

Document Revision History

Table 1 shows the revision history for this document.

<i>Table 1. Document Revision History (1)</i>		
Date and Document Version	Changes Made	Summary of Changes
May 2007 v14.7	<ul style="list-style-type: none"> ● Added Arria™ GX information ● Added Cyclone III tables ● Revised D2 and E2 dimensions for 144-Pin EQFP ● Revised 100-Pin MBGA - Wire Bond and 256-Pin MBGA - Wire Bond ● Added 780-Pin FBGA option 2 - Wire Bond, 256-Pin UBGA - Wire Bond, 68-Pin MBGA - Wire Bond, and 144-Pin MBGA - Wire Bond 	Changes and additions as described in "Changes Made" section.
February 2007 v14.6	<ul style="list-style-type: none"> ● Updated 144-Pin Plastic Thin Quad Flat Pack (TQFP) Data Sheet to correct title and ordering code reference ● Added revision history 	Revised one data sheet (144-Pin Plastic Thin Quad Flat Pack (TQFP) Data Sheet), added revision history.
December 2006 v14.5	<ul style="list-style-type: none"> ● Table 2 was added for Stratix III Device and Package Cross-Reference ● Tables 16, 17, and 18 were added for Stratix III Thermal Resistance information ● 1517-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip data sheet was added ● 1760-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip data sheet was added ● "Wire Bond" and "Flip Chip" was added to title of each data sheet, as appropriate ● "BGA" was spelled out as "Ball-Grid Array" in all titles ● Some package outline drawings were reformatted ● Weights were updated for many packages 	Added Tables for Stratix III, updated other data sheets.

Note to Table 1:

(1) Formal revision history for this document began with version 14.5.

Introduction

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

- [Device & Package Cross Reference](#) (below)
- [Thermal Resistance](#) (starting on page 19)
- [Package Outlines](#) (starting on page 41)

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

Device & Package Cross Reference

Tables 2 through 18 show the devices available in Ball-Grid Array (BGA), FineLine BGA® (FBGA), Ultra FineLine BGA (UBGA), Micro FineLine BGA (MBGA), Pin-Grid Array (PGA), Plastic J-Lead Chip Carrier (PLCC), Thin Quad Flat Pack (TQFP), Plastic Quad Flat Pack (PQFP), Ceramic Dual In-Line Package (CerDIP), and Hybrid FineLine BGA (HBGA):

- Arria™ GX FPGAs
- Stratix® series FPGAs
- Cyclone® series FPGAs
- MAX® series CPLDs
- HardCopy® series Structured ASICs
- APEX™ series FPGAs
- ACEX® 1K FPGAs
- Mercury™ FPGAs
- FLEX® series FPGAs
- Excalibur™ FPGA
- Enhanced configuration devices

Table 2. Arria GX Devices in FineLine Ball Grid Array (FBGA) - Flip Chip Packages (Part 1 of 2)

Device	Package	Pins
EP1AGX20	Flip-chip FBGA	484
	Flip-chip FBGA	780
EP1AGX35	Flip-chip FBGA	484
	Flip-chip FBGA	780
EP1AGX50	Flip-chip FBGA	484
	Flip-chip FBGA	780
	Flip-chip FBGA	1152

Table 2. Arria GX Devices in FineLine Ball Grid Array (FBGA) - Flip Chip Packages (Part 2 of 2)

Device	Package	Pins
EP1AGX60	Flip-chip FBGA	484
	Flip-chip FBGA	780
	Flip-chip FBGA	1152
EP1AGX90	Flip-chip FBGA	1152

Table 3. Stratix III Devices in FineLine Ball-Grid Array (FBGA) - Flip Chip Packages

Device	Package	Pins
EP3SL50	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP3SL70	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP3SL110	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP3SL150	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP3SL200	FBGA, Flip Chip	1152
	FBGA, Flip Chip	1517
EP3SL340	FBGA, Flip Chip	1517
	FBGA, Flip Chip	1760
EP3SE50	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP3SE80	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP3SE110	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP3SE260	FBGA, Flip Chip	1152
	FBGA, Flip Chip	1517

Table 4. Stratix II Devices		
Device	Package	Pins
EP2S15	FBGA, Flip Chip	484
	FBGA, Flip Chip	672
EP2S30	FBGA, Flip Chip	484
	FBGA, Flip Chip	672
EP2S60	FBGA, Flip Chip	484
	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP2S90	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508
EP2S130	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508
EP2S180	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508

Table 5. Stratix II GX Devices		
Device	Package	Pins
EP2SGX30	FBGA, Flip Chip	780
EP2SGX60	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP2SGX90	FBGA, Flip Chip	1152
	FBGA, Flip Chip	1508
EP2SGX130	FBGA, Flip Chip	1508

Table 6. Stratix GX Devices (Part 1 of 2)		
Device	Package	Pins
EP1SGX10C	FBGA, Flip Chip	672
EP1SGX10D	FBGA, Flip Chip	672

Table 6. Stratix GX Devices (Part 2 of 2)

Device	Package	Pins
EP1SGX25C	FBGA, Flip Chip	672
EP1SGX25D	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP1SGX25F	FBGA, Flip Chip	1,020
EP1SGX40D	FBGA, Flip Chip	1,020
EP1SGX40G	FBGA, Flip Chip	1,020

Table 7. Stratix Devices (Part 1 of 2)

Device	Package	Pins
EP1S10	FBGA, Flip Chip	484
	BGA, Wirebond	672
	FBGA, Wirebond (Option 2)	672
	FBGA, Flip Chip	780
EP1S20	FBGA, Flip Chip	484
	BGA, Wirebond	672
	FBGA, Wirebond (Option 2)	672
	FBGA, Flip Chip	780
EP1S25	BGA, Wirebond	672
	FBGA, Wirebond (Option 2)	672
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,020
EP1S30	FBGA, Flip Chip	780
	BGA, Flip Chip	956
	FBGA, Flip Chip	1,020
EP1S40	BGA, Flip Chip	956
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508
EP1S60	BGA, Flip Chip	956
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508

Device	Package	Pins
EP1S80	BGA, Flip Chip	956
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508

Device	Package (2)	Pins
EP3C5	Plastic Enhanced Quad Flat Pack (EQFP) – Wire Bond	144 (1)
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	256
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	256
EP3C10	Plastic Enhanced Quad Flat Pack (EQFP) – Wire Bond	144 (1)
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	256
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	256
EP3C16	Plastic Enhanced Quad Flat Pack (EQFP) – Wire Bond	144 (1)
	Plastic Quad Flat Pack (PQFP) – Wire Bond	240
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	256
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	256
	FineLine Ball-Grid Array (FBGA) – Option 3 – Wire Bond	484
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	484
EP3C25	Plastic Enhanced Quad Flat Pack (EQFP) – Wire Bond	144 (1)
	Plastic Quad Flat Pack (PQFP) – Wire Bond	240
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	256
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	256
	FineLine Ball-Grid Array (FBGA) – Wire Bond	324
EP3C40	Plastic Quad Flat Pack (PQFP) – Wire Bond	240
	FineLine Ball-Grid Array (FBGA) – Wire Bond	324
	FineLine Ball-Grid Array (FBGA) – Option 3 – Wire Bond	484
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	484
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	780
EP3C55	FineLine Ball-Grid Array (FBGA) – Option 3 – Wire Bond	484
	Ultra FineLine Ball-Grid Array (UBGA) – Wire Bond	484
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	780

Device	Package (2)	Pins
EP3C80	FineLine Ball-Grid Array (FBGA) – Option 3 – Wire Bond	484
	Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond	484
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	780
EP3C120	FineLine Ball-Grid Array (FBGA) – Option 3 – Wire Bond	484
	FineLine Ball-Grid Array (FBGA) – Option 2 – Wire Bond	780

Note to Table 8:

- (1) The E144 package has an exposed pad at the bottom of the package. This exposed pad is a ground pad that must be connected to the ground plane on your PCB. This exposed pad is used for electrical connectivity and not for thermal purposes.
- (2) The package type entries with "Option #" refer to instances where multiple package options exist for a given package type and pin count. The Option number identifies the specific type used by the corresponding device density.

Device	Package	Pins
EP2C5	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 2)	256
EP2C8	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 2)	256
EP2C20	PQFP, Wirebond	240
	FBGA, Wirebond (Option 2)	256
	FBGA, Wirebond (Option 3)	484
EP2C35	FBGA, Wirebond (Option 3)	484
	UBGA, Wirebond	484
	FBGA, Wirebond (Option 3)	672
EP2C50	FBGA, Wirebond (Option 3)	484
	UBGA, Wirebond	484
	FBGA, Wirebond (Option 3)	672
EP2C70	FBGA, Wirebond (Option 3)	672
	FBGA, Wirebond	896

Table 10. Cyclone Devices		
Device	Package	Pins
EP1C3	TQFP, Wirebond	100
	TQFP, Wirebond	144
EP1C4	FBGA, Wirebond	324
	FiBGA, Wirebond	400
EP1C6	TQFP, Wirebond	144
	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
EP1C12	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
	FBGA, Wirebond	324
EP1C20	FBGA, Wirebond	324
	FBGA, Wirebond	400

Table 11. MAX Series Devices (Part 1 of 3)		
Device	Package	Pins
MAX II Devices		
EPM240	TQFP, Wirebond	100
	FBGA, Wirebond (Option 2)	100
	MBGA, Wirebond	100
EPM570	TQFP, Wirebond	100
	TQFP, Wirebond	144
	MBGA, Wirebond	100
	FBGA, Wirebond (Option 2)	100
	FBGA, Wirebond (Option 1)	256
	MBGA, Wirebond	256
EPM1270	TQFP, Wirebond	144
	FBGA, Wirebond (Option 1)	256
	MBGA, Wirebond	256
EPM2210	FBGA, Wirebond (Option 1)	256
	FBGA, Wirebond	324
MAX 9000 Devices		
EPM9320	BGA, Wirebond	356

Table 11. MAX Series Devices (Part 2 of 3)		
Device	Package	Pins
EPM9320A	BGA, Wirebond	356
EPM9560	BGA, Wirebond	356
MAX 7000B Devices		
EPM7032B	PLCC, Wirebond	44
	PQFP, Wirebond	44
	TQFP, Wirebond	44
	UBGA, Wirebond	49
EPM7064B	TQFP, Wirebond	44
	UBGA, Wirebond	49
	FBGA, Wirebond	100
	TQFP, Wirebond	100
EPM7128B	UBGA, Wirebond	49
	TQFP, Wirebond	100
	FBGA, Wirebond	100
	TQFP, Wirebond	144
	UBGA, Wirebond	169
	FBGA, Wirebond (Option 1)	256
EPM7256B	TQFP, Wirebond	100
	TQFP, Wirebond	144
	UBGA, Wirebond	169
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EPM7512B	TQFP, Wirebond	144
	UBGA, Wirebond	169
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
	BGA, Wirebond (Option 1)	256
MAX 7000AE Devices		
EPM7032AE	PLCC, Wirebond	44
	TQFP, Wirebond	44

Table 11. MAX Series Devices (Part 3 of 3)		
Device	Package	Pins
EPM7064AE	PLCC, Wirebond	44
	TQFP, Wirebond	100
	TQFP, Wirebond	144
	UBGA, Wirebond	49
	FBGA, Wirebond	100
	FBGA, Wirebond (Option 1)	256
EPM7128AE	PLCC, Wirebond	84
	TQFP, Wirebond	100
	FBGA, Wirebond	100
	UBGA, Wirebond	169
	TQFP, Wirebond	144
	FBGA, Wirebond (Option 1)	256
EPM7256AE	TQFP, Wirebond	100
	FBGA, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EPM7512AE	TQFP, Wirebond	144
	PQFP, Wirebond	208
	BGA, Wirebond (Option 1)	256
	FBGA, Wirebond (Option 1)	256
MAX 7000A Devices		
EPM7032A	PLCC, Wirebond	44
	TQFP, Wirebond	44
EPM7128A	PLCC, Wirebond	84
	TQFP, Wirebond	100
	FBGA, Wirebond	100
	TQFP, Wirebond	144
	FBGA, Wirebond (Option 1)	256
EPM7256A	TQFP, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256

Table 12. HardCopy Series Devices

Device	Package	Pins
HC20K400	BGA, Wirebond (Option 3)	652
HC20K600	BGA, Wirebond (Option 3)	652
	Flip Chip FBGA	672
HC220	Flip Chip FPGA	672
	Flip Chip FBGA	780
HC230	Flip Chip FPGA	1020
HC1S25	FBGA, Wirebond (Option 3)	672
	BGA, Wirebond	672
HC1S30	Flip Chip FBGA	780
HC1S40	Flip Chip FBGA	780
HC1S60	Flip Chip FBGA	1,020
HC1S80	Flip Chip FBGA	1,020

Table 13. APEX Series Devices (Part 1 of 4)

Device	Package	Pins
APEX II Devices		
EP2A15	Flip Chip FBGA	672
	Flip Chip BGA	724
EP2A25	Flip Chip FBGA	672
	Flip Chip BGA	724
	Flip Chip FBGA	1,020
EP2A40	Flip Chip FBGA	672
	Flip Chip BGA	724
	Flip Chip FBGA	1,020
EP2A70	Flip Chip BGA	724
	Flip Chip FBGA	1,508
APEX 20KE Devices		
EP20K30E	TQFP, Wirebond	144
	FBGA, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond	324

Table 13. APEX Series Devices (Part 2 of 4)		
Device	Package	Pins
EP20K60E	TQFP, Wirebond	144
	FBGA, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond	324
	BGA, Wirebond	356
EP20K100E	TQFP, Wirebond	144
	FBGA, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond	324
	BGA, Wirebond	356
EP20K160E	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EP20K200E	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
	BGA, Wirebond (Option 2)	652
	FBGA, Wirebond (Option 2)	672
EP20K300E	PQFP, Wirebond	240
	BGA, Wirebond (Option 2)	652
	FBGA, Wirebond (Option 2)	672
EP20K400E	BGA, Wirebond (Option 3)	652
	Flip Chip FBGA	672
EP20K600E	BGA, Wirebond (Option 3)	652
	Flip Chip FBGA	672
	Flip Chip FBGA	1,020

Table 13. APEX Series Devices (Part 3 of 4)		
Device	Package	Pins
EP20K1000E	Flip Chip BGA	652
	Flip Chip FBGA	672
	Flip Chip FBGA	1,020
EP20K1500E	Flip Chip BGA	652
	Flip Chip FBGA	1,020
APEX 20KC Devices		
EP20K200C	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EP20K400C	BGA, Wirebond (Option 3)	652
	Flip Chip FBGA	672
EP20K600C	BGA, Wirebond (Option 3)	652
	Flip Chip FBGA	672
	Flip Chip FBGA	1,020
EP20K1000C	Flip Chip BGA	652
	Flip Chip FBGA	672
	Flip Chip FBGA	1,020
APEX 20K Devices		
EP20K100	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond	324
	BGA, Wirebond	356
EP20K160	PQFP, Wirebond	240
	TQFP, Wirebond	144
EP20K200	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EP20K300	FBGA, Wirebond (Option 2)	672

Table 13. APEX Series Devices (Part 4 of 4)		
Device	Package	Pins
EP20K400	BGA, Wirebond (Option 3)	652
	PGA, Wirebond	655
	Flip Chip FBGA	672

Table 14. ACEX 1K Devices		
Device	Package	Pins
EP1K10	TQFP, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EP1K30	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EP1K50	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
	FBGA, Wirebond (Option 2)	484
EP1K100	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
	FBGA, Wirebond (Option 2)	484

Table 15. Mercury Devices		
Device	Package	Pins
EP1M120	Flip Chip FBGA	484
EP1M350	Flip Chip FBGA	780

Table 16. FLEX Series Devices (Part 1 of 4)		
Device	Package	Pins
FLEX 10KA Devices		

Table 16. FLEX Series Devices (Part 2 of 4)		
Device	Package	Pins
EPF10K10A	TQFP, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EPF10K30A	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EPF10K100A	RQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
	BGA, Wirebond	600
EPF10K250A	PGA, Wirebond	599
	BGA, Wirebond	600
FLEX 10KS Devices		
EPF10K50S	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EPF10K200S	RQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
	BGA, Wirebond	600
	FBGA, Wirebond (Option 2)	672
FLEX 10KE Devices		
EPF10K30E	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
	FBGA, Wirebond (Option 2)	484

Table 16. FLEX Series Devices (Part 3 of 4)		
Device	Package	Pins
EPF10K50E	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EPF10K100E	PQFP, Wirebond	208
	PQFP, Wirebond	240
	FBGA, Wirebond (Option 1)	256
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
EPF10K130E	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond (Option 2)	484
	BGA, Wirebond	600
	FBGA, Wirebond (Option 2)	672
EPF10K200E	PGA, Wirebond	599
	BGA, Wirebond	600
	FBGA, Wirebond (Option 2)	672
EPF10K10	PLCC, Wirebond	84
	TQFP, Wirebond	144
	PQFP, Wirebond	208
EPF10K20	TQFP, Wirebond	144
	RQFP, Wirebond	208
	RQFP, Wirebond	240
EPF10K30	RQFP, Wirebond	208
	RQFP, Wirebond	240
	BGA, Wirebond	356
EPF10K40	RQFP, Wirebond	208
	RQFP, Wirebond	240
EPF10K50	RQFP, Wirebond	240
	BGA, Wirebond	356
	PGA, Wirebond	403

Table 16. FLEX Series Devices (Part 4 of 4)

Device	Package	Pins
EPF10K50V	RQFP, Wirebond	240
	PQFP, Wirebond	240
	BGA, Wirebond	356
	FBGA, Wirebond	484
EPF10K70	RQFP, Wirebond	240
	PGA, Wirebond	503
EPF10K100	PGA, Wirebond	503
EPF10K130V	PGA, Wirebond	599
	BGA, Wirebond	600
EPF6010A	TQFP, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
EPF6016	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond (Option 2)	256
EPF6016A	TQFP, Wirebond	100
	FBGA, Wirebond	100
	TQFP, Wirebond	144
	PQFP, Wirebond	208
	FBGA, Wirebond (Option 1)	256
EPF6024A	TQFP, Wirebond	144
	PQFP, Wirebond	208
	PQFP, Wirebond	240
	BGA, Wirebond (Option 2)	256
	FBGA, Wirebond (Option 1)	256
EPF8282A	PLCC, Wirebond	84
	TQFP, Wirebond	100
EPF8452A	TQFP, Wirebond	100
	PQFP, Wirebond	160

Device	Package	Pins
EPXA1	FBGA, Wirebond (Option 2)	484
	Flip Chip FBGA	672
EPXA4	Flip Chip FBGA	672
	Flip Chip FBGA	1,020
EPXA10	Flip Chip FBGA	1,020

Device	Package	Pins
EPC1	PDIP, Wirebond	8
	PLCC, Wirebond	20
EPC2	PLCC, Wirebond	20
	TQFP, Wirebond	32
EPC4	PLCC, Wirebond	44
	TQFP, Wirebond	44
	PQFP, Wirebond	100
	FPGA, Wirebond	144
EPC8	PQFP, Wirebond (Option 2)	100
EPC16	UBGA, Wirebond	88
	PQFP, Wirebond (Option 2)	100
EPC32	FPGA, Wirebond	88
EPC1441	PDIP, Wirebond	8
	PLCC, Wirebond	20
	TQFP, Wirebond	32

Thermal Resistance

Tables 19 through 41 provide θ_{JA} (junction-to-ambient thermal resistance) and θ_{JC} (junction-to-case thermal resistance) values for the following Altera device families:

- Arria GX
- Stratix series FPGAs
- Cyclone series FPGAs
- MAX series CPLDs
- HardCopy series Structured ASICs
- APEX series FPGAs
- ACEX 1K FPGAs
- Mercury FPGAs
- FLEX series FPGAs
- Excalibur FPGA
- Classic devices

Altera is transitioning to an industry-standard copper lid for its thermally enhanced BGA and thermally enhanced Flip Chip FBGA package offerings (as mentioned in the *Process Change Notice PCN024* available on Altera's website: <http://www.altera.com/literature/pcn/pcn0214.pdf>). This change affects the APEX 20KE, APEX 20KC, APEX II, Mercury, and Excalibur device families. Therefore, two thermal resistance specifications are provided for devices affected by this change. The older packages are identified as using the aluminum silicon carbide (AlSiC) lid, while the newer packages are identified as using the copper (Cu) lid.

Thermally enhanced BGA and thermally enhanced Flip Chip FBGA packages offered in the newer Altera families, including Stratix and Stratix GX, were introduced using an industry-standard Cu lid. Therefore, these device specifications include only a single thermal resistance specification.

Table 19. Thermal Resistance of Arria GX Devices (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)	θ_{JB} (° C/W)
EP1AGX20	484	FBGA	12.8	10.3	8.7	7.5	0.3	3.14
	780	FBGA	11.1	8.6	7.2	6.0	0.24	3.14
EP1AGX35	484	FBGA	12.8	10.3	8.7	7.5	0.3	3.14
	780	FBGA	11.1	8.6	7.2	6.0	0.24	3.14

Table 19. Thermal Resistance of Arria GX Devices (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)	θ_{JB} (° C/W)
EP1AGX50	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.86
	780	FBGA	10.9	8.4	6.9	5.8	0.15	2.84
	1152	FBGA	9.9	7.5	6.1	5.0	0.15	2.5
EP1AGX60	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.86
	780	FBGA	10.9	8.4	6.9	5.8	0.15	2.84
	1152	FBGA	9.9	7.5	6.1	5.0	0.15	2.5
EP1AGX90	1152	FBGA	9.6	7.3	5.9	4.9	0.11	2.33

Table 20. Thermal Resistance of Stratix III Devices (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)	θ_{JB} (°C/W)
EP3SL50	484	FBGA	12.6	10.0	8.5	7.2	0.27	2.72
	780	FBGA	11.1	8.6	7.2	6.0	0.27	2.34
EP3SL70	484	FBGA	12.6	10.0	8.5	7.2	0.27	2.72
	780	FBGA	11.1	8.6	7.2	6.0	0.27	2.34
EP3SL110	780	FBGA	10.8	8.4	6.9	5.7	0.16	1.99
	1152	FBGA	9.9	7.4	6.0	5.0	0.16	1.81
EP3SL150	780	FBGA	10.8	8.4	6.9	5.7	0.16	1.99
	1152	FBGA	9.9	7.4	6.0	5.0	0.16	1.81
EP3SL200	1152	FBGA	9.6	7.3	5.9	4.8	0.12	1.68
	1517	FBGA	8.9	6.7	5.4	4.4	0.12	1.67
EP3SL340	1517	FBGA	7.9	6.5	5.2	4.2	0.1	1.48
	1760	FBGA	7.6	6.2	5.0	4.0	0.1	1.21
EP3SE50	484	FBGA	12.6	10.0	8.5	7.2	0.27	2.72
	780	FBGA	11.1	8.6	7.2	6.0	0.27	2.34
EP3SE80	780	FBGA	10.8	8.4	6.9	5.7	0.16	1.99
	1152	FBGA	9.9	7.4	6.0	5.0	0.16	1.81

Table 20. Thermal Resistance of Stratix III Devices (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)	θ_{JB} (°C/W)
EP3SE110	780	FBGA	10.8	8.4	6.9	5.7	0.16	1.99
	1152	FBGA	9.9	7.4	6.0	5.0	0.16	1.81
EP3SE260	1152	FBGA	9.3	7.2	5.8	4.7	0.10	1.56
	1517	FBGA	8.6	6.6	5.3	4.3	0.10	1.56

Table 21. Thermal Resistance of Stratix 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.
EP2S15	484	Flip Chip FBGA	0.36	13.1	11.1	9.6	8.3
	672	Flip Chip FBGA	0.36	12.2	10.2	8.8	7.6
EP2S30	484	Flip Chip FBGA	0.21	12.6	10.6	9.1	7.9
	672	Flip Chip FBGA	0.21	11.7	9.7	8.3	7.1
EP2S60	484	Flip Chip FBGA	0.13	12.3	10.3	8.8	7.5
	672	Flip Chip FBGA	0.13	11.4	9.4	7.8	6.7
	1,020	Flip Chip FBGA	0.13	10.4	8.4	7.0	5.9
EP2S90	484	Flip Chip HBGA	0.07	12.0	9.9	8.3	7.1
	780	Flip Chip FBGA	0.09	10.80	8.8	7.3	6.1
	1,020	Flip Chip FBGA	0.10	10.2	8.2	6.8	5.7
	1,508	Flip Chip FBGA	0.10	9.3	7.4	6.1	5
EP2S130	780	Flip Chip FBGA	0.07	10.1	8.7	7.2	6.0
	1,020	Flip Chip FBGA	0.07	9.5	8.1	6.7	5.5
	1,508	Flip Chip FBGA	0.07	8.6	7.3	6.0	4.8
EP2S180	1,020	Flip Chip FBGA	0.05	9	7.9	6.5	5.4
	1,508	Flip Chip FBGA	0.05	8.1	7.1	5.8	4.7

Table 22. Thermal Resistance of Stratix II GX 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.
EP2SGX30	780	Flip Chip FBGA	0.24	11.1	8.6	7.2	6
EP2SGX60	780	Flip Chip FBGA	0.15	10.9	8.4	6.9	5.8
	1152	Flip Chip FBGA	0.15	9.9	7.5	6.1	5
EP2SGX90	1152	Flip Chip FBGA	0.11	9.6	7.3	5.9	4.9
	1508	Flip Chip FBGA	0.11	9	6.7	5.4	4.4
EP2SGX130	1508	Flip Chip FBGA	0.1	8.3	6.6	5.3	4.3

Table 23. Thermal Resistance of Stratix GX 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.
EP1SGX10C EP1SGX10D	672	Flip Chip FBGA	0.39	11.1	9.1	7.7	6.5
EP1SGX25C EP1SGX25D	672	Flip Chip FBGA	0.23	10.8	8.8	7.4	6.2
EP1SGX25D EP1SGX25F	1020	Flip Chip FBGA	0.23	9.9	7.9	6.5	5.4
EP1SGX40D EP1SGX40G	1020	Flip Chip FBGA	0.16	9.8	7.7	6.4	5.3

Table 24. Thermal Resistance of Stratix 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.
EP1S10	484	Flip Chip FBGA	0.38	11.9	9.8	8.4	7.2
	672	BGA	3.2	16.8	13.7	11.9	10.5
	672	FBGA	3.4	17.2	14	12.2	10.8
	780	Flip Chip FBGA	0.43	10.9	8.8	7.4	6.3
EP1S20	484	Flip Chip FBGA	0.30	11.8	9.7	8.3	7.1
	672	BGA	2.5	15.5	12.4	10.7	9.3
	672	FBGA	2.7	16	12.8	11	9.6
	780	Flip Chip FBGA	0.31	10.7	8.6	7.2	6.1

Table 24. Thermal Resistance of Stratix Devices (Part 2 of 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	Flip Chip FBGA	0.25	10.5	8.5	7.1	6.0
	1020	Flip Chip FBGA	0.25	10.0	8.0	6.6	5.5
EP1S30	780	Flip Chip FBGA	0.2	10.4	8.4	7.0	5.9
	956	Flip Chip BGA	0.2	9.1	7.1	5.8	4.8
	1020	Flip Chip FBGA	0.2	9.9	7.9	6.5	5.4
EP1S40	780	Flip Chip FBGA	0.17	10.4	8.3	6.9	5.8
	956	Flip Chip BGA	0.18	9.0	7.0	5.7	4.7
	1020	Flip Chip FBGA	0.17	9.8	7.8	6.4	5.3
	1508	Flip Chip FBGA	0.18	9.1	7.1	5.8	4.7
EP1S60	956	Flip Chip BGA	0.13	8.9	6.9	5.6	4.6
	1020	Flip Chip FBGA	0.13	9.7	7.7	6.3	5.2
	1508	Flip Chip FBGA	0.13	8.9	7.0	5.6	4.6
EP1S80	956	Flip Chip BGA	0.1	8.8	6.8	5.5	4.5
	1020	Flip Chip FBGA	0.1	9.6	7.6	6.2	5.1
	1508	Flip Chip FBGA	0.1	8.8	6.9	5.5	4.5

Table 25. Thermal Resistance of Cyclone III Devices (Part 1 of 2)

Device	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)
EP3C5	E144	20	17.5	15.4	14	8.4
EP3C5	F256	32.4	28.9	27	25.5	11.7
EP3C5	U256	32.5	29.1	27.2	25.6	12.2
EP3C10	E144	20	17.5	15.4	14	8.4
EP3C10	F256	32.4	28.9	27	25.5	11.7
EP3C10	U256	32.5	29.1	27.2	25.6	12.2
EP3C16	E144	20	17.5	15.4	14	8.4
EP3C16	Q240	27.2	24.7	22.1	17.8	4.3
EP3C16	F256	28.5	25.1	23.2	21.7	9.1
EP3C16	U256	28.8	25.4	23.5	22	9.7
EP3C16	U484	26.9	23.5	21.6	20.1	8.5

Table 25. Thermal Resistance of Cyclone III Devices (Part 2 of 2)

Device	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)
EP3C16	F484	22.9	19.4	17.7	16.2	6.9
EP3C25	E144	29	27.5	26.3	24.4	7.8
EP3C25	Q240	27	24.5	21.8	17.6	4.2
EP3C25	F256	27.5	24.1	22.2	20.7	8.5
EP3C25	U256	27.9	24.5	22.6	21.1	9.1
EP3C25	F324	26.6	23.1	21.3	19.8	8
EP3C40	Q240	25.8	23.2	20.6	17	4
EP3C40	F324	23.2	19.7	18	16.5	5.9
EP3C40	U484	22.8	19.3	17.6	16.1	5.9
EP3C40	F484	19.8	16.3	14.6	13.2	4.8
EP3C40	F780	18.7	15.2	13.5	12.2	4.5
EP3C55	U484	21.6	18.2	16.4	15	5.1
EP3C55	F484	18.9	15.4	13.8	12.2	4.2
EP3C55	F780	17.8	14.4	12.7	11.4	3.9
EP3C80	U484	20.4	16.9	15.2	13.8	4.4
EP3C80	F484	18	14.5	12.9	11.5	3.6
EP3C80	F780	16.9	13.5	11.8	10.5	3.3
EP3C120	F484	17.1	13.7	12	10.7	3.1
EP3C120	F780	16	12.6	11	9.7	2.8

Table 26. Thermal Resistance of Cyclone II 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.
EP2C5	144	TQFP	10	31	29.3	27.9	25.5
	208	PQFP	5.5	30.4	29.2	27.3	22.3
	256	FBGA	8.7	30.2	26.1	23.6	21.7
EP2C8	144	TQFP	9.9	29.8	28.3	26.9	24.9
	208	PQFP	5.4	30.2	28.8	26.9	21.7
	256	FBGA	7.1	27	23	20.5	18.5

Table 26. Thermal Resistance of Cyclone II Devices (Part 2 of 2)

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ C/W) 400 ft./min.
EP2C20	240	PQFP	4.2	26.6	24	21.4	17.4
	256	FBGA	5.5	24.2	20	17.8	16
	484	FBGA	4.2	21	17	14.8	13.1
EP2C35	484	FBGA	3.3	19.4	15.4	13.3	11.7
	484	UBGA	5.0	20.6	16.6	14.5	12.8
	672	FBGA	3.1	18.6	14.6	12.6	11.1
EP2C50	484	FBGA	2.8	18.4	14.4	12.4	10.9
	484	UBGA	4.4	19.6	15.6	13.6	11.9
	672	FBGA	2.6	17.7	13.7	11.8	10.2
EP2C70	672	FBGA	2.2	16.9	13	11.1	9.7
	896	FBGA	2.1	16.3	11.9	10.5	9.1

Table 27. Thermal Resistance of Cyclone Devices

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ C/W) 400 ft./min.
EP1C3	100	TQFP	11.0	37.5	35.4	33.4	29.8
	144	TQFP	10.0	31.1	29.4	27.9	25.5
EP1C6	144	TQFP	9.8	29.4	28.0	26.7	24.7
	240	PQFP	4.3	27.2	24.7	22.1	17.8
	256	FBGA	8.8	28.7	24.5	22.3	20.5
EP1C12	240	PQFP	4.0	26.0	23.4	20.8	17.1
	256	FBGA	6.6	24.3	20.2	18.1	16.4
	324	FBGA	6.1	23.0	19.8	17.7	16.1
EP1C20	324	FBGA	5.0	21.0	17.7	15.6	14.1
	400	FBGA	4.7	20.7	17.5	15.5	13.9

Table 28. Thermal Resistance of MAX 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.
EPM240	100	TQFP	12.0	39.5	37.5	35.5	31.6
	100	MBGA	32.1	53.8	47.7	45.7	44.0
	100	FBGA	20.8	51.2	45.2	43.2	41.5
EPM570	100	TQFP	11.2	38.7	36.6	34.6	30.8
	100	MBGA	25.0	46.5	40.4	38.4	36.8
	100	FBGA	14.8	42.8	36.8	34.9	33.3
	144	TQFP	10.5	32.1	30.3	28.7	26.1
	256	FBGA	13.0	37.4	33.1	30.5	28.4
	256	MBGA	12.9	39.5	33.6	31.6	30.1
EPM1270	144	TQFP	10.5	31.4	29.7	28.2	25.8
	256	FBGA	10.4	33.5	29.3	26.8	24.7
	256	MBGA	10.6	36.1	30.2	28.3	26.8
EPM2210	256	FBGA	8.7	30.2	26.1	23.6	21.7
	324	FBGA	8.2	29.8	25.7	23.3	21.3

