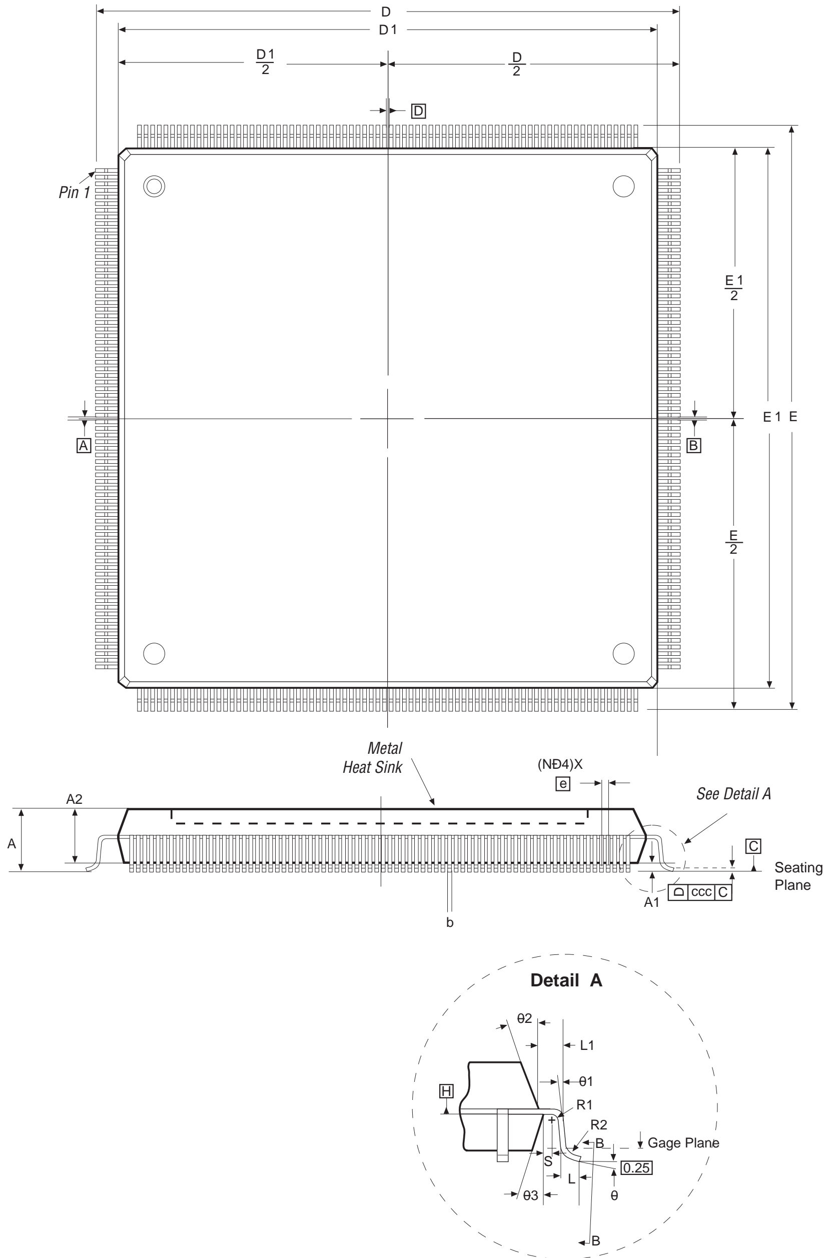
304-Pin Power Quad Flat Pack (RQFP)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- N is the number of leads.

Package Information	
Description	**Specification**
Ordering Code Reference	R
Package Acronym	RQFP
Lead Material	Copper
Lead Finish	Solder plate (85/15 typical)
JEDEC Outline	MS-029
JEDEC Option	JA
Maximum Lead Coplanarity	0.003 inches (0.08 mm)
Weight	26.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	4.50
A1	0.25	–	0.50
A2	3.70	–	3.90
D	42.35	–	42.85
D1	39.90	–	40.10
E	42.35	–	42.85
E1	39.90	–	40.10
e	0.50 BSC		
b	0.17	–	0.27
R2	0.08	–	0.25
R1	0.08	–	–
θ	0°	3.5°	8°
θ1	0°	–	–
θ2	5°	–	16°
θ3	5°	–	16°
C	0.09	–	0.20
L	0.40	–	0.60
L1	0.40	–	–
S	0.20	–	–
N	304		

Package Outline



324-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

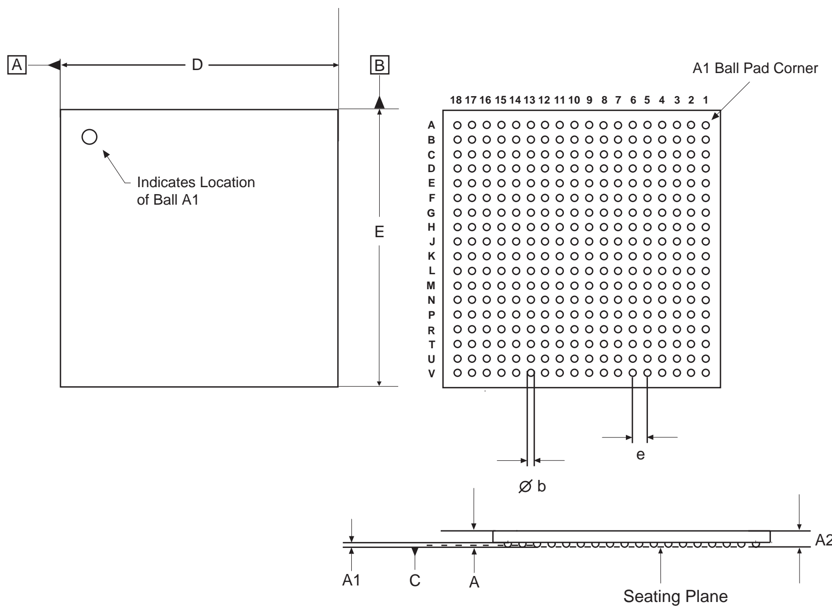
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAG-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
D/E	19.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
M	18		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



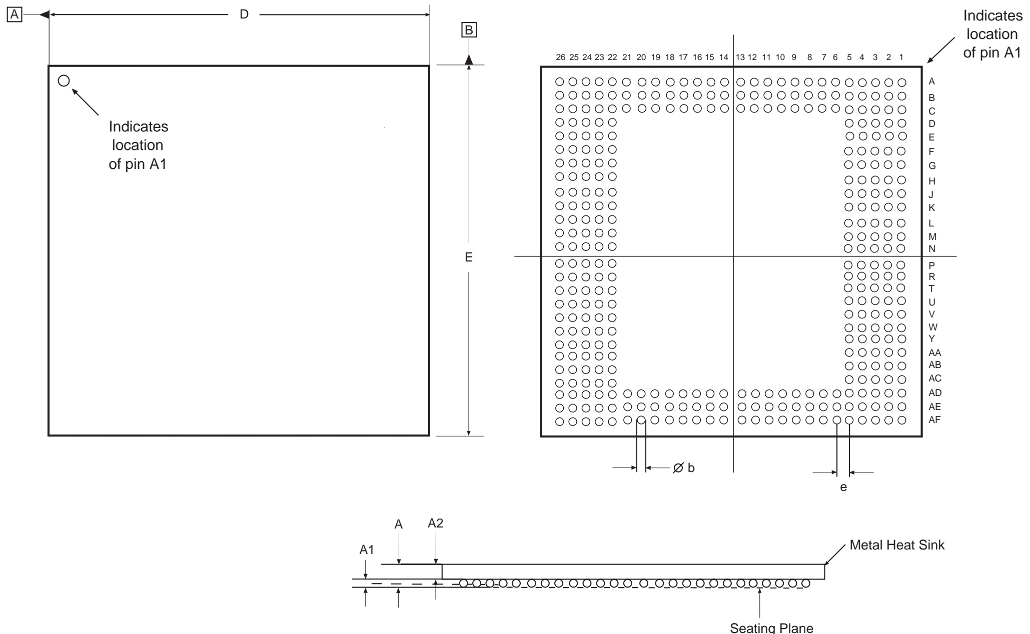
356-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Down

