Altera Device Package Information Data Sheet

DS-PKG-16.0

Introduction

This data sheet provides package information about Altera® devices, and includes the following sections:

- Device and Package Cross Reference
- Thermal Resistance (starting on page 21)
- Package Outlines (starting on page 49)

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

For information about trays, tubes, and dry packs, refer to *AN 71: Guidelines for Handling J-Lead, QFP, and BGA Devices*.

Device and Package Cross Reference

Table 2 through Table 27 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® series FPGAs
- Stratix® series FPGAs
- Cyclone® series FPGAs
- MAX® series CPLDs
- HardCopy® series ASICs
- APEX™ series FPGAs
- ACEX® 1K FPGAs
- Mercury™ FPGAs
- FLEX® series FPGAs
- Excalibur™ FPGA
- Enhanced configuration devices

Table 1. Arria II GX Devices

Device	Package	Pins
EP2AGX45	UBGA, Flip Chip	358
	FBGA, Flip Chip	572
	FBGA, Flip Chip	780
EP2AGX65	UBGA, Flip Chip	358
	FBGA, Flip Chip	572
	FBGA, Flip Chip	780
EP2AGX95	FBGA, Flip Chip	572
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP2AGX125	FBGA, Flip Chip	572
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP2AGX190	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152
EP2AGX260	FBGA, Flip Chip	780
	FBGA, Flip Chip	1152

Table 2. Arria GX Devices

Device	Package	Pins
EP1AGX20	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP1AGX35	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP1AGX50	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP1AGX60	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP1AGX90	FBGA, Flip Chip	1,152

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Table 3. Stratix IV Devices (Part 1 of 2)

Device	Package	Pins
EP4S40G2	FBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
EP4S40G5	HBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
EP4S100G2	FBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
EP4S100G3	FBGA, Flip Chip (Option 2)	1,932
EP4S100G4	FBGA, Flip Chip (Option 2)	1,932
EP4S100G5	HBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
	FBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,932
EP4SGX70	FBGA, Flip Chip (Option 3)	780
	FBGA, Flip Chip (Option 2)	1,152
EP4SGX110	FBGA, Flip Chip (Option 3)	780
	FBGA, Flip Chip (Option 2)	1,152
EP4SGX180	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip *(1)* (ES—16 channel and 24 channel, Option 1, Production—16 channel, Option 2; 24 channel, Option 1)	1,152
	FBGA, Flip Chip (Option 2)	1,517
EP4SGX230	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip *(1)* (ES—16 channel and 24 channel, Option 1, Production—16 channel, Option 2; 24 channel, Option 1)	1,152
	FBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
EP4SGX290	33 MM SQ HBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip (FF35) (Option 2)	1,152
	FBGA, Flip Chip (HF35) (Option 1)	1,152
	FBGA, Flip Chip (Option 2)	1,517
	FBGA, Flip Chip (Option 2)	1,760
	FBGA, Flip Chip (Option 2)	1,932
EP4SGX360	33 MM SQ HBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip (FF35) (Option 2)	1,152
	FBGA, Flip Chip (HF35) (Option 1)	1,152
	FBGA, Flip Chip (Option 2)	1,517
	FBGA, Flip Chip (Option 2)	1,760
	FBGA, Flip Chip (Option 2)	1,932
EP4SGX530	42.5 MM SQ HBGA, Flip Chip (ES—Option 1, Production—Option 3)	1,152
	42.5 MM SQ HBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
	FBGA, Flip Chip (Option 2)	1,760
	FBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,932
EP4SE230	FBGA, Flip Chip (Option 1)	780
EP4SE360	FBGA, Flip Chip (Option 1)	1,152
	33 MM SQ HBGA, Flip Chip (Option 1)	1,152

Table 3. Stratix IV Devices (Part 2 of 2)

Device	Package	Pins
EP4SE530	42.5 MM SQ HBGA, Flip Chip (ES—Option 1, Production—Option 3)	1,152
	42.5 MM SQ HBGA, Flip Chip (ES—Option 1, Production—Option 2)	1,517
	FBGA, Flip Chip (Option 2)	1,760
EP4SE820	40 MM SQ HBGA, Flip Chip (Option 4)	1,152
	FBGA, Flip Chip (Option 2)	1,517
	FBGA, Flip Chip (Option 2)	1,760

Note to Table 3:

(1) EP4SGX110, EP4SGX180, EP4SGX230, EP4SGX290, and EP4SGX360 devices are available in two 1152-pin packages: the 16 transceiver channel version and the 24 transceiver channel version.

Table 4. Stratix III Devices

Device	Package	Pins
EP3SL50	FBGA, Flip Chip	484
	FBGA, Flip Chip (Option 1)	780
EP3SL70	FBGA, Flip Chip	484
	FBGA, Flip Chip (Option 1)	780
EP3SL110	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
EP3SL150	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
EP3SL200	HBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
EP3SL340	HBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
	FBGA, Flip Chip	1,760
EP3SE50	FBGA, Flip Chip	484
	FBGA, Flip Chip (Option 1)	780
EP3SE80	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
EP3SE110	FBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
EP3SE260	HBGA, Flip Chip (Option 1)	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517

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Table 5. 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	HBGA, 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 6. Stratix II GX Devices

Device	Package	Pins
EP2SGX30	FBGA, Flip Chip	780
EP2SGX60	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP2SGX90	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,508
EP2SGX130	FBGA, Flip Chip	1,508

Table 7. Stratix GX Devices

Device	Package	Pins
EP1SGX10	FBGA, Flip Chip	672
EP1SGX25	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP1SGX40	FBGA, Flip Chip	1,020

Table 8. Stratix Devices

Device	Package	Pins
EP1S10	FBGA, Flip Chip	484
	BGA, Wire Bond	672
	FBGA, Wire Bond (Option 2)	672
	FBGA, Flip Chip	780
EP1S20	FBGA, Flip Chip	484
	BGA, Wire Bond	672
	FBGA, Wire Bond (Option 2)	672
	FBGA, Flip Chip	780
EP1S25	BGA, Wire Bond	672
	FBGA, Wire Bond (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
EP1S80	BGA, Flip Chip	956
	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508

Table 9. Cyclone IV Devices (Part 1 of 2)

Device	Package	Pins
EP4CE6	EQFP, Wire Bond	144
	FBGA, Wire Bond	256
EP4CE10	EQFP, Wire Bond	144
	FBGA, Wire Bond	256
EP4CE15	FBGA, Wire Bond	256
	FBGA, Wire Bond	484
EP4CE30	FBGA, Wire Bond	484
	FBGA, Wire Bond	780
EP4CE40	FBGA, Wire Bond	484
	FBGA, Wire Bond	780

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Table 9. Cyclone IV Devices (Part 2 of 2)

Device	Package	Pins
EP4CE55	FBGA, Wire Bond	484
	FBGA, Wire Bond	780
EP4CE75	FBGA, Wire Bond	484
	FBGA, Wire Bond	780
EP4CE115	FBGA, Wire Bond	484
	FBGA, Wire Bond	780
EP4CE155	FBGA, Wire Bond	484
	FBGA, Wire Bond	780

Table 10. Cyclone IV GX Devices

Device	Package	Pins
EP4CGX15	QFN, Wire Bond	148
	FBGA, Wire Bond	169
EP4CGX22	FBGA, Wire Bond	169
	FBGA, Wire Bond	324
EP4CGX30	FBGA, Wire Bond	169
	FBGA, Wire Bond	324
	FBGA, Wire Bond	484
EP4CGX50	UBGA, Wire Bond	484
	FBGA, Wire Bond	672
EP4CGX75	FBGA, Wire Bond	484
	FBGA, Wire Bond	672
EP4CGX110	FBGA, Wire Bond	484
	FBGA, Wire Bond	672
	FBGA, Wire Bond	896
EP4CGX150	FBGA, Wire Bond	484
	FBGA, Wire Bond	672
	FBGA, Wire Bond	896

Table 11. Cyclone III LS Devices (Part 1 of 2)

Device	Package	Pins
EP3CLS70	FBGA, Wire Bond (Option 2)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 2)	780
EP3CLS100	FBGA, Wire Bond (Option 2)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option2)	780
EP3CLS150	FBGA, Wire Bond (Option 2)	484
	FBGA, Wire Bond (Option 2)	780

Table 11. Cyclone III LS Devices (Part 2 of 2)

Device	Package	Pins
EP3CLS200	FBGA, Wire Bond (Option 2)	484
	FBGA, Wire Bond (Option 2)	780

Table 12. Cyclone III Devices (Part 1 of 2)

Device	Package *(2)*	Pins
EP3C5	EQFP, Wire Bond	144 *(1)*
	MBGA, Wire Bond	164
	FBGA, Wire Bond (Option 2)	256
	UBGA, Wire Bond	256
EP3C10	EQFP, Wire Bond	144 *(1)*
	MBGA, Wire Bond	164
	FBGA, Wire Bond (Option2)	256
	UBGA, Wire Bond	256
EP3C16	EQFP, Wire Bond	144 *(1)*
	MBGA, Wire Bond	164
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 2)	256
	UBGA, Wire Bond	256
	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
EP3C25	EQFP, Wire Bond	144 *(1)*
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 2)	256
	UBGA, Wire Bond	256
	FBGA, Wire Bond	324
EP3C40	PQFP, Wire Bond	240
	FBGA, Wire Bond	324
	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 2)	780
EP3C55	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 2)	780
EP3C80	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 2)	780

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Table 12. Cyclone III Devices (Part 2 of 2)

Device	Package *(2)*	Pins
EP3C120	FBGA, Wire Bond (Option 3)	484
	FBGA, Wire Bond (Option 2)	780

Notes to Table 12:

(1) The E144 package has an exposed pad at the bottom of the package. This exposed ground pad 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.