Table 29. 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 29. Thermal Resistance of MAX 9000 Devices (Part 2 of 2)

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ 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 30. Thermal Resistance of MAX 7000 Devices (Part 1 of 4)

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ 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	UBGA	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

Table 30. Thermal Resistance of MAX 7000 Devices (Part 2 of 4)

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ C/W) 400 ft./min.
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
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	UBGA	23.0	56.0	53.0	51.0	47.0
	100	TQFP	12.0	39.0	37.0	35.0	31.0
FBGA		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
		FBGA	18.0	44.0	42.0	39.0	35.0
	144	TQFP	9.0	31.0	29.0	28.0	25.0
	256	FBGA	12.0	38.0	36.0	34.0	31.0
EPM7128B	49	UBGA	22.0	53.0	50.0	48.0	44.0
	100	TQFP	11.0	38.0	36.0	34.0	31.0
		FBGA	19.0	46.0	44.0	41.0	37.0
	144	TQFP	9.0	32.0	30.0	29.0	26.0
	169	UBGA	16.0	44.0	42.0	39.0	35.0
	256	FBGA	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

Table 30. Thermal Resistance of MAX 7000 Devices (Part 3 of 4)

Device	Pin Count	Package	θ_{JC} ($^{\circ}C/W$)	θ_{JA} ($^{\circ}C/W$) Still Air	θ_{JA} ($^{\circ}C/W$) 100 ft./min.	θ_{JA} ($^{\circ}C/W$) 200 ft./min.	θ_{JA} ($^{\circ}C/W$) 400 ft./min.
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
		FBGA	14.0	43.0	40.0	38.0	37.0
	144	TQFP	11.0	33.0	30.0	28.0	26.0
	169	UBGA	14.0	42.0	40.0	38.0	36.0
	256	FBGA	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
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	FBGA	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	UBGA	13.0	40.0	38.0	36.0	34.0
	208	PQFP	5.0	31.0	29.0	27.0	22.0
	256	FBGA	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

Table 30. Thermal Resistance of MAX 7000 Devices (Part 4 of 4)

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ C/W) 400 ft./min.
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	FBGA	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
		FBGA	11.0	32.0	30.0	28.0	22.0
EPM7512B	144	TQFP	10.0	32.0	27.0	25.0	24.0
	169	UBGA	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	FBGA	11.0	32.0	30.0	28.0	27.0

Table 31. Thermal Resistance of MAX 3000A Devices

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ C/W) 400 ft./min.
EPM3032A	44	TQFP	14.0	46.0	45.0	43.0	40.0
		PLCC	9.0	31.0	30.0	28.0	25.0
EPM3064A	44	TQFP	14.0	46.0	45.0	43.0	40.0
		PLCC	9.0	31.0	30.0	28.0	25.0
	100	TQFP	12.0	39.0	37.0	35.0	31.0
EPM3128A	100	TQFP	12.0	38.0	36.0	34.0	30.0
	144	TQFP	11.0	33.0	30.0	28.0	26.0
EPM3256A	144	TQFP	9.0	33.0	29.0	27.0	25.0
	208	PQFP	5.0	31.0	29.0	27.0	22.0
EPM3512A	208	PQFP	5.0	30.0	28.0	25.0	21.0
	256	FBGA	11.0	32.0	30.0	28.0	22.0

Table 32. Thermal Resistance of HardCopy Series 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.
HC210	484	Flip Chip FBGA	0.8	13.4	11.2	9.6	8.3
	484	FBGA	6.6	24.2	20.3	18.3	16.6
HC220	672	Flip Chip FBGA	0.5	12.1	9.9	8.3	7.1
	780	Flip Chip FBGA	0.5	11.7	9.5	8.0	6.8
HC230	1020	Flip Chip FBGA	0.3	10.8	8.6	7.1	6.0
HC240	1020	Flip Chip FBGA	0.2	10.6	8.4	6.9	5.8
	1508	Flip Chip FBGA	0.2	9.7	7.5	6.1	5.0
HC20K400	652	BGA	0.5	9.1	7.9	6.4	5.3
HC20K600	672	Flip Chip FBGA	0.96	13.0	10.2	8.6	7.3
HC1S25	672	FBGA	3.6	19.7	15.8	13.9	12.4
		BGA	3.4	19.3	15.6	13.8	12.3
HC1S30	780	Flip Chip FBGA	0.43	10.9	8.8	7.4	6.3
HC1S40	780	Flip Chip FBGA	0.43	10.9	8.8	7.4	6.3
HC1S60	1020	Flip Chip FBGA	0.291	12.22	8.54	7.02	5.82
HC1S80	1020	Flip Chip FBGA	0.291	12.22	8.54	7.02	5.82

Table 33. Thermal Resistance of APEX II 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.
EP2A15	672	Flip Chip FBGA (Cu lid)	0.22	10.8	8.8	7.4	6.2
		Flip Chip FBGA (AlSiC lid)	0.34	11.6	9.6	8.0	6.6
	724	Flip Chip BGA (Cu lid)	0.23	9.7	7.7	6.4	5.3
		Flip Chip BGA (AlSiC lid)	0.35	10.0	8.2	6.6	5.4
EP2A25	672	FBGA (Cu lid)	0.17	10.7	8.7	7.2	6.1
		Flip Chip FBGA (AlSiC lid)	0.26	11.5	9.6	8.0	6.6
	724	Flip Chip BGA (Cu lid)	0.17	9.6	7.6	6.2	5.2
		Flip Chip BGA (AlSiC lid)	0.27	10.0	8.2	6.6	5.4
	1020	Flip Chip FBGA (Cu lid)	0.17	9.8	7.8	6.4	5.3
		Flip Chip FBGA (AlSiC lid)	0.27	10.4	8.5	6.9	5.7

Table 33. Thermal Resistance of APEX II 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.
EP2A40	672	Flip Chip FBGA (Cu lid)	0.24	10.0	8.2	6.9	5.9
		Flip Chip FBGA (AlSiC lid)	0.2	10.0	8.2	6.9	5.9
	724	Flip Chip BGA (Cu lid)	0.15	9.5	7.5	6.1	5.1
		Flip Chip BGA (AlSiC lid)	0.19	9.5	7.5	6.1	5.1
	1,020	Flip Chip FBGA (Cu lid)	0.15	9.7	7.7	6.3	5.2
		Flip Chip FBGA (AlSiC lid)	0.19	9.7	7.7	6.3	5.2
EP2A70	724	Flip Chip BGA (Cu lid)	0.10	9.3	7.3	6.0	4.9
		Flip Chip BGA (AlSiC lid)	0.14	10.0	7.9	6.4	5.3
	1,508	Flip Chip FBGA (Cu lid)	0.10	8.8	6.8	5.5	4.5
		Flip Chip FBGA (AlSiC lid)	0.14	9.3	7.3	5.8	4.7

Table 34. 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	FBGA	14.0	36.0	34.0	32.0	29.0
	324	FBGA	9.0	31.0	29.0	28.0	25.0
EP20K60E	144	TQFP	7.0	28.0	26.0	25.0	24.0
	144	FBGA	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	FBGA	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	FBGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0

Table 34. 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.
EP20K100E	144	TQFP	7.0	26.0	25.0	24.0	23.0
	144	FBGA	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	FBGA	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	FBGA	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	FBGA	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	FBGA	5.0	23.0	22.0	21.0	20.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FBGA	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
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	FBGA	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	FBGA	0.36	11.6	9.6	7.9	6.5
	672	FBGA w/ fin (1)	0.5	7.0	4.0	3.0	2.6

Table 34. 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.
EP20K400E EP20K400C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FBGA (Cu lid)	0.25	10.9	8.8	7.4	6.3
		FBGA (AISiC lid)	0.38	11.7	9.7	8.0	6.7
	672	FBGA 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	FBGA (Cu lid)	0.18	10.8	8.7	7.3	6.1
		FBGA (AISiC lid)	0.28	11.6	9.6	7.9	6.5
	672	FBGA w/ fin (1)	0.5	5.0	3.0	3.0	2.0
	1,020	FBGA (Cu lid)	0.19	9.9	7.8	6.5	5.4
		FBGA (AISiC lid)	0.29	10.4	8.4	6.8	5.6
1,020	FBGA w/ fin (1)	0.5	5.0	3.0	3.0	2.0	
EP20K1000E EP20K1000C	652	BGA (Cu lid)	0.12	8.3	7.0	5.6	4.5
		BGA (AISiC lid)	0.2	9.3	7.4	6.0	4.9
	652	FBGA w/ fin (1)	0.5	4.0	3.0	3.0	2.0
	672	FBGA (Cu lid)	0.12	10.6	8.6	7.2	6.0
		FBGA (AISiC lid)	0.2	11.4	9.4	7.7	6.3
	672	FBGA w/ fin (1)	0.5	6.0	4.0	3.0	2.0
	1,020	FBGA (Cu lid)	0.12	9.7	7.7	6.3	5.2
		FBGA (AISiC lid)	0.19	10.2	8.2	6.6	5.4
1,020	FBGA w/ fin (1)	0.5	5.0	3.0	2.0	2.0	
EP20K1500E	652	BGA (Cu lid)	0.10	8.2	6.9	5.5	4.4
		BGA (AISiC lid)	0.15	9.2	7.3	5.8	4.8
	652	FBGA	0.1	9.2	7.3	5.8	4.8
	652	FBGA w/ fin (1)	0.5	4.0	3.0	2.5	2.0
	1,020	FBGA (Cu lid)	0.10	9.6	7.6	6.2	5.1
		FBGA (AISiC lid)	0.15	10.1	8.1	6.4	5.3
	1,020	FBGA w/ fin (1)	0.5	5.0	3.0	2.5	2.0

Note to Table 34:

- (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 34 using the following fin specifications: width: 0.25 mm; height: 7.0 mm; pitch: 1.5 mm; base thickness: 0.5 mm.

Table 35. 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	FBGA	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	FBGA	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	FBGA	7.0	30.0	28.0	27.0	24.0
	484	FBGA	5.0	25.0	24.0	23.0	22.0
EP1K100	208	PQFP	5.0	28.0	26.0	23.0	18.0
	256	FBGA	6.0	28.0	26.0	25.0	23.0
	484	FBGA	5.0	24.0	23.0	22.0	21.0

Table 36. 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	FBGA (Cu lid)	0.58	12.2	10.1	8.7	7.5
	484	FBGA (AlSiC lid)	0.87	13.0	11.1	9.3	7.9
EP1M350	780	FBGA (Cu lid)	0.22	10.5	8.5	7.1	5.9
	780	FBGA (AlSiC lid)	0.34	11.0	9.2	7.6	6.3

Table 37. Thermal Resistance of FLEX 10K Devices (Part 1 of 4)

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

Table 37. Thermal Resistance of FLEX 10K Devices (Part 2 of 4)

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.
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	FBGA	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
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	FBGA	6.0	28.0	26.0	24.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	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	FBGA	9.0	31.0	29.0	28.0	25.0
	484	FBGA	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	FBGA	5.0	23.0	22.0	21.0	20.0

Table 37. Thermal Resistance of FLEX 10K Devices (Part 3 of 4)

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.
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	FBGA	6.0	29.0	27.0	26.0	24.0
	484	FBGA	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	FBGA	7.0	30.0	28.0	27.0	24.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	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	–	–	–
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	FBGA	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	FBGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	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	FBGA	5.0	23.0	22.0	21.0	20.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FBGA	5.0	21.0	20.0	19.0	18.0

Table 37. Thermal Resistance of FLEX 10K Devices (Part 4 of 4)

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.
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	FBGA	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	FBGA	5.0	22.0	21.0	20.0	19.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FBGA	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 37:

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

Table 38. Thermal Resistance of FLEX 8000 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.
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

Table 38. Thermal Resistance of FLEX 8000 Devices (Part 2 of 2)

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 39. Thermal Resistance of FLEX 6000 Devices

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ C/W) Still Air	θ_{JA} ($^{\circ}$ C/W) 100 ft./min.	θ_{JA} ($^{\circ}$ C/W) 200 ft./min.	θ_{JA} ($^{\circ}$ 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
		FBGA	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	FBGA	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
		FBGA	8.0	30.0	29.0	27.0	25.0

Table 40. 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	FBGA	4.0	20.0	18.3	15.8	13.9
	672	Flip Chip FBGA (Cu lid)	0.52	11.3	9.3	7.9	6.7
	672	Flip Chip FBGA (AlSiC lid)	0.78	12.2	10.2	8.6	7.2
EPXA4	672	Flip Chip FBGA (Cu lid)	0.21	10.8	8.8	7.3	6.2
	672	Flip Chip FBGA (AlSiC lid)	0.31	11.6	9.6	7.9	6.6
	1,020	Flip Chip FBGA (Cu lid)	0.21	9.9	7.9	6.5	5.4
	1,020	Flip Chip FBGA (AlSiC lid)	0.32	10.4	8.5	6.9	5.7
EPXA10	1,020	Flip Chip FBGA (Cu lid)	0.11	9.6	7.6	6.2	5.1
	1,020	Flip Chip FBGA (AlSiC lid)	0.17	10.0	8.0	6.4	5.7

Table 41. Thermal Resistance of Classic Devices

Device	Pin Count	Package	θ_{JC} ($^{\circ}$ C/W)	θ_{JA} ($^{\circ}$ 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	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

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.

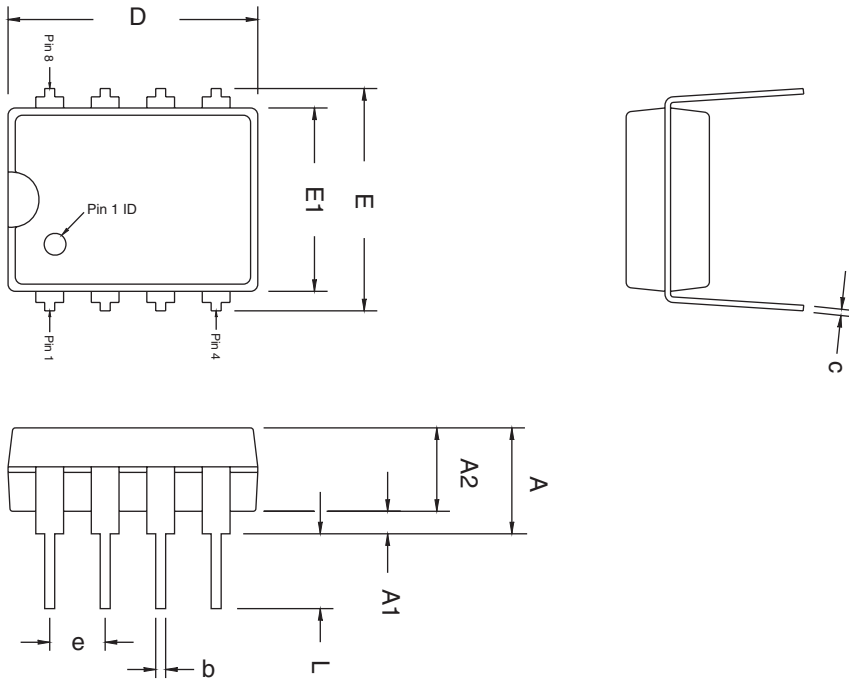
8-Pin Plastic Dual In-Line Package (PDIP) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	P
Package Acronym	PDIP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-001 Variation: BA
Maximum Lead Coplanarity	NA
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.170
A1	0.015	–	–
A2	0.130 TYP		
D	0.360	–	0.380
E	0.300	0.310	0.325
E1	0.240	0.250	0.260
L	0.125	–	0.135
b	0.016	0.018	0.020
c	0.008	0.010	0.014
e	0.100 BSC		

Package Outline



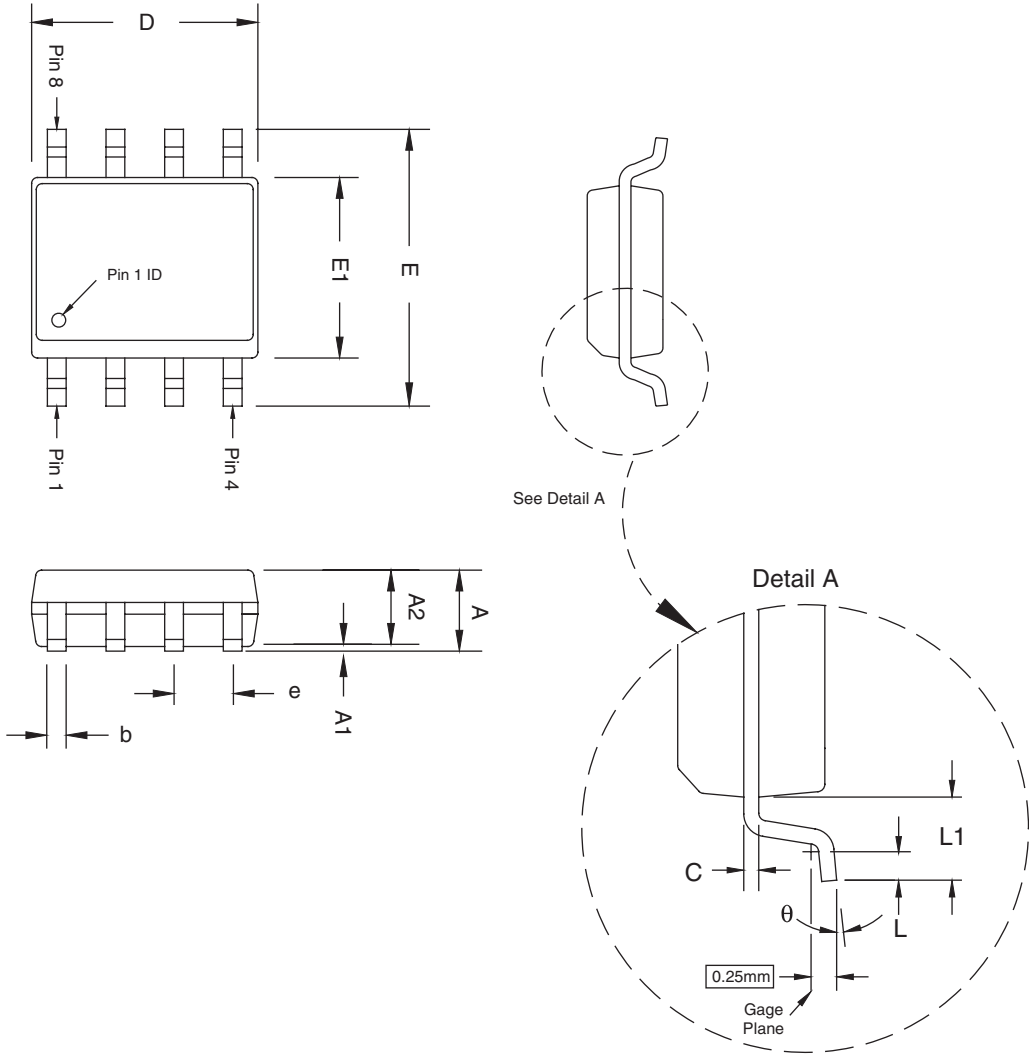
8-Pin Small Outline Integrated Circuit Package (SOIC) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	S
Package Acronym	SOIC
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ) Pb-free: NiPdAu (Preplated)
JEDEC Outline Reference	MS-012 Var. AA
Maximum Lead Coplanarity	0.1 mm
Weight	0.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Minimum	Nom.	Maximum
A	1.35	–	1.75
A1	0.10	–	0.25
A2	1.25	–	1.65
D	4.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
L	0.40	–	1.27
L1	1.04 REF		
B	0.31	–	0.51
c	0.17	–	0.25
e	1.27 BSC		
θ	0°	–	8°

Package Outline



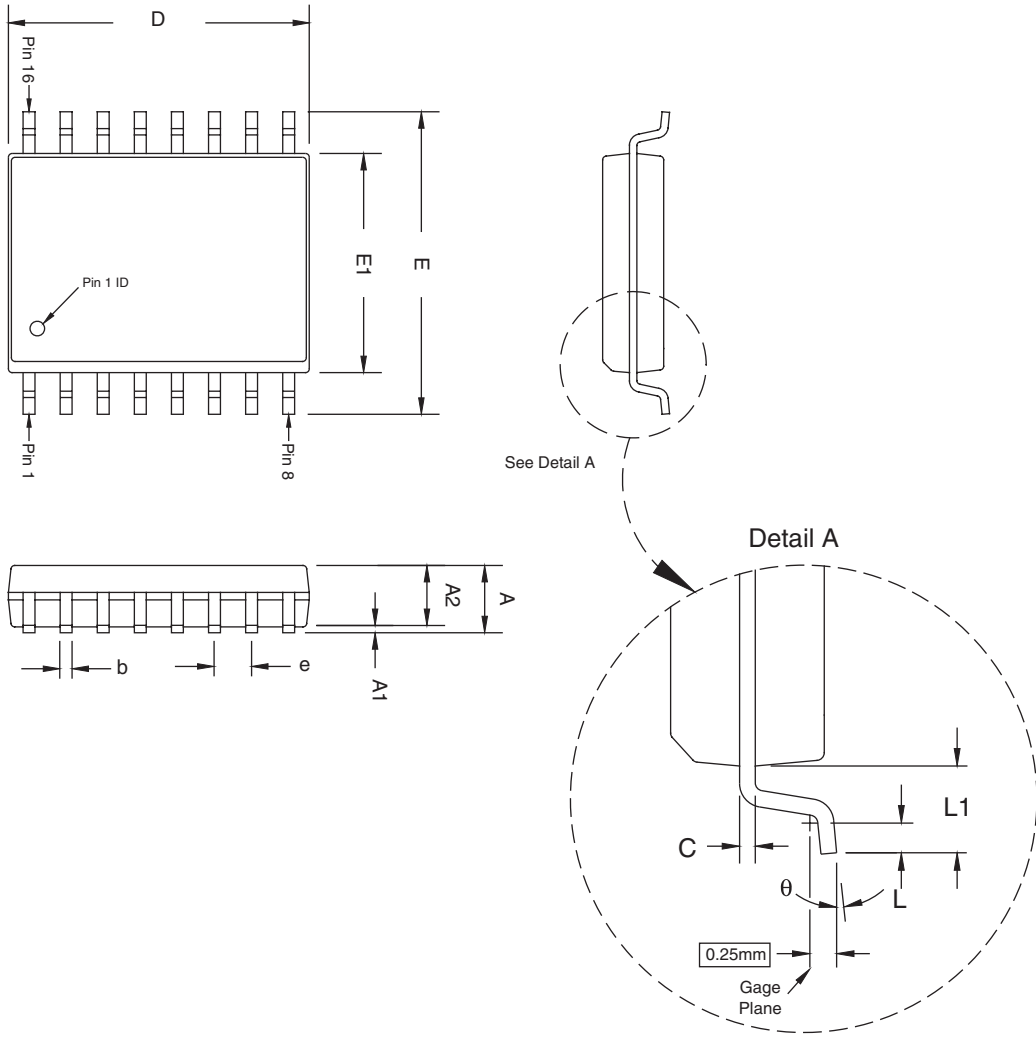
16-Pin Small Outline Integrated Circuit Package (SOIC) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	S
Package Acronym	SOIC
Leadframe Material	Copper
Lead Finish (Plating)	Pb-free: NiPdAu (Preplated)
JEDEC Outline Reference	MS-013 Var. AA
Maximum Lead Coplanarity	0.1 mm
Weight	0.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Minimum	Nom.	Maximum
A	2.35	–	2.65
A1	0.10	–	0.30
A2	2.05	–	2.55
D	10.30 BSC		
E	10.30 BSC		
E1	7.50 BSC		
L	0.40	–	1.27
L1	1.40 REF		
b	0.31	–	0.51
c	0.20	–	0.33
e	1.27 BSC		
θ	0°	–	8°

Package Outline



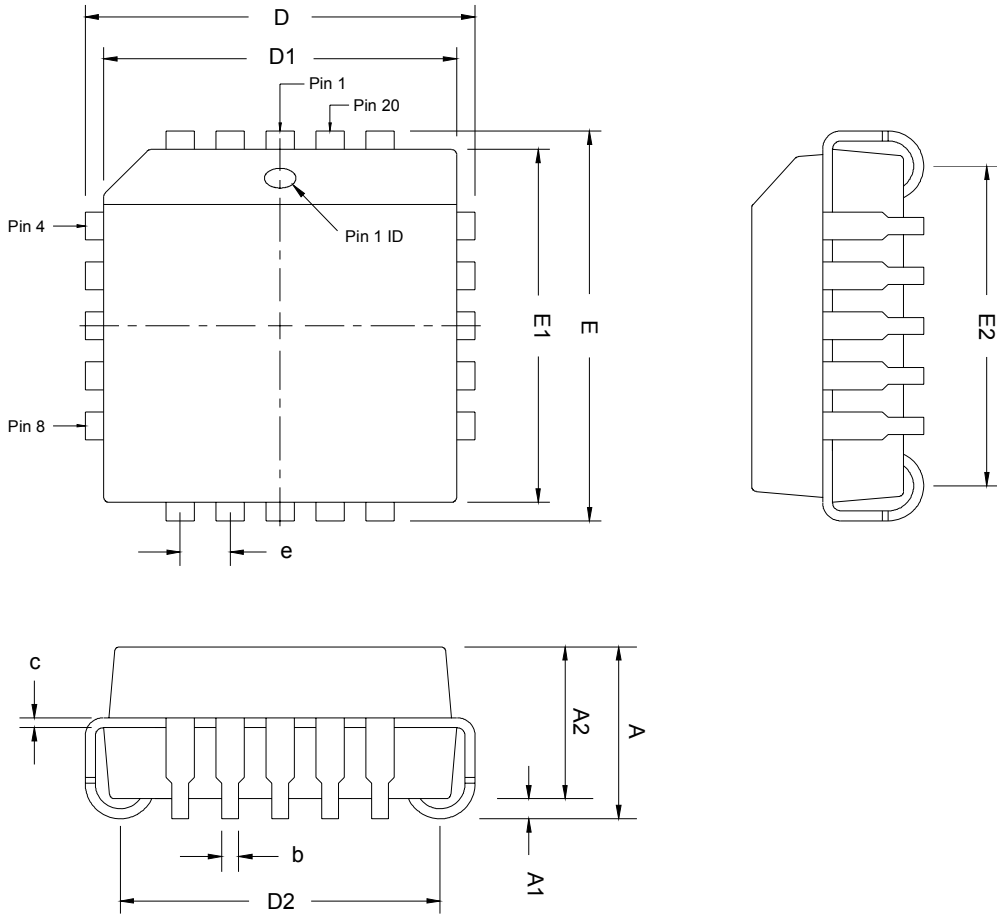
20-Pin Plastic J-Lead Chip Carrier (PLCC) Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

Package Information	
Description	Specification
Ordering Code Reference	L
Package Acronym	PLCC
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-018 Variation: AA
Maximum Lead Coplanarity	0.004 inches (0.10mm)
Weight	0.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.172	0.180
A1	0.020	–	–
A2	0.150 TYP		
D	0.385	0.390	0.395
D1	0.350	0.353	0.356
D2	0.290	0.310	0.330
E	0.385	0.390	0.395
E1	0.350	0.353	0.356
E2	0.290	0.310	0.330
b	0.013	–	0.021
c	0.010 TYP		
e	0.050 TYP		

Package Outline



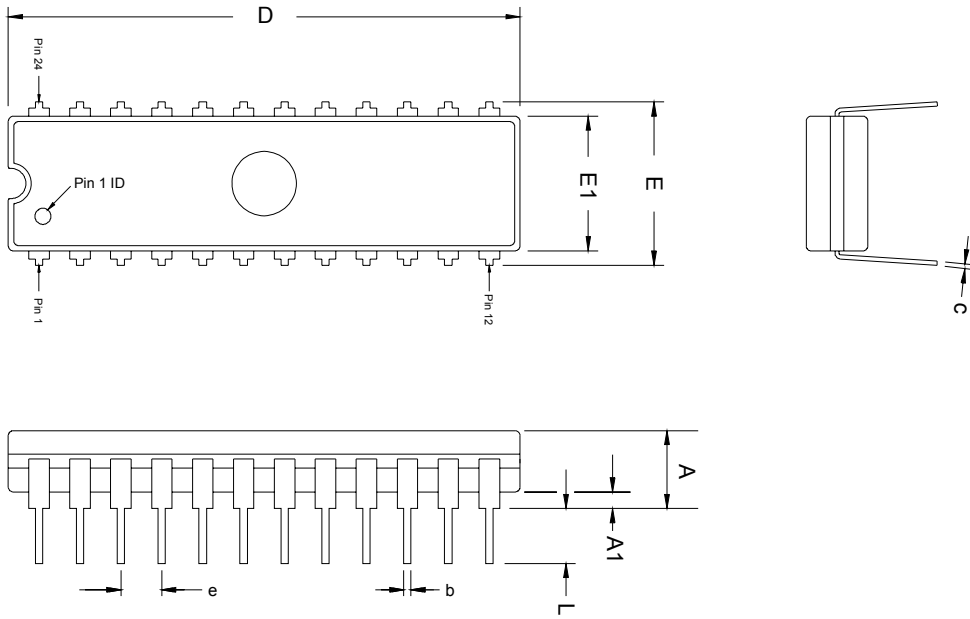
24-Pin Ceramic Dual In-Line Package (CerDIP) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	D
Package Acronym	CerDIP
Leadframe Material	Alloy 42
Lead Finish	Regular: 63Sn:37Pb (Typ.)
JEDEC Outline Reference	MS-030 Variation: AF
Maximum Lead Coplanarity	NA
Weight	4.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.200
A1	0.015	0.028	0.041
D	1.240	1.260	1.280
E	0.290	0.305	0.320
E1	0.280	0.295	0.310
L	0.125	–	–
b	0.015	0.018	0.021
e	0.100 BSC		

Package Outline



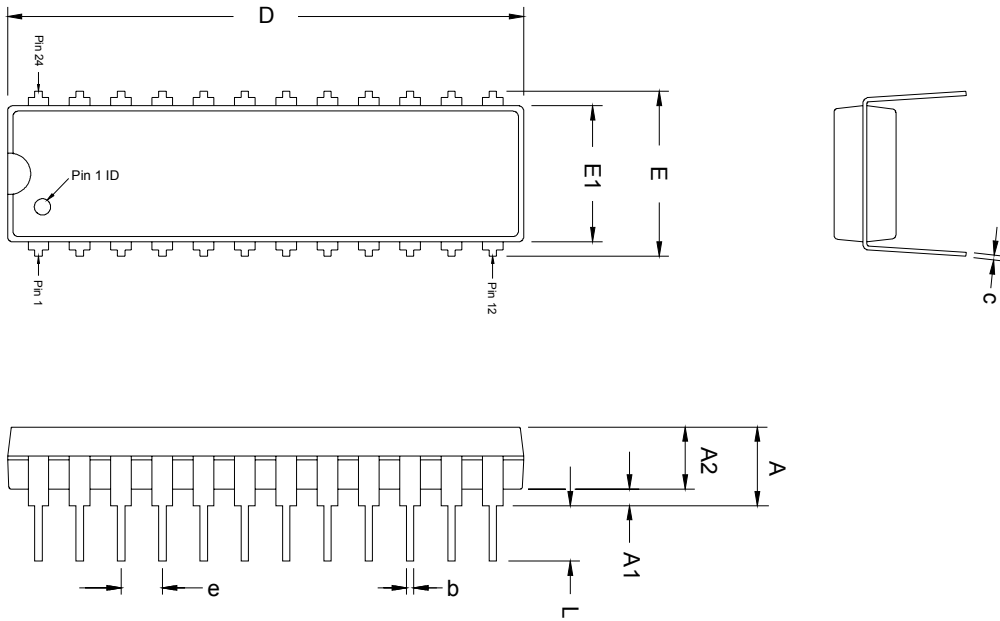
24-Pin Plastic Dual In-Line Package (PDIP) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	P
Package Acronym	PDIP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-001 Variation: AF
Maximum Lead Coplanarity	NA
Weight	1.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.170
A1	0.015	–	–
A2	0.130 TYP		
D	1.245	1.250	1.255
E	0.300	0.310	0.325
E1	0.245	–	0.270
L	0.125	–	0.135
b	0.014	0.018	0.022
c	0.008	0.010	0.014
e	0.100 BSC		

