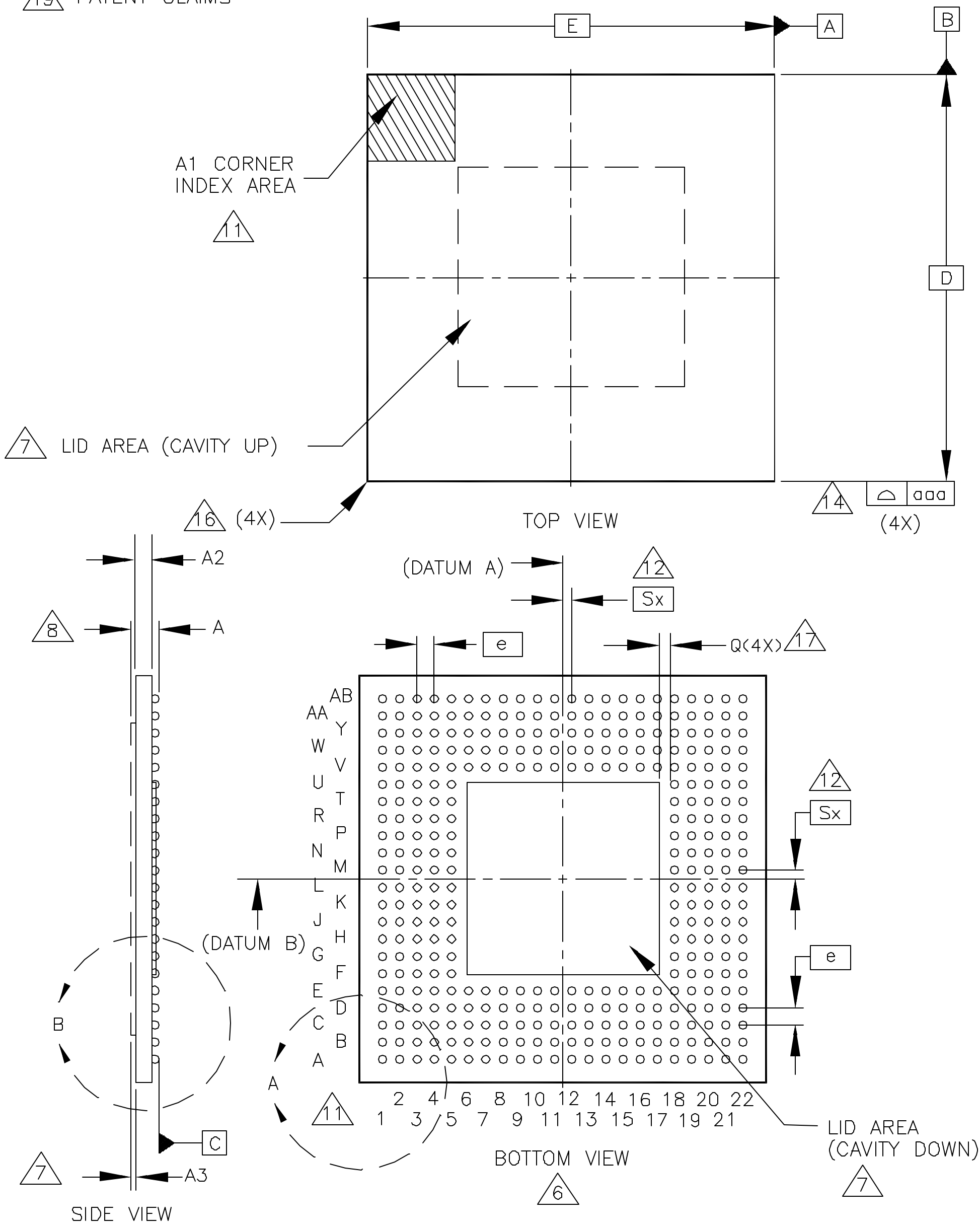
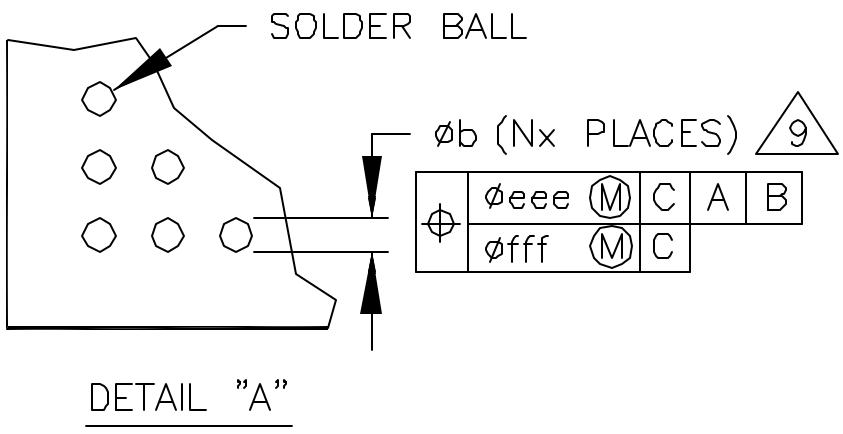
19 PATENT CLAIMS