Table 13. Cyclone II Devices

Device	Package	Pins
EP2C5	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 2)	256
EP2C8	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 2)	256
EP2C15	FBGA, Wire Bond (Option 2)	256
	FBGA, Wire Bond (Option 3)	484
EP2C20	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 2)	256
	FBGA, Wire Bond (Option 3)	484
EP2C35	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 3)	672
EP2C50	FBGA, Wire Bond (Option 3)	484
	UBGA, Wire Bond	484
	FBGA, Wire Bond (Option 3)	672
EP2C70	FBGA, Wire Bond (Option 3)	672
	FBGA, Wire Bond	896

Table 14. Cyclone Devices

Device	Package	Pins
EP1C3	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
EP1C4	FBGA, Wire Bond	324
	FBGA, Wire Bond	400
EP1C6	TQFP, Wire Bond	144
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
EP1C12	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond	324
EP1C20	FBGA, Wire Bond	324
	FBGA, Wire Bond	400

Table 15. MAX Series Devices (Part 1 of 3)

Device	Package	Pins
MAX II Devices		
EPM240	TQFP, Wire Bond	100
	FBGA, Wire Bond (Option 2)	100
	MBGA, Wire Bond	100
EPM570	TQFP, Wire Bond	100
	MBGA, Wire Bond	100
	FBGA, Wire Bond (Option 2)	100
	TQFP, Wire Bond	144
	FBGA, Wire Bond (Option 1)	256
	MBGA, Wire Bond	256
EPM1270	TQFP, Wire Bond	144
	FBGA, Wire Bond (Option 1)	256
	MBGA, Wire Bond	256
EPM2210	FBGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond	324
MAX 9000 Devices		
EPM9320	BGA, Wire Bond	356
EPM9320A	BGA, Wire Bond	356
EPM9560	BGA, Wire Bond	356
MAX 7000B Devices		
EPM7032B	PLCC, Wire Bond	44
	TQFP, Wire Bond	44
	UBGA, Wire Bond	49

Table 15. MAX Series Devices (Part 2 of 3)

Device	Package	Pins
EPM7064B	TQFP, Wire Bond	44
	UBGA, Wire Bond	49
	FBGA, Wire Bond	100
	TQFP, Wire Bond	100
EPM7128B	UBGA, Wire Bond	49
	TQFP, Wire Bond	100
	FBGA, Wire Bond	100
	TQFP, Wire Bond	144
	UBGA, Wire Bond	169
	FBGA, Wire Bond (Option 1)	256
EPM7256B	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	UBGA, Wire Bond	169
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
EPM7512B	TQFP, Wire Bond	144
	UBGA, Wire Bond	169
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
	BGA, Wire Bond (Option 1)	256
MAX 7000AE Devices		
EPM7032AE	PLCC, Wire Bond	44
	TQFP, Wire Bond	44
EPM7064AE	PLCC, Wire Bond	44
	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	UBGA, Wire Bond	49
	FBGA, Wire Bond	100
	FBGA, Wire Bond (Option 1)	256
EPM7128AE	PLCC, Wire Bond	84
	TQFP, Wire Bond	100
	FBGA, Wire Bond	100
	UBGA, Wire Bond	169
	TQFP, Wire Bond	144
	FBGA, Wire Bond (Option 1)	256

Table 15. MAX Series Devices (Part 3 of 3)

Device	Package	Pins
EPM7256AE	TQFP, Wire Bond	100
	FBGA, Wire Bond	100
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
EPM7512AE	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	BGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond (Option 1)	256
MAX 7000A Devices		
EPM7032A	PLCC, Wire Bond	44
	TQFP, Wire Bond	44
EPM7128A	PLCC, Wire Bond	84
	TQFP, Wire Bond	100
	FBGA, Wire Bond	100
	TQFP, Wire Bond	144
	FBGA, Wire Bond (Option 1)	256
EPM7256A	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256

Table 16. HardCopy IV E Devices

Device	Package	Pins
HC4E25WF484	FBGA, Wire Bond	484
HC4E25FF484	FBGA, Flip Chip	484
HC4E25WF780	FBGA, Wire Bond	780
HC4E25FF780	FBGA, Flip Chip	780
HC4E35LF1152	FBGA, Flip Chip	1,152
HC4E35FF1152	FBGA, Flip Chip	1,152
HC4E35LF1517	FBGA, Flip Chip	1,517
HC4E35FF1517	FBGA, Flip Chip	1,517

Table 17. HardCopy IV GX Devices

Device	Package	Pins
HC4GX15LF780	FBGA, Flip Chip	780
HC4GX15LAF780X	FBGA, Flip Chip	780
HC4GX25LF780	FBGA, Flip Chip	780
HC4GX25LF1152	FBGA, Flip Chip	1,152
HC4GX25FF1152	FBGA, Flip Chip	1,152
HC4GX35FF1152	FBGA, Flip Chip	1,152
HC4GX35FF1517	FBGA, Flip Chip	1,517

Table 18. HardCopy III Devices

Device	Package	Pins
HC315WF484	FBGA, Wire Bond	484
HC325WF484	FBGA, Wire Bond	484
HC325FF484	FBGA, Flip Chip	484
HC325WF780	FBGA, Wire Bond	780
HC325FF780	FBGA, Flip Chip	780
HC335LF1152	FBGA, Flip Chip	1, 152
HC335FF1152	FBGA, Flip Chip	1,152
HC335LF1517	FBGA, Flip Chip	1,157
HC335FF1517	FBGA, Flip Chip	1,157

Table 19. HardCopy II Devices

Device	Package	Pins
HC210	FBGA, Flip Chip	484
HC210W	FBGA, Wire Bond (Option 3)	484
HC220	FBGA, Flip Chip	672
	FBGA, Flip Chip	780
HC230	FBGA, Flip Chip	1,020
HC240	FBGA, Flip Chip	1,020
	FBGA, Flip Chip	1,508

Table 20. HardCopy Devices

Device	Package	Pins
HC1S25	FBGA, Wire Bond (Option 3)	672
	BGA, Wire Bond	672
HC1S30	FBGA, Flip Chip	780
HC1S40	FBGA, Flip Chip	780
HC1S60	FBGA, Flip Chip	1,020
HC1S80	FBGA, Flip Chip	1,020

Table 21. HardCopy APEX Devices

Device	Package	Pins
HC20K400	BGA, Wire Bond (Option 3)	652
HC20K600	BGA, Wire Bond (Option 3)	652
	FBGA, Flip Chip	672

Table 22. APEX Series Devices (Part 1 of 3)

Device	Package	Pins
APEX II Devices		
EP2A15	FBGA, Flip Chip	672
	BGA, Flip Chip	724
EP2A25	FBGA, Flip Chip	672
	BGA, Flip Chip	724
	FBGA, Flip Chip	1,020
EP2A40	FBGA, Flip Chip	672
	BGA, Flip Chip	724
	FBGA, Flip Chip	1,020
EP2A70	BGA, Flip Chip	724
	FBGA, Flip Chip	1,508
APEX 20KE Devices		
EP20K30E	TQFP, Wire Bond	144
	FBGA, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond	324
EP20K60E	TQFP, Wire Bond	144
	FBGA, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond	324
	BGA, Wire Bond	356
EP20K100E	TQFP, Wire Bond	144
	FBGA, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond	324
	BGA, Wire Bond	356

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Table 22. APEX Series Devices (Part 2 of 3)

Device	Package	Pins
EP20K160E	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EP20K200E	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
	BGA, Wire Bond (Option 2)	652
	FBGA, Wire Bond (Option 2)	672
EP20K300E	PQFP, Wire Bond	240
	BGA, Wire Bond (Option 2)	652
	FBGA, Wire Bond (Option 2)	672
EP20K400E	BGA, Wire Bond (Option 3)	652
	FBGA, Flip Chip	672
EP20K600E	BGA, Wire Bond (Option 3)	652
	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP20K1000E	BGA, Flip Chip	652
	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP20K1500E	BGA, Flip Chip	652
	FBGA, Flip Chip	1,020
APEX 20KC Devices		
EP20K200C	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EP20K400C	BGA, Wire Bond (Option 3)	652
	FBGA, Flip Chip	672
EP20K600C	BGA, Wire Bond (Option 3)	652
	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020
EP20K1000C	BGA, Flip Chip	652
	FBGA, Flip Chip	672
	FBGA, Flip Chip	1,020

Table 22. APEX Series Devices (Part 3 of 3)

Device	Package	Pins
APEX 20K Devices		
EP20K100	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond	324
	BGA, Wire Bond	356
EP20K160	PQFP, Wire Bond	240
	TQFP, Wire Bond	144
EP20K200	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EP20K300	FBGA, Wire Bond (Option 2)	672
EP20K400	BGA, Wire Bond (Option 3)	652
	PGA, Wire Bond	655
	FBGA, Flip Chip	672

Table 23. ACEX 1K Devices

Device	Package	Pins
EP1K10	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
EP1K30	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
EP1K50	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond (Option 2)	484
EP1K100	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond (Option 2)	484

Table 24. Mercury Devices

Device	Package	Pins
EP1M120	FBGA, Flip Chip	484
EP1M350	FBGA, Flip Chip	780

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Table 25. FLEX Series Devices (Part 1 of 3)

Device	Package	Pins
FLEX 10KA Devices		
EPF10K10A	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
EPF10K30A	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EPF10K100A	RQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
	BGA, Wire Bond	600
EPF10K250A	PGA, Wire Bond	599
	BGA, Wire Bond	600
FLEX 10KS Devices		
EPF10K50S	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EPF10K200S	RQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
	BGA, Wire Bond	600
	FBGA, Wire Bond (Option 2)	672
FLEX 10KE Devices		
EPF10K30E	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256
	FBGA, Wire Bond (Option 2)	484

Table 25. FLEX Series Devices (Part 2 of 3)

Device	Package	Pins
EPF10K50E	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EPF10K100E	PQFP, Wire Bond	208
	PQFP, Wire Bond	240
	FBGA, Wire Bond (Option 1)	256
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
EPF10K130E	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond (Option 2)	484
	BGA, Wire Bond	600
	FBGA, Wire Bond (Option 2)	672
EPF10K200E	PGA, Wire Bond	599
	BGA, Wire Bond	600
	FBGA, Wire Bond (Option 2)	672
EPF10K10	PLCC, Wire Bond	84
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
EPF10K20	TQFP, Wire Bond	144
	RQFP, Wire Bond	208
	RQFP, Wire Bond	240
EPF10K30	RQFP, Wire Bond	208
	RQFP, Wire Bond	240
	BGA, Wire Bond	356
EPF10K40	RQFP, Wire Bond	208
	RQFP, Wire Bond	240
EPF10K50	RQFP, Wire Bond	240
	BGA, Wire Bond	356
	PGA, Wire Bond	403
EPF10K50V	RQFP, Wire Bond	240
	PQFP, Wire Bond	240
	BGA, Wire Bond	356
	FBGA, Wire Bond	484
EPF10K70	RQFP, Wire Bond	240
	PGA, Wire Bond	503

Table 25. FLEX Series Devices (Part 3 of 3)

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

Table 26. Excalibur Devices

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

Table 27. Enhanced Configuration Devices

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

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Thermal Resistance

Table 28 through Table 58 provide θ_{JA} (junction-to-ambient thermal resistance) and θ_{JC} (junction-to-case thermal resistance) values for the following Altera device families:

- Arria series FPGAs
- Stratix series FPGAs
- Cyclone series FPGAs
- MAX series CPLDs
- HardCopy series 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 PCN0214* 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.

☞ Contact Altera if you need typical +/– values of A dimensions for thermal analysis. The max numbers are provided for physical layout.

Arria Series Devices Thermal Resistance

Table 28 and Table 29 provide thermal resistance values for Arria series devices.

Table 28. Thermal Resistance of Arria II GX Devices

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)
EP2AGX45	358	FBGA	18.3	16.5	14.8	13.4	0.06	5.6
	572	FBGA	14.8	14.0	12.2	10.9	0.10	5.7
	780	FBGA	13.8	13.0	11.4	10.1	0.10	5.7
EP2AGX65	358	FBGA	18.3	16.5	14.8	13.4	0.06	5.6
	572	FBGA	14.8	14.0	12.2	10.9	0.10	5.7
	780	FBGA	13.8	13.0	11.4	10.1	0.10	5.7
EP2AGX95	572	FBGA	13.7	12.9	11.2	9.9	0.05	4.5
	780	FBGA	13.3	12.6	10.9	9.6	0.05	5.0
	1152	FBGA	12.7	11.9	10.3	9.0	0.05	5.3
EP2AGX125	572	FBGA	13.7	12.9	11.2	9.9	0.05	4.5
	780	FBGA	13.3	12.6	10.9	9.6	0.05	5.0
	1152	FBGA	12.7	11.9	10.3	9.0	0.05	5.3
EP2AGX190	780	FBGA	11.7	11.5	10.0	8.7	0.03	3.9
	1152	FBGA	10.8	10.7	9.3	8.0	0.04	4.1
EP2AGX260	780	FBGA	11.7	11.5	10.0	8.7	0.03	3.9
	1152	FBGA	10.8	10.7	9.3	8.0	0.04	4.1

Table 29. Thermal Resistance of Arria GX Devices

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	3.1
	780	FBGA	11.1	8.6	7.2	6.0	0.2	3.1
EP1AGX35	484	FBGA	12.8	10.3	8.7	7.5	0.3	3.1
	780	FBGA	11.1	8.6	7.2	6.0	0.2	3.1
EP1AGX50	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.9
	780	FBGA	10.9	8.4	6.9	5.8	0.2	2.9
	1152	FBGA	9.9	7.5	6.1	5.0	0.2	2.5
EP1AGX60	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.9
	780	FBGA	10.9	8.4	6.9	5.8	0.2	2.8
	1152	FBGA	9.9	7.5	6.1	5.0	0.2	2.5
EP1AGX90	1152	FBGA	9.6	7.3	5.9	4.9	0.1	2.3

Stratix Series Devices Thermal Resistance

Table 30 through Table 35 provide thermal resistance values for Stratix series devices.

