Understanding Embedded - CPLDs (Complex Programmable Logic Devices)

Embedded - CPLDs, or Complex Programmable Logic Devices, are highly versatile digital logic devices used in electronic systems. These programmable components are designed to perform complex logical operations and can be customized for specific applications. Unlike fixed-function ICs, CPLDs offer the flexibility to reprogram their configuration, making them an ideal choice for various embedded systems. They consist of a set of logic gates and programmable interconnects, allowing designers to implement complex logic circuits without needing custom hardware.

Applications of Embedded - CPLDs

Details	
Product Status	Obsolete
Programmable Type	EE PLD
Delay Time tpd(1) Max	10 ns
Voltage Supply - Internal	4.75V ~ 5.25V
Number of Logic Elements/Blocks	-
Number of Macrocells	10
Number of Gates	-
Number of I/O	-
Operating Temperature	0°C ~ 75°C (TA)
Mounting Type	Through Hole
Package / Case	24-DIP (0.300", 7.62mm)
Supplier Device Package	24-PDIP
Purchase URL	https://www.e-xfl.com/product-detail/lattice-semiconductor/gal20ra10b-10lp

30-Ball WLSC Package

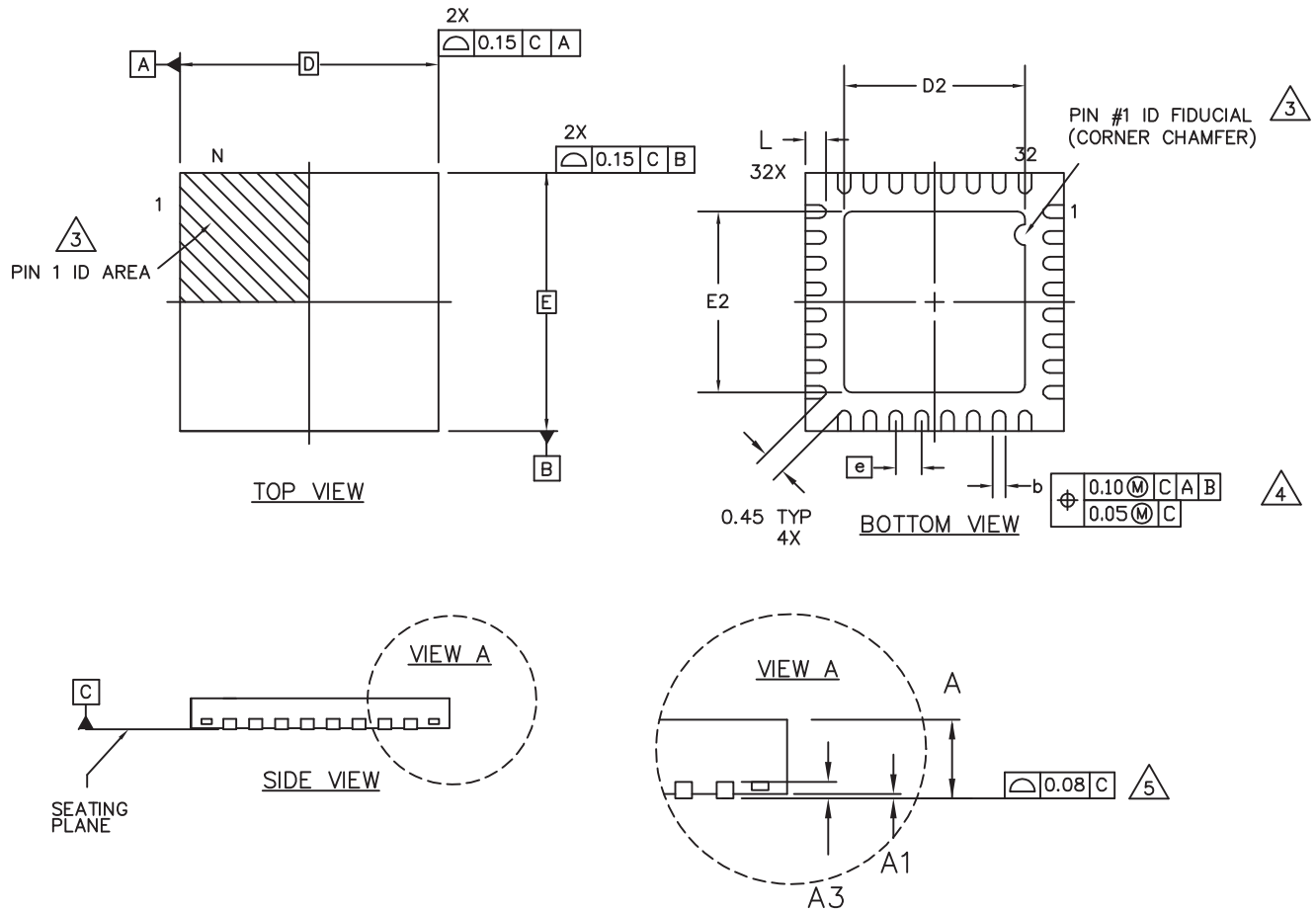Dimensions in Millimeters
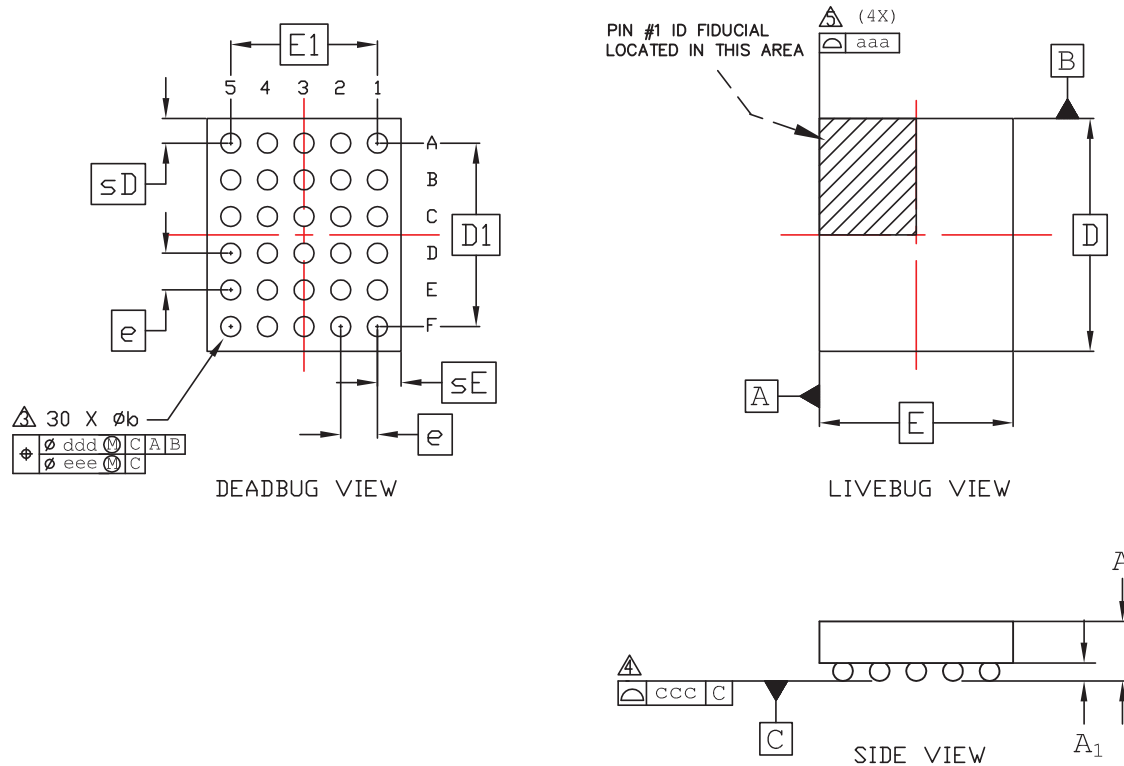
DEADBUG VIEW

LIVEBUG VIEW

SIDE VIEW

Notes:
1 ALL DIMENSIONS AND TOLERANCE PER ASME Y 14.5M − 1994.
2 ALL DIMENSIONS ARE IN MILLIMETERS.
3 DIMENSION "b" IS MEASURED AT THE MAXIMUM BUMP DIAMETER PARALLEL TO PRIMARY DATUM C.
4 PRIMARY DATUM C AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BUMPS.
5 BILATERAL TOLERANCE ZONE IS APPLIED TO EACH SIDE OF THE PACKAGE BODY.

REF.	Min.	Nom.	Max.
A	–	–	0.600
A1	0.140	–	–
b	0.230	0.260	0.290
D	2.537 BSC		
E	2.114 BSC		
D1	2.00 BSC		
E1	1.60 BSC		
e	0.40 BSC		
sD	–	0.26	–
sE	–	0.27	–
aaa	0.030		
ccc	0.050		
ddd	0.015		
eee	0.050		

32-Pin QFN Package Option 3: MachXO2 SG32C

Dimensions in Millimeters

TOP VIEW

BOTTOM VIEW

SIDE VIEW

VIEW A

```
NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
     PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3.   EXACT SHAPE AND SIZE OF THIS
     FEATURE IS OPTIONAL.

4.   DIMENSION b APPLIES TO PLATED
     TERMINAL AND IS MEASURED BETWEEN
     0.15 AND 0.30 mm FROM TERMINAL TIP.

5.   APPLIES TO EXPOSED PORTION OF TERMINALS.

6.   JEDEC REFERENCE MO-248 AND DR-4.2
```

SYMBOL	MIN.	NOM.	MAX.
A	0.50	0.55	0.65
A1	0.00	0.02	0.05
A3	0.2 REF		
D	5.0 BSC		
D2	3.40	3.50	3.60
E	5.0 BSC		
E2	3.40	3.50	3.60
b	0.18	0.25	0.30
e	0.50 BSC		
L	0.35	0.40	0.45

36-Ball ucfBGA Package: iCE40 Ultra™

Dimensions in Millimeters

TOP VIEW

4X

BOTTOM VIEW

b ø

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES
    PER ANSI Y14.5M.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSION "b" IS MEASURED AT THE
    MAXIMUM SOLDER BALL DIAMETER,
    PARALLEL TO PRIMARY DATUM [C]