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-192
JEDEC Option	BAR-2, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	7.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
b	0.60	0.75	0.90
D/E	35.00 BSC		
e	1.27 BSC		
M	26		

Package Outline

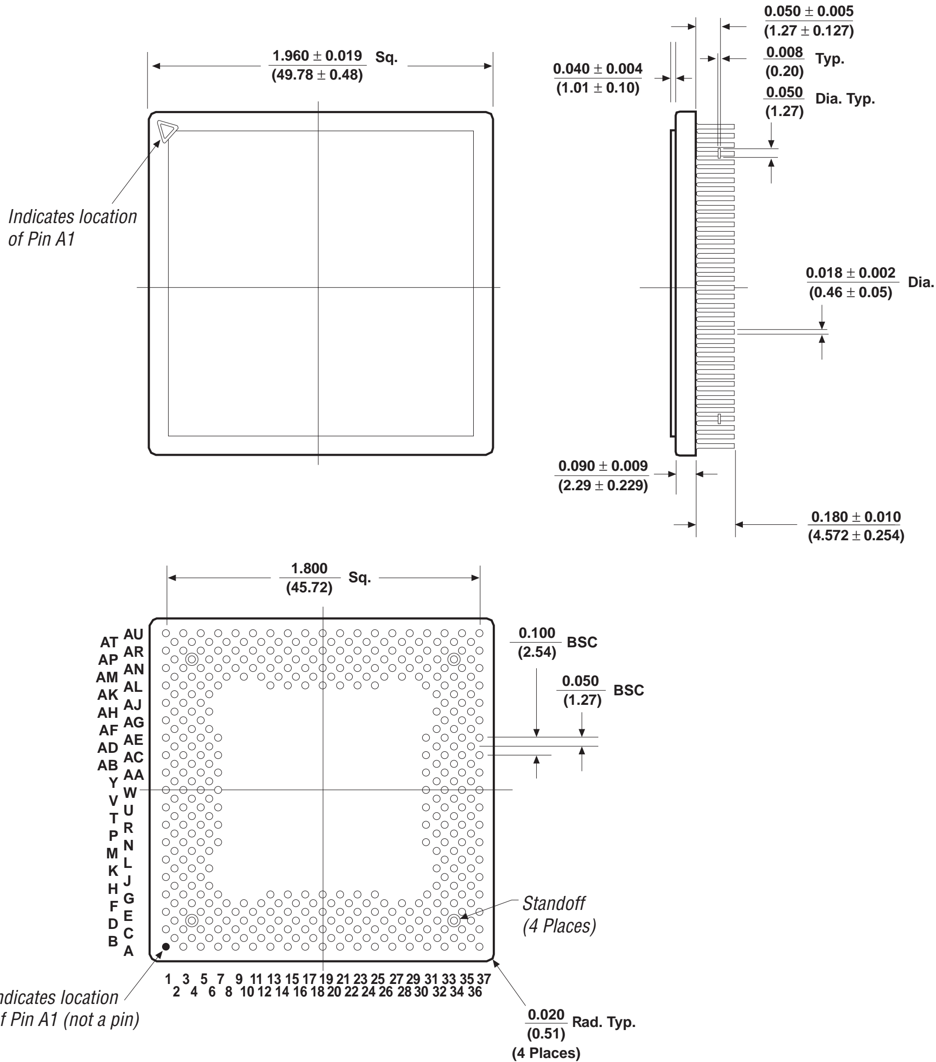


403-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ASME Y14.5M – 1994
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-128
JEDEC Option	AL
Maximum Lead Coplanarity	N/A
Weight	47.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



484-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

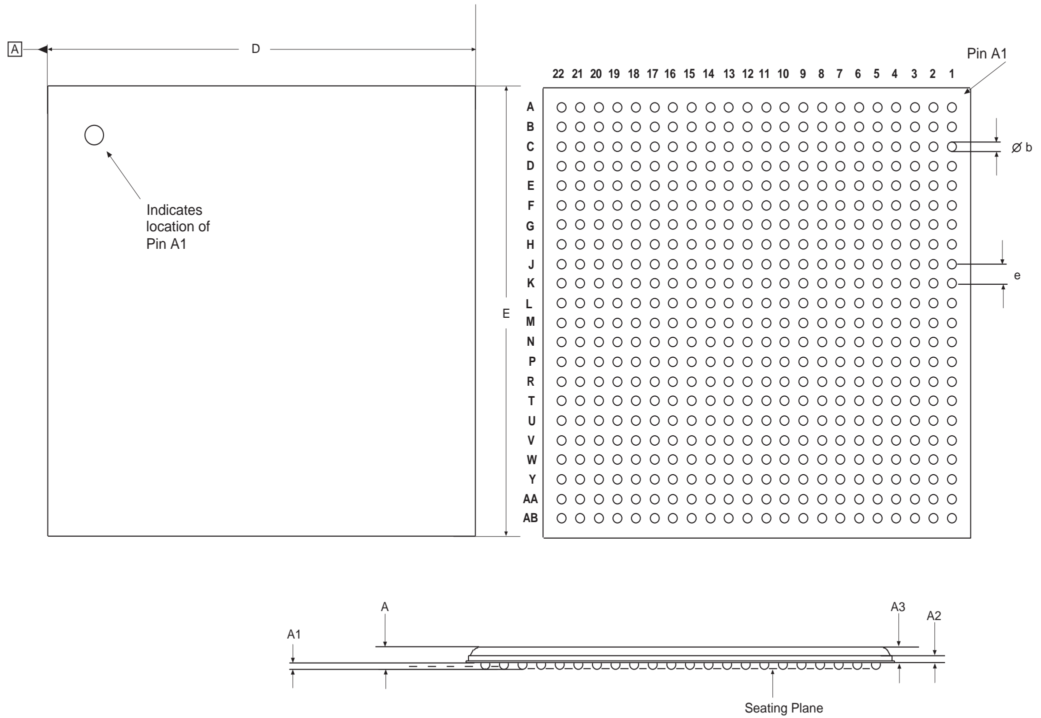
Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAJ-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D/E	23.00 BSC		
b‡	0.50	0.60	0.70
e	1.00 BSC		
M	22		

†Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

‡Ball size, parameter "b", can go up to a maximum of 0.74. Contact Altera Applications for more information.