Table 30. Thermal Resistance of Stratix IV 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)
JEDEC 2S2P Board								
EP4SE230	780	FBGA	9.7	8.4	7.0	5.8	0.2	2.0
EP4SE360	780	HBGA	9.0	8.2	6.7	5.6	0.2	2.6
	1152	FBGA	8.3	7.4	6.0	4.9	0.2	1.6
	1517	FBGA	7.7	6.8	5.4	4.4	0.2	1.7
EP4SE530	1152	HBGA	7.6	6.9	5.7	4.7	0.1	2.8
	1517	HBGA	7.2	6.4	5.2	4.3	0.1	1.8
	1760	FBGA	7.0	6.1	5.0	4.1	0.1	1.4
EP4SE680	1152	HBGA	8.0	7.2	5.8	4.7	0.1	2.3
	1517	FBGA	7.7	6.7	5.4	4.3	0.1	1.4
	1760	FBGA	7.0	6.1	5.0	4.1	0.1	1.4
EP4SE820	1152	HBGA	7.6	6.9	5.7	4.7	0.1	2.8
	1517	HBGA	7.2	6.4	5.2	4.3	0.1	1.9
	1760	FBGA	7.0	6.1	5.0	4.1	0.1	1.3
EP4SGX70	780	FBGA	10.7	8.6	7.2	6.0	0.3	2.3
	1152	FBGA	9.8	7.7	6.3	5.2	0.3	2.0
EP4SGX110	780	FBGA	10.7	8.6	7.2	6.0	0.3	2.3
	1152	FBGA	9.8	7.7	6.3	5.2	0.3	2.0
EP4SGX180	780	FBGA	9.7	8.4	7.0	5.8	0.2	2.0
	1152	FBGA	8.8	7.5	6.1	5.0	0.2	1.7
	1517	FBGA	8.2	6.9	5.5	4.5	0.2	1.8
EP4SGX230	780	FBGA	9.7	8.4	7.0	5.8	0.2	2.0
	1152	FBGA	8.8	7.5	6.1	5.0	0.2	1.7
	1517	FBGA	8.2	6.9	5.5	4.5	0.2	1.8
EP4SGX290	780	HBGA	9.0	8.2	6.7	5.6	0.2	2.6
	1152	FBGA	8.3	7.4	6.0	4.9	0.2	1.6
	1517	FBGA	7.7	6.8	5.4	4.4	0.2	1.7
	1760	FBGA	7.0	6.2	5.1	4.2	0.2	1.5
	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5
EP4SGX360	780	HBGA	9.0	8.2	6.7	5.6	0.2	2.6
	1152	FBGA	8.3	7.4	6.0	4.9	0.2	1.6
	1517	FBGA	7.7	6.8	5.4	4.4	0.2	1.7
	1760	FBGA	7.0	6.2	5.1	4.2	0.2	1.5
	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5

Table 30. Thermal Resistance of Stratix IV 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)
EP4SGX530	1152	HBGA	7.6	6.9	5.7	4.7	0.1	2.8
	1517	HBGA	7.2	6.4	5.2	4.3	0.1	1.8
	1760	FBGA	7.0	6.1	5.0	4.1	0.1	1.4
	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5
EP4S40G2	1517	FBGA	8.2	6.9	5.5	4.5	0.2	1.8
EP4S100G2	1517	FBGA	8.2	6.9	5.5	4.5	0.2	1.8
EP4S40G5	1517	HBGA	7.2	6.4	5.2	4.3	0.1	1.8
EP4S100G5	1517	HBGA	7.2	6.4	5.2	4.3	0.1	1.8
EP4S100G3	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5
EP4S100G4	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5
EP4S100G5	1932	FBGA	6.8	5.9	4.8	3.9	0.1	1.5

Table 31. 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)
EP3SE50	484	FBGA	12.7	10.1	8.6	7.3	0.3	2.8
	780	FBGA	11.3	8.7	7.2	6.1	0.3	2.4
EP3SL50	484	FBGA	12.7	10.1	8.6	7.3	0.3	2.8
	780	FBGA	11.3	8.7	7.3	6.1	0.3	2.4
EP3SL70	484	FBGA	12.7	10.1	8.6	7.3	0.3	2.8
	780	FBGA	11.3	8.7	7.3	6.1	0.3	2.4
EP3SE80	780	FBGA, Flip Chip	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA, Flip Chip	9.4	7.6	6.2	5.1	0.2	2.0
EP3SE110	780	FBGA, Flip Chip	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA, Flip Chip	9.4	7.6	6.2	5.1	0.2	2.0
EP3SL110	780	FBGA, Flip Chip	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA, Flip Chip	9.4	7.6	6.2	5.1	0.2	2.0
EP3SL150	780	FBGA, Flip Chip	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA, Flip Chip	9.4	7.6	6.2	5.1	0.2	2.0

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Table 31. 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)
EP3SL200	780	HBGA, Flip Chip	9.0	8.1	6.7	5.5	0.1	2.5
	1152	FBGA, Flip Chip	8.4	7.4	6.0	4.9	0.1	1.8
	1517	FBGA, Flip Chip	7.8	6.8	5.5	4.4	0.1	1.7
EP3SE260	780	HBGA, Flip Chip	9.0	8.1	6.7	5.5	0.1	2.5
	1152	FBGA, Flip Chip	8.4	7.4	6.0	4.9	0.1	1.8
	1517	FBGA, Flip Chip	7.8	6.8	5.5	4.4	0.1	1.7
EP3SL340	1152	HBGA, Flip Chip	8.1	7.2	5.8	4.7	0.1	2.3
	1517	FBGA, Flip Chip	7.7	6.8	5.4	4.4	0.1	1.4
	1760	FBGA, Flip Chip	7.5	6.5	5.2	4.2	0.1	1.3

Table 32. 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.	θ_{JB} (° C/W)
EP2S15	484	FBGA, Flip Chip	0.4	13.1	11.1	9.6	8.3	4.2
	672	FBGA, Flip Chip	0.4	12.2	10.2	8.8	7.6	4.1
EP2S30	484	FBGA, Flip Chip	0.2	12.6	10.6	9.1	7.9	3.7
	672	FBGA, Flip Chip	0.2	11.7	9.7	8.3	7.1	3.4
EP2S60	484	FBGA, Flip Chip	0.1	12.3	10.3	8.8	7.5	3.4
	672	FBGA, Flip Chip	0.1	11.4	9.4	7.8	6.7	3.0
	1,020	FBGA, Flip Chip	0.1	10.4	8.4	7.0	5.9	2.7
EP2S90	484	HBGA, Flip Chip	0.1	12.0	9.9	8.3	7.1	3.7
	780	FBGA, Flip Chip	0.1	10.8	8.8	7.3	6.1	2.6
	1,020	FBGA, Flip Chip	0.1	10.2	8.2	6.8	5.7	2.4
	1,508	FBGA, Flip Chip	0.1	9.3	7.4	6.1	5.0	2.2
EP2S130	780	FBGA, Flip Chip	0.1	10.1	8.7	7.2	6.0	2.4
	1,020	FBGA, Flip Chip	0.1	9.5	8.1	6.7	5.5	2.2
	1,508	FBGA, Flip Chip	0.1	8.6	7.3	6.0	4.8	2.1
EP2S180	1,020	FBGA, Flip Chip	0.1	9.0	7.9	6.5	5.4	2.1
	1,508	FBGA, Flip Chip	0.1	8.1	7.1	5.8	4.7	1.9

Table 33. 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.	θ_{JB} (°C/W)
EP2SGX30	780	FBGA, Flip Chip	0.2	11.1	8.6	7.2	6.0	3.1
EP2SGX60	780	FBGA, Flip Chip	0.2	10.9	8.4	6.9	5.8	2.8
	1152	FBGA, Flip Chip	0.2	9.9	7.5	6.1	5.0	2.5
EP2SGX90	1152	FBGA, Flip Chip	0.1	9.6	7.3	5.9	4.9	2.3
	1508	FBGA, Flip Chip	0.1	9.0	6.7	5.4	4.4	1.9
EP2SGX130	1508	FBGA, Flip Chip	0.1	8.3	6.6	5.3	4.3	1.8

Table 34. 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	FBGA, Flip Chip	0.4	11.1	9.1	7.7	6.5
EP1SGX25C EP1SGX25D	672	FBGA, Flip Chip	0.2	10.8	8.8	7.4	6.2
EP1SGX25D EP1SGX25F	1020	FBGA, Flip Chip	0.2	9.9	7.9	6.5	5.4
EP1SGX40D EP1SGX40G	1020	FBGA, Flip Chip	0.2	9.8	7.7	6.4	5.3

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Table 35. Thermal Resistance of Stratix Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EP1S10	484	FBGA, Flip Chip	0.4	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	14.0	12.2	10.8
	780	FBGA, Flip Chip	0.4	10.9	8.8	7.4	6.3
EP1S20	484	FBGA, Flip Chip	0.3	11.8	9.7	8.3	7.1
	672	BGA	2.5	15.5	12.4	10.7	9.3
	672	FBGA	2.7	16.0	12.8	11.0	9.6
	780	FBGA, Flip Chip	0.3	10.7	8.6	7.2	6.1
EP1S25	672	BGA	2.2	14.8	11.7	10.0	8.7
	672	FBGA	2.3	15.3	12	10.4	9.0
	780	FBGA, Flip Chip	0.3	10.5	8.5	7.1	6.0
	1020	FBGA, Flip Chip	0.3	10.0	8.0	6.6	5.5
EP1S30	780	FBGA, Flip Chip	0.2	10.4	8.4	7.0	5.9
	956	BGA, Flip Chip	0.2	9.1	7.1	5.8	4.8
	1020	FBGA, Flip Chip	0.2	9.9	7.9	6.5	5.4
EP1S40	780	FBGA, Flip Chip	0.2	10.4	8.3	6.9	5.8
	956	BGA, Flip Chip	0.2	9.0	7.0	5.7	4.7
	1020	FBGA, Flip Chip	0.2	9.8	7.8	6.4	5.3
	1508	FBGA, Flip Chip	0.2	9.1	7.1	5.8	4.7
EP1S60	956	BGA, Flip Chip	0.1	8.9	6.9	5.6	4.6
	1020	FBGA, Flip Chip	0.1	9.7	7.7	6.3	5.2
	1508	FBGA, Flip Chip	0.1	8.9	7.0	5.6	4.6
EP1S80	956	BGA, Flip Chip	0.1	8.8	6.8	5.5	4.5
	1020	FBGA, Flip Chip	0.1	9.6	7.6	6.2	5.1
	1508	FBGA, Flip Chip	0.1	8.8	6.9	5.5	4.5

Cyclone Series Devices Thermal Resistance

Table 36 through Table 41 provide thermal resistance values for Cyclone series devices.