4. PRIMARY DATUM [C] AND SEATING
    PLANE ARE DEFINED BY THE SPHERICAL
    CROWNS OF THE SOLDER BALLS.

5. BILATERAL TOLERANCE ZONE IS APPLIED
    TO EACH SIDE OF THE PACKAGE BODY.

6. EXACT SHAPE AND SIZE OF THIS FEATURE
    IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	0.81	0.91
A1	0.12	–	–
A2	–	–	0.70
D/E	2.50 BSC		
M/N	2.00 BSC		
S	0.20 BSC		
b	0.20	0.25	0.30
e	0.40 BSC		
aaa	–	–	0.10
bbb	–	–	0.10
ddd	–	–	0.10

36-Ball WLCS Package Option 2: MachXO3™

Dimensions in Millimeters
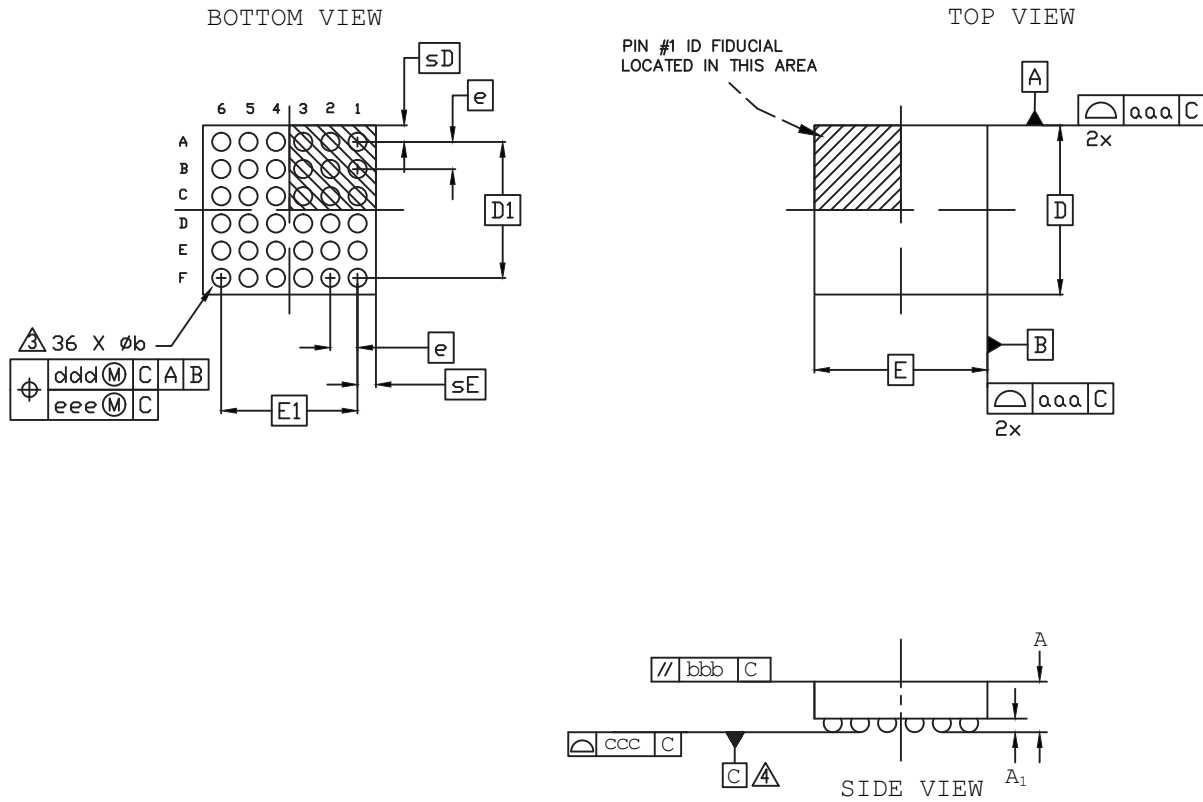
BOTTOM VIEW

TOP VIEW

PIN #1 ID FIDUCIAL
LOCATED IN THIS AREA

SIDE VIEW

NOTES:

1. ALL DIMENSIONS AND TOLERANCE PER ASME Y 14.5M – 1994.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

⚠ DIMENSION "b" IS MEASURES AT THE MAXIMUM BUMP DIAMETER
PARALLEL TO PRIMARY DATUM C.

⚠ PRIMARY DATUM C AND SEATING PLANE ARE DEFINED BY THE
SPHERICAL CROWNS OF THE SOLDER BUMPS.

REF.	Min.	Nom.	Max.
A	0.510	0.543	0.576
A1	0.167	0.196	0.225
b	0.239	0.266	0.319
D		2.487 BSC	
E		2.541 BSC	
D1		2.00 BSC	
E1		2.00 BSC	
e		0.40 BSC	
sD	–	0.244	–
sE	–	0.271	–
aaa		0.025	
bbb		0.060	
ccc		0.030	
ddd		0.0150	
eee		0.050	

48-Pin TQFP Package (1.0 mm thick)

Dimensions in Millimeters
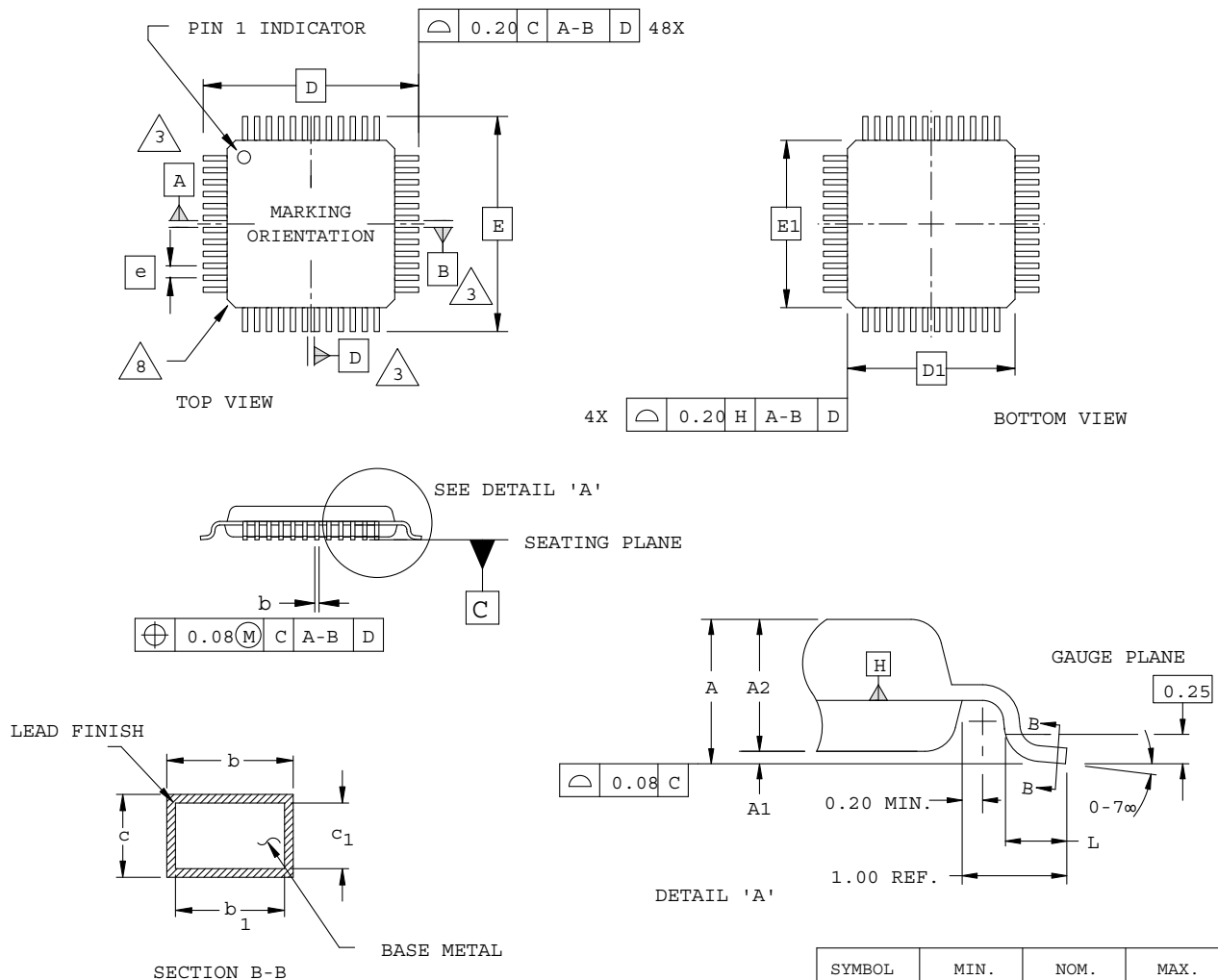
PIN 1 INDICATOR

⌒ 0.20 C A-B D 48X

D

3

A

MARKING
ORIENTATION

e

B

E

3

8

D

3

TOP VIEW

E1

D1

4X ⌒ 0.20 H A-B D

BOTTOM VIEW

SEE DETAIL 'A'

SEATING PLANE

b

C

⊕ 0.08 Ⓜ C A-B D

LEAD FINISH

b

c

c₁

b₁

BASE METAL

SECTION B-B

H

GAUGE PLANE

0.25

A   A2

⌒ 0.08 C

A1

B

B

0-7∞

0.20 MIN.

L

1.00 REF.

DETAIL 'A'