Package Outline



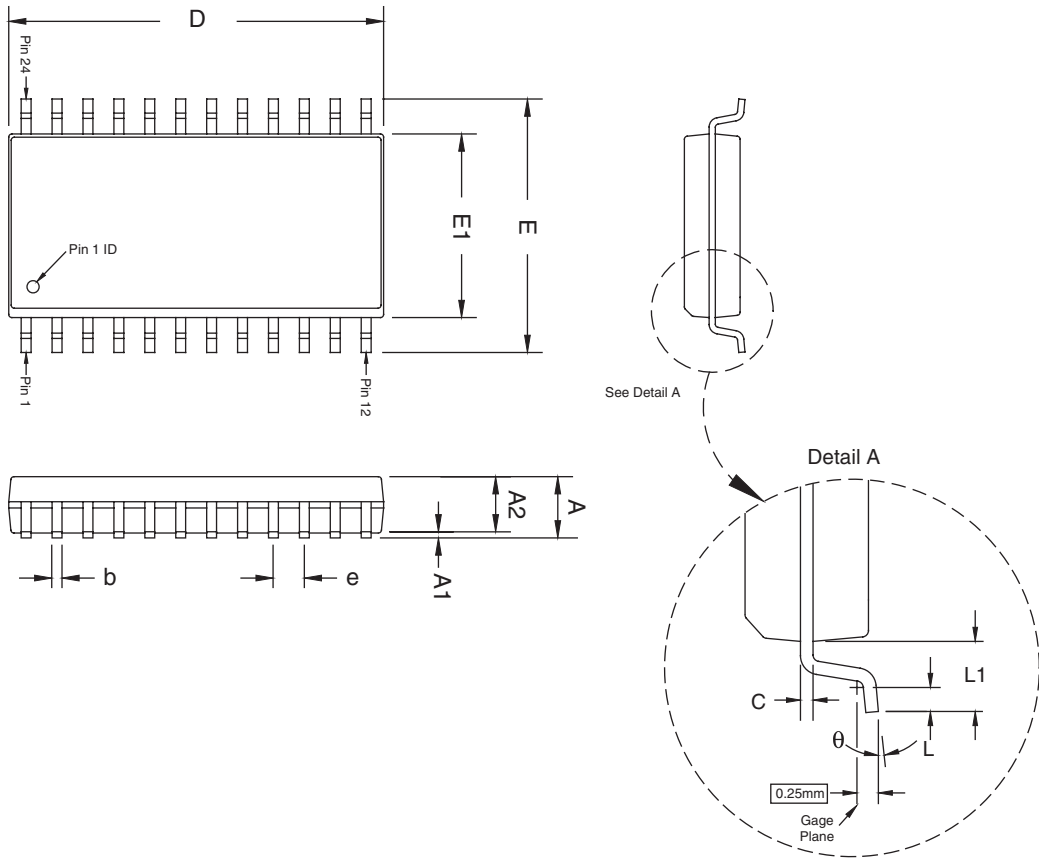
24-Pin Small Outline Integrated Circuit Package (SOIC) - Wire Bond

- 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.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	S
Package Acronym	SOIC
Leadframe Material	Copper
Lead Finish (Plating)	Regular 85Sn:15Pb (Typ)
JEDEC Outline Reference	MS-013 Variation: AD
Maximum Lead Coplanarity	0.1 mm
Weight	0.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Minimum	Nom.	Maximum
A	2.35	–	2.65
A1	0.10	–	0.30
A2	2.05	–	2.55
D	15.40 BSC		
E	10.30 BSC		
E1	7.50 BSC		
L	0.40	–	1.27
L1	1.40 REF		
b	0.31	–	0.51
c	0.20	–	0.33
e	1.27 BSC		
θ	0°	–	8°

Package Outline



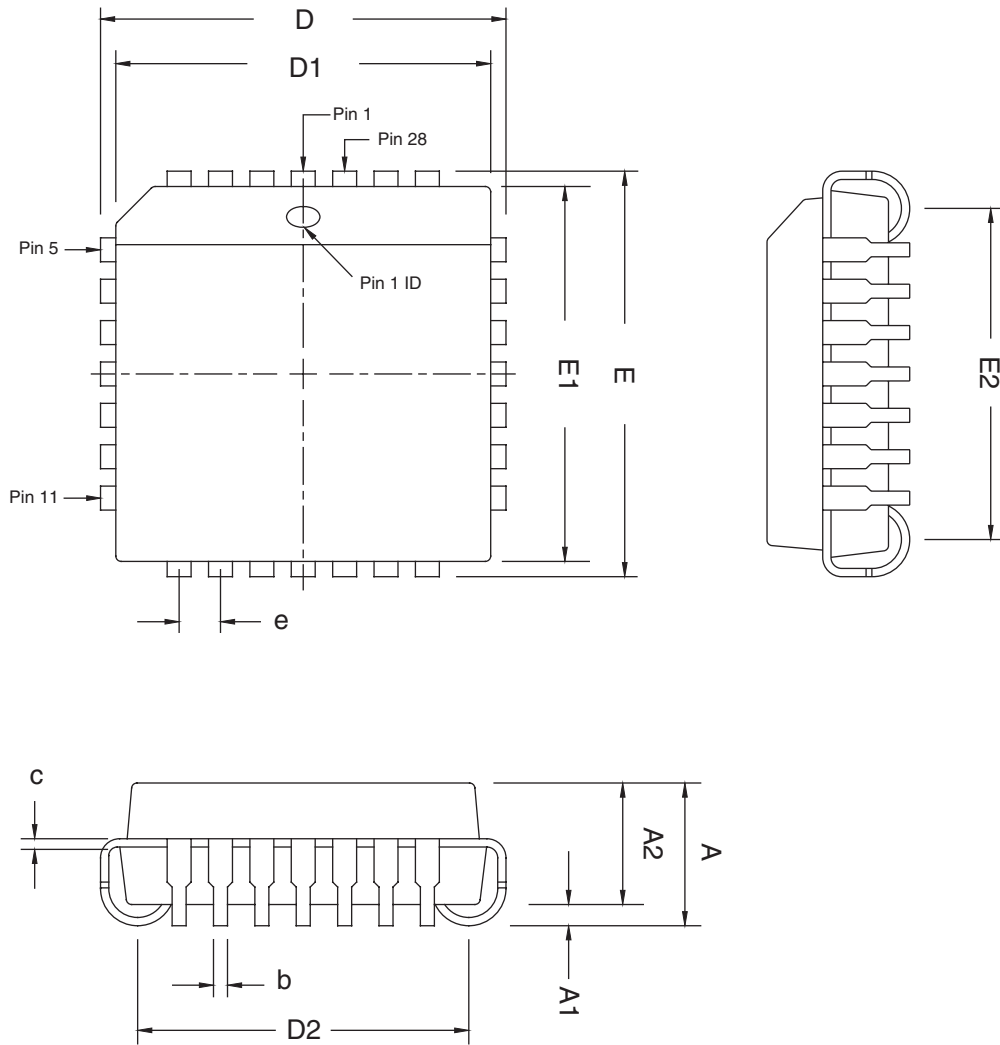
28-Pin Plastic J-Lead Chip Carrier (PLCC) - Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

Package Information	
Description	Specification
Ordering Code Reference	L
Package Acronym	PLCC
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-018 Variation: AB
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	1.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.172	0.180
A1	0.020	–	–
A2	0.150 TYP		
D	0.485	0.490	0.495
D1	0.450	0.453	0.456
D2	0.382	0.410	0.438
E	0.485	0.490	0.495
E1	0.450	0.453	0.456
E2	0.382	0.410	0.438
b	0.013	–	0.021
c	0.010 TYP		
e	0.050 TYP		

Package Outline



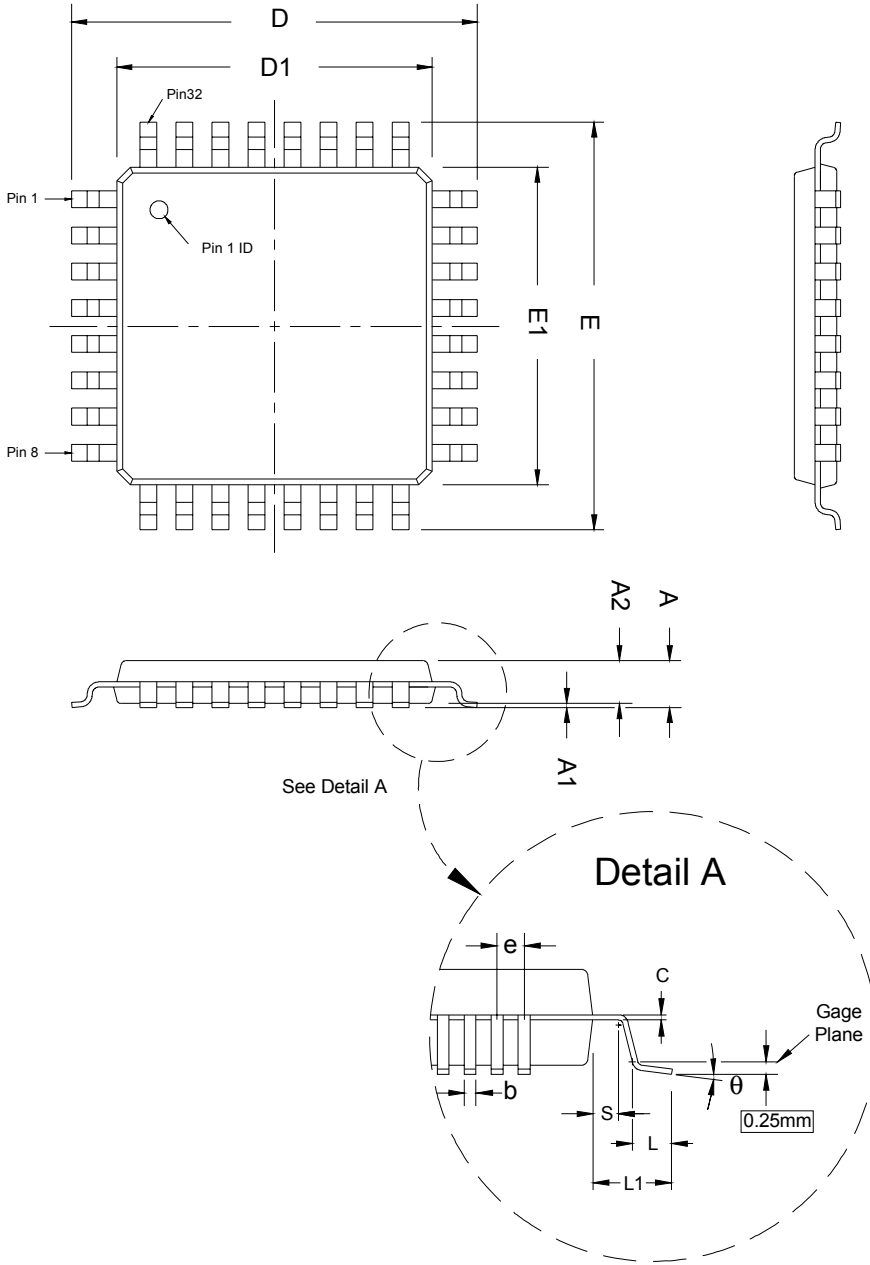
32-Pin Plastic Thin Quad Flat Pack (TQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	T
Package Acronym	TQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: ABA
Maximum Lead Coplanarity	0.004 inches (0.1mm)
Weight	0.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.95	1.00	1.05
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
S	0.20	–	–
b	0.30	0.37	0.45
c	0.09	–	0.20
e	0.80 BSC		
θ	0°	3.5°	7°

Package Outline



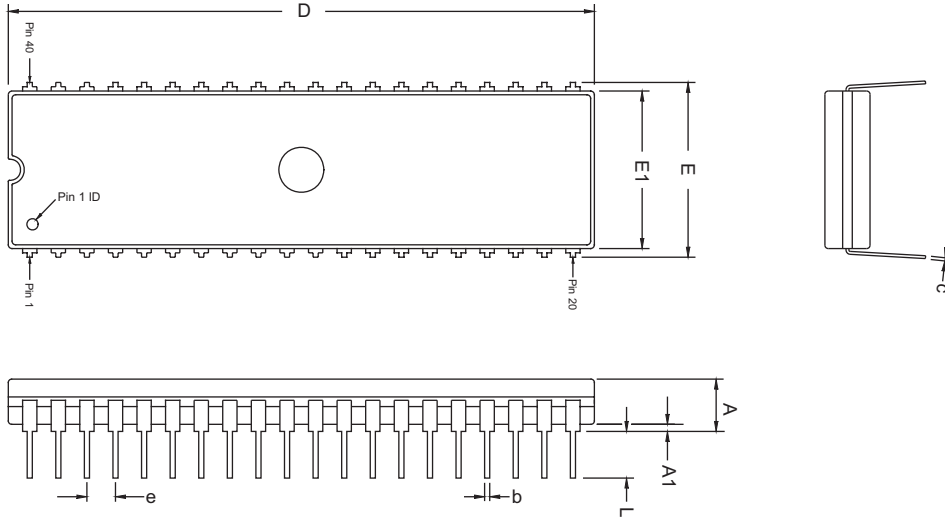
40-Pin Ceramic Dual In-Line Package (CerDIP) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	D
Package Acronym	CerDIP
Leadframe Material	Alloy 42
Lead Finish	Regular: 63Sn:37Pb (Typ.)
JEDEC Outline Reference	MS-032 Variation: AD
Maximum Lead Coplanarity	N/A
Weight	12.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.225
A1	0.015	0.025	0.035
D	2.030	2.050	2.070
E	0.600	0.610	0.620
E1	0.510	0.550	0.590
L	0.125	–	–
b	0.016	0.018	0.020
c	0.008	0.010	0.012
e	0.100 BSC		

Package Outline



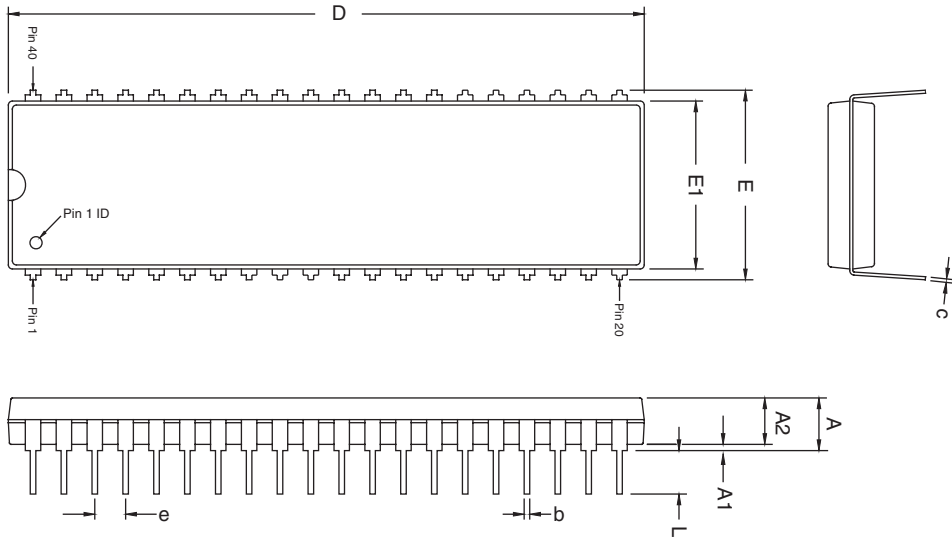
40-Pin Plastic Dual In-Line Package (PDIP) - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	P
Package Acronym	PDIP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.)
JEDEC Outline Reference	MS-011 Variation: AC
Maximum Lead Coplanarity	N/A
Weight	7.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.190
A1	0.015	–	–
A2	0.150 BSC		
D	2.030	2.050	2.070
E	0.600	–	0.625
E1	0.520	0.540	0.560
L	0.125	–	0.135
b	0.015	0.018	0.022
c	0.008	–	0.012
e	0.100 BSC		

Package Outline



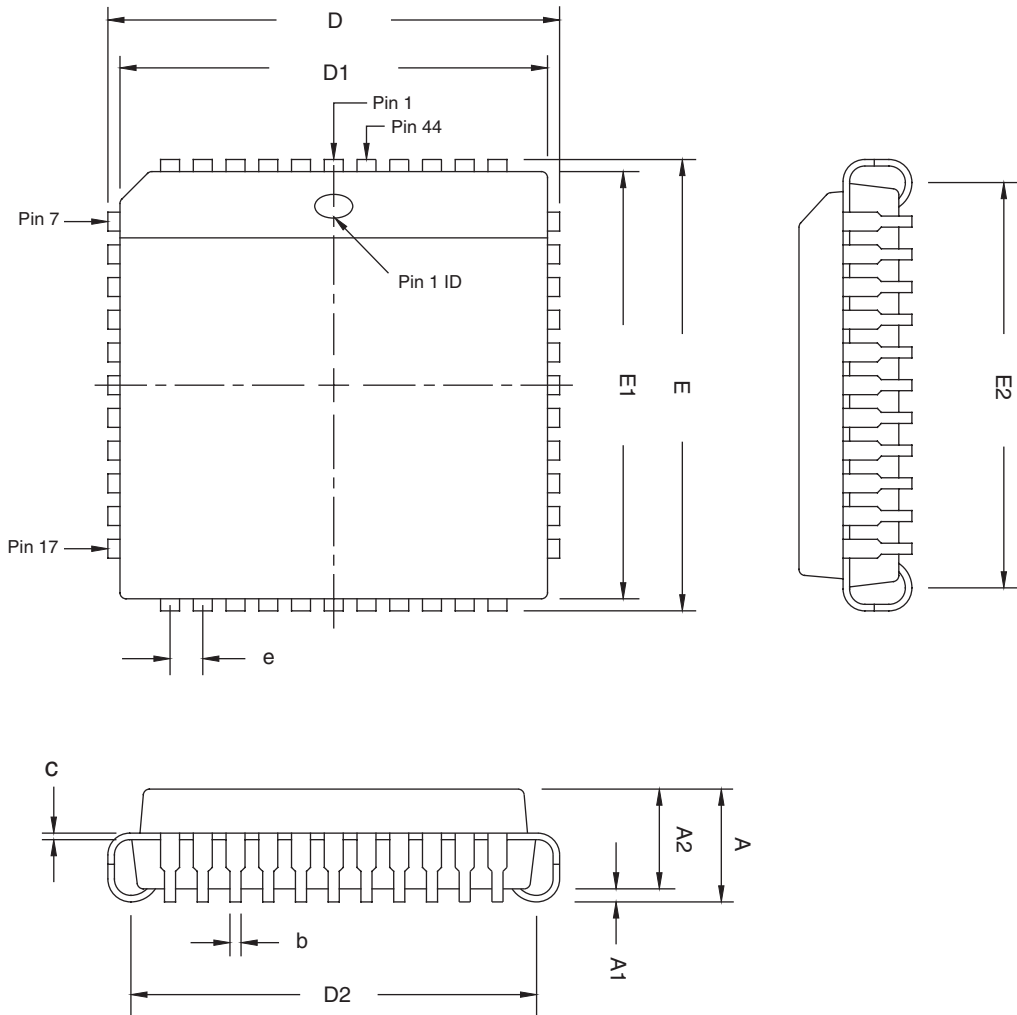
44-Pin Plastic J-Lead Chip Carrier (PLCC) - Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

Package Information	
Description	Specification
Ordering Code Reference	L
Package Acronym	PLCC
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-018 Variation: AC
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	2.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.172	0.180
A1	0.020	–	–
A2	0.150 TYP		
D	0.685	0.690	0.695
D1	0.650	0.653	0.656
D2	0.582	0.610	0.638
E	0.685	0.690	0.695
E1	0.650	0.653	0.656
E2	0.582	0.610	0.638
b	0.013	–	0.021
c	0.010 TYP		
e	0.050 TYP		

Package Outline



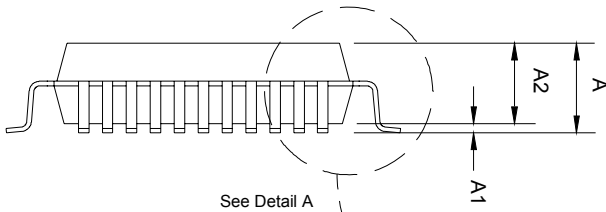
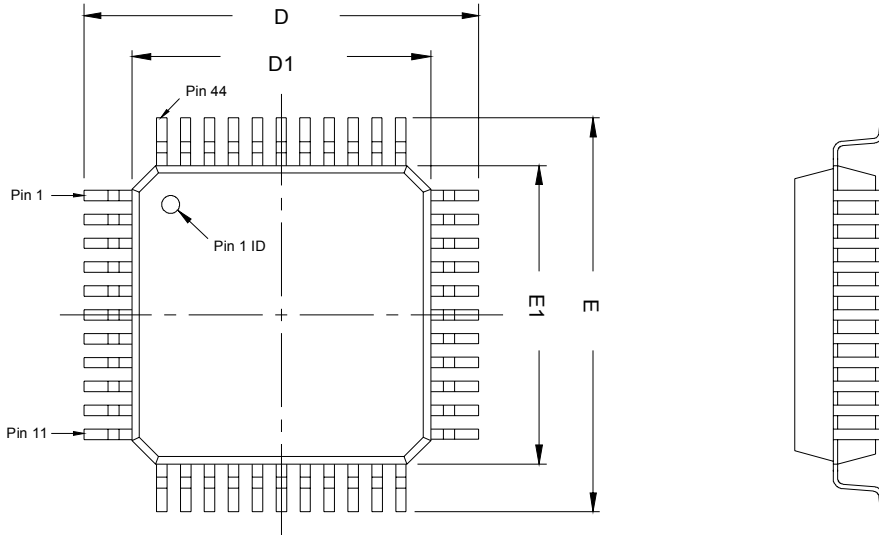
44-Pin Plastic Quad Flat Pack (PQFP) - Wire Bond

- 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.

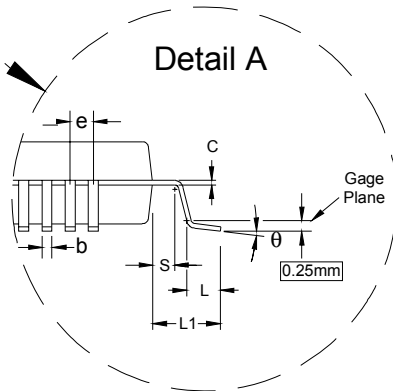
Package Information	
Description	Specification
Ordering Code Reference	Q
Package Acronym	PQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-022 Variation: AB
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.45
A1	–	–	0.25
A2	1.80	2.00	2.20
D	13.20 BSC		
D1	10.00 BSC		
E	13.20 BSC		
E1	10.00 BSC		
L	0.73	0.88	1.03
L1	1.60 REF		
S	0.20	–	–
b	0.29	–	0.45
c	0.11	–	0.23
e	0.80 BSC		
θ	0°	–	7°

Package Outline



See Detail A



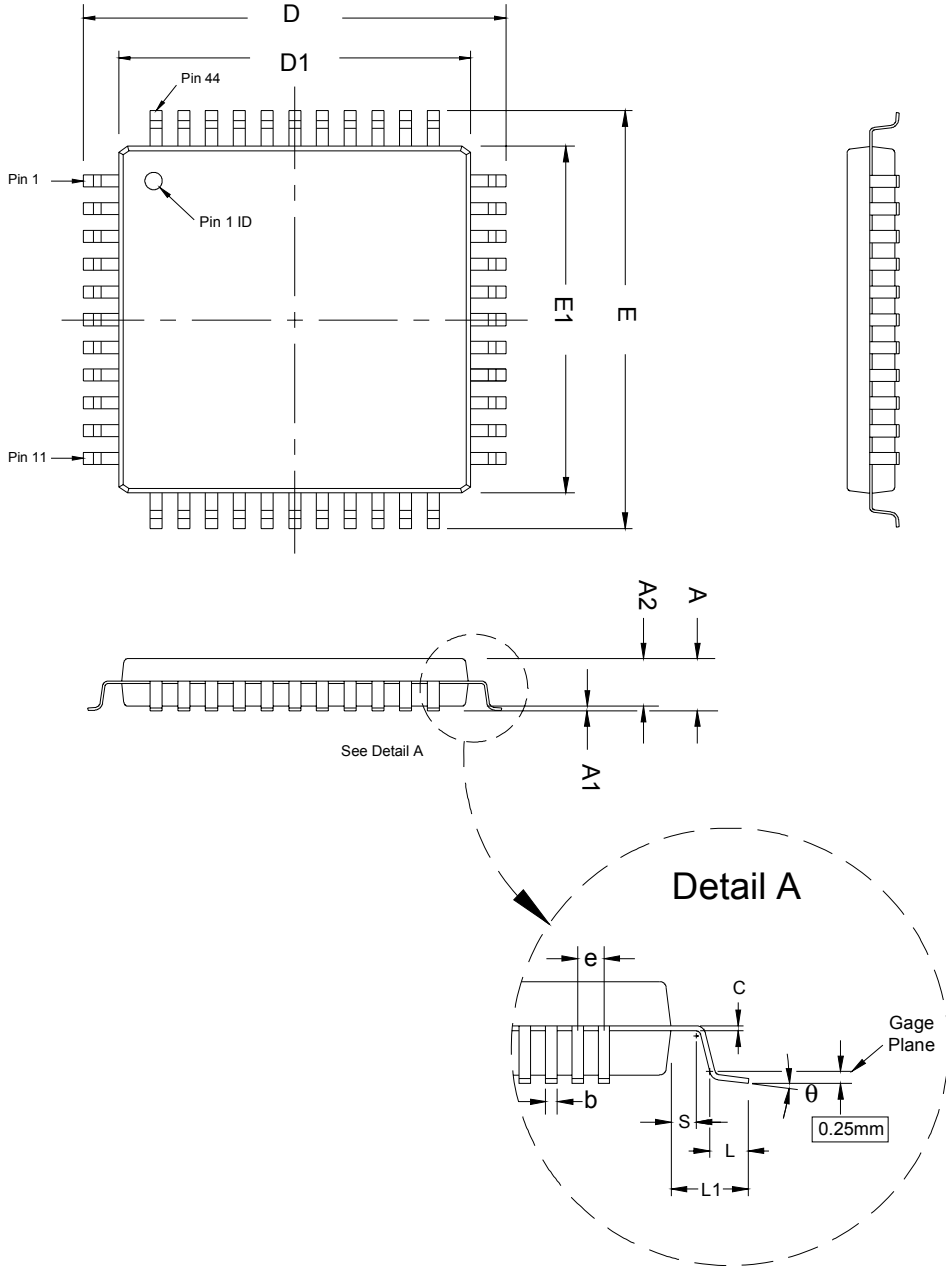
44-Pin Plastic Thin Quad Flat Pack (TQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	T
Package Acronym	TQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: ACB
Maximum Lead Coplanarity	0.004 inches (0.1mm)
Weight	0.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.95	–	–
D	12.00 BSC		
D1	10.00 BSC		
E	12.00 BSC		
E1	10.00 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
S	0.20	–	–
b	0.30	0.37	0.45
c	0.09	–	0.20
e	0.80 BSC		
θ	0°	3.5°	7°

Package Outline



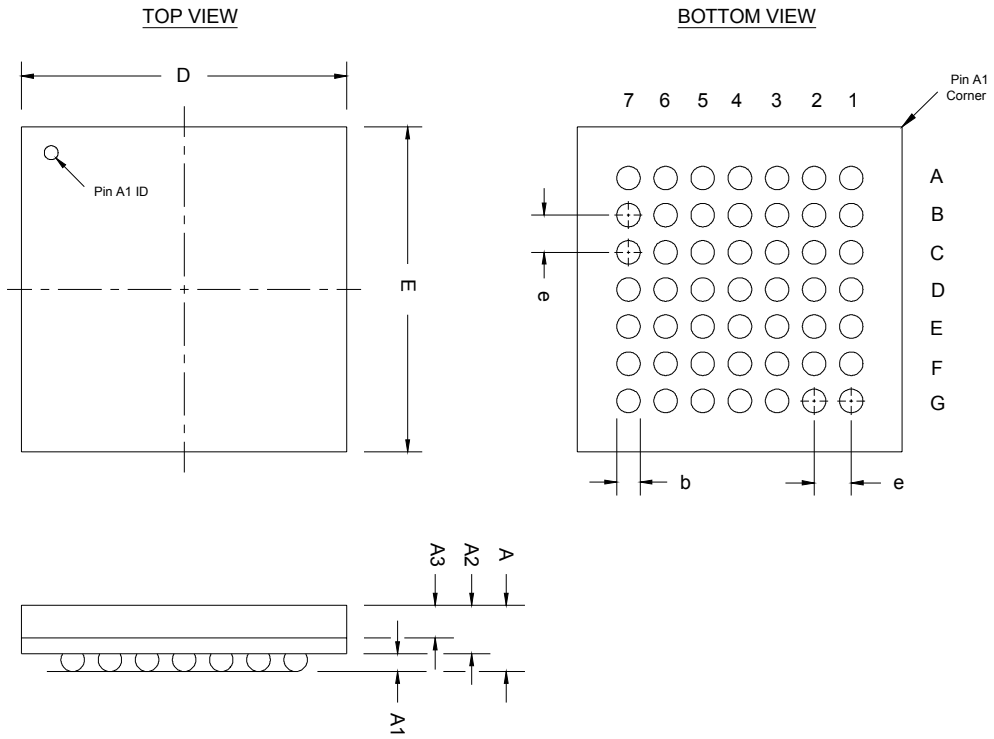
49-Pin Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond

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

<i>Package Information</i>	
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: BAB-2
Maximum Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.55
A1	0.20	–	–
A2	–	–	1.35
A3	0.70 TYP		
D	7.00 BSC		
E	7.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline



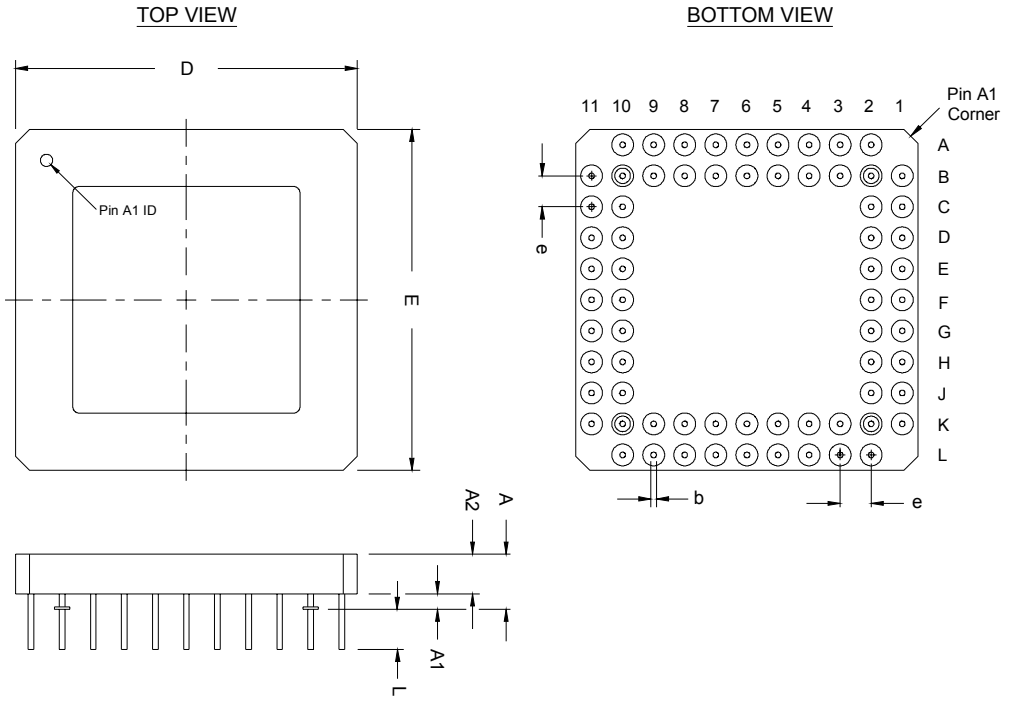
68-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-066 Variation: AC
Maximum Lead Coplanarity	N/A
Weight	10.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.154	0.177	0.200
A1	0.050 TYP		
A2	0.114	0.127	0.140
D	1.100	1.120	1.140
E	1.100	1.120	1.140
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