☞ The data in Table 36 and Table 37 is preliminary and subject to change.

Table 36. Thermal Resistance of Cyclone IV Devices

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)	θ_{JB} (° C/W)
EP4CE6	E144	27.1	22.1	20.9	18.5	10.7	12.4
	F256	36.3	29.9	28.0	26.4	9.8	20.6
EP4CE10	E144	27.1	22.1	20.9	18.5	10.7	12.4
	F256	36.3	29.9	28.0	26.4	9.8	20.6
EP4CE15	F256	32.2	25.7	23.9	22.3	7.3	16.5
	F484	31.4	25.1	23.4	21.9	10.5	17.5
EP4CE30	F484	25.3	20.3	18.7	17.2	7.1	12.8
	F780	24.7	19.9	18.2	16.9	6.9	13.4
EP4CE40	F484	25.3	20.3	18.7	17.2	7.1	12.8
	F780	24.7	19.9	18.2	16.9	6.9	13.4
EP4CE55	F484	24.0	19.1	17.4	16.0	6.3	11.5
	F780	23.4	18.6	17.0	15.6	6.1	12.2
EP4CE75	F484	21.6	17.6	15.9	14.5	5.3	10.0
	F780	21.0	17.1	15.4	14.1	5.1	10.6
EP4CE115	F484	18.6	15.9	14.3	12.9	4.4	8.4
	F780	18.1	15.4	13.8	12.5	4.2	9.0
EP4CE155	F484	16.0	13.8	12.2	10.9	3.2	6.2
	F780	15.4	13.2	11.7	10.4	3.0	6.7

Table 37. Thermal Resistance of Cyclone IV GX 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)	θ_{JB} (° C/W)
EP4CGX15	QFN148	28.4	23.7	22.7	20.4	3.6	10.5
	F169	31.2	27.1	25.2	23.6	7.7	17.0
EP4CGX22	F169	26.9	23.4	21.5	19.9	5.6	13.2
	F324	25.2	21.7	20.0	18.5	5.3	13.1
EP4CGX30	F169	26.9	23.4	21.5	19.9	5.6	13.2
	F324	25.2	21.7	20.0	18.5	5.3	13.1
	F484	17.2	15.7	14.1	12.8	4.4	8.2
EP4CGX50	F484	17.2	15.7	14.1	12.8	4.4	8.2
	F672	16.9	15.3	13.8	12.5	4.2	8.6
EP4CGX75	F484	17.2	15.7	14.1	12.8	4.4	8.2
	F672	16.9	15.3	13.8	12.5	4.2	8.6

Table 37. Thermal Resistance of Cyclone IV GX 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)	θ_{JB} (° C/W)
EP4CGX110	F484	14.7	13.8	12.2	10.9	3.3	6.2
	F672	14.3	13.4	11.9	10.6	3.1	6.7
	F896	14.0	13.1	11.7	10.4	3.1	7.1
EP4CGX150	F484	14.7	13.8	12.2	10.9	3.3	6.2
	F672	14.3	13.4	11.9	10.6	3.1	6.7
	F896	14.0	13.1	11.7	10.4	3.1	7.1

Table 38. Thermal Resistance of Cyclone III LS Devices

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)	θ_{JB} (° C/W)
EP3CLS70	F484 Wire Bond (Option 2)	17.5	12.7	11.1	9.8	3.4	5.5
	U484 Wire Bond	18.7	13.8	12.2	10.8	3.2	6.4
	F780 Wire Bond (Option 2)	16.6	11.8	10.3	9.0	3.0	5.2
EP3CLS100	F484 Wire Bond (Option 2)	17.5	12.7	11.1	9.8	3.4	5.5
	U484 Wire Bond	18.7	13.8	12.2	10.8	3.2	6.4
	F780 Wire Bond (Option 2)	16.6	11.8	10.3	9.0	3.0	5.2
EP3CLS150	F484 Wire Bond (Option 2)	14.5	11.5	9.9	8.6	2.6	4.4
	F780 Wire Bond (Option 2)	13.5	10.5	9.0	7.8	2.2	4.1
EP3CLS200	F484 Wire Bond (Option 2)	14.5	11.5	9.9	8.6	2.6	4.4
	F780 Wire Bond (Option 2)	13.5	10.5	9.0	7.8	2.2	4.1

Table 39. Thermal Resistance of Cyclone III Devices (Part 1 of 3)

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)	θ_{JB} (° C/W)
EP3C5	E144 Wire Bond	20.0	17.5	15.4	14.0	8.4	—
EP3C5	F256 Wire Bond (Option 2)	32.4	28.9	27.0	25.5	11.7	15.6
EP3C5	U256 Wire Bond	32.5	29.1	27.2	25.6	12.2	17.3
EP3C10	E144 Wire Bond	20.0	17.5	15.4	14.0	8.4	—

Table 39. Thermal Resistance of Cyclone III Devices (Part 2 of 3)

EP3C10	M164 Wire Bond	39.0	32.3	30.4	28.7	9.9	20.0
EP3C10	F256 Wire Bond (Option 2)	32.4	28.9	27.0	25.5	11.7	15.6
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)**	**θ_{JB} (° C/W)**
EP3C10	U256 Wire Bond	32.5	29.1	27.2	25.6	12.2	17.3
EP3C16	E144 Wire Bond	20.0	17.5	15.4	14.0	8.4	—
EP3C16	M164 Wire Bond	35.0	28.4	26.4	24.7	7.6	15.8
EP3C16	Q240 Wire Bond	27.2	24.7	22.1	17.8	4.3	—
EP3C16	F256 Wire Bond (Option 2)	28.5	25.1	23.2	21.7	9.1	13.2
EP3C16	U256 Wire Bond	28.8	25.4	23.5	22.0	9.7	14.1
EP3C16	U484 Wire Bond	26.1	23.5	21.6	20.1	8.5	11.4
EP3C16	F484 Wire Bond (Option 3)	22.9	19.4	17.7	16.2	6.9	10.2
EP3C25	E144 Wire Bond	29.0	27.5	26.3	24.4	7.8	—
EP3C25	Q240 Wire Bond	27.0	24.5	21.8	17.6	4.2	—
EP3C25	F256 Wire Bond (Option 2)	27.5	24.1	22.2	20.7	8.5	12.5
EP3C25	U256 Wire Bond	27.9	24.5	22.6	21.1	9.1	13.6
EP3C25	F324 Wire Bond	26.6	23.1	21.3	19.8	8.0	11.5
EP3C40	Q240 Wire Bond	25.8	23.2	20.6	17.0	4.0	—
EP3C40	F324 Wire Bond	23.2	19.7	18.0	16.5	5.9	8.9
EP3C40	U484 Wire Bond	22.8	19.3	17.6	16.1	5.9	8.5
EP3C40	F484 Wire Bond (Option 3)	19.8	16.3	14.6	13.2	4.8	7.6
EP3C40	F780 Wire Bond (Option 2)	18.7	15.2	13.5	12.2	4.5	7.0
EP3C55	U484 Wire Bond	21.6	18.2	16.4	15.0	5.1	8.2
EP3C55	F484 Wire Bond (Option 3)	18.9	15.4	13.8	12.2	4.2	6.9

Table 39. Thermal Resistance of Cyclone III Devices (Part 3 of 3)

EP3C55	F780 Wire Bond (Option 2)	17.8	14.4	12.7	11.4	3.9	6.7
EP3C80	U484 Wire Bond	20.4	16.9	15.2	13.8	4.4	7.2
EP3C80	F484 Wire Bond (Option 3)	18.0	14.5	12.9	11.5	3.6	6.1
EP3C80	F780 Wire Bond (Option 2)	16.9	13.5	11.8	10.5	3.3	5.9
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)**	**θ_{JB} (° C/W)**
EP3C120	F484 Wire Bond (Option 3)	17.1	13.7	12.0	10.7	3.1	5.4
EP3C120	F780 Wire Bond (Option 2)	16.0	12.6	11.0	9.7	2.8	5.1

Table 40. Thermal Resistance of Cyclone 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.
EP2C5	144	TQFP, Wire Bond	10.0	31.0	29.3	27.9	25.5
	208	PQFP, Wire Bond	5.5	30.4	29.2	27.3	22.3
	256	FBGA, Wire Bond	8.7	30.2	26.1	23.6	21.7
EP2C8	144	TQFP, Wire Bond	9.9	29.8	28.3	26.9	24.9
	208	PQFP, Wire Bond	5.4	30.2	28.8	26.9	21.7
	256	FBGA, Wire Bond	7.1	27.0	23.0	20.5	18.5
EP2C15	256	FBGA, Wire Bond	5.5	24.2	20.0	17.8	16.0
	484	FBGA, Wire Bond	4.2	21.0	17.0	14.8	13.1
EP2C20	240	PQFP, Wire Bond	4.2	26.6	24.0	21.4	17.4
	256	FBGA, Wire Bond	5.5	24.2	20.0	17.8	16.0
	484	FBGA, Wire Bond	4.2	21.0	17.0	14.8	13.1
EP2C35	484	FBGA, Wire Bond	3.3	19.4	15.4	13.3	11.7
	484	UBGA, Wire Bond	5.0	20.6	16.6	14.5	12.8
	672	FBGA, Wire Bond	3.1	18.6	14.6	12.6	11.1
EP2C50	484	FBGA, Wire Bond	2.8	18.4	14.4	12.4	10.9
	484	UBGA, Wire Bond	4.4	19.6	15.6	13.6	11.9
	672	FBGA, Wire Bond	2.6	17.7	13.7	11.8	10.2
EP2C70	672	FBGA, Wire Bond	2.2	16.9	13.0	11.1	9.7
	896	FBGA, Wire Bond	2.1	16.3	11.9	10.5	9.1

Table 41. Thermal Resistance of Cyclone 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.
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

MAX Series Devices Thermal Resistance

Table 42 through Table 45 provide thermal resistance values for MAX series devices.

Table 42. 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

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Table 43. Thermal Resistance of MAX 9000 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.
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
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 44. Thermal Resistance of MAX 7000 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.
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

Table 44. Thermal Resistance of MAX 7000 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.
EPM7064S	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	44.0	43.0	40.0
	84	PLCC	9.0	28.0	26.0	25.0	23.0
	100	TQFP	11.0	39.0	37.0	35.0	32.0
EPM7064	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	13.0	44.0	43.0	41.0	38.0
	68	PLCC	9.0	29.0	28.0	26.0	23.0
	84	PLCC	9.0	28.0	26.0	25.0	22.0
	100	PQFP	6.0	33.0	32.0	31.0	30.0
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 44. Thermal Resistance of MAX 7000 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.
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
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

Table 44. Thermal Resistance of MAX 7000 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.
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 45. Thermal Resistance of MAX 3000A Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPM3032A	44	TQFP	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
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

HardCopy Series Devices Thermal Resistance

Table 46 through Table 49 provide thermal resistance values for HardCopy series devices.

