Altera Device Package Information Data Sheet

DS-PKG-15.4

Introduction

This data sheet provides package information about Altera® devices. It includes the following sections:

- Device and Package Cross Reference
- Thermal Resistance (starting on page 17)
- Package Outlines (starting on page 39)

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

Device and Package Cross Reference

Table 1 through Table 20 show the devices available in Ball-Grid Array (BGA), FineLine BGA (FBGA), Ultra FineLine BGA (UBGA), Micro FineLine BGA (MBGA), Pin-Grid Array (PGA), Plastic J-Lead Chip Carrier (PLCC), Thin Quad Flat Pack (TQFP), Plastic Quad Flat Pack (PQFP), Ceramic Dual In-Line Package (CerDIP), and Hybrid FineLine BGA (HBGA):

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

Table 1. 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

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

Device	Package	Pins
EP4SGX70	FBGA, Flip Chip	780
EP4SGX110	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP4SGX230	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
EP4SGX290	33 MM SQ HBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
EP4SGX360	33 MM SQ HBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
EP4SGX530	42.5 MM SQ HBGA, Flip Chip	1,152
	42.5 MM SQ HBGA, Flip Chip	1,517
	FBGA, Flip Chip	1,932
EP4SE110	FBGA, Flip Chip	780
EP4SE230	FBGA, Flip Chip	780
EP4SE290	33 MM SQ HBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
EP4SE360	33 MM SQ HBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517

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

Device	Package	Pins
EP4SE530	42.5 MM SQ HBGA, Flip Chip	1,152
	42.5 MM SQ HBGA, Flip Chip	1,517
	FBGA, Flip Chip	1,760
EP4SE680	40 MM SQ HBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517
	FBGA, Flip Chip	1,760

Table 3. Stratix III Devices

Device	Package	Pins
EP3SL50	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP3SL70	FBGA, Flip Chip	484
	FBGA, Flip Chip	780
EP3SL110	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP3SL150	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP3SL200	FBGA, Flip Chip	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	780
EP3SE80	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP3SE110	FBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
EP3SE260	HBGA, Flip Chip	780
	FBGA, Flip Chip	1,152
	FBGA, Flip Chip	1,517

Table 4. Stratix II Devices (Part 1 of 2)

Device	Package	Pins
EP2S15	FBGA, Flip Chip	484
	FBGA, Flip Chip	672
EP2S30	FBGA, Flip Chip	484
	FBGA, Flip Chip	672

Table 4. Stratix II Devices (Part 2 of 2)

Device	Package	Pins
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 5. 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 6. 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 7. Stratix Devices (Part 1 of 2)

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

Table 7. Stratix Devices (Part 2 of 2)

Device	Package	Pins
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 8. 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

Table 8. Cyclone III Devices (Part 2 of 2)

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

Notes to Table 8:

(1) The E144 package has an exposed pad at the bottom of the package. This exposed ground pad that must be connected to the ground plane on your PCB. This exposed pad is used for electrical connectivity and not for thermal purposes.

(2) The package type entries with "Option #" refer to instances where multiple package options exist for a given package type and pin count. The Option number identifies the specific type used by the corresponding device density.

Table 9. 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 10. 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 11. 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
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

Table 11. MAX Series Devices (Part 2 of 3)

Device	Package	Pins
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
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

Table 11. MAX Series Devices (Part 3 of 3)

Device	Package	Pins
EPM7256A	TQFP, Wire Bond	100
	TQFP, Wire Bond	144
	PQFP, Wire Bond	208
	FBGA, Wire Bond (Option 1)	256

Table 12. 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 13. 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 14. 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 15. 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

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

Device	Package	Pins
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
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

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

Device	Package	Pins
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
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 16. 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 17. Mercury Devices

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

Table 18. FLEX Series Devices (Part 1 of 4)

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

Table 18. FLEX Series Devices (Part 2 of 4)

Device	Package	Pins
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
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

Table 18. FLEX Series Devices (Part 3 of 4)

Device	Package	Pins
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
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

Table 18. FLEX Series Devices (Part 4 of 4)

Device	Package	Pins
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 19. 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 20. 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

Thermal Resistance

Table 21 through Table 45 provide θ_{JA} (junction-to-ambient thermal resistance) and θ_{JC} (junction-to-case thermal resistance) values for the following Altera device families:

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

Altera is transitioning to an industry-standard copper lid for its thermally enhanced BGA and thermally enhanced Flip Chip FBGA package offerings (as mentioned in the *Process Change Notice 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.

Arria GX Devices Thermal Resistance

Table 21 provides thermal resistance values for Arria GX devices.

Table 21. 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	3.14
	780	FBGA	11.1	8.6	7.2	6.0	0.24	3.14
EP1AGX35	484	FBGA	12.8	10.3	8.7	7.5	0.3	3.14
	780	FBGA	11.1	8.6	7.2	6.0	0.24	3.14
EP1AGX50	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.86
	780	FBGA	10.9	8.4	6.9	5.8	0.15	2.84
	1152	FBGA	9.9	7.5	6.1	5.0	0.15	2.5
EP1AGX60	484	FBGA	12.7	10.2	8.6	7.3	0.2	2.86
	780	FBGA	10.9	8.4	6.9	5.8	0.15	2.84
	1152	FBGA	9.9	7.5	6.1	5.0	0.15	2.5
EP1AGX90	1152	FBGA	9.6	7.3	5.9	4.9	0.11	2.33

Stratix Series Devices Thermal Resistance

Table 22 through Table 27 provide thermal resistance values for Stratix series devices.

Table 22. Thermal Resistance of Stratix IV Devices (Part 1 of 3)

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 without OPD and 8-Layer Substrates								
EP4SE110	780	FBGA	10.7	8.6	7.2	6.0	0.31	2.3
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	0.16	2.6
EP4SGX110	780	FBGA	10.7	8.6	7.2	6.0	0.31	2.3
	1152	FBGA	9.8	7.7	6.3	5.2	0.32	2.0
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
EP4SGX360	780	HBGA	9.0	8.2	6.7	5.6	0.16	2.6
	1152	FBGA	8.3	7.4	6.0	4.9	0.16	1.6
	1517	FBGA	7.8	6.8	5.5	4.4	0.16	1.7
EP4SGX530	1517	FBGA	7.7	6.7	5.4	4.3	0.13	1.6
JEDEC 2S2P Board with OPD and 14-Layer Substrates								
EP4SE360	1152	FBGA	8.3	7.4	6.0	4.9	0.16	1.6
	1517	FBGA	7.7	6.8	5.4	4.4	0.16	1.7

Table 22. Thermal Resistance of Stratix IV Devices (Part 2 of 3)

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)
EP4SE530	1152	HBGA	7.9	7.1	5.7	4.6	0.13	2.4
	1517	HBGA	7.6	6.7	5.3	4.3	0.13	1.7
	1760	FBGA	7.4	6.5	5.1	4.1	0.13	1.2
EP4SE680	1152	HBGA	8.0	7.2	5.8	4.7	0.13	2.3
	1517	FBGA	7.7	6.7	5.4	4.3	0.13	1.4
	1760	FBGA	7.4	6.5	5.2	4.1	0.13	1.2
EP4SGX110	1152	FBGA	9.8	7.7	6.3	5.2	0.3	2.0
EP4SGX230	1152	FBGA	8.8	7.5	6.1	5.0	0.2	1.7
	1517	FBGA	8.2	6.9	5.5	4.5	0.19	1.8
EP4SGX360	1152	FBGA	8.3	7.4	6.0	4.9	0.16	1.6
	1517	FBGA	7.7	6.8	5.4	4.4	0.16	1.7
	1760	FBGA	7.5	6.5	5.2	4.2	0.16	1.4
EP4SGX530	1152	HBGA	7.9	7.1	5.7	4.6	0.13	2.4
	1517	HBGA	7.6	6.7	5.3	4.3	0.13	1.7
	1760	FBGA	7.4	6.5	5.1	4.1	0.13	1.2
	1932	FBGA	7.2	6.3	5.0	4.0	0.13	1.3
Typical Board without OPD and 8-Layer Substrates								
EP4SE110	780	FBGA	10.3	8.1	6.5	5.3	—	1.7
EP4SE230	780	FBGA	9.1	7.8	6.3	5.1	—	1.5
EP4SE360	780	HBGA	8.3	7.4	5.9	4.8	—	1.7
EP4SGX110	780	FBGA	10.3	8.1	6.5	5.3	—	1.7
	1152	FBGA	9.3	7.2	5.7	4.6	—	1.4
EP4SGX230	780	FBGA	9.1	7.8	6.3	5.1	—	1.5
	1152	FBGA	8.1	6.9	5.5	4.4	—	1.2
EP4SGX360	780	HBGA	8.3	7.4	5.9	4.8	—	1.7
	1152	FBGA	7.7	6.7	5.3	4.3	—	1.1
	1517	FBGA	7.1	6.1	4.8	3.8	—	1.1
EP4SGX530	1517	FBGA	7.0	6.1	4.8	3.7	—	1.0
Typical Board with OPD and 14-Layer Substrates								
EP4SE360	1152	FBGA	7.7	6.8	5.4	4.3	—	1.1
	1517	FBGA	7.0	6.1	4.8	3.8	—	1.1
EP4SE530	1152	HBGA	7.1	6.2	4.9	3.9	—	1.5
	1517	HBGA	6.8	5.9	4.6	3.6	—	1.0
	1760	FBGA	6.7	5.8	4.5	3.5	—	0.9
	1932	FBGA	6.5	5.6	4.4	3.4	—	0.9
EP4SE680	1152	HBGA	7.2	6.3	5.0	4.0	—	1.4
	1517	FBGA	7.0	6.0	4.7	3.7	—	1.0
	1760	FBGA	6.7	5.8	4.5	3.6	—	0.9

Table 22. Thermal Resistance of Stratix IV Devices (Part 3 of 3)

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)
EP4SGX110	1152	FBGA	9.3	7.2	5.7	4.6	—	1.5
EP4SGX230	1152	FBGA	8.1	6.9	5.5	4.4	—	1.2
	1517	FBGA	7.4	6.2	4.9	3.9	—	1.2
EP4SGX360	1152	FBGA	7.7	6.8	5.4	4.3	—	1.1
	1517	FBGA	7.0	6.1	4.8	3.8	—	1.1
	1760	FBGA	6.8	5.8	4.6	3.6	—	1.0
EP4SGX530	1152	SHBGA	7.1	6.2	4.9	3.9	—	1.5
	1517	HBGA	6.8	5.9	4.6	3.6	—	1.0
	1760	FBGA	6.7	5.8	4.5	3.5	—	0.9
	1932	FBGA	6.5	5.6	4.4	3.4	—	0.9

Table 23. Thermal Resistance of Stratix 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)
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
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
EP3SE110	780	FBGA	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA	9.4	7.6	6.2	5.1	0.2	2.0
EP3SL150	780	FBGA	10.2	8.5	7.0	5.8	0.2	2.0
	1152	FBGA	9.4	7.6	6.2	5.1	0.2	2.0
EP3SL200	780	FBGA	9.6	8.4	6.9	5.7	0.1	1.9
	1152	FBGA	8.8	7.5	6.1	5.0	0.1	1.8
	1517	FBGA	8.2	6.9	5.6	4.6	0.1	1.8
EP3SE260	780	HBGA	9.0	8.1	6.7	5.5	0.1	2.5
	1152	FBGA	8.4	7.4	6.0	4.9	0.1	1.8
	1517	FBGA	7.8	6.8	5.5	4.4	0.1	1.7
EP3SL340	1152	HBGA	8.1	7.2	5.8	4.7	0.1	2.3
	1517	HBGA	7.7	6.8	5.4	4.4	0.1	1.4
	1760	HBGA	7.5	6.5	5.2	4.2	0.1	1.3

Table 24. Thermal Resistance of Stratix II Devices (Part 1 of 2)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.	θ_{JB} (° C/W)
EP2S15	484	FBGA, Flip Chip	0.36	13.1	11.1	9.6	8.3	4.19
	672	FBGA, Flip Chip	0.36	12.2	10.2	8.8	7.6	4.09

Table 24. Thermal Resistance of Stratix II Devices (Part 2 of 2)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.	θ_{JB} (° C/W)
EP2S30	484	FBGA, Flip Chip	0.21	12.6	10.6	9.1	7.9	3.72
	672	FBGA, Flip Chip	0.21	11.7	9.7	8.3	7.1	3.35
EP2S60	484	FBGA, Flip Chip	0.13	12.3	10.3	8.8	7.5	3.38
	672	FBGA, Flip Chip	0.13	11.4	9.4	7.8	6.7	2.95
	1,020	FBGA, Flip Chip	0.13	10.4	8.4	7.0	5.9	2.67
EP2S90	484	HBGA, Flip Chip	0.07	12.0	9.9	8.3	7.1	3.73
	780	FBGA, Flip Chip	0.09	10.80	8.8	7.3	6.1	2.59
	1,020	FBGA, Flip Chip	0.10	10.2	8.2	6.8	5.7	2.41
	1,508	FBGA, Flip Chip	0.10	9.3	7.4	6.1	5.0	2.24
EP2S130	780	FBGA, Flip Chip	0.07	10.1	8.7	7.2	6.0	2.44
	1,020	FBGA, Flip Chip	0.07	9.5	8.1	6.7	5.5	2.24
	1,508	FBGA, Flip Chip	0.07	8.6	7.3	6.0	4.8	2.08
EP2S180	1,020	FBGA, Flip Chip	0.05	9.0	7.9	6.5	5.4	2.10
	1,508	FBGA, Flip Chip	0.05	8.1	7.1	5.8	4.7	1.94

Table 25. Thermal Resistance of Stratix II GX 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.	θ_{JB} (°C/W)
EP2SGX30	780	FBGA, Flip Chip	0.24	11.1	8.6	7.2	6	3.14
EP2SGX60	780	FBGA, Flip Chip	0.15	10.9	8.4	6.9	5.8	2.84
	1152	FBGA, Flip Chip	0.15	9.9	7.5	6.1	5	2.5

Table 25. Thermal Resistance of Stratix II GX Devices (Continued) (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.	θ_{JB} (°C/W)
EP2SGX90	1152	FBGA, Flip Chip	0.11	9.6	7.3	5.9	4.9	2.33
	1508	FBGA, Flip Chip	0.11	9	6.7	5.4	4.4	1.94
EP2SGX130	1508	FBGA, Flip Chip	0.1	8.3	6.6	5.3	4.3	1.78

Table 26. 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.
EP1SGX10CE P1SGX10D	672	FBGA, Flip Chip	0.39	11.1	9.1	7.7	6.5

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.
EP1SGX25CE P1SGX25D	672	FBGA, Flip Chip	0.23	10.8	8.8	7.4	6.2
EP1SGX25DE P1SGX25F	1020	FBGA, Flip Chip	0.23	9.9	7.9	6.5	5.4
EP1SGX40DE P1SGX40G	1020	FBGA, Flip Chip	0.16	9.8	7.7	6.4	5.3

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

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EP1S10	484	FBGA, Flip Chip	0.38	11.9	9.8	8.4	7.2
	672	BGA	3.2	16.8	13.7	11.9	10.5
	672	FBGA	3.4	17.2	14	12.2	10.8
	780	FBGA, Flip Chip	0.43	10.9	8.8	7.4	6.3
EP1S20	484	FBGA, Flip Chip	0.30	11.8	9.7	8.3	7.1
	672	BGA	2.5	15.5	12.4	10.7	9.3
	672	FBGA	2.7	16	12.8	11	9.6
	780	FBGA, Flip Chip	0.31	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
	780	FBGA, Flip Chip	0.25	10.5	8.5	7.1	6.0
	1020	FBGA, Flip Chip	0.25	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

Table 27. Thermal Resistance of Stratix Devices (Part 2 of 2)

EP1S40	780	FBGA, Flip Chip	0.17	10.4	8.3	6.9	5.8
	956	BGA, Flip Chip	0.18	9.0	7.0	5.7	4.7
	1020	FBGA, Flip Chip	0.17	9.8	7.8	6.4	5.3
	1508	FBGA, Flip Chip	0.18	9.1	7.1	5.8	4.7
EP1S60	956	BGA, Flip Chip	0.13	8.9	6.9	5.6	4.6
	1020	FBGA, Flip Chip	0.13	9.7	7.7	6.3	5.2
	1508	FBGA, Flip Chip	0.13	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 28 through Table 30 provide thermal resistance values for Cyclone series devices.

Table 28. Thermal Resistance of Cyclone III 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)
EP3C5	E144	20	17.5	15.4	14	8.4
EP3C5	F256	32.4	28.9	27	25.5	11.7
EP3C5	U256	32.5	29.1	27.2	25.6	12.2
EP3C10	E144	20	17.5	15.4	14	8.4
EP3C10	F256	32.4	28.9	27	25.5	11.7
EP3C10	U256	32.5	29.1	27.2	25.6	12.2
EP3C16	E144	20	17.5	15.4	14	8.4
EP3C16	Q240	27.2	24.7	22.1	17.8	4.3
EP3C16	F256	28.5	25.1	23.2	21.7	9.1
EP3C16	U256	28.8	25.4	23.5	22	9.7
EP3C16	U484	26.9	23.5	21.6	20.1	8.5
EP3C16	F484	22.9	19.4	17.7	16.2	6.9
EP3C25	E144	29	27.5	26.3	24.4	7.8
EP3C25	Q240	27	24.5	21.8	17.6	4.2
EP3C25	F256	27.5	24.1	22.2	20.7	8.5
EP3C25	U256	27.9	24.5	22.6	21.1	9.1
EP3C25	F324	26.6	23.1	21.3	19.8	8
EP3C40	Q240	25.8	23.2	20.6	17	4
EP3C40	F324	23.2	19.7	18	16.5	5.9
EP3C40	U484	22.8	19.3	17.6	16.1	5.9
EP3C40	F484	19.8	16.3	14.6	13.2	4.8
EP3C40	F780	18.7	15.2	13.5	12.2	4.5
EP3C55	U484	21.6	18.2	16.4	15	5.1
EP3C55	F484	18.9	15.4	13.8	12.2	4.2
EP3C55	F780	17.8	14.4	12.7	11.4	3.9
EP3C80	U484	20.4	16.9	15.2	13.8	4.4
EP3C80	F484	18	14.5	12.9	11.5	3.6
EP3C80	F780	16.9	13.5	11.8	10.5	3.3
EP3C120	F484	17.1	13.7	12	10.7	3.1
EP3C120	F780	16	12.6	11	9.7	2.8

Table 29. 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	10	31	29.3	27.9	25.5
	208	PQFP	5.5	30.4	29.2	27.3	22.3
	256	FBGA	8.7	30.2	26.1	23.6	21.7
EP2C8	144	TQFP	9.9	29.8	28.3	26.9	24.9
	208	PQFP	5.4	30.2	28.8	26.9	21.7
	256	FBGA	7.1	27	23	20.5	18.5
EP2C15	256	FBGA	5.5	24.2	20	17.8	16
	484	FBGA	4.2	21	17	14.8	13.1
EP2C20	240	PQFP	4.2	26.6	24	21.4	17.4
	256	FBGA	5.5	24.2	20	17.8	16
	484	FBGA	4.2	21	17	14.8	13.1
EP2C35	484	FBGA	3.3	19.4	15.4	13.3	11.7
	484	UBGA	5.0	20.6	16.6	14.5	12.8
	672	FBGA	3.1	18.6	14.6	12.6	11.1
EP2C50	484	FBGA	2.8	18.4	14.4	12.4	10.9
	484	UBGA	4.4	19.6	15.6	13.6	11.9
	672	FBGA	2.6	17.7	13.7	11.8	10.2
EP2C70	672	FBGA	2.2	16.9	13	11.1	9.7
	896	FBGA	2.1	16.3	11.9	10.5	9.1

Table 30. 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 31 through Table 34 provide thermal resistance values for MAX series devices.

Table 31. Thermal Resistance of MAX II Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPM240	100	TQFP	12.0	39.5	37.5	35.5	31.6
	100	MBGA	32.1	53.8	47.7	45.7	44.0
	100	FBGA	20.8	51.2	45.2	43.2	41.5
EPM570	100	TQFP	11.2	38.7	36.6	34.6	30.8
	100	MBGA	25.0	46.5	40.4	38.4	36.8
	100	FBGA	14.8	42.8	36.8	34.9	33.3
	144	TQFP	10.5	32.1	30.3	28.7	26.1
	256	FBGA	13.0	37.4	33.1	30.5	28.4
	256	MBGA	12.9	39.5	33.6	31.6	30.1
EPM1270	144	TQFP	10.5	31.4	29.7	28.2	25.8
	256	FBGA	10.4	33.5	29.3	26.8	24.7
	256	MBGA	10.6	36.1	30.2	28.3	26.8
EPM2210	256	FBGA	8.7	30.2	26.1	23.6	21.7
	324	FBGA	8.2	29.8	25.7	23.3	21.3

Table 32. Thermal Resistance of MAX 9000 Devices (Part 1 of 2)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPM9320	84	PLCC	9.0	29.0	27.0	25.0	23.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	280	PGA	2.0	14.0	10.0	7.0	5.0
	356	BGA	2.0	14.0	12.0	11.0	10.0
EPM9320A	84	PLCC	9.0	29.0	27.0	26.0	23.0
	208	RQFP	2.0	17.0	16.0	15.0	13.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EPM9400	84	PLCC	9.0	29.0	27.0	25.0	23.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPM9480	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	12.0	11.0	10.0	9.0
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

Table 32. Thermal Resistance of MAX 9000 Devices (Part 2 of 2)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
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 33. Thermal Resistance of MAX 7000 Devices (Part 1 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPM7032	44	PLCC	10.0	33.0	31.0	30.0	27.0
		PQFP	15.0	48.0	46.0	45.0	42.0
		TQFP	14.0	46.0	44.0	43.0	40.0
EPM7032B	44	PLCC	10.0	33.0	31.0	30.0	27.0
		TQFP	14.0	46.0	44.0	43.0	40.0
	49	UBGA	23.0	69.0	67.0	66.0	62.0
EPM7032S	44	PLCC	10.0	33.0	31.0	30.0	27.0
		TQFP	14.0	46.0	44.0	43.0	40.0
EPM7032V	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	45.0	44.0	42.0	39.0
EPM7032AE	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	45.0	43.0	40.0
EPM7064S	44	PLCC	9.0	31.0	30.0	28.0	25.0
		TQFP	14.0	46.0	44.0	43.0	40.0
	84	PLCC	9.0	28.0	26.0	25.0	23.0
	100	TQFP	11.0	39.0	37.0	35.0	32.0
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

Table 33. Thermal Resistance of MAX 7000 Devices (Part 2 of 3)

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

Table 33. Thermal Resistance of MAX 7000 Devices (Part 3 of 3)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
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
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 34. 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
	144	TQFP	11.0	33.0	30.0	28.0	26.0
EPM3256A	144	TQFP	9.0	33.0	29.0	27.0	25.0
	208	PQFP	5.0	31.0	29.0	27.0	22.0
EPM3512A	208	PQFP	5.0	30.0	28.0	25.0	21.0
	256	FBGA	11.0	32.0	30.0	28.0	22.0

HardCopy Series Devices Thermal Resistance

Table 35 and Table 36 provide thermal resistance values for HardCopy series devices.

Table 35. 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	4.63
	484	FBGA, Wire Bond	5.5	21.3	17.4	15.3	13.8	9.60
HC220	672	FBGA, Flip Chip	0.5	12.1	9.9	8.3	7.1	3.64
	780	FBGA, Flip Chip	0.5	11.7	9.5	8.0	6.8	3.47
HC230	1020	FBGA, Flip Chip	0.3	10.8	8.6	7.1	6.0	2.94
HC240	1020	FBGA, Flip Chip	0.2	10.6	8.4	6.9	5.8	2.69
	1508	FBGA, Flip Chip	0.2	9.7	7.5	6.1	5.0	2.56

Table 36. 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.
HC210	**484**	FBGA, Flip Chip	0.8	13.4	11.2	9.6	8.3
	484	FBGA	6.6	24.2	20.3	18.3	16.6
HC220	672	FBGA, Flip Chip	0.5	12.1	9.9	8.3	7.1
	780	FBGA, Flip Chip	0.5	11.7	9.5	8.0	6.8
HC230	1020	FBGA, Flip Chip	0.3	10.8	8.6	7.1	6.0
HC240	1020	FBGA, Flip Chip	0.2	10.6	8.4	6.9	5.8
	1508	FBGA, Flip Chip	0.2	9.7	7.5	6.1	5.0
HC20K400	652	BGA	0.5	9.1	7.9	6.4	5.3
HC20K600	672	FBGA, Flip Chip	0.96	13.0	10.2	8.6	7.3
HC1S25	672	FBGA	3.6	19.7	15.8	13.9	12.4
		BGA	3.4	19.3	15.6	13.8	12.3
HC1S30	780	FBGA, Flip Chip	0.43	10.9	8.8	7.4	6.3
HC1S40	780	FBGA, Flip Chip	0.43	10.9	8.8	7.4	6.3
HC1S60	1020	FBGA, Flip Chip	0.291	12.22	8.54	7.02	5.82
HC1S80	1020	FBGA, Flip Chip	0.291	12.22	8.54	7.02	5.82

APEX Series Devices Thermal Resistance

Table 37 and Table 38 provide thermal resistance values for APEX series devices.

Table 37. 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)	0.22	10.8	8.8	7.4	6.2
		FBGA, Flip Chip (AlSiC lid)	0.34	11.6	9.6	8.0	6.6
	724	BGA, Flip Chip (Cu lid)	0.23	9.7	7.7	6.4	5.3
		BGA, Flip Chip (AlSiC lid)	0.35	10.0	8.2	6.6	5.4
EP2A25	672	FBGA (Cu lid)	0.17	10.7	8.7	7.2	6.1
		FBGA, Flip Chip (AlSiC lid)	0.26	11.5	9.6	8.0	6.6
	724	BGA, Flip Chip (Cu lid)	0.17	9.6	7.6	6.2	5.2
		BGA, Flip Chip (AlSiC lid)	0.27	10.0	8.2	6.6	5.4
	1020	FBGA, Flip Chip (Cu lid)	0.17	9.8	7.8	6.4	5.3
		FBGA, Flip Chip (AlSiC lid)	0.27	10.4	8.5	6.9	5.7
EP2A40	672	FBGA, Flip Chip (Cu lid)	0.24	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)	0.15	9.5	7.5	6.1	5.1
		BGA, Flip Chip (AlSiC lid)	0.19	9.5	7.5	6.1	5.1
	1,020	FBGA, Flip Chip (Cu lid)	0.15	9.7	7.7	6.3	5.2
		FBGA, Flip Chip (AlSiC lid)	0.19	9.7	7.7	6.3	5.2
EP2A70	724	BGA, Flip Chip (Cu lid)	0.10	9.3	7.3	6.0	4.9
		BGA, Flip Chip (AlSiC lid)	0.14	10.0	7.9	6.4	5.3
	1,508	FBGA, Flip Chip (Cu lid)	0.10	8.8	6.8	5.5	4.5
		FBGA, Flip Chip (AlSiC lid)	0.14	9.3	7.3	5.8	4.7

Table 38. 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

Table 38. 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.
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
EP20K200C	208	PQFP	4.0	25.0	23.0	20.0	17.0
	240	PQFP	3.0	22.0	19.0	18.0	16.0
	356	BGA	2.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0
EP20K300E	240	PQFP	3.0	19.0	18.0	16.0	15.0
	652	BGA	1.0	12.0	11.0	10.0	9.0
	672	FBGA	5.0	20.0	19.0	18.0	17.0
EP20K400	652	BGA	0.5	9.0	8.0	7.0	6.0
	655	PGA	1.0	8.0	7.0	6.0	4.0
	672	FBGA	0.36	11.6	9.6	7.9	6.5
	672	FBGA w/ fin *(1)*	0.5	7.0	4.0	3.0	2.6

Table 38. 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.
EP20K400E	652	BGA	0.5	9.0	8.0	7.0	6.0
EP20K400C	672	FBGA (Cu lid)	0.25	10.9	8.8	7.4	6.3
		FBGA (AlSiC lid)	0.38	11.7	9.7	8.0	6.7
	672	FBGA w/ fin *(1)*	0.5	7.0	4.0	3.0	2.6
EP20K600E	652	BGA	0.5	9.0	8.0	7.0	6.0
EP20K600C	672	FBGA (Cu lid)	0.18	10.8	8.7	7.3	6.1
		FBGA (AlSiC lid)	0.28	11.6	9.6	7.9	6.5
	672	FBGA w/ fin *(1)*	0.5	5.0	3.0	3.0	2.0
	1,020	FBGA (Cu lid)	0.19	9.9	7.8	6.5	5.4
		FBGA (AlSiC lid)	0.29	10.4	8.4	6.8	5.6
	1,020	FBGA w/ fin *(1)*	0.5	5.0	3.0	3.0	2.0
EP20K1000E	652	BGA (Cu lid)	0.12	8.3	7.0	5.6	4.5
EP20K1000C		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)	0.12	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)	0.12	9.7	7.7	6.3	5.2
		FBGA (AlSiC lid)	0.19	10.2	8.2	6.6	5.4
	1,020	FBGA w/ fin *(1)*	0.5	5.0	3.0	2.0	2.0
EP20K1500E	652	BGA (Cu lid)	0.10	8.2	6.9	5.5	4.4
		BGA (AlSiC lid)	0.15	9.2	7.3	5.8	4.8
	652	FBGA	0.1	9.2	7.3	5.8	4.8
	652	FBGA w/ fin *(1)*	0.5	4.0	3.0	2.5	2.0
	1,020	FBGA (Cu lid)	0.10	9.6	7.6	6.2	5.1
		FBGA (AlSiC lid)	0.15	10.1	8.1	6.4	5.3
	1,020	FBGA w/ fin *(1)*	0.5	5.0	3.0	2.5	2.0

Note to Table 38:

(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 38 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 39 provides thermal resistance values for ACEX 1K devices.

Table 39. 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

Mercury Devices Thermal Resistance

Table 40 provides thermal resistance values for Mercury devices.

Table 40. Thermal Resistance of Mercury Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EP1M120	484	FBGA (Cu lid)	0.58	12.2	10.1	8.7	7.5
	484	FBGA (AlSiC lid)	0.87	13.0	11.1	9.3	7.9
EP1M350	780	FBGA (Cu lid)	0.22	10.5	8.5	7.1	5.9
	780	FBGA (AlSiC lid)	0.34	11.0	9.2	7.6	6.3

FLEX Series Devices Thermal Resistance

Table 41 through Table 43 provide thermal resistance values for FLEX series devices.

Table 41. Thermal Resistance of FLEX 10K Devices (Part 1 of 4)

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

Table 41. Thermal Resistance of FLEX 10K Devices (Part 2 of 4)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPF10K10A	100	TQFP	10.0	35.0	33.0	31.0	28.0
	144	TQFP	7.0	29.0	28.0	26.0	25.0
	208	PQFP	5.0	30.0	29.0	27.0	21.0
	256	FBGA	7.0	33.0	30.0	28.0	26.0
EPF10K20	144	TQFP	6.0	24.0	23.0	22.0	21.0
	208	RQFP	1.0	17.0	16.0	15.0	13.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPF10K30	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
EPF10K30A	144	TQFP	7.0	25.0	24.0	23.0	22.0
	208	PQFP	5.0	29.0	27.0	24.0	19.0
	240	PQFP	4.0	25.0	22.0	20.0	17.0
	256	FBGA	6.0	28.0	26.0	24.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	24.0	22.0	21.0	20.0
EPF10K30E	144	TQFP	9.0	28.0	27.0	26.0	24.0
	208	PQFP	5.0	30.0	28.0	26.0	21.0
	256	FBGA	9.0	31.0	29.0	28.0	25.0
	484	FBGA	6.0	26.0	25.0	24.0	22.0
EPF10K40	208	RQFP	1.0	17.0	16.0	15.0	12.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
EPF10K50	240	RQFP	1.0	12.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	403	PGA	3.0	12.0	10.0	9.0	8.0
		PGA *(1)*	3.0	10.0	8.0	7.0	6.0
EPF10K50V	240	PQFP	4.0	25.0	22.0	20.0	17.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0
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

Table 41. Thermal Resistance of FLEX 10K Devices (Part 3 of 4)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPF10K50S	144	TQFP	9.0	26.0	25.0	24.0	23.0
	208	PQFP	5.0	29.0	28.0	25.0	20.0
	240	PQFP	4.0	26.0	23.0	20.0	17.0
	256	FBGA	7.0	30.0	28.0	27.0	24.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	25.0	24.0	23.0	22.0
EPF10K70	240	RQFP	1.0	12.0	11.0	10.0	9.0
	503	PGA	1.0	8.0	7.0	6.0	4.0
EPF10K100	503	PGA	1.0	8.0	7.0	6.0	4.0
		PGA *(1)*	1.0	6.0	5.0	4.0	3.0
		PGA *(2)*	—	2.0	—	—	—
EPF10K100A	240	RQFP	1.0	13.0	11.0	10.0	9.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	22.0	21.0	20.0	18.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
EPF10K100E	208	PQFP	5.0	28.0	26.0	23.0	18.0
	240	PQFP	4.0	23.0	21.0	19.0	16.0
	256	FBGA	6.0	28.0	26.0	25.0	23.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	24.0	23.0	22.0	21.0
EPF10K130V	599	PGA	1.0	8.0	7.0	6.0	4.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
EPF10K130E	240	PQFP	4.0	21.0	19.0	17.0	15.0
	356	BGA	1.0	12.0	11.0	10.0	9.0
	484	FBGA	5.0	23.0	22.0	21.0	20.0
	600	BGA	0.5	10.0	9.0	8.0	7.0
	672	FBGA	5.0	21.0	20.0	19.0	18.0
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

Table 41. Thermal Resistance of FLEX 10K Devices (Part 4 of 4)

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
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 41:

(1) With attached pin-fin heat sink.

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

Table 42. Thermal Resistance of FLEX 8000 Devices

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPF8282A	84	PLCC	10.0	30.0	28.0	26.0	23.0
	100	TQFP	11.0	36.0	34.0	32.0	29.0
EPF8452A	84	PLCC	10.0	30.0	28.0	26.0	23.0
	100	TQFP	11.0	35.0	33.0	31.0	28.0
	160	PQFP	6.0	32.0	31.0	30.0	28.0
	160	PGA	6.0	20.0	13.0	10.0	8.0
EPF8636A	84	PLCC	10.0	29.0	28.0	26.0	23.0
	160	PQFP	6.0	32.0	31.0	30.0	27.0
	192	PGA	6.0	16.0	11.0	8.0	6.0
	208	PQFP	5.0	30.0	38.0	26.0	20.0
	208	RQFP	1.0	17.0	16.0	15.0	14.0
EPF8820A	144	TQFP	9.0	26.0	25.0	24.0	23.0
	160	PQFP	6.0	32.0	31.0	30.0	27.0
	192	PGA	6.0	16.0	11.0	8.0	6.0
	208	PQFP	5.0	29.0	27.0	25.0	20.0
	208	RQFP	1.0	17.0	16.0	15.0	14.0
	225	BGA	6.0	28.0	19.0	14.0	11.0
EPF81188A	208	PQFP	5.0	28.0	26.0	24.0	19.0
	232	PGA	2.0	14.0	10.0	7.0	5.0
	240	PQFP	4.0	24.0	21.0	19.0	16.0
	240	RQFP	1.0	14.0	12.0	11.0	10.0
EPF81500A	240	PQFP	4.0	22.0	20.0	19.0	16.0
	240	RQFP	1.0	13.0	12.0	11.0	10.0
	280	PGA	2.0	14.0	10.0	7.0	5.0
	304	RQFP	1.0	11.0	10.0	9.0	8.0

Table 43. 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 44 provides thermal resistance values for Excalibur Embedded Processor Solutions.

Table 44. Thermal Resistance of Excalibur Embedded Processor Solutions

Device	Pin Count	Package	θ_{JC} (° C/W)	θ_{JA} (° C/W) Still Air	θ_{JA} (° C/W) 100 ft./min.	θ_{JA} (° C/W) 200 ft./min.	θ_{JA} (° C/W) 400 ft./min.
EPXA1	484	FBGA	4.0	20.0	18.3	15.8	13.9
	672	FBGA, Flip Chip (Cu lid)	0.52	11.3	9.3	7.9	6.7
	672	FBGA, Flip Chip (AlSiC lid)	0.78	12.2	10.2	8.6	7.2
EPXA4	672	FBGA, Flip Chip (Cu lid)	0.21	10.8	8.8	7.3	6.2
	672	FBGA, Flip Chip (AlSiC lid)	0.31	11.6	9.6	7.9	6.6
	1,020	FBGA, Flip Chip (Cu lid)	0.21	9.9	7.9	6.5	5.4
	1,020	FBGA, Flip Chip (AlSiC lid)	0.32	10.4	8.5	6.9	5.7
EPXA10	1,020	FBGA, Flip Chip (Cu lid)	0.11	9.6	7.6	6.2	5.1
	1,020	FBGA, Flip Chip (AlSiC lid)	0.17	10.0	8.0	6.4	5.7

Classic Devices Thermal Resistance

Table 45 provides thermal resistance values for Classic devices.