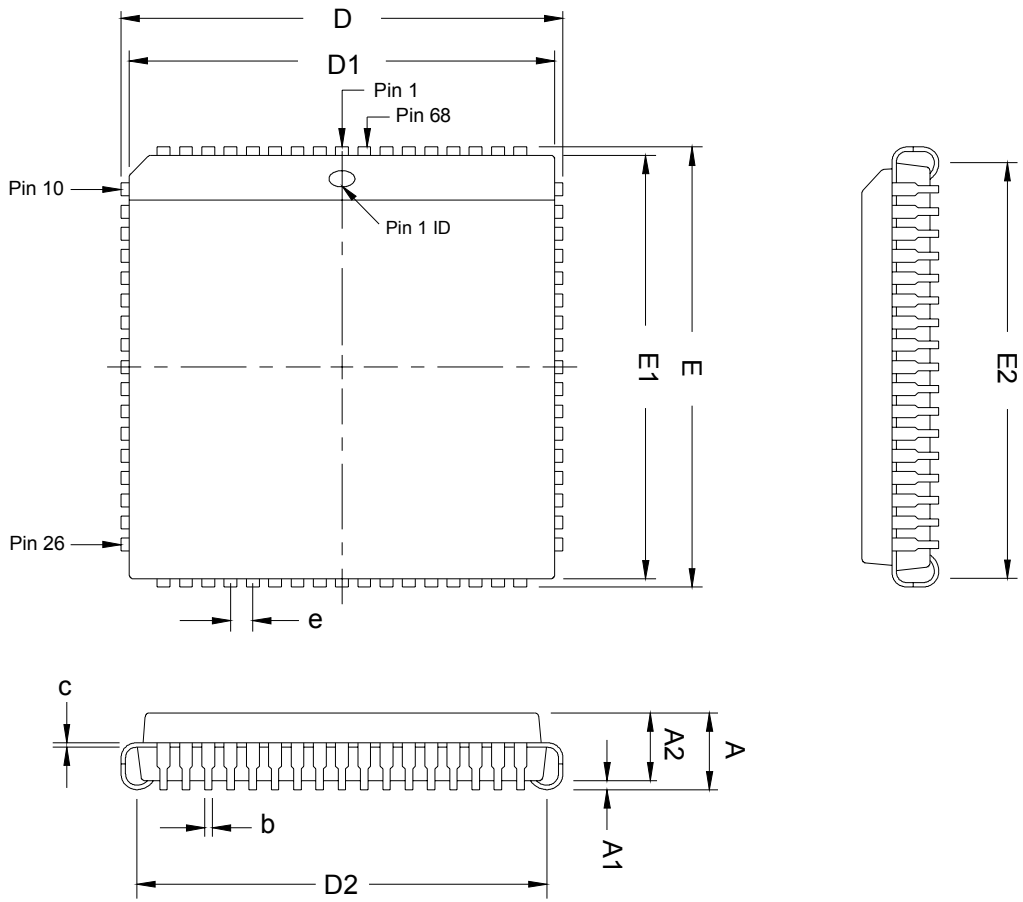
68-Pin Plastic J-Lead Chip Carrier (PLCC) - Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

Package Information	
Description	Specification
Ordering Code Reference	L
Package Acronym	PLCC
Lead Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-018 Variation: AE
Maximum Lead Coplanarity	0.004 inches (0.10 mm)
Weight	5.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.172	0.180
A1	0.020	–	–
A2	0.150 TYP		
D	0.985	0.990	0.995
D1	0.950	0.954	0.958
D2	0.882	0.910	0.938
E	0.985	0.990	0.995
E1	0.950	0.954	0.958
E2	0.882	0.910	0.938
b	0.013	–	0.021
c	0.008 TYP		
e	0.050 TYP		

Package Outline



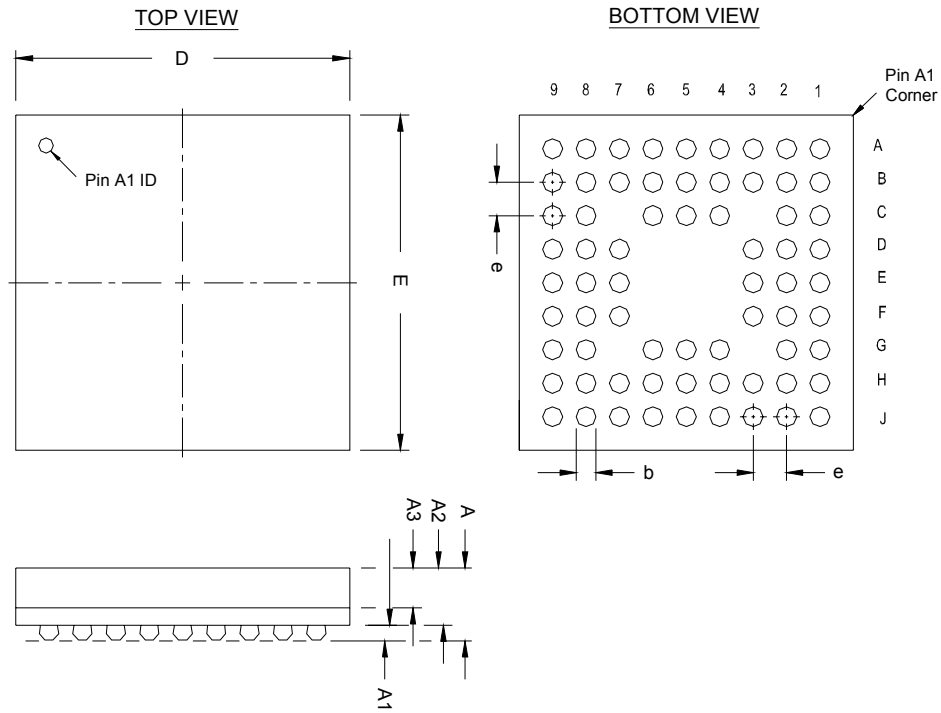
68-Pin Micro FineLine Ball-Grid Array (MBGA) - Wire Bond

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

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

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	—	—	1.20
A1	0.15	—	—
A2	—	—	1.00
A3	0.60 REF		
D	5.00 BSC		
E	5.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

Package Outline



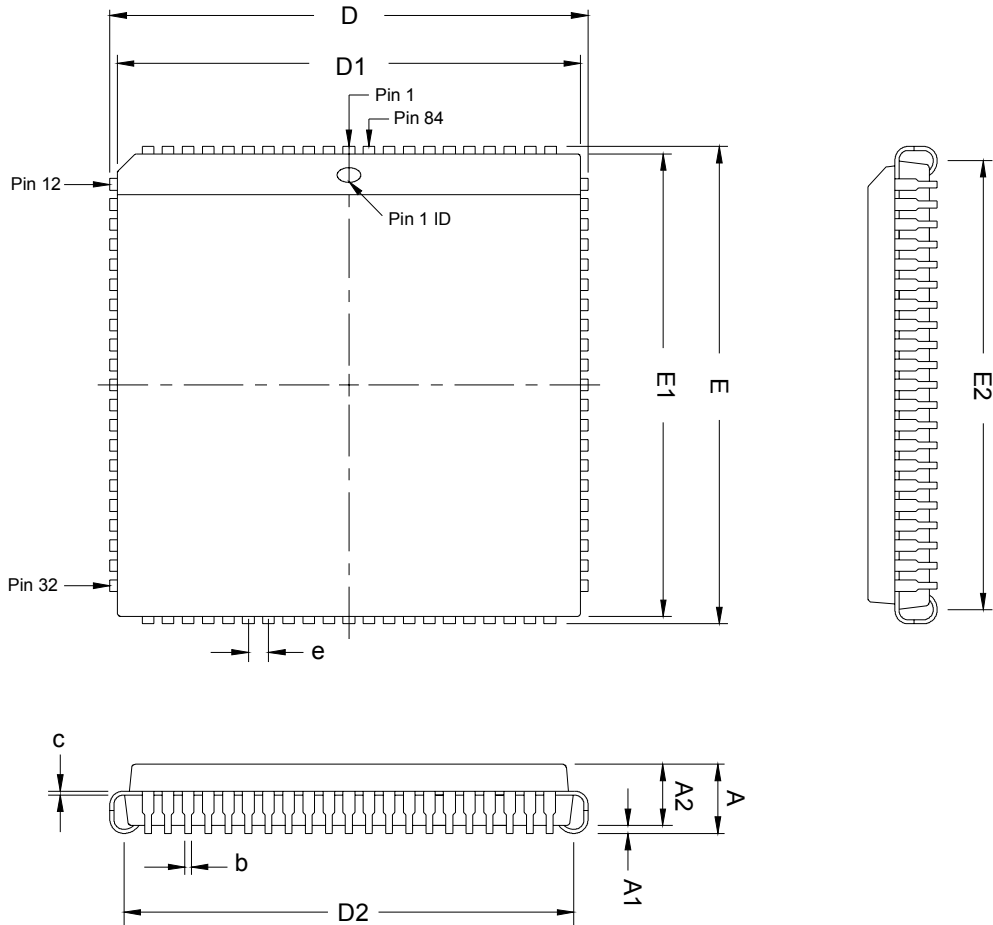
84-Pin Plastic J-Lead Chip Carrier (PLCC) - Wire Bond

- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

Package Information	
Description	Specification
Ordering Code Reference	L
Package Acronym	PLCC
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-018 Variation: AF
Maximum Lead Coplanarity	0.004 inches (0.10mm)
Weight	7.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.172	0.180
A1	0.020	–	–
A2	0.150 TYP		
D	1.185	1.190	1.195
D1	1.150	1.154	1.158
D2	1.082	1.110	1.138
E	1.185	1.190	1.195
E1	1.150	1.154	1.158
E2	1.082	1.110	1.138
b	0.013	–	0.021
c	0.008 TYP		
e	0.050 TYP		

Package Outline



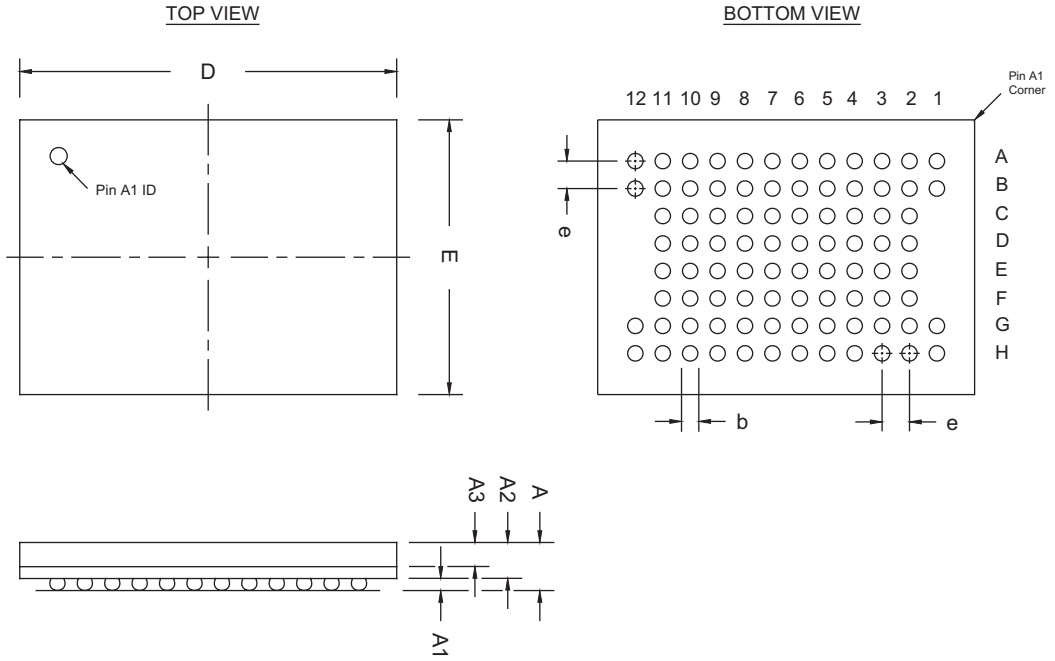
88-Pin Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond

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

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	MO-219
Maximum Lead Coplanarity	0.005 inches (0.12 mm)
Weight	0.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.40
A1	0.25	–	–
A2	0.80	–	–
D	11.00 BSC		
E	8.00 BSC		
b	0.40	0.45	0.50
e	0.80 BSC		

Package Outline



100-Pin FineLine Ball-Grid Array (FBGA) - Option 1 - Wire Bond

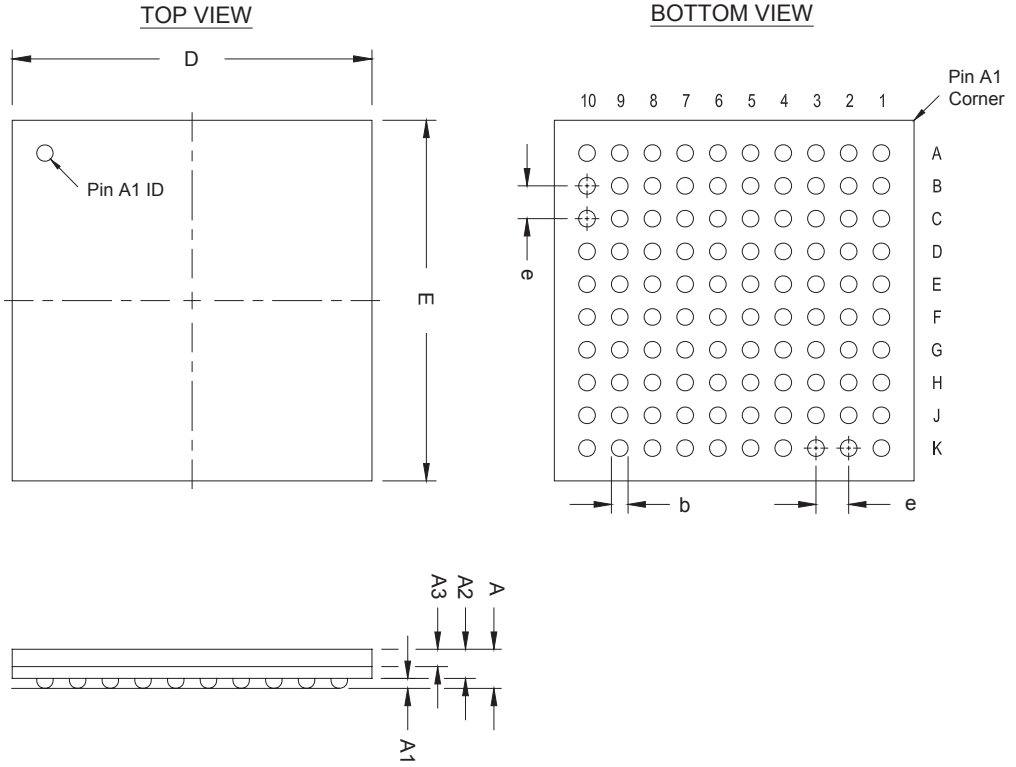
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on the package surface.

Note: This POD is applicable to F100 packages of all products except MAX II, which is assembled in Option 2 package outlines.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder ball composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: AAC-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.70
A1	0.30	–	–
A2	0.25	–	1.10
A3	–	–	0.80
D	11.00 BSC		
E	11.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



100-Pin FineLine Ball-Grid Array (FBGA) - Option 2 - Wire Bond

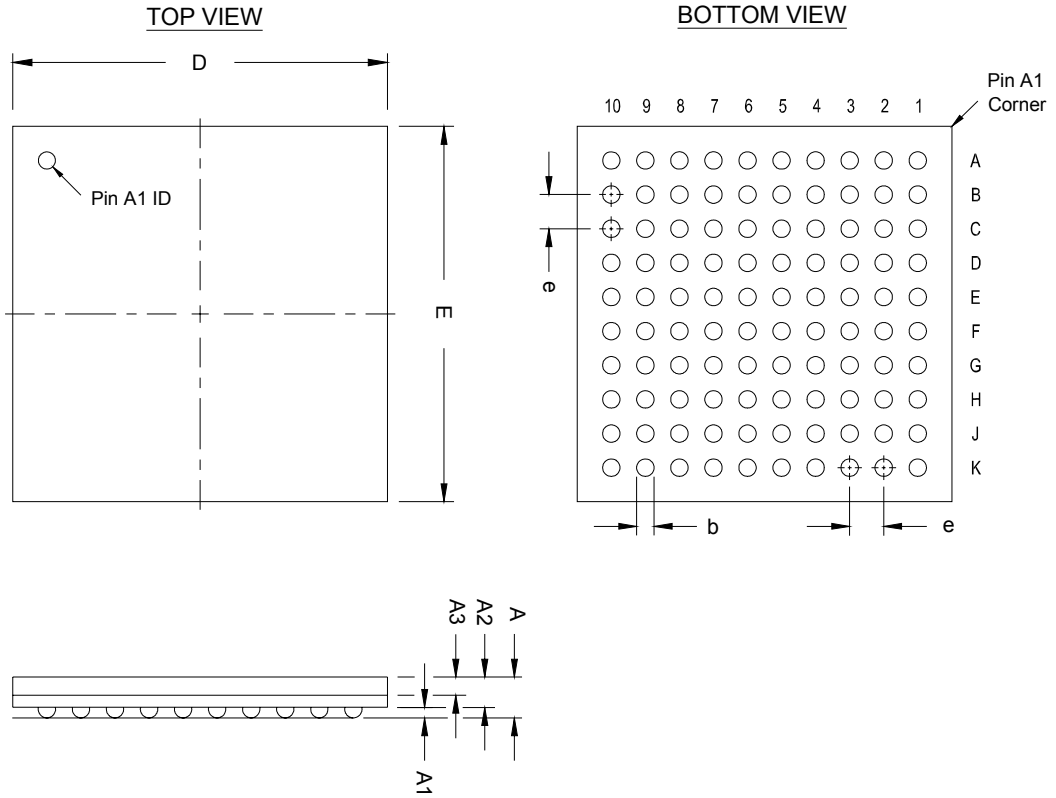
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Note: This POD is applicable to F100 packages of the MAX II device only.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder ball composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: DAC-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.55
A1	0.25	–	–
A2	1.05 Ref		
A3	–	–	0.80
D	11.00 BSC		
E	11.00 BSC		
b	0.45	0.50	0.55
e	1.00 BSC		

Package Outline



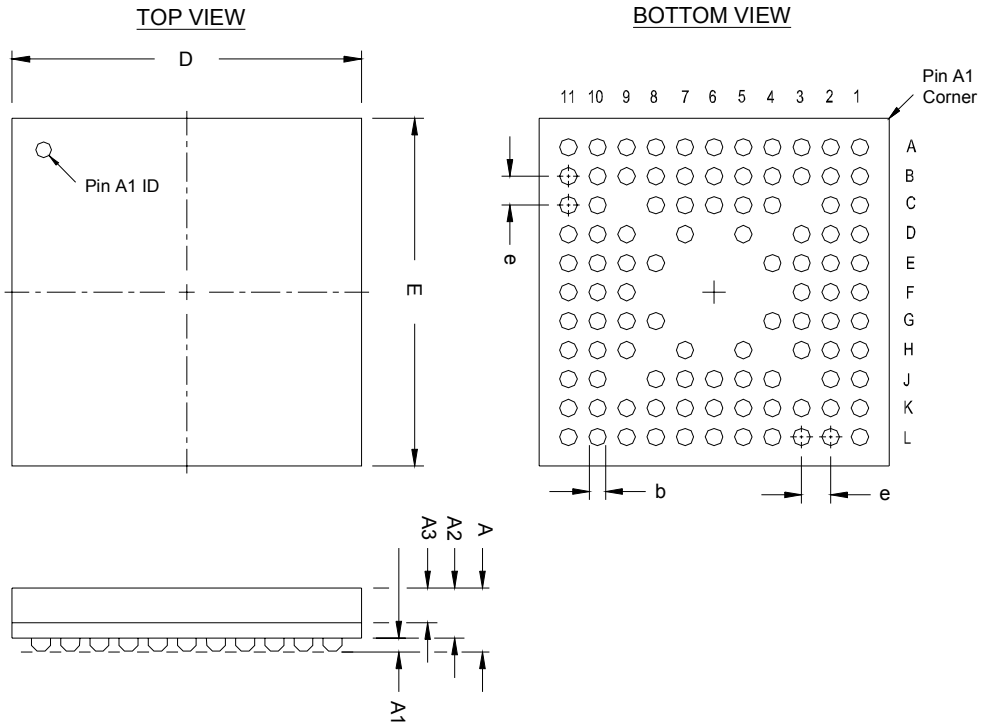
100-Pin Micro FineLine Ball-Grid Array (MBGA) - Wire Bond

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

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

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

Package Outline



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

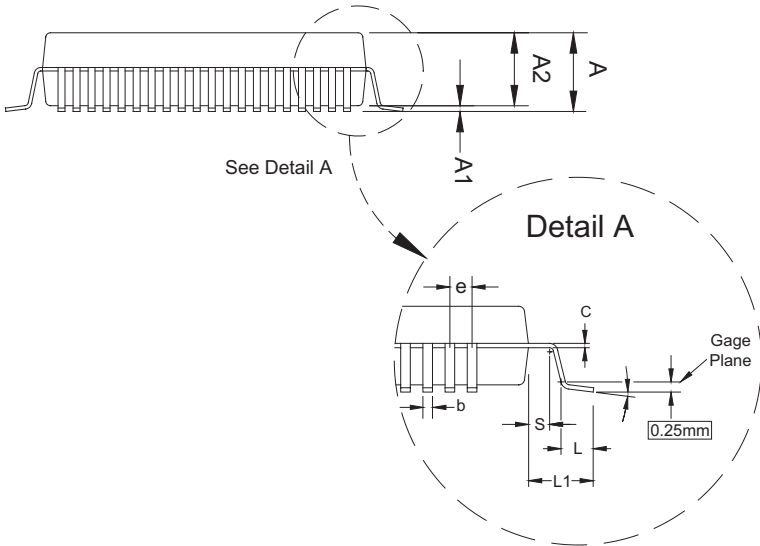
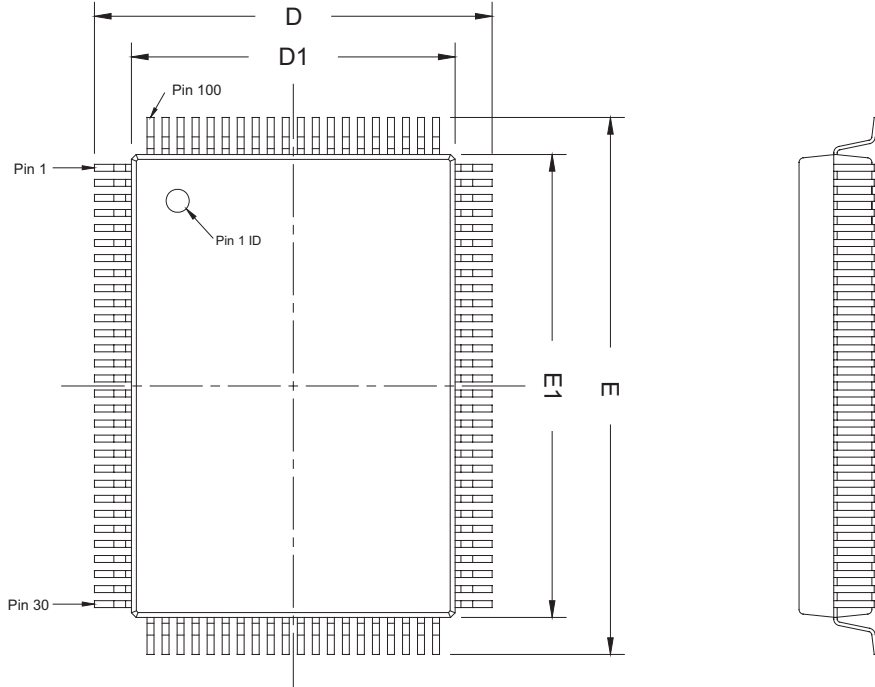
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin 1 may be indicated by an ID dot, or a special feature, in its proximity on the package surface.

Note: This POD is applicable to Q100 packages of all products not noted in Option 2.

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-022 Variation: GC-1
Maximum Lead Coplanarity	0.004 inches (0.10mm)
Weight	1.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.40
A1	0.25	–	0.50
A2	2.50	2.70	2.90
D	17.20 BSC		
D1	14.00 BSC		
E	23.20 BSC		
E1	20.00 BSC		
L	0.73	0.88	1.03
L1	1.60 REF		
S	0.20	–	–
b	0.22	–	0.40
c	0.11	–	0.23
e	0.65 BSC		
θ	0°	–	7°

Package Outline



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

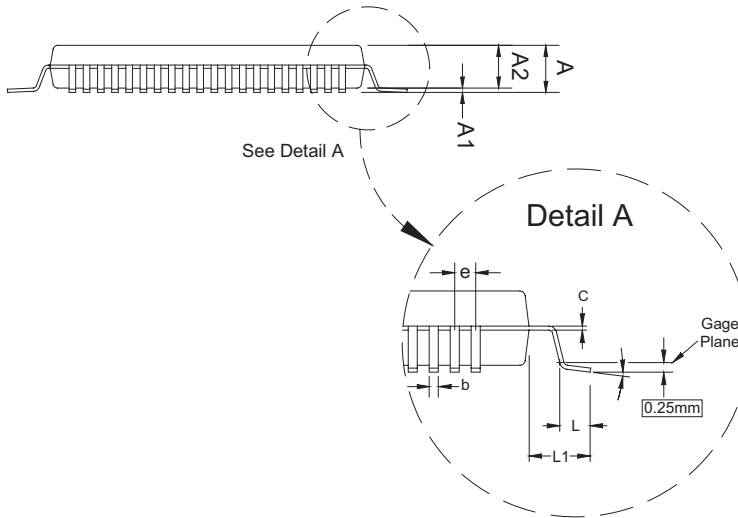
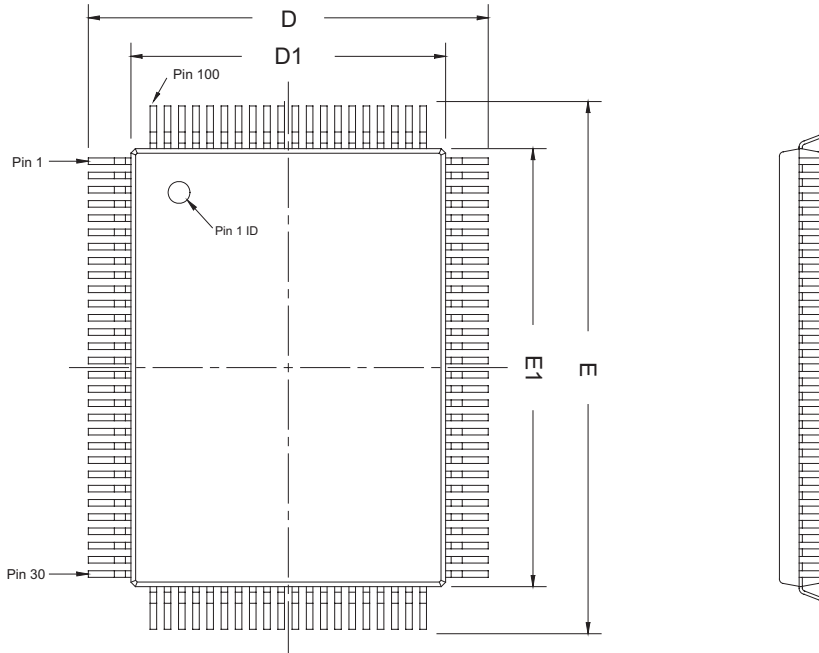
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin 1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Note: This POD is only applicable to Q100 packages of EPC8 & EPC16 manufactured in Japan. Refer to PCN0506 for details.

Package Information	
Description	Specification
Ordering Code Reference	Q
Package Acronym	PQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.)
JEDEC Outline Reference	N/A
Maximum Lead Coplanarity	0.006 inches (0.15mm)
Weight	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	1.75	1.95	2.15
A1	0.0	0.10	0.20
A2	1.85 TYP		
D	17.90	18.30	18.70
D1	13.80	14.00	14.20
E	23.90	24.30	24.70
E1	19.80	20.00	20.20
L	1.20 REF		
L1	2.15 REF		
b	0.20	0.30	0.40
c	0.10	0.15	0.20
e	0.65 BSC		
θ	0°	–	10°

Package Outline



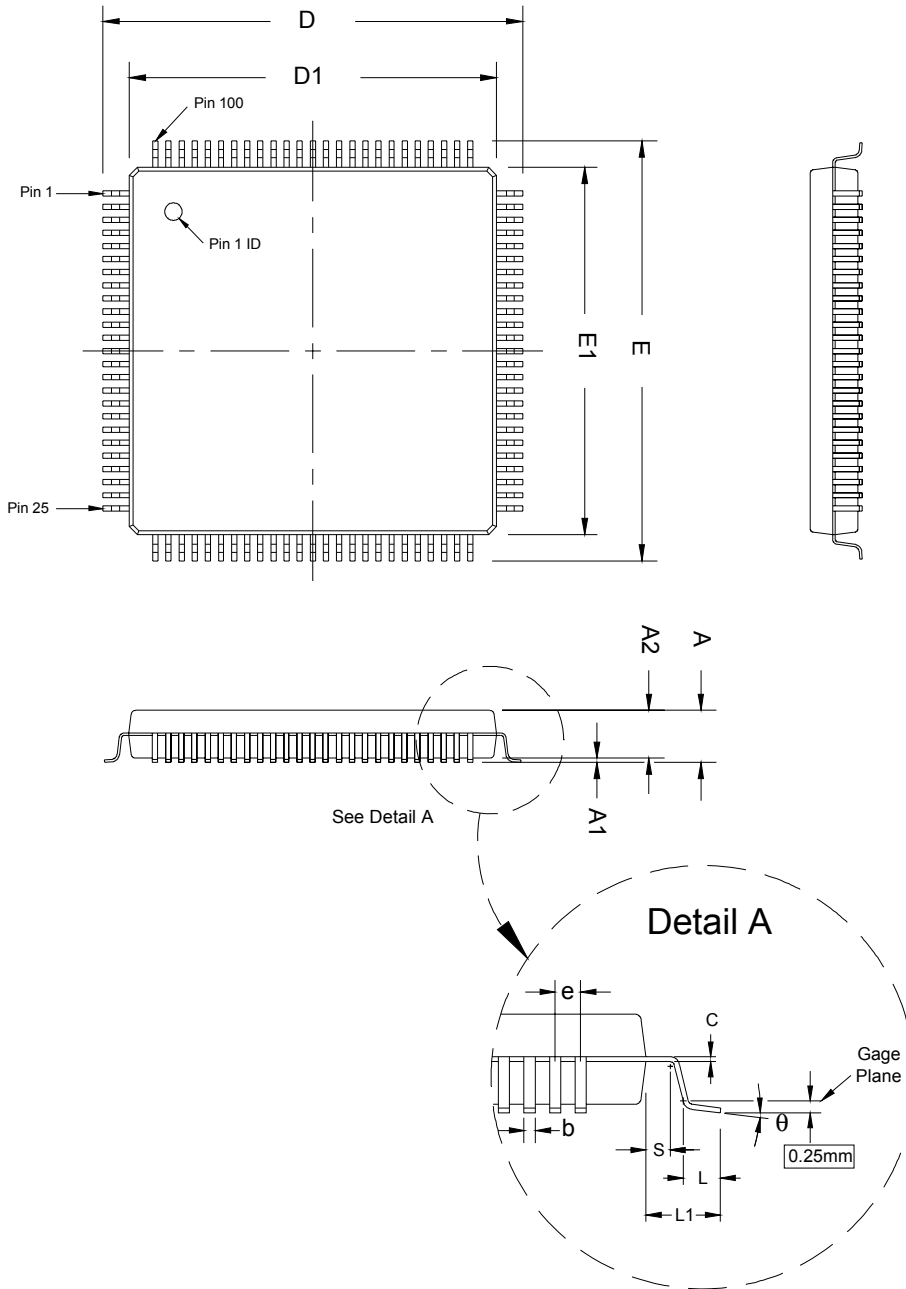
100-Pin Plastic Thin Quad Flat Pack (TQFP) - Wire Bond

- 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.