☞ The data in Table 46 and Table 47 is preliminary and subject to change.

Table 46. Thermal Resistance of HardCopy IV 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)
FineLine Ball-Grid Array (FBGA) — Flip Chip — Wire Bond								
HC4E25	484	FBGA, Wire Bond	15.8	13.2	11.7	10.4	3.9	5.6
	780	FBGA, Wire Bond	14.5	12.3	10.8	9.6	3.5	5.8
FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless								
HC4E25	484	FBGA, Flip Chip	15.3	13.6	11.8	10.5	0.05	4.9
	780	FBGA, Flip Chip	13.7	12.3	10.6	9.3	0.05	5.0

Table 46. Thermal Resistance of HardCopy IV 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)
HC4E35	1152	FBGA, Flip Chip	11.8	10.9	9.3	8.0	0.04	4.3
	1517	FBGA, Flip Chip	11.1	10.5	8.9	7.6	0.03	4.6
HC4GX15	78 0	FBGA, Flip Chip	13.2	12.4	10.7	9.4	0.05	4.9
HC4GX25	780	FBGA, Flip Chip	12.1	11.6	9.9	8.6	0.03	3.9
	1152	FBGA, Flip Chip	11.2	10.5	8.9	7.6	0.03	3.8
HC4GX35	1152	FBGA, Flip Chip	10.2	10.0	8.4	7.1	0.02	3.3
	1517	FBGA, Flip Chip	9.8	9.5	7.9	6.7	0.02	3.5
FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid								
HC4E25	484	FBGA, Flip Chip	13.1	10.4	8.8	7.6	0.5	3.2
	780	FBGA, Flip Chip	11.3	9.0	7.6	6.4	0.5	2.8
HC4E35	1152	FBGA, Flip Chip	9.6	8.0	6.5	5.4	0.3	2.4
	1517	FBGA, Flip Chip	8.7	7.3	6.0	4.9	0.3	2.4
HC4GX15	780	FBGA, Flip Chip	11.1	9.4	7.9	6.7	0.7	3.0
HC4GX25	780	FBGA, Flip Chip	10.6	9.2	7.7	6.5	0.5	2.5
	1152	FBGA, Flip Chip	9.4	7.9	6.5	5.4	0.4	2.3
HC4GX35	1152	FBGA, Flip Chip	8.7	7.7	6.3	5.2	0.3	2.0
	1517	FBGA, Flip Chip	8.2	7.1	5.8	4.7	0.3	2.0

Table 47. Thermal Resistance of HardCopy III Devices

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)
FineLine Ball-Grid Array (FBGA) — Flip Chip — Wire Bond								
HC315	484	FBGA, Wire Bond	18.4	15.6	14.0	12.7	5.7	7.9
HC325	484	FBGA, Wire Bond	15.8	13.2	11.7	10.4	3.9	5.6
	780	FBGA, Wire Bond	14.5	12.3	10.8	9.6	3.5	5.8
FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless								
HC325	484	FBGA, Flip Chip	15.3	13.6	11.8	10.5	0.05	4.9
	780	FBGA, Flip Chip	13.7	12.3	10.6	9.3	0.05	5.0
HC335	1152	FBGA, Flip Chip	11.8	10.9	9.3	8.0	0.04	4.3
	1517	FBGA, Flip Chip	11.1	10.5	8.9	7.6	0.03	2.4
FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid								
HC325	484	FBGA, Flip Chip	13.1	10.4	8.8	7.6	0.5	3.2
	780	FBGA, Flip Chip	11.3	9.0	7.6	6.4	0.5	2.8
HC335	1152	FBGA, Flip Chip	9.6	8.0	6.5	5.4	0.3	2.4
	1517	FBGA, Flip Chip	8.7	7.3	6.0	4.9	0.3	2.4

Table 48. Thermal Resistance of HardCopy 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.	θ_{JB} (° C/W)
HC210	484	FBGA, Flip Chip	0.8	13.4	11.2	9.6	8.3	4.6
	484	FBGA, Wire Bond	5.5	21.3	17.4	15.3	13.8	9.6
HC220	672	FBGA, Flip Chip	0.5	12.1	9.9	8.3	7.1	3.6
	780	FBGA, Flip Chip	0.5	11.7	9.5	8.0	6.8	3.5
HC230	1020	FBGA, Flip Chip	0.3	10.8	8.6	7.1	6.0	2.9
HC240	1020	FBGA, Flip Chip	0.2	10.6	8.4	6.9	5.8	2.7
	1508	FBGA, Flip Chip	0.2	9.7	7.5	6.1	5.0	2.6

Table 49. Thermal Resistance of HardCopy 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.
HC20K400	652	BGA, Flip Chip	0.5	9.1	7.9	6.4	5.3
HC20K600	672	FBGA, Flip Chip	1.0	13.0	10.2	8.6	7.3
HC1S25	672	FBGA, Wire Bond	3.7	19.7	15.8	13.9	12.4
		BGA, Wire Bond	3.4	19.3	15.6	13.8	12.3
HC1S30	780	FBGA, Flip Chip	0.4	10.9	8.8	7.4	6.3
HC1S40	780	FBGA, Flip Chip	0.4	10.9	8.8	7.4	6.3
HC1S60	1020	FBGA, Flip Chip	0.3	10.3	8.54	7.0	5.8
HC1S80	1020	FBGA, Flip Chip	0.3	10.3	8.54	7.0	5.8

APEX Series Devices Thermal Resistance

Table 50 and Table 51 provide thermal resistance values for APEX series devices.

Table 50. Thermal Resistance of APEX II Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EP2A15	672	FBGA, Flip Chip (Cu lid)	0.2	10.8	8.8	7.4	6.2
		FBGA, Flip Chip (AlSiC lid)	0.3	11.6	9.6	8.0	6.6
	724	BGA, Flip Chip (Cu lid)	0.2	9.7	7.7	6.4	5.3
		BGA, Flip Chip (AlSiC lid)	0.4	10.0	8.2	6.6	5.4
EP2A25	672	FBGA (Cu lid)	0.2	10.7	8.7	7.2	6.1
		FBGA, Flip Chip (AlSiC lid)	0.3	11.5	9.6	8.0	6.6
	724	BGA, Flip Chip (Cu lid)	0.2	9.6	7.6	6.2	5.2
		BGA, Flip Chip (AlSiC lid)	0.3	10.0	8.2	6.6	5.4
	1020	FBGA, Flip Chip (Cu lid)	0.2	9.8	7.8	6.4	5.3
		FBGA, Flip Chip (AlSiC lid)	0.3	10.4	8.5	6.9	5.7
EP2A40	672	FBGA, Flip Chip (Cu lid)	0.2	10.0	8.2	6.9	5.9
		FBGA, Flip Chip (AlSiC lid)	0.2	10.0	8.2	6.9	5.9
	724	BGA, Flip Chip (Cu lid)	0.2	9.5	7.5	6.1	5.1
		BGA, Flip Chip (AlSiC lid)	0.2	9.5	7.5	6.1	5.1
	1,020	FBGA, Flip Chip (Cu lid)	0.2	9.7	7.7	6.3	5.2
		FBGA, Flip Chip (AlSiC lid)	0.2	9.7	7.7	6.3	5.2
EP2A70	724	BGA, Flip Chip (Cu lid)	0.1	9.3	7.3	6.0	4.9
		BGA, Flip Chip (AlSiC lid)	0.1	10.0	7.9	6.4	5.3
	1,508	FBGA, Flip Chip (Cu lid)	0.1	8.8	6.8	5.5	4.5
		FBGA, Flip Chip (AlSiC lid)	0.1	9.3	7.3	5.8	4.7

Table 51. Thermal Resistance of APEX 20K and 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
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

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Table 51. Thermal Resistance of APEX 20K and 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.
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	0.4	11.6	9.6	7.9	6.5
	672	FBGA w/ fin *(1)*	0.5	7.0	4.0	3.0	2.6
EP20K400E EP20K400C	652	BGA	0.5	9.0	8.0	7.0	6.0
	672	FBGA (Cu lid)	0.3	10.9	8.8	7.4	6.3
		FBGA (AlSiC lid)	0.4	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)	0.2	10.8	8.7	7.3	6.1
		FBGA (AlSiC lid)	0.3	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)	0.2	9.9	7.8	6.5	5.4
		FBGA (AlSiC lid)	0.3	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)	0.1	8.3	7.0	5.6	4.5
		BGA (AlSiC 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)	0.1	10.6	8.6	7.2	6.0
		FBGA (AlSiC 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)	0.1	9.7	7.7	6.3	5.2
		FBGA (AlSiC lid)	0.2	10.2	8.2	6.6	5.4
	1,020	FBGA w/ fin *(1)*	0.5	5.0	3.0	2.0	2.0

Table 51. Thermal Resistance of APEX 20K and 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.
EP20K1500E	652	BGA (Cu lid)	0.1	8.2	6.9	5.5	4.4
		BGA (AlSiC lid)	0.2	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)	0.1	9.6	7.6	6.2	5.1
		FBGA (AlSiC lid)	0.2	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 51:

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

ACEX 1K Devices Thermal Resistance

Table 52 provides thermal resistance values for ACEX 1K devices.

Table 52. 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

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Mercury Devices Thermal Resistance

Table 53 provides thermal resistance values for Mercury devices.

Table 53. 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)	0.6	12.2	10.1	8.7	7.5
	484	FBGA (AlSiC lid)	0.9	13.0	11.1	9.3	7.9
EP1M350	780	FBGA (Cu lid)	0.2	10.5	8.5	7.1	5.9
	780	FBGA (AlSiC lid)	0.3	11.0	9.2	7.6	6.3

FLEX Series Devices Thermal Resistance

Table 54 through Table 56 provide thermal resistance values for FLEX series devices.

Table 54. Thermal Resistance of FLEX 10K Devices (Part 1 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPF10K10	84	PLCC	9.0	28.0	26.0	24.0	22.0
	144	TQFP	7.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
EPF10K10A	100	TQFP	10.0	35.0	33.0	31.0	28.0
	144	TQFP	7.0	29.0	28.0	26.0	25.0
	208	PQFP	5.0	30.0	29.0	27.0	21.0
	256	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

Table 54. Thermal Resistance of FLEX 10K Devices (Part 2 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
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
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

Table 54. Thermal Resistance of FLEX 10K Devices (Part 3 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
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
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 54:

(1) With attached pin-fin heat sink.

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

Table 55. 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
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

Table 55. Thermal Resistance of FLEX 8000 Devices (Part 2 of 2)

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 56. Thermal Resistance of FLEX 6000 Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPF6010A	100	TQFP	11.0	35.0	33.0	31.0	28.0
	144	TQFP	10.0	28.0	26.0	25.0	24.0
EPF6016	144	TQFP	10.0	28.0	26.0	25.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	240	PQFP	4.0	26.0	24.0	21.0	17.0
	256	BGA	6.0	28.0	22.0	20.0	19.0
EPF6016A	100	TQFP	11.0	35.0	33.0	31.0	28.0
		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

Excalibur Embedded Processor Solutions Thermal Resistance

Table 57 provides thermal resistance values for Excalibur Embedded Processor Solutions.