Table 45. 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	55.0
EP1800I	68	PLCC	13.0	44.0
EP1810	68	JLCC	12.0	47.0
		PLCC	13.0	44.0
		PGA	6.0	38.0

Package Outlines

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

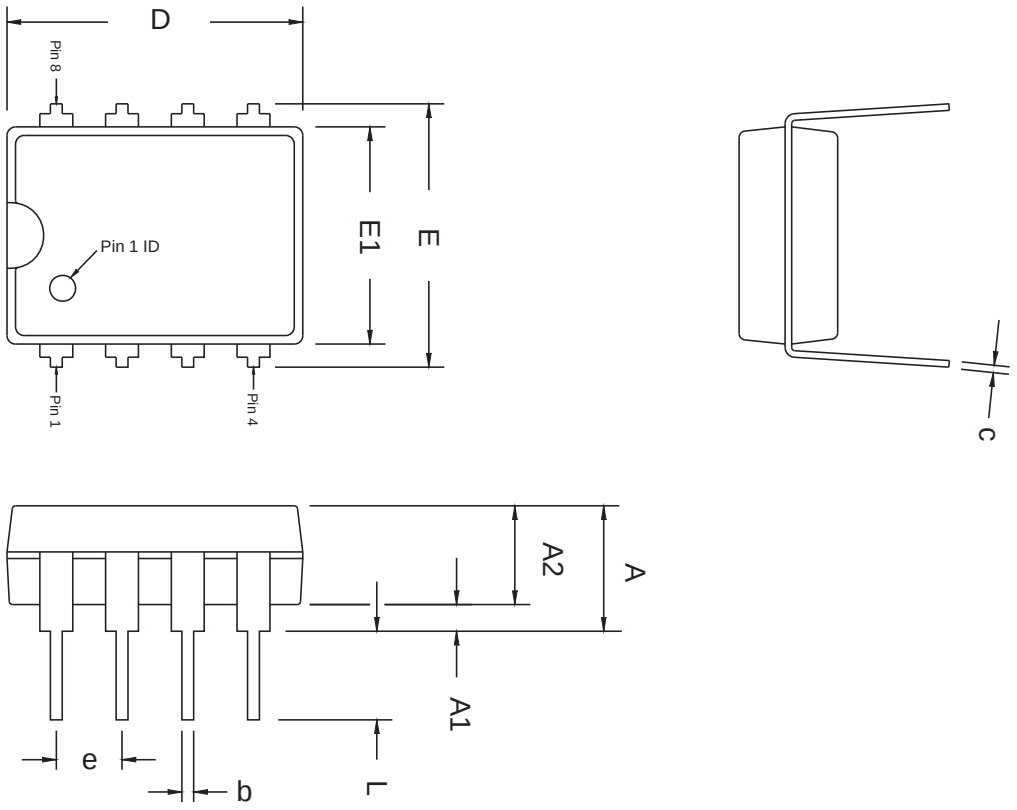
8-Pin Plastic Dual In-Line Package (PDIP) — Wire Bond

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

Package Information	
Description	**Specification**
Ordering Code Reference	P
Package Acronym	PDIP
Leadframe Material	Copper
Lead Finish (Plating)	Regular: 85Sn:15Pb (Typ.) Pb-free: Matte Sn
JEDEC Outline Reference	MS-001 Variation: BA
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



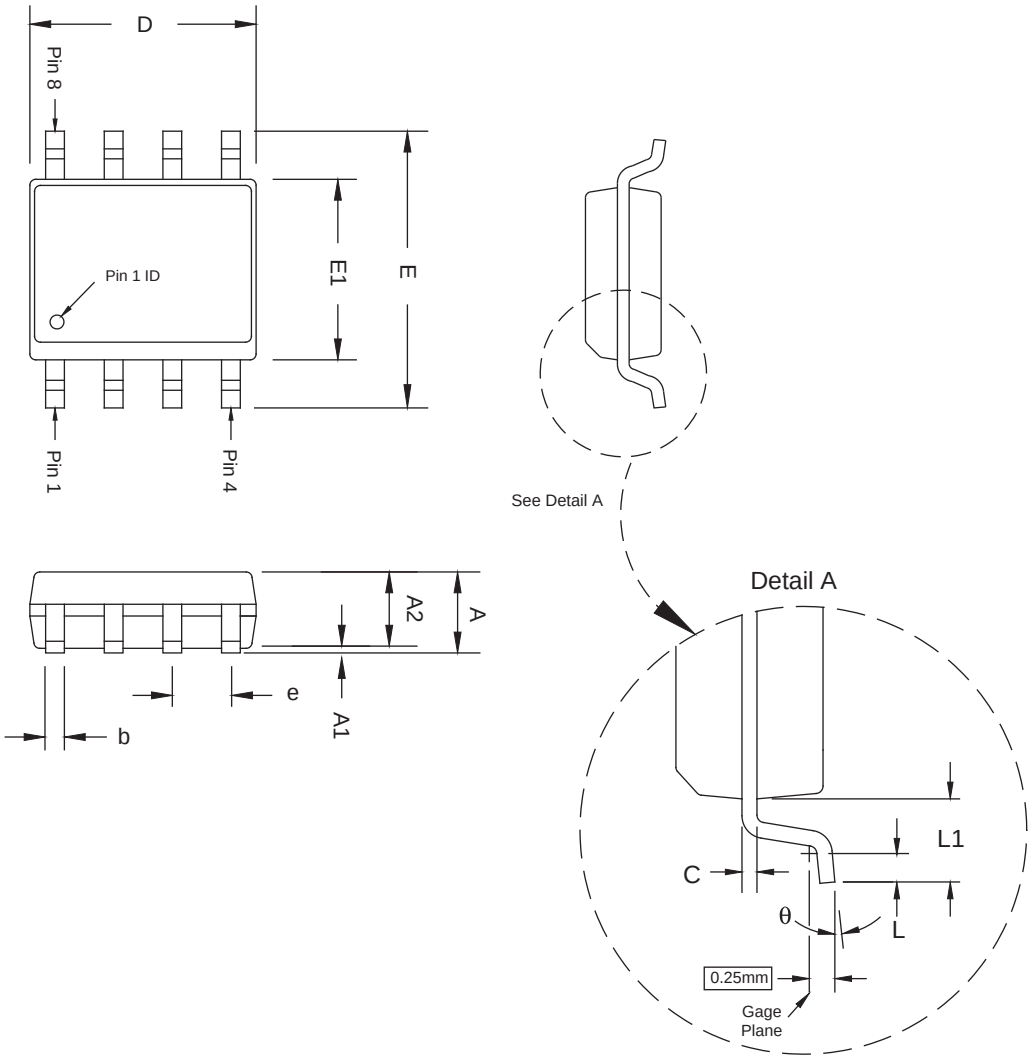
8-Pin Small Outline Integrated Circuit Package (SOIC) — Wire Bond

- 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.)

Package Outline Dimension Table			
Symbol	**Inches**		
	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		
q	0°	–	8°

Package Outline



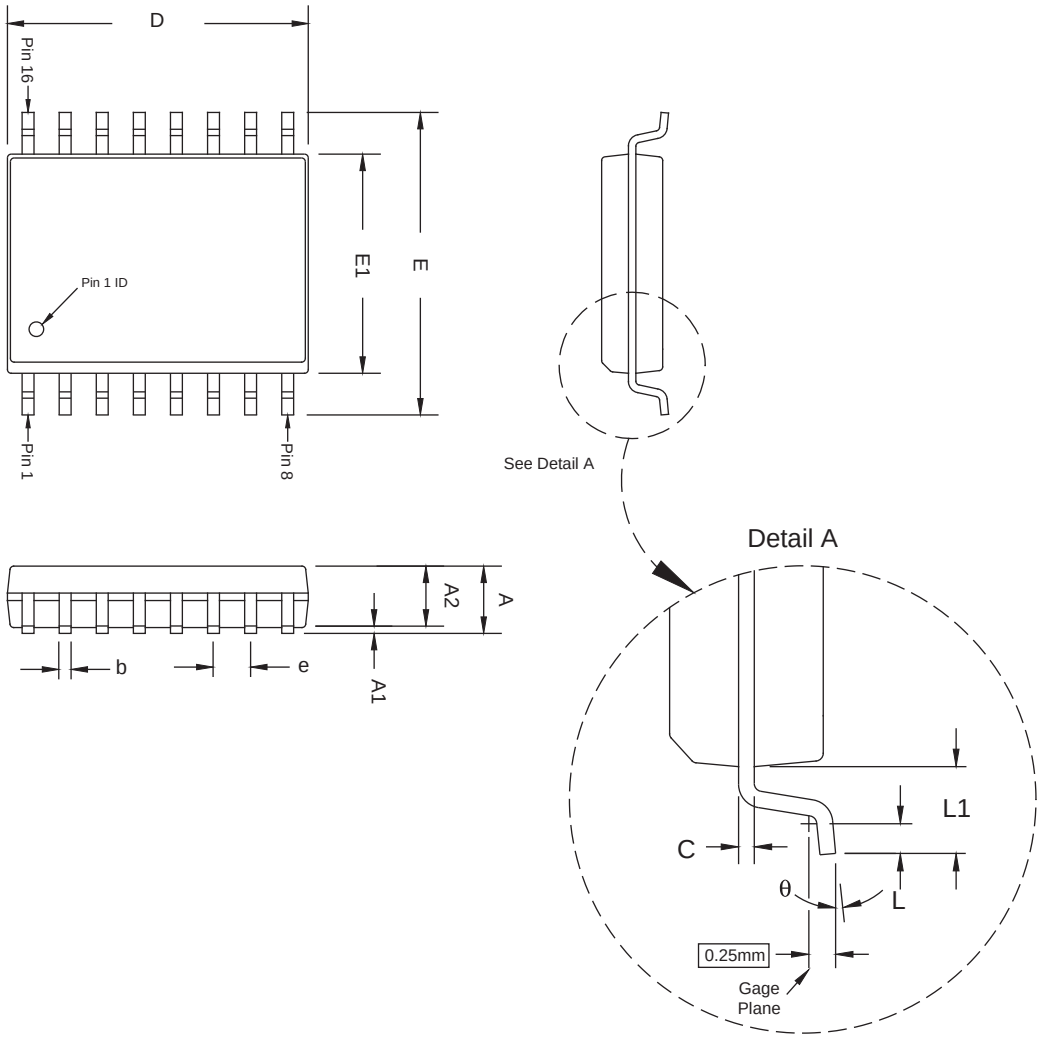
16-Pin Small Outline Integrated Circuit Package (SOIC) — Wire Bond

- 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	**Inches**		
	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		
q	0°	–	8°
A	2.35	–	2.65
A1	0.10	–	0.30
A2	2.05	–	2.55

Package Outline



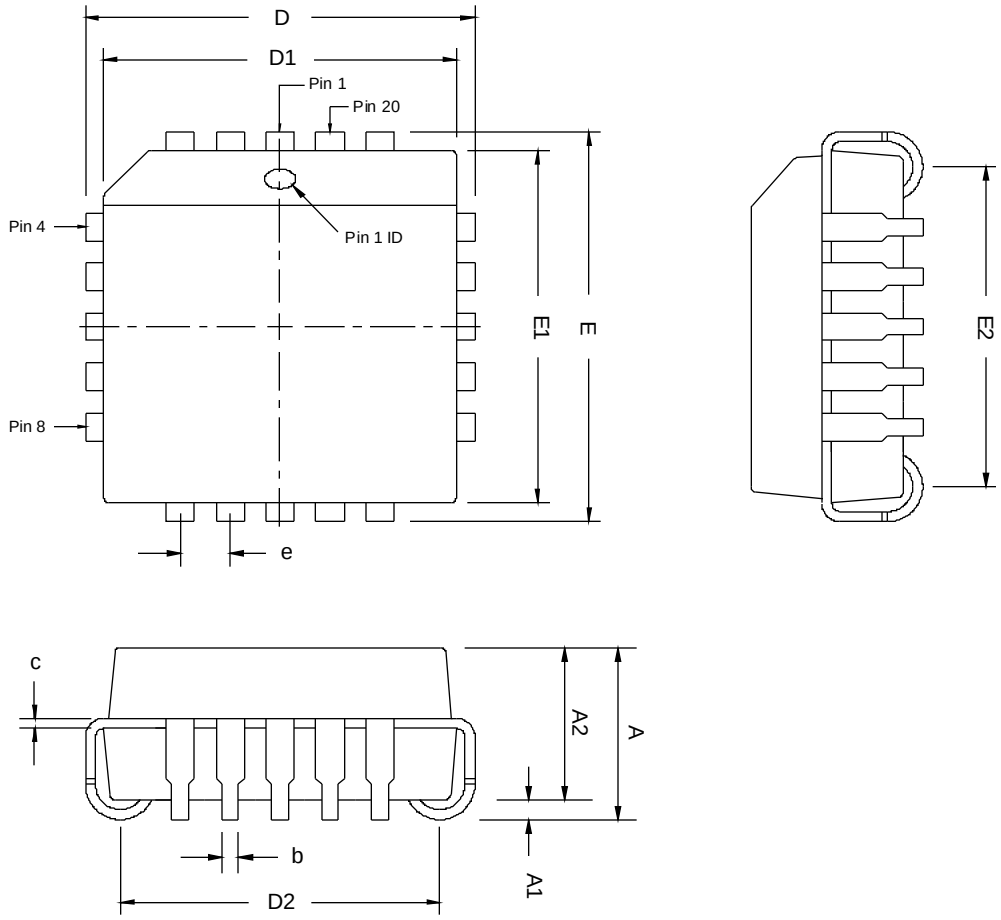
20-Pin Plastic J-Lead Chip Carrier (PLCC) Wire Bond

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



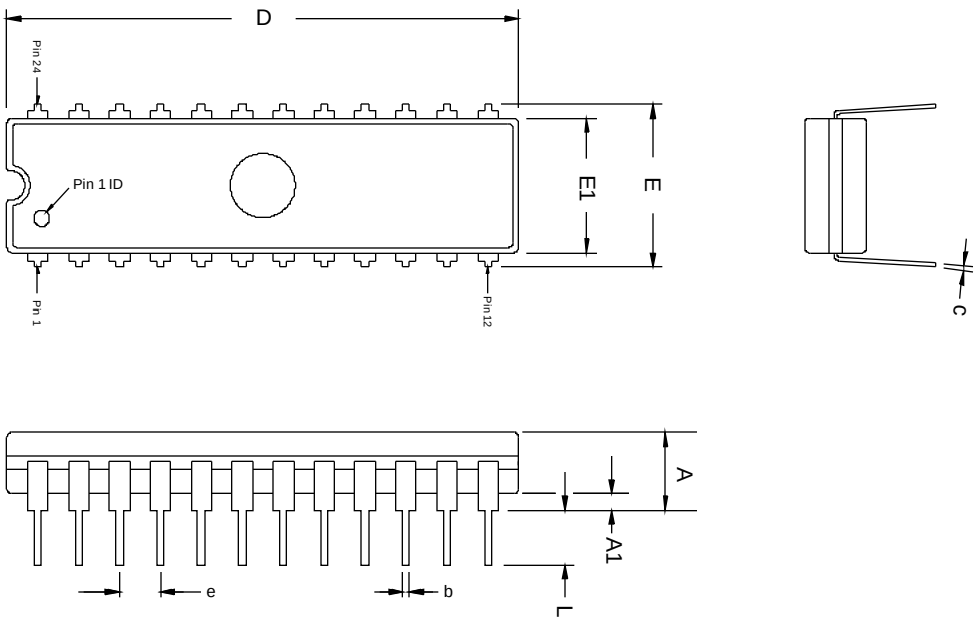
24-Pin Ceramic Dual In-Line Package (CerDIP) —Wire Bond

- 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



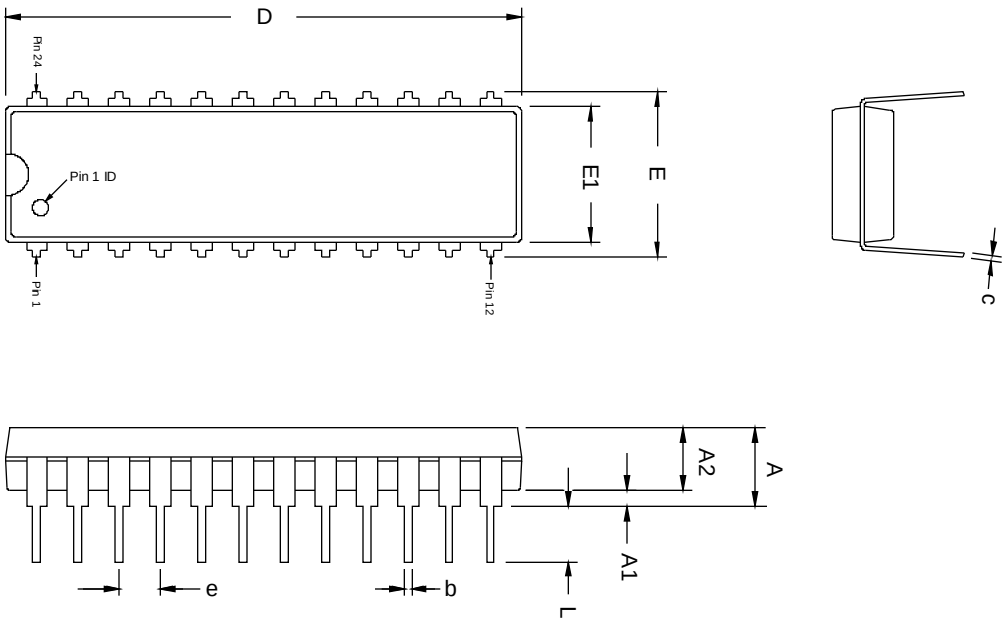
24-Pin Plastic Dual In-Line Package (PDIP) — Wire Bond

- 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



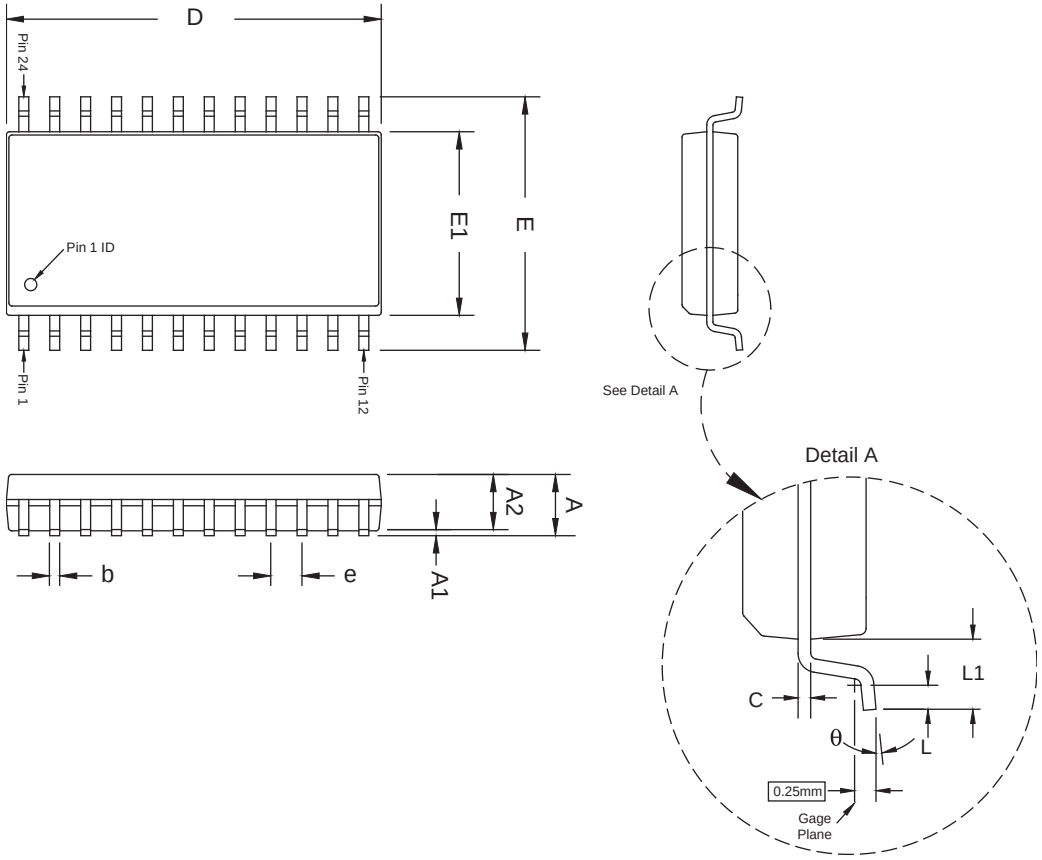
24-Pin Small Outline Integrated Circuit Package (SOIC) — Wire Bond

- 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		
q	0°	–	8°

Package Outline



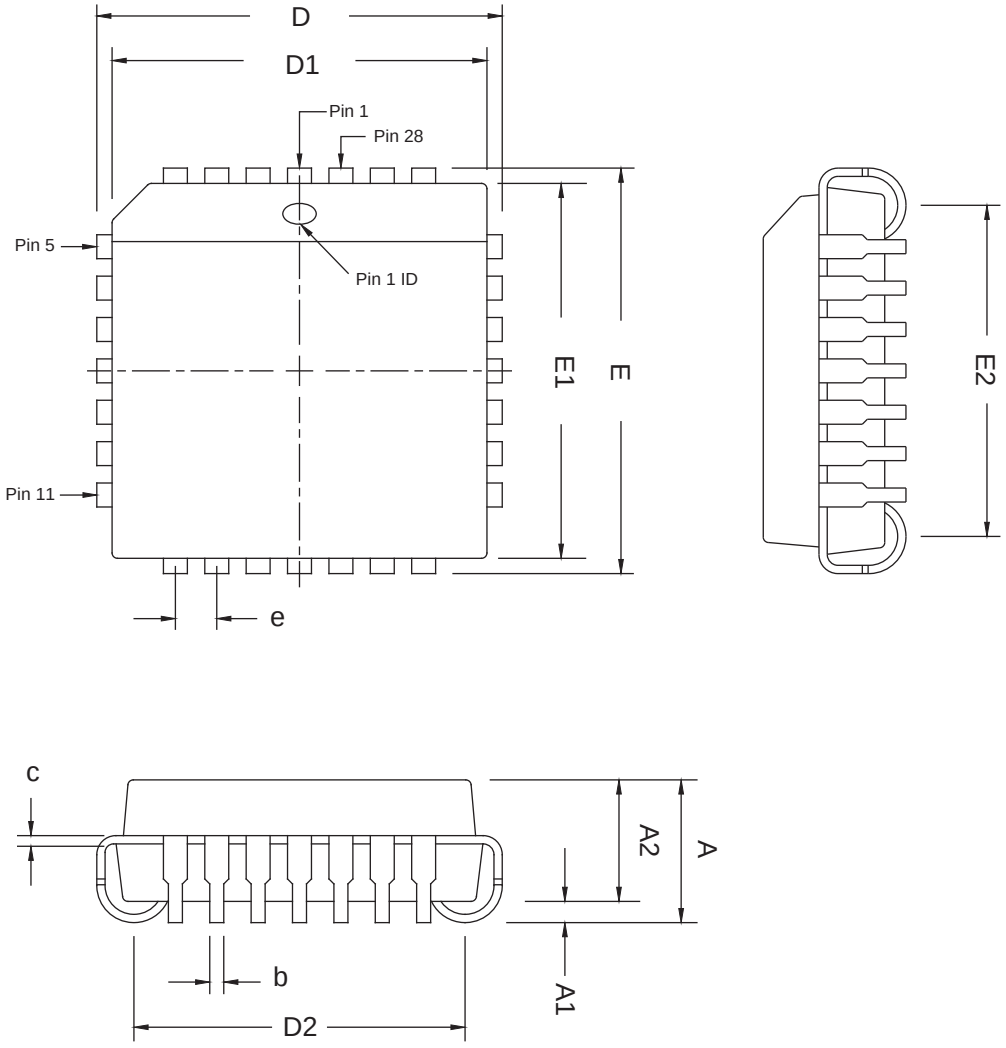
28-Pin Plastic J-Lead Chip Carrier (PLCC) — Wire Bond

- 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



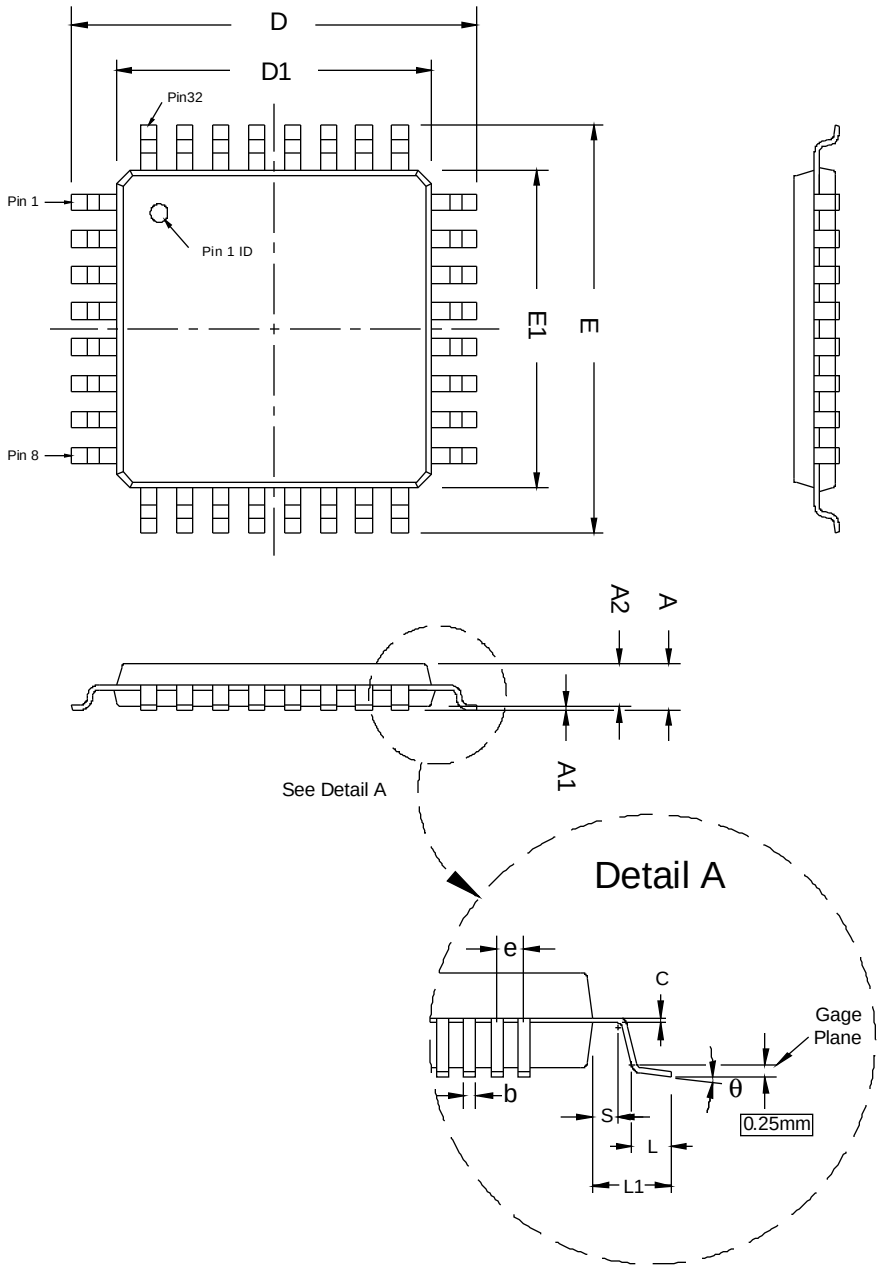
32-Pin Plastic Thin Quad Flat Pack (TQFP) — Wire Bond

- 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	
q	0°	3.5°	7°

Package Outline



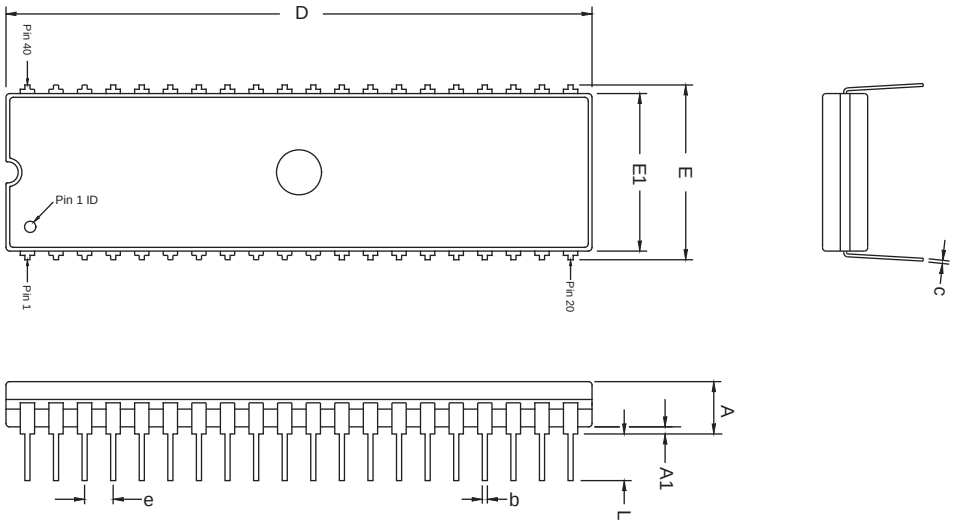
40-Pin Ceramic Dual In-Line Package (CerDIP) — Wire Bond

- 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



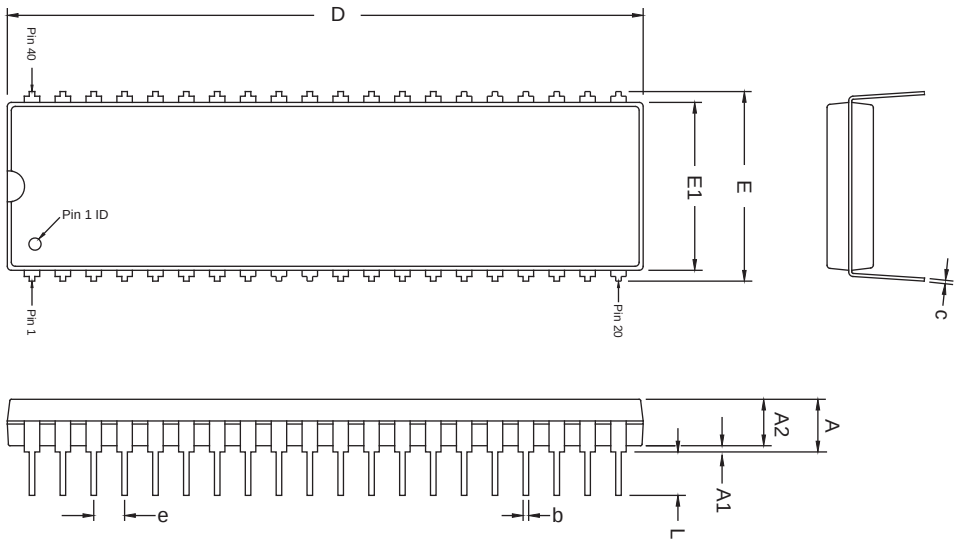
40-Pin Plastic Dual In-Line Package (PDIP) — Wire Bond

- 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



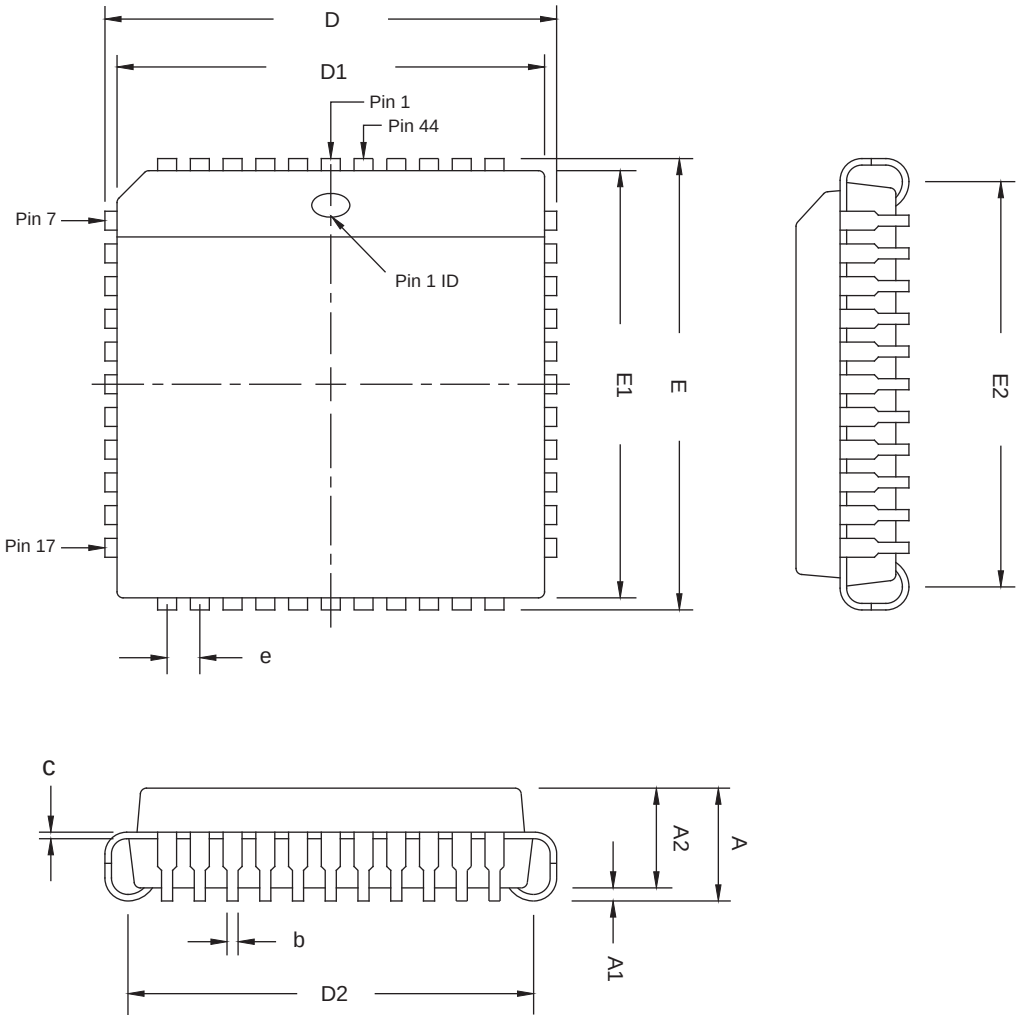
44-Pin Plastic J-Lead Chip Carrier (PLCC) — Wire Bond

- 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



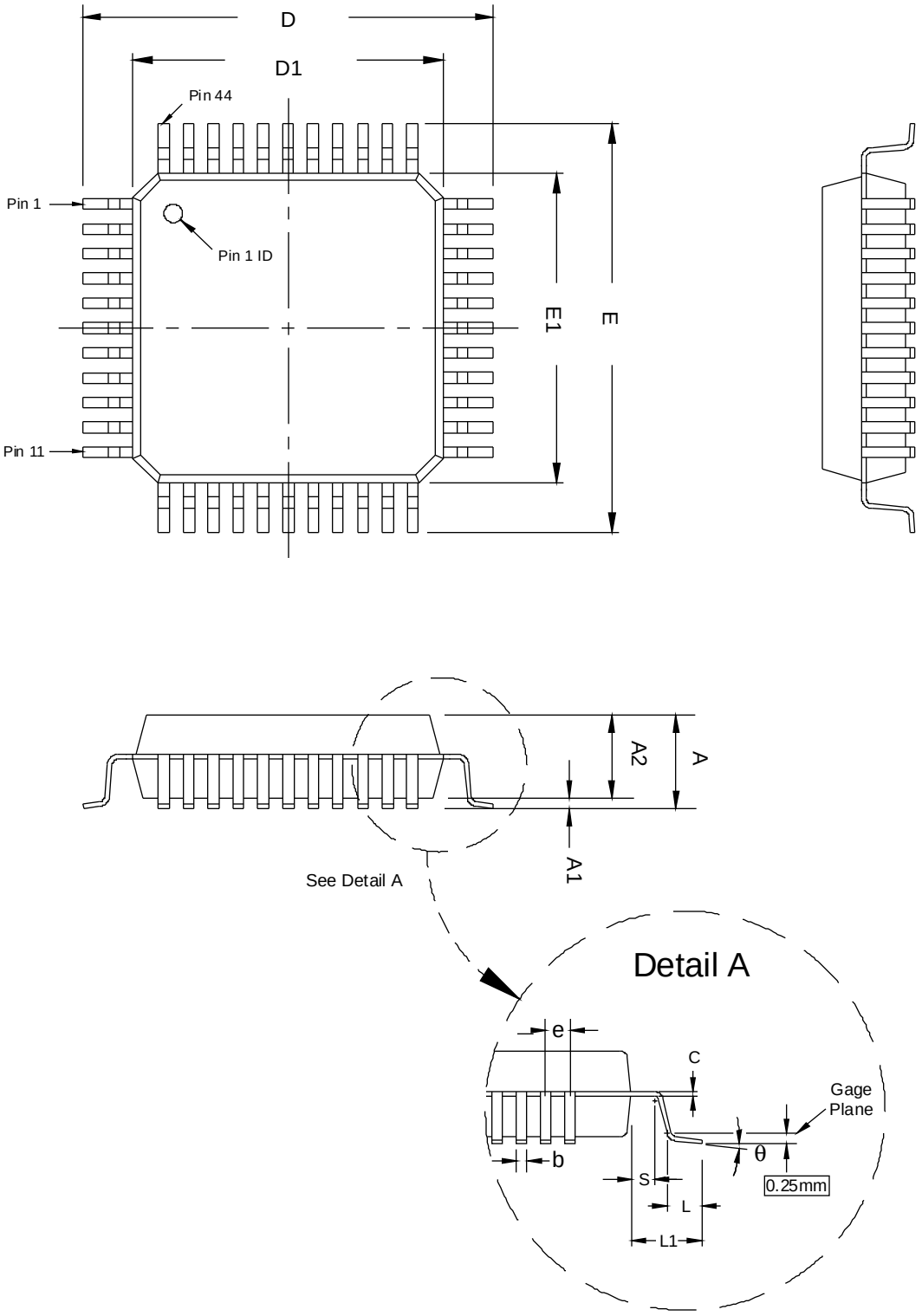
44-Pin Plastic Quad Flat Pack (PQFP) — Wire Bond

- 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	
q	0°	–	7°

Package Outline



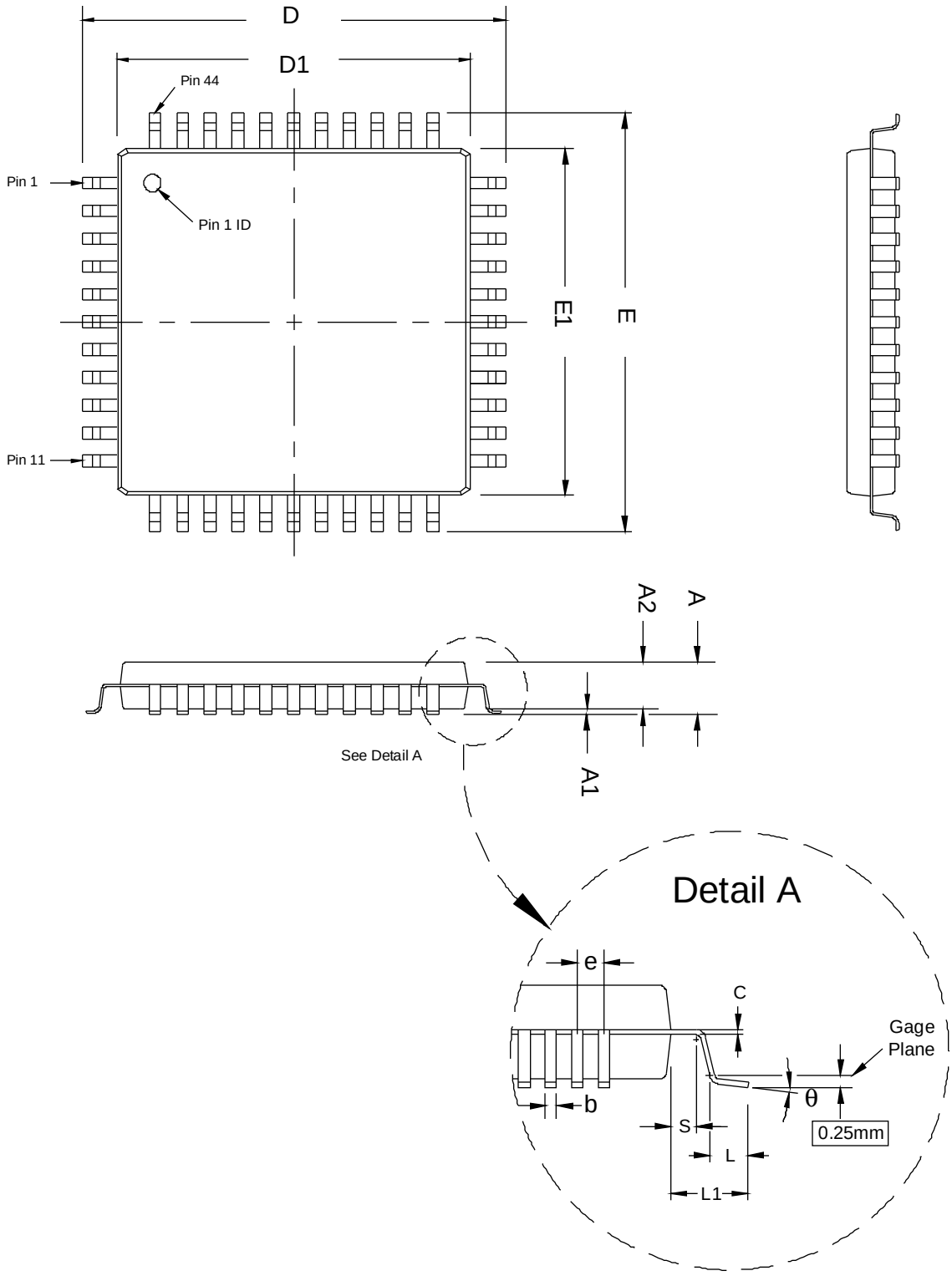
44-Pin Plastic Thin Quad Flat Pack (TQFP) — Wire Bond