Package Outline



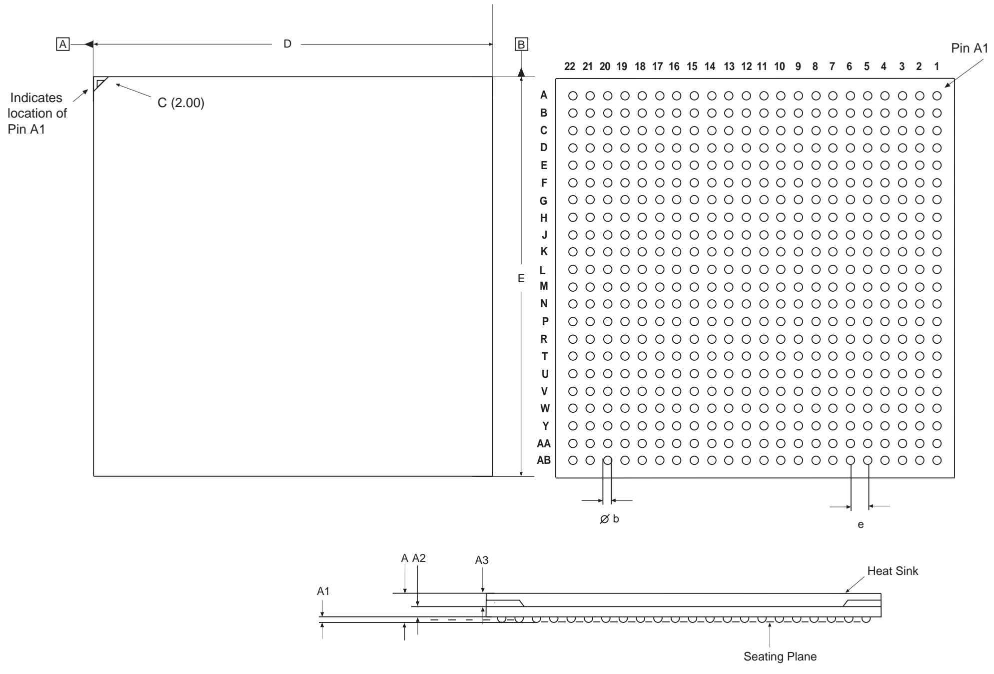
484-Pin Thermally Enhanced FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Some devices have a chamfered corner at the A-1 ball location.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAJ-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D/E	23.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
M	22		

Package Outline

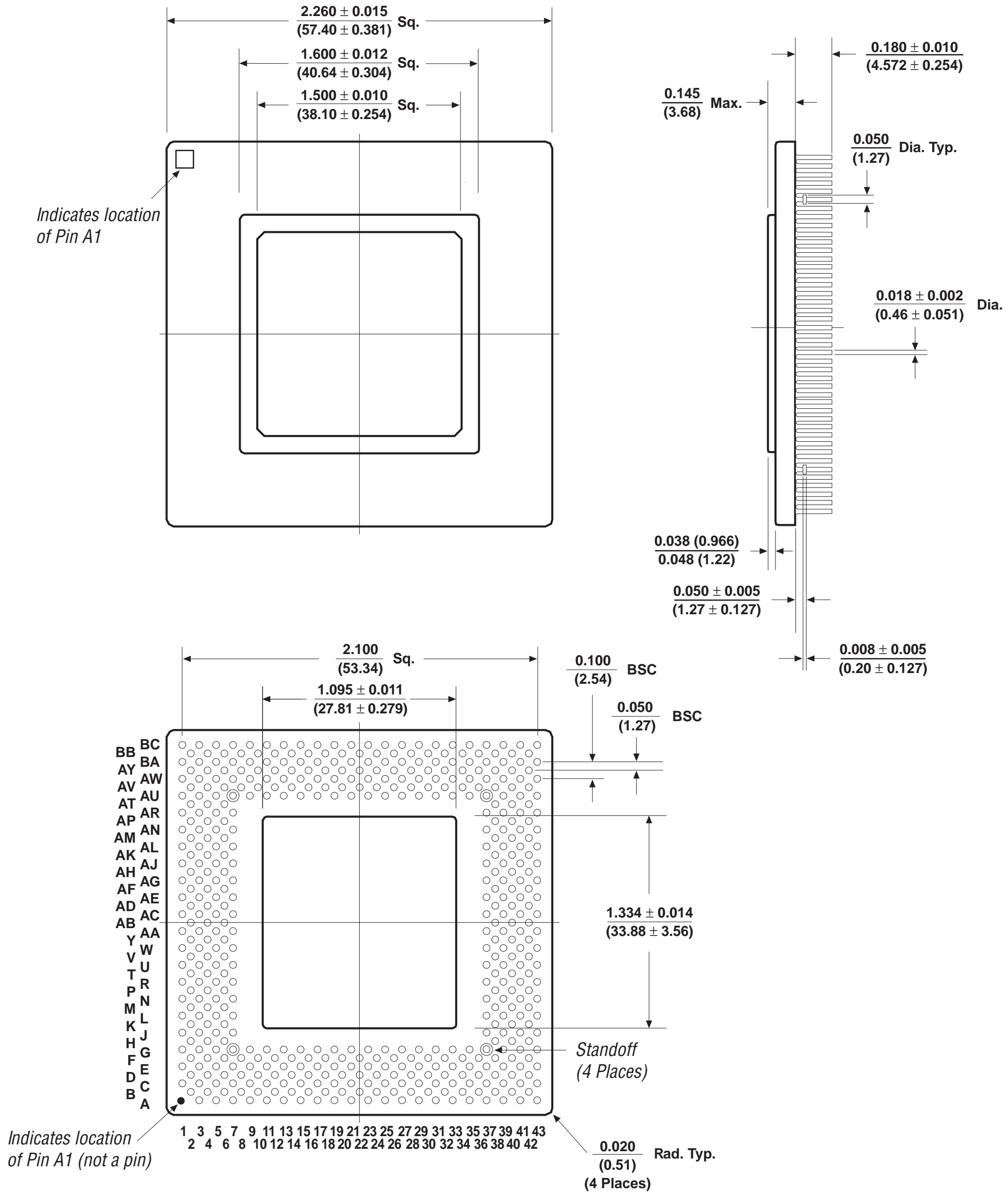


503-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	M0-128
JEDEC Option	AN
Maximum Lead Coplanarity	N/A
Weight	59.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline

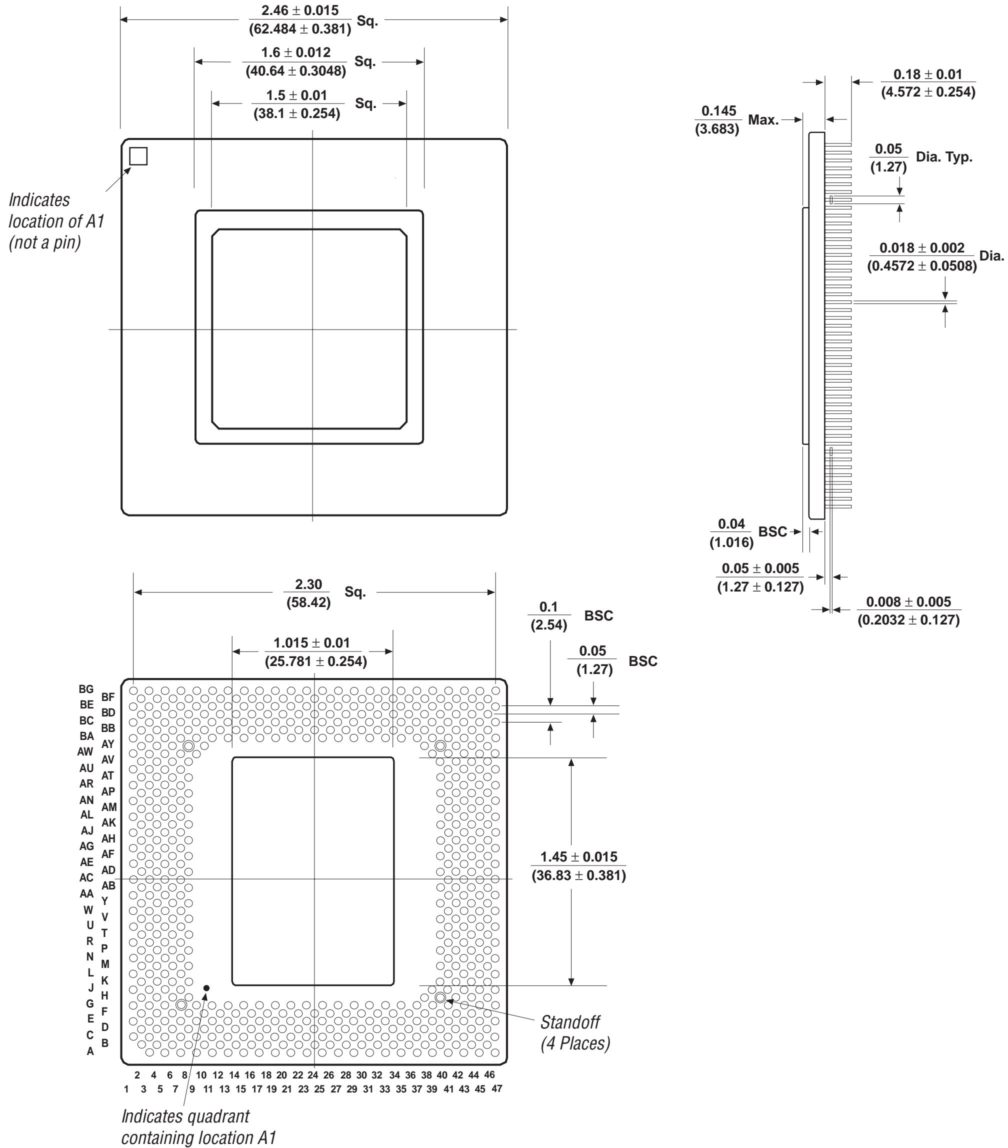


599-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-128
JEDEC Option	AP
Maximum Lead Coplanarity	N/A
Weight	69.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



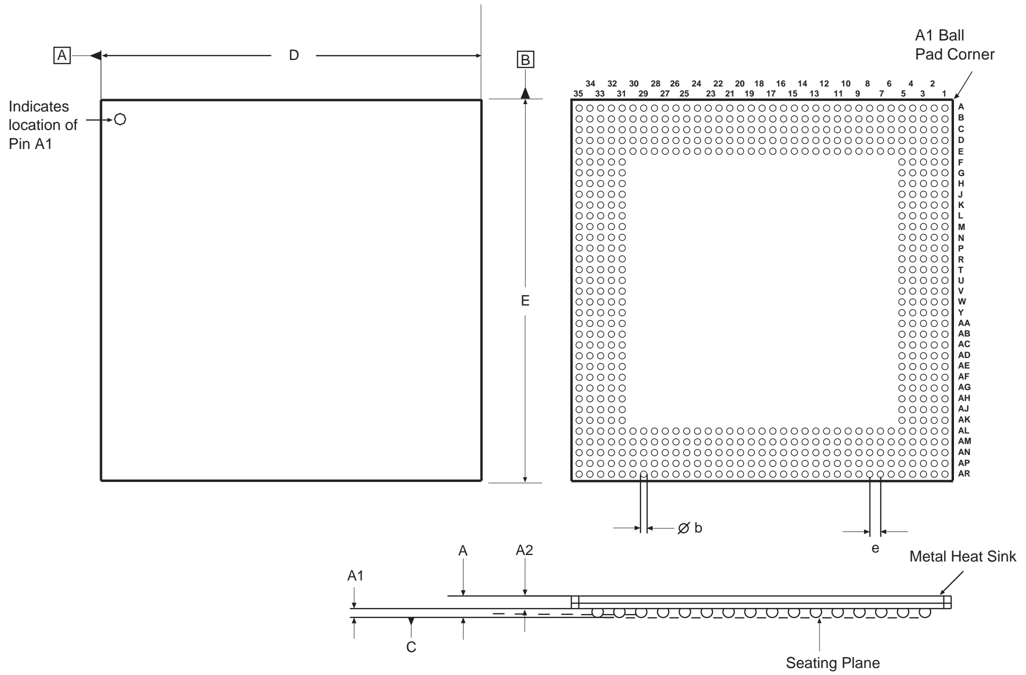
600-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Down

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-192
JEDEC Option	BAW-1, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	12.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
b	0.60	0.75	0.90
D/E	44.90	45.00	45.10
e	1.27 BSC		
M	35		

Package Outline



652-Pin Non-Thermally Enhanced Ball-Grid Array (BGA) Cavity Up

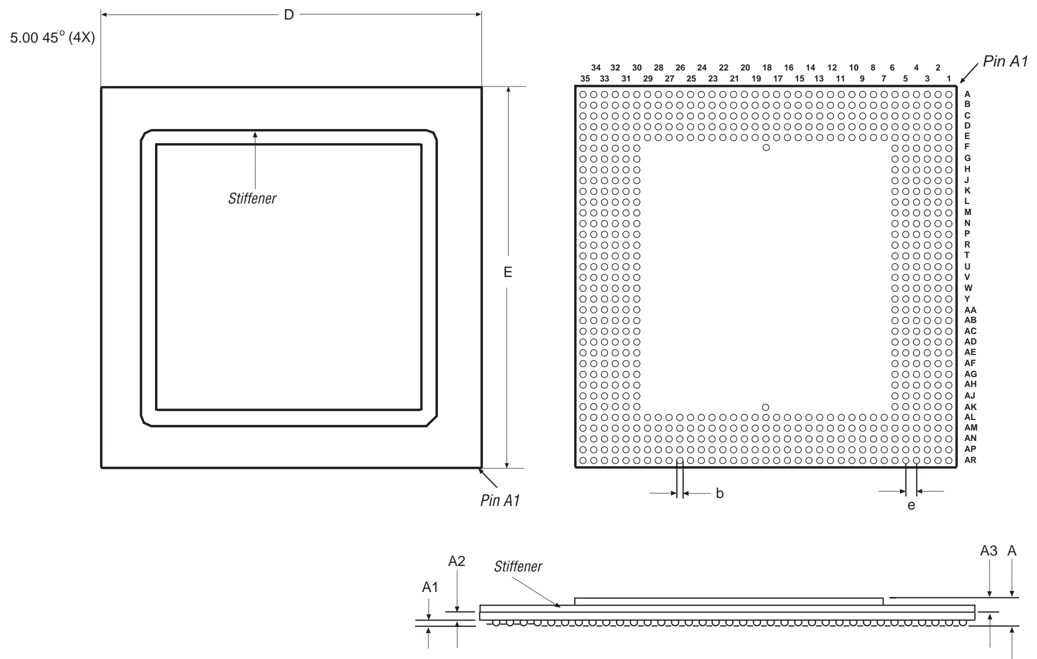
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	9.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.60	0.75	0.90
D/E	45.00 BSC		
e	1.27	–	–
M	35		

† Altera's thickness specification for A is 3.2 mm maximum. The Max item for A in this table reflects the JEDEC specification.

Package Outline



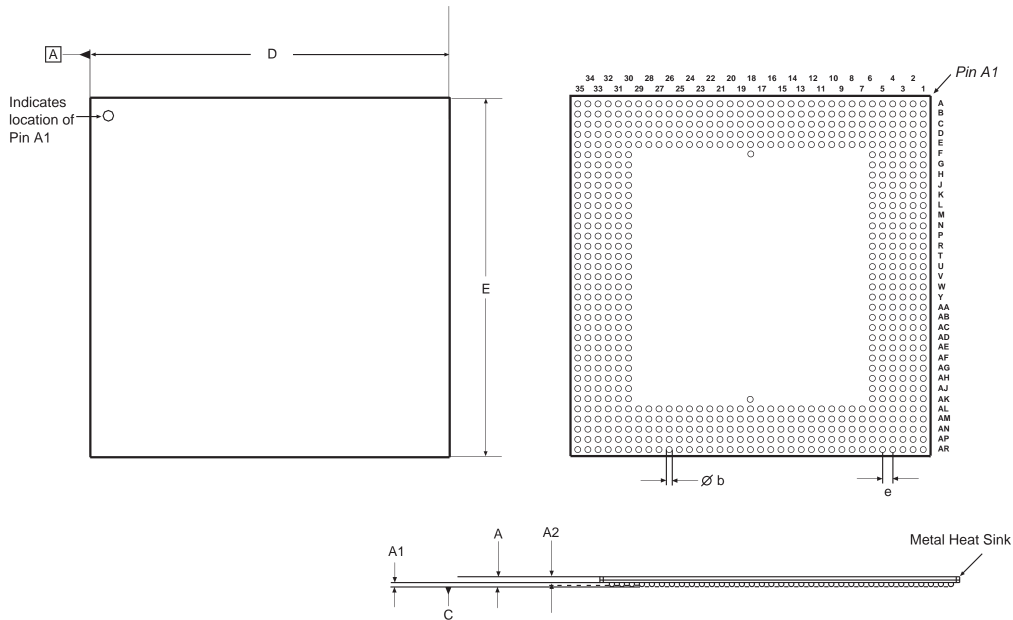
652-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Down