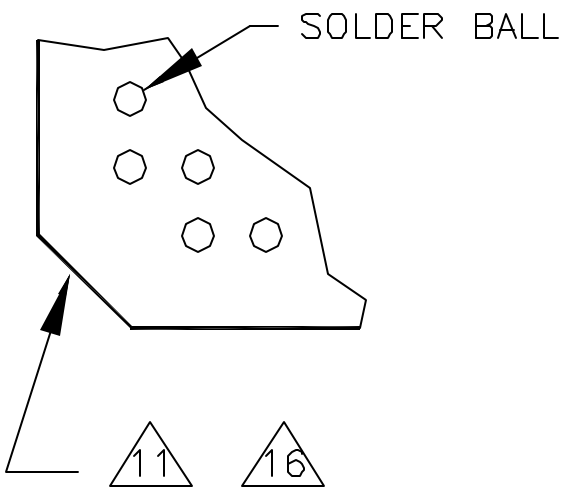
JEDEC SOLID STATE PRODUCT OUTLINE	THIS *REGISTERED OUTLINE* HAS BEEN PREPARED BY THE JEDEC JC-11 COMMITTEE AND REFLECTS A PRODUCT WITH ANTICIPATED USAGE IN THE ELECTRONICS INDUSTRY; CHANGES ARE LIKELY TO OCCUR.

TITLE	PACKAGE DESIGNATOR	ISSUE	DATE		SHEET
LOW PROFILE SQUARE BALL GRID ARRAY FAMILY	S-LBGA-B/LBGA	F	AUG 03	MO-192	1 OF 9

MO-192.DWG

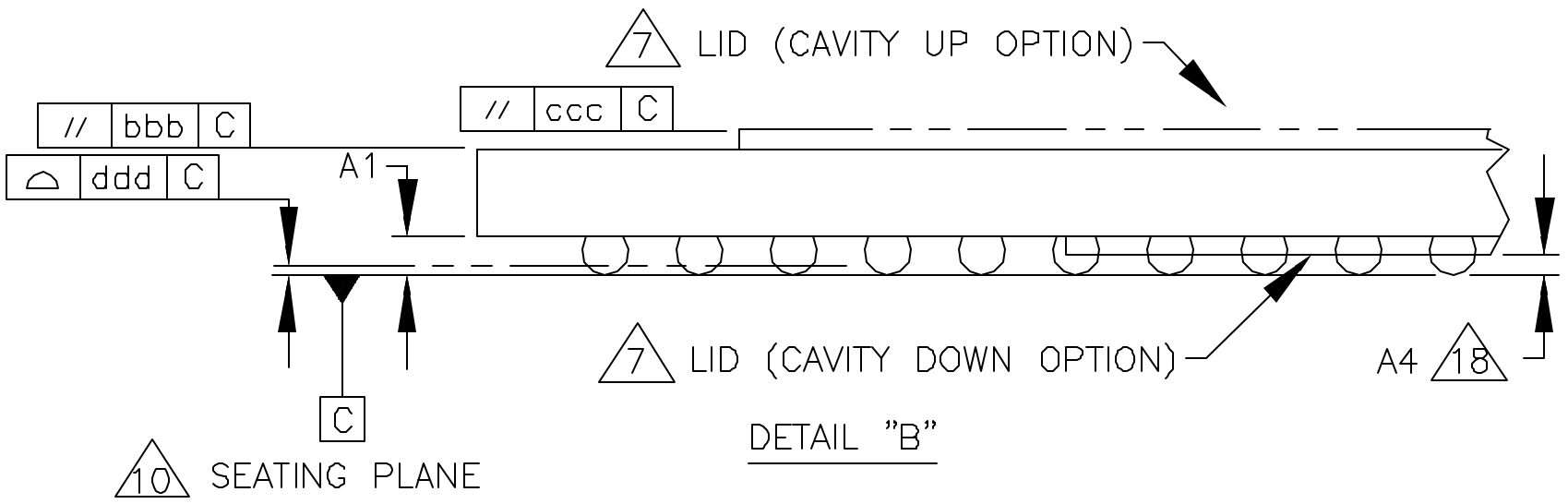


DETAIL "A"