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

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

Package Outline



144-Pin Plastic Enhanced Quad Flat Pack (EQFP) - Wire Bond

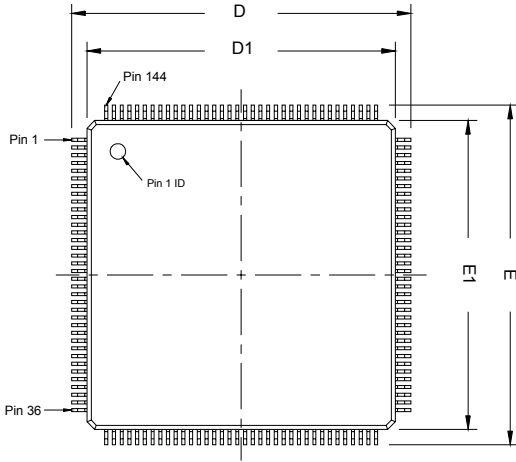
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin 1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

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

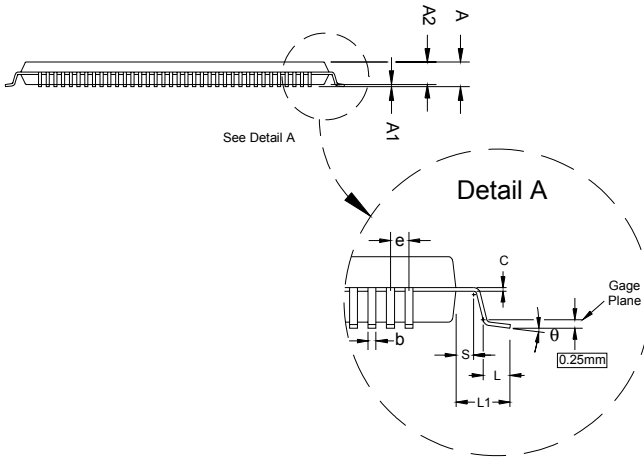
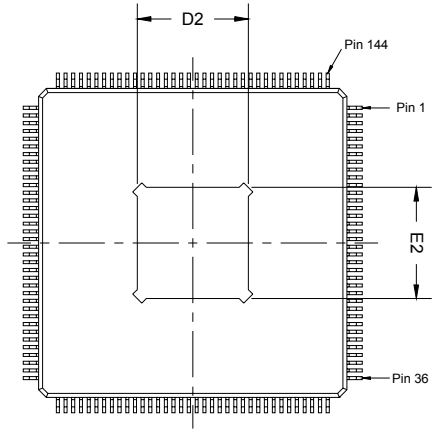
Package Outline Figure Reference			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.60
A1	0.05	–	0.15
A2	1.35	1.40	1.45
D	22.00 BSC		
D1	20.00 BSC		
D2	4.00	–	–
E	22.00 BSC		
E1	20.00 BSC		
E2	4.00	–	–
L	0.45	0.60	0.75
L1	1.00 REF		
S	0.20	–	–
b	0.17	0.22	0.27
c	0.09	–	0.20
e	0.50 BSC		
θ	0°	3.5°	7°

Package Outline

TOP VIEW



BOTTOM VIEW



144-Pin FineLine Ball-Grid Array (FBGA) - Wire Bond

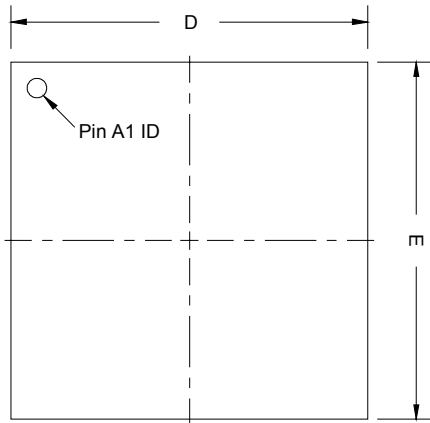
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: AAD-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

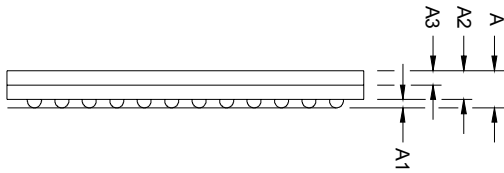
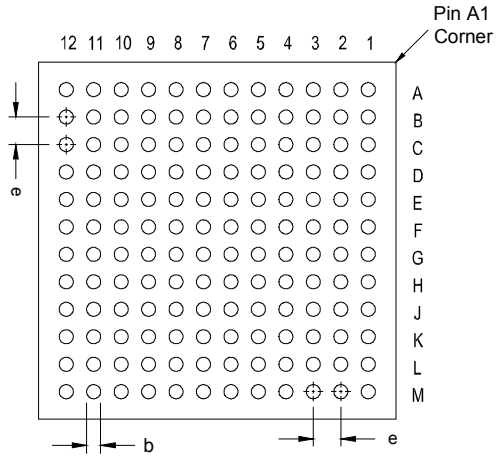
Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.70
A1	0.30	–	–
A2	0.25	–	1.10
A3	–	–	0.80
D	13.00 BSC		
E	13.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



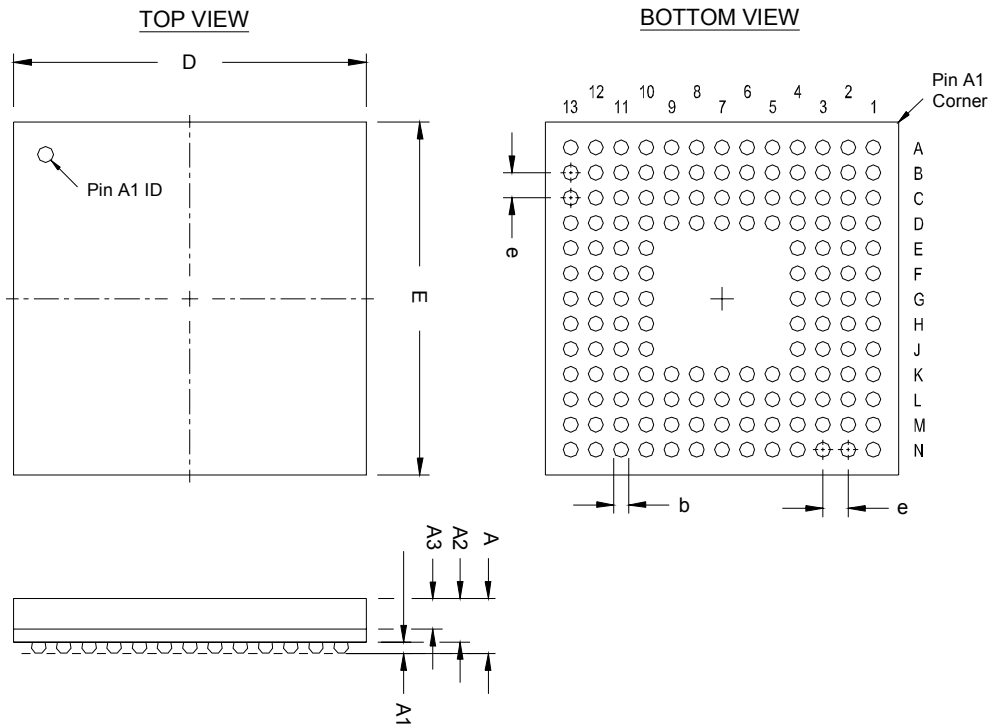
144-Pin Micro FineLine Ball-Grid Array (MBGA) - Wire Bond

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

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

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

Package Outline



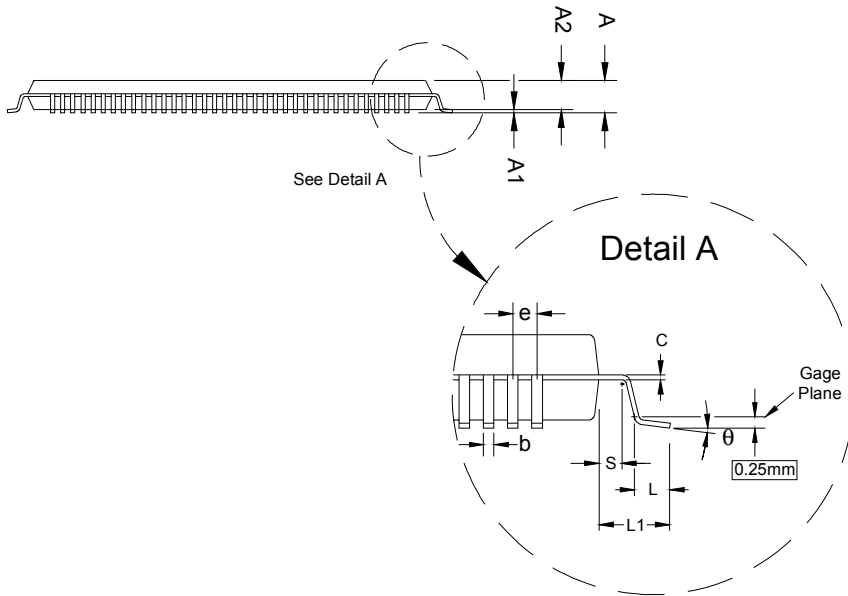
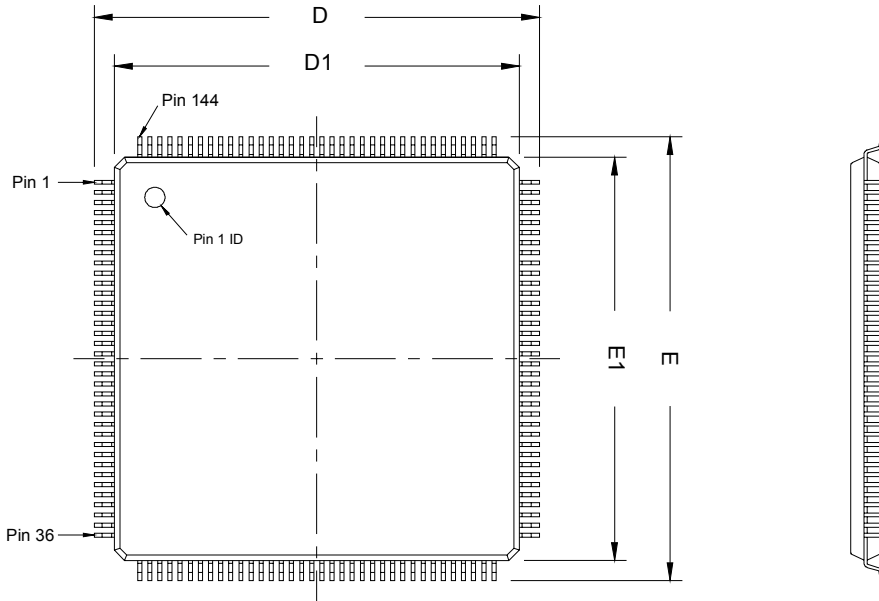
144-Pin Plastic Thin Quad Flat Pack (TQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	T
Package Acronym	TQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-026 Variation: BFB
Maximum Lead Coplanarity	0.003 inches (0.08mm)
Weight	1.1 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
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°

Package Outline



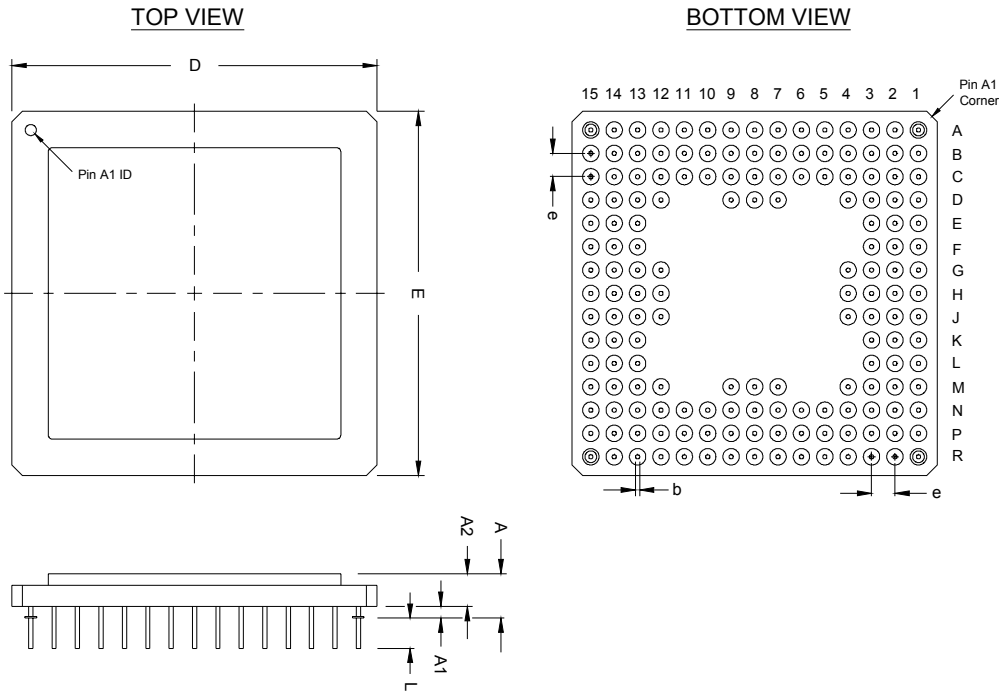
160-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-067 Variation: AG
Maximum Lead Coplanarity	N/A
Weight	19.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.160	0.190	0.220
A1	0.050 TYP		
A2	0.120	0.140	0.160
D	1.540	1.560	1.580
E	1.540	1.560	1.580
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



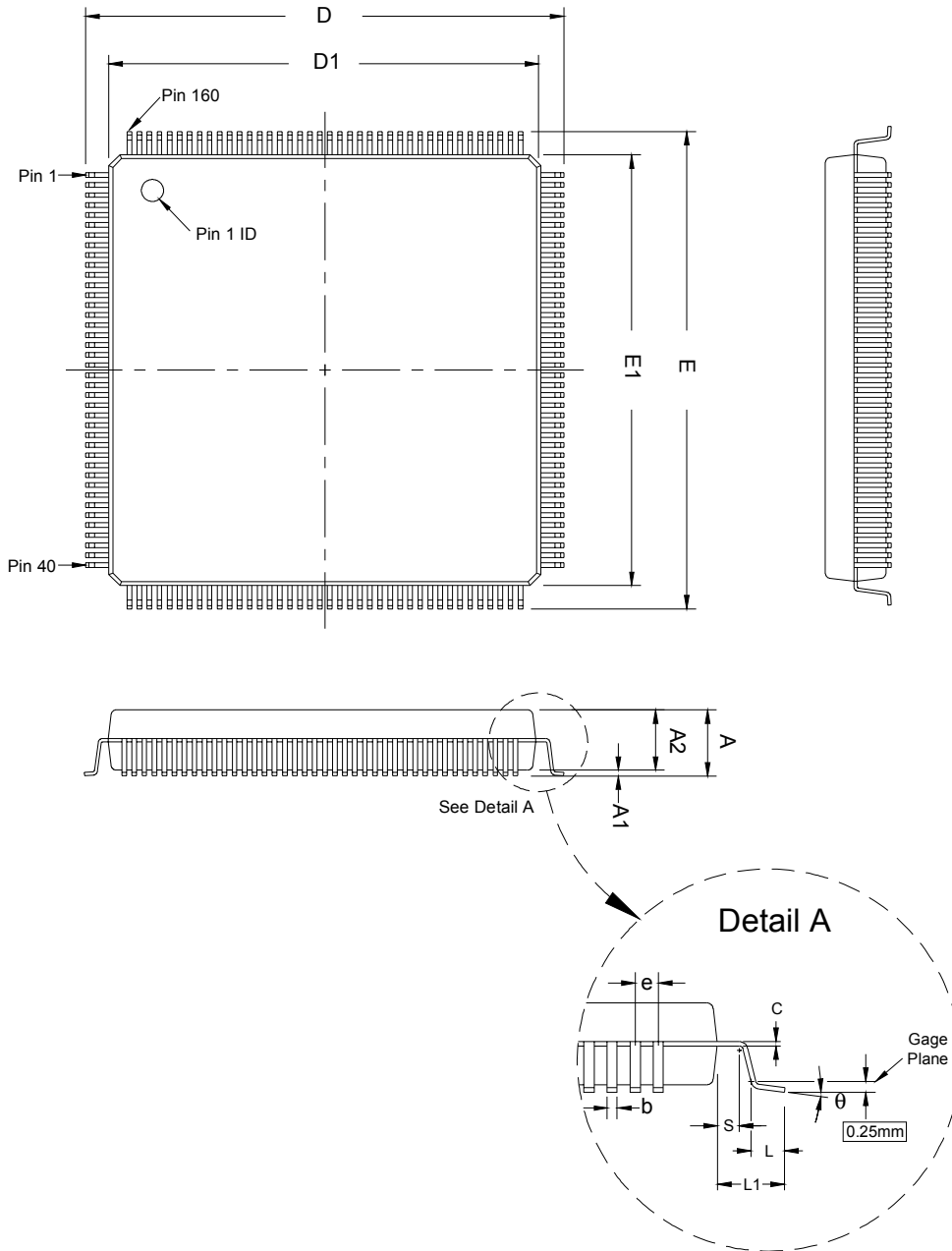
160-Pin Plastic Quad Flat Pack (PQFP) - Wire Bond

- 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.

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-022 Variation: DD-1
Maximum Lead Coplanarity	0.004 inches (0.10mm)
Weight	6.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	4.10
A1	0.25	–	0.50
A2	3.20	3.40	3.60
D	31.20 BSC		
D1	28.00 BSC		
E	31.20 BSC		
E1	28.00 BSC		
L	0.50	–	1.03
L1	1.60 REF		
S	0.20	–	–
b	0.22	–	0.40
c	0.09	–	0.23
e	0.65 BSC		
θ	0°	–	7°

Package Outline



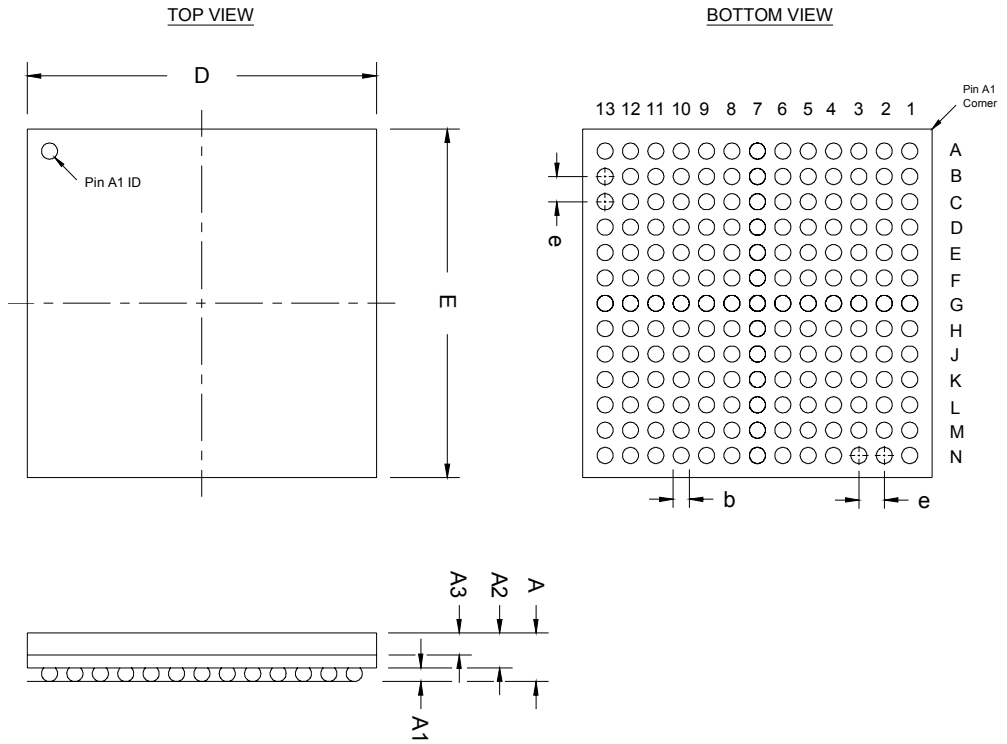
169-Pin Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond

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

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: BAF-1
Maximum Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.70
A1	0.20	–	–
A2	0.65	–	–
A3	0.70 TYP		
D	11.00 BSC		
E	11.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline



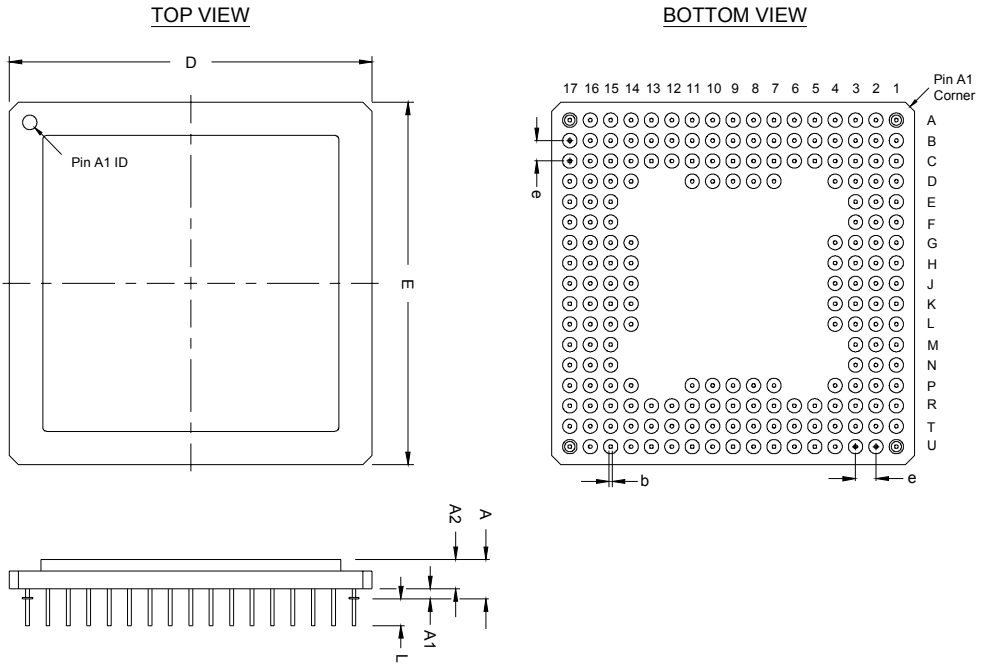
192-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-067 Variation: AJ
Maximum Lead Coplanarity	N/A
Weight	21.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.167	0.192	0.217
A1	0.050 TYP		
A2	0.127	0.142	0.157
D	1.740	1.760	1.780
E	1.740	1.760	1.780
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



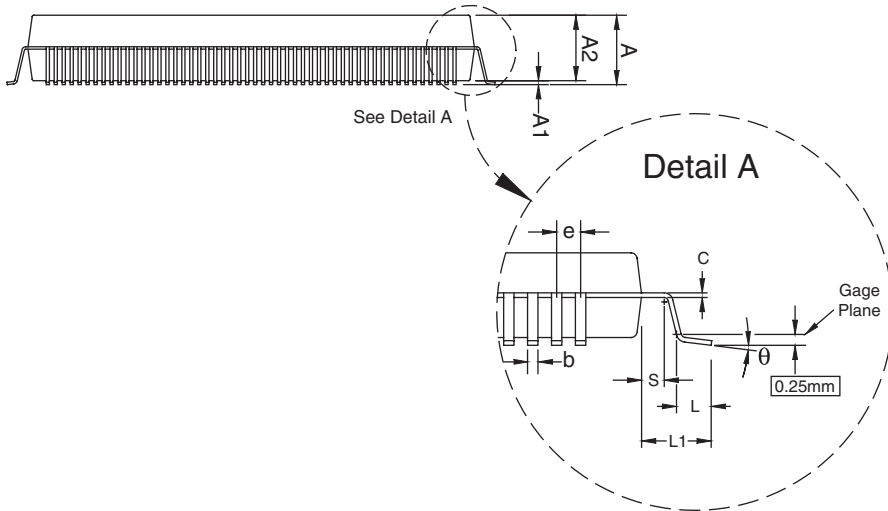
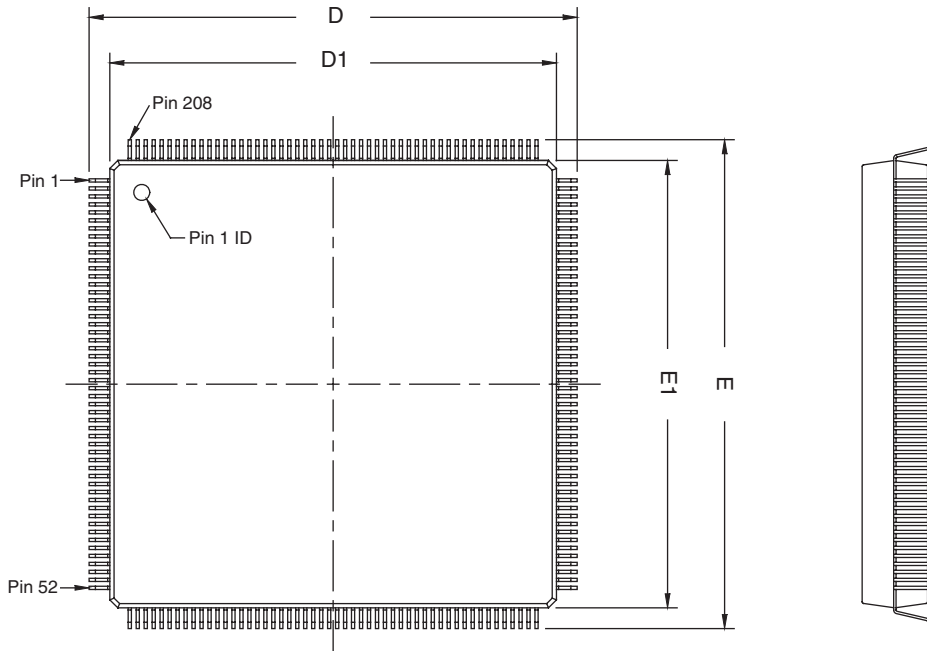
208-Pin Plastic Quad Flat Pack (PQFP) - Wire Bond

- 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.

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	6.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	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
e	0.50 BSC		
θ	0°	3.5°	8°

Package Outline



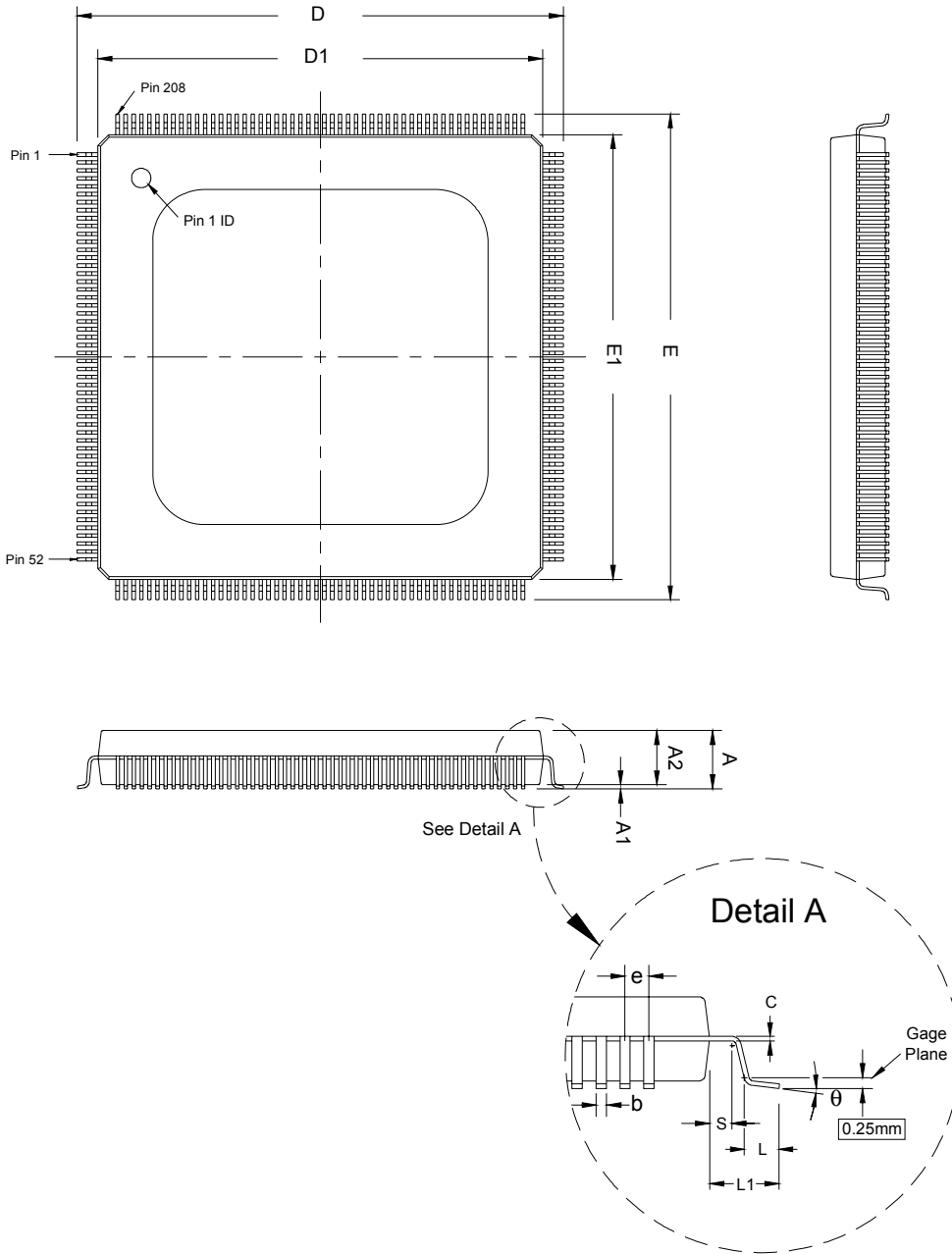
208-Pin Power Quad Flat Pack (RQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	R
Package Acronym	RQFP
Leadframe 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 (0.08mm)
Weight	6.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	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	0.45	0.60	0.75
L1	1.30 REF		
S	0.20	–	–
b	0.17	–	0.27
c	0.09	–	0.20
e	0.50 BSC		
θ	0°	3.5°	8°

Package Outline



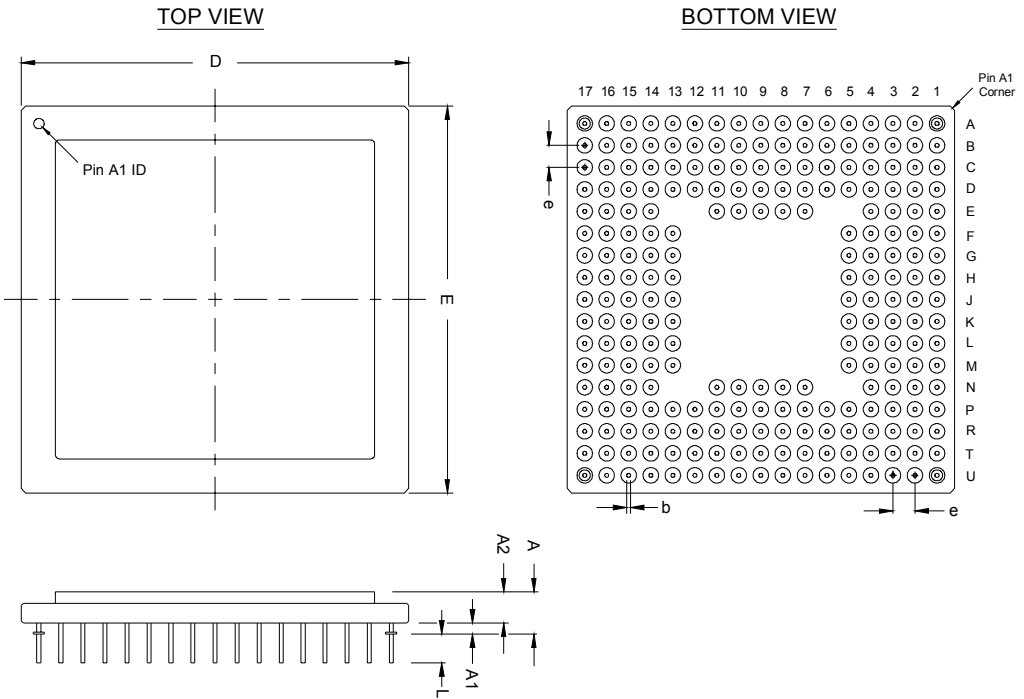
232-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-067 Variation: AJ
Maximum Lead Coplanarity	N/A
Weight	25.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.174	0.192	0.210
A1	0.050 TYP		
A2	0.134	0.142	0.150
D	1.740	1.760	1.780
E	1.740	1.760	1.780
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



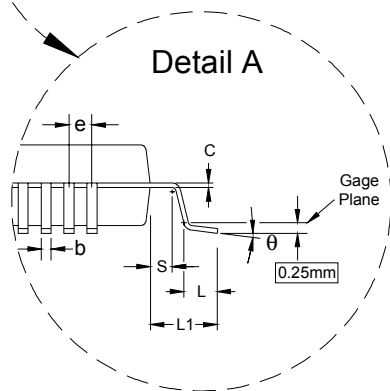
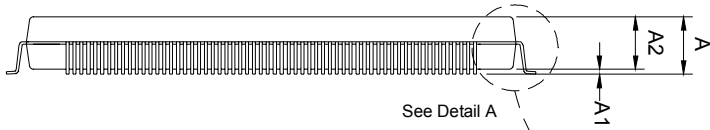
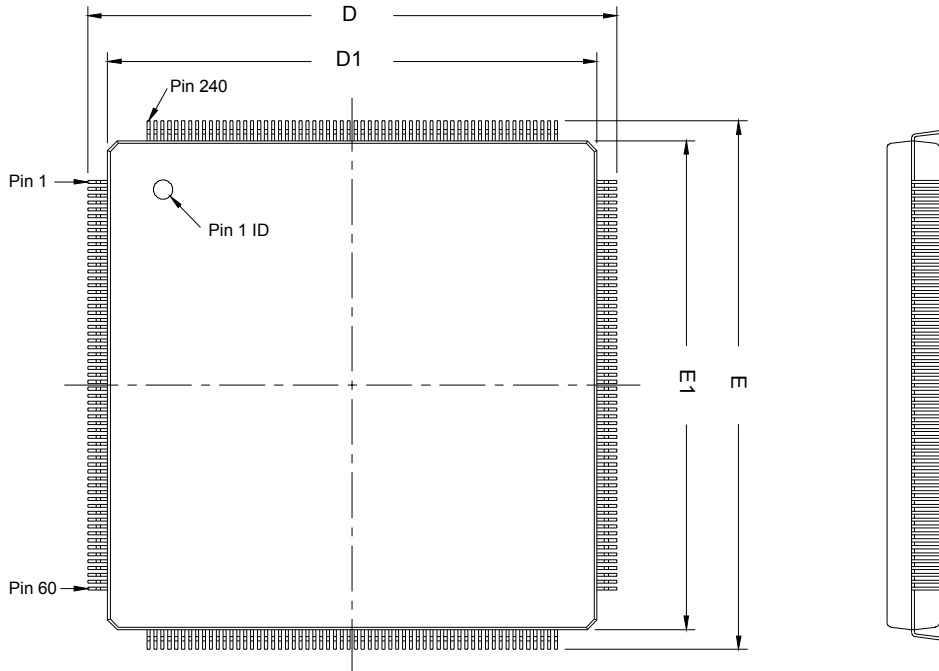
240-Pin Plastic Quad Flat Pack (PQFP) - Wire Bond

- 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.