- 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		
q	0°	3.5°	7°

Package Outline



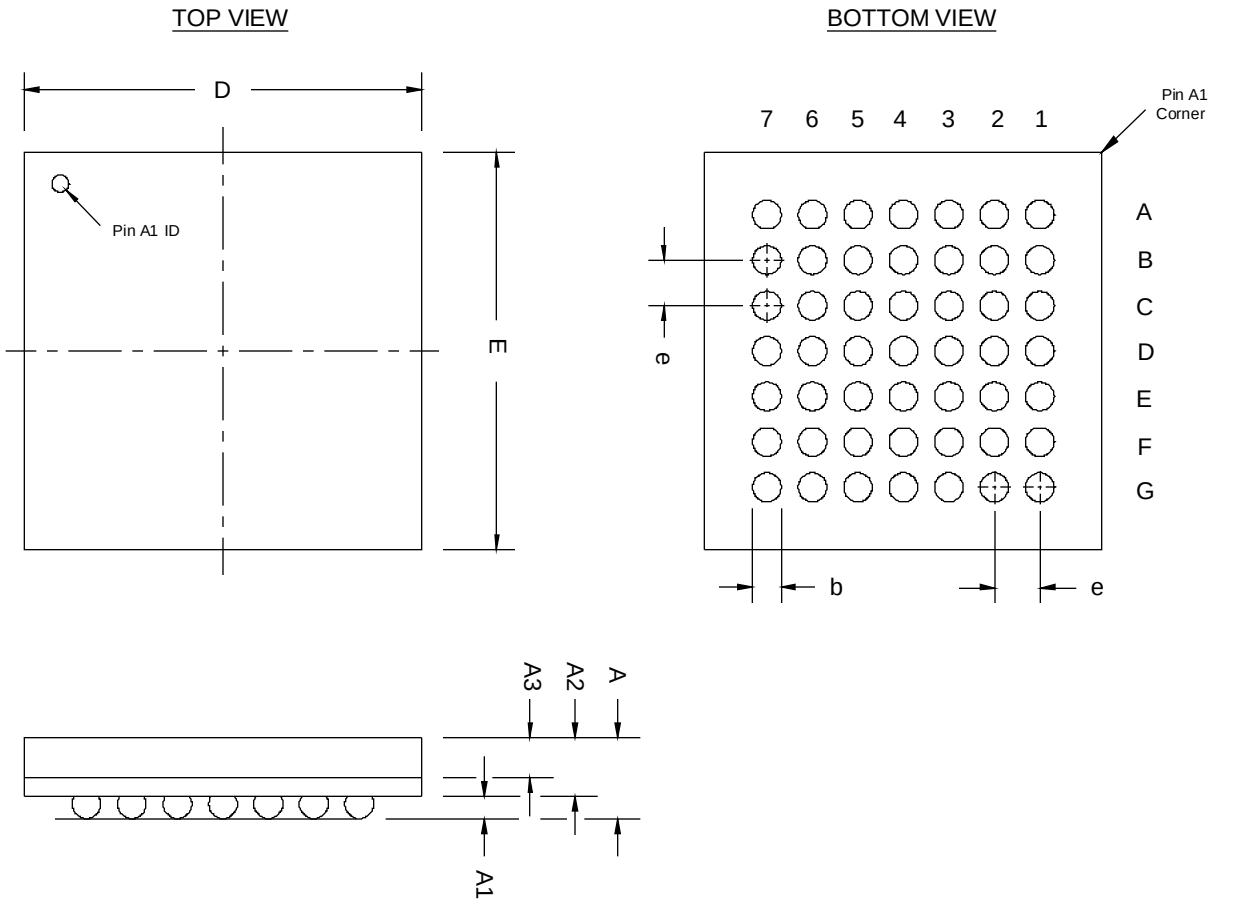
49-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond

- 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



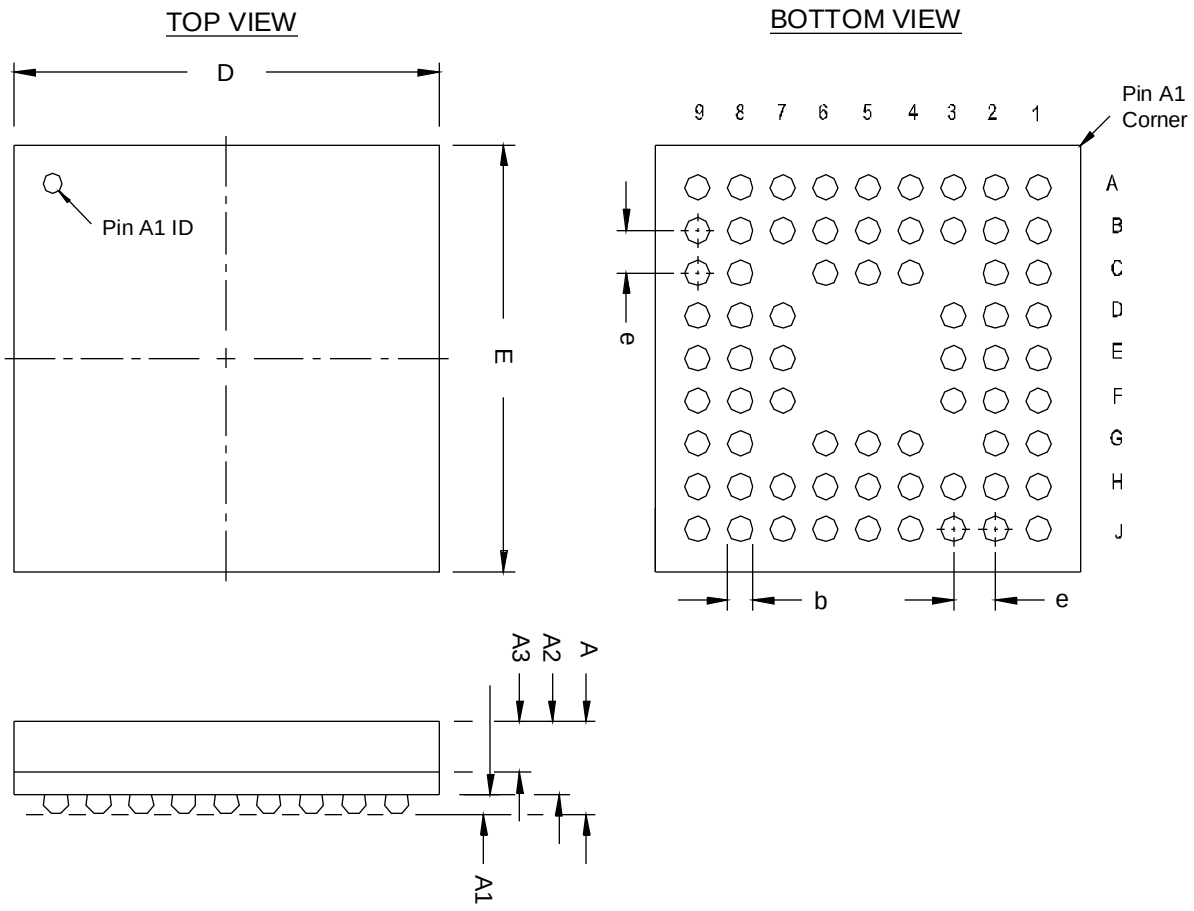
68-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond

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

Package Information	
Description	**Specification**
Ordering Code Reference	M
Package Acronym	MBGA
Substrate Material	BT
Solder Ball Composition	Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MO-195 Variation: AB
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



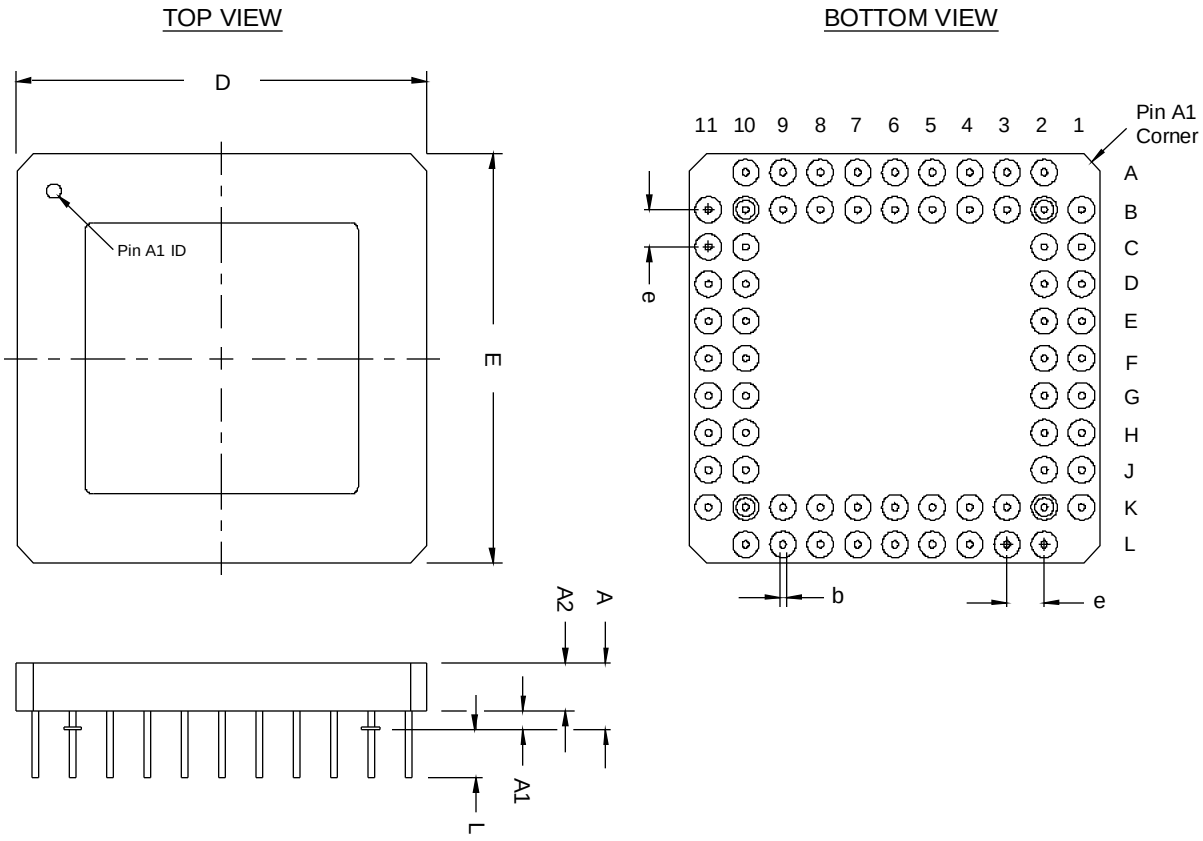
68-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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

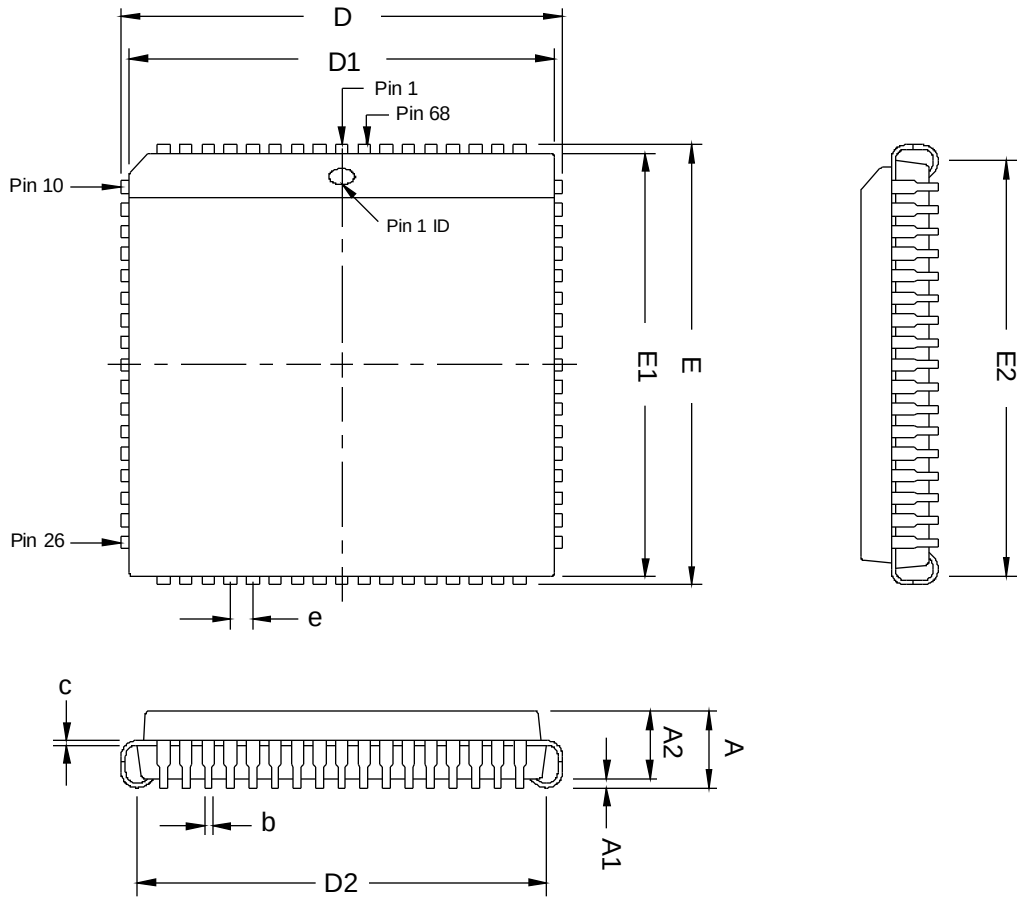
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in inches.
- Pin 1 is generally indicated by an indentation in the plastic body, in Pin 1's proximity, on package surface.

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



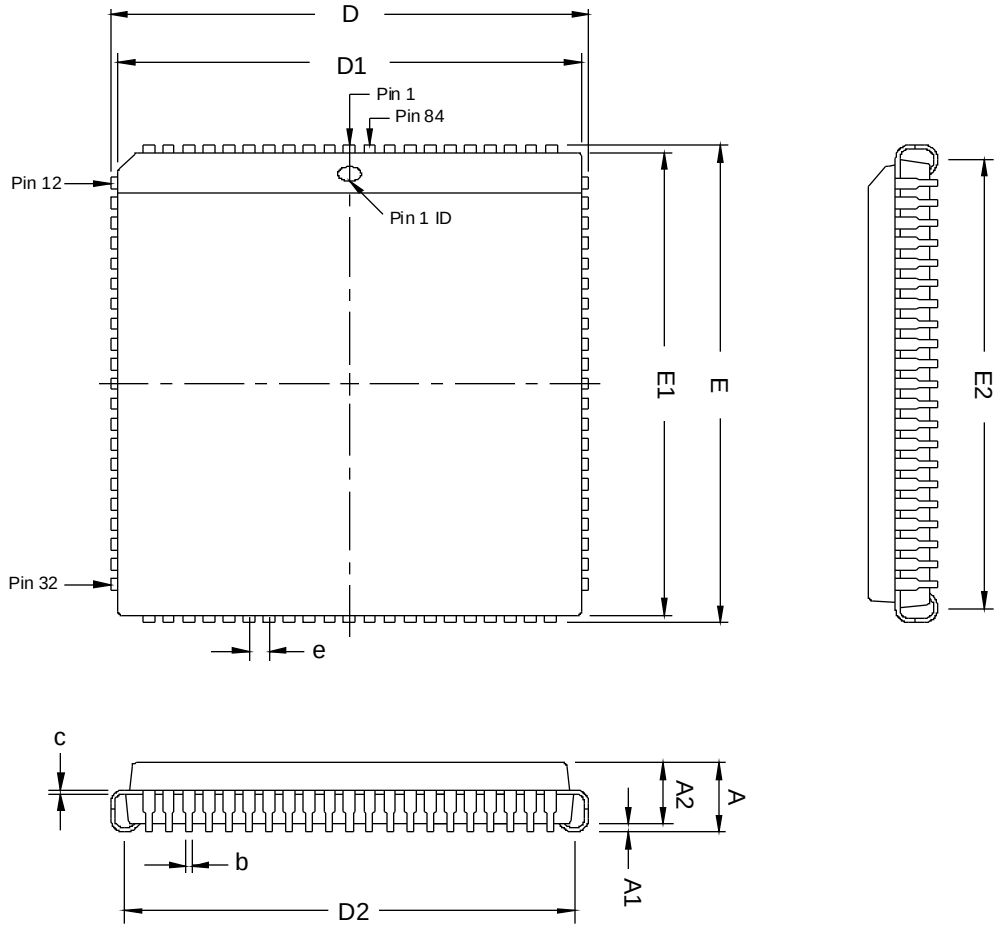
84-Pin Plastic J-Lead Chip Carrier (PLCC) — Wire Bond

- 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



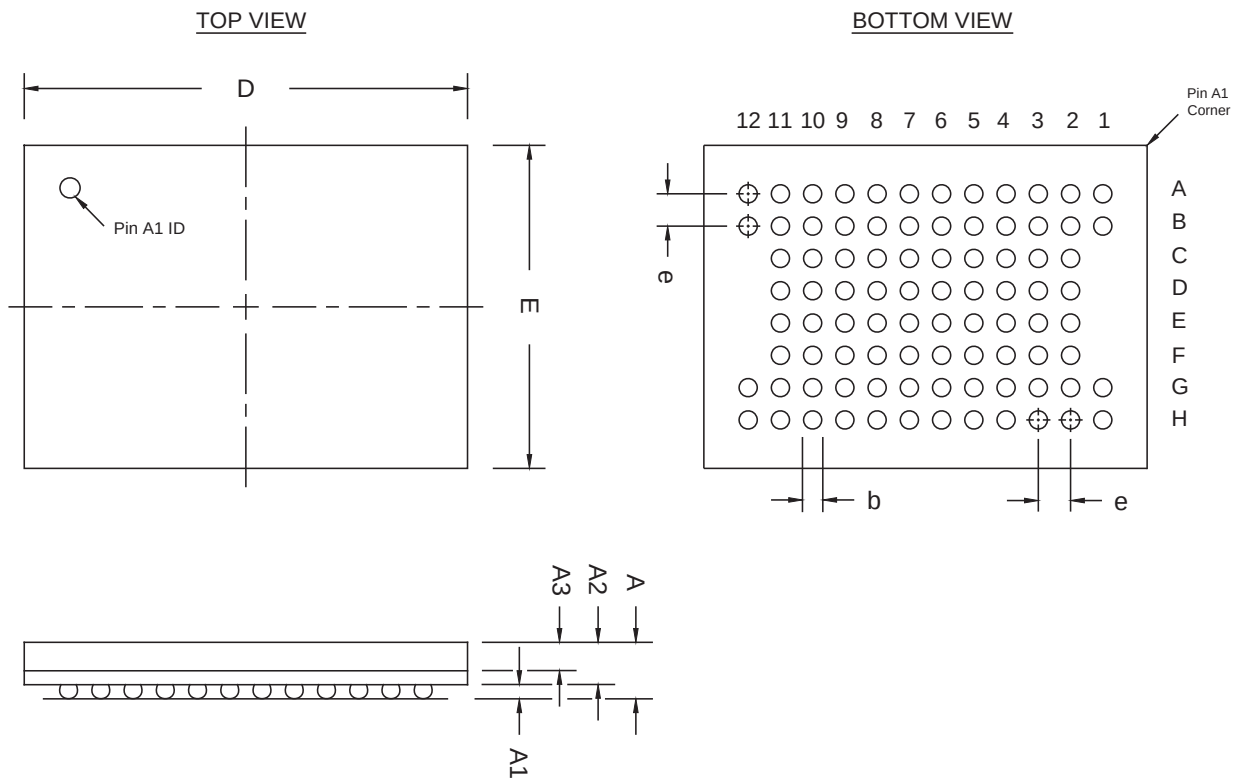
88-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond

- 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

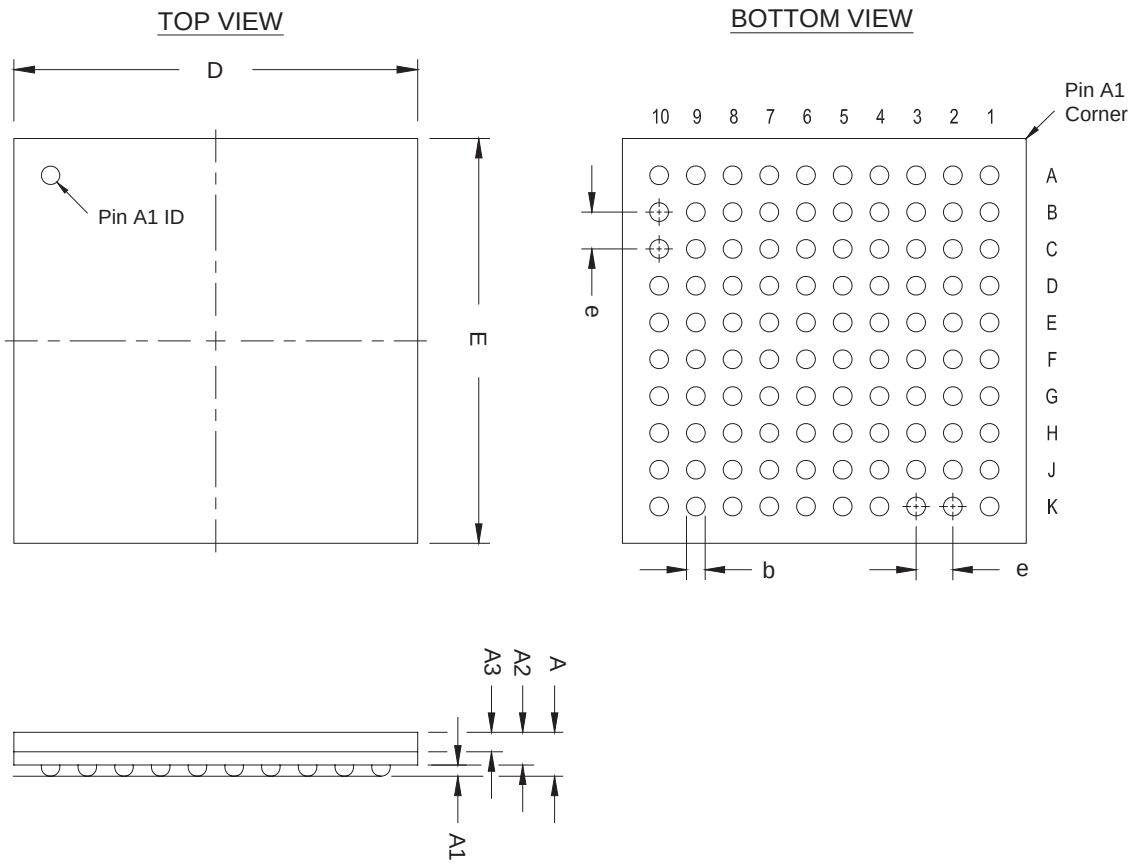
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on the package surface.

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

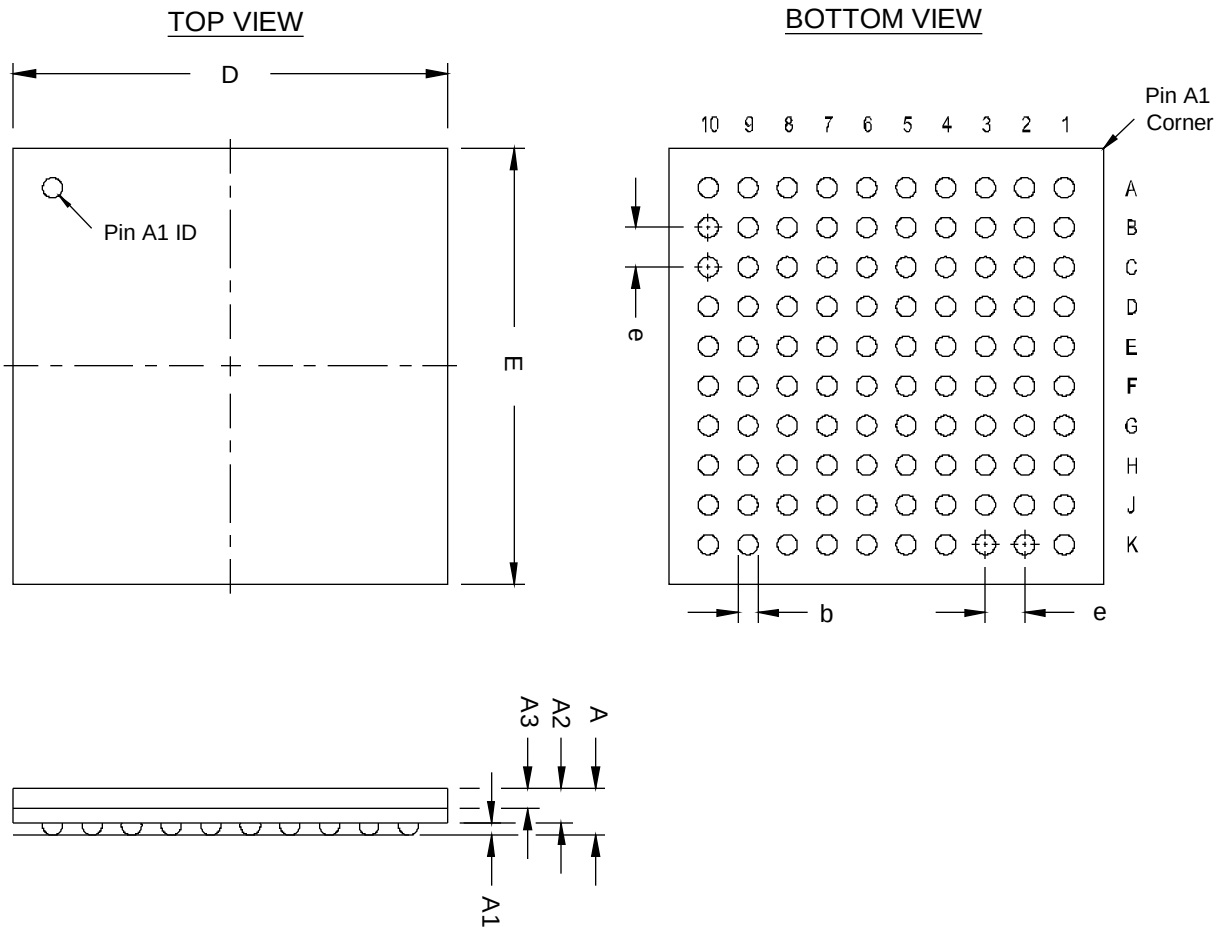
- All dimensions and tolerances conform to ASME Y14.5M – 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

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



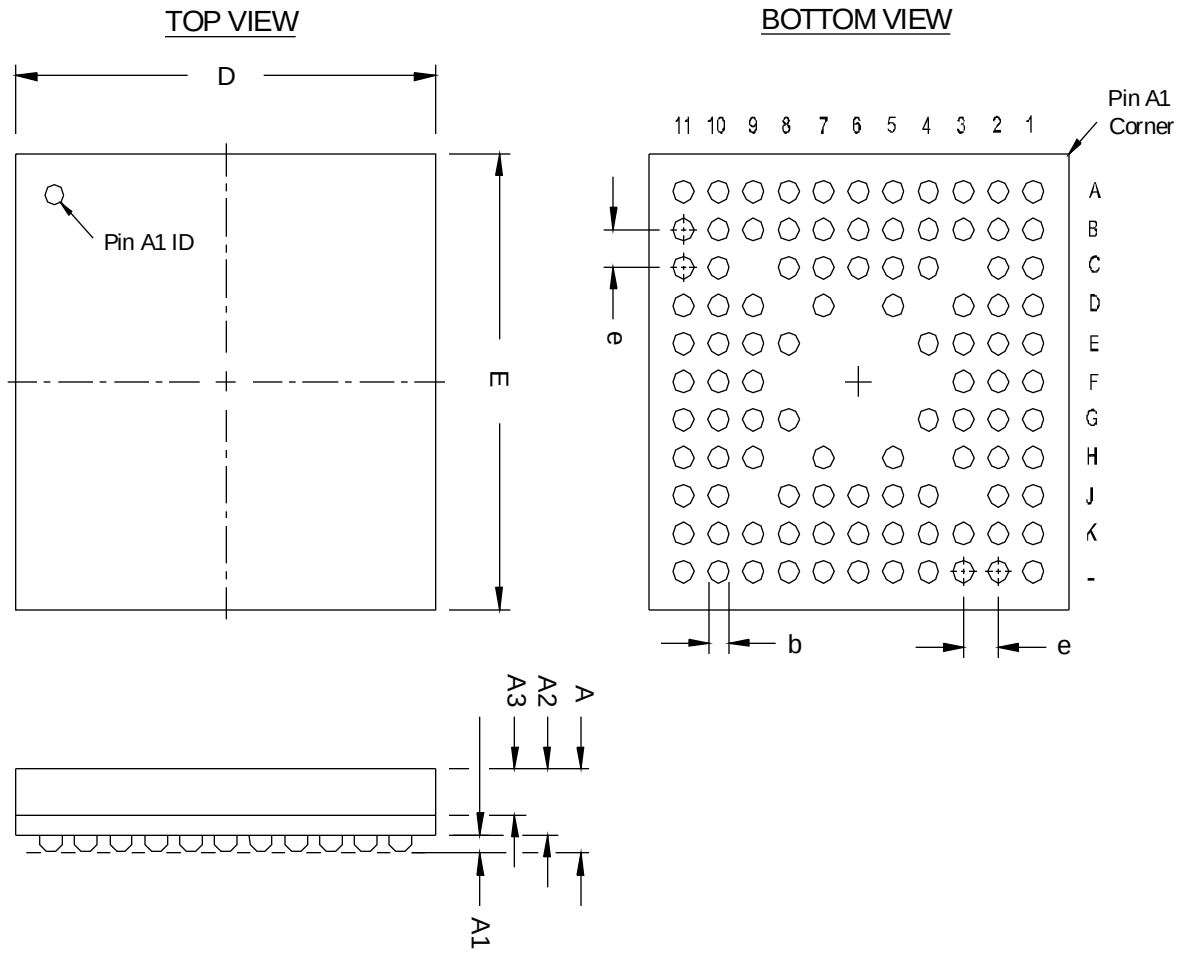
100-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond

- 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



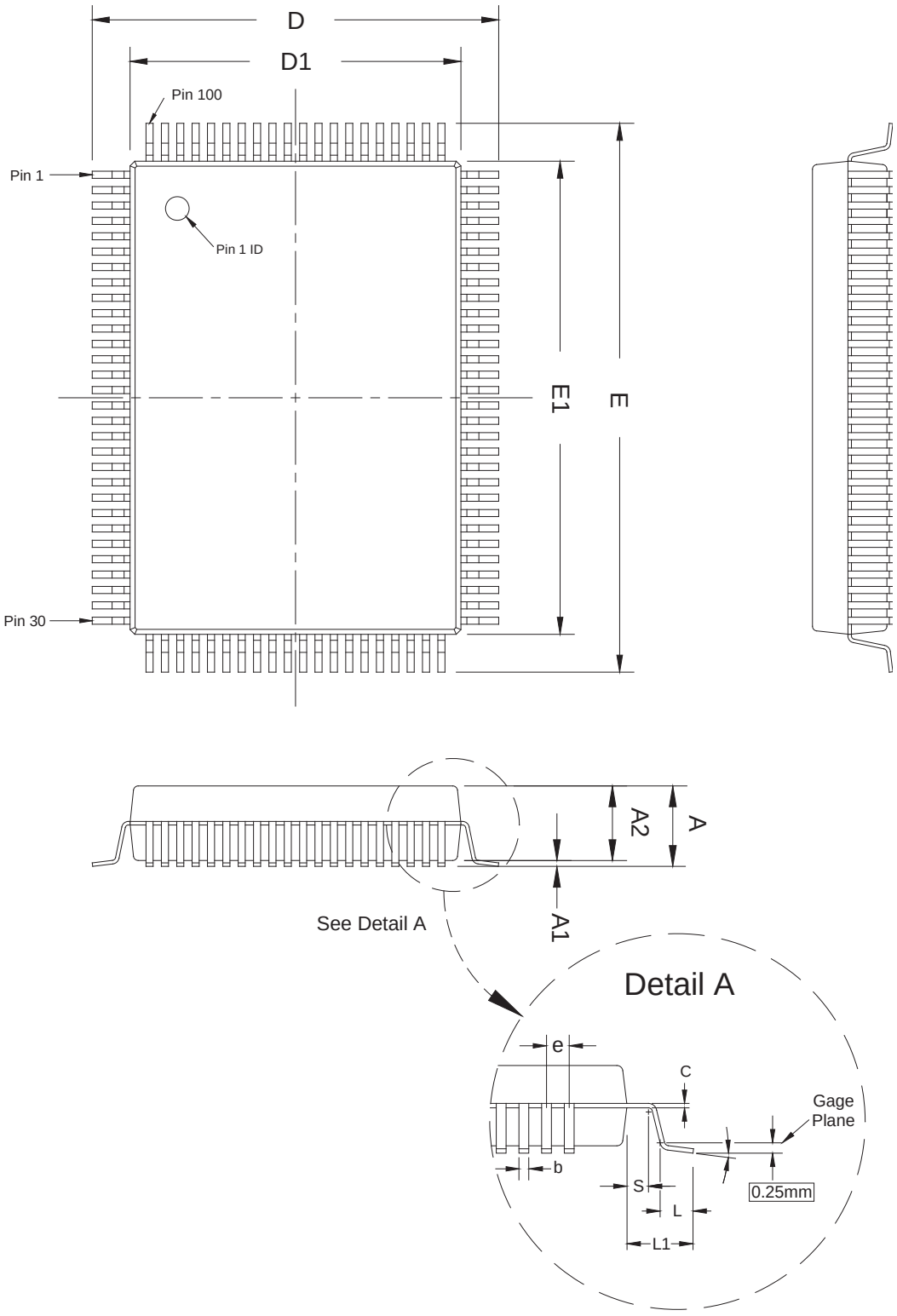
100-Pin Plastic Quad Flat Pack (PQFP) — Wire Bond

- 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	**Inches**		
	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		
q	0°	–	7°

Package Outline



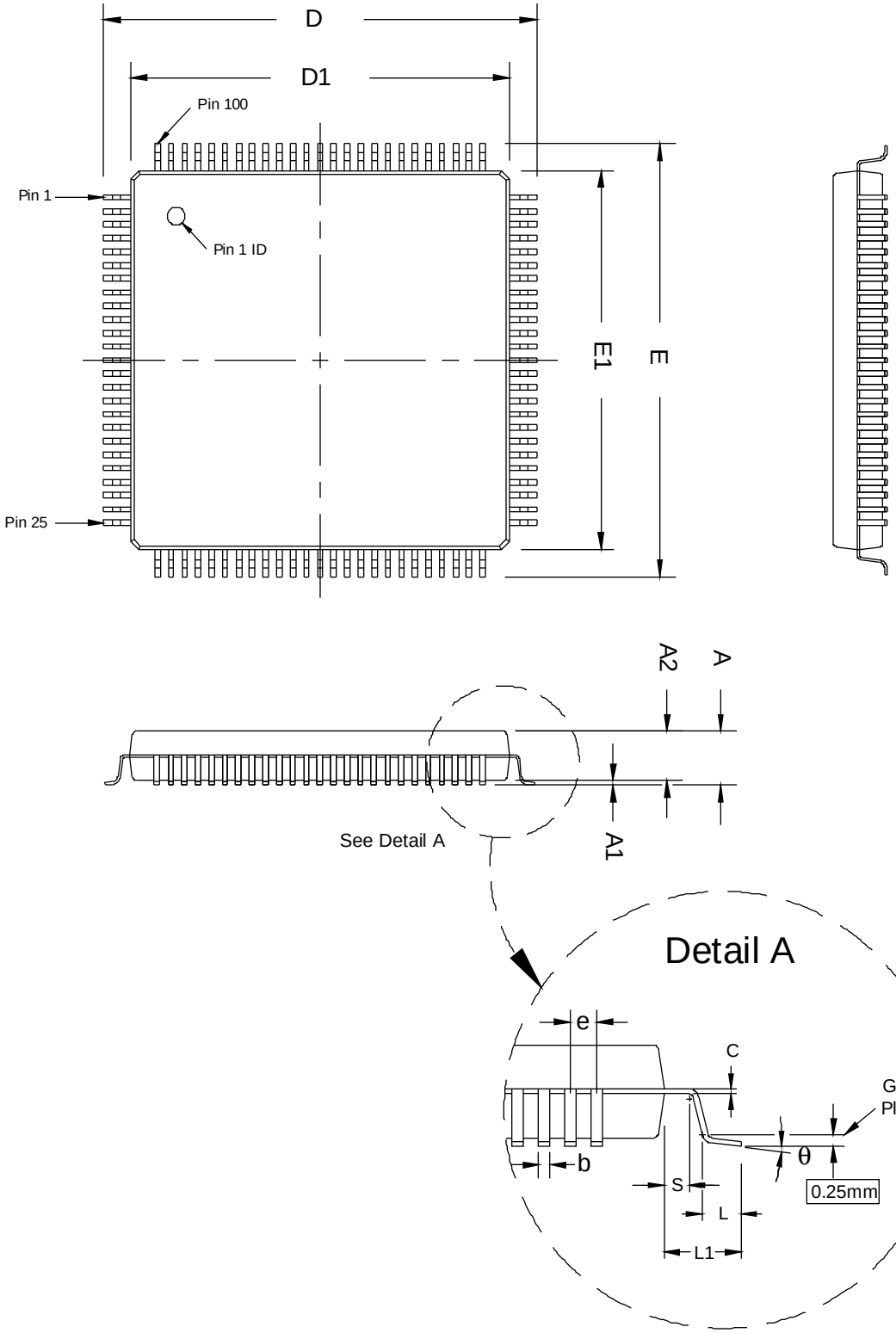
100-Pin Plastic Thin Quad Flat Pack (TQFP) — Wire Bond

- 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	**Inches**		
	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		
q	0°	3.5°	7°