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1982.
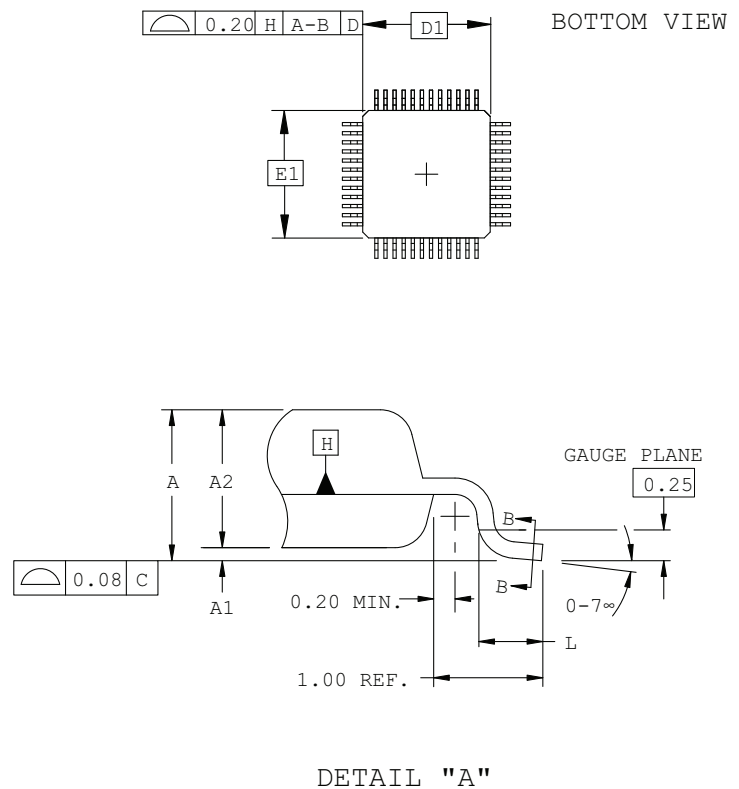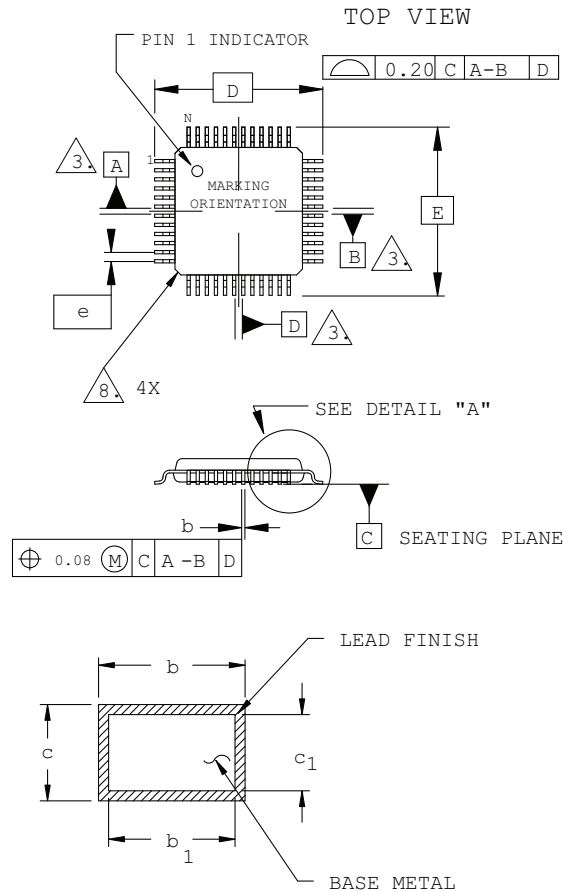
2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DATUMS A, B AND D TO BE DETERMINED AT DATUM PLANE H.

4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION.
    ALLOWABLE MOLD PROTRUSION IS 0.254 MM ON D1 AND E1
    DIMENSIONS.

5. THE TOP OF PACKAGE MAY BE SMALLER THAN THE BOTTOM
    OF THE PACKAGE BY 0.15 MM.

6. SECTION B-B:
    THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE
    LEAD BETWEEN 0.10 AND 0.25 MM FROM THE LEAD TIP.

7. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE
    TO THE LOWEST POINT ON THE PACKAGE BODY.

8. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	-	-	1.20
A1	0.05	-	0.15
A2	.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
N	48		
e	0.50 BSC		
b	0.17	0.22	0.27
b1	0.17	0.20	0.23
c	0.09	0.15	0.20
c1	0.09	0.13	0.16

48-Pin TQFP Package (1.4 mm thick)

Dimensions in Millimeters

TOP VIEW

PIN 1 INDICATOR

⌒ 0.20 C A-B D

N

3 A

1

MARKING
ORIENTATION

D

E

B 3

e

D 3

8 4X

SEE DETAIL "A"

b

⊕ 0.08 Ⓜ C A-B D

C SEATING PLANE

LEAD FINISH

b

c

c₁

b₁

BASE METAL

SECTION B - B

⌒ 0.20 H A-B D

D1

BOTTOM VIEW

E1

+

A A2

H

GAUGE PLANE

0.25

B

⌒ 0.08 C
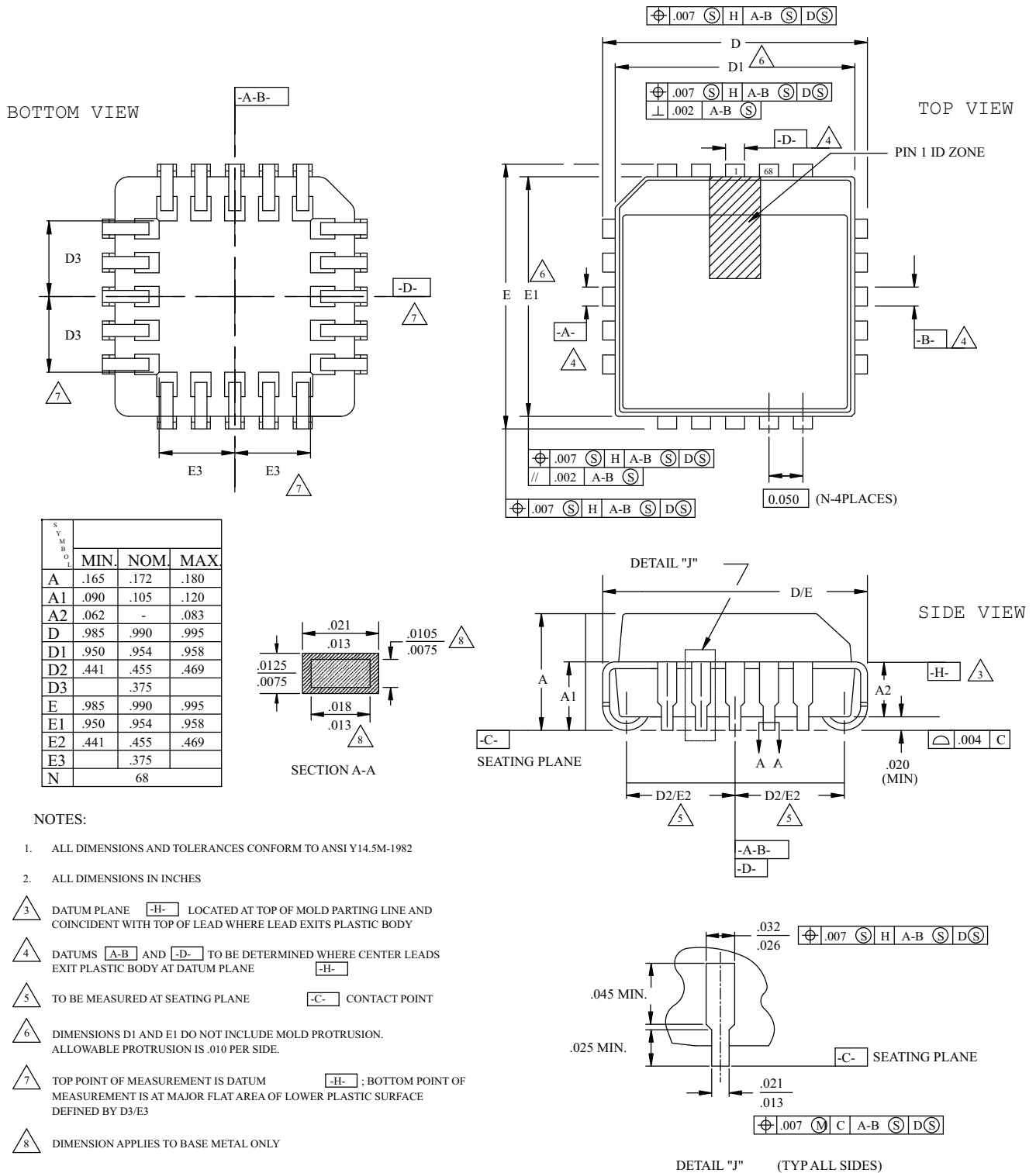
A1

0.20 MIN.

B

0-7∞

L

1.00 REF.

DETAIL "A"

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1982.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DATUMS A, B AND D TO BE DETERMINED AT DATUM PLANE H.

4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION.
    ALLOWABLE MOLD PROTRUSION IS 0.254 MM ON D1 AND E1
    DIMENSIONS.

5. THE TOP OF PACKAGE MAY BE SMALLER THAN THE BOTTOM
    OF THE PACKAGE BY 0.15 MM.

6. SECTION B-B:
    THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE
    LEAD BETWEEN 0.10 AND 0.25 MM FROM THE LEAD TIP.

7. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE
    TO THE LOWEST POINT ON THE PACKAGE BODY.

8. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.60
A1	0.05	–	0.15
A2	1.35	1.40	1.45
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
L	0.45	0.60	0.75
N	48		
e	0.50 BSC		
b	0.17	0.22	0.27
b1	0.17	0.20	0.23
c	0.09	0.15	0.20
c1	0.09	0.13	0.16

68-Pin PLCC Package

Dimensions in Inches

BOTTOM VIEW

-A-B-

D3

D3

E3   E3

-D-

7

7

7

S Y M B O L	MIN.	NOM.	MAX.
A	.165	.172	.180
A1	.090	.105	.120
A2	.062	-	.083
D	.985	.990	.995
D1	.950	.954	.958
D2	.441	.455	.469
D3		.375	
E	.985	.990	.995
E1	.950	.954	.958
E2	.441	.455	.469
E3		.375	
N		68	

.021
.013

.0105
.0075

.0125
.0075

.018
.013

SECTION A-A

⊕ | .007 | S | H | A-B | S | D | S

D

D1   6

⊕ | .007 | S | H | A-B | S | D | S
⊥ | .002 | A-B | S

-D-   4

PIN 1 ID ZONE

TOP VIEW

1   68

E   E1

6

-A-

4

-B-   4

⊕ | .007 | S | H | A-B | S | D | S
// | .002 | A-B | S

⊕ | .007 | S | H | A-B | S | D | S

0.050   (N-4 PLACES)

DETAIL "J"

D/E

SIDE VIEW

A

A1

-H-   3

A2

-C-
SEATING PLANE

A A

.004 | C

D2/E2   D2/E2

5   5

.020
(MIN)

-A-B-
-D-

NOTES:

1.   ALL DIMENSIONS AND TOLERANCES CONFORM TO ANSI Y14.5M-1982

2.   ALL DIMENSIONS IN INCHES

3.   DATUM PLANE -H- LOCATED AT TOP OF MOLD PARTING LINE AND COINCIDENT WITH TOP OF LEAD WHERE LEAD EXITS PLASTIC BODY

4.   DATUMS A-B AND -D- TO BE DETERMINED WHERE CENTER LEADS EXIT PLASTIC BODY AT DATUM PLANE -H-

5.   TO BE MEASURED AT SEATING PLANE -C- CONTACT POINT

6.   DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .010 PER SIDE.

7.   TOP POINT OF MEASUREMENT IS DATUM -H- ; BOTTOM POINT OF MEASUREMENT IS AT MAJOR FLAT AREA OF LOWER PLASTIC SURFACE DEFINED BY D3/E3

8.   DIMENSION APPLIES TO BASE METAL ONLY

.032
.026

⊕ | .007 | S | H | A-B | S | D | S

.045 MIN.