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	8.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	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
e	0.50 BSC		
θ	0°	3.5°	8°

Package Outline



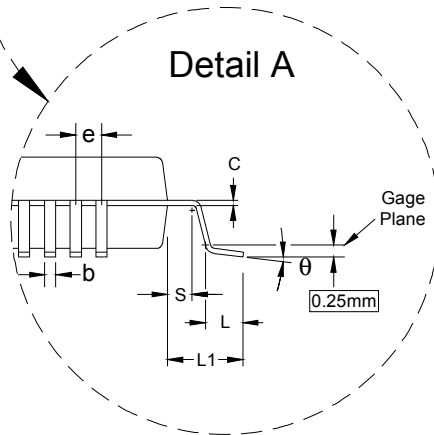
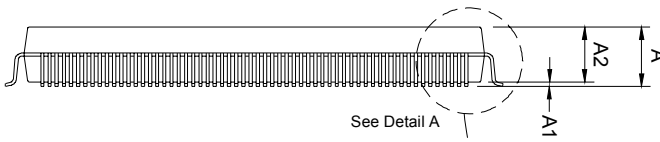
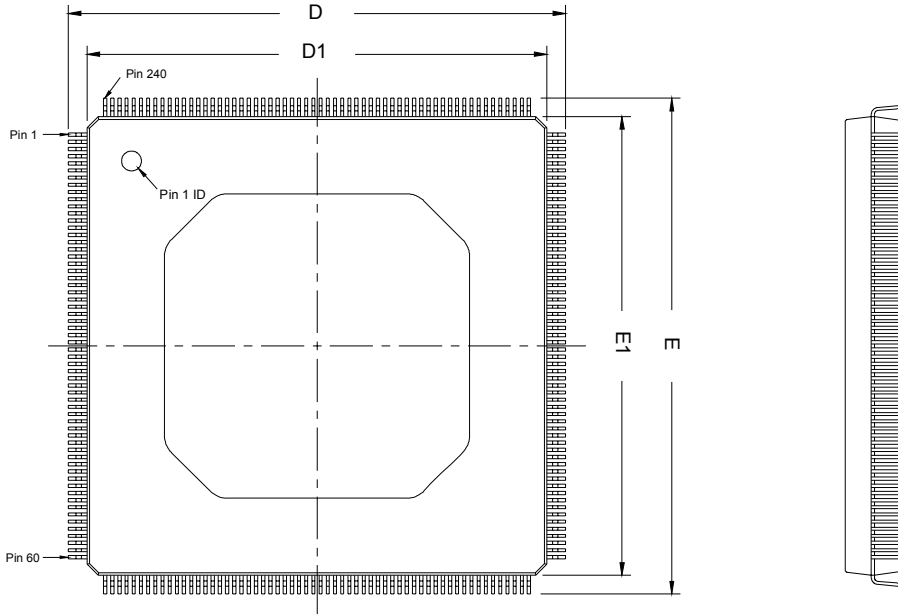
240-Pin Power Quad Flat Pack (RQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	R
Package Acronym	RQFP
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	8.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	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
e	0.50 BSC		
θ	0°	3.5°	8°

Package Outline



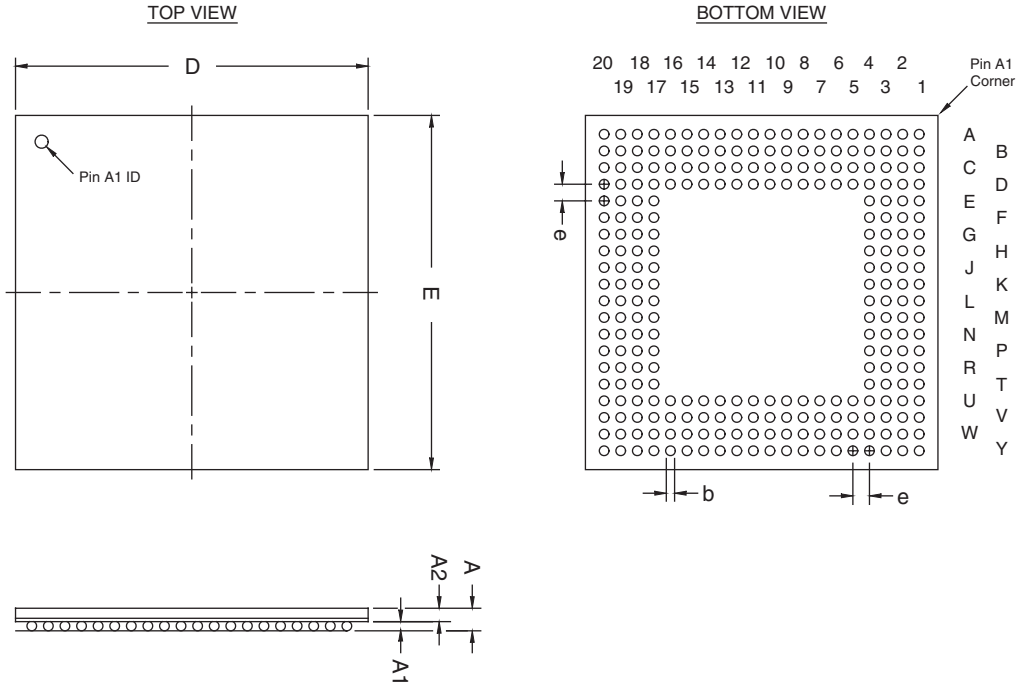
256-Pin Ball-Grid Array (BGA) - Option 1 - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT or tape
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: BAL-2
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
D	27.00 BSC		
E	27.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



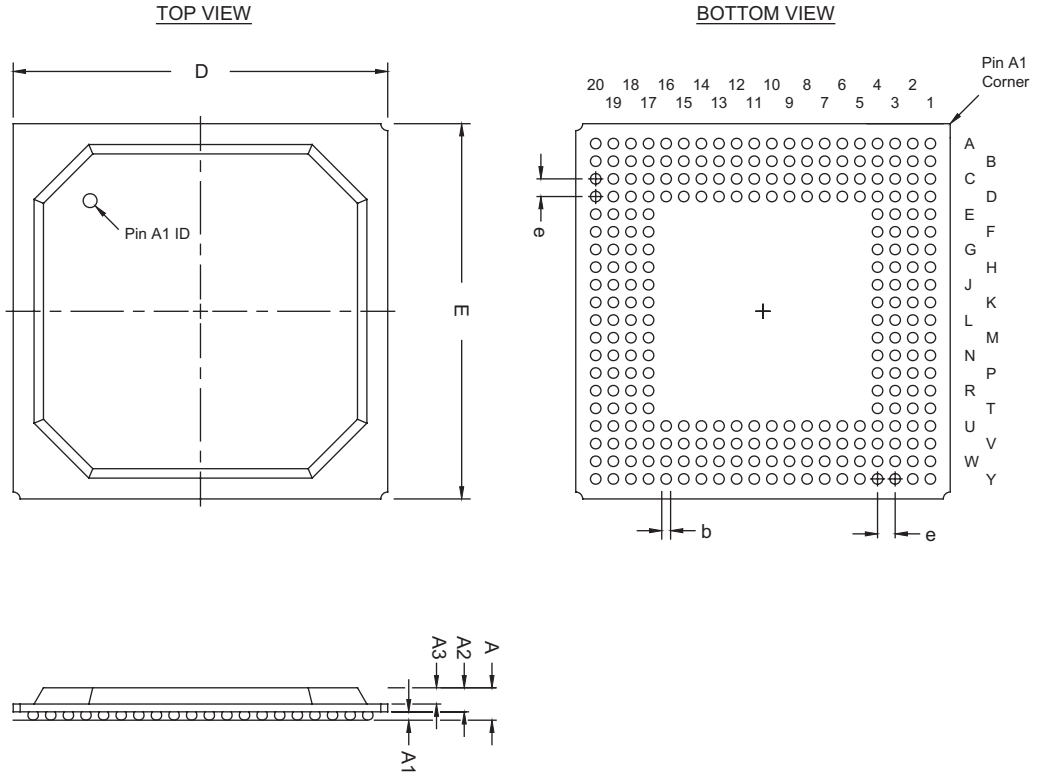
256-Pin Plastic Ball-Grid Array (BGA) - Option 2 - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAL-2
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.35	–	–
A2	–	–	2.20
A3	–	–	1.80
D	27.00 BSC		
E	27.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



256-Pin FineLine Ball-Grid Array (FBGA) - Option 1 - Wire Bond

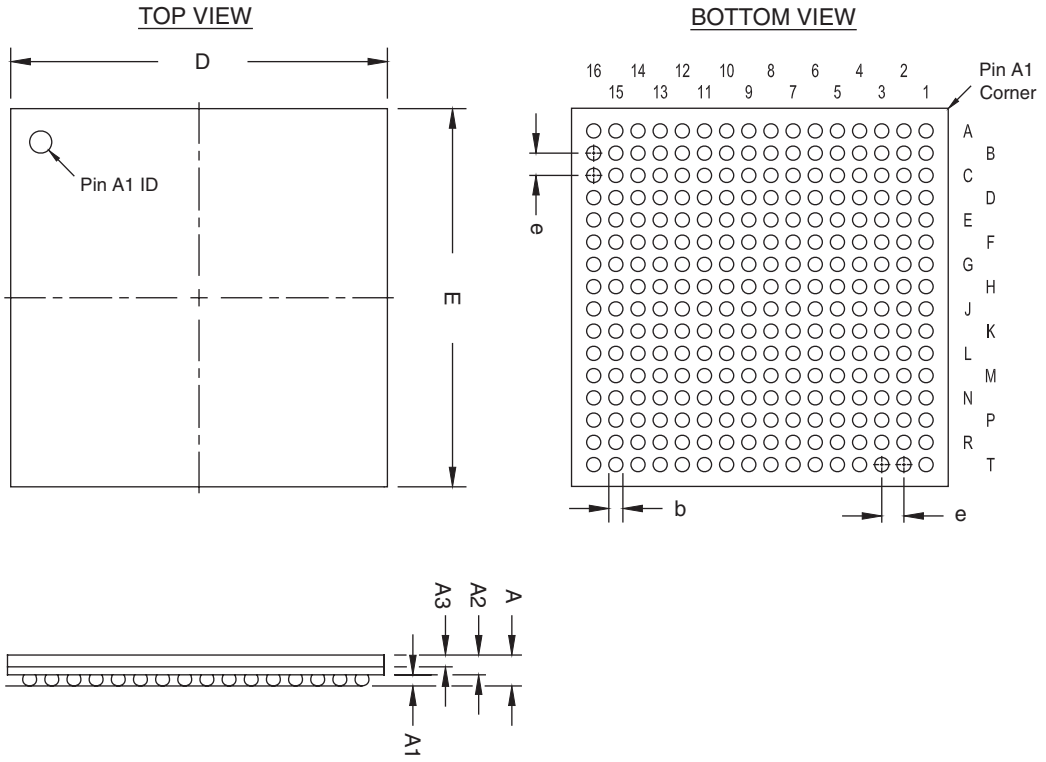
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Note: This POD is applicable to F256 packages of all products except Cyclone II, which is assembled in Option 2 package outlines.

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

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

Package Outline



256-Pin FineLine Ball-Grid Array (FBGA) - Option 2 - Wire Bond

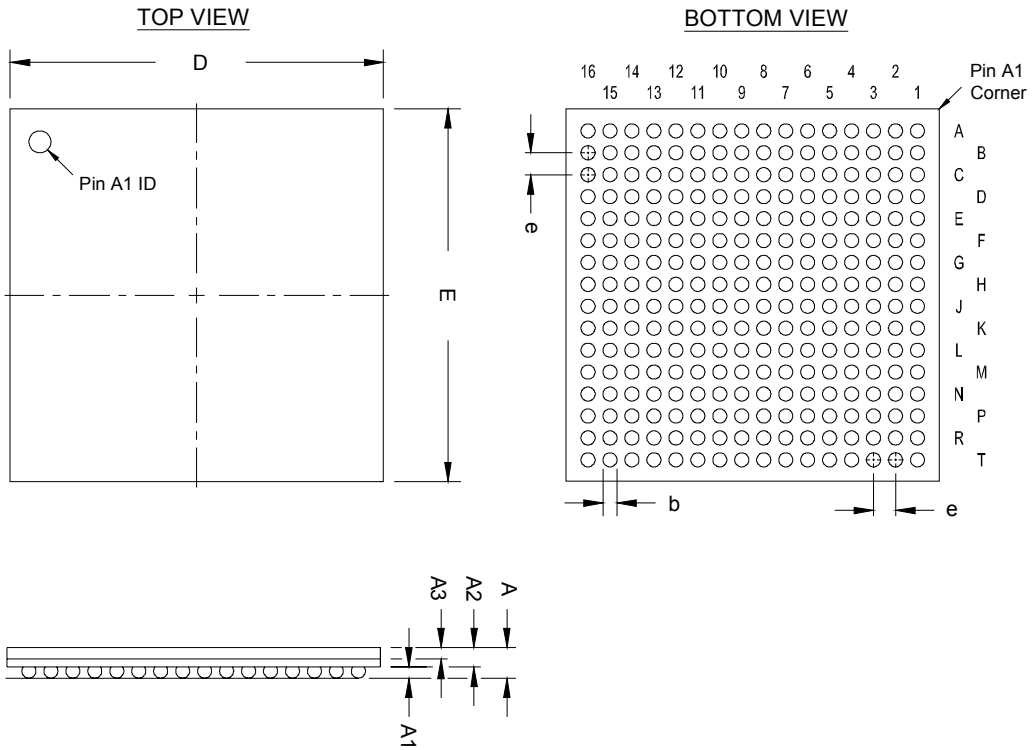
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on the package surface.

Note: This POD is applicable to F256 packages of the Cyclone II product only.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: DAF-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
	Millimeters		
	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	0.45	0.50	0.55
e	1.00 BSC		

Package Outline



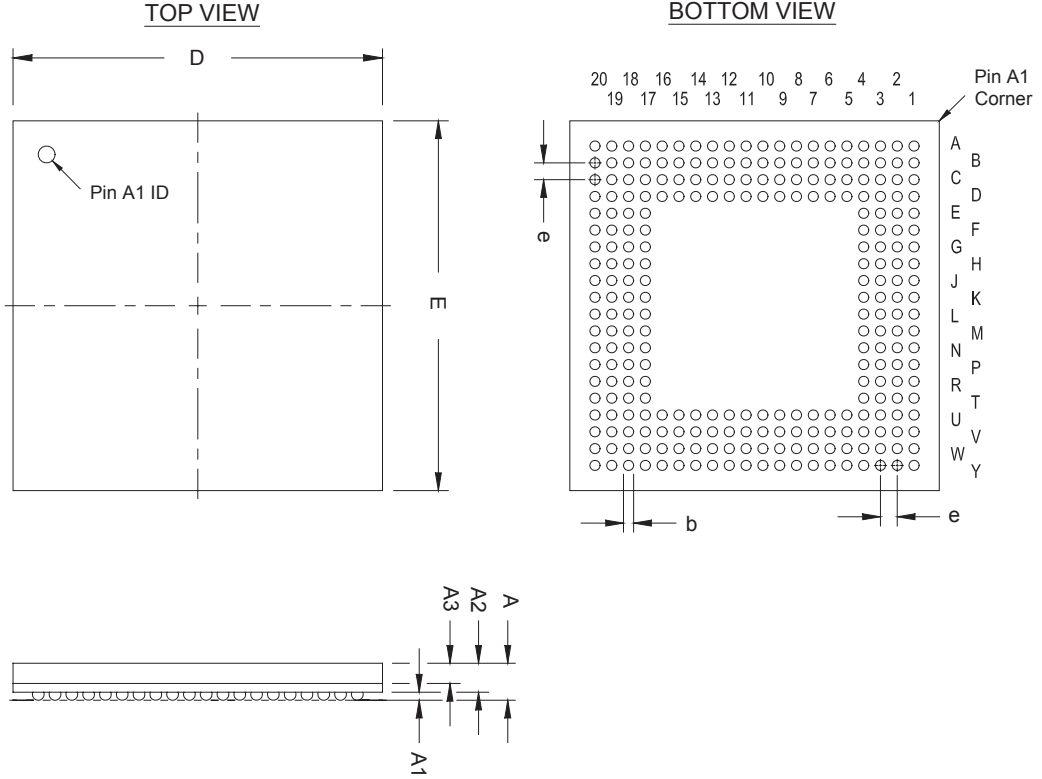
256-Pin Micro FineLine Ball-Grid Array (MBGA) - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-195 Variation: BH
Maximum Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.20
A1	0.15	–	–
A2	–	–	1.00
A3	0.60 REF		
D	11.00 BSC		
E	11.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

Package Outline



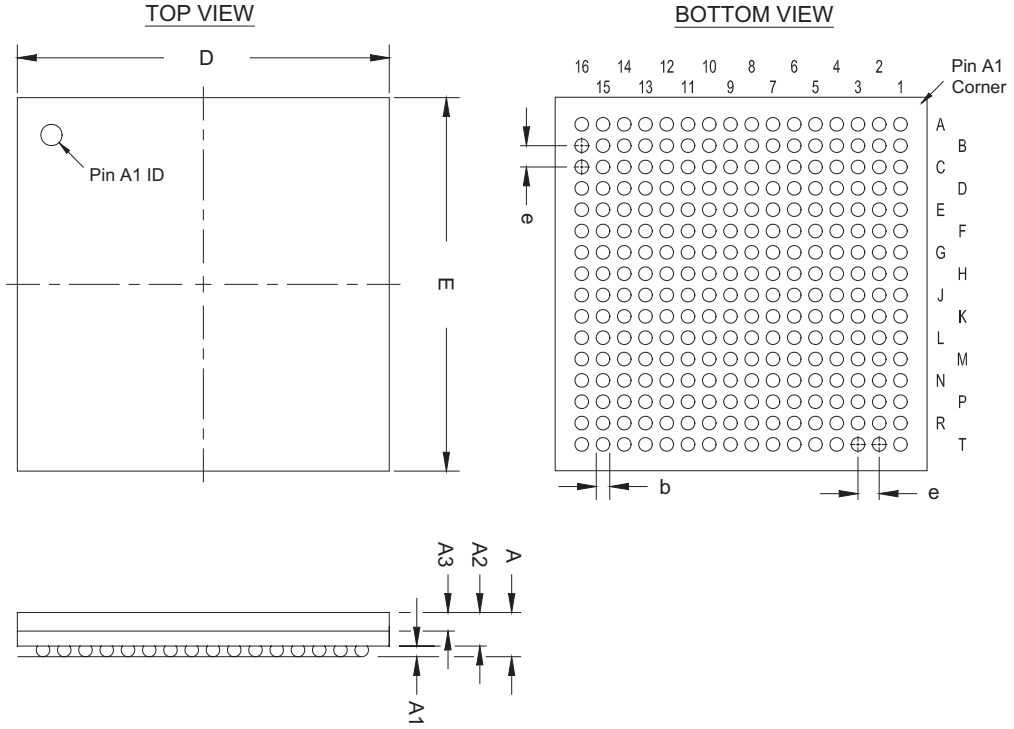
256-Pin Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond

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

<i>Package Information</i>	
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: BAJ-2
Maximum Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.20
A1	0.20	–	–
A2	0.65	–	–
A3	0.80 TYP		
D	14.00 BSC		
E	14.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline



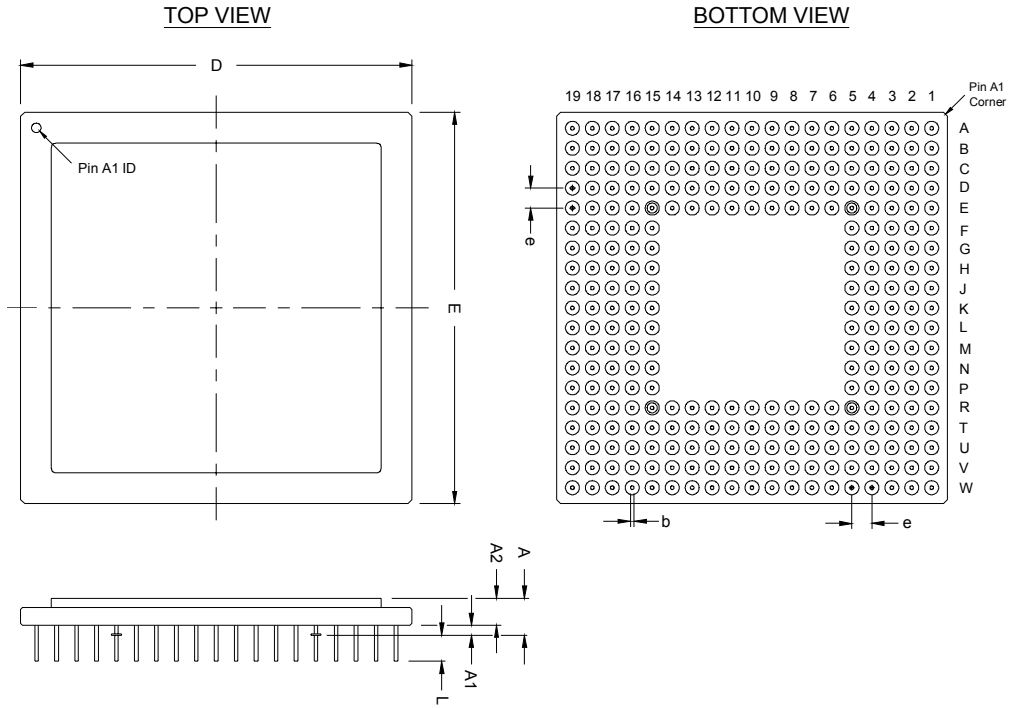
280-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-067 Variation: AL
Maximum Lead Coplanarity	N/A
Weight	29.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.165	0.185	0.205
A1	0.050 TYP		
A2	0.125	0.135	0.145
D	1.940	1.960	1.980
E	1.940	1.960	1.980
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



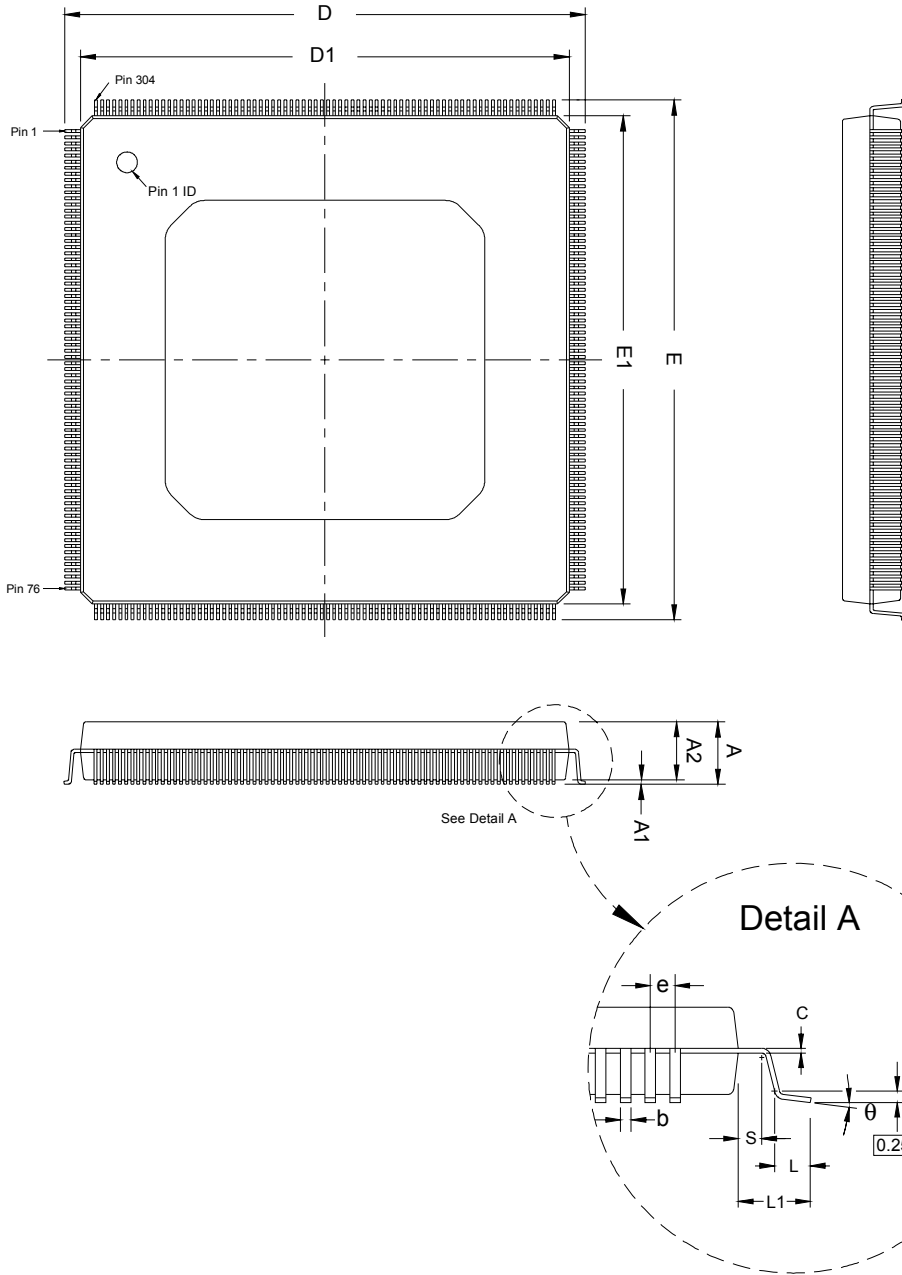
304-Pin Power Quad Flat Pack (RQFP) - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	R
Package Acronym	RQFP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-029 Variation: JA
Maximum Lead Coplanarity	0.003 inches (0.08mm)
Weight	14.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	4.50
A1	0.25	–	0.50
A2	3.55	3.80	4.05
D	42.60 BSC		
D1	40.00 BSC		
E	42.60 BSC		
E1	40.00 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
e	0.50 BSC		
θ	0°	3.5°	8°

Package Outline



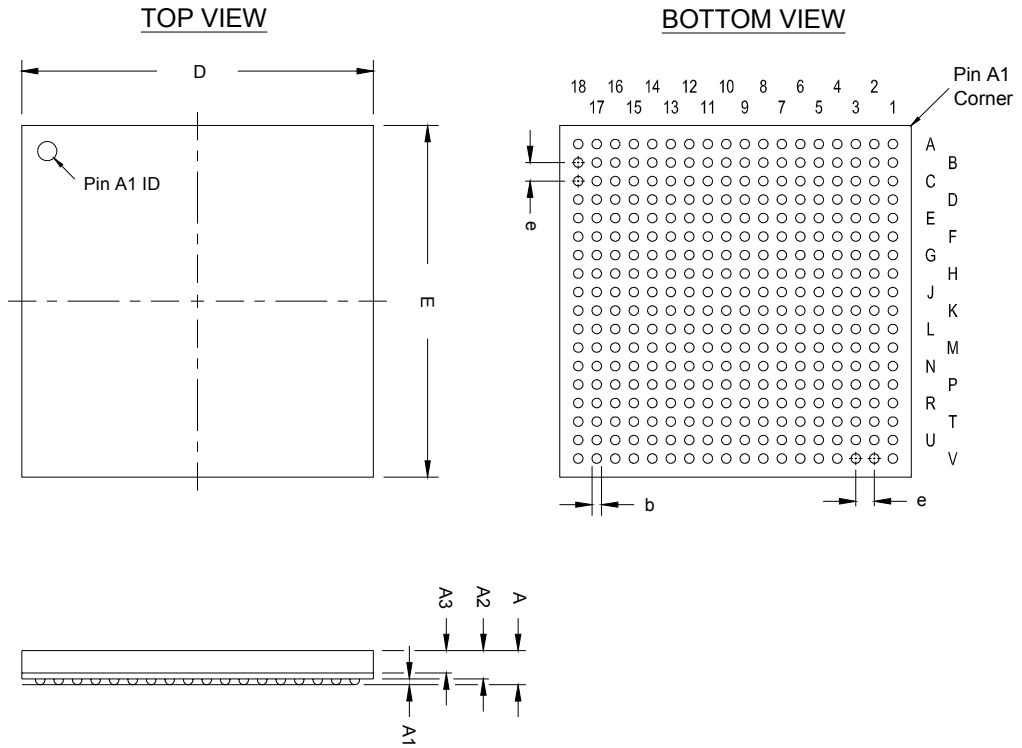
324-Pin FineLine Ball-Grid Array (FBGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAG-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.20
A1	0.30	–	–
A2	–	–	1.80
A3	0.70 REF		
D	19.00 BSC		
E	19.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



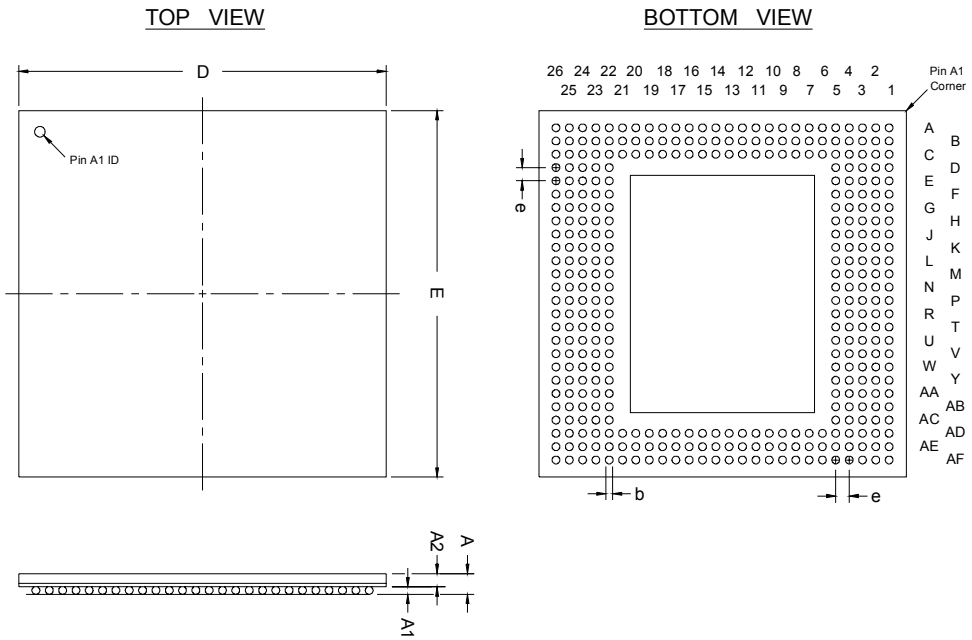
356-Pin Ball-Grid Array (BGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT or tape
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: BAR-2
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	7.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	1.70
A1	0.35	–	–
A2	0.25	–	1.10
D	35.00 BSC		
E	35.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



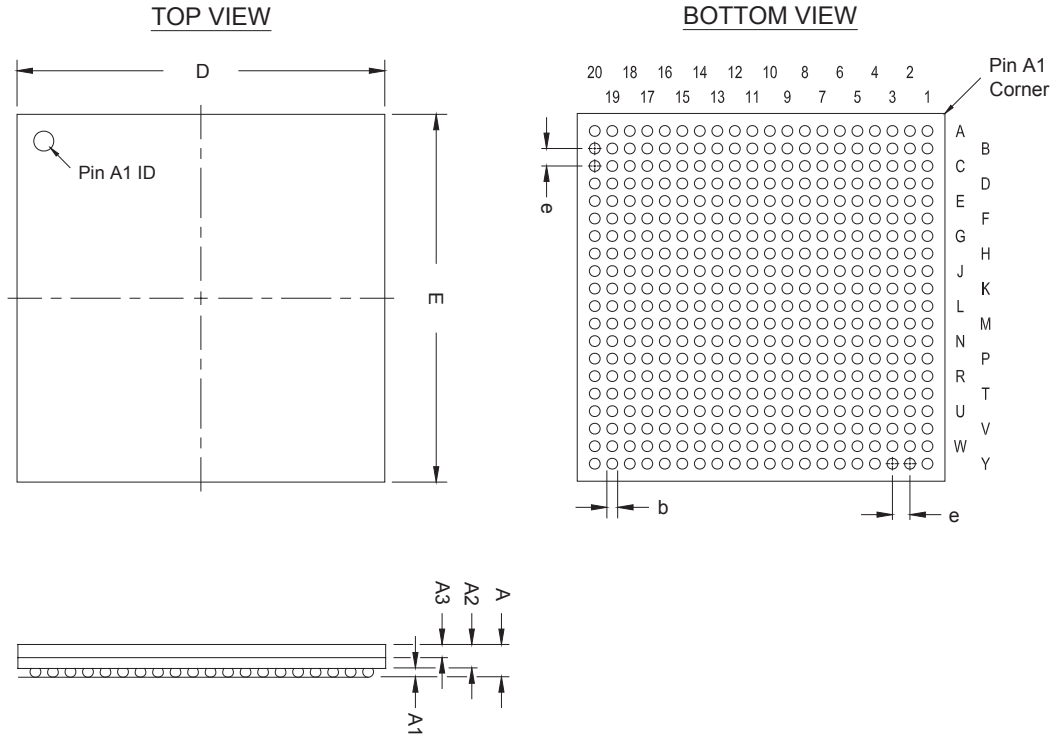
400-Pin FineLine Ball-Grid Array (FBGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAH-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	2.3 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.20
A1	0.30	–	–
A2	–	–	1.80
A3	0.80 REF		
D	21.00 BSC		
E	21.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