Package Outline



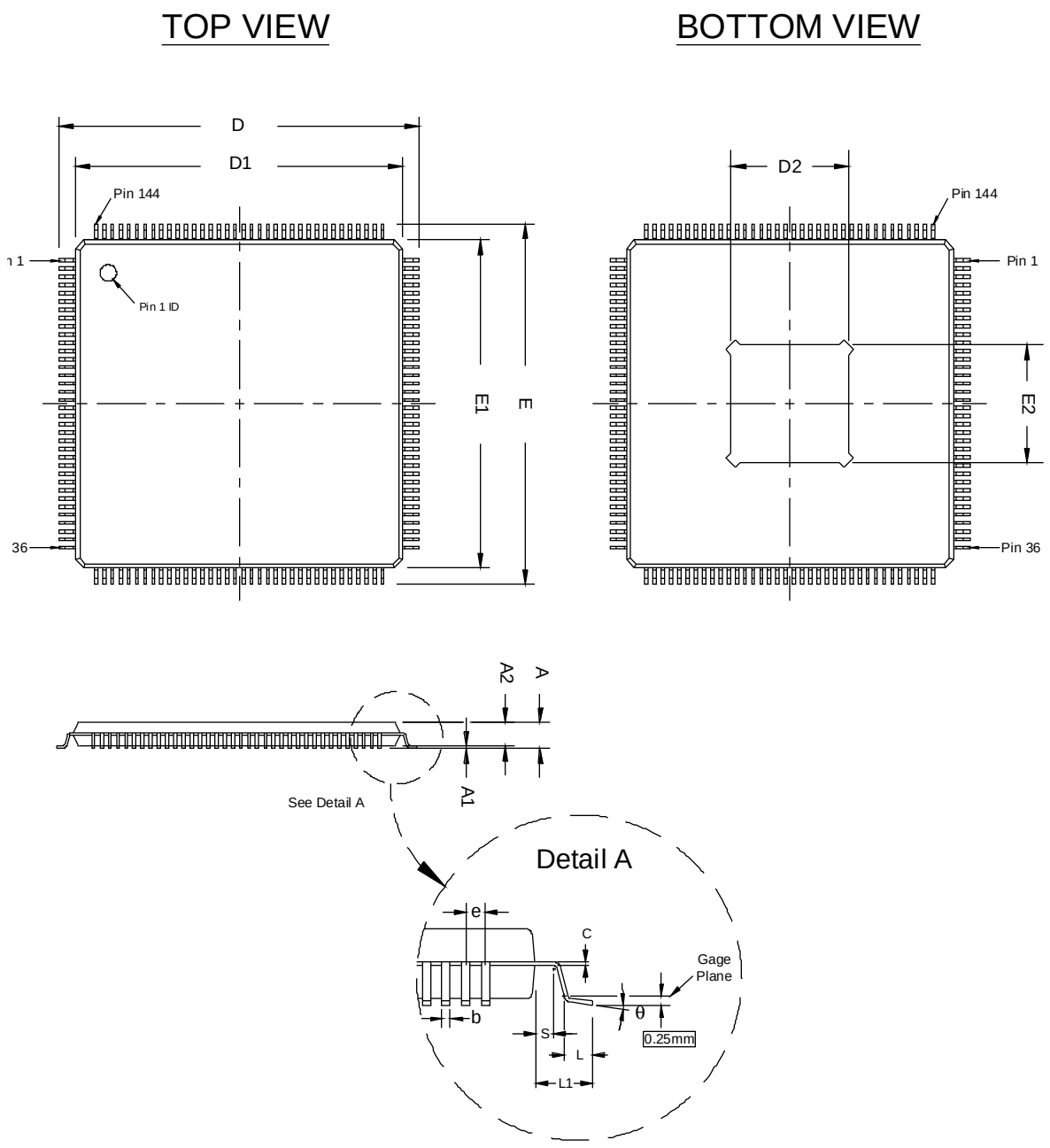
144-Pin Plastic Enhanced Quad Flat Pack (EQFP) — Wire Bond

- 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	
q	0°	3.5°	7°

Package Outline



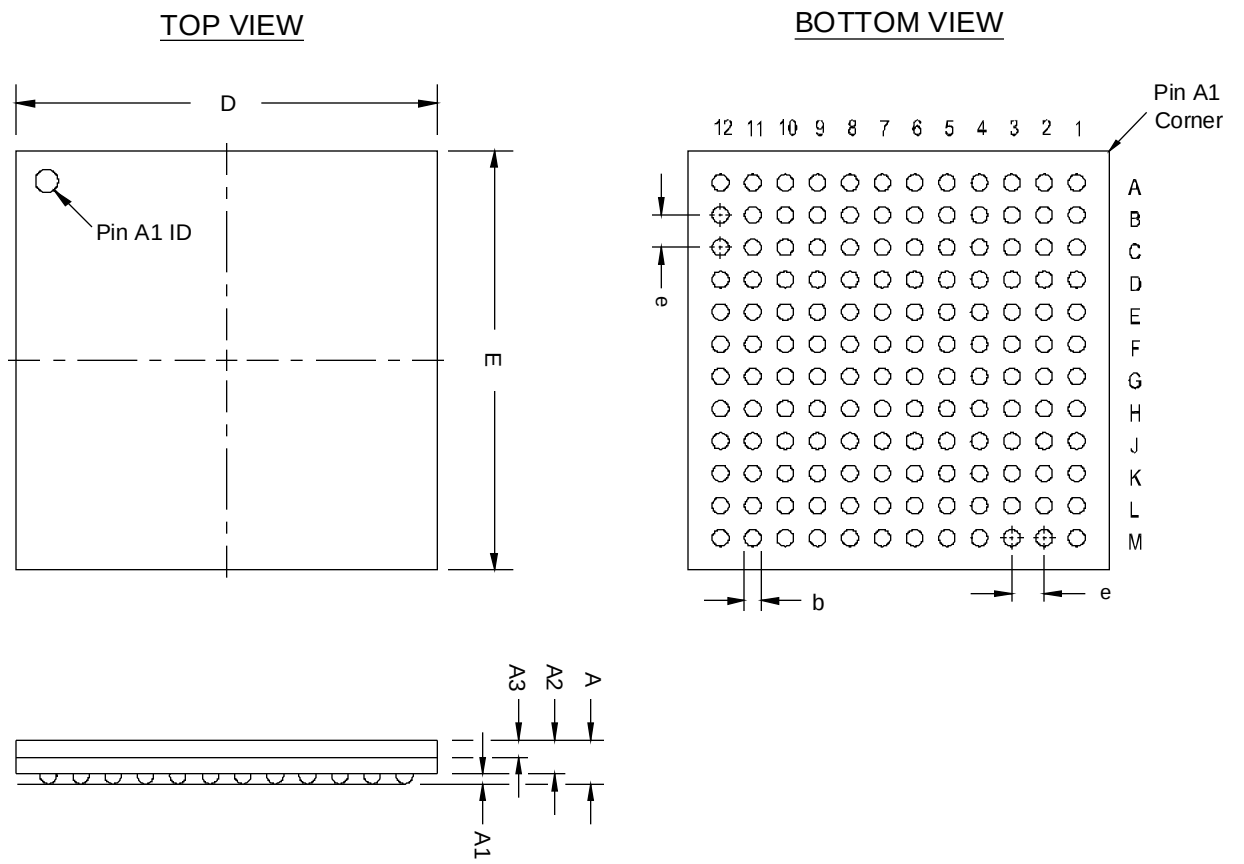
144-Pin FineLine Ball-Grid Array (FBGA) — Wire Bond

- 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



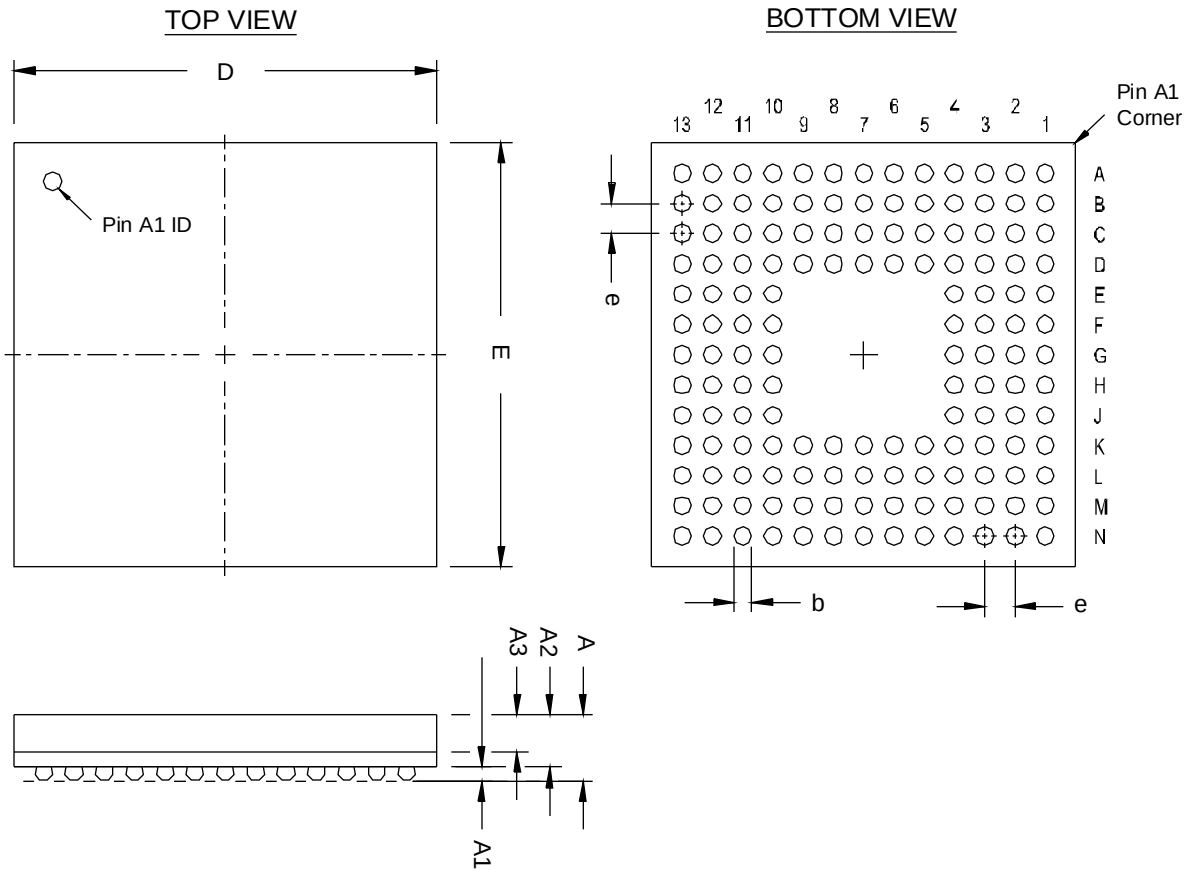
144-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond

- 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



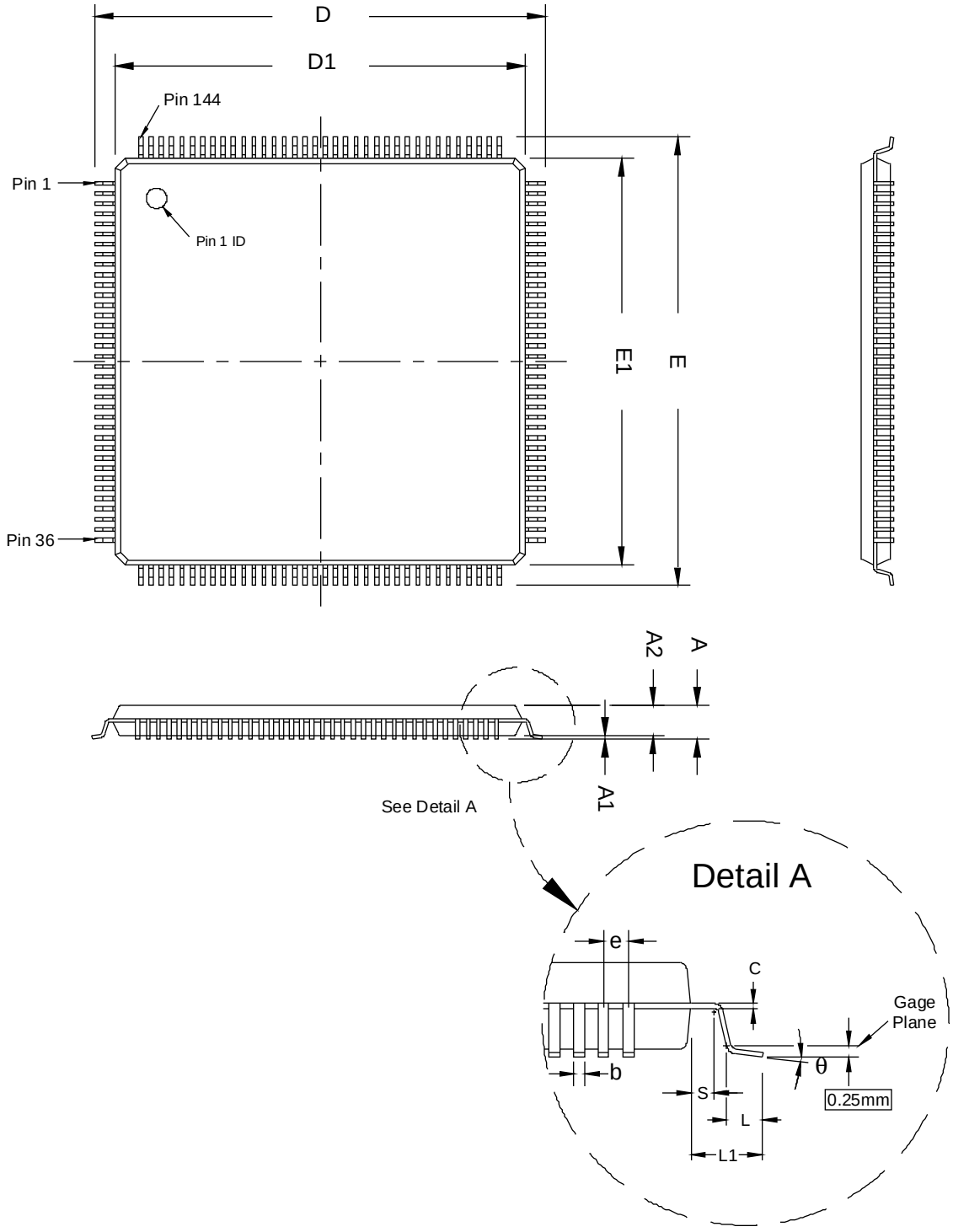
144-Pin Plastic Thin Quad Flat Pack (TQFP) — Wire Bond

- 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		
q	0°	3.5°	7°

Package Outline



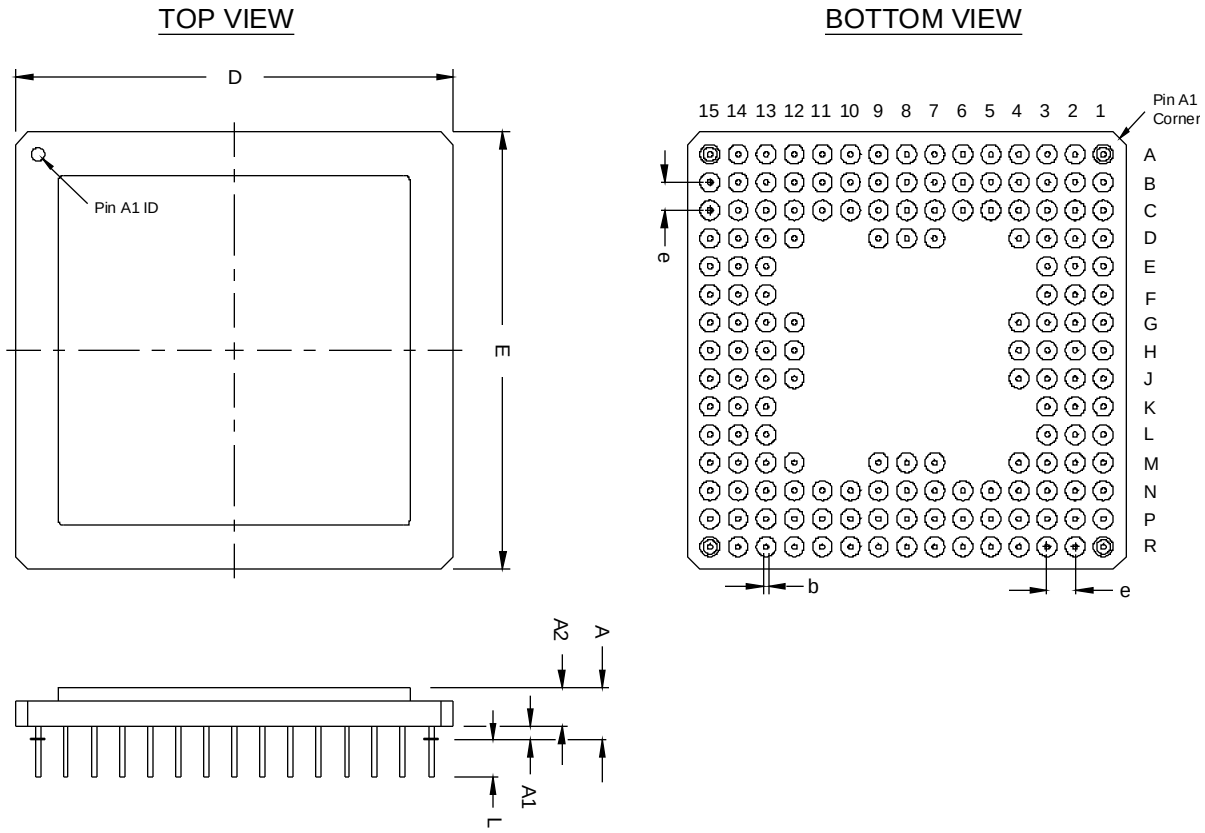
160-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

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

Package Information	
Description	**Specification**
Ordering Code Reference	G
Package Acronym	PGA
Leadframe Material	Alloy 42
Lead Finish	Gold Over Nickel Plate
JEDEC Outline Reference	MO-067 Variation: AG
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



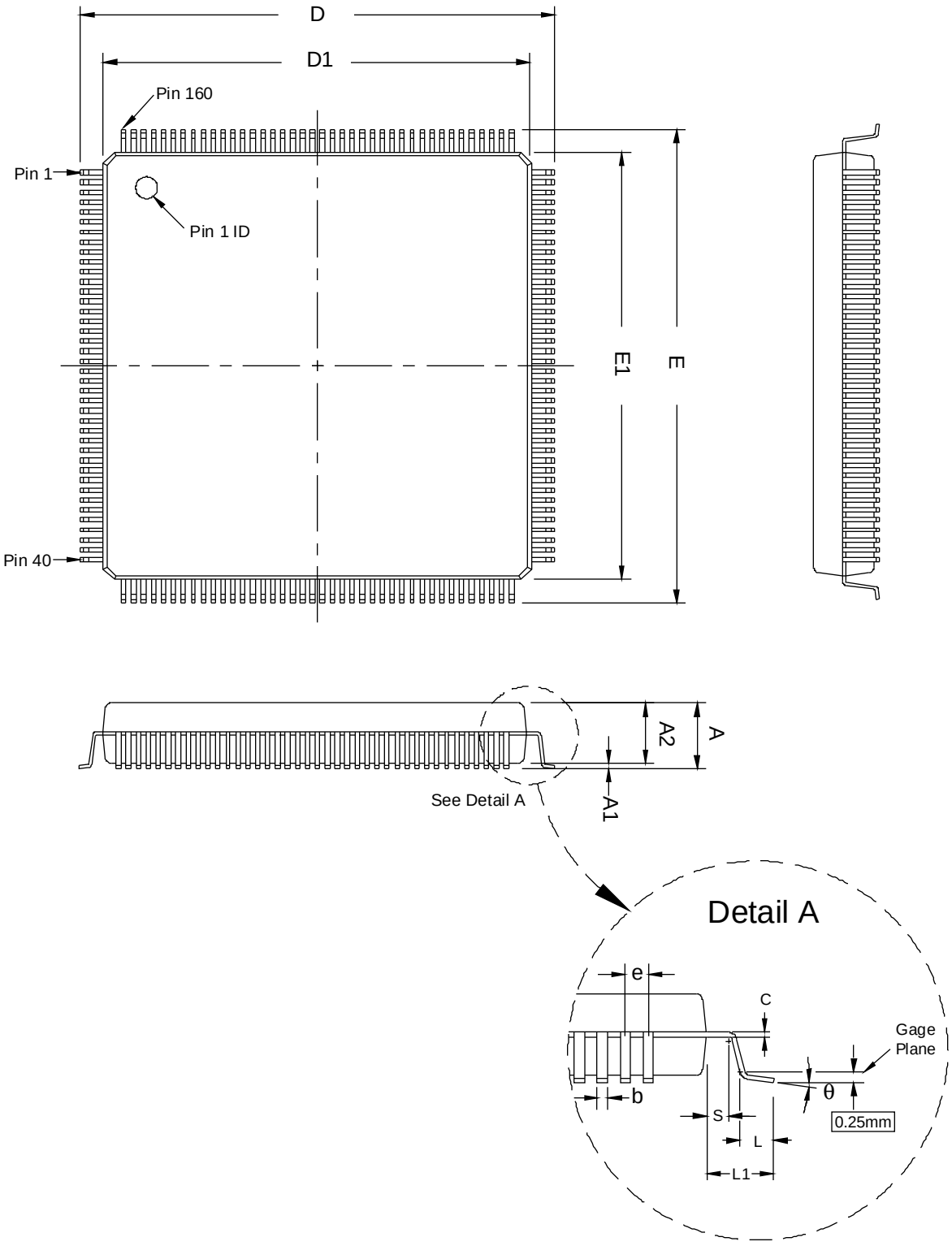
160-Pin Plastic Quad Flat Pack (PQFP) — Wire Bond

- 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		
q	0°	–	7°

Package Outline



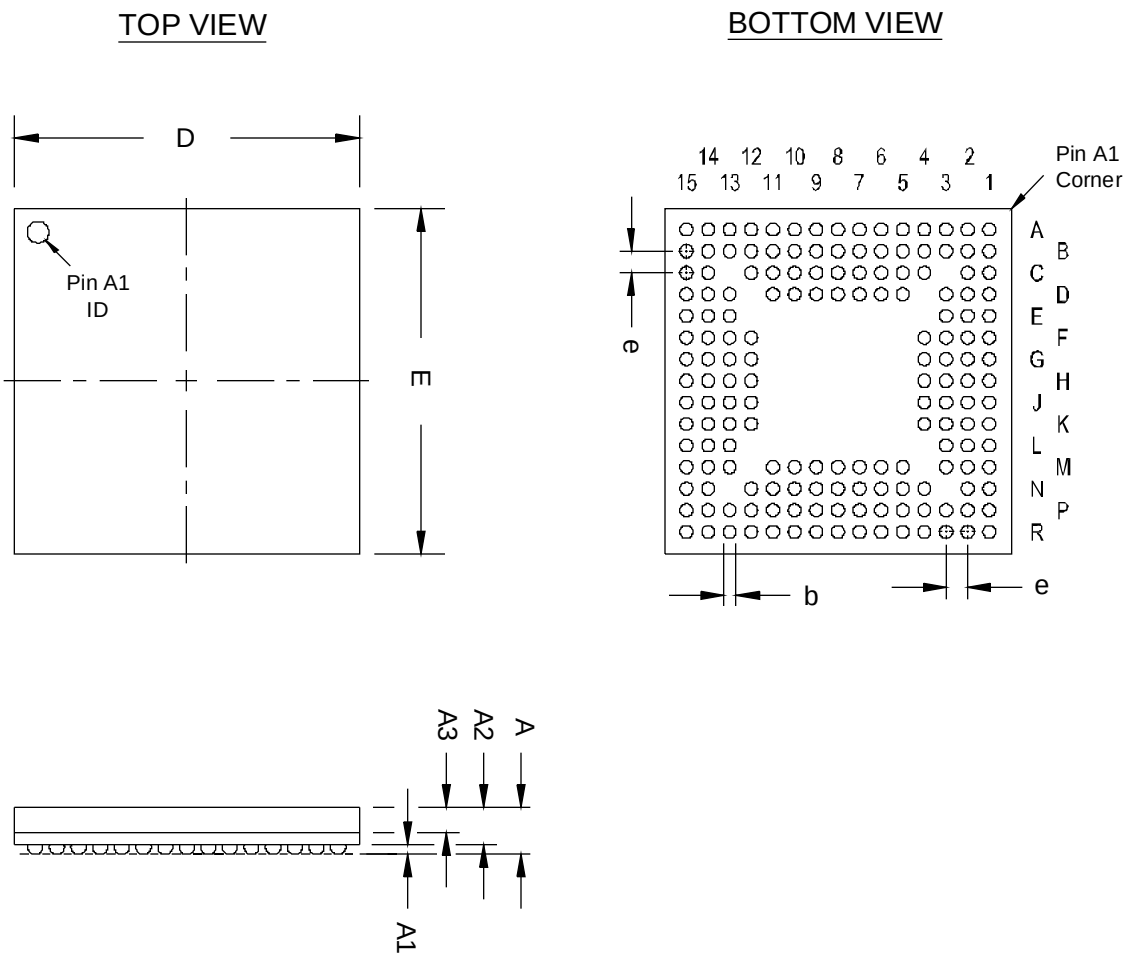
164-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond

- 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



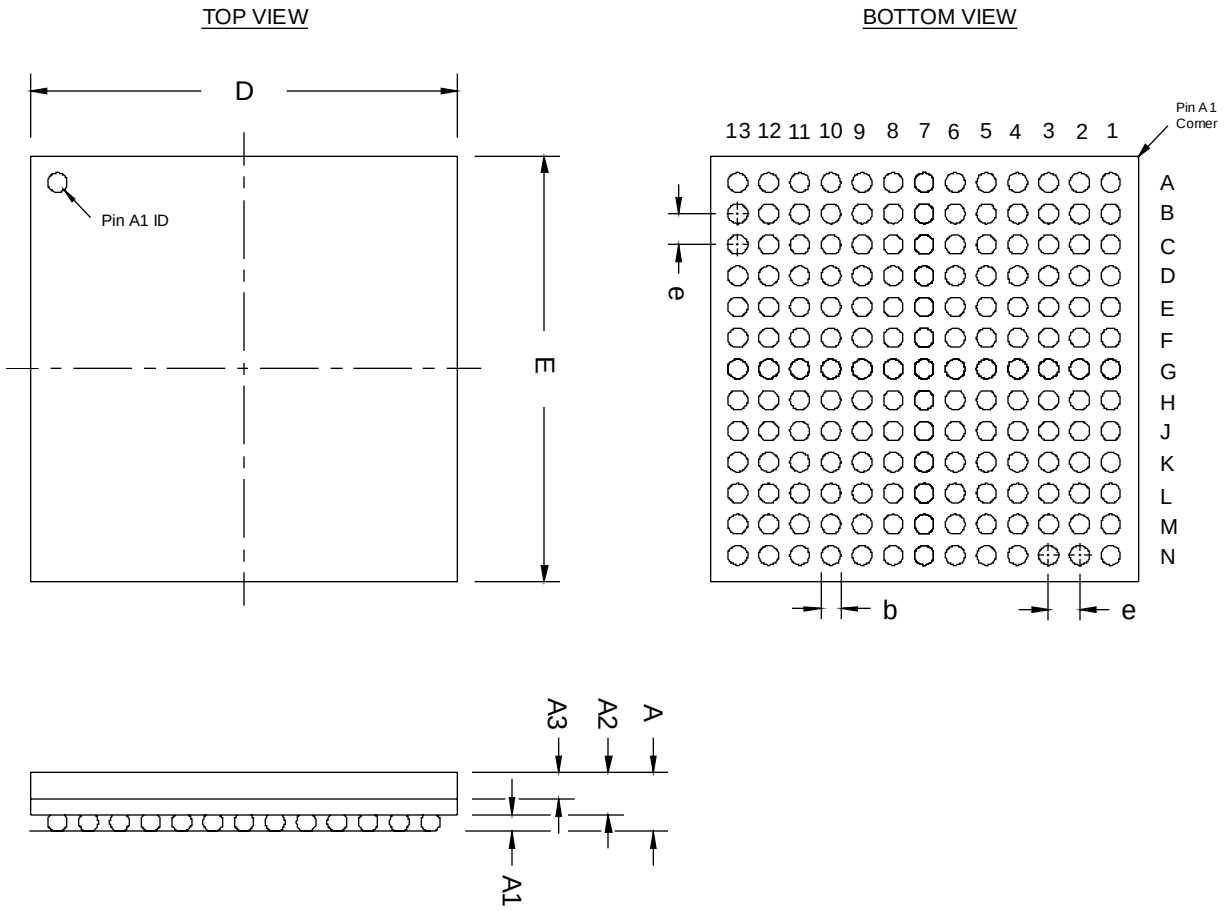
169-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond

- 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



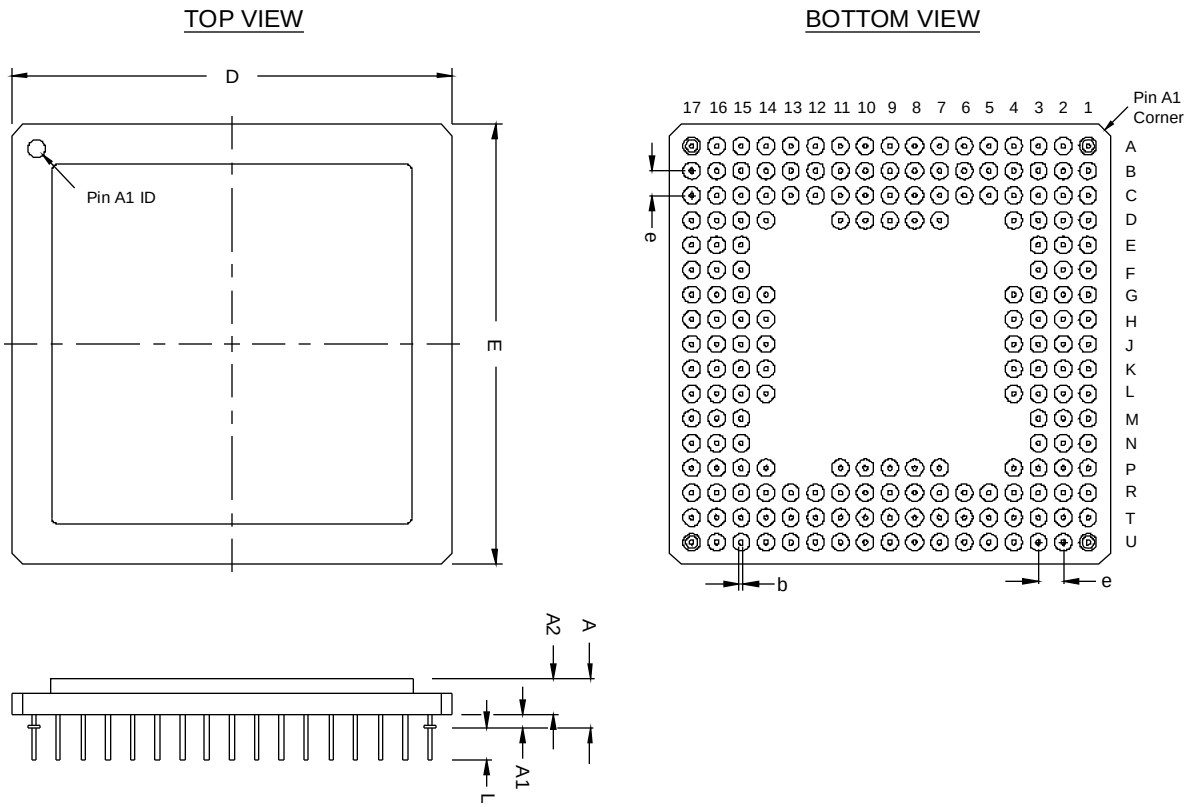
192-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



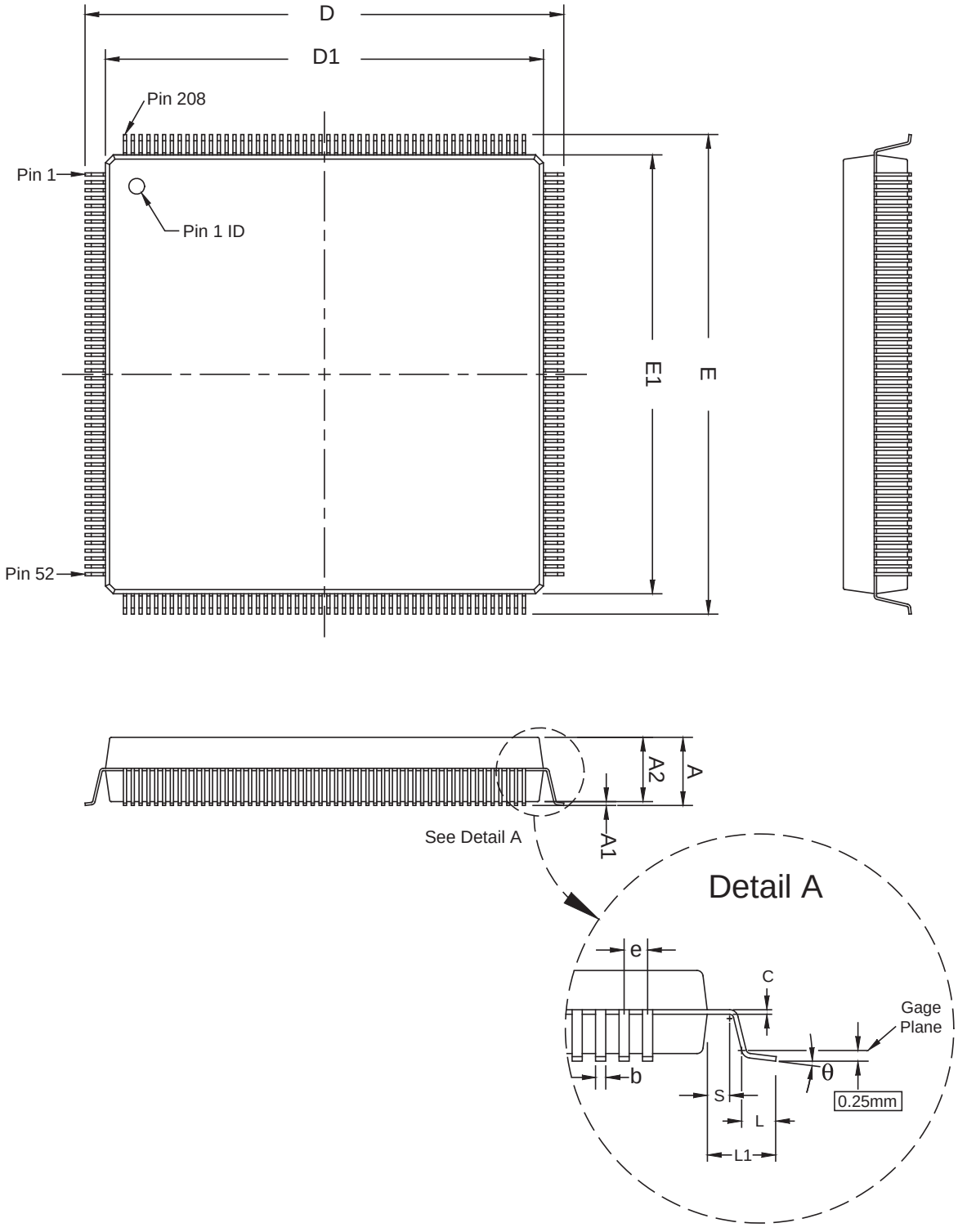
208-Pin Plastic Quad Flat Pack (PQFP) — Wire Bond

- 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		
q	0°	3.5°	8°

Package Outline



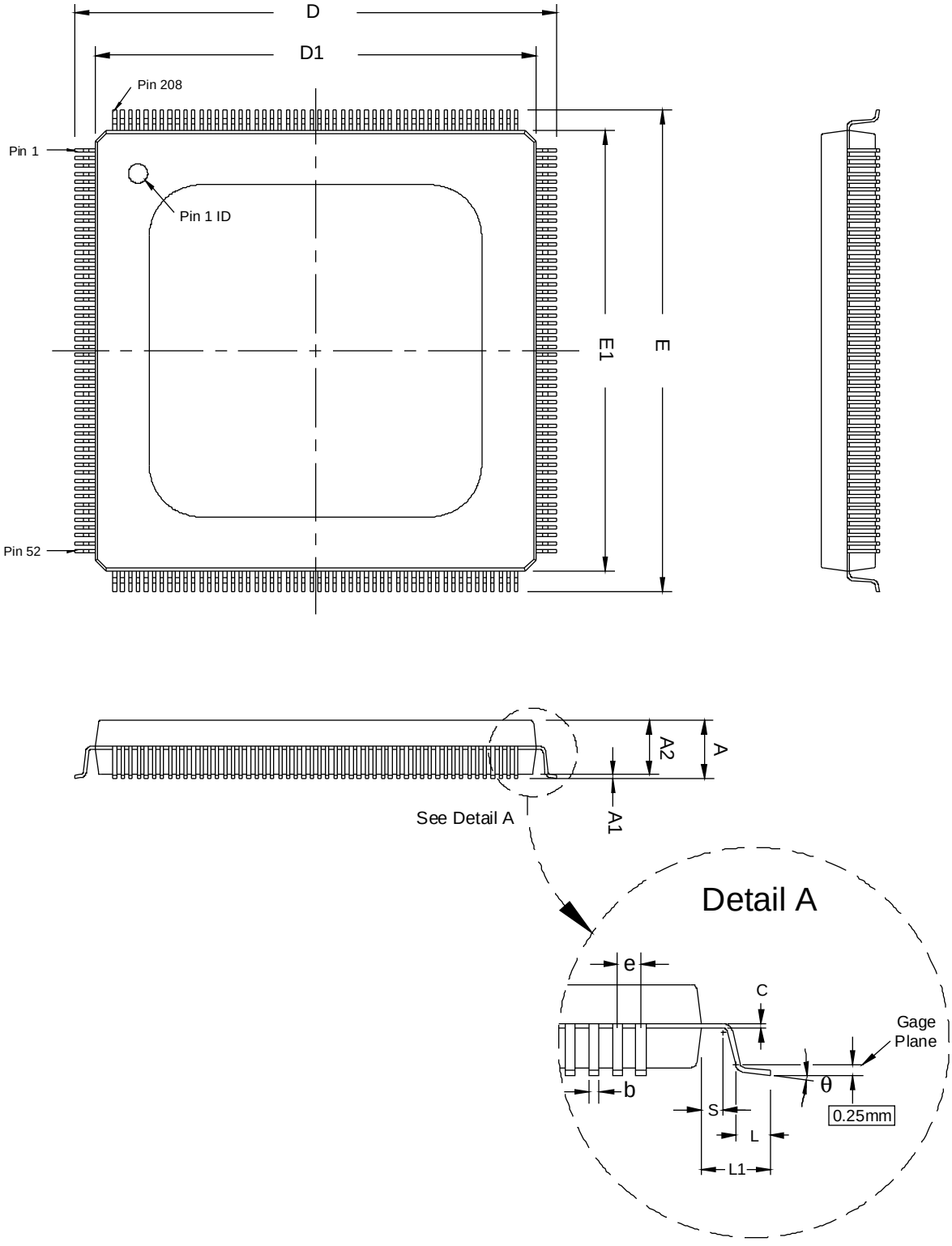
208-Pin Power Quad Flat Pack (RQFP) — Wire Bond