.025 MIN.

-C-   SEATING PLANE

.021
.013

⊕ | .007 | M | C | A-B | S | D | S

DETAIL "J"   (TYP ALL SIDES)

100-Pin PQFP Package

Dimensions in Millimeters

TOP VIEW

PIN 1 INDICATOR

⌐ 0.25 C A-B D 4X

E

-A- △3

N

1

△3
-D-

D

BOTTOM VIEW

E1

D1

⌐ 0.20 H A-B D 4X

△8
△3 -B-

SEE DETAIL "A"

(N-4)X

e

SEATING
PLANE

-C-

⊕ 0.12Ⓜ C A-B D

b

0.40 MIN.

0° MIN.

-H- ▲

DETAIL "A"

A   A2

0.13/0.30 R.

0.13
R. MIN.   B

GAGE PLANE

0.25

⌐ 0.10 C

A1

B

L

0-7°

1.60 REF.

SECTION B - B

b

c

c1

b₁

LEAD FINISH

BASE METAL
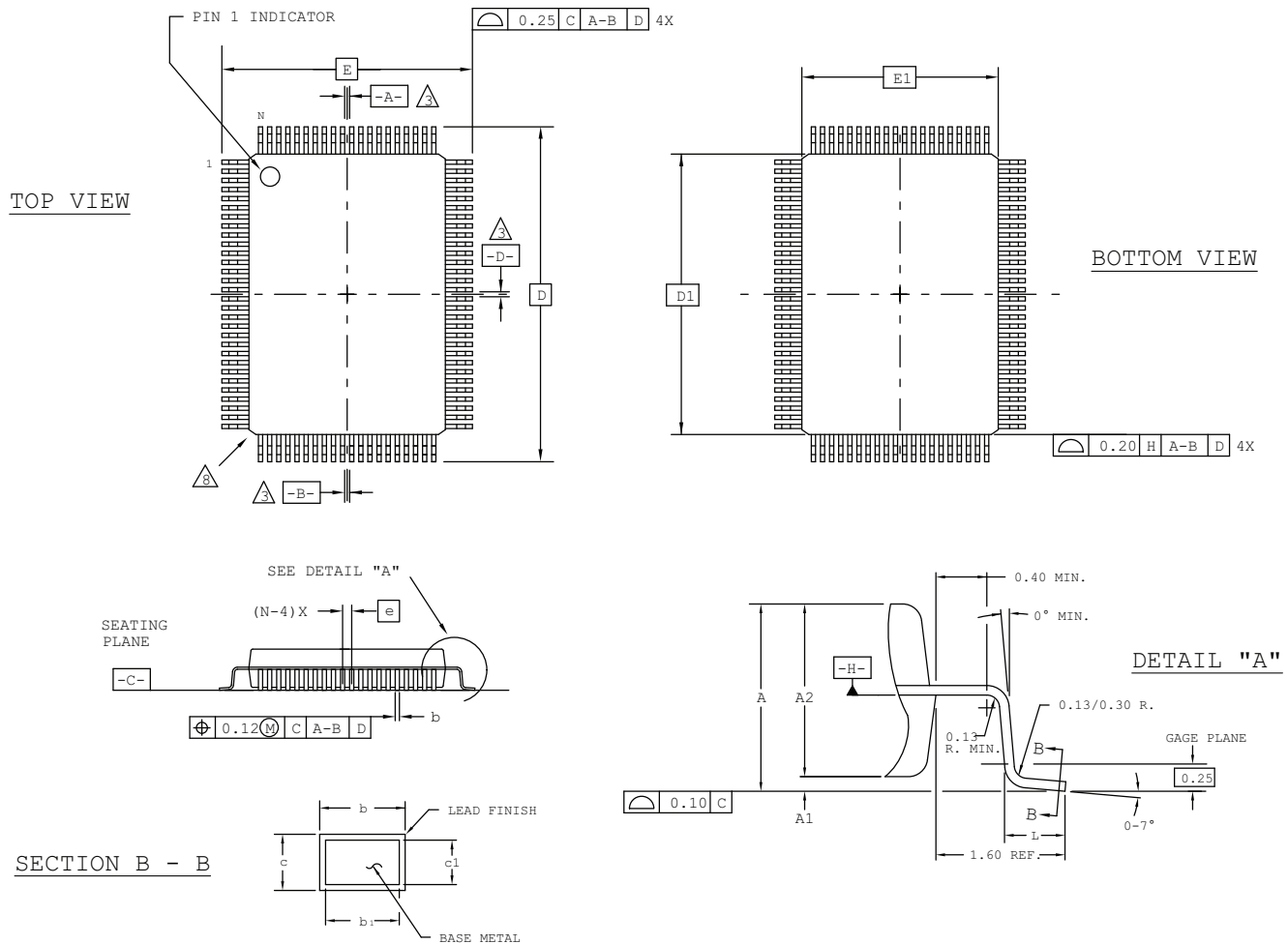
NOTES:

1.0 DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1982.

2.0 ALL DIMENSIONS ARE IN MILLIMETERS.

△3 DATUMS A, B AND D TO BE DETERMINED AT DATUM PLANE H.

4.0 DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION.
    ALLOWABLE MOLD PROTRUSION IS 0.254 MM ON D1 AND E1
    DIMENSIONS.

5.0 THE TOP OF PACKAGE MAY BE SMALLER THAN THE BOTTOM
    OF THE PACKAGE BY 0.15 MM.

6.0 SECTION B-B:
    THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE
    LEAD BETWEEN 0.10 AND 0.25 MM FROM THE LEAD TIP.

7.0 A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE
    TO THE LOWEST POINT ON THE PACKAGE BODY.

△8 EXACT SHAPE OF EACH CORNER IS OPTIONAL.

△9 EXACT SHAPE OF EXPOSED HEATSINK IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	–	3.40
A1	0.25	–	0.50
A2	2.50	2.70	2.90
D	23.20 BSC		
D1	20.00 BSC		
E	17.20 BSC		
E1	14.00 BSC		
L	0.73	0.88	1.03
N	100		
e	0.65 BSC		
b	0.22	–	0.40
b1	0.22	0.30	0.36
c	0.11	–	0.23
c1	0.11	0.15	0.19

121-Ball ucBGA Package

Dimensions in Millimeters

BOTTOM VIEW

PIN #1 ID FIDUCIAL
LOCATED IN THIS AREA

TOP VIEW

aaa (4X) ⬜

D

M

e

11 10 9 8 7 6 5 4 3 2 1

A
B
C
D
E
F
G
H
J
K
L

N

e

b Ø

Ø.15 ⓜ C A B
Ø.05 ⓜ C

3

// bbb C

ddd C

C

4

SIDE VIEW

A
A1
A2

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES
   PER ANSI Y14.5M.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSION "b" IS MEASURED AT THE
   MAXIMUM SOLDER BALL DIAMETER,
   PARALLEL TO PRIMARY DATUM C

4. PRIMARY DATUM C AND SEATING
   PLANE ARE DEFINED BY THE SPHERICAL
   CROWNS OF THE SOLDER BALLS.

5. BILATERAL TOLERANCE ZONE IS APPLIED
   TO EACH SIDE OF THE PACKAGE BODY.

6. EXACT SHAPE AND SIZE OF THIS FEATURE
   IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.00
A1	0.10	–	–
A2	–	–	0.90
D/E	5.00 BSC		
M/N	4.00 BSC		
b	0.20	0.25	0.30
e	0.40 BSC		
aaa	–	–	0.10
bbb	–	–	0.10
ddd	–	–	0.10

128-Pin TQFP Package

Dimensions in Millimeters

TOP VIEW

PIN 1 INDICATOR

BOTTOM VIEW

MARKING ORIENTATION

SIDE VIEW

SEE DETAIL "A"