- All dimensions and tolerances conform to AMSE Y14.5M – 1994.
- Controlling dimension is in millimeters.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MO-192
JEDEC Option	BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
D	–	45.00	–
E	–	45.00	–
b	0.60	0.75	0.90
e	–	1.27	–
M	35		

Package Outline



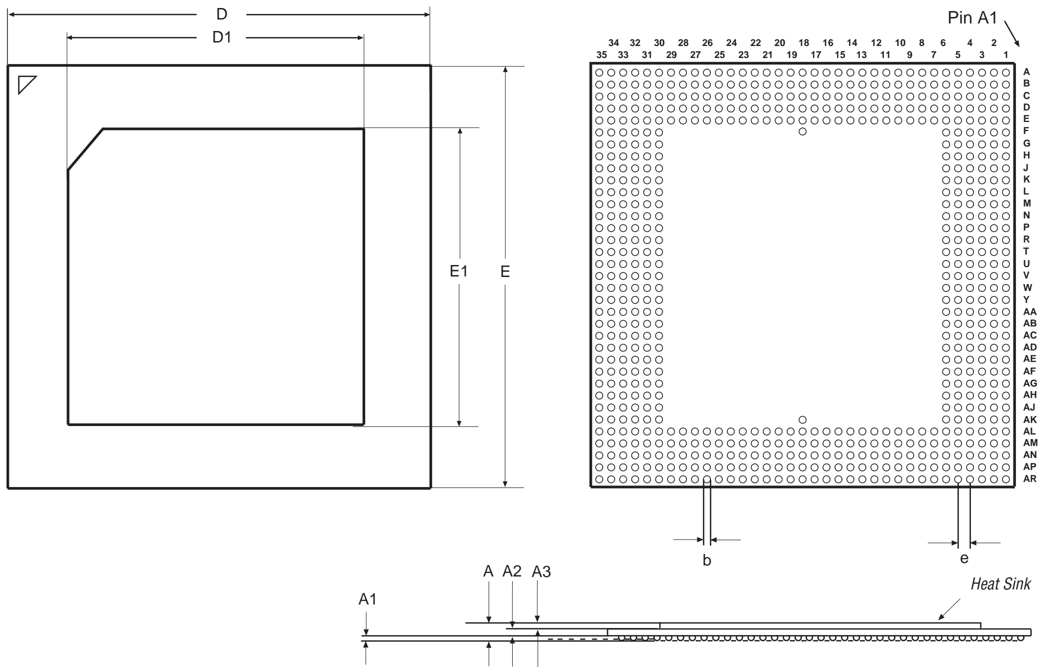
652-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Up

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	9.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.60	0.75	0.90
D/E	45.00 BSC		
D1/E1	33.00 BSC		
e	1.27 BSC		
M	35		

Package Outline



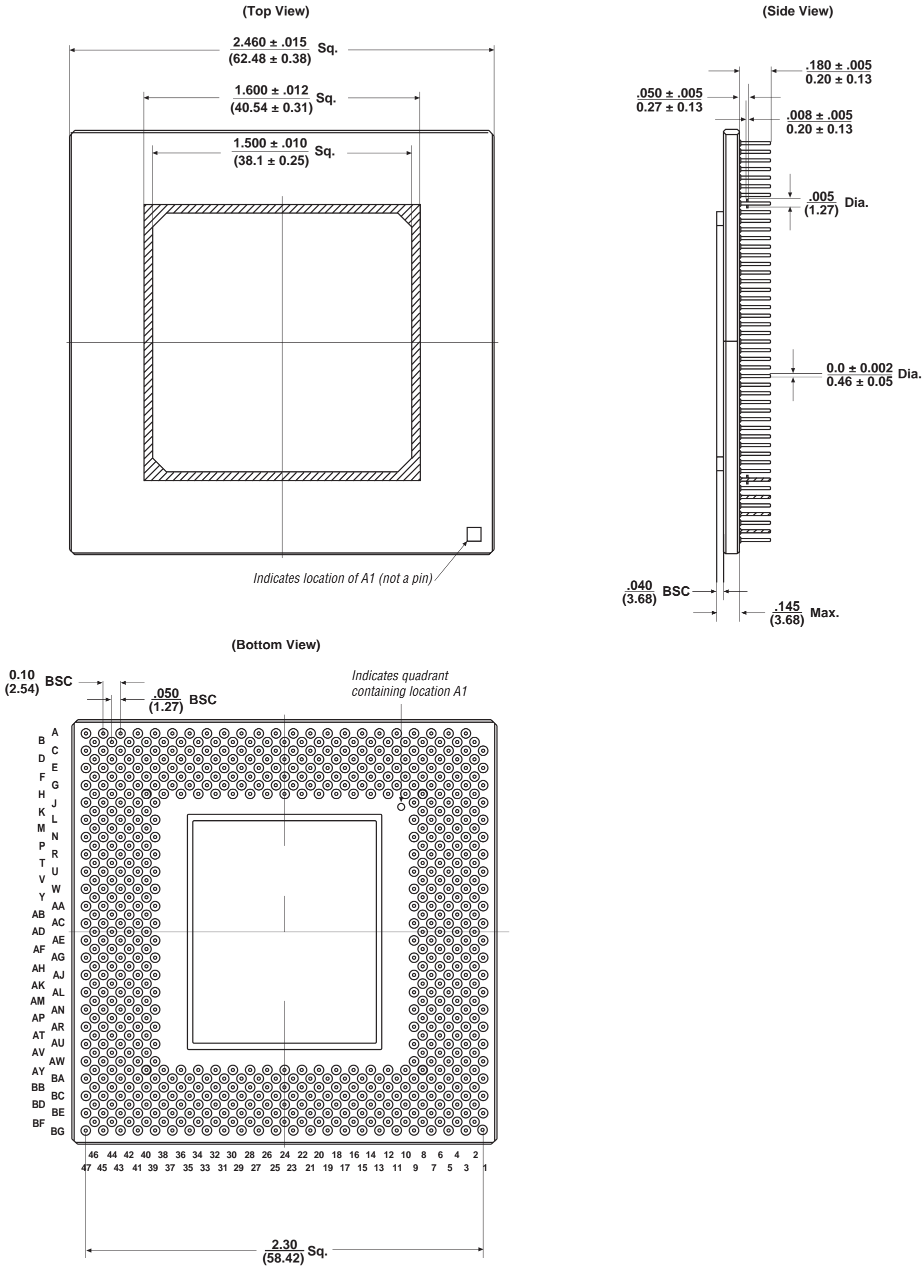
655-Pin Ceramic Pin-Grid Array (PGA)

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in inches. Millimeter measurements, shown in parenthesis, are for reference only.
- An industry-standard lead glass called T-187 (lead oxide glass) is used to seal PGA packages. This material is manufactured by the Sumitomo Corporation.