- 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	
q	0°	3.5°	8°

Package Outline



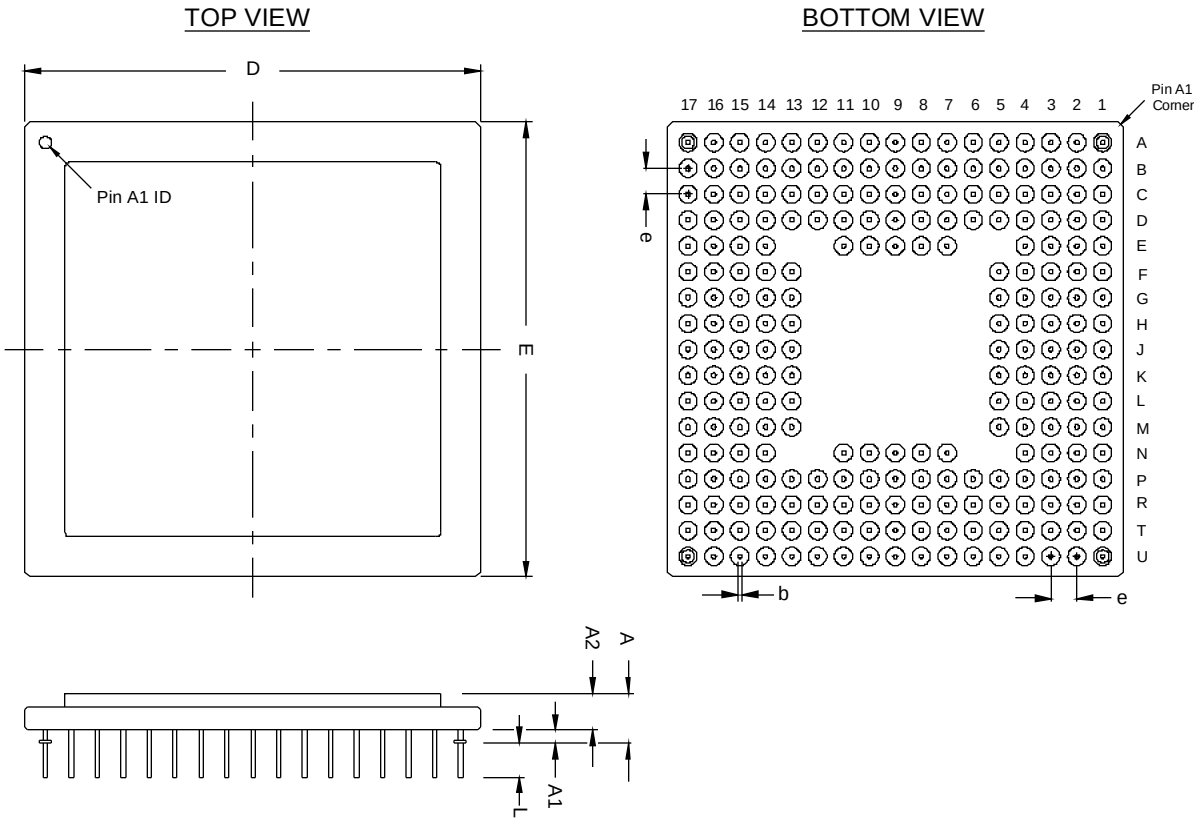
232-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



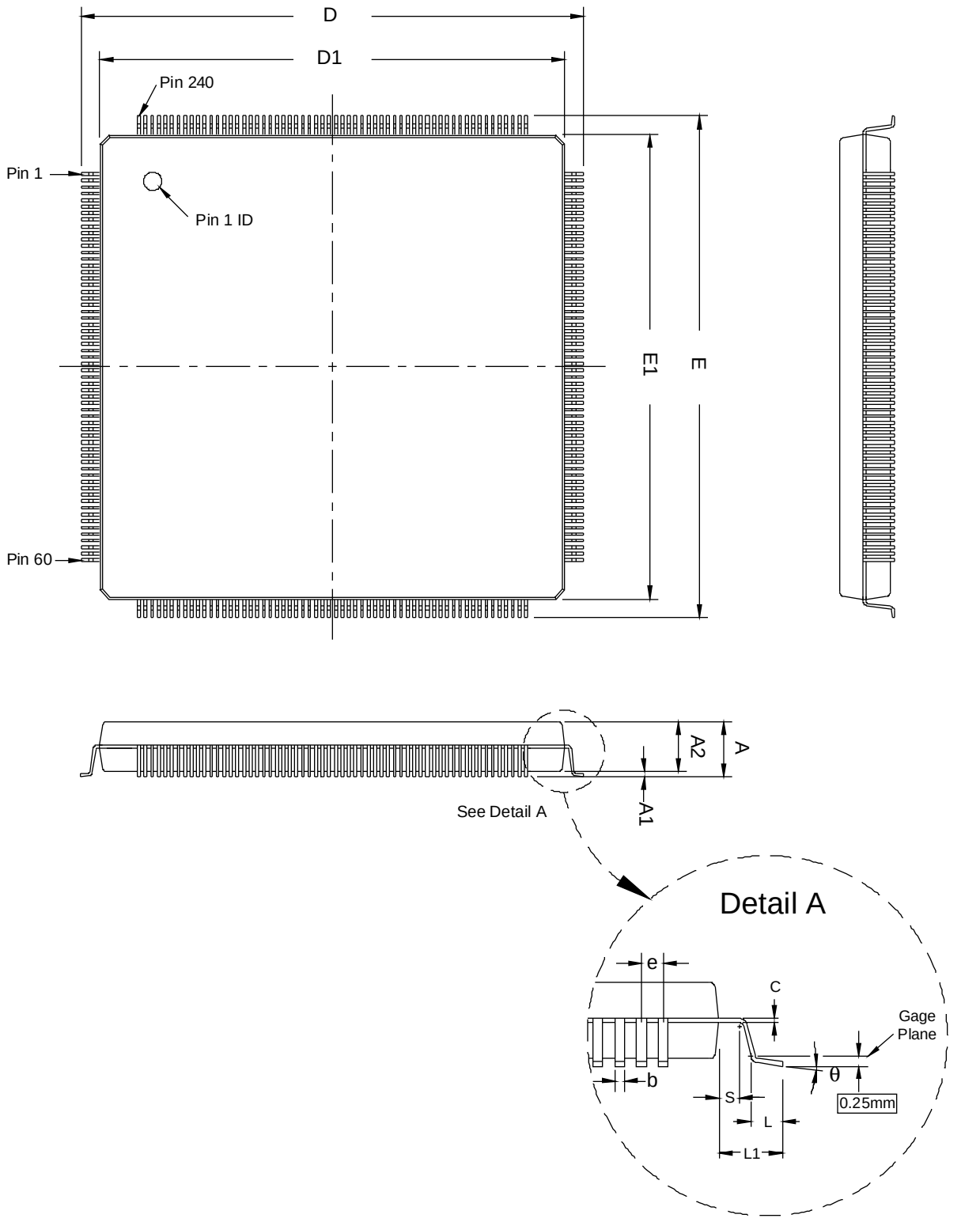
240-Pin Plastic Quad Flat Pack (PQFP) — Wire Bond

- 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	
q	0°	3.5°	8°

Package Outline



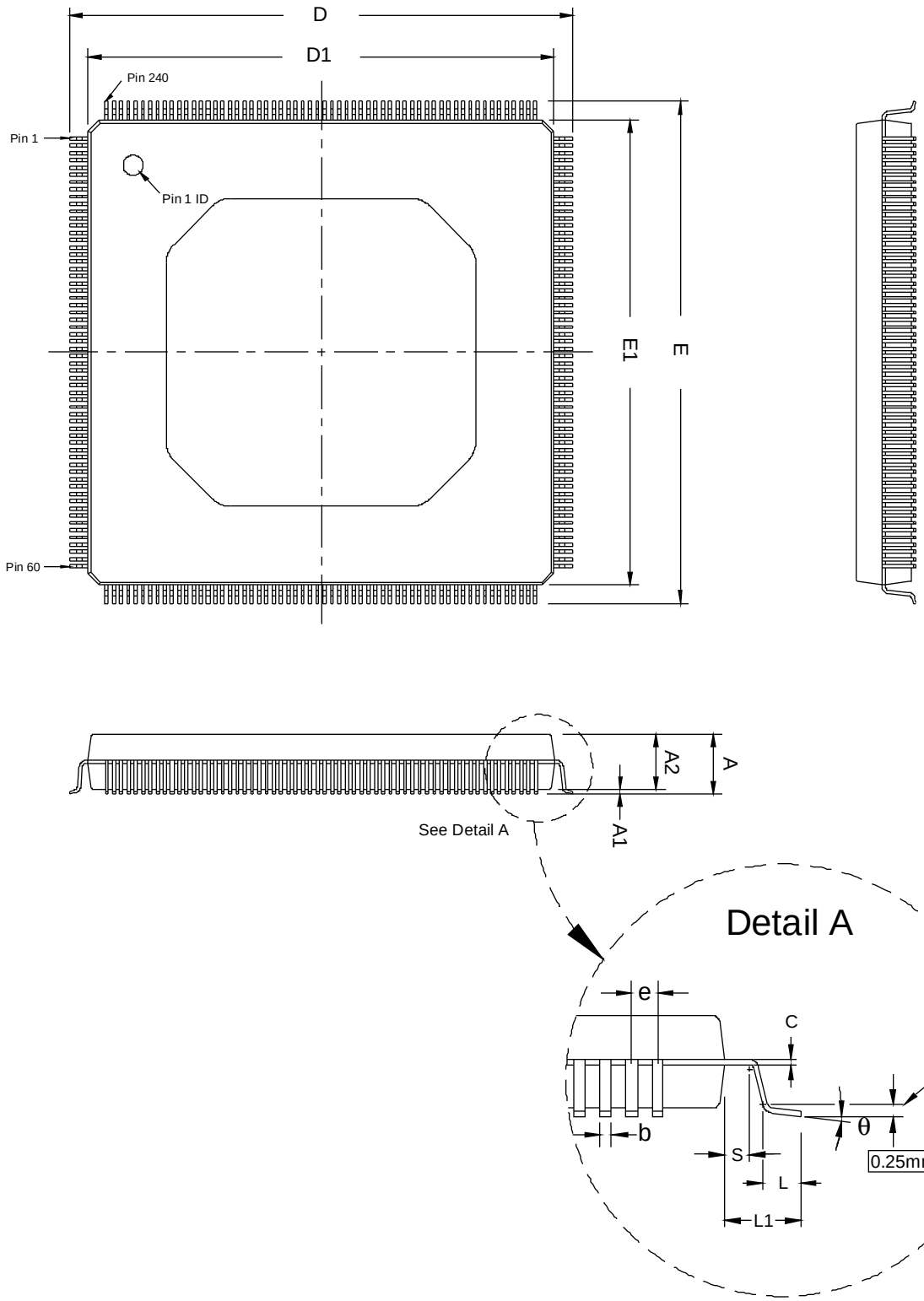
240-Pin Power Quad Flat Pack (RQFP) — Wire Bond

- 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		
q	0°	3.5°	8°

Package Outline



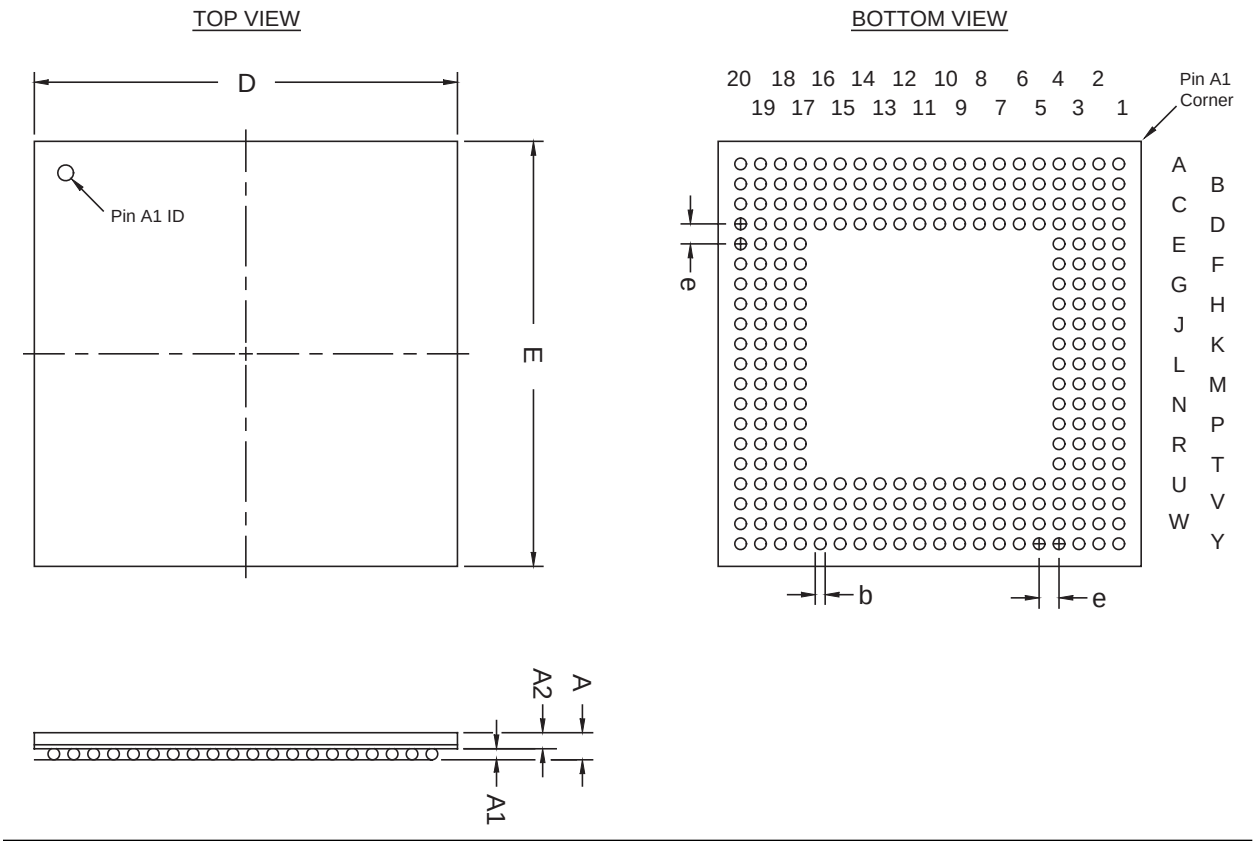
256-Pin Ball-Grid Array (BGA), Option 1 — Wire Bond

- 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	**Inches**		
	Min.	**Nom.**	**Max.**
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



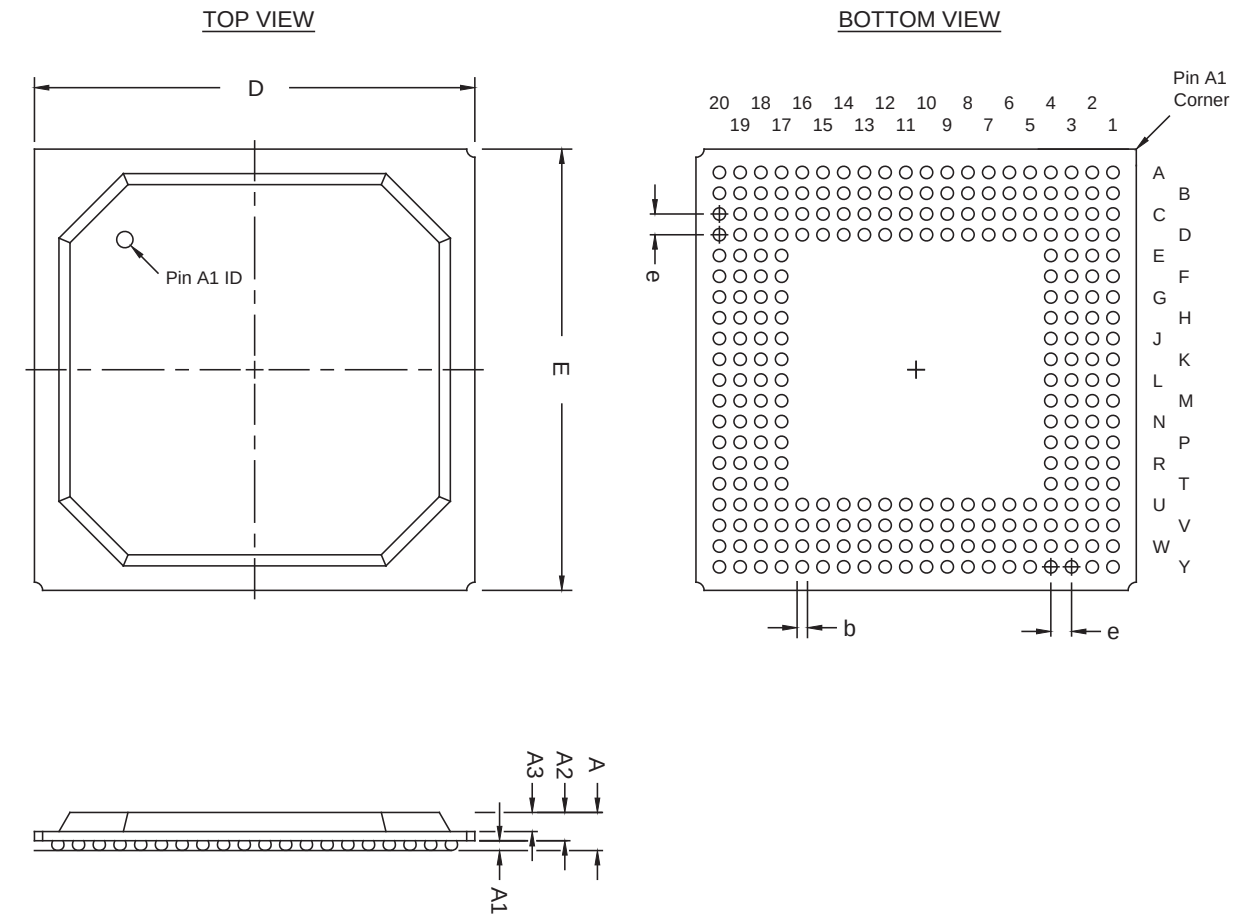
256-Pin Plastic Ball-Grid Array (BGA), Option 2 — Wire Bond

- 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

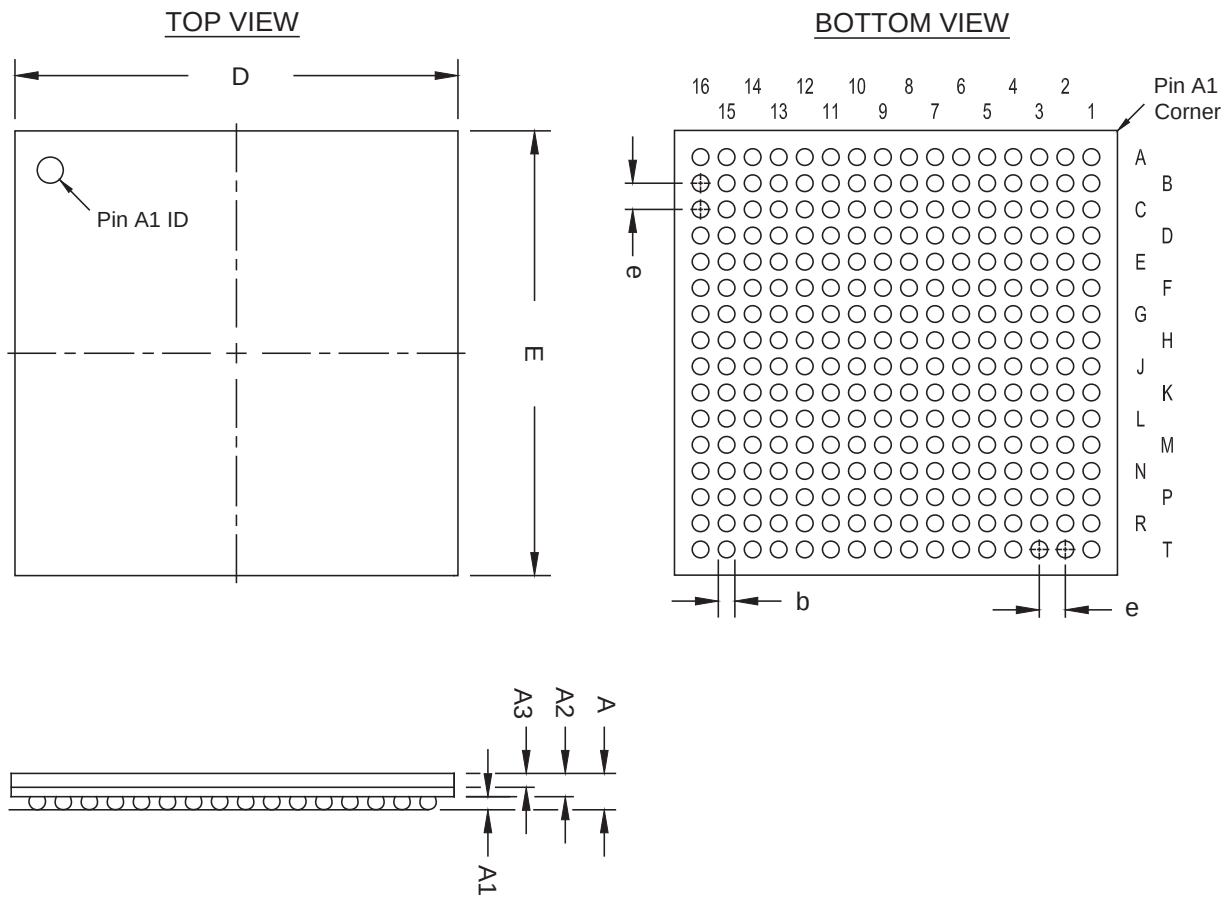
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on package surface.

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

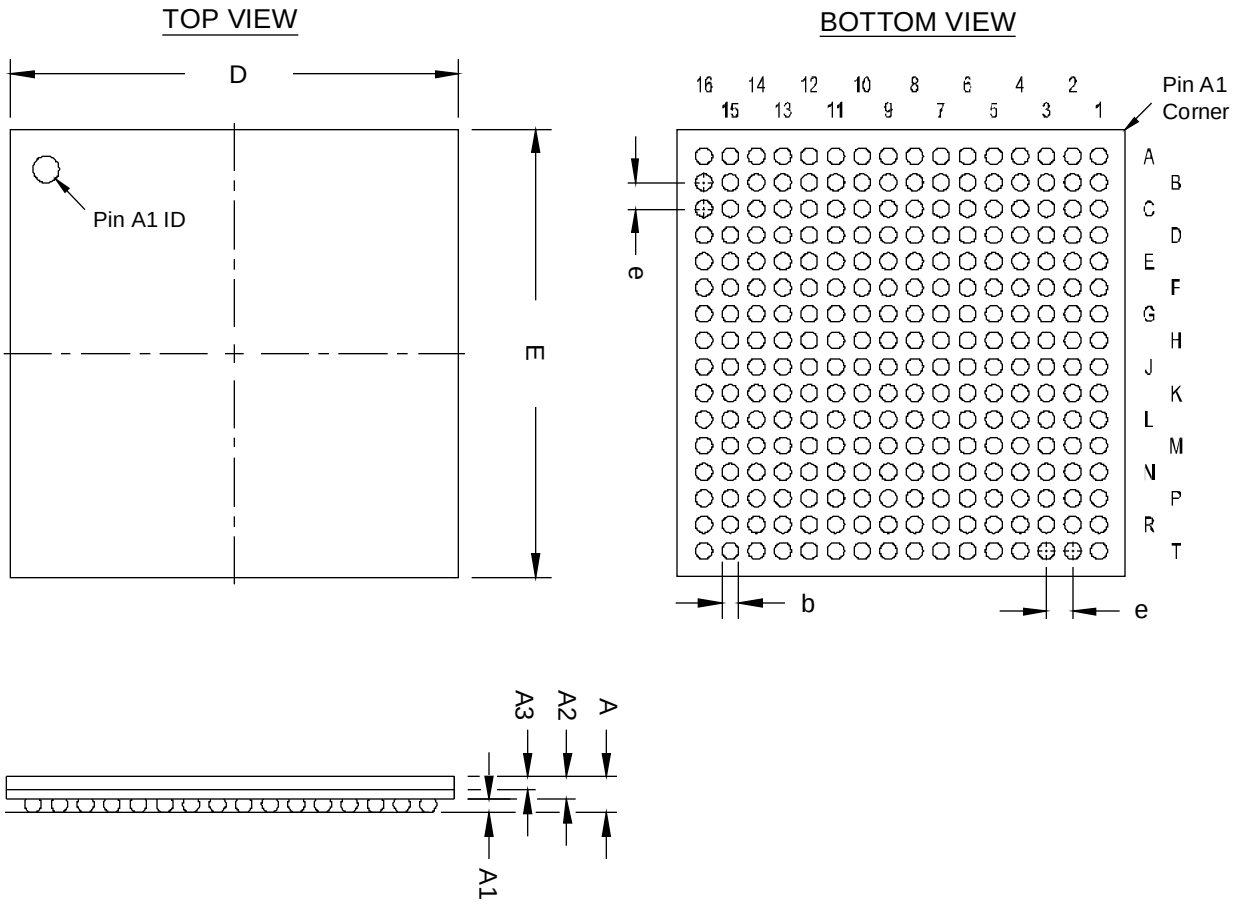
- All dimensions and tolerances conform to ASME Y14.5M - 1994.
- Controlling dimension is in millimeters.
- Pin A1 may be indicated by an ID dot, or a special feature, in its proximity on the package surface.

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



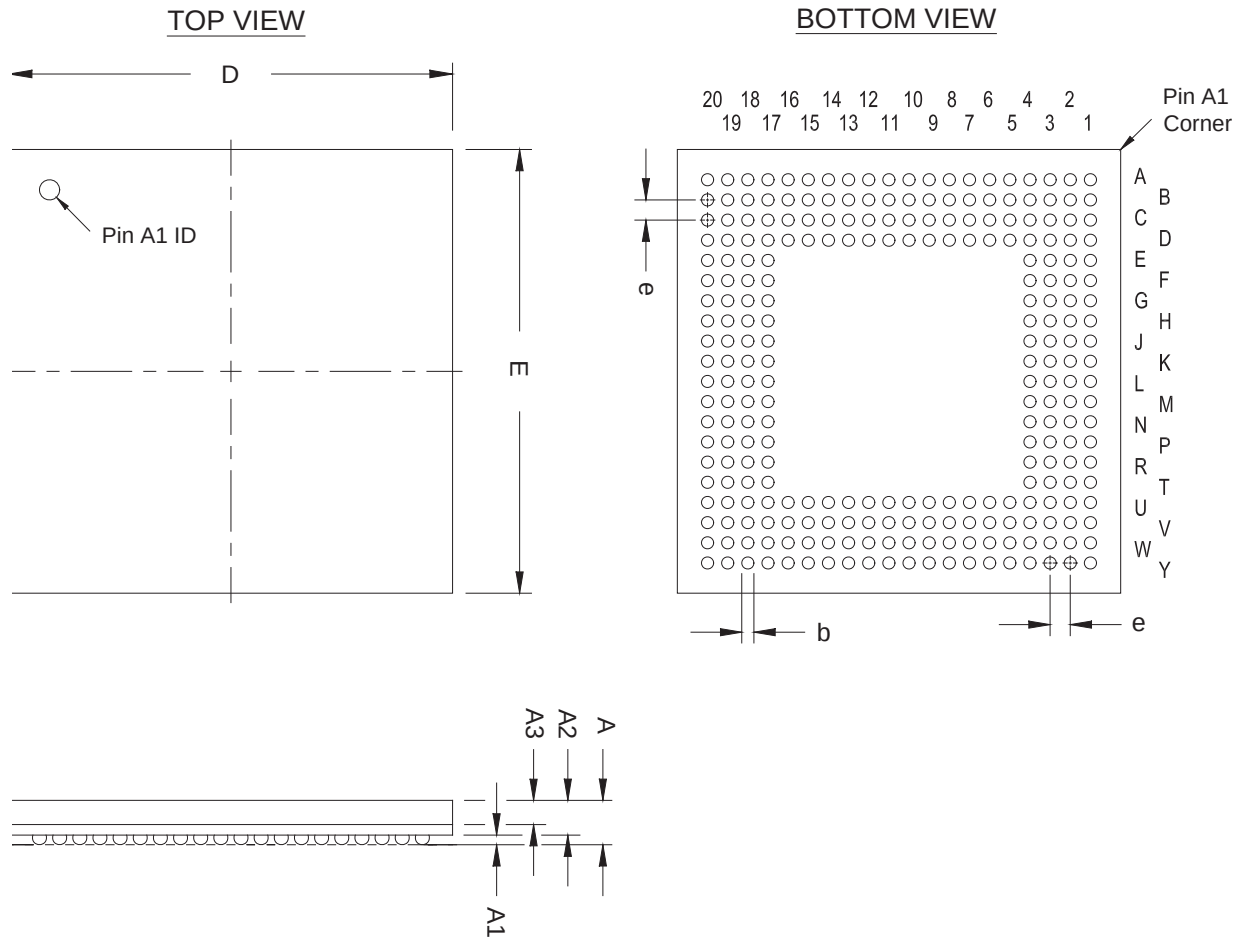
256-Pin Micro FineLine Ball-Grid Array (MBGA) — Wire Bond

- 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



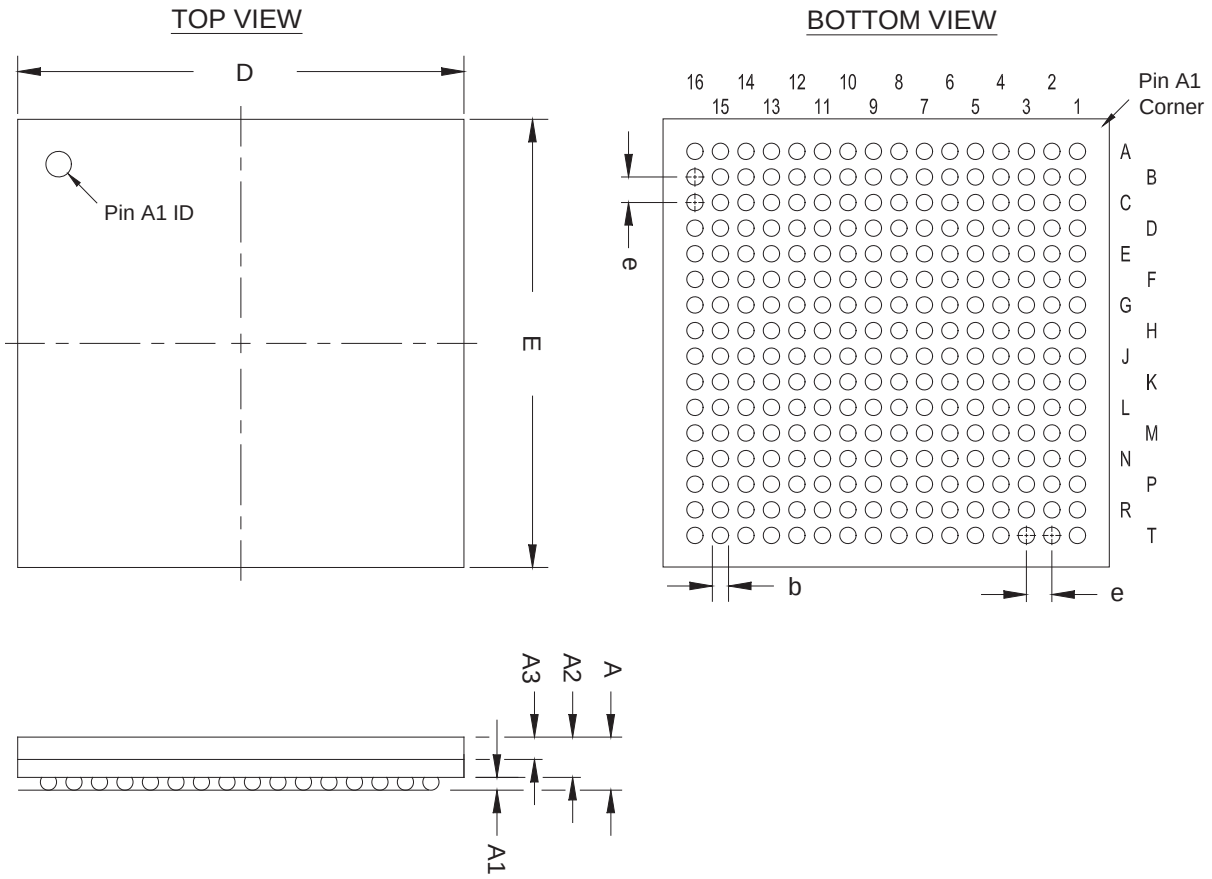
256-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond

- 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	–	–	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



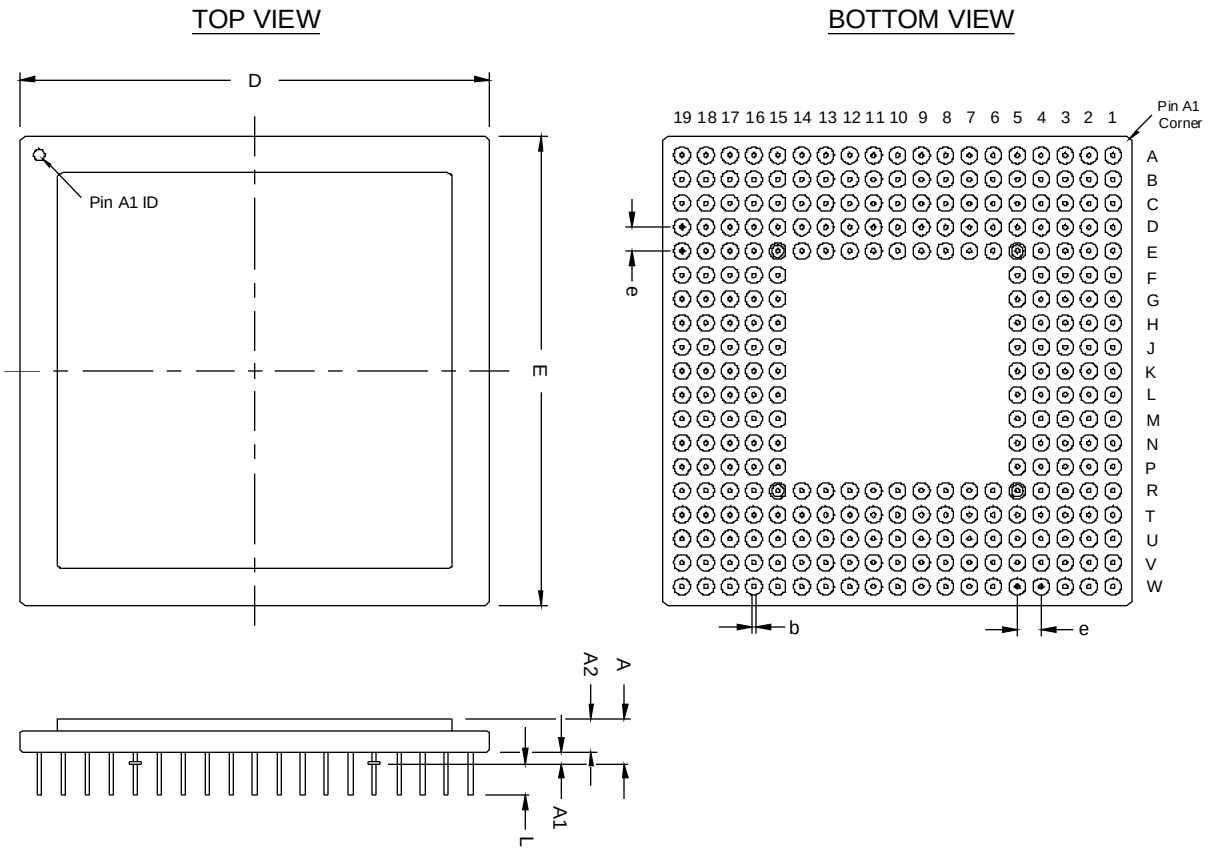
280-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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
Ordering Code Reference	G

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



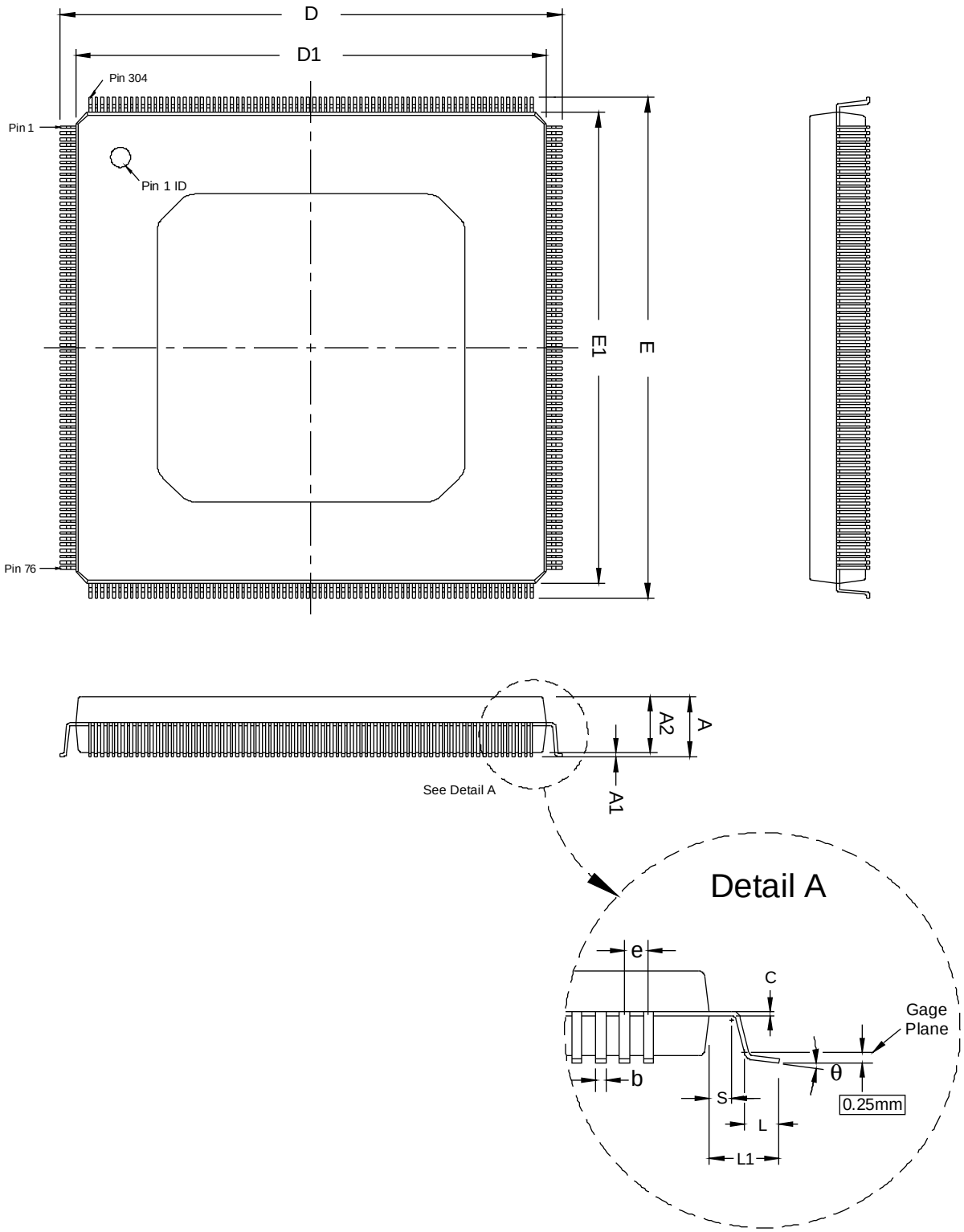
304-Pin Power Quad Flat Pack (RQFP) — Wire Bond