SEATING PLANE

LEAD FINISH

BASE METAL

SECTION B - B

DETAIL "A"
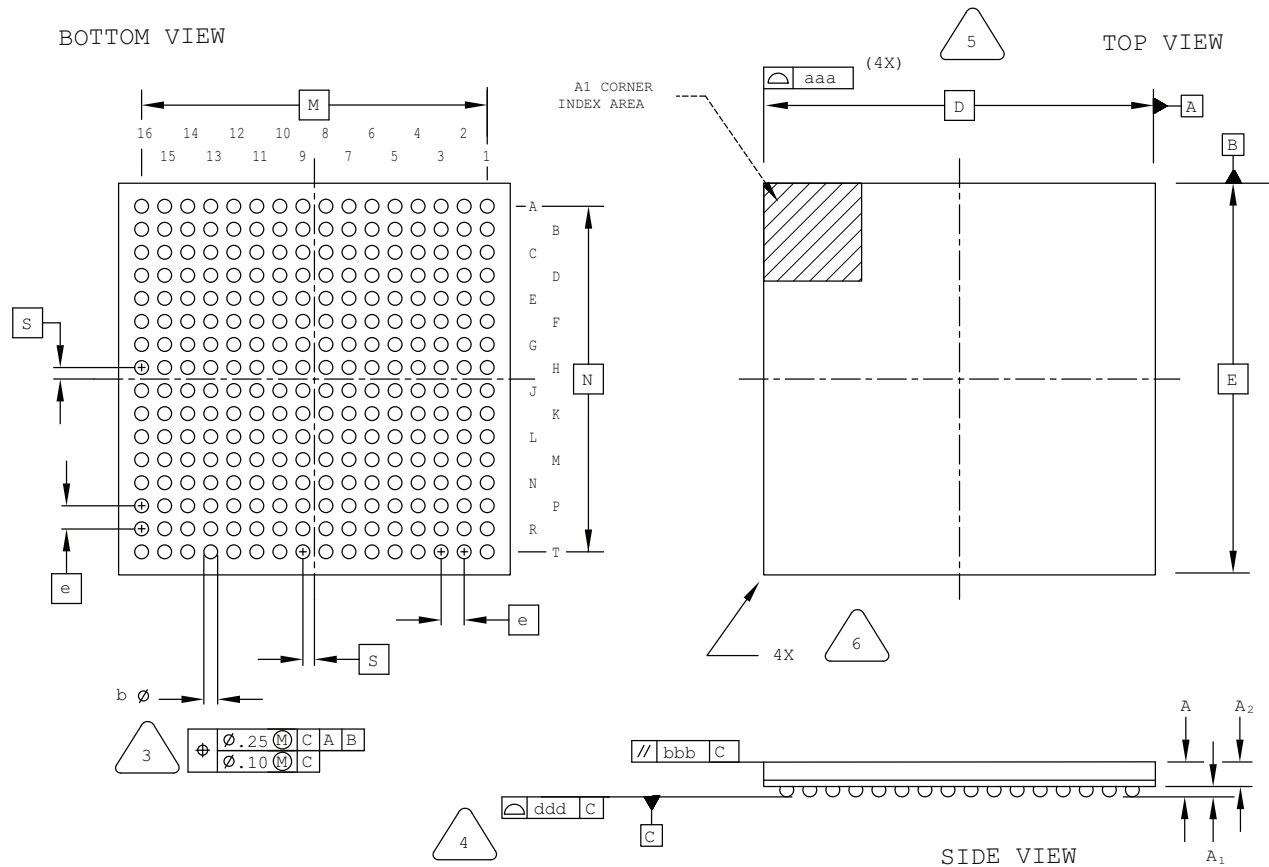
GAUGE PLANE

SIDE VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1982.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DATUMS A, B AND D TO BE DETERMINED AT DATUM PLANE H.

4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.254 MM ON D1 AND E1 DIMENSIONS.

5. THE TOP OF PACKAGE MAY BE SMALLER THAN THE BOTTOM OF THE PACKAGE BY 0.15 MM.

6. SECTION B-B: THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10 AND 0.25 MM FROM THE LEAD TIP.

7. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

8. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.60
A1	0.05	–	0.15
A2	1.35	1.40	1.45
D	16.00 BSC		
D1	14.00 BSC		
E	16.00 BSC		
E1	14.00 BSC		
L	0.45	0.60	0.75
N	128		
e	0.40 BSC		
b	0.13	0.18	0.23
b1	0.13	0.16	0.19
c	0.09	0.15	0.20
c1	0.09	0.13	0.16

256-Ball ftBGA Package Option 2: LatticeECP3™

Dimensions in Millimeters

BOTTOM VIEW

TOP VIEW

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSION "b" IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO PRIMARY DATUM C

4. PRIMARY DATUM C AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
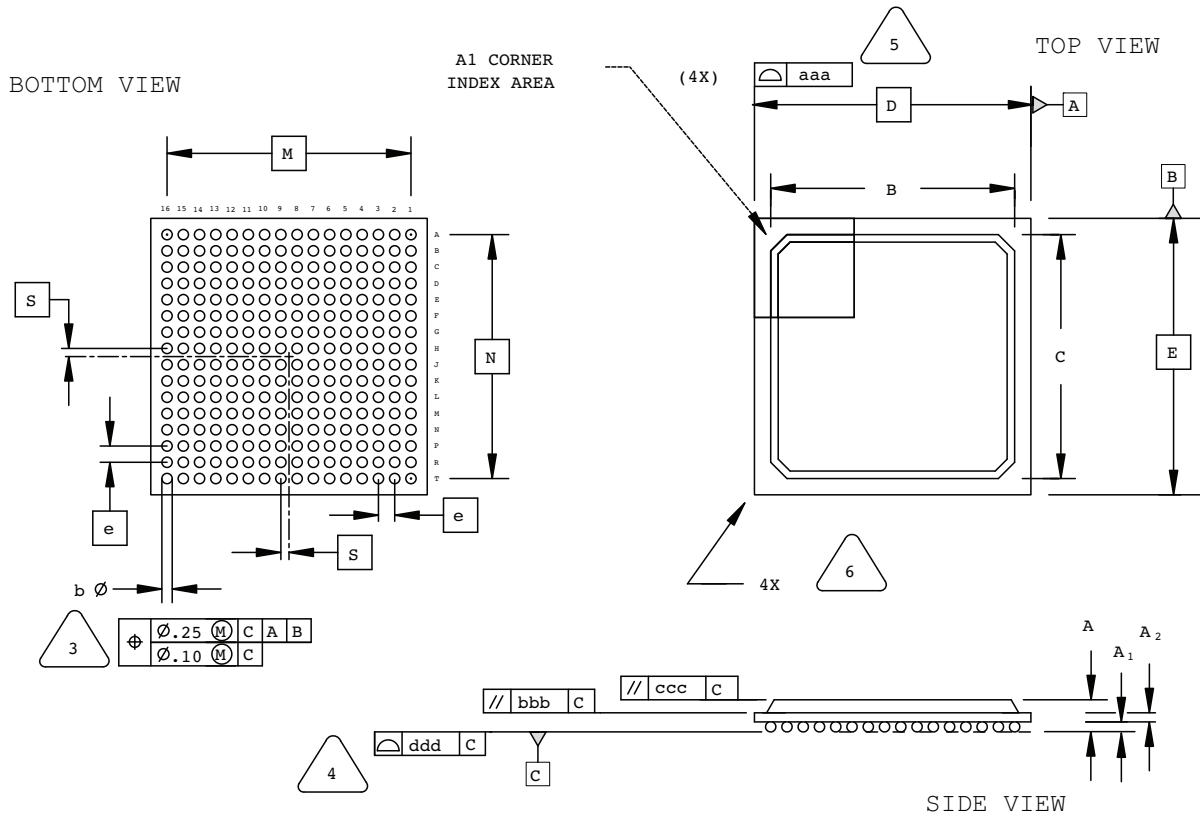
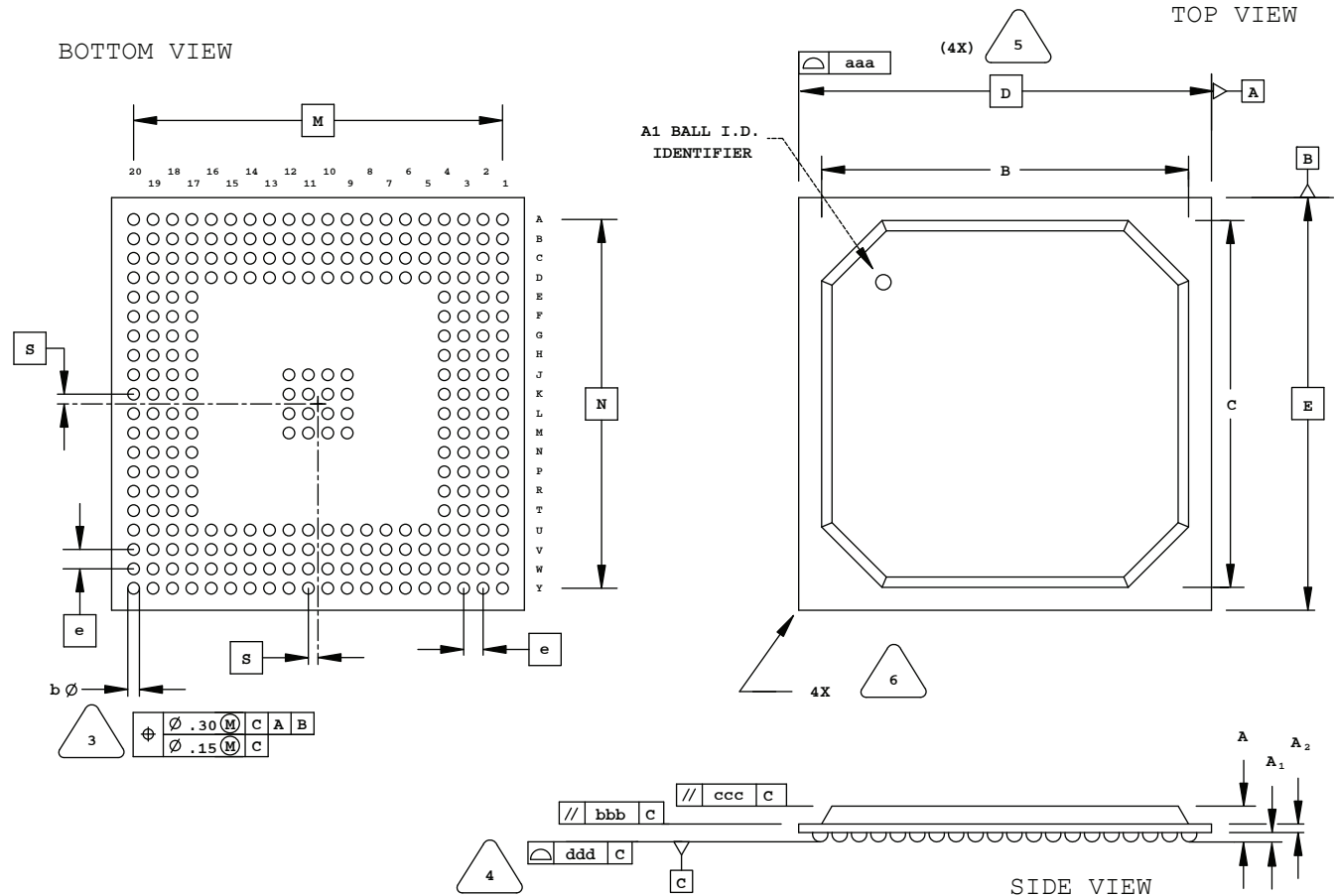5. BILATERAL TOLERANCE ZONE IS APPLIED TO EACH SIDE OF THE PACKAGE BODY.