DETAIL "A"

CORNER A1
OPTIONAL CONFIGURATION



DETAIL "B"

TABLE1: COMMON DIMENSIONS

DIMENSION	e = 1.00 (Var. DXX)			e = 1.00 (Var. AXX)			e = 1.27 (Var. BXX)			e = 1.50 (Var. CXX)		
	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX
A	–	–	1.70	–	–	1.70	–	–	1.70	–	–	1.70
A1	0.25	–	–	0.30	–	–	0.35	–	–	0.35	–	–
A2	0.25	–	1.10	0.25	–	1.10	0.25	–	1.10	0.25	–	1.10
A3	–	–	0.80	–	–	0.80	–	–	0.80	–	–	0.80
A4	0.10	–	–	0.10	–	–	0.10	–	–	0.10	–	–
b	0.45	0.50	0.55	0.50	0.60	0.70	0.60	0.75	0.90	0.60	0.75	0.90
Q	0.25	–	–	0.25	–	–	0.25	–	–	0.25	–	–
ddd	0.12			0.20			0.20			0.20		
Notes:	1, 3, 7, 9, 10, 15			1, 3, 7, 9, 10, 15								
Ref	11-602			11-588								
Issue	E			D								

TABLE 2: TOLERANCES OF FORM AND POSITION

DIMENSION	e = 1.00	e = 1.27	e = 1.50
aaa	0.20	0.20	0.20
bbb	0.25	0.25	0.25
ccc	0.35	0.35	0.35
eee	0.25	0.30	0.30
fff	0.10	0.15	0.15
Notes:	1, 3, 7, 9, 10, 15		
Ref	11–464		
Issue	A		

TABLE 3: REFERENCE COMPOSITE OF 1.00, 1.27 & 1.50 PITCH MATRICES

D / E	e = 1.00				e = 1.27				e = 1.50				NOTE
	M1	N1	M2	N2	M1	N1	M2	N2	M1	N1	M2	N2	
7.00	6	36	5	25	5	25	4	16	4	16	3	9	
8.00	7	49	6	36	6	36	5	25	5	25	4	16	
9.00	8	64	7	49	6	36	5	25	6	36	5	25	
10.00	9	81	8	64	7	49	6	36	6	36	5	25	
11.00	10	100	9	81	8	64	7	49	7	49	6	36	
12.00	11	121	10	100	9	81	8	64	8	64	7	49	
13.00	12	144	11	121	10	100	9	81	8	64	7	49	
14.00	13	169	12	144	10	100	9	81	9	81	8	64	
15.00	14	196	13	169	11	121	10	100	10	100	9	81	
17.00	16	256	15	225	13	169	12	144	11	121	10	100	
19.00	18	324	17	289	15	225	14	196	12	144	11	121	
21.00	20	400	19	361	16	256	15	225	14	196	13	169	
23.00	22	484	21	441	18	324	17	289	15	225	14	196	
25.00	24	576	23	529	19	361	18	324	16	256	15	225	
27.00	26	676	25	625	21	441	20	400	18	324	17	289	
29.00	28	784	27	729	22	484	21	441	19	361	18	324	
31.00	30	900	29	841	24	576	23	529	20	400	19	361	
33.00	32	1024	31	961	26	676	25	625	22	484	21	441	
35.00	34	1156	33	1089	27	729	26	676	23	529	22	484	
37.50	37	1369	36	1296	29	841	28	784	25	625	24	576	
40.00	39	1521	38	1444	31	961	30	900	26	676	25	625	
42.50	42	1764	41	1681	33	1089	32	1024	28	784	27	729	
45.00	44	1936	43	1849	35	1225	34	1156	30	900	29	841	
47.50	47	2209	46	2116	37	1369	36	1296	31	961	30	900	
50.00	49	2401	48	2304	39	1521	38	1444	33	1089	32	1024	
Notes:	4	5,13	4	5,13	4	5,13	4	5,13	4	5,13	4	5,13	
	1, 3, 12, 15												
Ref.	11–556												
Issue	B												

TABLE 4: VARIATIONS – 1.00 PITCH (b = 0.50mm nom.)