Table 57. Thermal Resistance of Excalibur Embedded Processor Solutions (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.
EPXA1	484	FBGA	4.0	20.0	18.3	15.8	13.9
	672	FBGA, Flip Chip (Cu lid)	0.5	11.3	9.3	7.9	6.7
	672	FBGA, Flip Chip (AlSiC lid)	0.8	12.2	10.2	8.6	7.2

Table 57. Thermal Resistance of Excalibur Embedded Processor Solutions (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.
EPXA4	672	FBGA, Flip Chip (Cu lid)	0.2	10.8	8.8	7.3	6.2
	672	FBGA, Flip Chip (AlSiC lid)	0.3	11.6	9.6	7.9	6.6
	1,020	FBGA, Flip Chip (Cu lid)	0.2	9.9	7.9	6.5	5.4
	1,020	FBGA, Flip Chip (AlSiC lid)	0.3	10.4	8.5	6.9	5.7
EPXA10	1,020	FBGA, Flip Chip (Cu lid)	0.1	9.6	7.6	6.2	5.1
	1,020	FBGA, Flip Chip (AlSiC lid)	0.2	10.0	8.0	6.4	5.7

Classic Devices Thermal Resistance

Table 58 provides thermal resistance values for Classic devices.

Table 58. Thermal Resistance of Classic Devices

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

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*.

☞ All flip chip packages are vented packages and all wire bond packages are non-vented packages.

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
Lead Coplanarity	NA
Weight	0.6 g (Typ.)
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 Variation. AA
Lead Coplanarity	0.1 mm
Weight	0.1 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
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
Lead Coplanarity	0.1 mm
Weight	0.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
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
Lead Coplanarity	0.004 inches (0.10mm)
Weight	0.8 g (Typ.)
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
Lead Coplanarity	NA
Weight	4.1 g (Typ.)
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
Lead Coplanarity	NA
Weight	1.9 g (Typ.)
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.

Package Information	
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
Lead Coplanarity	0.1 mm
Weight	0.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
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
Lead Coplanarity	0.004 inches (0.10 mm)
Weight	1.3 g (Typ.)
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
Lead Coplanarity	0.004 inches (0.1mm)
Weight	0.2 g (Typ.)
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
Lead Coplanarity	N/A
Weight	12.8 g (Typ.)
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.

Package Information	
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
Lead Coplanarity	N/A
Weight	7.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
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
Lead Coplanarity	0.004 inches (0.10 mm)
Weight	2.6 g (Typ.)
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
Lead Coplanarity	0.004 inches (0.10 mm)
Weight	0.5 g (Typ.)
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

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
Lead Coplanarity	0.004 inches (0.1mm)
Weight	0.3 g (Typ.)
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.

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: BAB-2
Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
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 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: AB
Lead Coplanarity	0.003 inch (0.08 mm)
Weight	0.1 g (Typ.)
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	5.00 BSC		
E	5.00 BSC		
b	0.25	0.30	0.35
e	0.50 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
Lead Coplanarity	N/A
Weight	10.4 g (Typ.)
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.

Figure 19–1.

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
Lead Coplanarity	0.004 inches (0.10 mm)
Weight	5.5 g (Typ.)
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

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
Lead Coplanarity	0.004 inches (0.10mm)
Weight	7.9 g (Typ.)
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
Lead Coplanarity	0.005 inches (0.12 mm)
Weight	0.4 g (Typ.)
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	–	–
A3	0.70 REF		
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.

☞ 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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.6 g (Typ.)
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.

☞ 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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.6 g (Typ.)
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
Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.1 g (Typ.)
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) — 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.

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
Lead Coplanarity	0.004 inches (0.10mm)
Weight	1.9 g (Typ.)
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 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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	0.6 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	1.1 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
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

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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	2.20
A1	0.30	–	–
A2	0.25	–	1.80
A3	0.70 REF		
D	13.00 BSC		
E	13.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

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

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

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
Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.1 g (Typ.)
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	0.50 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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	1.1 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
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

148-Pin Quad Flat No-Lead Package (QFN) — 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	N
Package Acronym	QFN
Substrate Material	Tape
Solder Ball Composition	Pb-free: NiAu
JEDEC Outline Reference	MO-247 Variation: BWQQB
Lead Coplanarity	0.003 inches (0.08mm)
Weight	0.6 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	0.70	0.75	0.80
A1	0.00	0.01	0.05
D	11.00 BSC		
D1	8.35	8.40	8.45
D2	6.85	6.90	6.95
E	11.00 BSC		
E1	8.35	8.40	8.45
E2	5.65	5.70	5.75
d	0.20	0.25	0.30
eT	0.50 BSC		
eR	0.65 BSC		
k	0.20	—	—
L	0.25	0.30	0.35
L1	0.05	0.10	0.15

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
Lead Coplanarity	N/A
Weight	19.9 g (Typ.)
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
Lead Coplanarity	0.004 inches (0.10mm)
Weight	6.2 g (Typ.)
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

164-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: AE
Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.2 g (Typ.)
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	8.00 BSC		
E	8.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

Package Outline

164-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond (EP3C16)

- 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: AE
Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	0.90	1.05	1.20
A1	0.15	0.20	0.25
A2	0.65	0.85	1.05
A3	0.55	0.60	0.65
D	8.00 BSC		
E	8.00 BSC		
b	0.25	0.30	0.35
e	0.50 BSC		

Package Outline

169-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: DBE-1
Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.25	1.40	1.55
A1	0.30	0.35	0.40
A2	0.85	1.05	1.25
A3	0.60	0.70	0.80
D	14.00 BSC		
E	14.00 BSC		
b	0.45	0.50	0.55
e	1.00 BSC		

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
Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.6 g (Typ.)
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
Lead Coplanarity	N/A
Weight	21.0 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08 mm)
Weight	6.3 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	11.0 g (Typ.)
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
Lead Coplanarity	N/A
Weight	25.5 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	8.0 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	15.4 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.8 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.2 g (Typ.)
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.

☞ This POD is applicable to F256 packages of all products except Cyclone II and III, 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.5 g (Typ.)
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	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.

☞ This POD is applicable to F256 packages of the Cyclone II and III products 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.5 g (Typ.)
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	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.

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: BH
Lead Coplanarity	0.003 inch (0.08mm)
Weight	0.3 g (Typ.)
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	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.

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: BAJ-2
Lead Coplanarity	0.005 inches (0.12mm)
Weight	0.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.55
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
Lead Coplanarity	N/A
Weight	29.5 g (Typ.)
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
Lead Coplanarity	0.003 inches (0.08mm)
Weight	26.1 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	1.6 g (Typ.)
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

324-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.

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-192 Variation: DAG-1
Lead Coplanarity	0.005 inches (0.12mm)
Weight	1.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.25	1.40	1.55
A1	0.30	0.35	0.40
A2	0.85	1.05	1.25
A3	0.60	0.70	0.80
D	19.00 BSC		
E	19.00 BSC		
b	0.45	0.50	0.55
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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	7.7 g (Typ.)
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

358-Pin Ultra FineLine Ball-Grid Array (UBGA) — 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	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: BAM-1
Lead Coplanarity	0.008 inches (0.20mm)
Weight	1.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	1.70
A1	0.25	–	–
A2	0.80	-	1.10
A3	0.80 TYP		
D	17.00 BSC		
E	17.00 BSC		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline

358-Pin Ultra FineLine Ball-Grid Array (UBGA) — Flip Chip — Lidless (EP2AGX45)

- 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: BAM-1
Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.30	1.55	1.80
A1	0.30	0.35	0.40
A2	0.90	1.20	1.50
A3	0.35	0.55	0.75
D	17.00 BSC		
D1	11.10 (Typ.)		
E	17.00 BSC		
E1	10.50 (Typ.)		
b	0.40	0.50	0.60
e	0.80 BSC		

Package Outline

358-Pin Ultra FineLine Ball-Grid Array (UBGA) — Flip Chip — Lidless (EP2AGX65)

- 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: BAM-1
Lead Coplanarity	0.008 inches (0.20mm)
Weight	0.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.30	1.55	1.80
A1	0.30	0.35	0.40
A2	0.90	1.20	1.50
A3	0.35	0.55	0.75
D	17.00 BSC		
D1	11.10 (Typ.)		
E	17.00 BSC		
E1	10.50 (Typ.)		
b	0.40	0.50	0.60
e	0.80 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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	2.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeteres**		
	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
Lead Coplanarity	N/A
Weight	47.7 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	7.1 g (Typ.)
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.

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.6 g (Typ.)
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	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.

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.6 g (Typ.)
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	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 4 — 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: AAJ-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.8 g (Typ.)
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		
D1	17.00 BSC		
E	23.00 BSC		
E1	17.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

484-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Dual-Piece Lid (EP2S15)

- 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: AAJ-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	6.4 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.35	1.45	1.55
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) — Flip Chip — Single-Piece Lid (EP2S15)

- 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: AAJ-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.10	3.30
A1	0.40	0.50	0.60
A2	2.30	2.60	2.90
A3	1.35	1.40	1.45
D	23.00 BSC		
D1	17.00 BSC		
E	23.00 BSC		
E1	17.00 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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	10.0 g (Typ.)
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

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
Lead Coplanarity	0.005 inches (0.12mm)
Weight	1.6 g (Typ.)
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

484-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond (EP3C40)

- 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
Lead Coplanarity	0.005 inches (0.12mm)
Weight	1.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.75	1.90	2.05
A1	0.30	0.40	0.50
A2	1.25	1.50	1.75
A3	0.90	0.95	1.00
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
Lead Coplanarity	N/A
Weight	59.0 g (Typ.)
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	2.245	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

572-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 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: AAK-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	6.2 g (Typ.)
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	25.00 BSC		
D1	19.00 BSC		
E	25.00 BSC		
E1	19.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

572-Pin FineLine Ball-Grid Array (FBGA) — Lidless — Flip Chip (EP2AGX45)

- 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: AAK-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.70	1.95	2.20
A1	0.40	0.50	0.60
A2	1.10	1.45	1.80
A3	0.65	0.85	1.05
D	25.00 BSC		
D1	11.10 (Typ.)		
E	25.00 BSC		
E1	10.50 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

572-Pin FineLine Ball-Grid Array (FBGA) — Lidless — Flip Chip (EP2AGX65)

- 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: AAK-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.70	1.95	2.20
A1	0.40	0.50	0.60
A2	1.10	1.45	1.80
A3	0.65	0.85	1.05
D	25.00 BSC		
D1	11.10 (Typ.)		
E	25.00 BSC		
E1	10.50 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

572-Pin FineLine Ball-Grid Array (FBGA) — Lidless — Flip Chip (EP2AGX95)

- 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: AAK-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	1.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.70	1.95	2.20
A1	0.40	0.50	0.60
A2	1.10	1.45	1.80
A3	0.65	0.85	1.05
D	25.00 BSC		
D1	13.40 (Typ.)		
E	25.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

572-Pin FineLine Ball-Grid Array (FBGA) — Lidless — Flip Chip (EP2AGX125)

- 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: AAK-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	2.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	1.70	1.95	2.20
A1	0.40	0.50	0.60
A2	1.10	1.45	1.80
A3	0.65	0.85	1.05
D	25.00 BSC		
D1	13.40 (Typ.)		
E	25.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 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
Lead Coplanarity	N/A
Weight	69.0 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20mm)
Weight	12.0 g (Typ.)
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.

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: BAW-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	23.8 g (Typ.)
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	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 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: BAW-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	15.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
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.

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	15.1 g (Typ.)
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

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
Lead Coplanarity	N/A
Weight	74.9 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.8 g (Typ.)
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	10.2 g (Typ.)
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

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.