- 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	
q	0°	3.5°	8°

Package Outline



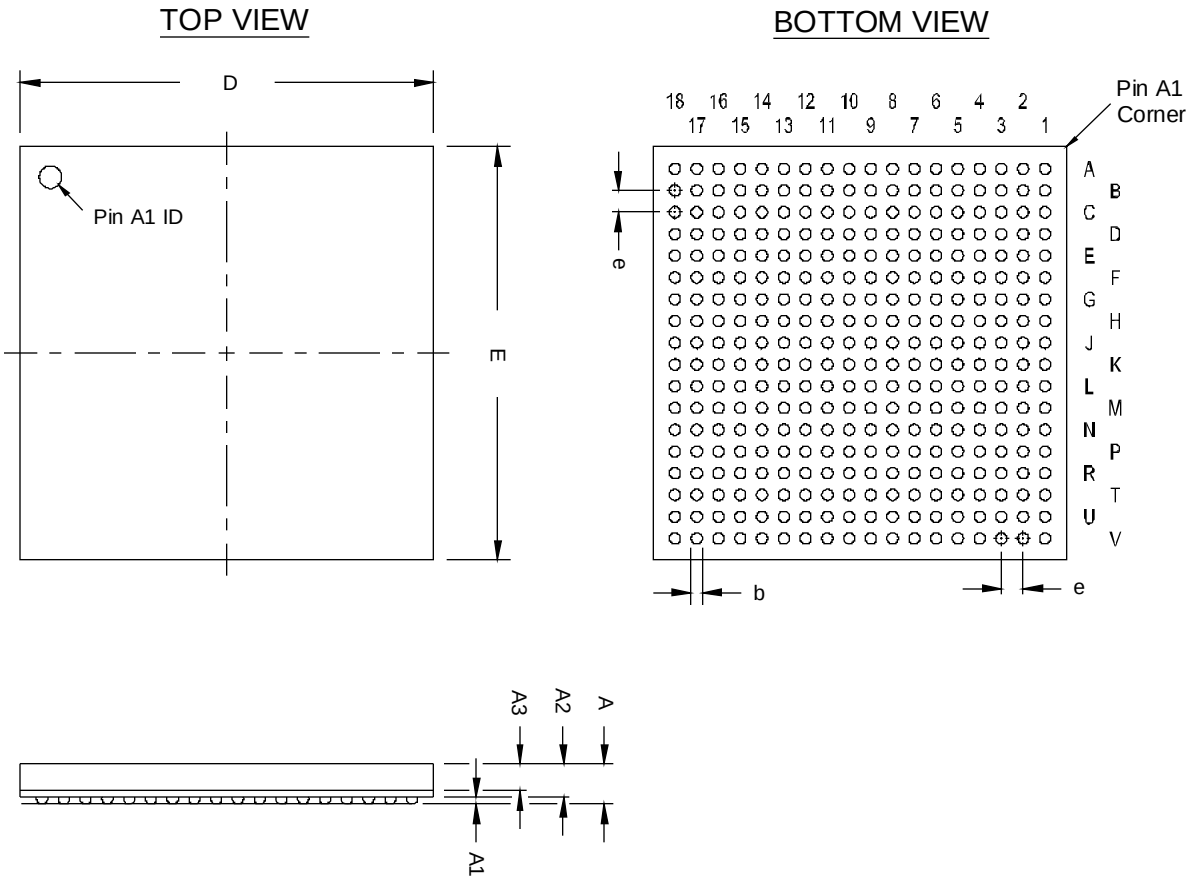
324-Pin FineLine Ball-Grid Array (FBGA) — Wire Bond

- 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



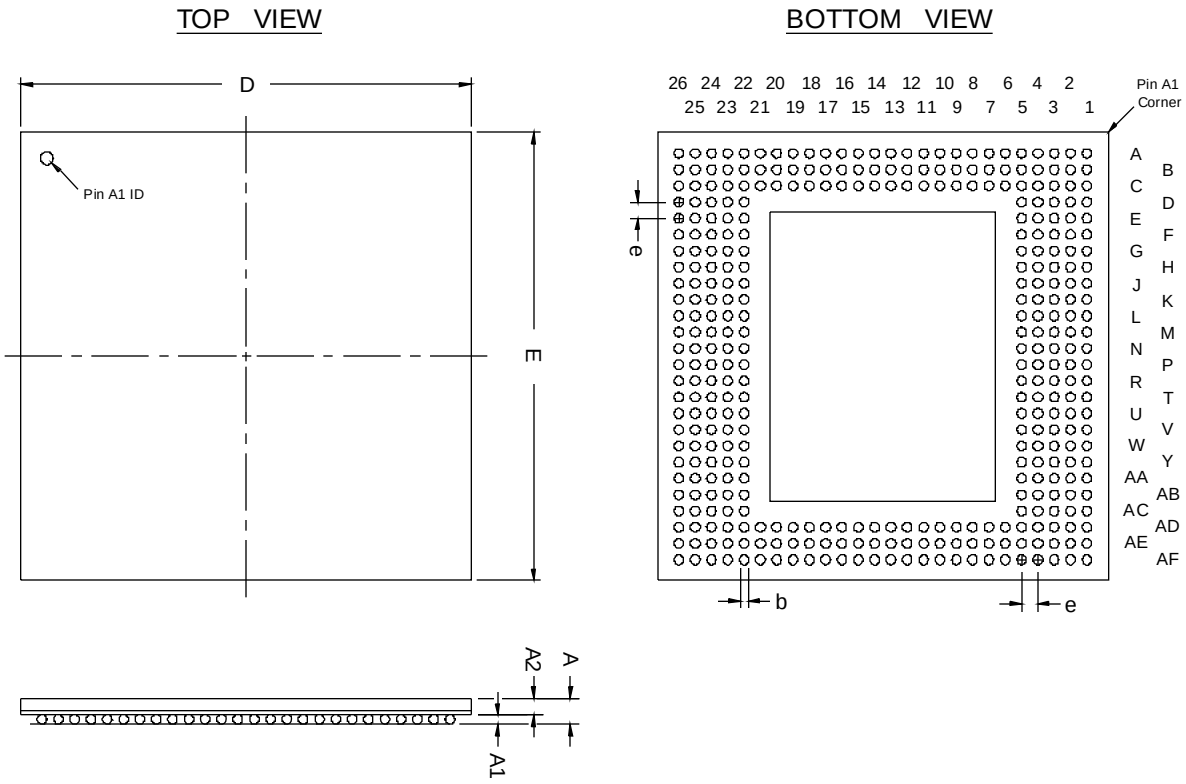
356-Pin Ball-Grid Array (BGA) — Wire Bond

- 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



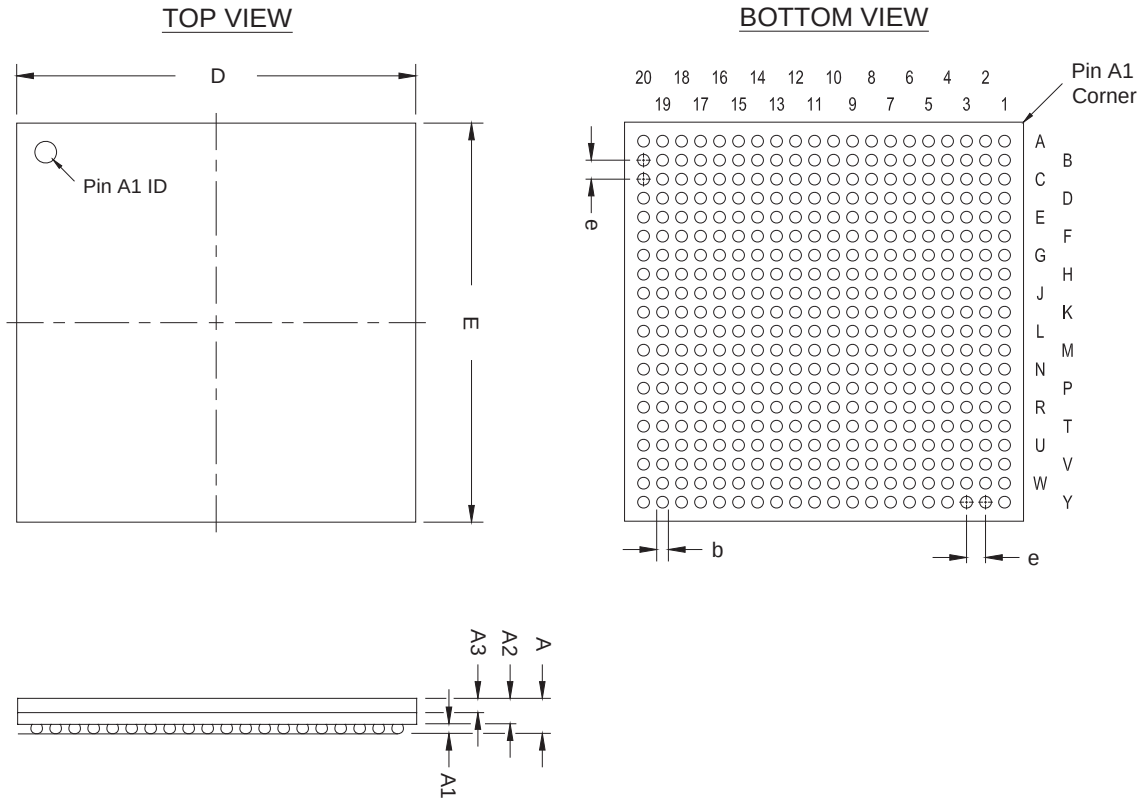
400-Pin FineLine Ball-Grid Array (FBGA) — Wire Bond

- 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



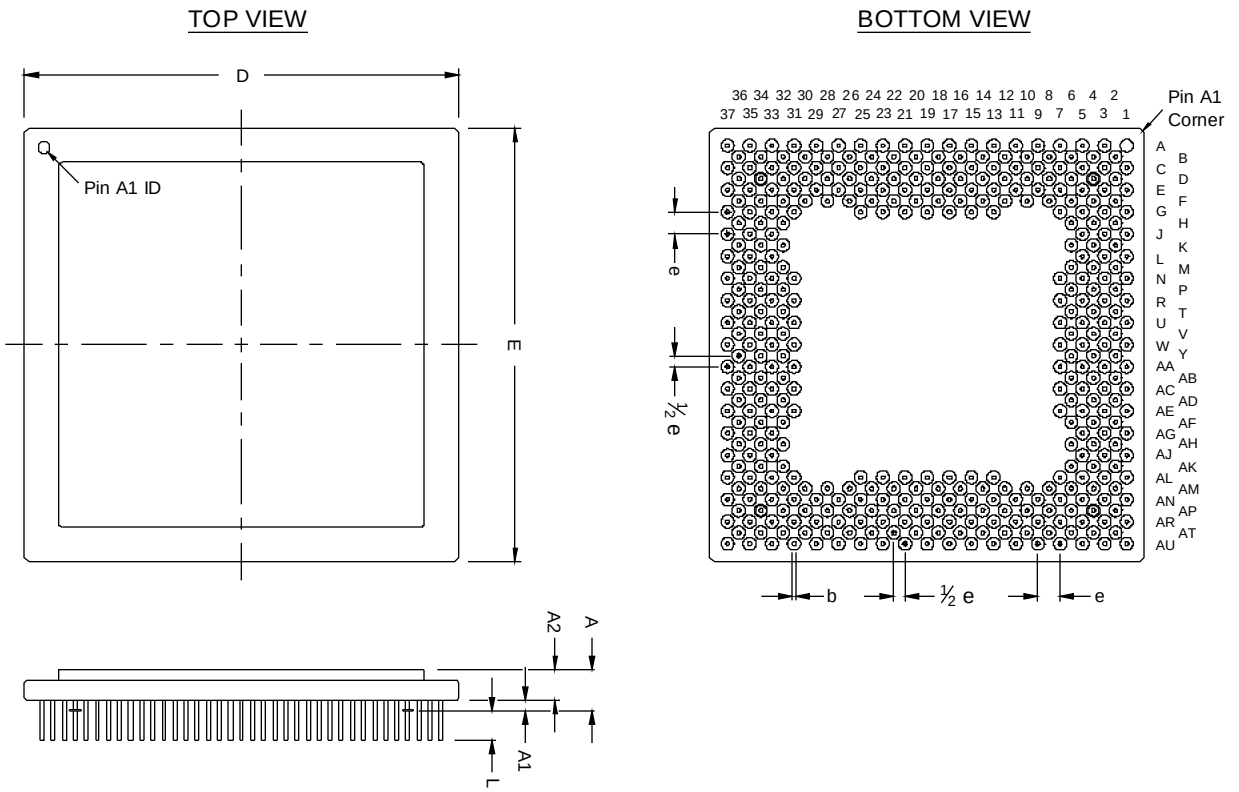
403-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



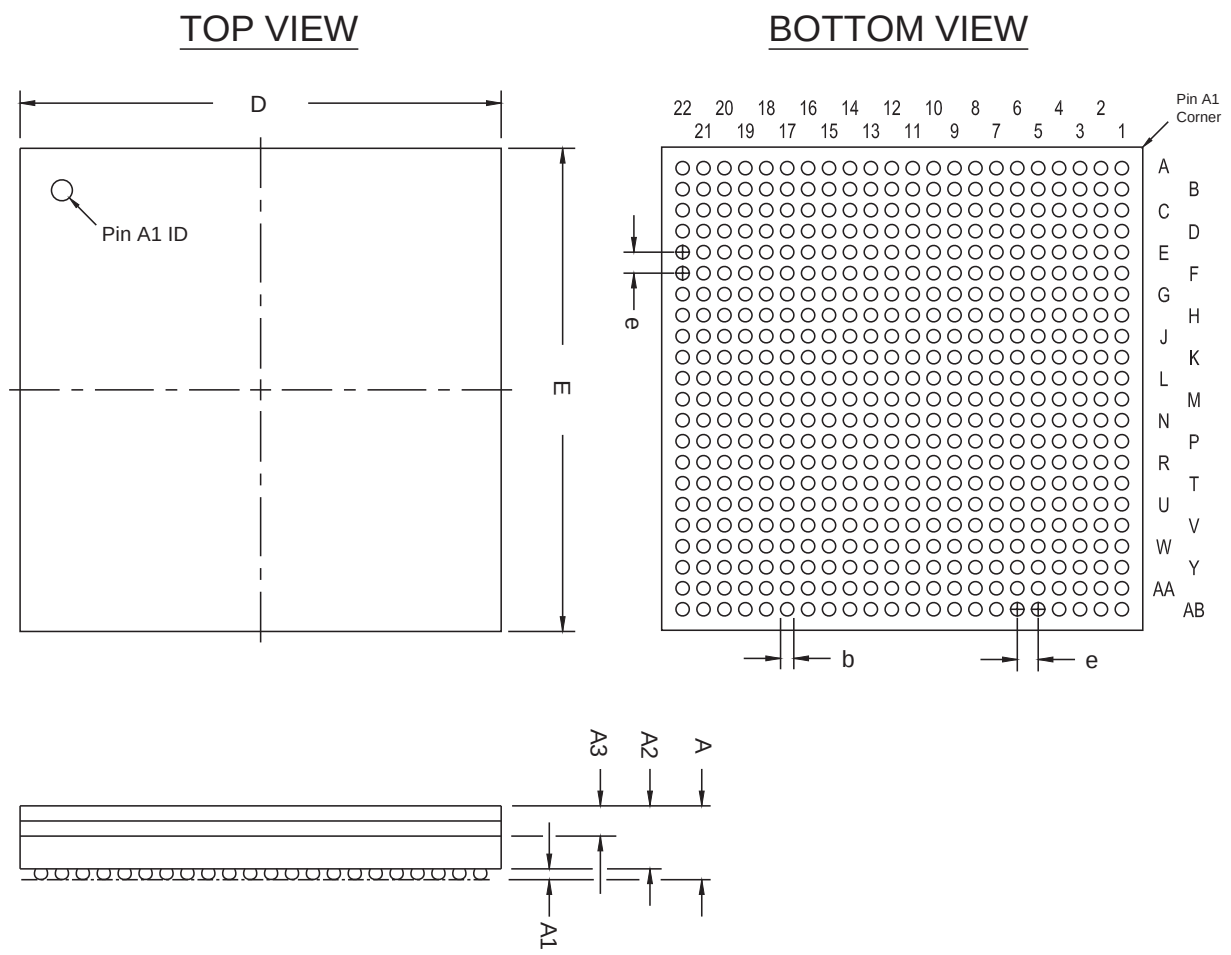
484-Pin FineLine Ball-Grid Array (FBGA), Option 1 — Flip Chip

- 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



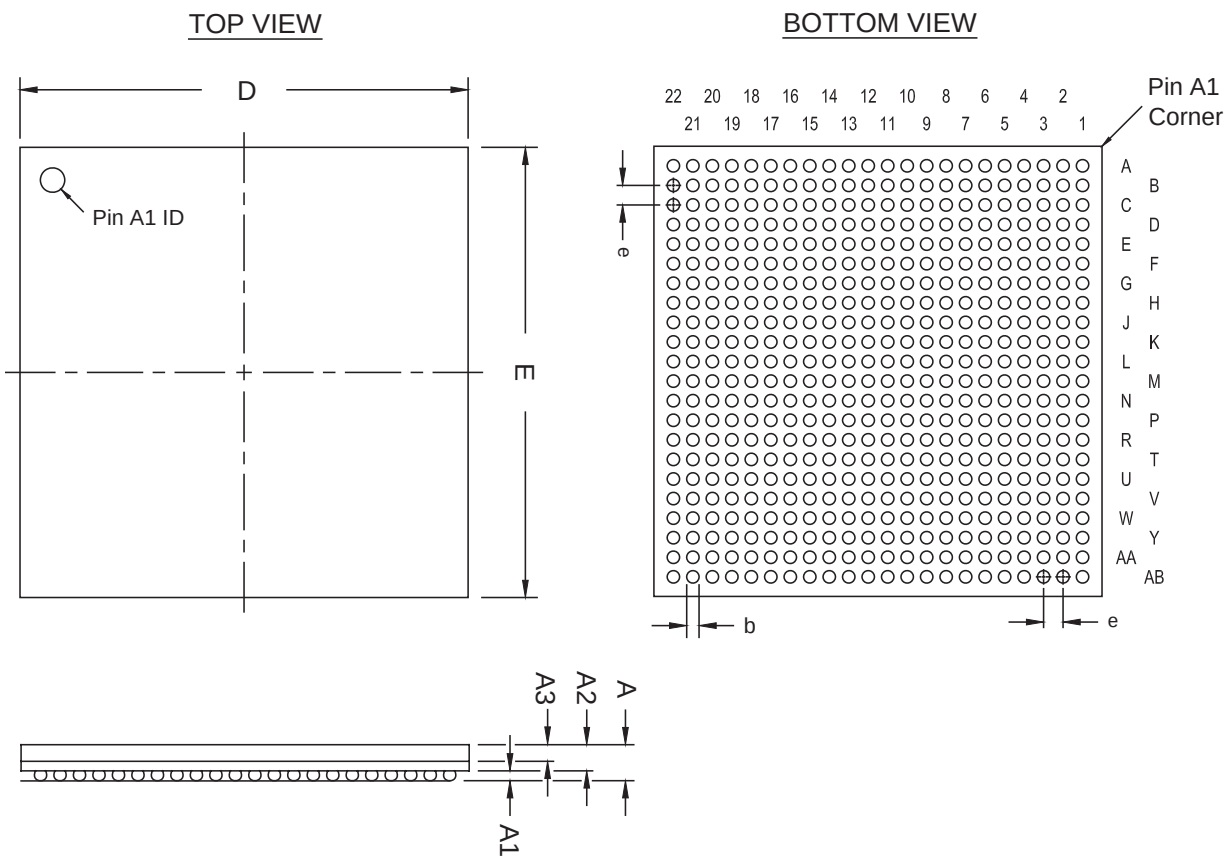
484-Pin FineLine Ball-Grid Array (FBGA), Option 2 — Wire Bond

- 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



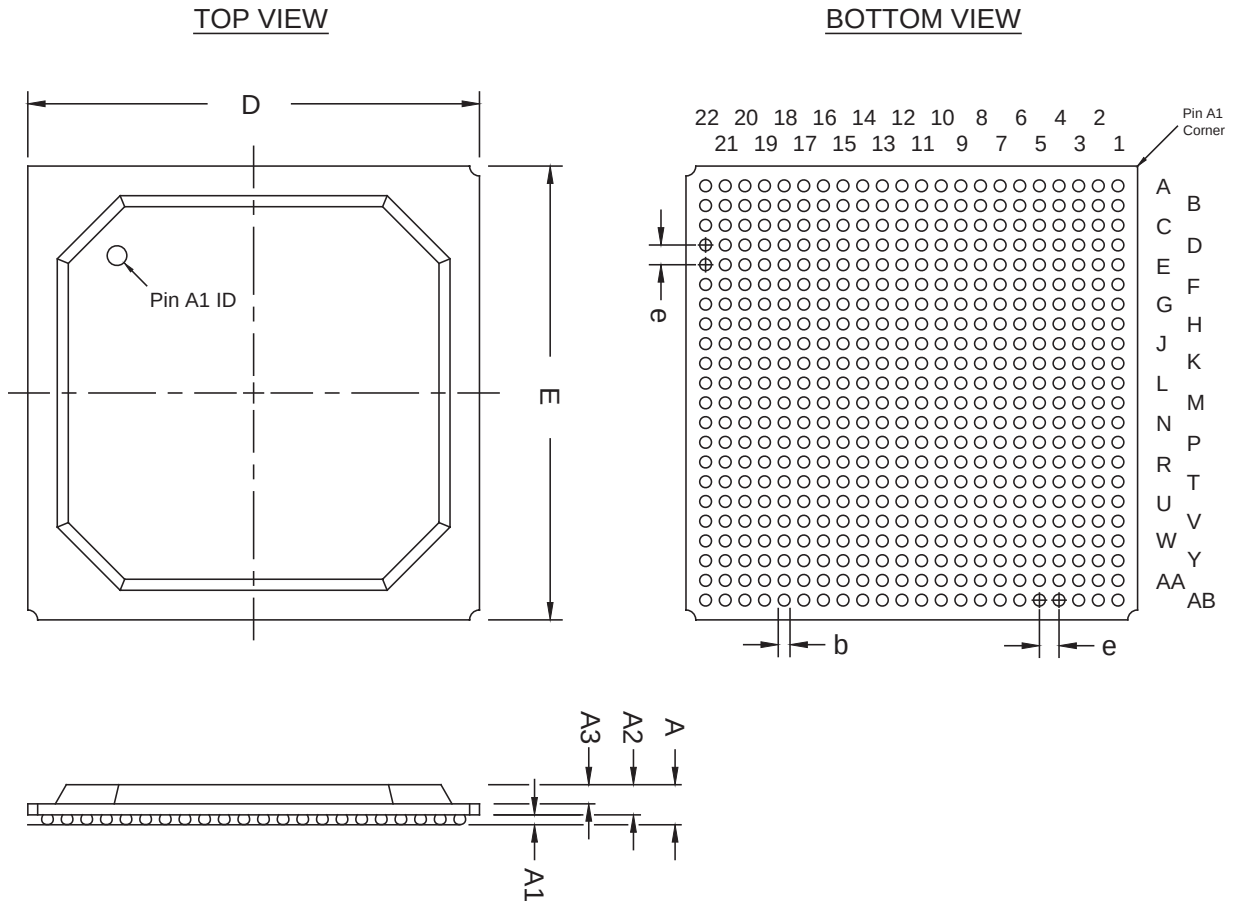
484-Pin FineLine Ball-Grid Array (FBGA), Option 3 — Wire Bond

- 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



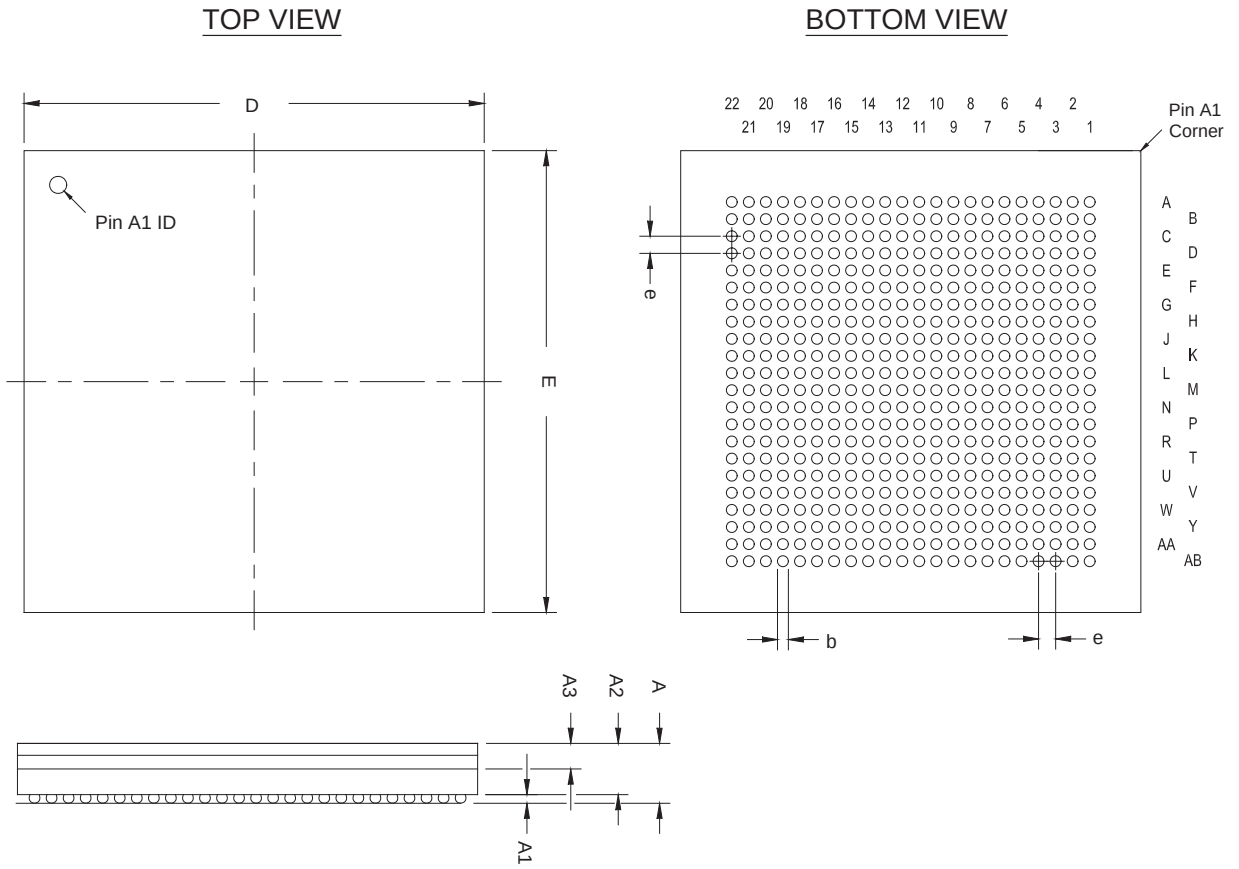
484-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip

- 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



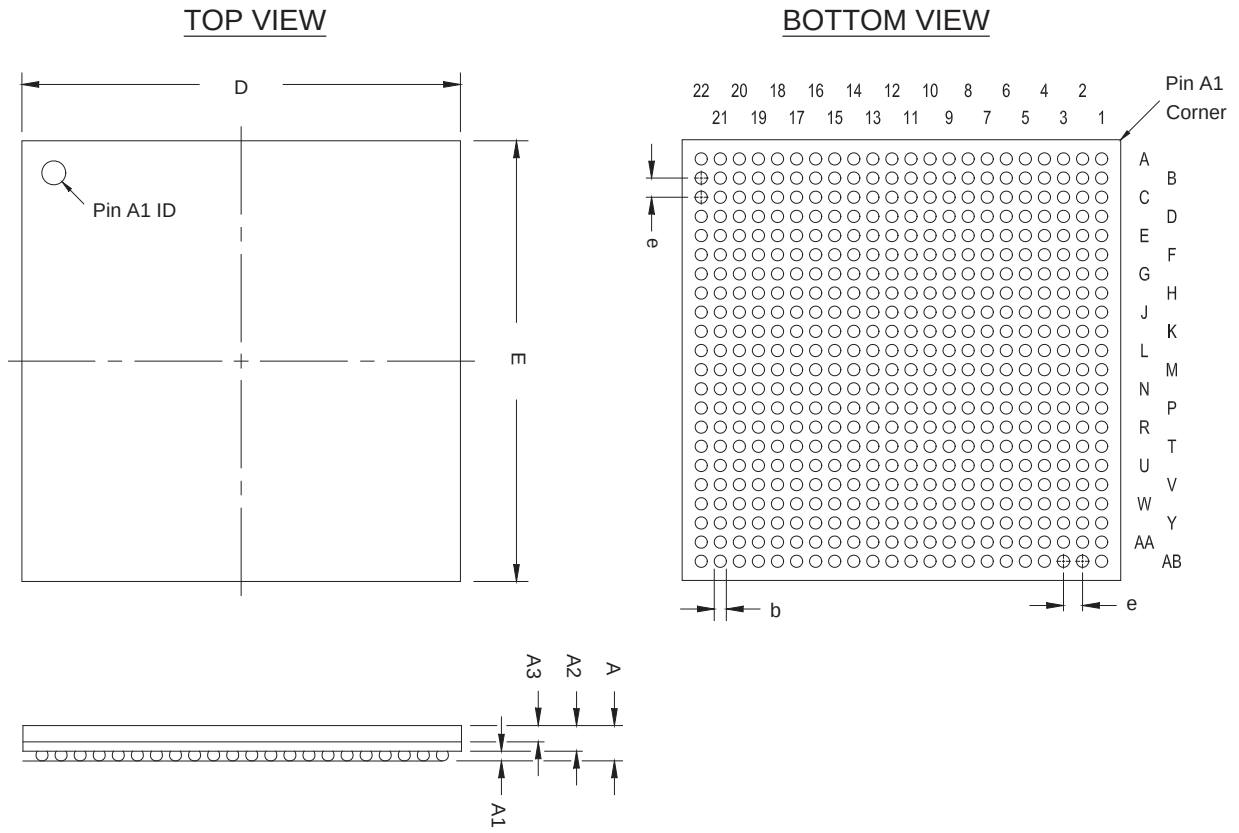
484-Pin Ultra FineLine Ball-Grid Array (UBGA) — Wire Bond

- 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



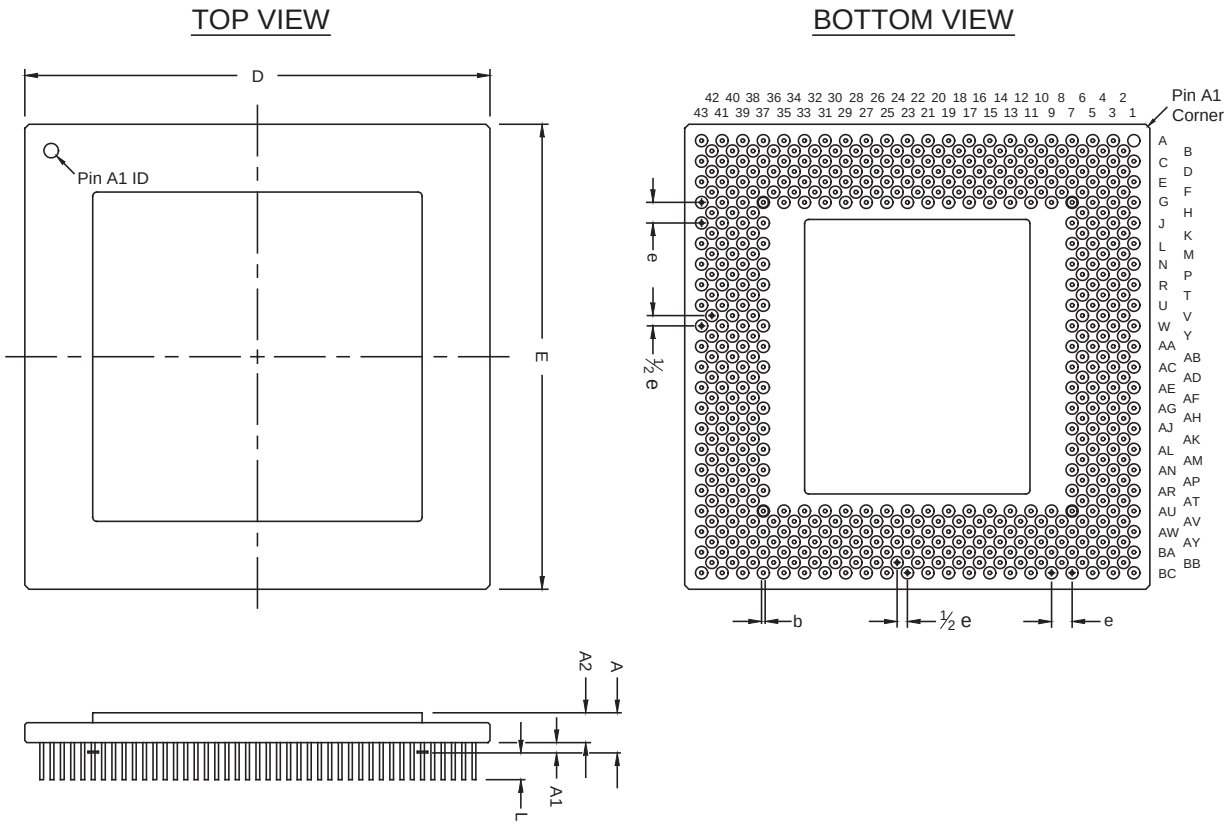
503-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



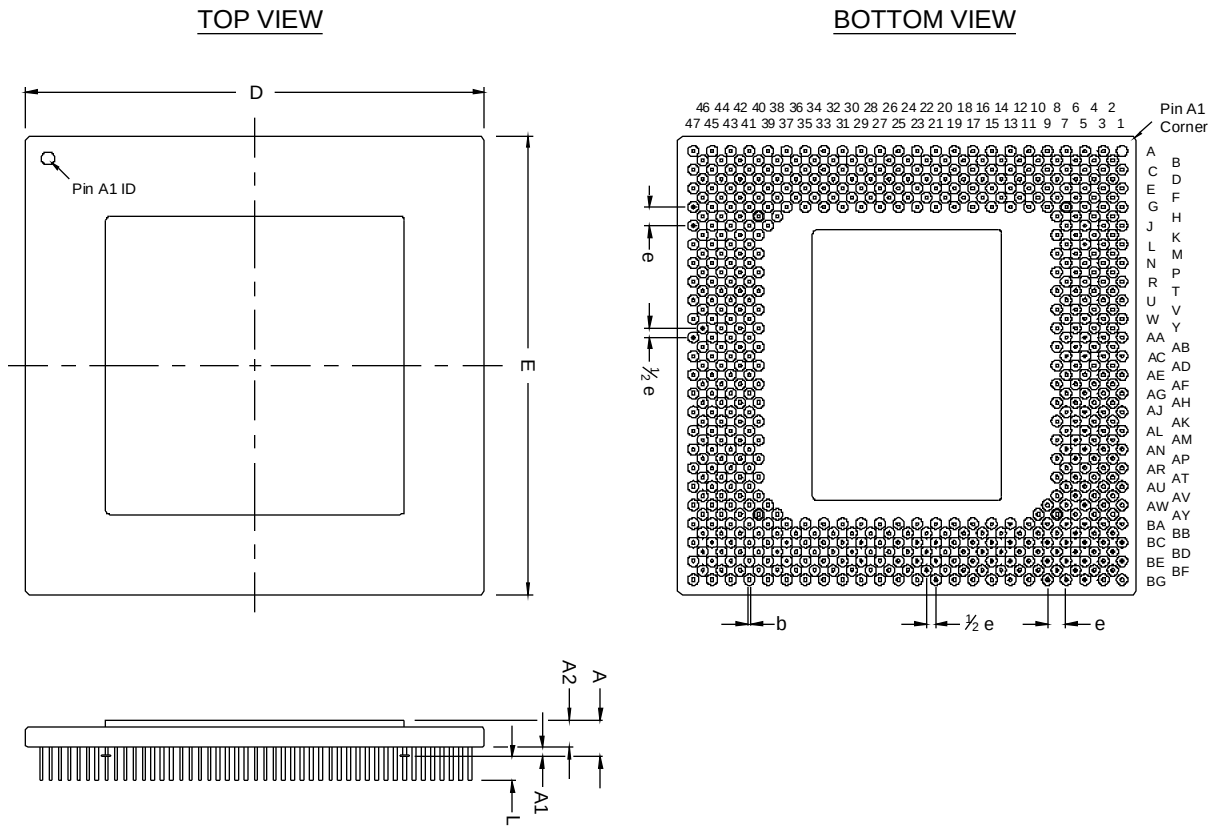
599-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



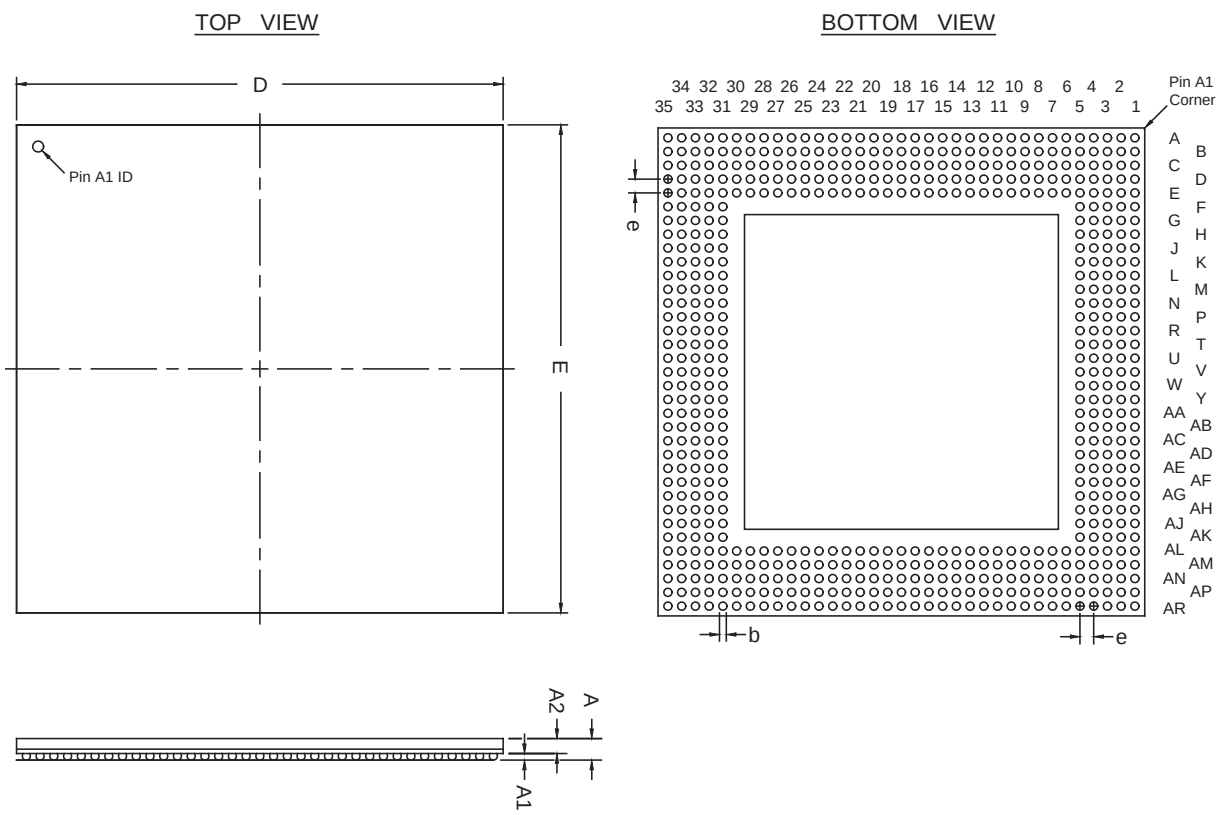
600-Pin Ball-Grid Array (BGA) — Wire Bond