Package Information

Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Lead Material	Alloy 42
Lead Finish	Gold over nickel plate
JEDEC Outline	MO-128
JEDEC Option	AP
Maximum Lead Coplanarity	N/A
Weight	74.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline



672-Pin Non-Thermally Enhanced FineLine Ball-Grid Array (FBGA)

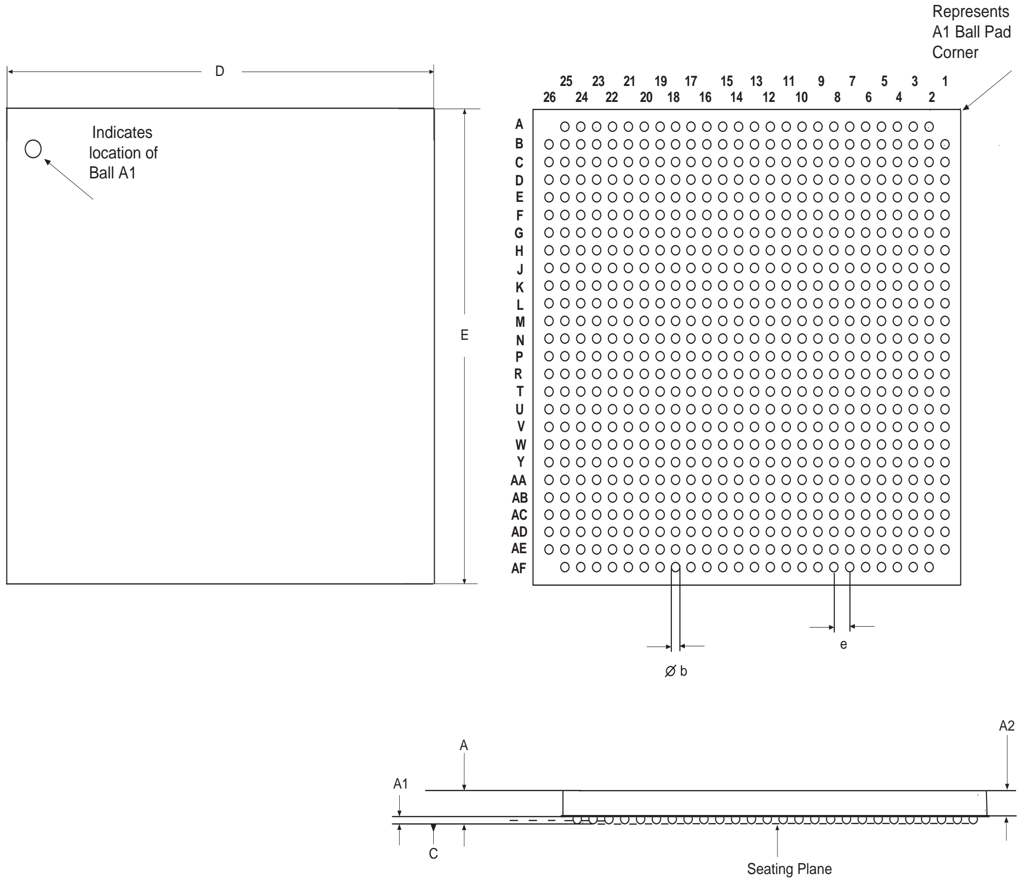
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Some devices have a chamfered corner at the A-1 ball location.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAL-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A†	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
D/E	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
M	26		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



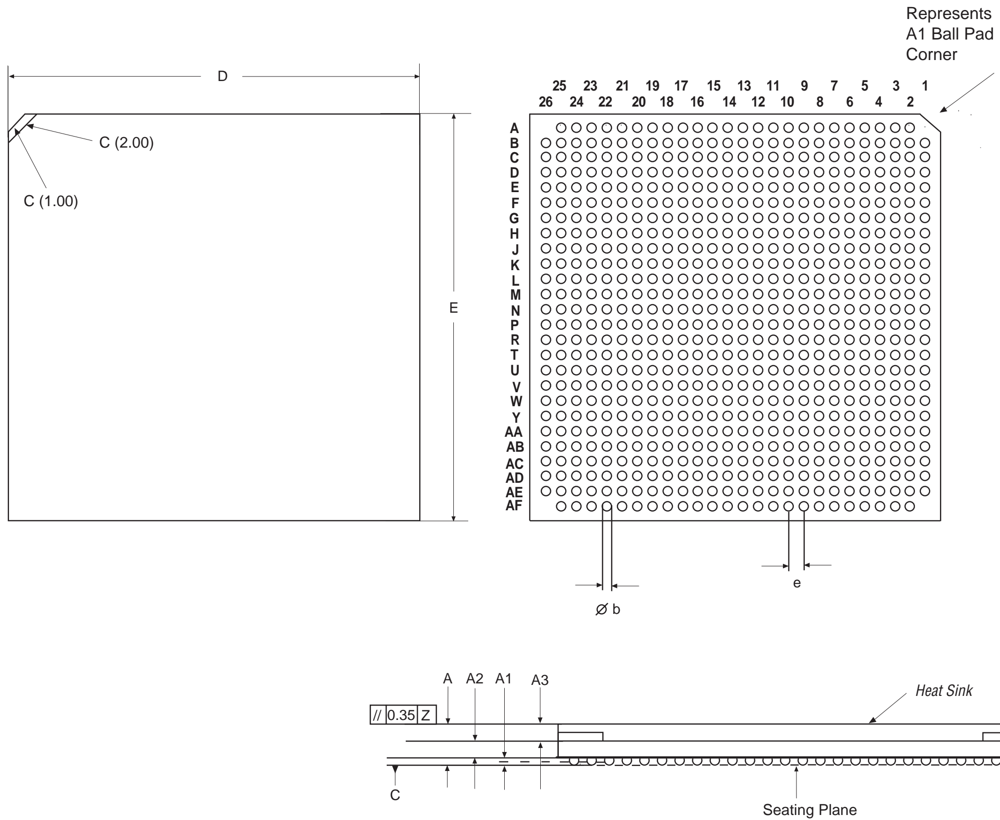
672-Pin Thermally Enhanced FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAL-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.50	0.60	0.70
e	1.00 BSC		
D/E	27.00 BSC		
M	26		

Package Outline



672-Pin Non-Thermally Enhanced Ball-Grid Array (BGA) Cavity Up

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- M is the maximum solder ball matrix size.

Package Information

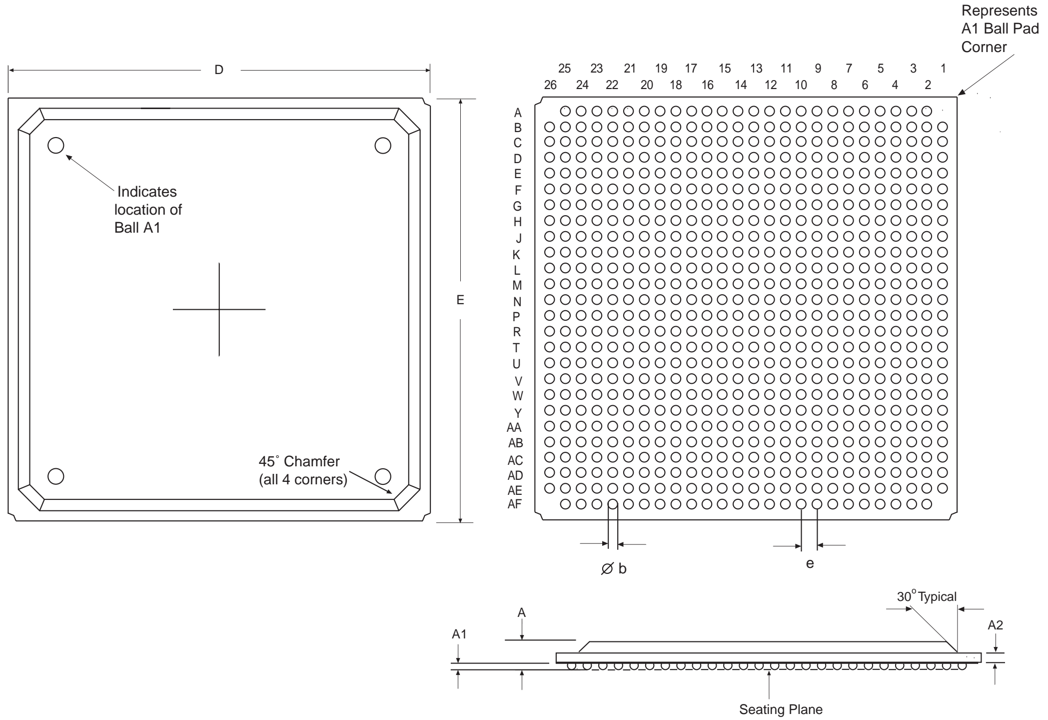
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAR-2, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference

Symbol	Millimeters		
	Min.	Nom.	Max.
A†	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
b	0.60	0.75	0.90
D/E	35.00 BSC		
e	1.27 BSC		
M	26		

† Altera's thickness specification for A is 2.6 mm maximum. The Max item for A in the table reflects the JEDEC specification.

Package Outline



724-Pin Thermally Enhanced Ball-Grid Array (BGA) Cavity Up

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- The orientation of the package shown is by a chamfer and/or a pin 1 mark.
- M is the maximum solder ball matrix size.

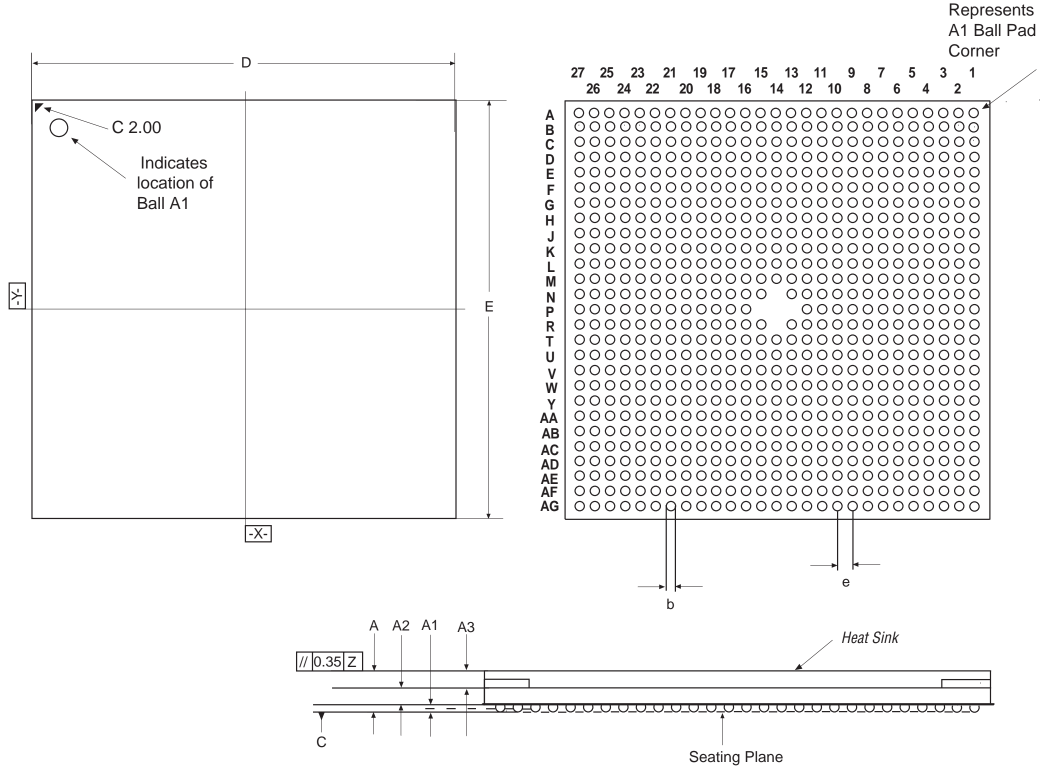
Package Information

Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAR-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference

Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.60	0.75	0.90
D/E	35.00 BSC		
e	1.27 BSC		
M	27		

Package Outline



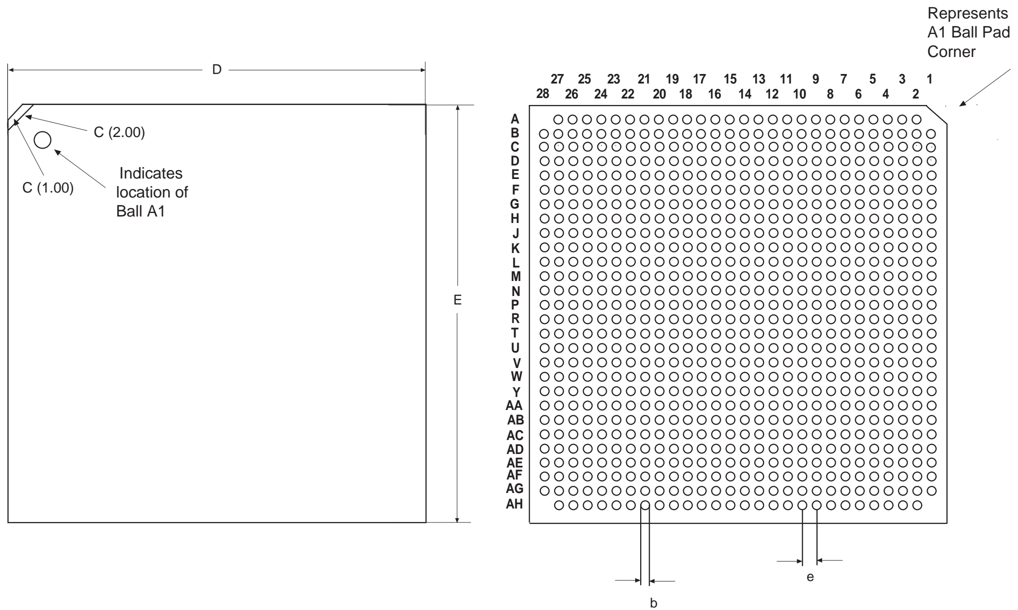
780-Pin Thermally Enhanced FineLine Ball-Grid Array (FBGA)

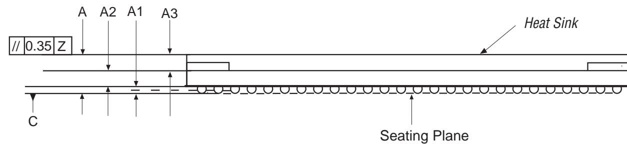
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAM-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.50	0.60	0.70
e	1.00 BSC		
D/E	29.00 BSC		
M	28		