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.8 g (Typ.)
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

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.9 g (Typ.)
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

672-Pin FineLine Ball-Grid Array (FBGA), Option 4 — 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	8.3 g (Typ.)
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		
D1	20.00 BSC		
E	27.00 BSC		
E1	20.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

672-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Dual-Piece Lid (EP2S15)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	8.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.35	1.45	1.55
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) — Flip Chip — Single-Piece Lid (EP2S15)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	6.6 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.10	3.40
A1	0.40	0.50	0.60
A2	2.30	2.60	2.90
A3	1.35	1.40	1.45
D	27.00 BSC		
D1	20.00 BSC		
E	27.00 BSC		
E1	20.00		
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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	13.6 g (Typ.)
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

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.

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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.9 g (Typ.)
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	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 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.0 g (Typ.)
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

780-Pin FineLine Ball-Grid Array (FBGA), Option 3 — 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	8.5 g (Typ.)
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	29.00 BSC		
D1	21.00 BSC		
E	29.00 BSC		
E1	21.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX45)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.25	2.50	2.75
A1	0.40	0.50	0.60
A2	1.65	2.00	2.35
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	11.10 (Typ.)		
E	29.00 BSC		
E1	10.50 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX65)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.25	2.50	2.75
A1	0.40	0.50	0.60
A2	1.65	2.00	2.35
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	11.10 (Typ.)		
E	29.00 BSC		
E1	10.50 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX95)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.1 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	13.40 (Typ.)		
E	29.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX125)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	13.40 (Typ.)		
E	29.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX190)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	17.20 (Typ.)		
E	29.00 BSC		
E1	16.60 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX260)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	17.20 (Typ.)		
E	29.00 BSC		
E1	16.60 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (HC325)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	3.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.25	2.50	2.75
A1	0.40	0.50	0.60
A2	1.65	2.00	2.35
A3	0.65	0.85	1.05
D	29.00 BSC		
D1	11.00 (Typ.)		
E	29.00 BSC		
E1	9.60 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Channel Lid (EP4SGX230)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	9.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.05	3.25	3.45
A1	0.40	0.50	0.60
A2	2.45	2.75	3.05
A3	1.45	1.55	1.65
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) — Flip Chip — Single-Piece Lid (HC325)

- 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: AAM-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	8.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.80	3.05	3.30
A1	0.40	0.50	0.60
A2	2.20	2.55	2.90
A3	1.20	1.40	1.60
D	29.00 BSC		
D1	21.00 BSC		
E	29.00 BSC		
E1	21.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

780-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: AAP-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.1 g (Typ.)
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

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.

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: AAN-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.7 g (Typ.)
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	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), 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	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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	19.6 g (Typ.)
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	40.00 BSC		
E	40.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

956-Pin Ball-Grid Array (BGA), Option 2 — 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: BAU-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	17.0 g (Typ.)
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	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.60	0.75	0.90
e	1.27 BSC		

Package Outline

1020-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: AAP-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.1 g (Typ.)
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

1020-Pin FineLine Ball-Grid Array (FBGA), Option 2 — 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	12.4 g (Typ.)
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		
D1	26.80 BSC		
E	33.00 BSC		
E1	26.80 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-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: AAR-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	15.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA), Option 2 — 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	12.1 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	35.00 BSC		
D1	27.00 BSC		
E	35.00 BSC		
E1	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX95)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	13.40 (Typ.)		
E	35.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX125)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	13.40 (Typ.)		
E	35.00 BSC		
E1	13.10 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX190)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	17.20 (Typ.)		
E	35.00 BSC		
E1	16.60 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW

BOTTOM VIEW

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (EP2AGX260)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	4.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.10	2.35	2.60
A1	0.40	0.50	0.60
A2	1.50	1.85	2.20
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	17.20 (Typ.)		
E	35.00 BSC		
E1	16.60 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW

BOTTOM VIEW

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (HC335)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.35	2.60	2.85
A1	0.40	0.50	0.60
A2	1.75	2.10	2.45
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	13.50 (Typ.)		
E	35.00 BSC		
E1	11.90 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (HC4E35)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	5.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.35	2.60	2.85
A1	0.40	0.50	0.60
A2	1.75	2.10	2.45
A3	0.65	0.85	1.05
D	35.00 BSC		
D1	13.50 (Typ.)		
E	35.00 BSC		
E1	11.90 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

TOP VIEW

BOTTOM VIEW

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1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Channel Lid (EP4SGX230)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.15	3.45	3.75
A1	0.40	0.50	0.60
A2	2.55	2.95	3.35
A3	1.45	1.55	1.65
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Channel Lid (EP4SGX360)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	13.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.15	3.35	3.55
A1	0.40	0.50	0.60
A2	2.55	2.85	3.15
A3	1.45	1.55	1.65
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Dual-Piece Lid (EP4SGX230)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	14.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.40	1.50	1.60
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (H4E35)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.15	3.40
A1	0.40	0.50	0.60
A2	2.30	2.65	3.00
A3	1.20	1.40	1.60
D	35.00 BSC		
D1	27.00 BSC		
E	35.00 BSC		
E1	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (HC335)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.15	3.40
A1	0.40	0.50	0.60
A2	2.30	2.65	3.00
A3	1.20	1.40	1.60
D	35.00 BSC		
D1	27.00 BSC		
E	35.00 BSC		
E1	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX230)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.10	3.30
A1	0.40	0.50	0.60
A2	2.30	2.60	2.90
A3	1.30	1.40	1.50
D	35.00 BSC		
D1	27.00 BSC		
E	35.00 BSC		
E1	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX360)

- 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
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	11.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.10	3.30
A1	0.40	0.50	0.60
A2	2.30	2.60	2.90
A3	1.30	1.40	1.50
D	35.00 BSC		
D1	27.00 BSC		
E	35.00 BSC		
E1	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA), 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	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: AAU-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	20.4 g (Typ.)
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	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA), Option 2 — 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
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

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA), Option 3 — 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: AAV-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	42.50 BSC		
D1	36.00 BSC		
E	42.50 BSC		
E1	36.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA), Option 4 — 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: AAV-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	17.8 g (Typ.)
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	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Dual-Piece Lid (EP4SGX530)

- 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: AAV-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	20.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.10	3.30	3.50
A1	0.40	0.50	0.60
A2	2.50	2.80	3.10
A3	1.40	1.50	1.60
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Single-Piece Lid (EP4SGX530)

- 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: AAV-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.20 BSC		
E	42.50 BSC		
E1	36.20 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1152-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Single-Piece Lid (EP4SGX820)

- 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: AAV-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.0 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.20 BSC		
E	42.50 BSC		
E1	36.20 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1508-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: AAU-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	20.4 g (Typ.)
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	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1508-Pin FineLine Ball-Grid Array (FBGA), Option 2 — 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: AAU-1
Lead Coplanarity	0.008 inches (0.20 mm)
Weight	17.8 g (Typ.)
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	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	20.4 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA), Option 2 — 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.8 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (HC335)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	7.6 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.35	2.60	2.85
A1	0.40	0.50	0.60
A2	1.75	2.10	2.45
A3	0.65	0.85	1.05
D	40.00 BSC		
D1	13.50 (Typ.)		
E	40.00 BSC		
E1	11.90 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Lidless (HC4E35)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	7.6 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.35	2.60	2.85
A1	0.40	0.50	0.60
A2	1.75	2.10	2.45
A3	0.65	0.85	1.05
D	40.00 BSC		
D1	13.50 (Typ.)		
E	40.00 BSC		
E1	11.90 (Typ.)		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (HC335)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	15.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.15	3.40
A1	0.40	0.50	0.60
A2	2.30	2.65	3.00
A3	1.20	1.40	1.60
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (HC4E35)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	15.2 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	2.90	3.15	3.40
A1	0.40	0.50	0.60
A2	2.30	2.65	3.00
A3	1.20	1.40	1.60
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4S40G2 and EP4S100G2)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	16.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.20	3.40	3.60
A1	0.40	0.50	0.60
A2	2.60	2.90	3.20
A3	1.30	1.40	1.50
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX230)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	15.3 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX360)

- 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: AAU-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	15.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	40.00 BSC		
D1	30.00 BSC		
E	40.00 BSC		
E1	30.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA), 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	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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA), Option 2 — 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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	42.50 BSC		
D1	36.00 BSC		
E	42.50 BSC		
E1	36.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Single-Piece Lid (EP4S100G5)

- 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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	18.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.20	3.40	3.60
A1	0.40	0.50	0.60
A2	2.60	2.90	3.20
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.20 BSC		
E	42.50 BSC		
E1	36.20 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Dual-Piece Lid (EP4SGX530)

- 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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	21.4 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.10	3.40	3.70
A1	0.40	0.50	0.60
A2	2.50	2.90	3.30
A3	1.40	1.50	1.60
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Single-Piece Lid (EP4SGX530)

- 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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.4 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.20 BSC		
E	42.50 BSC		
E1	36.20 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1517-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip — Single-Piece Lid (EP4SGX820)

- 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: AAV -1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.4 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.20 BSC		
E	42.50 BSC		
E1	36.20 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1760-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: AAV-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1760-Pin FineLine Ball-Grid Array (FBGA), Option 2— 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
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	22.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.50 *(1)*
A1	0.30	–	–
A2	0.25	–	3.00 *(2)*
A3	–	–	2.50
D	42.50 BSC		
D1	36.00 BSC		
E	42.50 BSC		
E1	36.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Notes:

For Stratix IV GX products:

(1) Overall package thickness (Dimension “A”) is 3.90 mm maximum.

(2) Package body thickness (Dimension “A2”) is 3.30 mm maximum.

Package Outline

1760-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Dual-Piece Lid (EP4SGX530)

- 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
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	20.9 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.10	3.30	3.50
A1	0.40	0.50	0.60
A2	2.50	2.80	3.10
A3	1.40	1.50	1.60
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1760-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX530)

- 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
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.00 BSC		
E	42.50 BSC		
E1	36.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1760-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX820)

- 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
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	17.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.00	3.20	3.40
A1	0.40	0.50	0.60
A2	2.40	2.70	3.00
A3	1.30	1.40	1.50
D	42.50 BSC		
D1	36.00 BSC		
E	42.50 BSC		
E1	36.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1932-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: AAW-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	24.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.90
A1	0.30	–	–
A2	0.25	–	3.30
A3	–	–	2.50
D	45.00 BSC		
E	45.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1932-Pin FineLine Ball-Grid Array (FBGA), Option 2 — 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: AAW-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	24.7 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	–	–	3.90
A1	0.30	–	–
A2	0.25	–	3.30
A3	–	–	2.50
D	45.00 BSC		
D1	39.00 BSC		
E	45.00 BSC		
E1	39.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1932-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Dual-Piece Lid (EP4SGX530)

- 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: AAW-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	24.6 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.30	3.50	3.70
A1	0.40	0.50	0.60
A2	2.70	3.00	3.30
A3	1.40	1.50	1.60
D	45.00 BSC		
E	45.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1932-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SGX530)

- 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: AAW-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	20.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.20	3.40	3.60
A1	0.40	0.50	0.60
A2	2.60	2.90	3.20
A3	1.30	1.40	1.50
D	45.00 BSC		
D1	38.90 BSC		
E	45.00 BSC		
E1	38.90 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

1932-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip — Single-Piece Lid (EP4SG100G5)

- 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: AAW-1
Lead Coplanarity	0.010 inches (0.25 mm)
Weight	20.5 g (Typ.)
Moisture Sensitivity Level	Printed on moisture barrier bag

Package Outline Dimension Table			
Symbol	**Millimeters**		
	Min.	**Nom.**	**Max.**
A	3.20	3.40	3.60
A1	0.40	0.50	0.60
A2	2.60	2.90	3.20
A3	1.30	1.40	1.50
D	45.00 BSC		
D1	38.90 BSC		
E	45.00 BSC		
E1	38.90 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline

Additional Information

This section contains revision history and contact information.