- 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



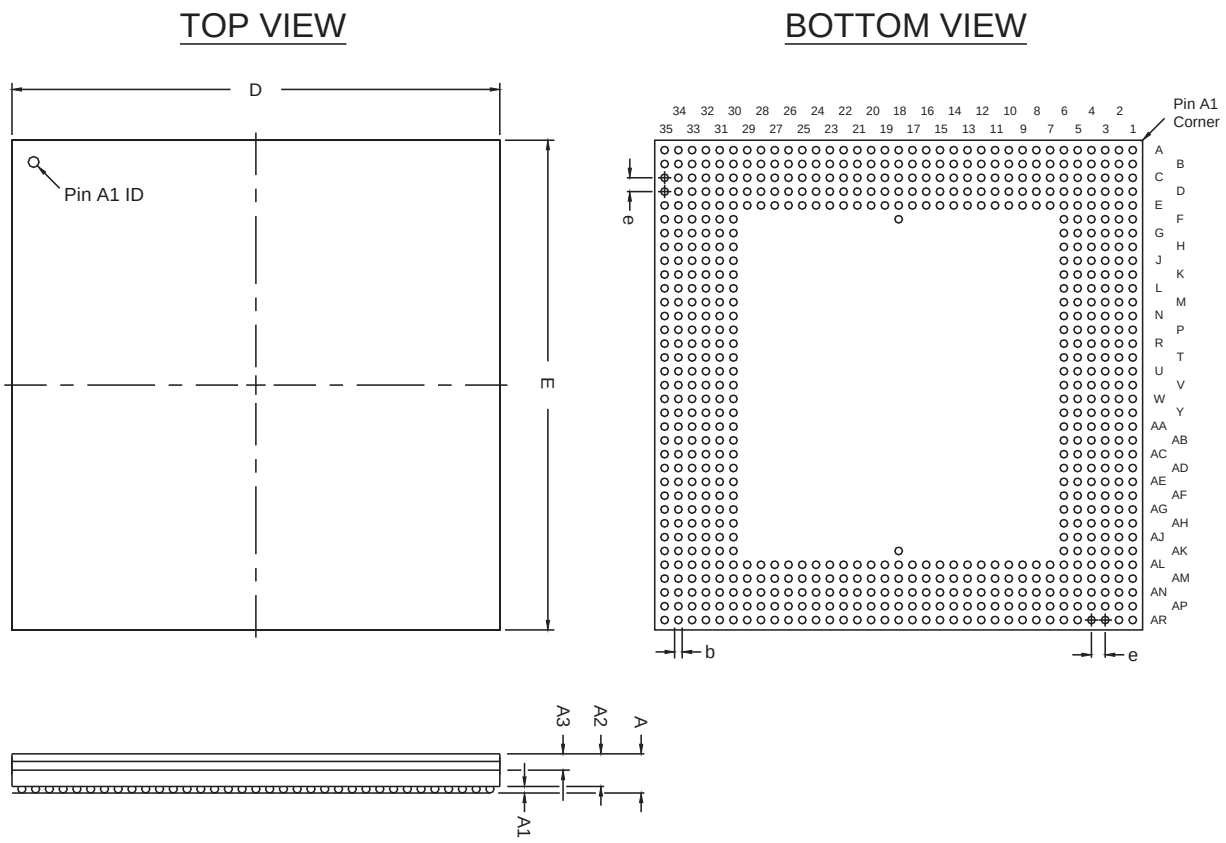
652-Pin Ball-Grid Array (BGA), Option 1 — Flip Chip

- 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



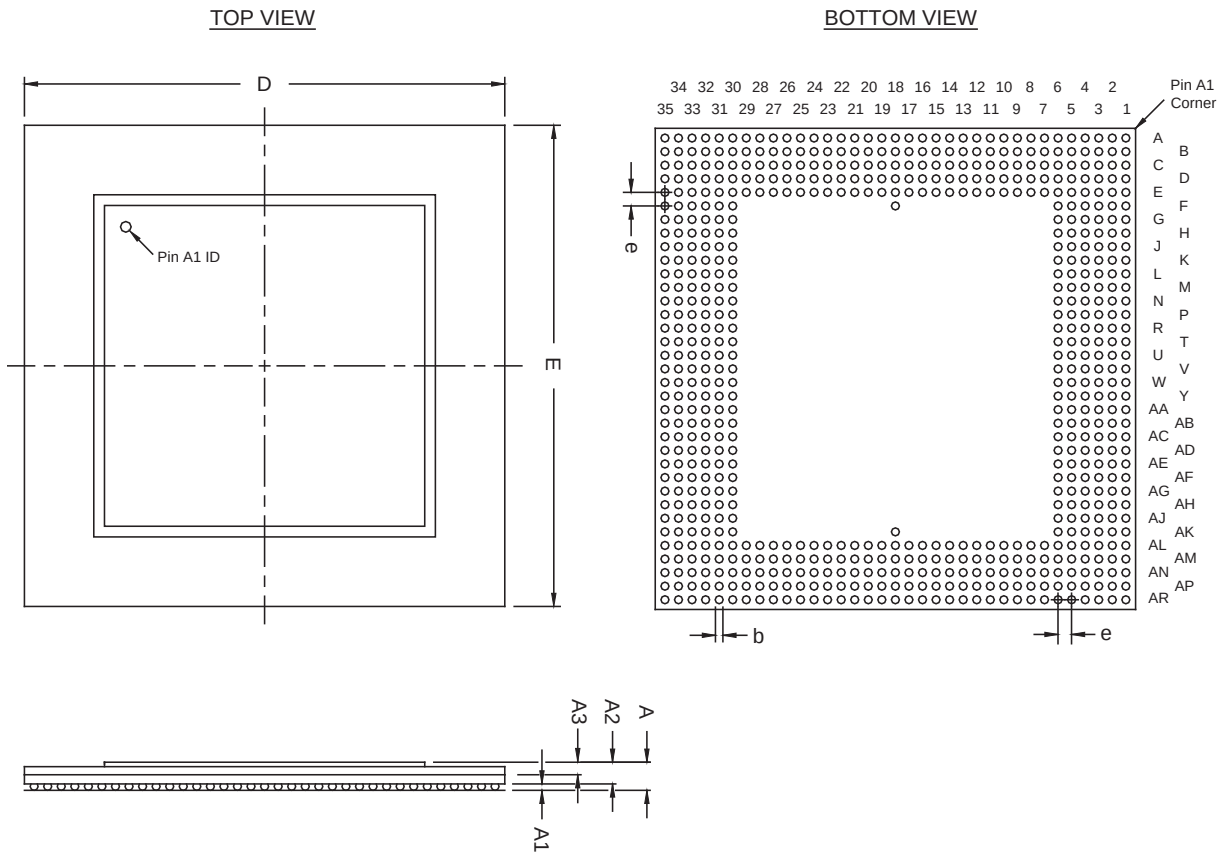
652-Pin Plastic Ball-Grid Array (BGA), Option 2 — Wire Bond

- 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.**
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



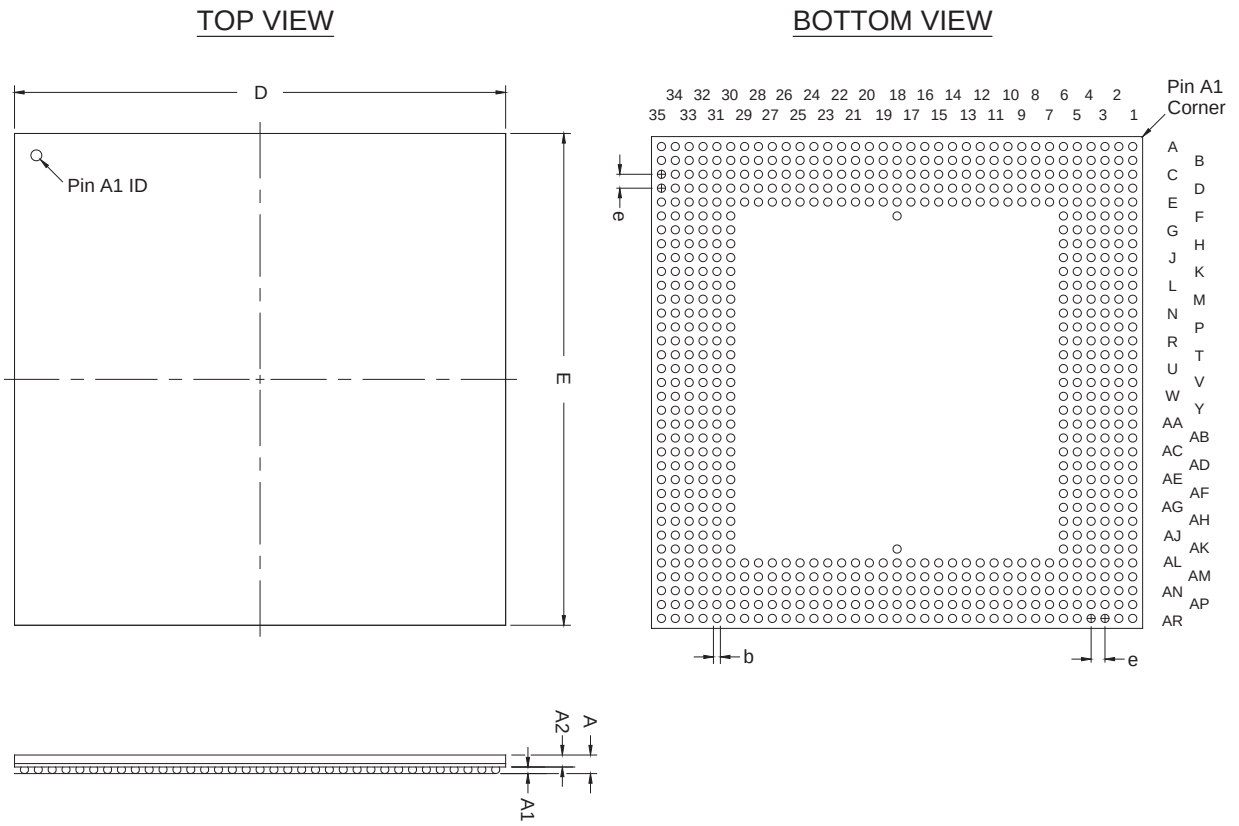
652-Pin Plastic Ball-Grid Array (BGA), Option 3 — Wire Bond

- 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



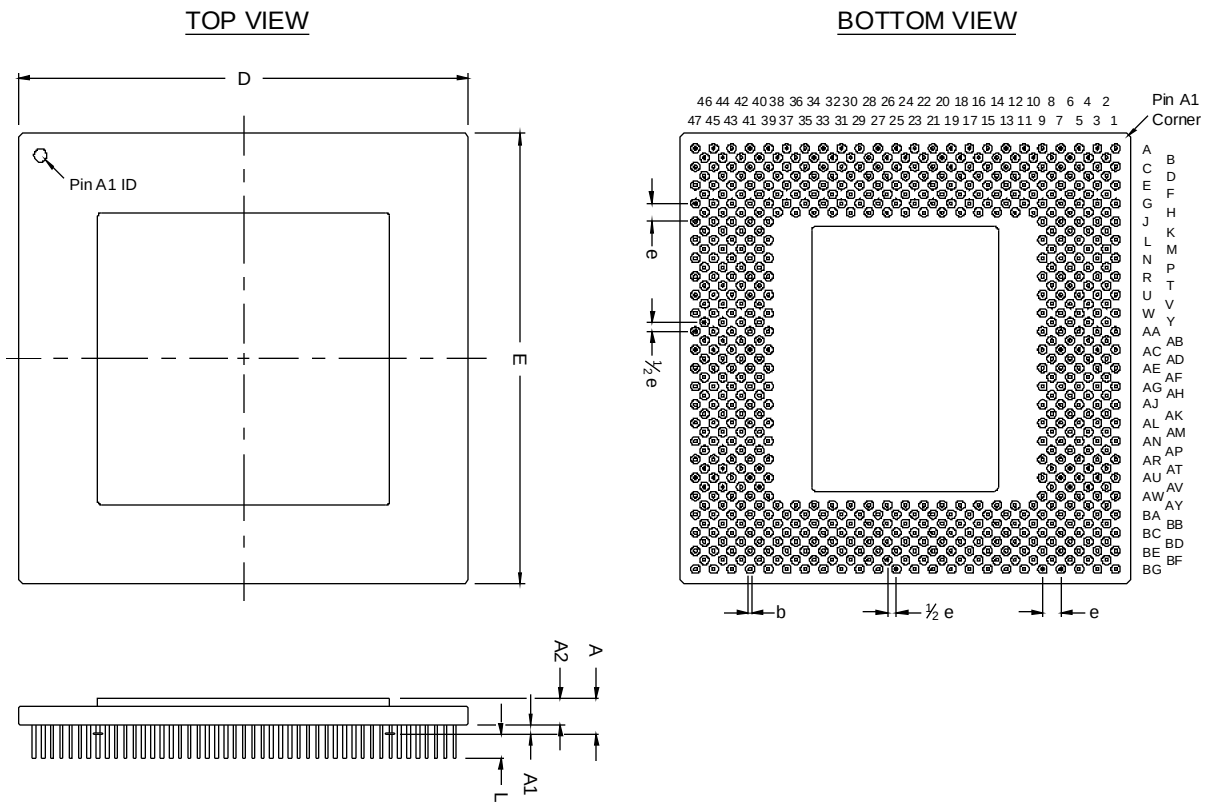
655-Pin Ceramic Pin-Grid Array (PGA) — Wire Bond

- 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



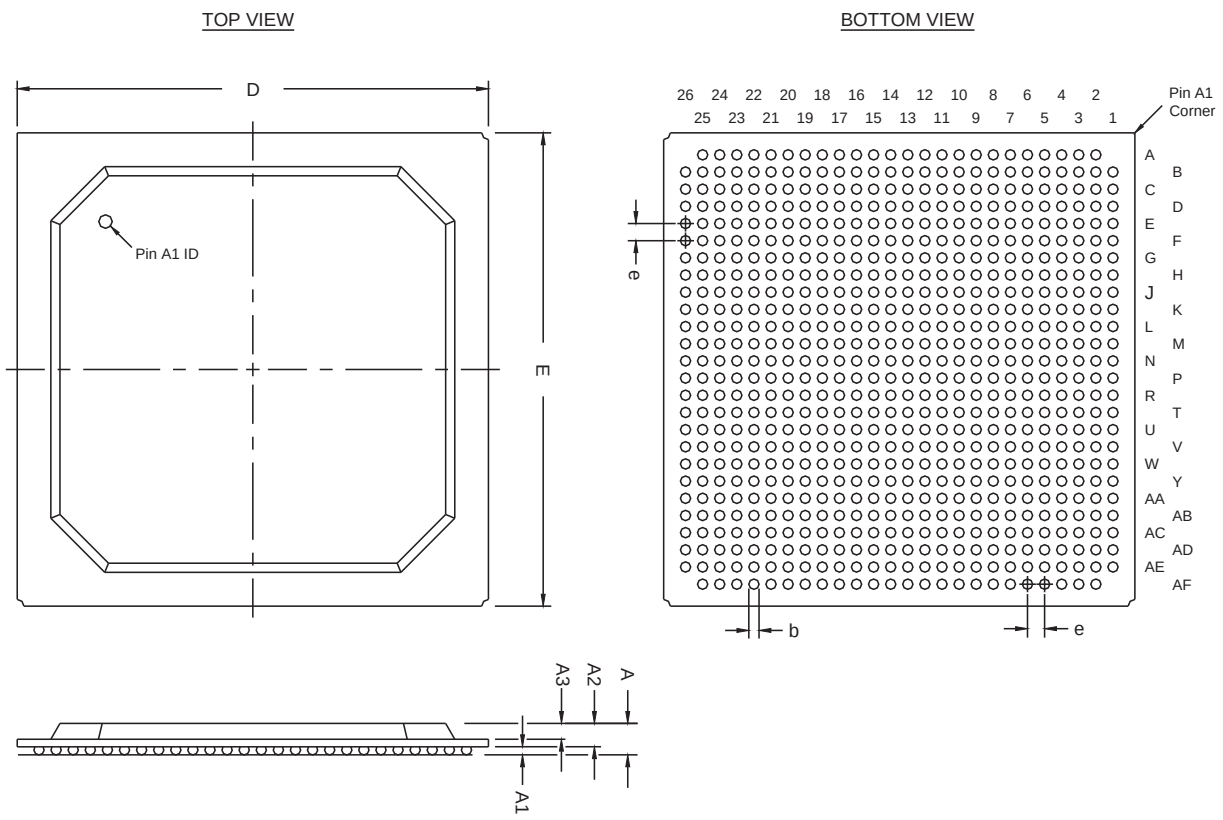
672-Pin Plastic Ball-Grid Array (BGA) — Wire Bond

- 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



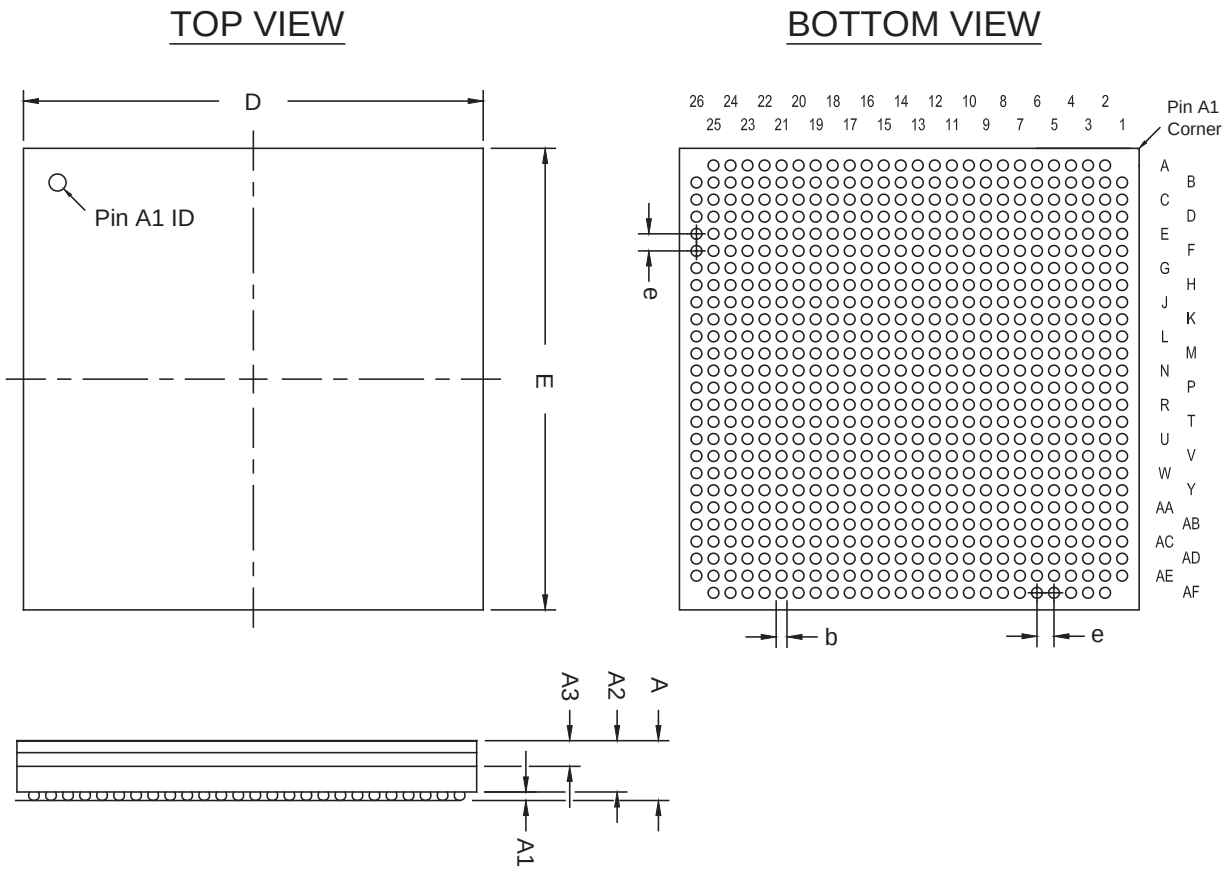
672-Pin FineLine Ball-Grid Array (FBGA), Option 1 — Flip Chip

- 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



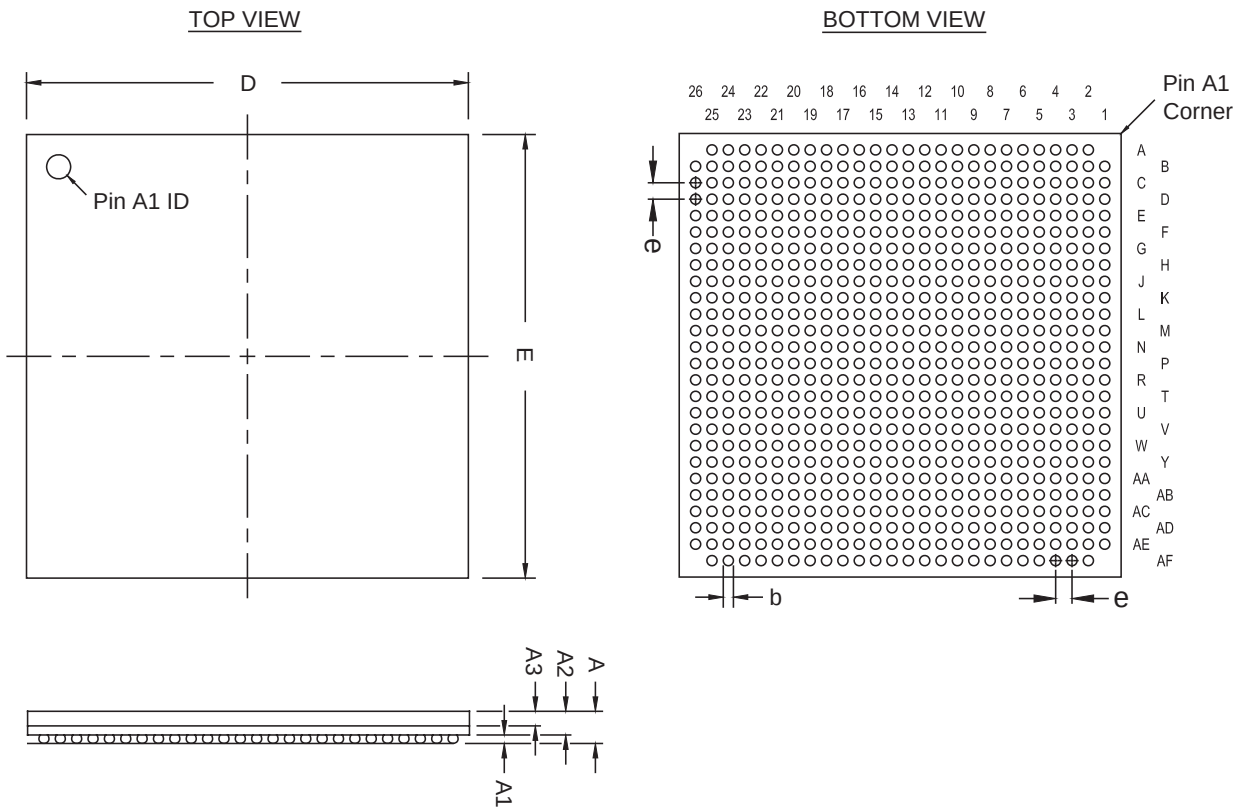
672-Pin FineLine Ball-Grid Array (FBGA), Option 2 — Wire Bond

- 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



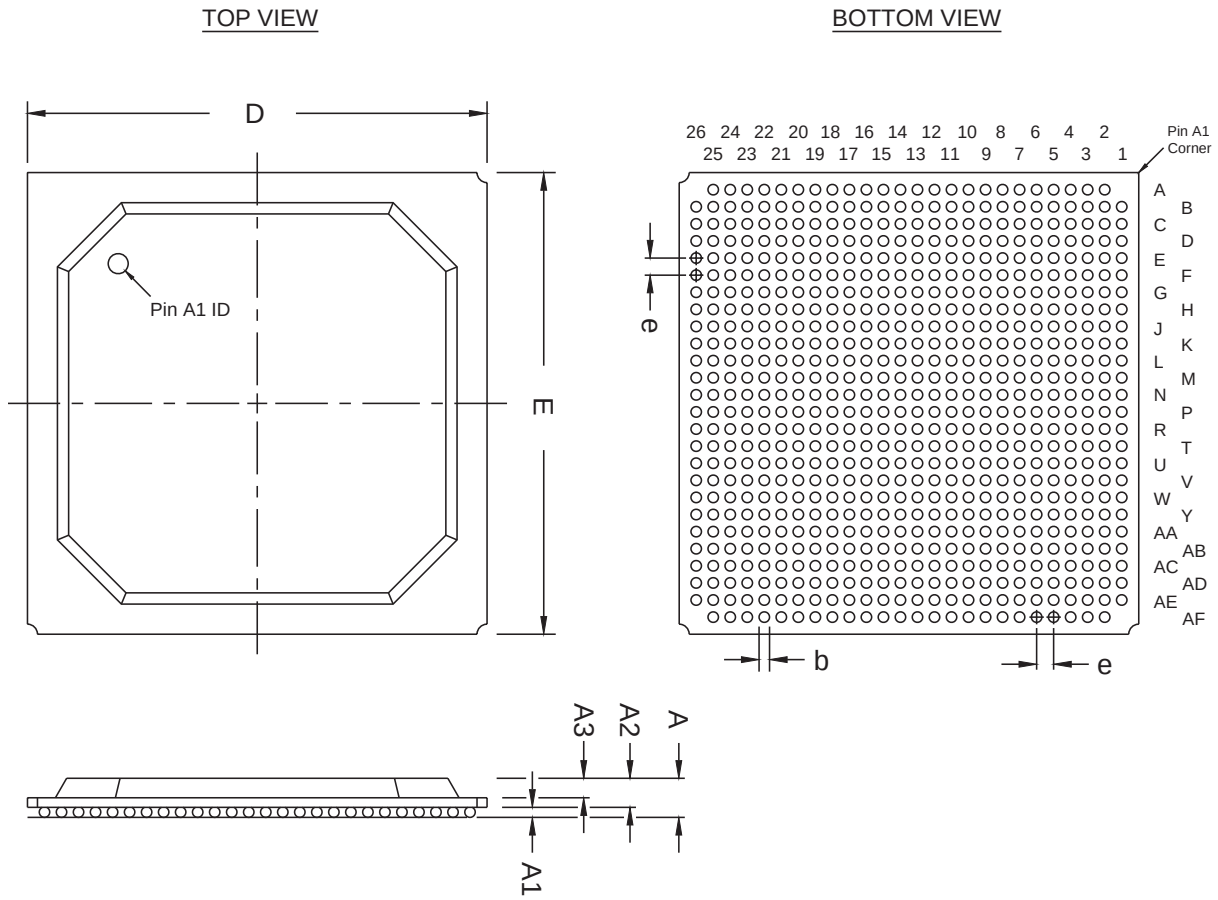
672-Pin FineLine Ball-Grid Array (FBGA), Option 3 — Wire Bond

- 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	**Inches**		
	Min.	**Nom.**	**Max.**
A	–	–	2.60
A1	0.30	–	–
A2	–	–	2.20
A3	–	–	1.80
D	27.00 BSC		
E	27.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

Package Outline



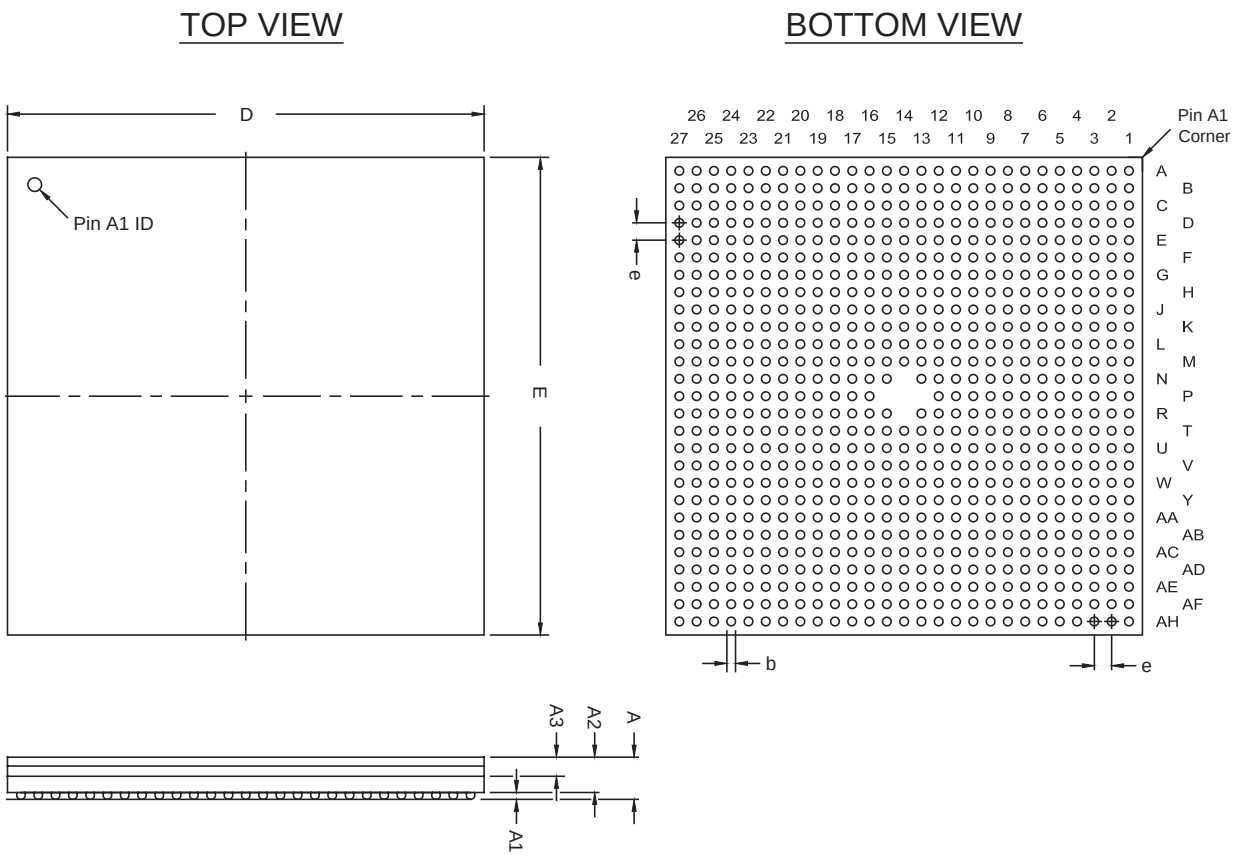
724-Pin Ball-Grid Array (BGA) — Flip Chip

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

Package Information	
Description	**Specification**
Ordering Code Reference	B
Package Acronym	BGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: BAR-1
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



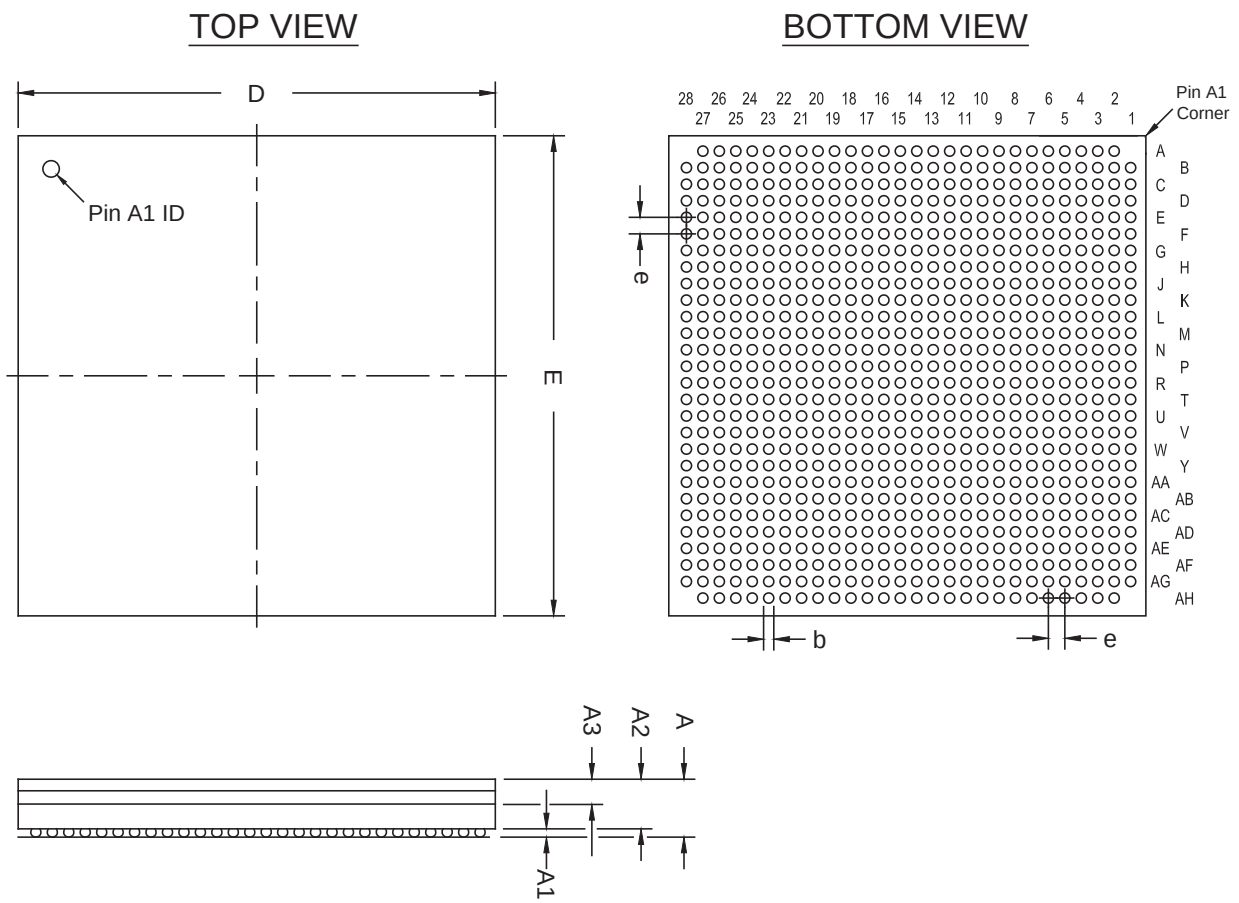
780-Pin FineLine Ball-Grid Array (FBGA), Option 1 — Flip Chip

- 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



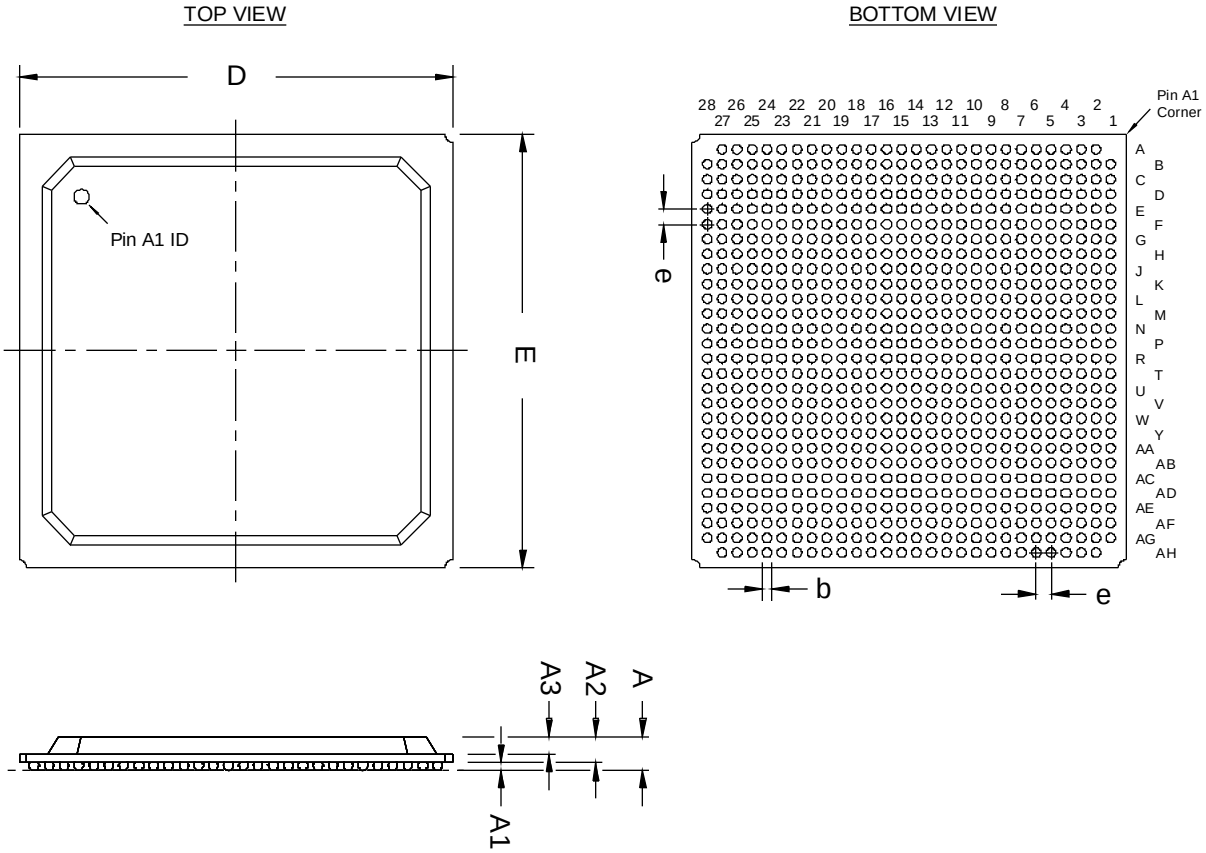
780-Pin FineLine Ball-Grid Array (FBGA), Option 2 — Wire Bond

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

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAM-1
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