6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	1.30	1.70	2.10
A1	0.30	0.50	0.70
A2	1.40 REF		
D/E	17.0 BSC		
M/N	15.0 BSC		
S	0.50 BSC		
b	0.50	0.60	0.70
e	1.0 BSC		
aaa	–	–	0.20
bbb	–	–	0.25
ddd	–	–	0.20

256-Ball fpBGA Package

Dimensions in Millimeters

BOTTOM VIEW

A1 CORNER
INDEX AREA

(4X)

TOP VIEW

aaa

D | A

B

B

C

N

E

M

S

N

e

S

e

b Ø

⌖ | Ø.25 Ⓜ C A B
  | Ø.10 Ⓜ C

3

4X

6

5

A   A₂
  A₁

// | bbb | C

// | ccc | C

⌒ | ddd | C

C

4

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3.   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM C

4.   PRIMARY DATUM C AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5.   BILATERAL TOLERANCE ZONE IS APPLIED
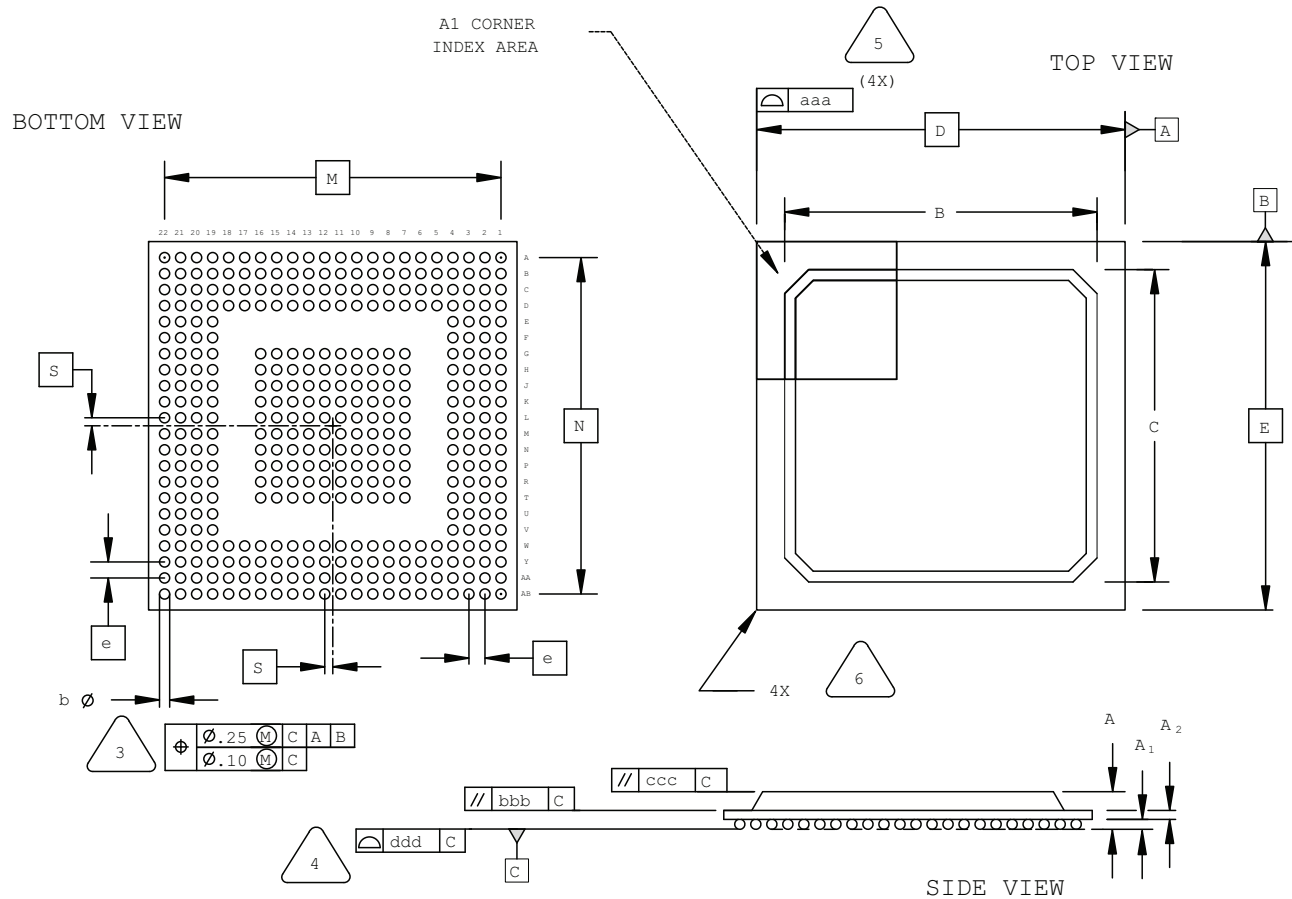   TO EACH SIDE OF THE PACKAGE BODY.

6.   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	1.30	1.70	2.10
A1	0.30	0.50	0.70
A2	0.30	0.50	0.70
B/C	14.80	15.30	15.80
D/E	17.00 BSC		
M/N	15.00 BSC		
S	0.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
aaa	–	–	0.20
bbb	–	–	0.25
ccc	–	–	0.35
ddd	–	–	0.20

272-Ball BGA Package

Dimensions in Millimeters

BOTTOM VIEW

TOP VIEW

A1 BALL I.D.
IDENTIFIER

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3.   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM C

4.   PRIMARY DATUM C AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5.   BILATERAL TOLERANCE ZONE IS APPLIED
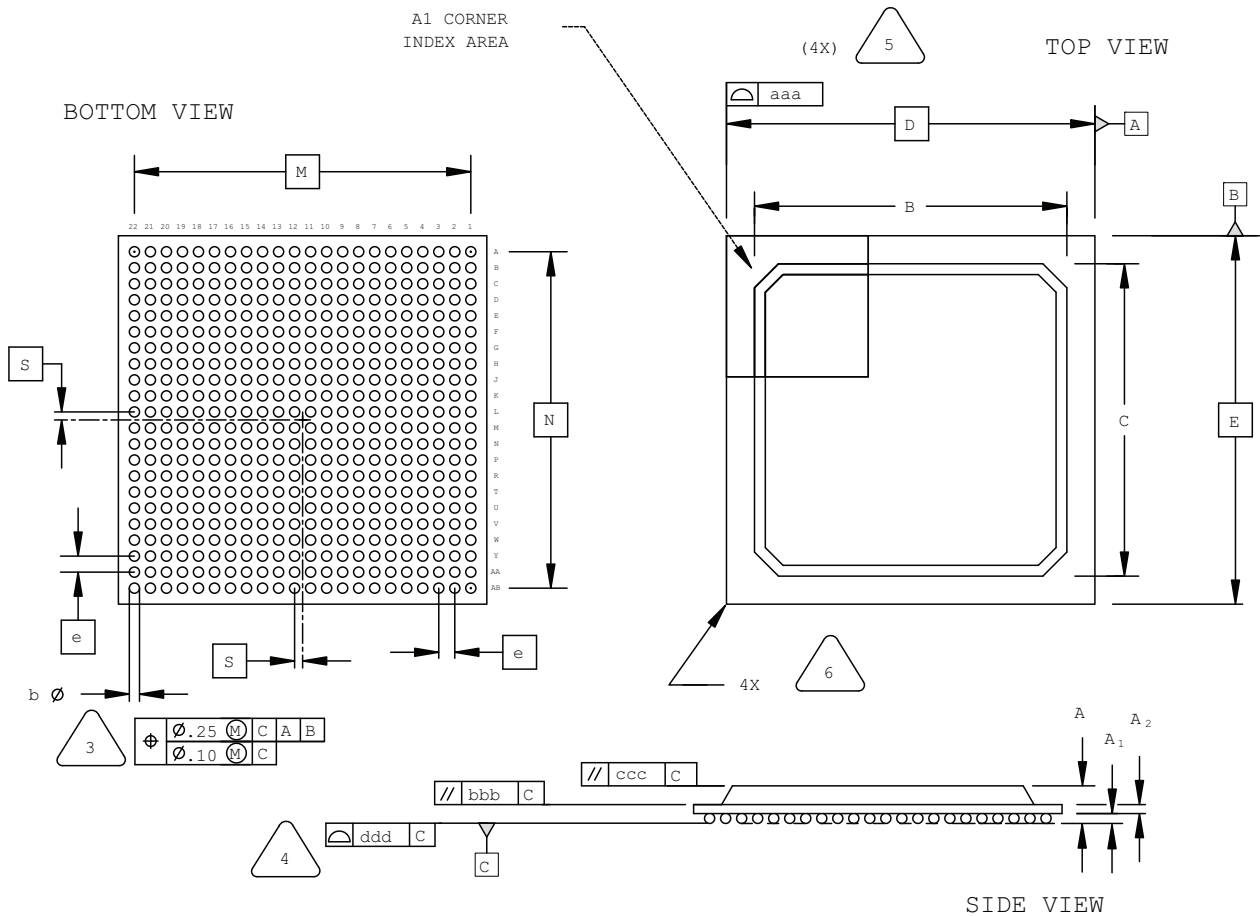   TO EACH SIDE OF THE PACKAGE BODY.