Revision History

Table 59 shows the revision history for this document.

Table 59. Document Revision History *(1)* (Part 1 of 4)

Date and Document Version	Changes Made	Summary of Changes
December 2009	■ Added notes for preliminary thermal information (Table 36, Table 37, Table 46, and Table 47)	Updated for version 16.0
November 2009	■ Added Cyclone IV information ■ Added notes to 1152-Pin HBGA Option 3 Data Sheet ■ Corrected drawings for 358-Pin UBGA—Lidless (EP2AGX45), 358-Pin UBGA—Lidless (EP2AGX65), and 1152-Pin FBGA—Lidless (EP2AGX95) Data Sheets ■ Added 148-Pin QFN, 169-Pin FBGA, and 324-Pin FBGA Option 2 Data Sheets ■ Added 1517-Pin—Lidless (HC4E35) and 1517-Pin Single-Piece Lid (HC4E35) Data Sheets ■ Added 780-pin FBGA—Channel Lid (EP4SGX230), 780-Pin HBGA—Channel Lid (EP4SGX 360), 1152-Pin FBGA—Channel Lid (EP4SGX230), 1152-Pin FBGA—Channel Lid (EP4SGX360), 1152-Pin FBGA—Dual-Piece Lid (EP4SGX230), 1152-Pin FBGA—Single-Piece Lid (EP4SGX230), 1152-Pin FBGA—Single-Piece Lid (EP4SGX360), 1152-Pin HBGA—Single-Piece Lid (EP4SGX530), 1152-Pin HBGA—Single-Piece Lid (EP4SGX820), 1517-Pin FBGA—Dual-Piece Lid (EP4SGX230), 1517-Pin FBGA—Single-Piece Lid (EP4SGX230), 1517-Pin FBGA—Single-Piece Lid (EP4SGX360), 1517-Pin HBGA—Dual-Piece Lid (EP4SGX530), 1517-Pin HBGA—Single-Piece Lid (EP4SGX530), 1517-Pin HBGA—Single-Piece Lid (EP4S40G2 and EP4S100G2), 1517-Pin HBGA—Single-Piece Lid (EP4S100G5), 1517-Pin HBGA—Single-Piece Lid (EP4SGX820), 1760-Pin FBGA—Dual-Piece Lid (EP4SGX530), 1760-Pin FBGA—Single-Piece Lid (EP4SGX360), 1760-Pin FBGA—Single-Piece Lid (EP4SGX820), 1932-Pin FBGA—Dual-Piece Lid (EP4SGX530), 1932-Pin FBGA—Single-Piece Lid (EP4SGX530), 1932-Pin FBGA—Single-Piece Lid (EP4S100G2) Data Sheets ■ Added 484-Pin FBGA—Dual-Piece Lid (EP2S15), 484-Pin FBGA—Single-Piece Lid (EP2S15), 672-Pin FBGA—Dual-Piece Lid (EP2S15), 672-Pin FBGA—Single-Piece Lid (EP2S15), 164-Pin MBGA (EP3C16), and 484-Pin UBGA (EP3C40) Data Sheets	Updated for version 15.9

Table 59. Document Revision History *(1)* (Part 2 of 4)

Date and Document Version	Changes Made	Summary of Changes
October 2009	■ Added 1152-Pin HBGA Option 3, 1152-Pin HBGA Option 4, 1517-Pin HBGA Option 2, 1760-Pin FBGA Option 2, and 1932-Pin FBGA Option 2 Data Sheets ■ Added 358-Pin UBGA—Lidless (EP2AGX45), 358-Pin UBGA—Lidless (EP2AGX65), 572-Pin FBGA—Lidless (EP2AGX45), 572-Pin FBGA—Lidless (EP2AGX65), 572-Pin FBGA—Lidless (EP2AGX95), 572-Pin FBGA—Lidless (EP2AGX125), 780-Pin FBGA—Lidless (EP2AGX45), 780-Pin FBGA—Lidless (EP2AGX65), 780-Pin FBGA—Lidless (EP2AGX95), 780-Pin FBGA—Lidless (EP2AGX125), 780-Pin FBGA—Lidless (EP2AGX190), 780-Pin FBGA—Lidless (EP2AGX260), 1152-Pin FBGA—Lidless (EP2AGX95), 1152-Pin FBGA—Lidless (EP2AGX125), 1152-Pin FBGA—Lidless (EP2AGX190), and 1152-Pin FBGA—Lidless (EP2AGX260) Data Sheets ■ Added 780-Pin FBGA—Lidless (HC325), 780-Pin FBGA—Single-Piece Lid (HC325), 1152-Pin FBGA—Lidless (HC335), 1152-Pin FBGA—Single-Piece Lid (HC335), 1152-Pin FBGA—Lidless (HC4E35), 1152-Pin FBGA—Single-Piece Lid (HC4E35), 1517-Pin FBGA—Lidless (HC335), and 1517-Pin FBGA—Single-Piece Lid (HC335) Data Sheets ■ Removed EP2AGX20 and EP2AGX30 entries from Table 1 and Table 28 ■ Added EP4SE820 entries to Table 30 ■ Added Stratix IV GT devices to Table 3; added option references ■ Updated thermal resistance values in Table 28	Updated for version 15.8
June 2009	■ Made three corrections to Stratix III thermal resistance table ■ Added Cyclone III LS information ■ Added Stratix IV GT thermal resistance values ■ Added and/or HardCopy III and IV cross-reference and thermal resistance tables ■ Updated HardCopy III and IV part numbers ■ Added Cyclone III M164 package information ■ Added 484-Pin FBGA Option 4, 672-Pin FBGA Option 4, 1020-Pin FBGA Option 2, 1508-Pin FBGA Option 2, and 1517-Pin Option 2 FBGA Data Sheets ■ Revised 1508-Pin FBGA Option 1, 1020-Pin FBGA Option 1, 1517-Pin FBGA Option 1, 572-Pin FBGA, and 1152-Pin FBGA Option 2 Data Sheets ■ Added 956-Pin BGA Option 2 Data Sheet	Updated for version 15.7
March 2009	■ Corrected “b Nom.” value in 358-Pin UBGA Data Sheet ■ Corrected “A Max.” value and replaced package drawing in 780-Pin FBGA - Option 3 Data Sheet ■ Corrected “A Max.” value in 256-Pin UBGA Data Sheet ■ Modified thermal resistance values for EP3SL200 device in Stratix III thermal resistance table	Updated for version 15.6

Table 59. Document Revision History *(1)* (Part 3 of 4)

Date and Document Version	Changes Made	Summary of Changes
March 2009	■ Fixed theta symbols in several data sheet Dimension Tables ■ Updated dimensions in 256-Pin UBGA Data Sheet ■ Added 358-Pin UBGA Data Sheet, 572-Pin, 780-Pin Option 3, and 1152-Pin Option 2 FBGA Data Sheets ■ Added Arria II GX thermal resistance table ■ Added Arria II GX device and package cross-reference table ■ Added EP3SL50, EP3SE80, and EP3SL110 devices to Stratix III thermal resistance table ■ Added EP4SGX70, EP4SGX180, and EP4SGX290 devices and updated Stratix IV GX thermal resistance table ■ Added HardCopy III and HardCopy IV thermal resistance table ■ Miscellaneous formatting changes	Updated for version 15.5
December 2008	■ Changed dimension “A” Max. value in 1932-Pin FBGA Data Sheet	Updated for version 15.4
November 2008	■ Moved Revision History to the end and added “How to Contact Altera” section ■ Added subheadings in Thermal Resistance section ■ Converted to 8-1/2 x 11 page size ■ Changed “Maximum Lead Coplanarity” to “Lead Coplanarity” and added “(Typ.)” to weights for all packages ■ Added EP2C15 information to Cyclone II tables	Updated for version 15.3
September 2008	■ Added thermal resistance values for Stratix IV ■ Added new 1152-Pin HBGA Option 2 (42.5 MM SQ.) Data Sheet ■ Added new 1517-Pin HBGA (42.5 MM SQ.) Data Sheet ■ Added theta-JB thermal resistance values for Stratix II ■ Added HardCopy II thermal resistance values ■ Revised weights for 256-Pin BGA Option 2, 652-Pin BGA Option 2, 652-Pin BGA Option 3, 208-Pin RQFP, 240-Pin RQFP, and 304-Pin RQFP Data Sheets ■ Added notes to 1152-Pin FBGA, 1517-Pin FBGA, 1760-Pin FBGA; changed dimension “A” thickness and “A2” thickness in 1932-Pin FBGA Data Sheet	Updated for version 15.2
May 2008	■ Added 1932-Pin FBGA Data Sheet ■ Added Device and Package Cross Reference table for Stratix IV	Updated for version 15.1
April 2008	■ Revised Maximum Lead Coplanarity values for 1517-Pin FBGA and 1760-Pin FBGA Data Sheets ■ Added three entries to Table 3 ■ Corrected minor typos in Table 4 and Table 10 ■ Corrected HC210W package in Table 12 ■ Many tables updated for formatting consistency	Updated for version 15.0

Table 59. Document Revision History *(1)* (Part 4 of 4)

Date and Document Version	Changes Made	Summary of Changes
February 2008	■ Added 164-Pin MBGA information in Table 8 ■ Added HardCopy II device information in Table 12 ■ Updated Stratix III thermal resistance values in Table 22 ■ Added 164-Pin MBGA Data Sheet ■ Corrected 8-Pin SOIC Data Sheet (changed “B” to “b” in Package Outline Dimension Table) ■ Corrected 68-Pin MBGA Data Sheet (changed “Inches” to “Millimeters” in Package Outline Dimension Table)	Updated for version 14.9
October 2007	■ Removed note from 100-Pin PQFP Option 1 Data Sheet ■ Removed 100-Pin PQFP Option 2 Data Sheet ■ Updated 88-Pin UBGA, 144-Pin EQFP, 256-Pin FBGA Option 1, 256-Pin FBGA Option 2, 256-Pin UBGA, 1517-Pin FBGA, and 1760-Pin FBGA Data Sheets ■ Added 780-Pin HBGA and 1152-Pin HBGA Data Sheets	Updated for version 14.8
May 2007 v14.7	■ 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	■ 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	■ 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 59:

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

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How to Contact Altera

For the most up-to-date information about Altera® products, see the following table.

Contact *(Note 1)*	Contact Method	Address
Technical support	Website	www.altera.com/support
Technical training	Website	www.altera.com/training
	Email	custrain@altera.com
Altera literature services	Email	literature@altera.com
Non-technical support (General)	Email	nacomp@altera.com
(Software Licensing)	Email	authorization@altera.com

Note:

(1) You can also contact your local Altera sales office or sales representative.

101 Innovation Drive
San Jose, CA 95134
www.altera.com
Technical Support
www.altera.com/support

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