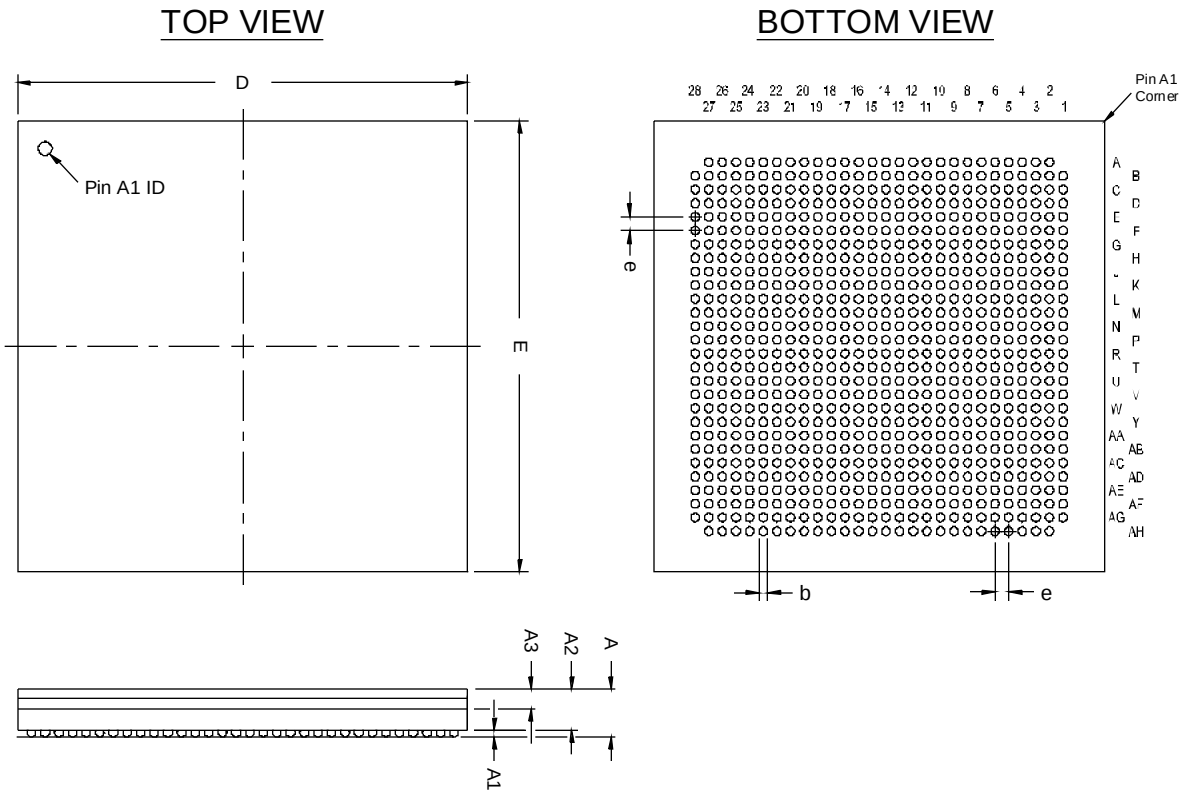
780-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip

- 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



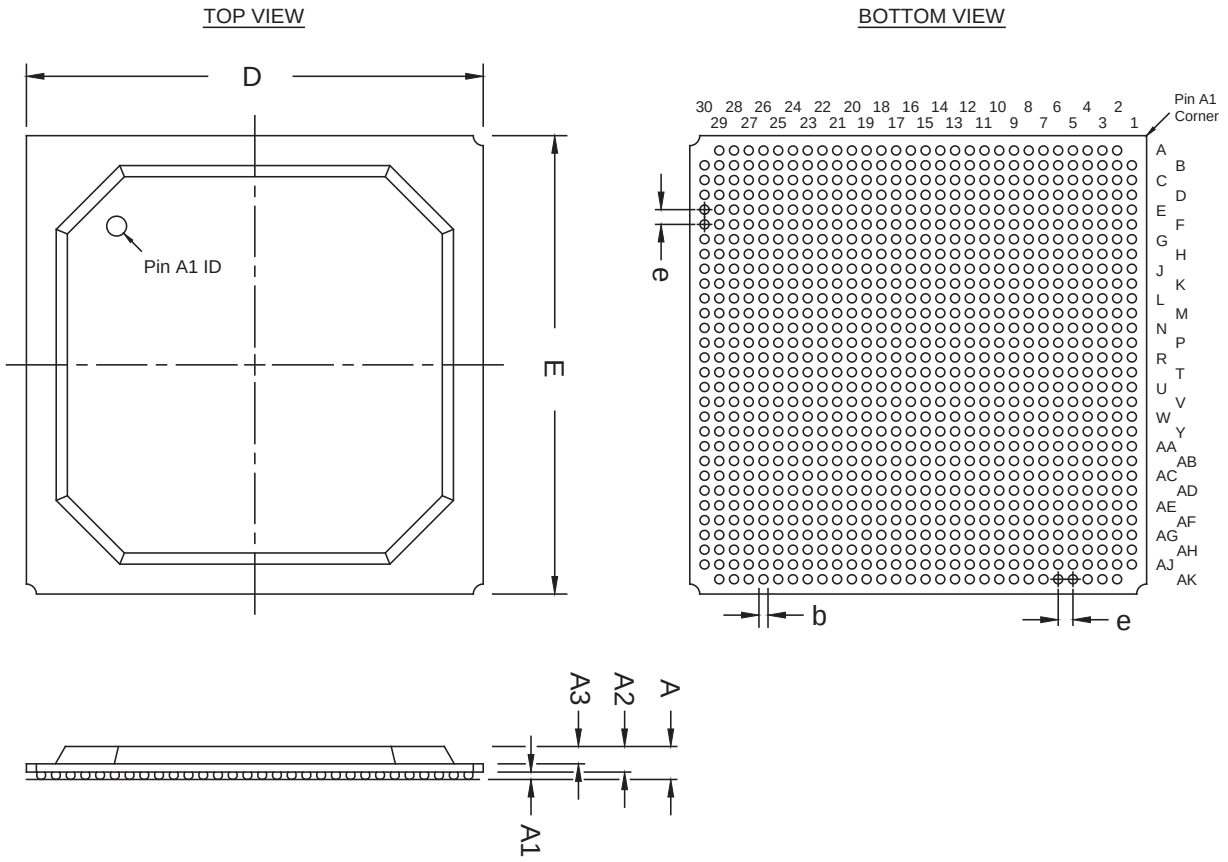
896-Pin FineLine Ball-Grid Array (FBGA) — Wire Bond

- 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



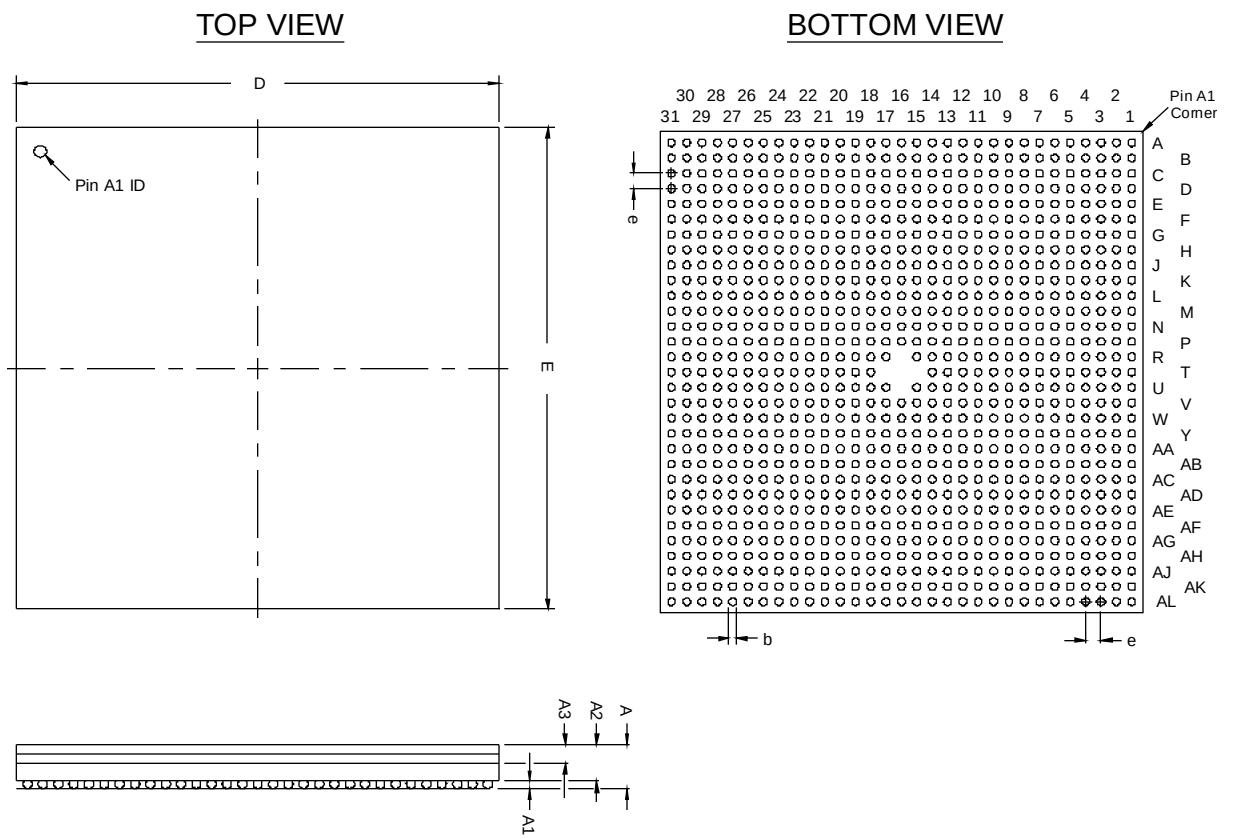
956-Pin Ball-Grid Array (BGA) — Flip Chip

- 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



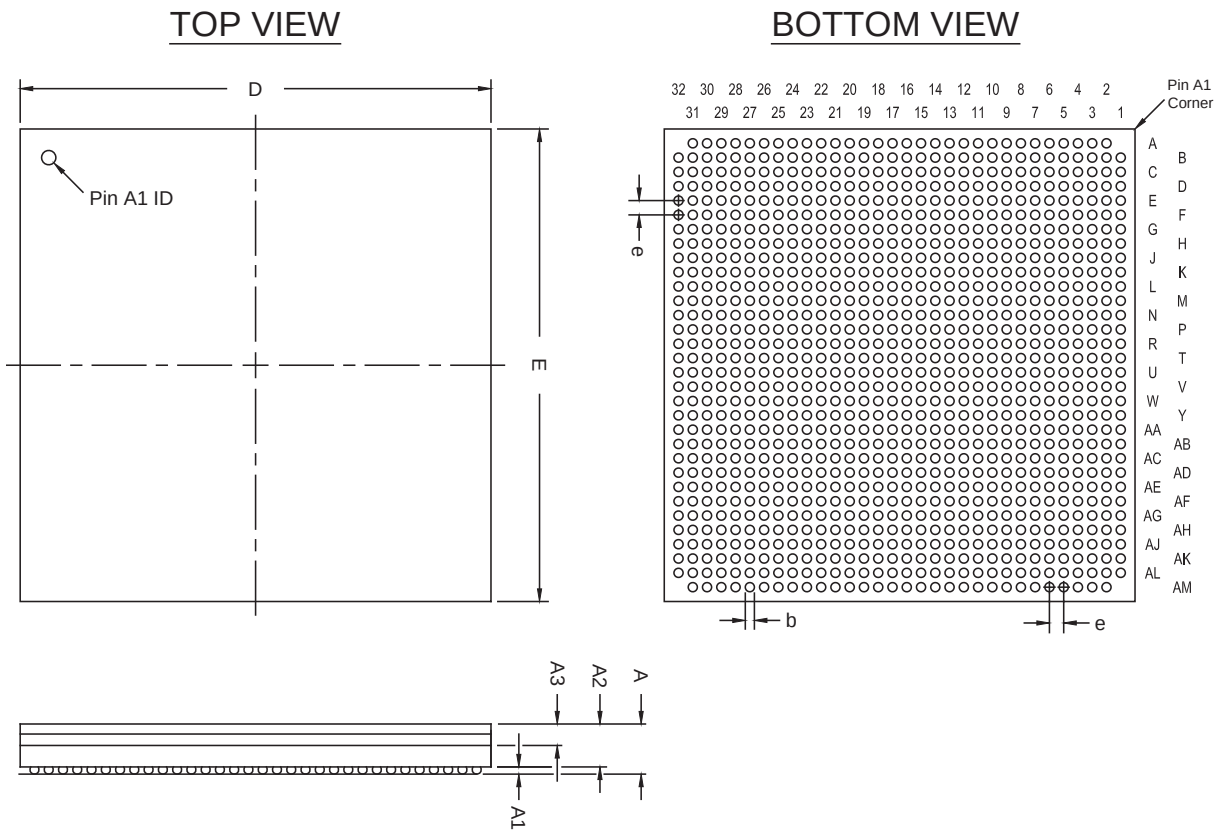
1020-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip

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

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAP-1
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



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

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

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAR-1
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)*, *(2)*
A1	0.30	–	–
A2	0.25	–	3.00 *(1)*, *(2)*
A3	–	–	2.50
D	35.00 BSC		
E	35.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

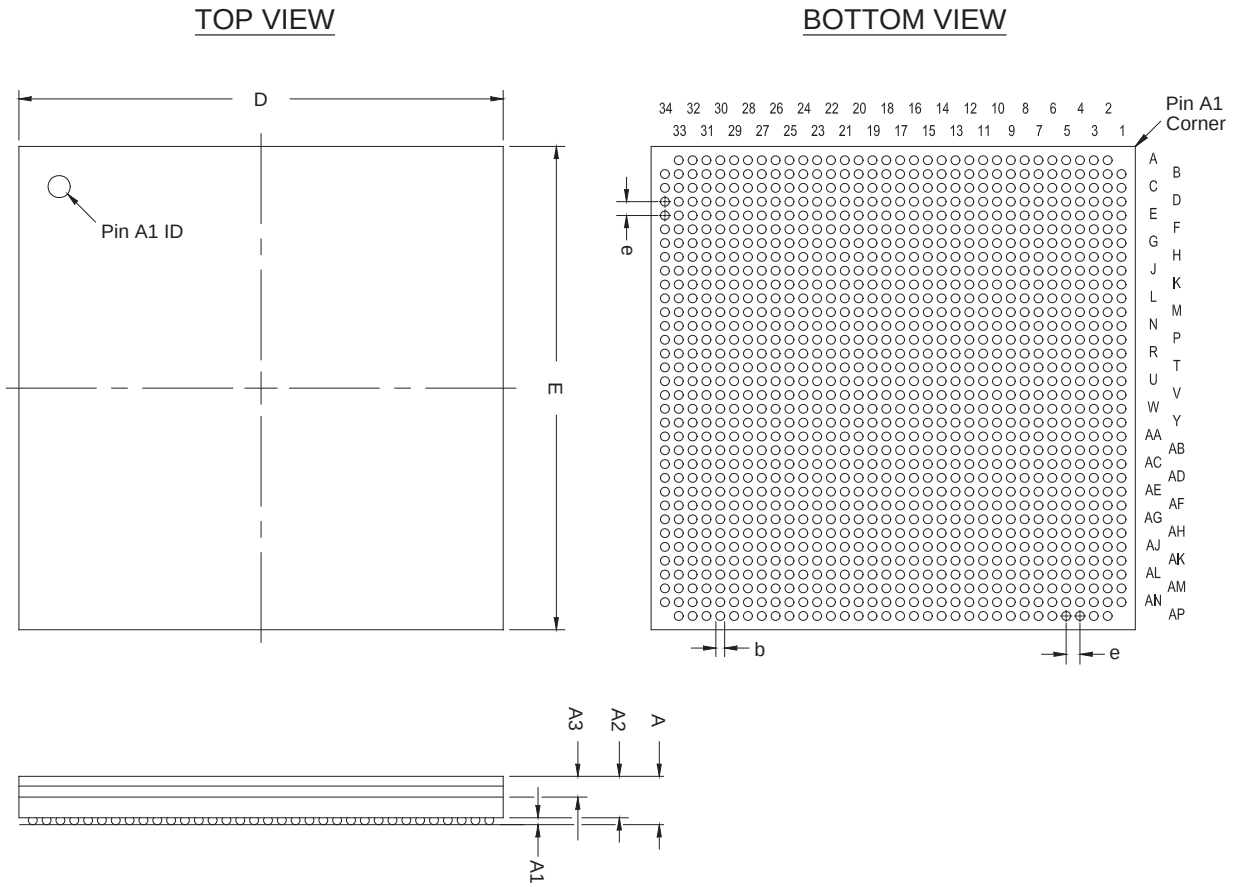
Notes:

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



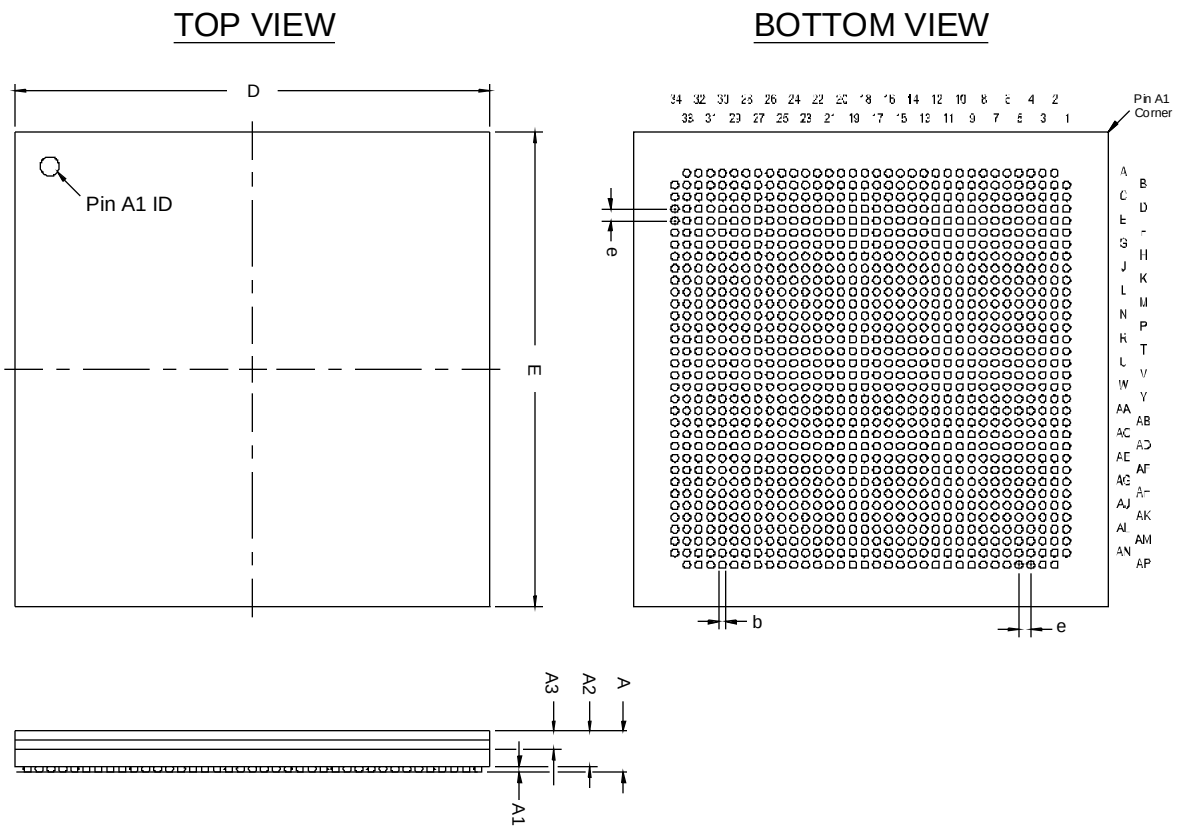
1152-Pin Hybrid FineLine Ball-Grid Array (HBGA) — Flip Chip

- 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: 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



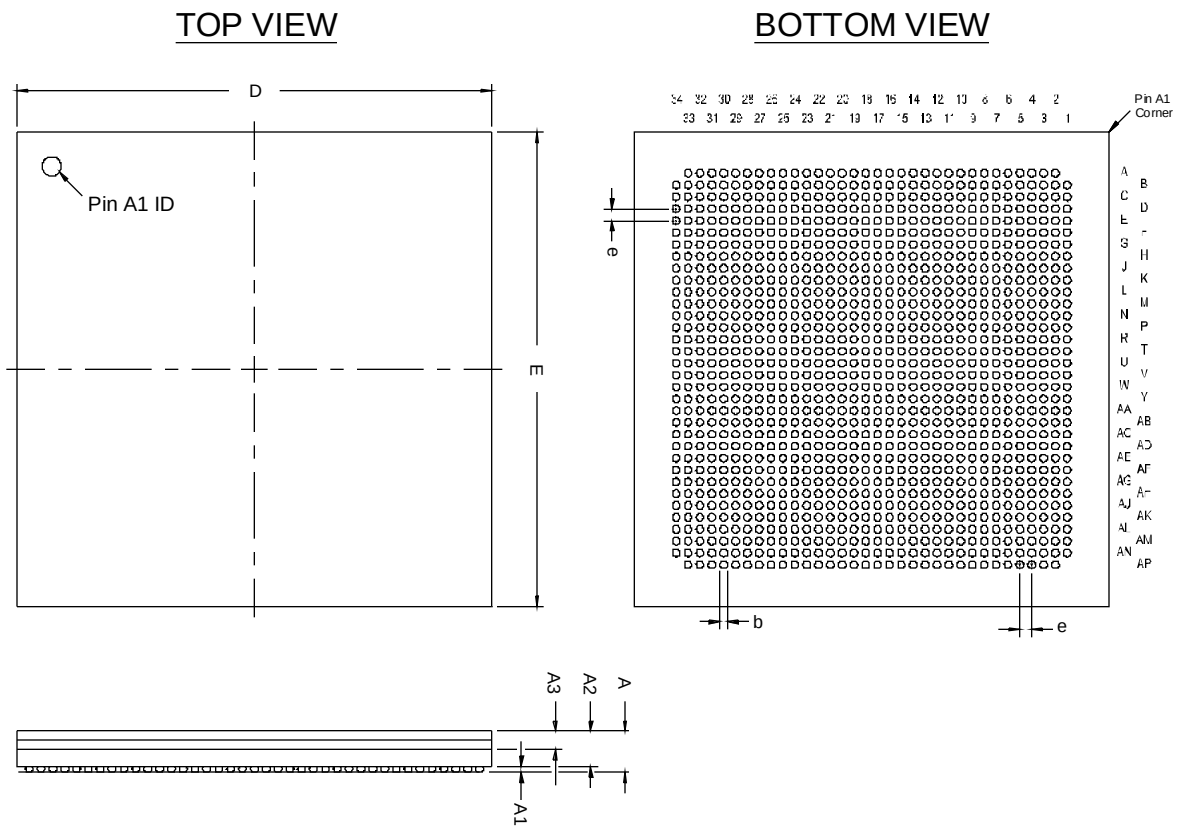
1152-Pin Hybrid FineLine Ball-Grid Array (HBGA), Option 2 — Flip Chip

- 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



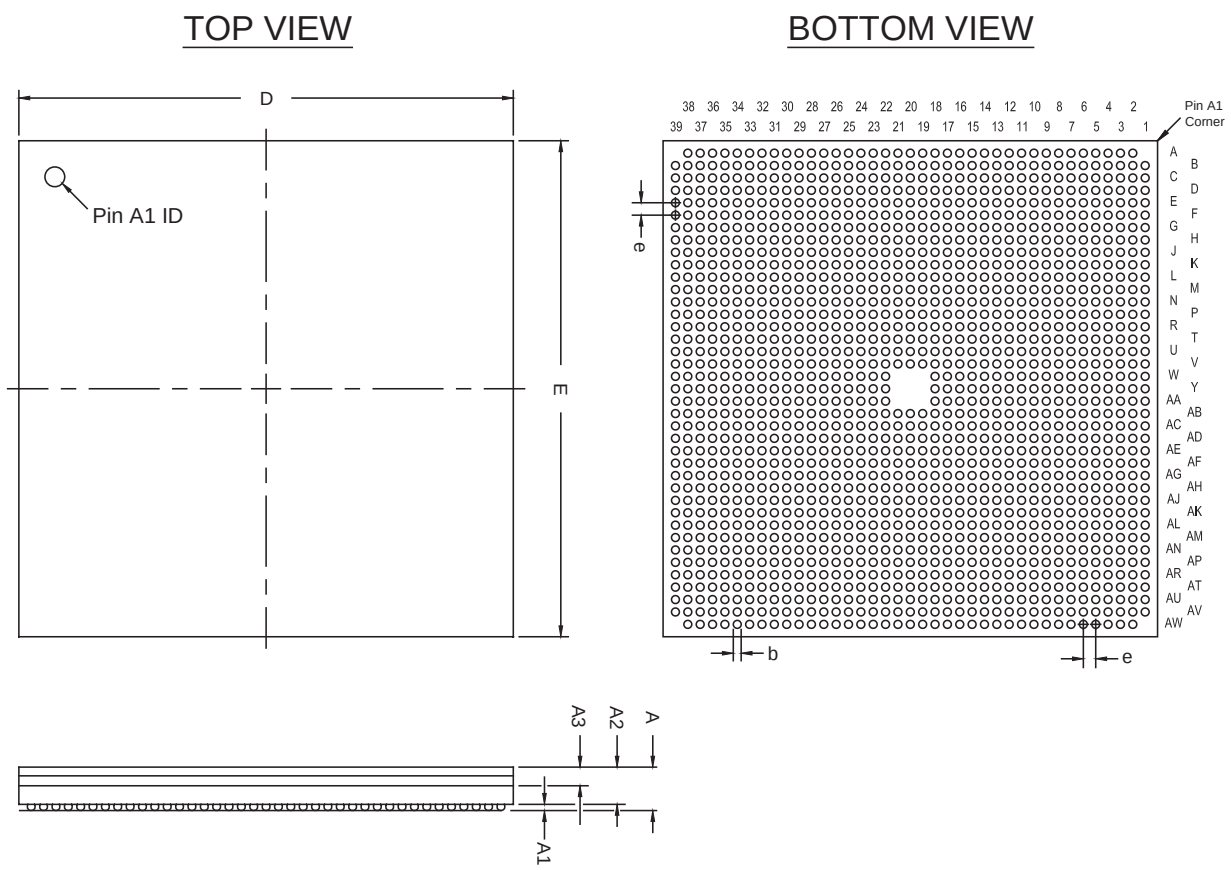
1508-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip

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

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



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

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

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)*, *(2)*
A1	0.30	–	–
A2	0.25	–	3.00 *(1)*, *(2)*
A3	–	–	2.50
D	40.00 BSC		
E	40.00 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

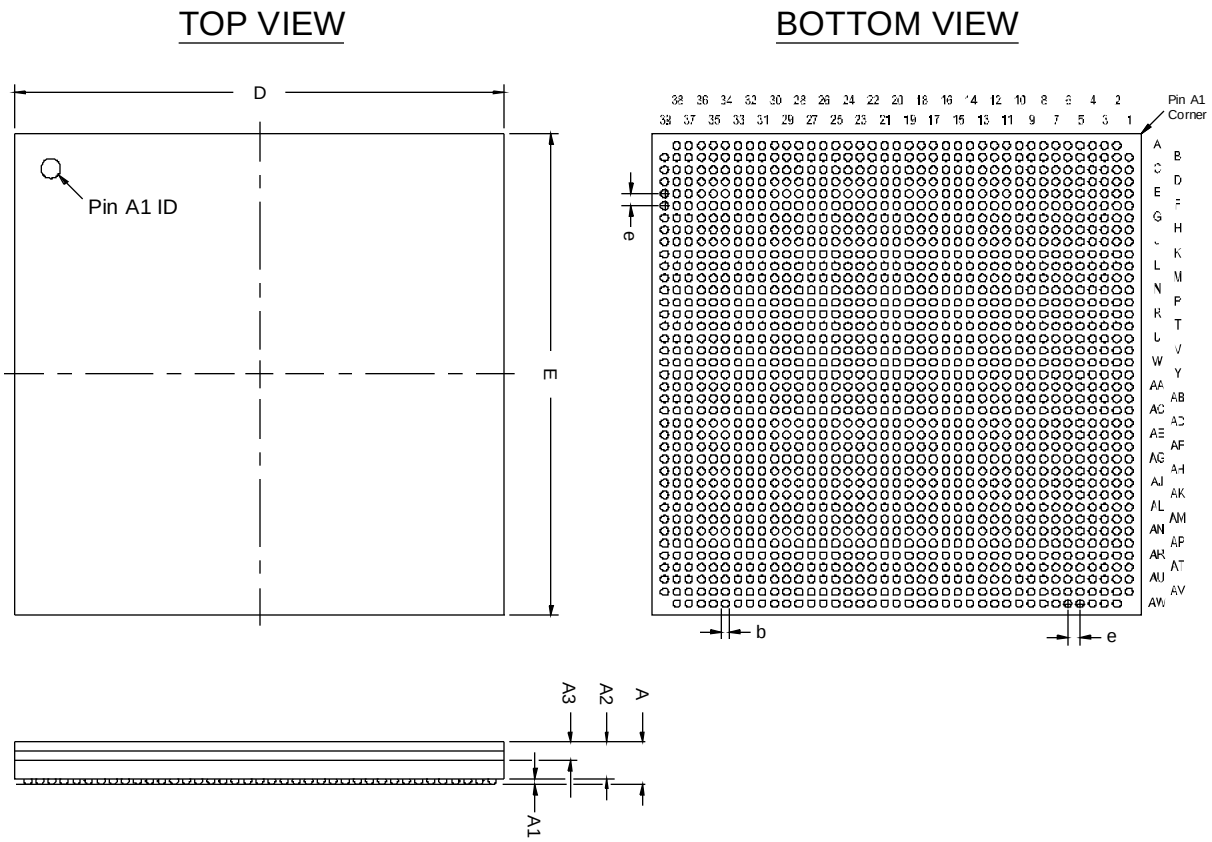
Notes:

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



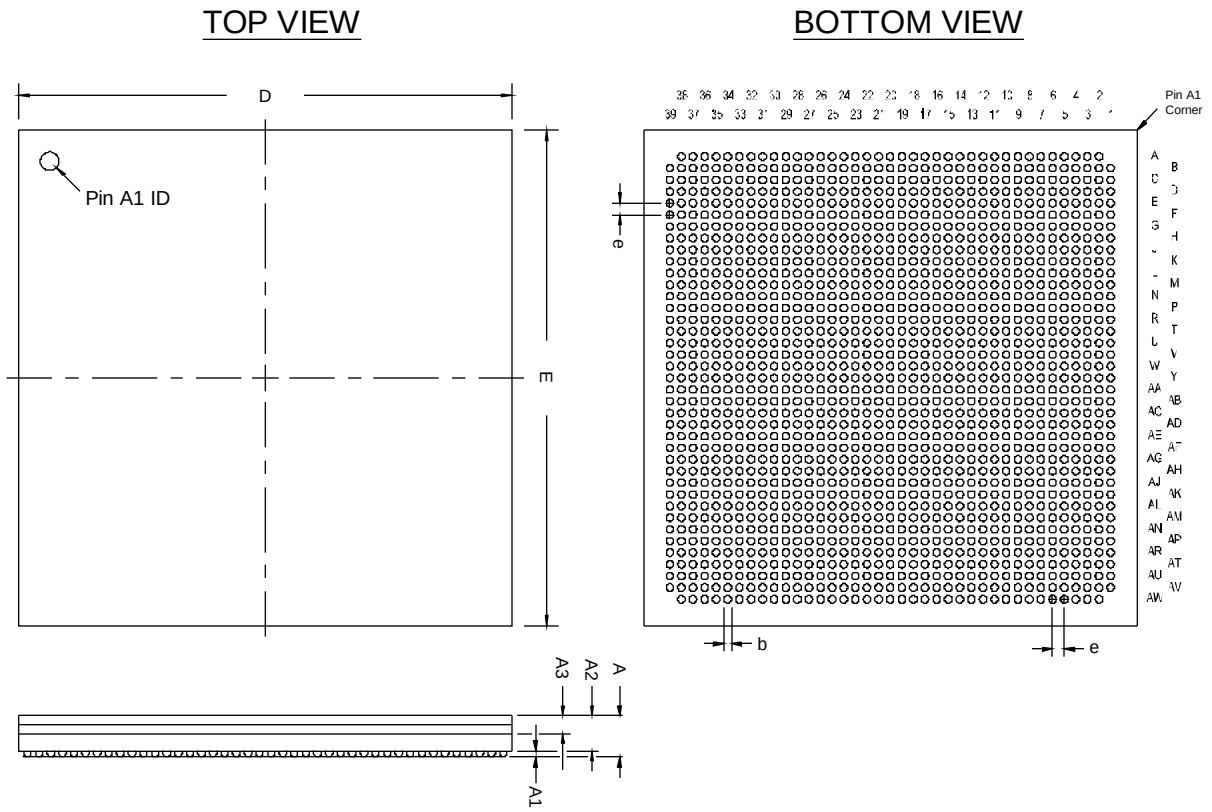
1517-Pin Hybrid FineLine Ball-Grid Array (FBGA) — Flip Chip

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

Package Information	
Description	**Specification**
Ordering Code Reference	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
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



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

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

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: AAV-1
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)*, *(2)*
A1	0.30	–	–
A2	0.25	–	3.00 *(1)*, *(2)*
A3	–	–	2.50
D	42.50 BSC		
E	42.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		

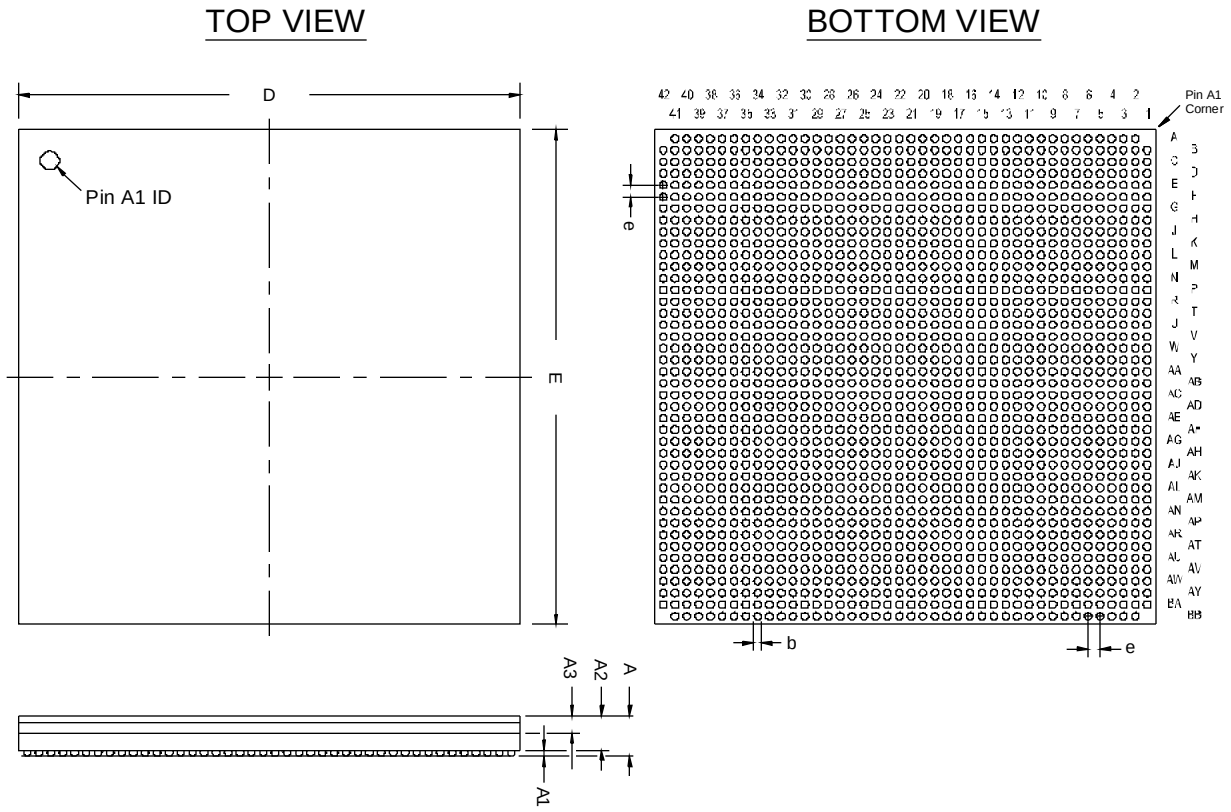
Notes:

For Stratix IV GX products:

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

(2) Package body thickness (Dimension “A2”) is 3.40 mm maximum.

Package Outline



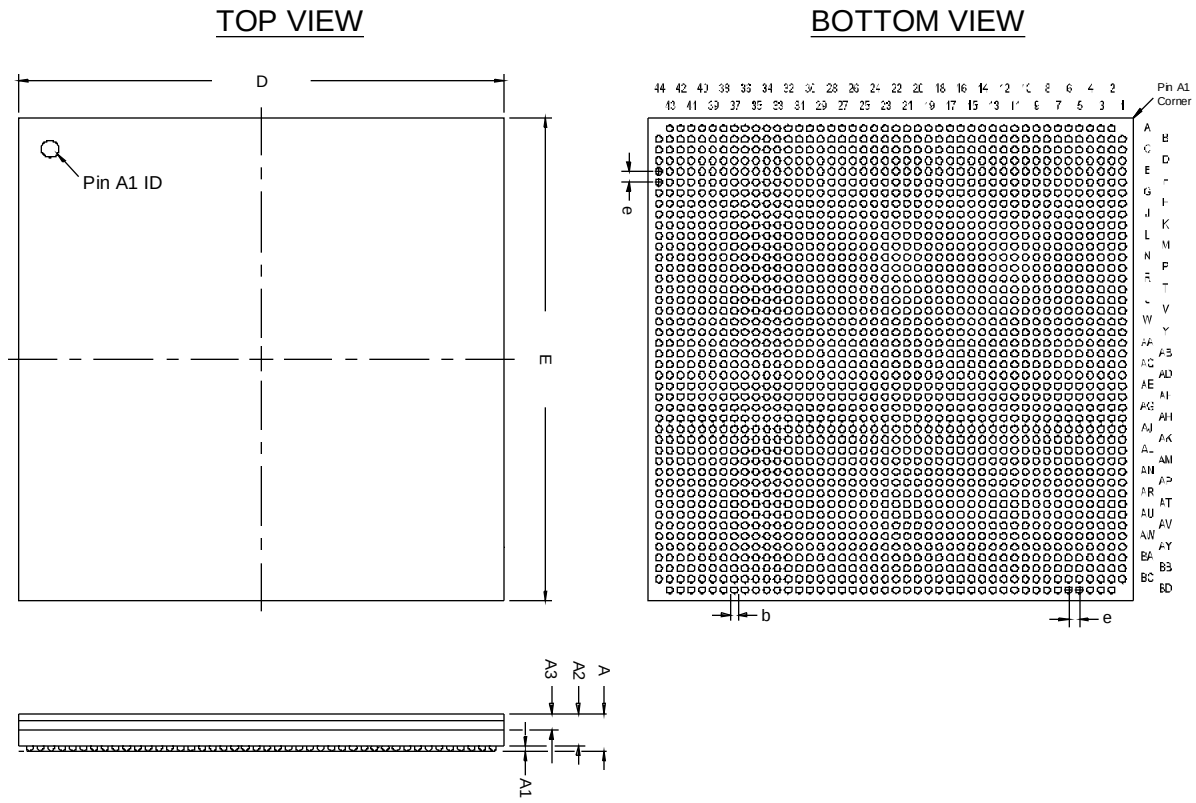
1932-Pin FineLine Ball-Grid Array (FBGA) — Flip Chip

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

Package Information	
Description	**Specification**
Ordering Code Reference	F
Package Acronym	FBGA
Substrate Material	BT
Solder Ball Composition	Regular: 63Sn:37Pb (Typ.) Pb-free: Sn:3Ag:0.5Cu (Typ.)
JEDEC Outline Reference	MS-034 Variation: 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



Additional Information

This section contains revision history and contact information.

Revision History

Table 46 shows the revision history for this document.

Table 46. Document Revision History *(1)* (Part 1 of 2)

Date and Document Version	Changes Made	Summary of Changes
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 46. Document Revision History *(1)* (Part 2 of 2)

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 46:

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

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