6.   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	1.90	2.25	2.80
A1	0.50	0.65	0.80
A2	0.28	0.54	0.80
B/C	23.80	24.30	24.80
D/E		27.00 BSC	
M/N		24.13 BSC	
S		0.635 BSC	
b	0.60	0.75	0.90
e		1.27 BSC	
aaa	-	-	0.20
bbb	-	-	0.25
ccc	-	-	0.35
ddd	-	-	0.20

388-Ball fpBGA Package

Dimensions in Millimeters

BOTTOM VIEW

A1 CORNER
INDEX AREA

TOP VIEW

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED
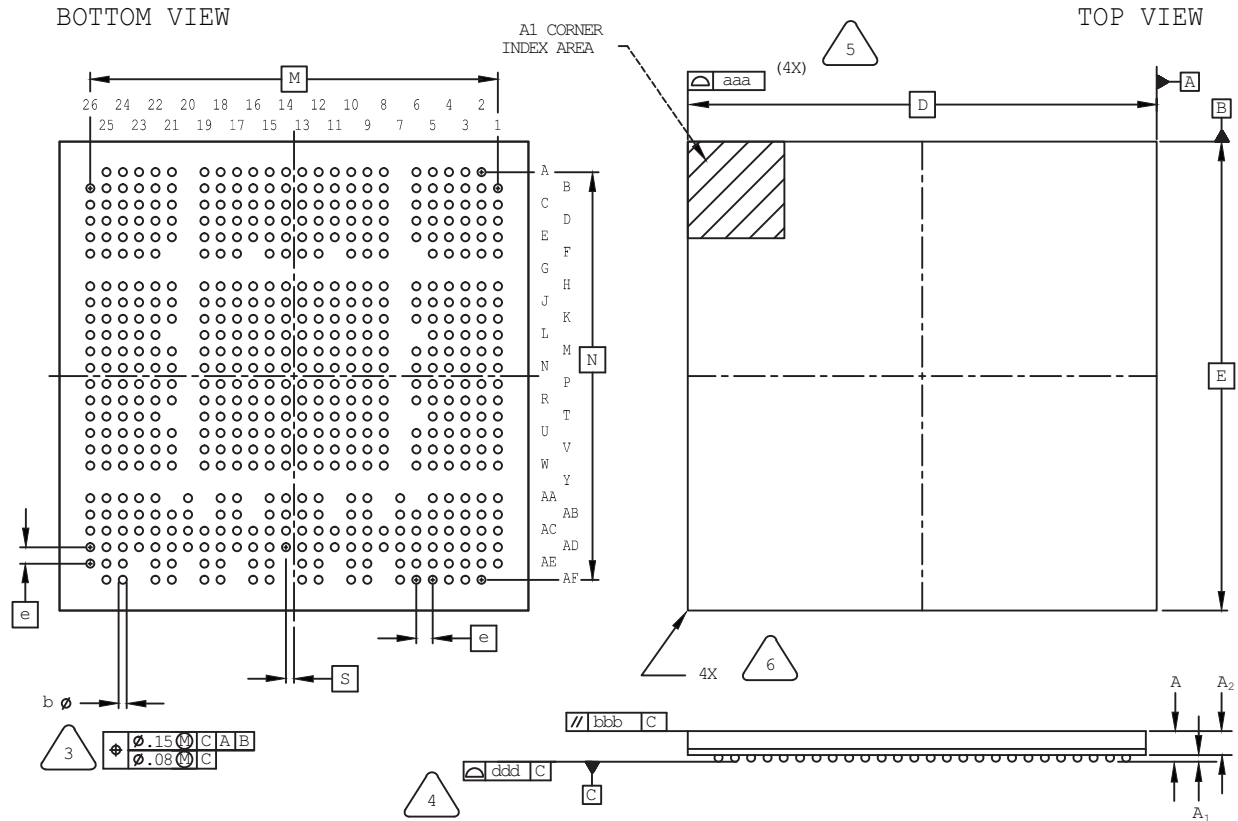
1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSION "b" IS MEASURED AT THE
    MAXIMUM SOLDER BALL DIAMETER,
    PARALLEL TO PRIMARY DATUM C

4. PRIMARY DATUM C AND SEATING
    PLANE ARE DEFINED BY THE SPHERICAL
    CROWNS OF THE SOLDER BALLS.

5. BILATERAL TOLERANCE ZONE IS APPLIED
    TO EACH SIDE OF THE PACKAGE BODY.

6. EXACT SHAPE AND SIZE OF THIS FEATURE
    IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	1.70	2.15	2.60
A1	0.30	0.50	0.70
A2	0.30	0.50	0.70
B/C	19.30	19.80	20.30
D/E		23.00 BSC	
M/N		21.00 BSC	
S		0.50 BSC	
b	0.50	0.60	0.70
e		1.00 BSC	
aaa	–	–	0.20
bbb	–	–	0.25
ccc	–	–	0.35
ddd	–	–	0.20

484-Ball fpBGA Package

Dimensions in Millimeters

NOTES: UNLESS OTHERWISE SPECIFIED
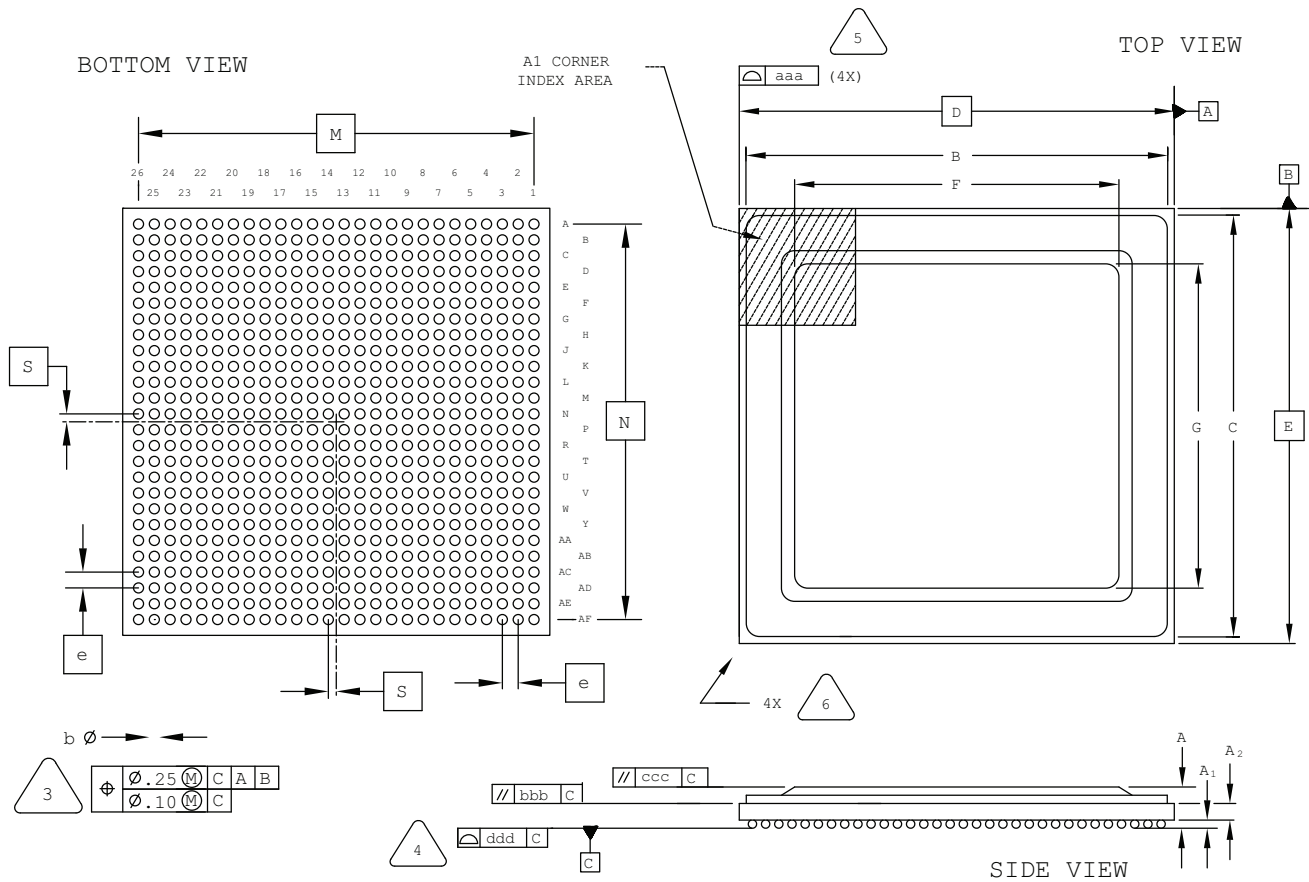
1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3.   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM [C]

4.   PRIMARY DATUM [C] AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5.   BILATERAL TOLERANCE ZONE IS APPLIED
        TO EACH SIDE OF THE PACKAGE BODY.

6.   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	1.70	2.15	2.60
A1	0.30	0.50	0.70
A2	0.30	0.50	0.70
B/C	19.30	19.80	20.30
D/E	23.00 BSC		
M/N	21.00 BSC		
S	0.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
aaa	–	–	0.20
bbb	–	–	0.25
ccc	–	–	0.35
ddd	–	–	0.20

554-Ball caBGA Package

Dimensions in Millimeters

BOTTOM VIEW

A1 CORNER
INDEX AREA

TOP VIEW

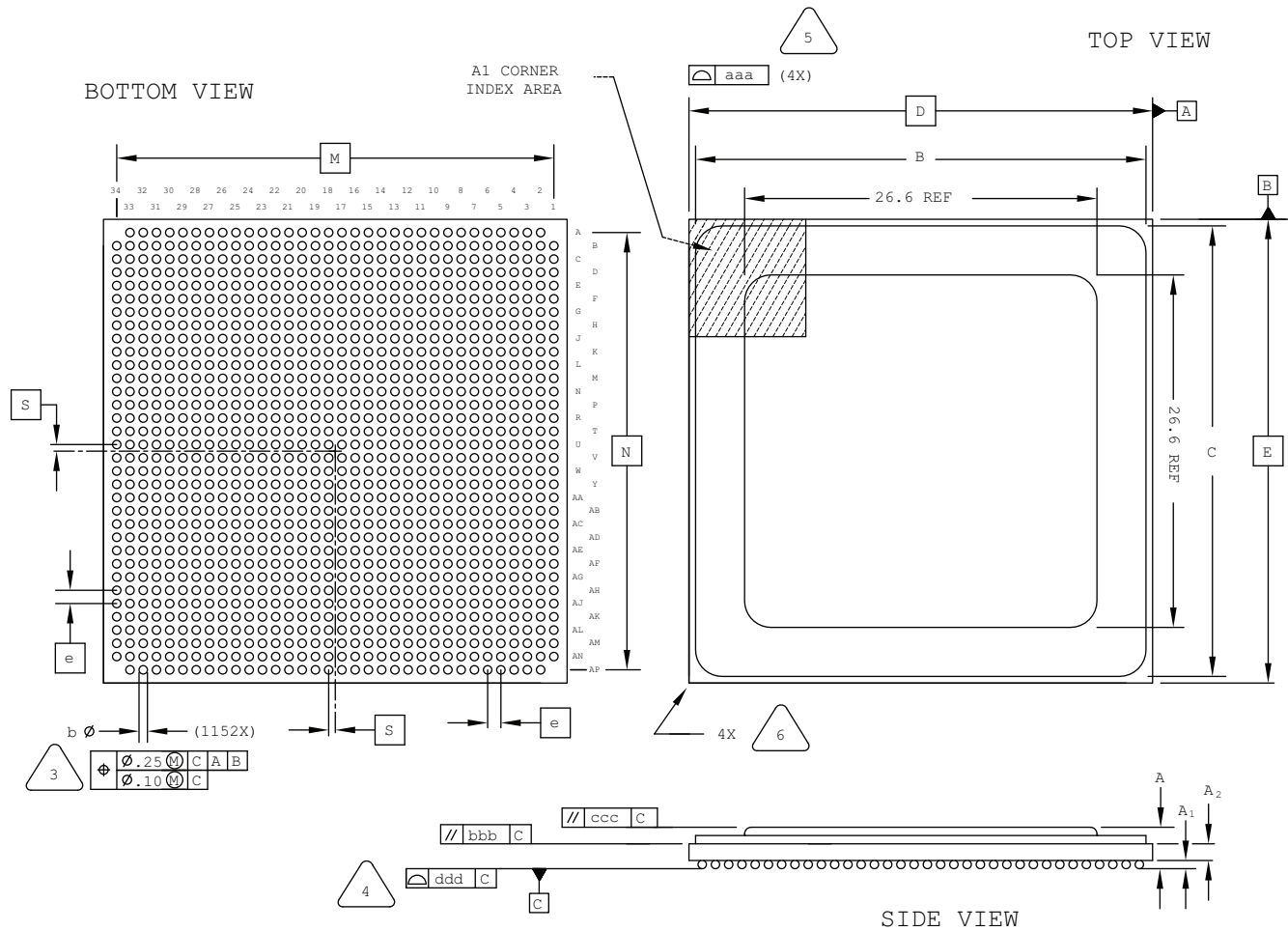NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM C