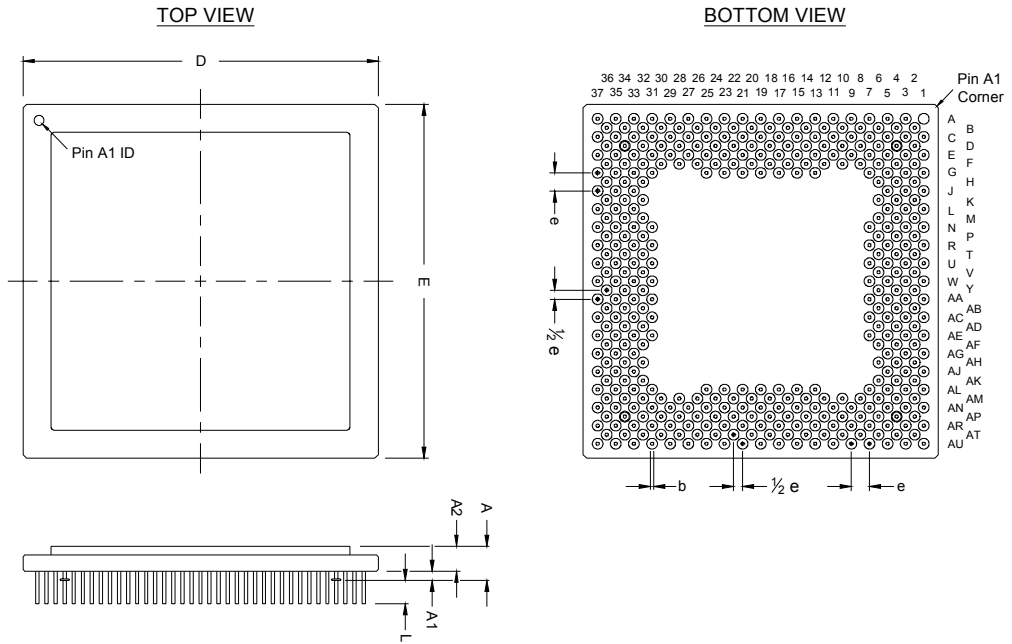
403-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-128 Variation: AL
Maximum Lead Coplanarity	N/A
Weight	47.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	0.157	0.180	0.203
A1	0.050 TYP		
A2	0.117	0.130	0.143
D	1.940	1.960	1.980
E	1.940	1.960	1.980
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



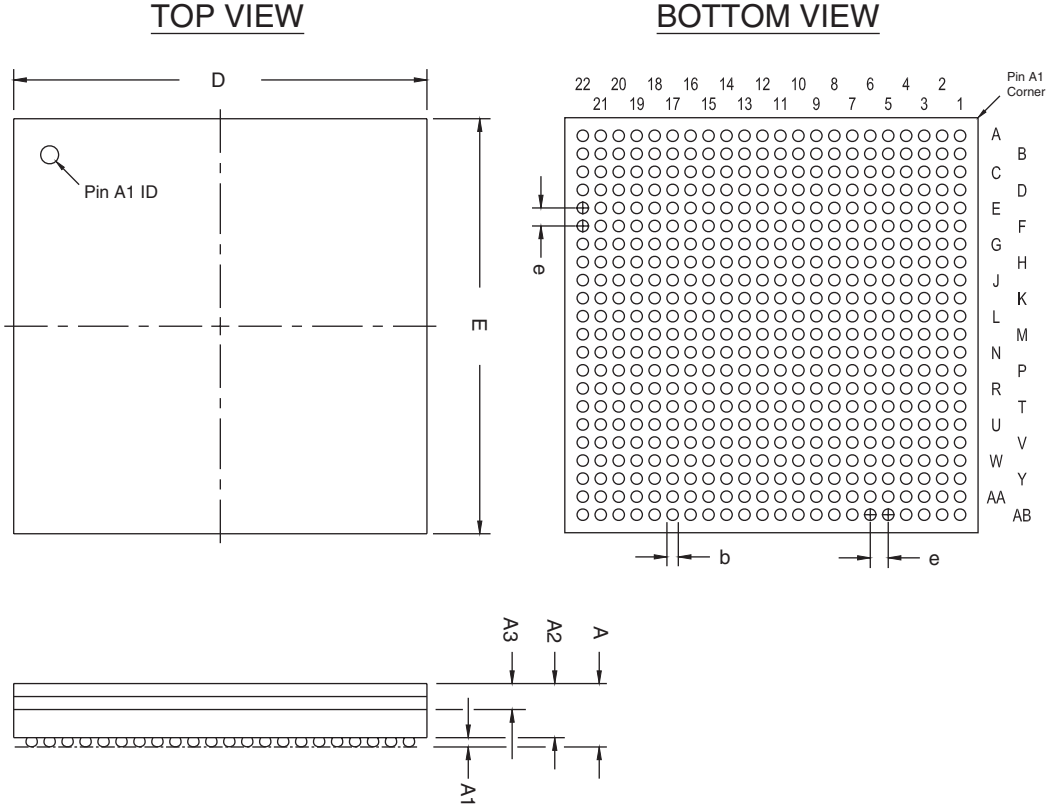
484-Pin FineLine Ball-Grid Array (FBGA) - Option 1 - Flip Chip

- 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.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAJ-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	7.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	23.00 BSC		
E	23.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



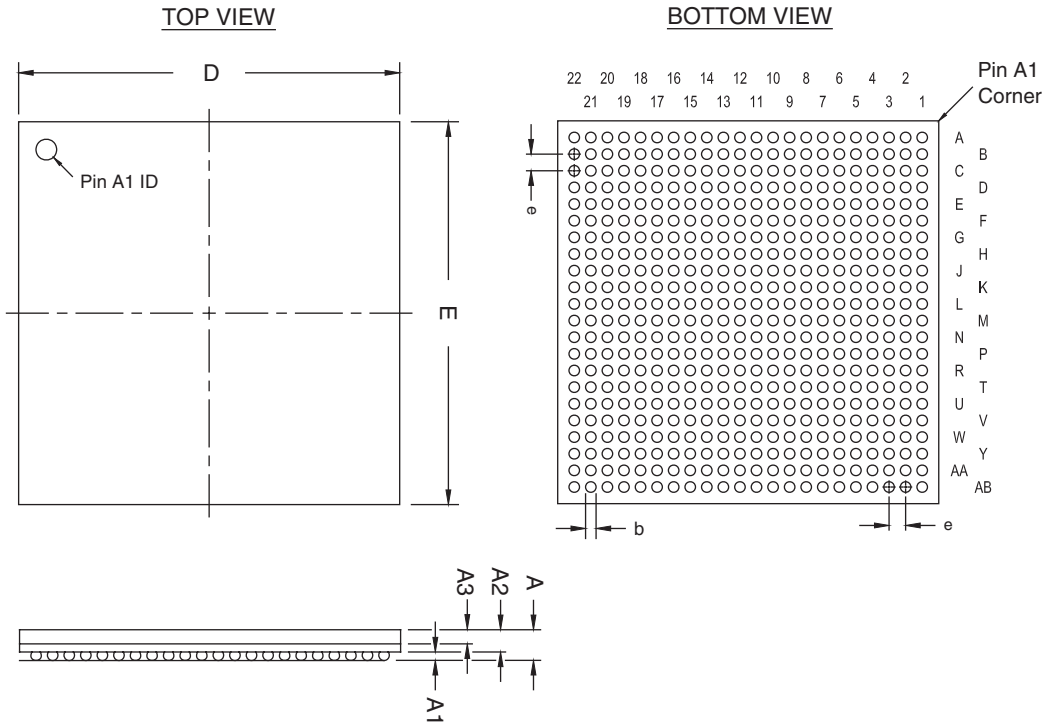
484-Pin FineLine Ball-Grid Array (FBGA) - Option 2 - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAJ-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	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		

Package Outline



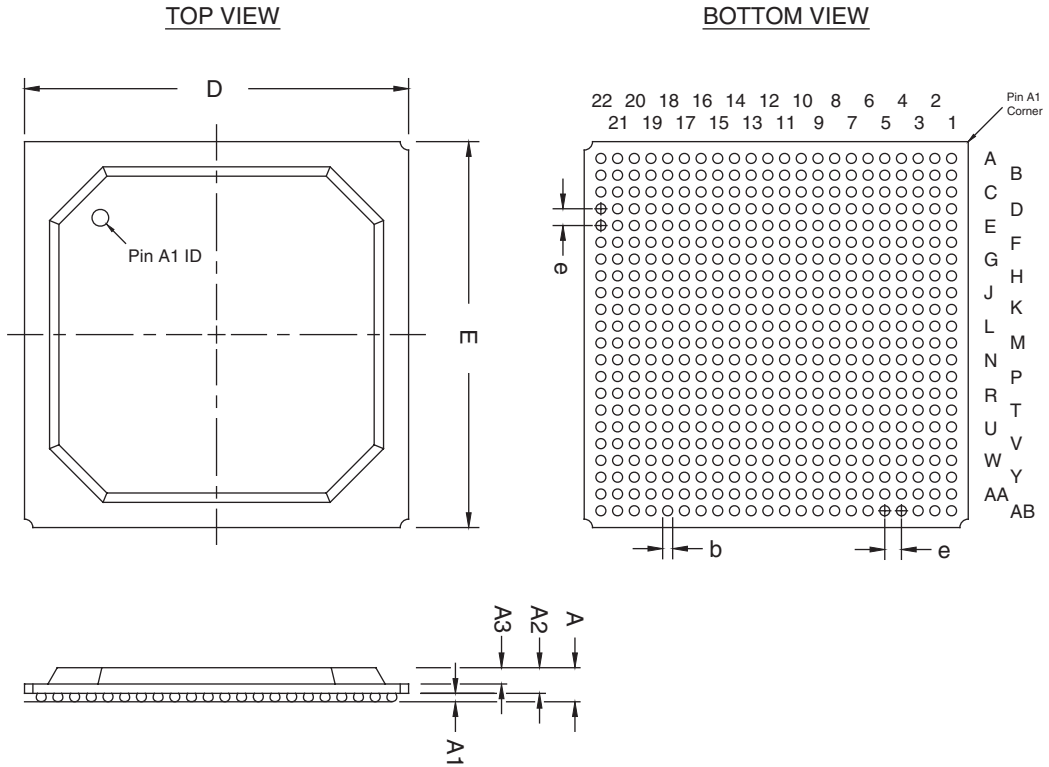
484-Pin FineLine Ball-Grid Array (FBGA) - Option 3 - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAJ-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	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		

Package Outline



484-Pin Hybrid FineLine Ball-Grid Array (HBGA) - Flip Chip

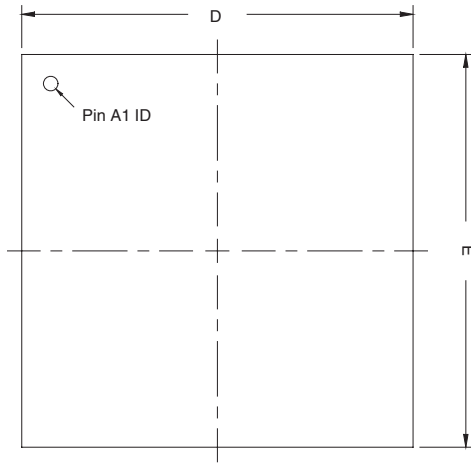
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Package Information	
Description	Specification
Ordering Code Reference	H
Package Acronym	HBGA
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 (0.20mm)
Weight	10.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

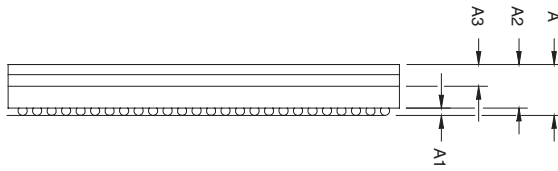
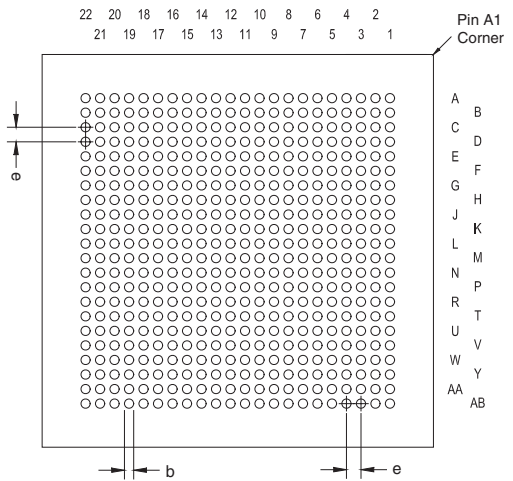
Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	27.00 BSC		
E	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



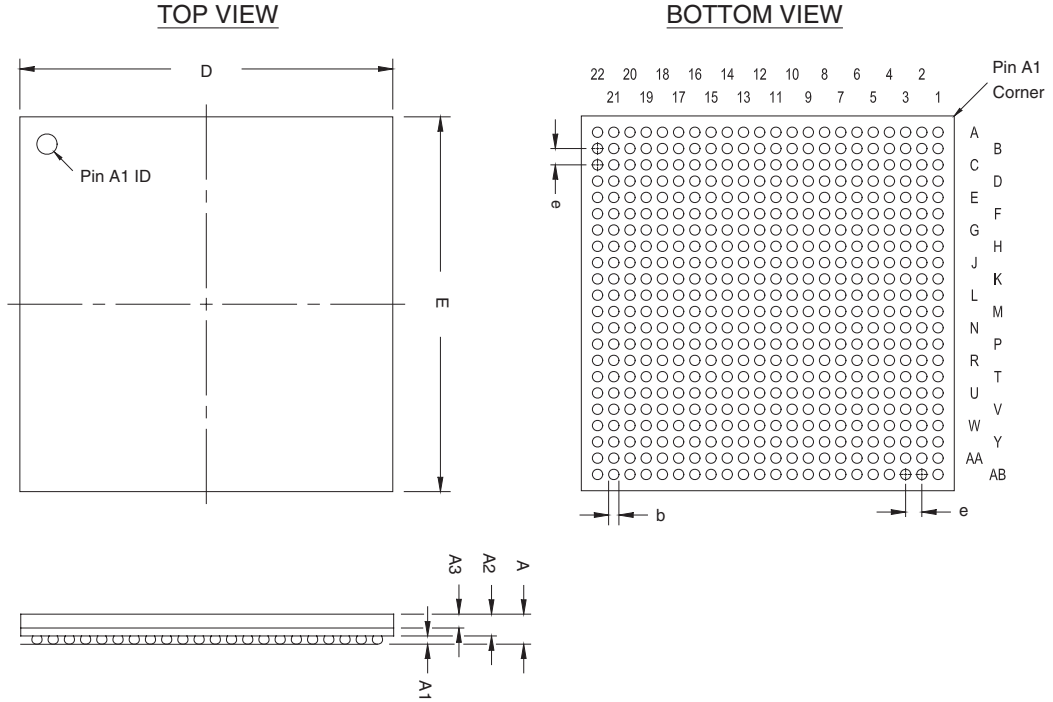
484-Pin Ultra FineLine Ball-Grid Array (UBGA) - Wire Bond

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

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	1.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.20
A1	0.20	–	–
A2	0.65	–	–
A3	0.95 TYP		
D	19.00 BSC		
E	19.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline



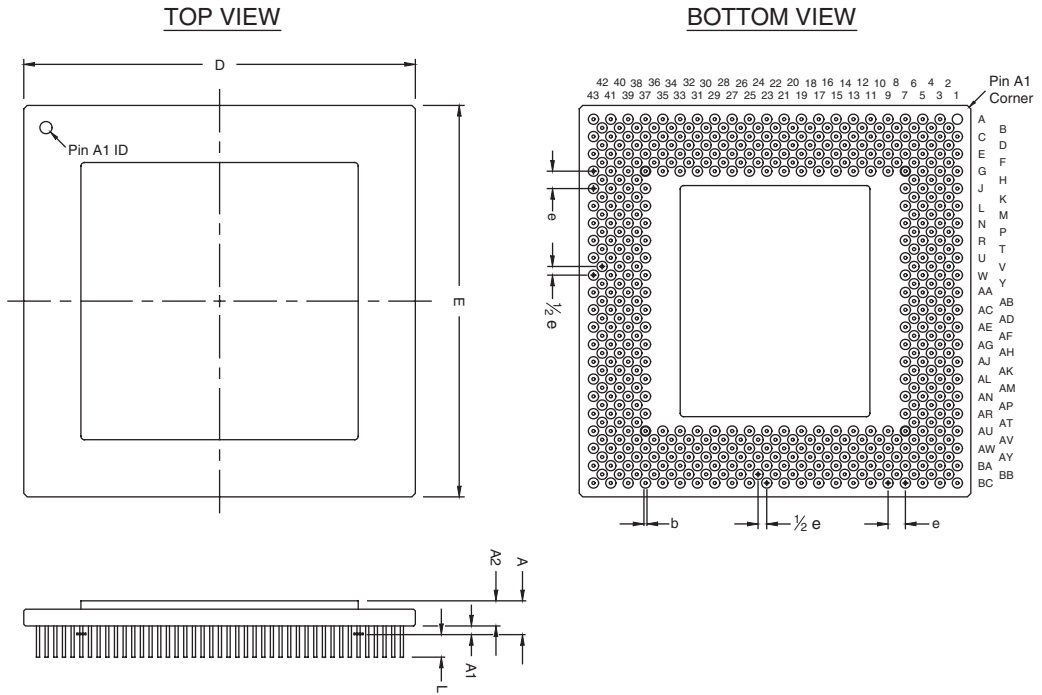
503-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-128 Variation: AN
Maximum Lead Coplanarity	N/A
Weight	59.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
	Inches		
	Min.	Nom.	Max.
A	–	–	0.205
A1	0.050 TYP		
A2	–	–	0.145
D	2.245	2.260	2.275
E	2.245	2.260	2.275
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



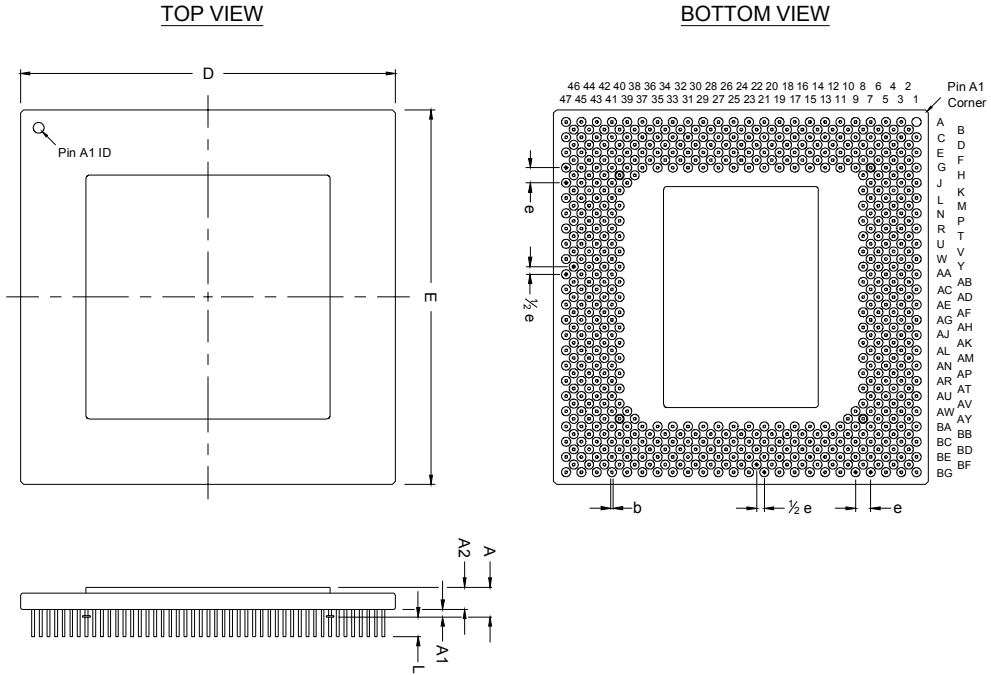
599-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-128 Variation: AP
Maximum Lead Coplanarity	N/A
Weight	69.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.205
A1	0.050 TYP		
A2	–	–	0.145
D	2.445	2.460	2.475
E	2.445	2.460	2.475
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



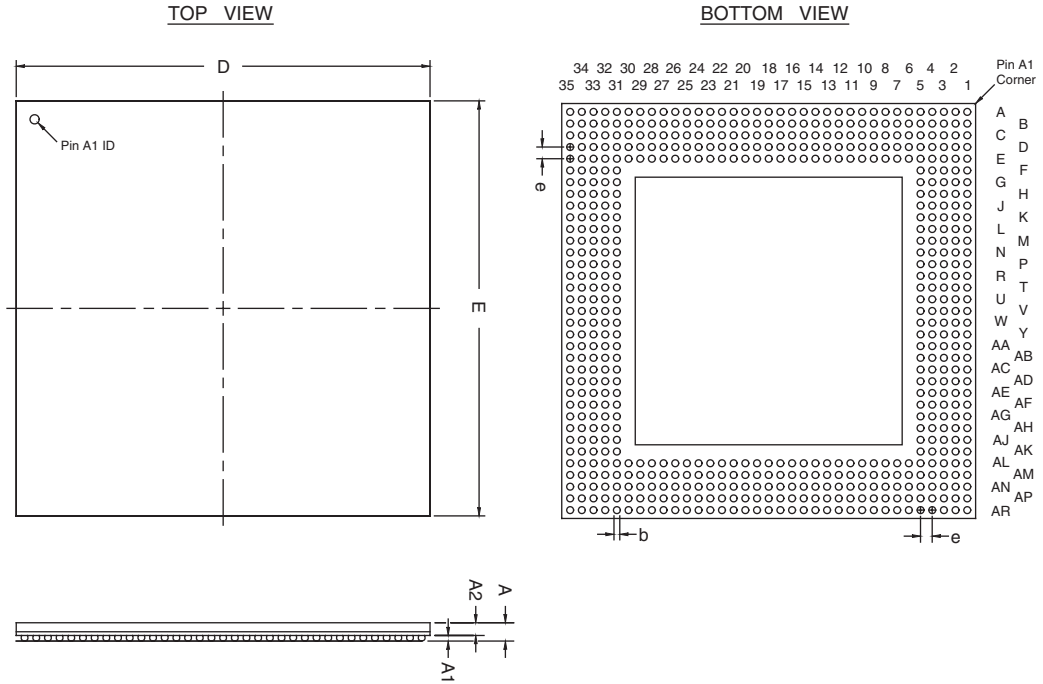
600-Pin Ball-Grid Array (BGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT or tape
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20mm)
Weight	12.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.00
A1	0.35	–	–
A2	0.25	–	1.10
D	45.00 BSC		
E	45.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



652-Pin Ball-Grid Array (BGA) - Option 1 - Flip Chip

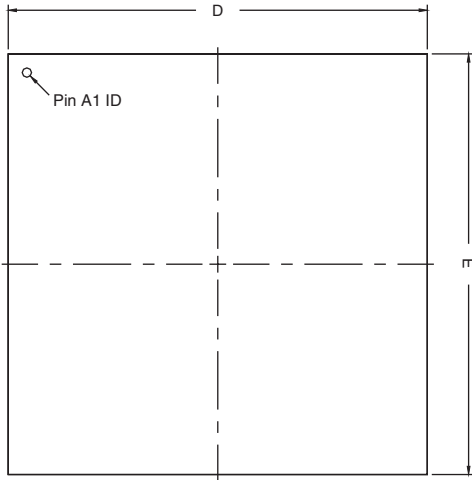
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	23.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

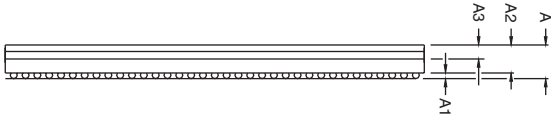
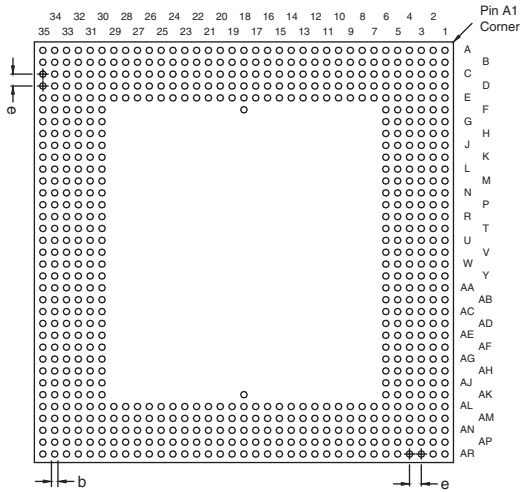
<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	45.00 BSC		
E	45.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



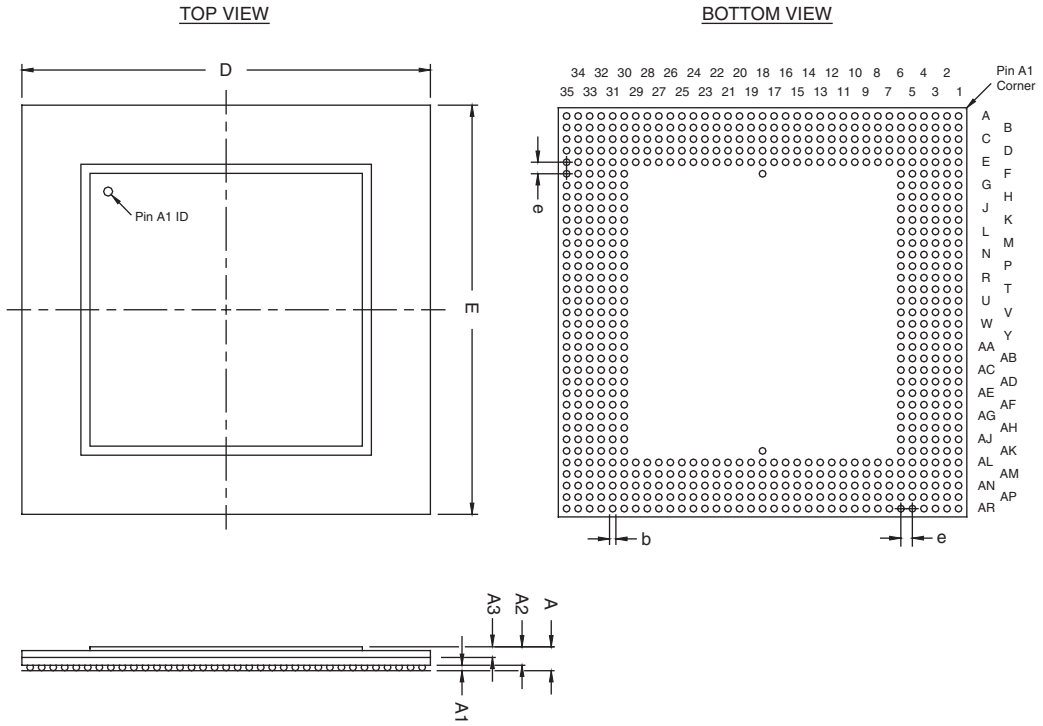
652-Pin Plastic Ball-Grid Array (BGA) - Option 2 - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	9.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.20
A1	0.35	–	–
A2	–	–	2.80
A3	–	–	2.40
D	45.00 BSC		
E	45.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



652-Pin Plastic Ball-Grid Array (BGA) - Option 3 - Wire Bond

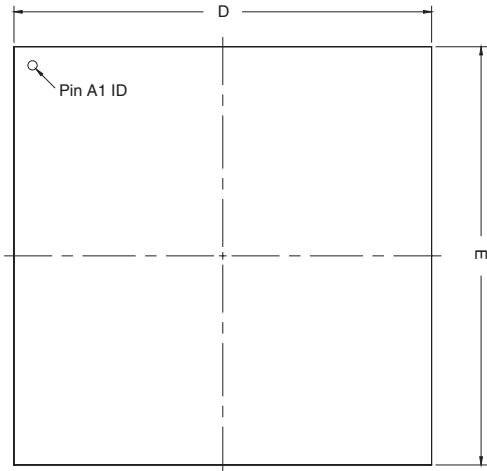
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT or tape
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-192 Variation: BAW-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	12.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

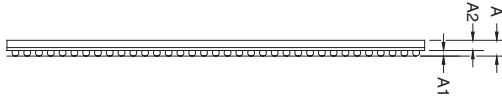
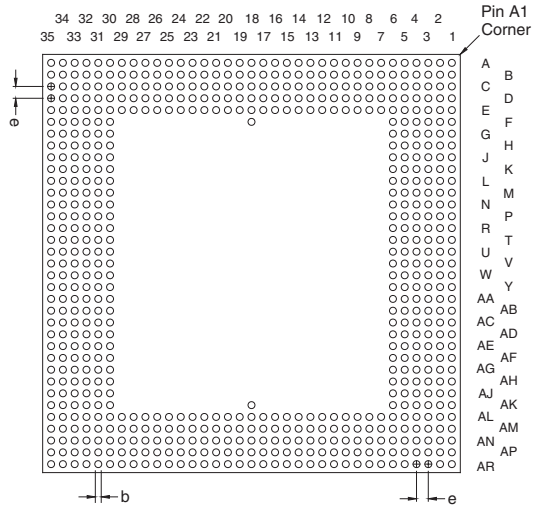
<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.00
A1	0.35	–	–
A2	0.25	–	1.10
D	45.00 BSC		
E	45.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



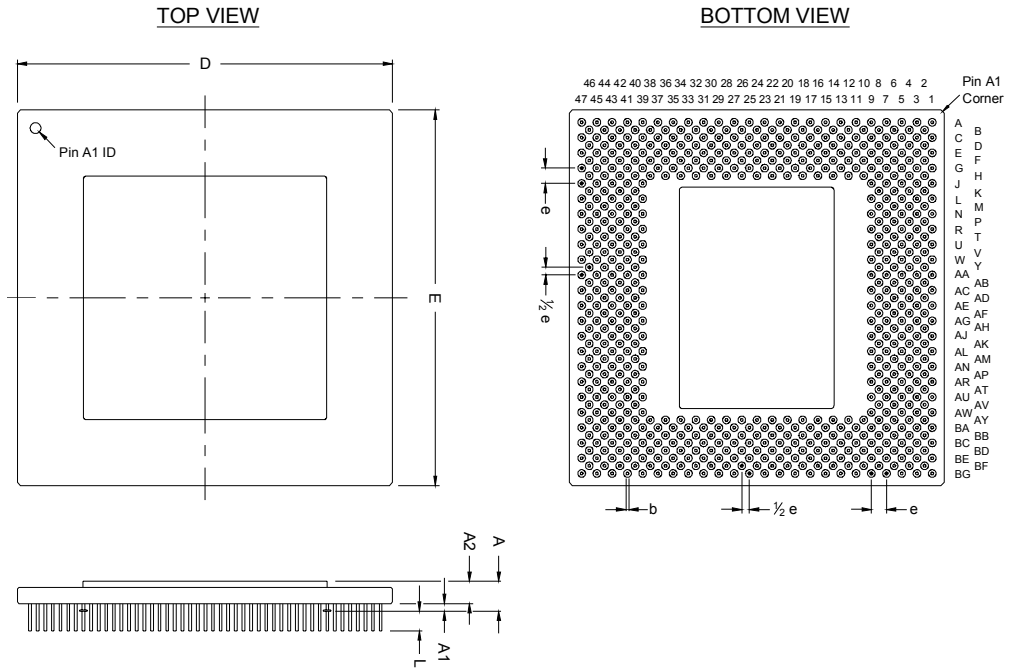
655-Pin Ceramic Pin-Grid Array (PGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-128 Variation: AP
Maximum Lead Coplanarity	N/A
Weight	74.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Inches		
	Min.	Nom.	Max.
A	–	–	0.205
A1	0.050 TYP		
A2	–	–	0.145
D	2.445	2.460	2.475
E	2.445	2.460	2.475
L	0.130 TYP		
b	0.016	0.018	0.020
e	0.100 BSC		