D / E	e = 1.00											
	M1	N1	S1	VARIATION	REF	ISSUE	M2	N2	S2	VARIATION	REF	ISSUE
7.00	6	36	0.5	DAA–1	11–602	E	5	25	0.0	DAA–2	11–602	E
8.00	7	49	0.5	DBB–1	11–602	E	6	36	0.0	DBB–2	11–602	E
9.00	8	64	0.5	DAB–1	11–602	E	7	49	0.0	DAB–2	11–602	E
10.00	9	81	0.5	DBC–1	11–602	E	8	64	0.0	DBC–2	11–602	E
11.00	10	100	0.5	DAC–1	11–602	E	9	81	0.0	DAC–2	11–602	E
12.00	11	121	0.5	DBD–1	11–602	E	10	100	0.0	DBD–2	11–602	E
13.00	12	144	0.5	DAD–1	11–602	E	11	121	0.0	DAD–2	11–602	E
14.00	13	169	0.5	DBE–1	11–602	E	12	144	0.0	DBE–2	11–602	E
15.00	14	196	0.5	DAE–1	11–602	E	13	169	0.0	DAE–2	11–602	E
17.00	16	256	0.5	DAF–1	11–602	E	15	225	0.0	DAF–2	11–602	E
19.00	18	324	0.5	DAG–1	11–602	E	17	289	0.0	DAG–2	11–602	E
21.00	20	400	0.5	DAH–1	11–602	E	19	361	0.0	DAH–2	11–602	E
23.00	22	484	0.5	DAJ–1	11–602	E	21	441	0.0	DAJ–2	11–602	E
25.00	24	576	0.5	DAK–1	11–602	E	23	529	0.0	DAK–2	11–602	E
27.00	26	676	0.5	DAL–1	11–602	E	25	625	0.0	DAL–2	11–602	E
29.00	28	784	0.5	DAM–1	11–602	E	27	729	0.0	DAM–2	11–602	E
31.00	30	900	0.5	DAN–1	11–602	E	29	841	0.0	DAN–2	11–602	E
33.00	32	1024	0.5	DAP–1	11–602	E	31	961	0.0	DAP–2	11–602	E
35.00	34	1156	0.5	DAR–1	11–602	E	33	1089	0.0	DAR–2	11–602	E
37.50	37	1369	0.0	DAT–1	11–602	E	36	1296	0.5	DAT–2	11–602	E
40.00	39	1521	0.0	DAU–1	11–602	E	38	1444	0.5	DAU–2	11–602	E
42.50	42	1764	0.5	DAV–1	11–602	E	41	1681	0.0	DAV–2	11–602	E
45.00	44	1936	0.5	DAW–1	11–602	E	43	1849	0.0	DAW–2	11–602	E
47.50	47	2209	0.0	DAY–1	11–602	E	46	2116	0.5	DAY–2	11–602	E
50.00	49	2401	0.0	DBA–1	11–602	E	48	2304	0.5	DBA–2	11–602	E
Notes:	4	5,13	12				4	5,13	12			
	1, 3, 15						1, 3, 15					

TABLE 5: VARIATIONS – 1.00 PITCH (b = 0.60mm nom.)