4   PRIMARY DATUM C AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5   BILATERAL TOLERANCE ZONE IS APPLIED
        TO EACH SIDE OF THE PACKAGE BODY.

6   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	–	–	1.76
A1	0.25	0.30	0.35
A2	0.80	–	–
D/E	23.0 BSC		
M/N	20.0 BSC		
S	0.40 BSC		
b	0.35	0.40	0.45
e	0.80 BSC		
aaa	–	–	0.15
bbb	–	–	0.20
ddd	–	–	0.12

676-Ball fcBGA Package

Dimensions in Millimeters

BOTTOM VIEW

TOP VIEW

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM [C]

4   PRIMARY DATUM [C] AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5   BILATERAL TOLERANCE ZONE IS APPLIED
        TO EACH SIDE OF THE PACKAGE BODY.

6   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	2.55	2.90	3.25
A1	0.40	0.50	0.60
A2	1.20 REF		
B/C	26.55	26.60	26.65
D/E	27.00 BSC		
F/G	18.55	18.60	18.65
M/N	25.00 BSC		
S	0.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
aaa	–	–	0.20
bbb	–	–	0.25
ccc	–	–	0.35
ddd	–	–	0.20

1152-Ball Organic fcBGA Package Option 1: LatticeSC/SCM40

Dimensions in Millimeters

BOTTOM VIEW

TOP VIEW

A1 CORNER
INDEX AREA

SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

1.   DIMENSIONS AND TOLERANCES
        PER ANSI Y14.5M.

2.   ALL DIMENSIONS ARE IN MILLIMETERS.

3.   DIMENSION "b" IS MEASURED AT THE
        MAXIMUM SOLDER BALL DIAMETER,
        PARALLEL TO PRIMARY DATUM C

4.   PRIMARY DATUM C AND SEATING
        PLANE ARE DEFINED BY THE SPHERICAL
        CROWNS OF THE SOLDER BALLS.

5.   BILATERAL TOLERANCE ZONE IS APPLIED
        TO EACH SIDE OF THE PACKAGE BODY.

6.   EXACT SHAPE AND SIZE OF THIS FEATURE
        IS OPTIONAL.

SYMBOL	MIN.	NOM.	MAX.
A	2.55	2.90	3.25
A1	0.35	0.50	0.65
A2	1.20 REF		
B/C	34.25	34.50	34.75
D/E	35.00 BSC		
M/N	33.00 BSC		
S	0.50 BSC		
b	0.50	0.60	0.70
e	1.00 BSC		
aaa	–	–	0.20
bbb	–	–	0.25
ccc	–	–	0.35
ddd	–	–	0.20

Revision History

Date	Version	Change Summary
March 2017	5.4	Added ispMACH 4000 to 100-Pin TQFP Package Option 1: MachXO2, MachXO™, isp-MACH® 4000.
		Added 121-Ball caBGA Package (9x9 mm Body).
December 2016	5.3	Updated "32-Pin QFNS Package" headings to "32-Pin QFN Package".
		Added 32-Pin QFN Package Option 3: MachXO2 SG32C.
		Added 30-Ball WLSC Package.
		Added iCE40 UltraPlus and MachXO2 to 48-Pin QFN Package Option 2: L-ASC10, iCE40 Ultra, iCE40 UltraPlus, MachXO2.
		Added 484-Ball caBGA Package.
June 2016	5.2	Updated 285-ball csfBGA package outline drawing.
		Added 36-Ball WLCS Package Option 3: LIFMD™.
		Fixed typo in 48-Pin QFN Package Option 2: L-ASC10, iCE40 Ultra, iCE40 UltraPlus, MachXO2.
		Added 64-Ball ucfBGA Package.
		Added 80-Ball ctfBGA Package.
		Added 81-Ball csfBGA Package.
February 2015	5.1	Added 36-Ball ucfBGA Package: iCE40 Ultra.
		Updated 36-Ball ucBGA Package heading to 36-Ball ucBGA Package Option 1.
		Updated 48-Pin QFN Package Option 2: L-ASC10 heading to 48-Pin QFN Package Option 2: L-ASC10, iCE40 Ultra.
January 2015	5.0	Added 16-Ball WLCS Package Option 2: iCE40 UltraLite.
		Updated 16-Ball WLCS Package heading to 16-Ball WLCS Package Option 1: iCE40 LP.
October 2014	4.9	Updated 48-Pin QFN Package heading and moved the section after 48-Pin QFN Package Option 1 (previously Option 2).
	4.8	Removed 20-Ball WLCS Package.
	4.7	Updated 121-Ball csfBGA Package. Revised M/N dimension.
September 2014	4.6	Updated 84-Pin QFN Package. Revised pin numbers from A36 and B27 to A37 and B28.
August 2014	4.5	Updated 16-Ball WLCS Package. Changed second E to e in REF. column.
		Updated 36-Ball WLCS Package Option 1: iCE40 Ultra heading.
		Added 36-Ball WLCS Package Option 2: MachXO3.
		Added 81-Ball WLCS Package.
		Added 121-Ball csfBGA Package.
		Added 256-Ball csfBGA Package.
		Added 324-Ball caBGA Package.
		Added 324-Ball csfBGA Package.
		Added 400-Ball caBGA Package.
		Updated 84-Pin QFN Package. Revised dimension "b" maximum value.
		Updated 256-Ball ftBGA Package Option 1: ispMACH 4000, MachXO, LatticeXP2. Revised dimension "A" values.

Date	Version	Change Summary
June 2014	4.4	Updated 48-Pin QFNS Package to 48-Pin QFN Package.
		Added 48-Pin QFN Package Option 2.
		Added 49-Ball WLCS Package.
		Added 237-Ball ftBGA Package.
		Added 285-Ball csfBGA Package.
		Added 20-Ball WLCS Package.
		Added 36-Ball WLCS Package.
March 2014	04.3	Restored references to indicate top. bottom, and side views.
		Added 381-Ball caBGA Package.
		Added 554-Ball caBGA Package.
		Added 756-Ball caBGA Package.
December 2013	04.2	Added "1" and "N" characters to 100-Pin TQFP Package Option 1: MachXO2, MachXO diagram (Top View).
September 2013	04.1	Added 16-ball WLCS package.
		Revised 25-Ball WLCS Package title to 25-Ball WLCS Package (0.40mm Pitch).
		Added 25-Ball WLCS Package (0.35mm Pitch).
		Added references to indicate top. bottom, and side views.
August 2013	04.0	Revised 144-pin TQFP package diagram.
February 2013	03.9	Added 184-ball csBGA package.
November 2012	03.8	Added iCE40 to the list of applicable products for the 32-pin QFNS Option 1 package.
October 2012	03.7	Revised 324-ball ftBGA package drawing.
September 2012	03.6	Nomenclature change – "iCE40 100-Pin TQFP Package Option 2" changed to "iCE40 100-Pin VQFP Package Option 2".
August 2012	03.5	Added 36-ball ucBGA, 49-ball ucBGA, 81-ball ucBGA, 81-ball csBGA, 84-pin QFN, 100-pin TQFP Option 2, 121-ball csBGA, 121-ball ucBGA, 132-ball csBGA Option 2, 196-ball csBGA, 225-ball ucBGA, 284-ball csBGA packages.
July 2012	03.4	Added 676-ball fcBGA package.
March 2012	03.3	Added new 32-Pin QFNS Package Option 2 for MachXO2. Moved 32-pin QFN (punch singulated) package drawing to new Package Archive Appendix.
February 2012	03.2	Updated document with new corporate logo.
December 2011	03.1	Updated WLCS package offering.
October 2011	03.0	Added 49-ball WLCS package and updated 25-ball WLCS package.
		Added 328-ball csBGA package.
July 2011	02.8	Included revised diagrams for the following packages: 56-ball csBGA, 100-ball csBGA and 132-ball csBGA. Added new 256-ball ftBGA Option 3 package.
May 2011	02.7	Added MachXO2 to the list of applicable products for the 256 ftBGA Option 1 package outline.
November 2010	02.6	Added 25-ball WLCS and 332-ball caBGA package drawings. Revised 100-pin PQFP, 120-pin PQFP, 128-pin PQFP, 160-pin PQFP and 208-pin PQFP package drawings. Removed obsolete packages including 144-, 240- and 304-pin PQFP packages.
October 2010	02.5	Added 208-ball ftBGA package.
September 2010	02.4	Revised maximum coplanarity values on Organic 1152 Flip Chip BGA – Option 2 and on Organic 1704 Flip Chip BGA from 0.20 mm to 0.23 mm.
March 2010	02.3	Added new 1020-ball Organic fcBGA rev.2, 1152-ball Organic fcBGA, and 1704-ball Organic fcBGA package drawings. Removed obsolete 492-Ball BGA package.
February 2010	02.2	Revised 256-ball caBGA nominal solder ball diameter from 0.5 mm to 0.45 mm to better match actual dimension.
December 2009	02.1	Revised 256-ball caBGA package to specify correct JEDEC reference number.