Package Outline



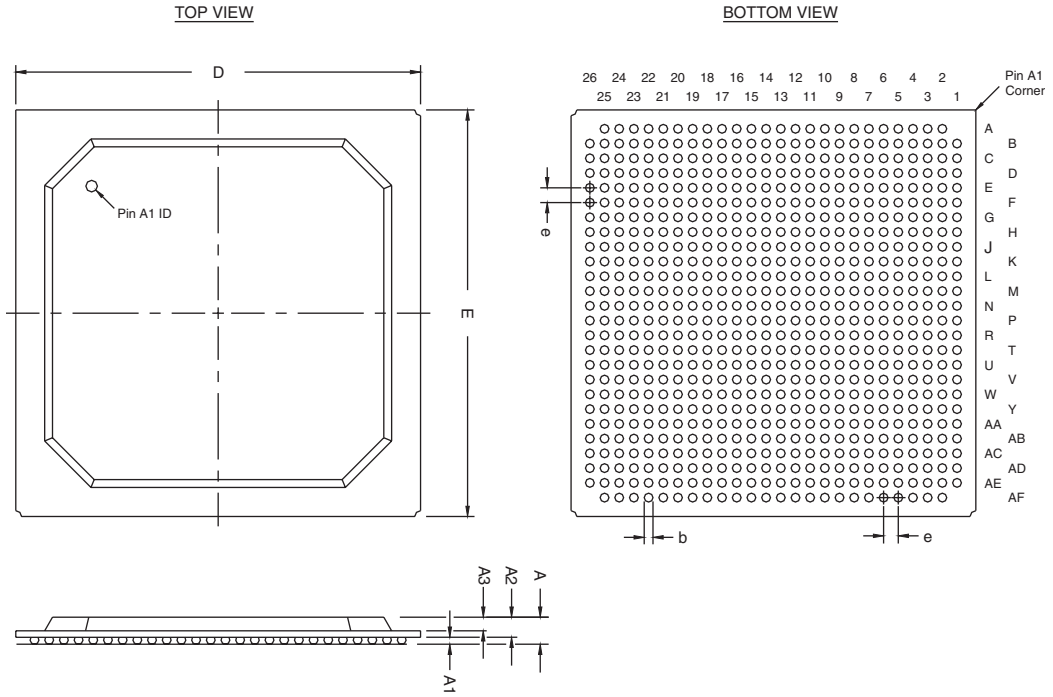
672-Pin Plastic Ball-Grid Array (BGA) - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAR-2
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.35	–	–
A2	–	–	2.20
A3	–	–	1.80
D	35.00 BSC		
E	35.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline



672-Pin FineLine Ball-Grid Array (FBGA) - Option 1 - Flip Chip

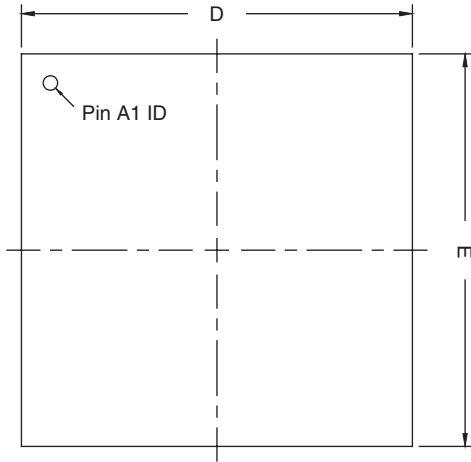
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAL-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	10.2 g
Moisture Sensitivity Level	Printed on moisture barrier bag

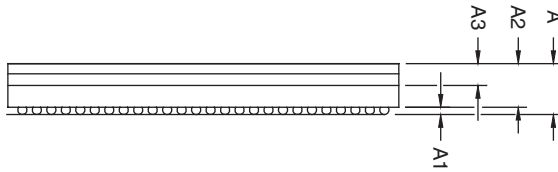
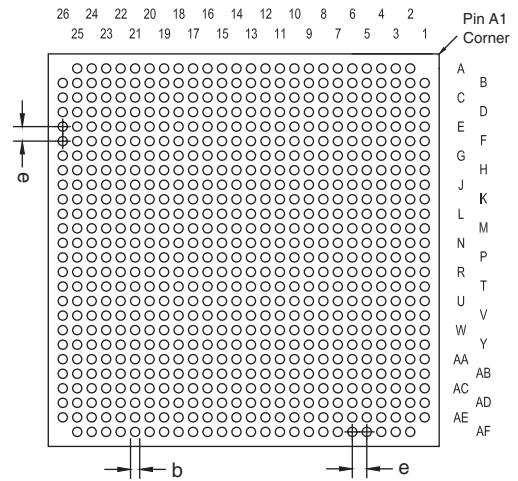
Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	27.00 BSC		
E	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



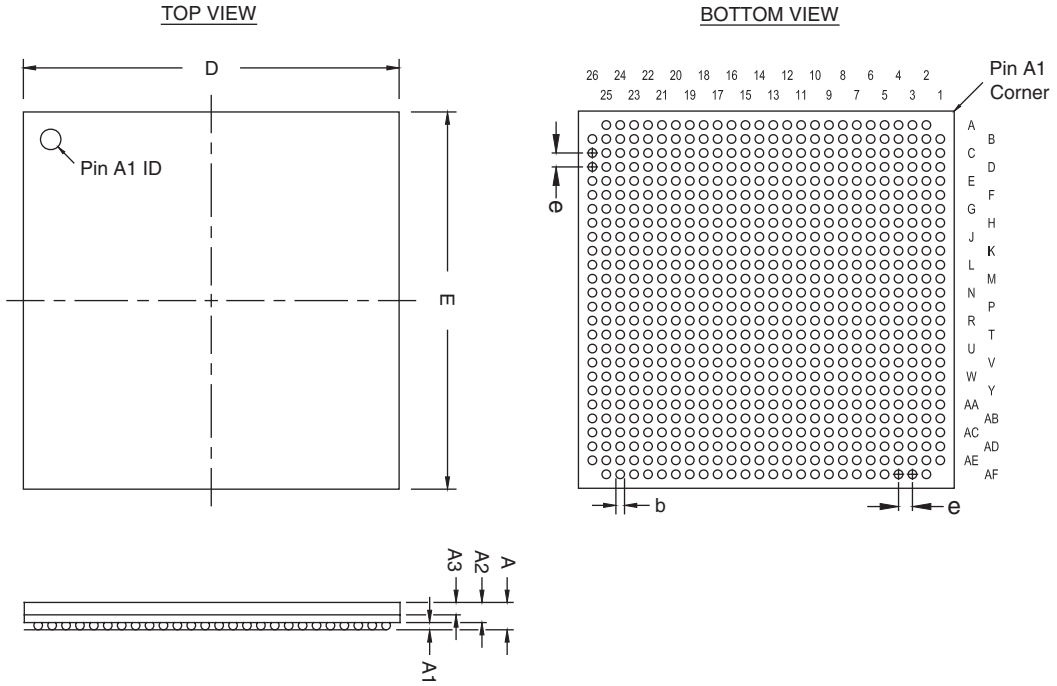
672-Pin FineLine Ball-Grid Array (FBGA) - Option 2 - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAL-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	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		

Package Outline



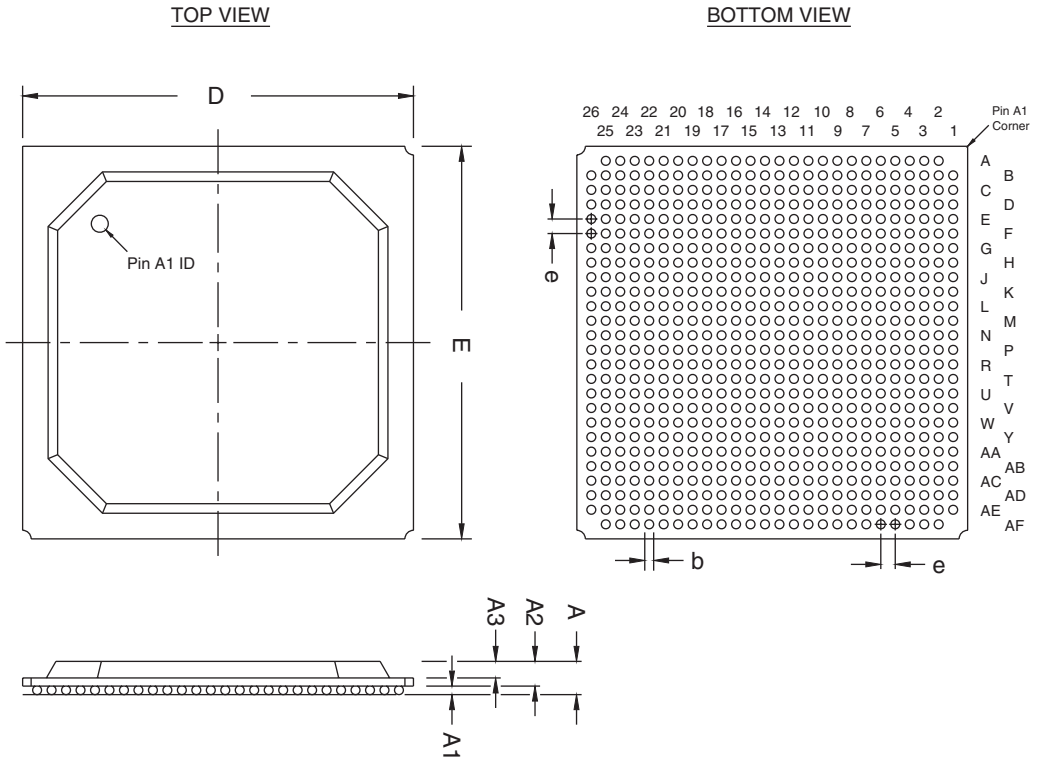
672-Pin FineLine Ball-Grid Array (FBGA) - Option 3 - Wire Bond

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

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAL-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	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		

Package Outline



724-Pin Ball-Grid Array (BGA) - Flip Chip

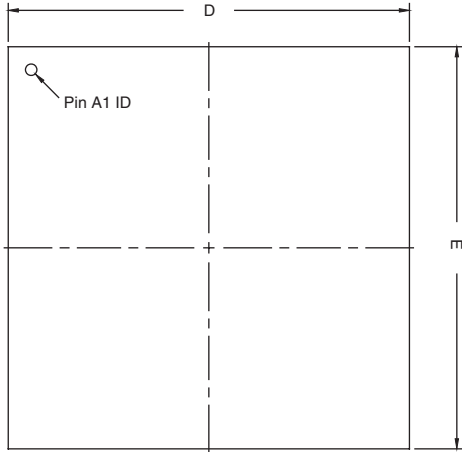
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Package Information	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAR-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	13.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

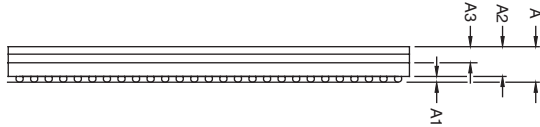
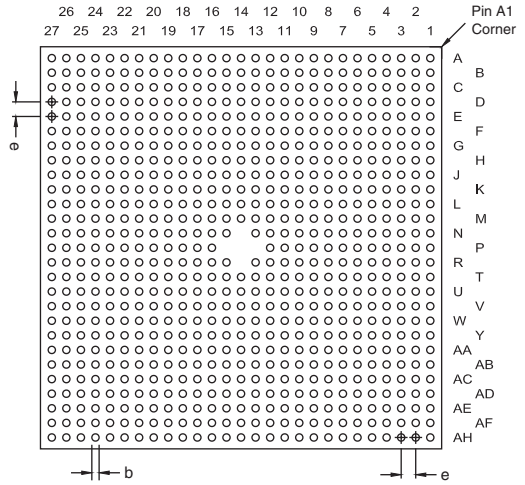
Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	35.00 BSC		
E	35.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



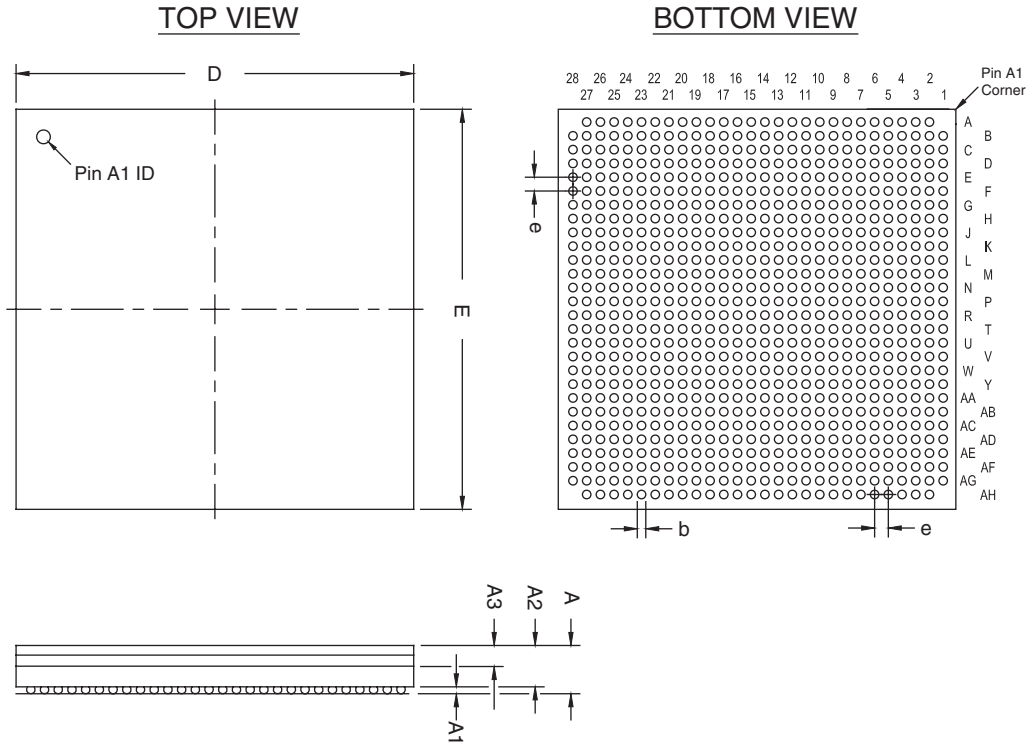
780-Pin FineLine Ball-Grid Array (FBGA) - Option 1 - Flip Chip

- 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.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAM-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.9 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	29.00 BSC		
E	29.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



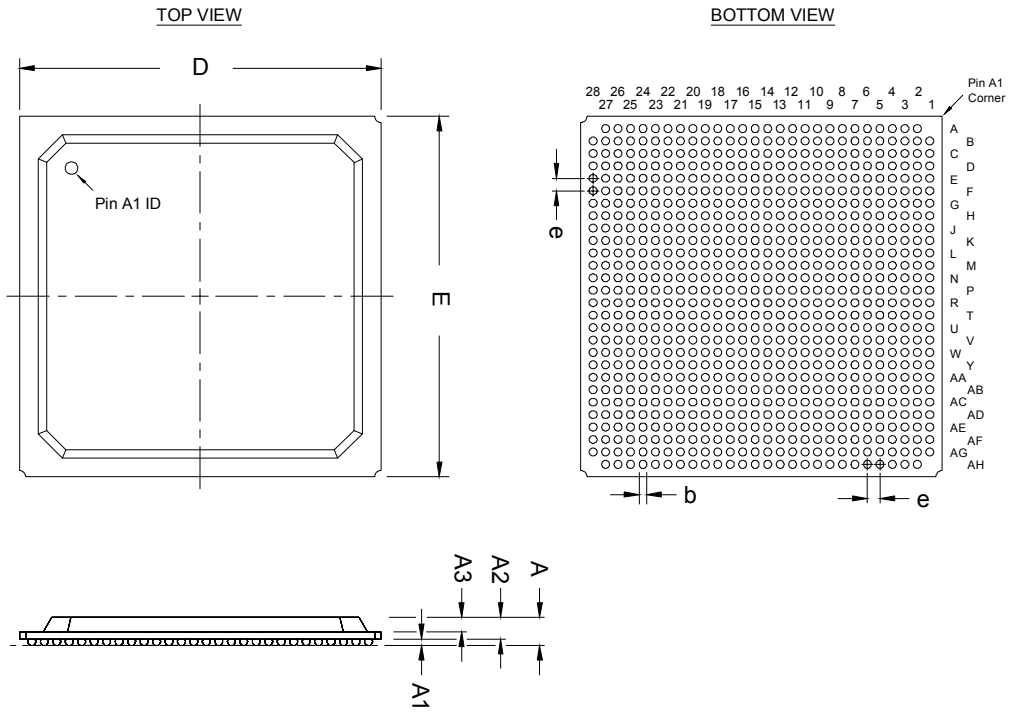
780-Pin FineLine Ball-Grid Array (FBGA) - Option 2 - Wire Bond

- 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.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAM-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.0 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	2.60
A1	0.30	–	–
A2	–	–	2.20
A3	–	–	1.80
D	29.00 BSC		
E	29.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



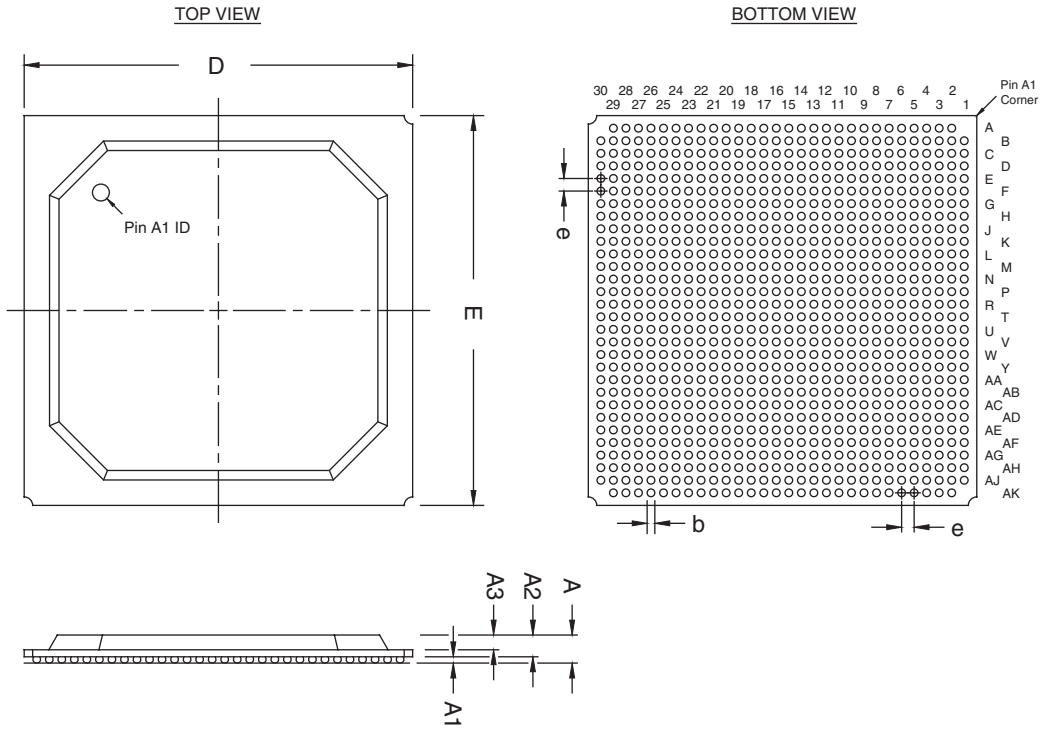
896-Pin FineLine Ball-Grid Array (FBGA) - Wire Bond

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

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAN-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.7 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	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		

Package Outline



956-Pin Ball-Grid Array (BGA) - Flip Chip

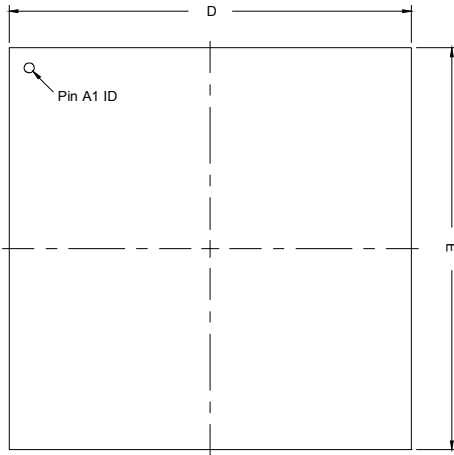
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAU-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	19.6 g
Moisture Sensitivity Level	Printed on moisture barrier bag

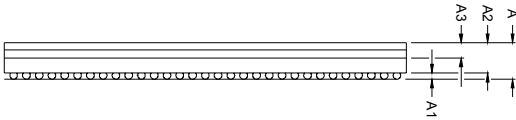
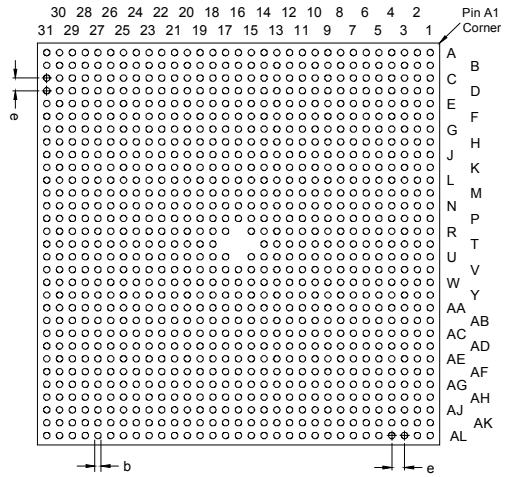
<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	40.00 BSC		
E	40.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



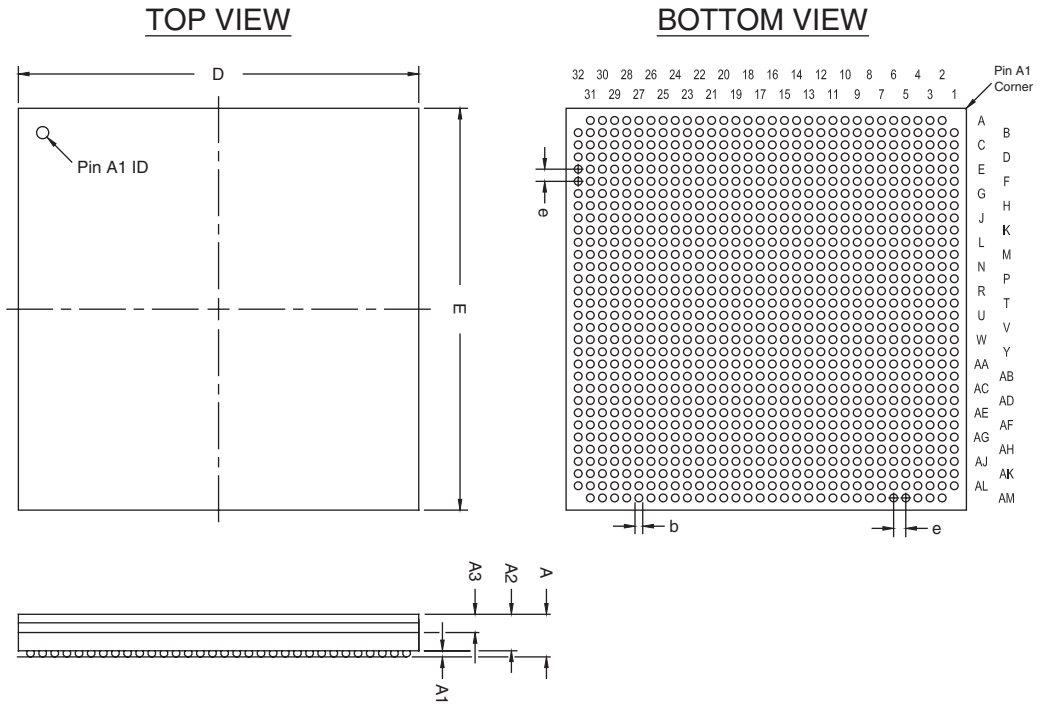
1020-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip

- 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.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAP-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.1 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	33.00 BSC		
E	33.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



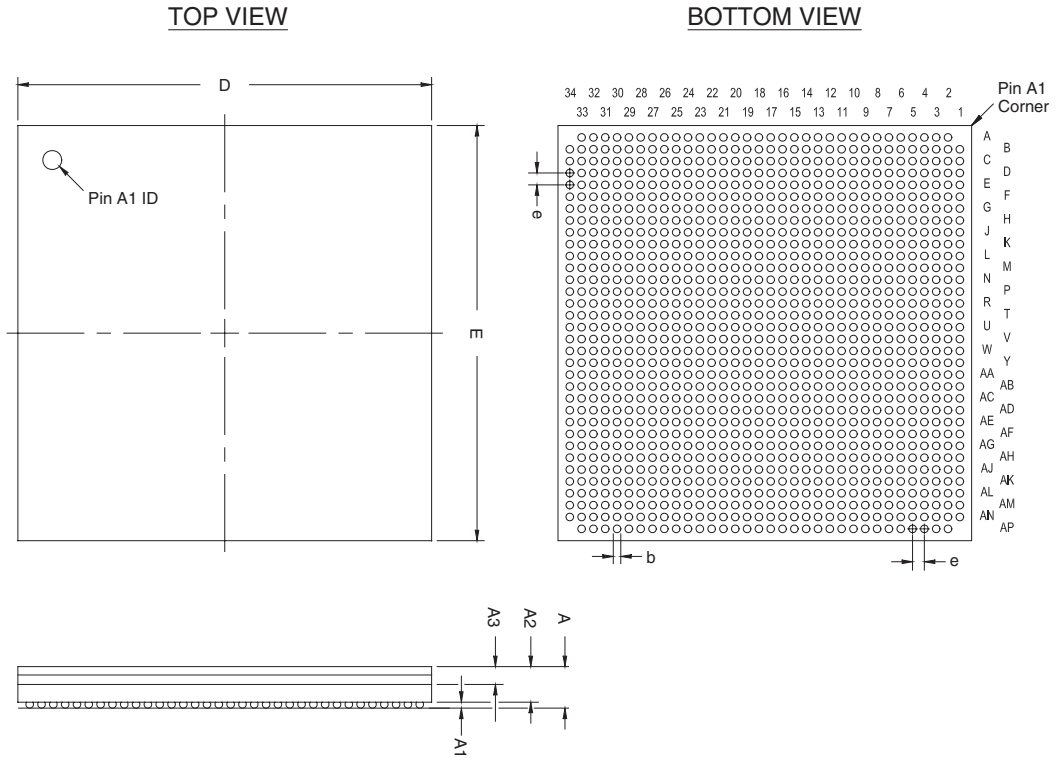
1152-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip

- 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.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAR-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	15.8 g
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



1508-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip

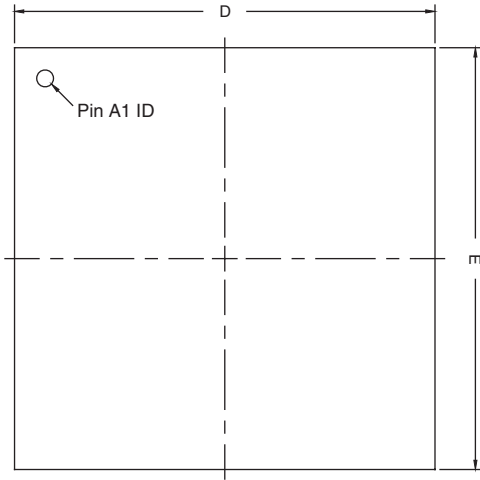
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAU-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	20.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

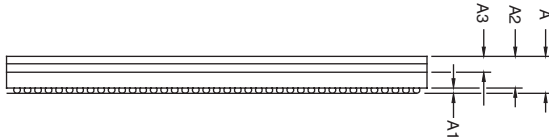
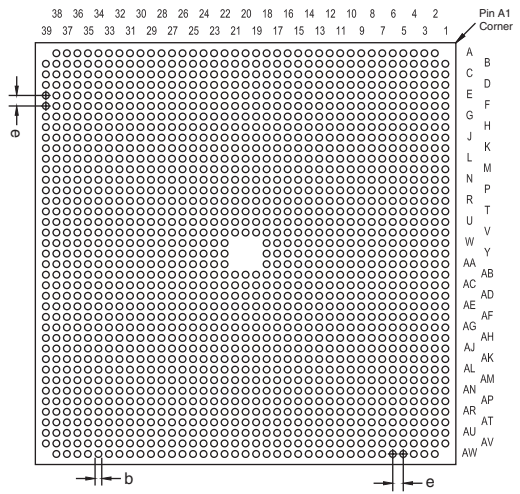
<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW



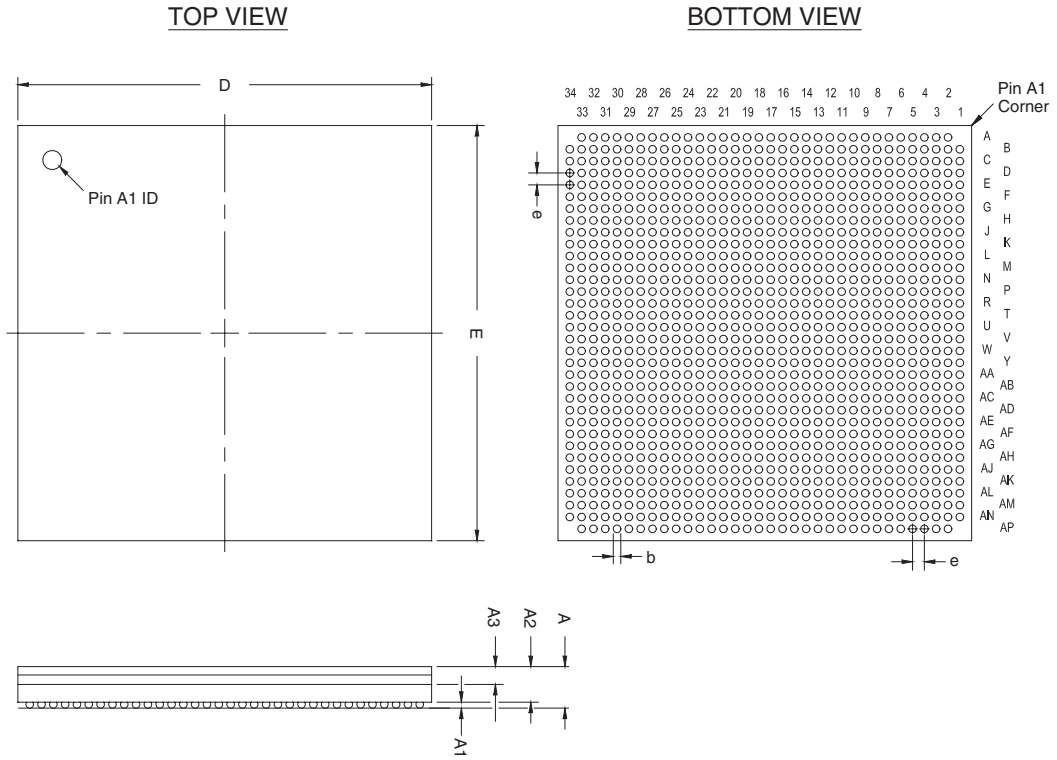
1517-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip

- 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.

<i>Package Information</i>	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAR-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	20.4 g
Moisture Sensitivity Level	Printed on moisture barrier bag

<i>Package Outline Dimension Table</i>			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



1760-Pin FineLine Ball-Grid Array (FBGA) - Flip Chip

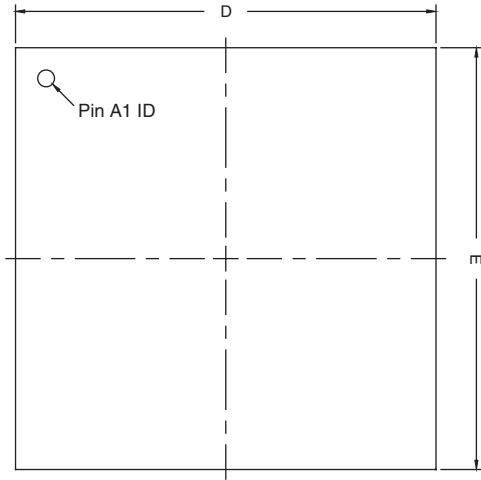
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

Package Information	
Description	Specification
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAV-1
Maximum Lead Coplanarity	0.008 inches (0.20 mm)
Weight	22.5 g
Moisture Sensitivity Level	Printed on moisture barrier bag

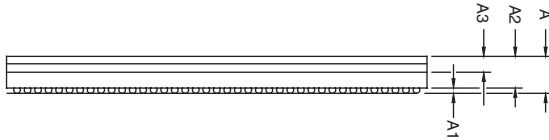
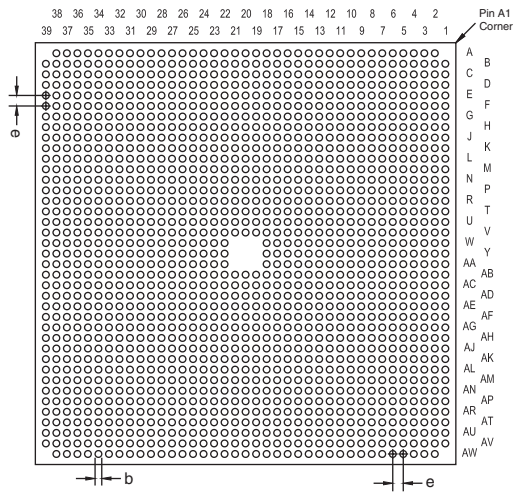
Package Outline Dimension Table			
Symbol	Millimeters		
	Min.	Nom.	Max.
A	–	–	3.50
A1	0.30	–	–
A2	0.25	–	3.00
A3	–	–	2.50
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW



BOTTOM VIEW





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I.S. EN ISO 9001