Package Outline





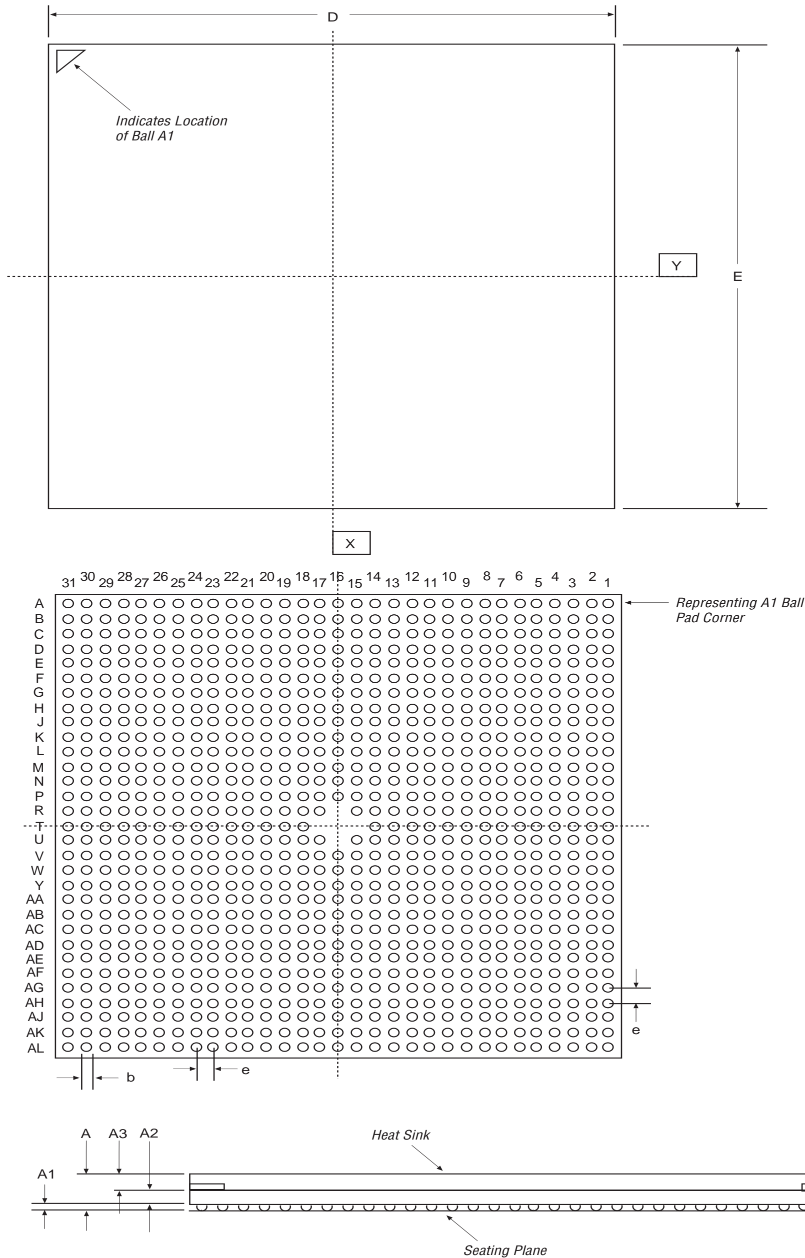
956-Pin Thermally Enhanced Ball Grid Array (BGA) Cavity Up

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	BAU-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	8.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.5
A1	–	–	0.35
A2	–	–	0.25
A3	–	–	2.5
b	0.60	0.75	0.90
D/E	40.00 BSC		
e	1.27 BSC		
M	31		

Package Outline



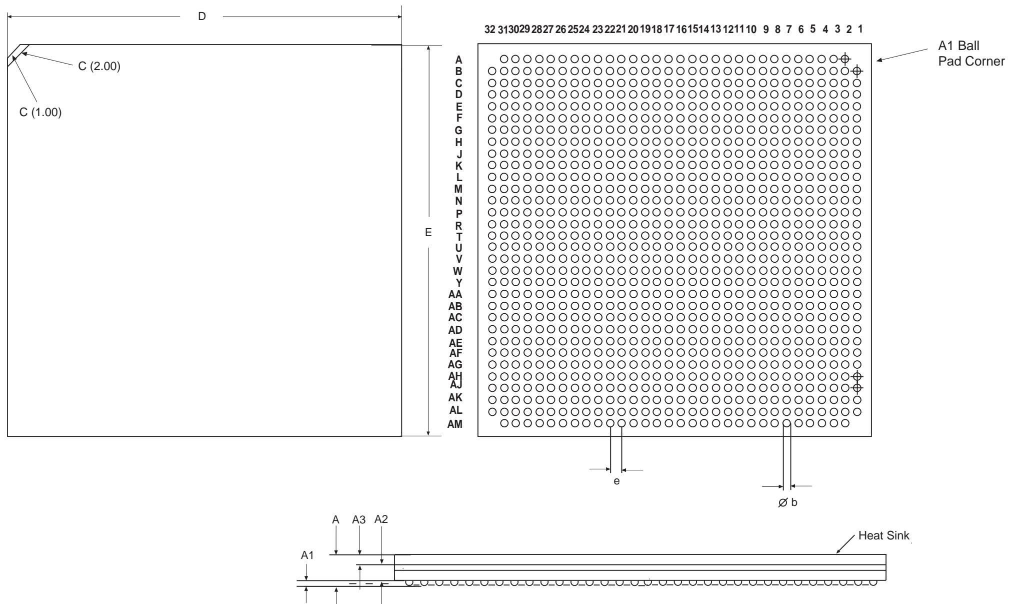
1020-Pin Thermally Enhanced FineLine Ball-Grid Array (FBGA)

- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.
- M is the maximum solder ball matrix size.

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAP-1, depopulated
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	7.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.50	0.60	0.70
e	1.00 BSC		
D/E	33.00 BSC		
M	32		

Package Outline



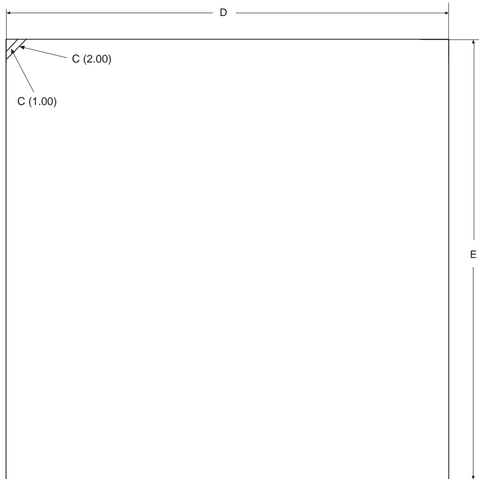
1508-Pin Thermally Enhanced FineLine Ball-Grid Array (FBGA)

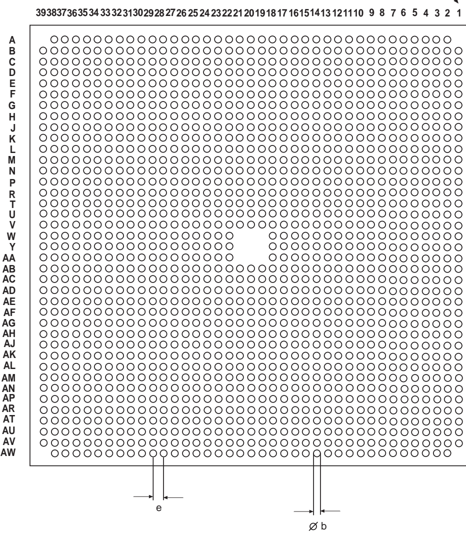
- All dimensions and tolerances conform to ANSI Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Orientation of the package is shown by a chamfer and/or a pin 1 mark.
- M is the maximum solder ball matrix size.

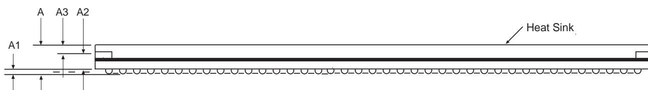
Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Lead Material	Tin-lead alloy (63/37)
Lead Finish	N/A
JEDEC Outline	MS-034
JEDEC Option	AAU-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	9.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Figure Reference			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50
A1	0.35	–	–
A2	0.25	–	3.00
A3	–	–	2.50
b	0.50	0.60	0.70
e	1.00 BSC		
D/E	40.00 BSC		
M	39		

Package Outline







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