D / E	e = 1.00											
	M1	N1	S1	VARIATION	REF	ISSUE	M2	N2	S2	VARIATION	REF	ISSUE
7.00	6	36	0.5	AAA–1	11–464	A	5	25	0.0	AAA–2	11–556	B
8.00	7	49	0.5	ABB–1	11–556	B	6	36	0.0	ABB–2	11–556	B
9.00	8	64	0.5	AAB–1	11–464	A	7	49	0.0	AAB–2	11–556	B
10.00	9	81	0.5	ABC–1	11–556	B	8	64	0.0	ABC–2	11–556	B
11.00	10	100	0.5	AAC–1	11–464	A	9	81	0.0	AAC–2	11–556	B
12.00	11	121	0.5	ABD–1	11–556	B	10	100	0.0	ABD–2	11–556	B
13.00	12	144	0.5	AAD–1	11–464	A	11	121	0.0	AAD–2	11–556	B
14.00	13	169	0.5	ABE–1	11–556	B	12	144	0.0	ABE–2	11–556	B
15.00	14	196	0.5	AAE–1	11–464	A	13	169	0.0	AAE–2	11–556	B
17.00	16	256	0.5	AAF–1	11–464	A	15	225	0.0	AAF–2	11–556	B
19.00	18	324	0.5	AAG–1	11–464	A	17	289	0.0	AAG–2	11–556	B
21.00	20	400	0.5	AAH–1	11–464	A	19	361	0.0	AAH–2	11–556	B
23.00	22	484	0.5	AAJ–1	11–464	A	21	441	0.0	AAJ–2	11–556	B
25.00	24	576	0.5	AAK–1	11–464	A	23	529	0.0	AAK–2	11–556	B
27.00	26	676	0.5	AAL–1	11–464	A	25	625	0.0	AAL–2	11–556	B
29.00	28	784	0.5	AAM–1	11–464	A	27	729	0.0	AAM–2	11–556	B
31.00	30	900	0.5	AAN–1	11–464	A	29	841	0.0	AAN–2	11–556	B
33.00	32	1024	0.5	AAP–1	11–464	A	31	961	0.0	AAP–2	11–556	B
35.00	34	1156	0.5	AAR–1	11–464	A	33	1089	0.0	AAR–2	11–556	B
37.50	37	1369	0.0	AAT–1	11–464	A	36	1296	0.5	AAT–2	11–556	B
40.00	39	1521	0.0	AAU–1	11–464	A	38	1444	0.5	AAU–2	11–556	B
42.50	42	1764	0.5	AAV–1	11–464	A	41	1681	0.0	AAV–2	11–556	B
45.00	44	1936	0.5	AAW–1	11–464	A	43	1849	0.0	AAW–2	11–556	B
47.50	47	2209	0.0	AAY–1	11–464	A	46	2116	0.5	AAY–2	11–556	B
50.00	49	2401	0.0	ABA–1	11–464	A	48	2304	0.5	ABA–2	11–556	B
Notes:	4	5,13	12				4	5,13	12			
	1, 3, 15						1, 3, 15					

TABLE 6: VARIATIONS – 1.27 PITCH

D / E	e = 1.27											
	M1	N1	S1	VARIATION	REF	ISSUE	M2	N2	S2	VARIATION	REF	ISSUE
7.00	5	25	0.000	BAA–1	11–464	A	4	16	0.635	BAA–2	11–464	A
8.00	6	36	0.635	BBB–1	11–556	B	5	25	0.000	BBB–2	11–556	B
9.00	6	36	0.635	BAB–1	11–464	A	5	25	0.000	BAB–2	11–464	A
10.00	7	49	0.000	BBC–1	11–556	B	6	36	0.635	BBC–2	11–556	B
11.00	8	64	0.635	BAC–1	11–464	A	7	49	0.000	BAC–2	11–464	A
12.00	9	81	0.000	BBD–1	11–556	B	8	64	0.635	BBD–2	11–556	B
13.00	10	100	0.635	BAD–1	11–464	A	9	81	0.000	BAD–2	11–464	A
14.00	10	100	0.635	BBE–1	11–556	B	9	81	0.000	BBE–2	11–556	B
15.00	11	121	0.000	BAE–1	11–464	A	10	100	0.635	BAE–2	11–464	A
17.00	13	169	0.000	BAF–1	11–464	A	12	144	0.635	BAF–2	11–464	A
19.00	14	196	0.635	BAG–1	11–464	A	13	169	0.000	BAG–2	11–464	A
21.00	16	256	0.635	BAH–1	11–464	A	15	225	0.000	BAH–2	11–464	A
23.00	18	324	0.635	BAJ–1	11–464	A	17	289	0.000	BAJ–2	11–464	A
25.00	19	361	0.000	BAK–1	11–464	A	18	324	0.635	BAK–2	11–464	A
27.00	21	441	0.000	BAL–1	11–464	A	20	400	0.635	BAL–2	11–464	A
29.00	22	484	0.635	BAM–1	11–464	A	21	441	0.000	BAM–2	11–464	A
31.00	24	576	0.635	BAN–1	11–464	A	23	529	0.000	BAN–2	11–464	A
33.00	25	625	0.000	BAP–1	11–464	A	24	576	0.635	BAP–2	11–464	A
35.00	27	729	0.000	BAR–1	11–464	A	26	676	0.635	BAR–2	11–464	A
37.50	29	841	0.000	BAT–1	11–464	A	28	784	0.635	BAT–2	11–464	A
40.00	31	961	0.000	BAU–1	11–464	A	30	900	0.635	BAU–2	11–464	A
42.50	33	1089	0.000	BAV–1	11–464	A	32	1024	0.635	BAV–2	11–464	A
45.00	35	1225	0.000	BAW–1	11–464	A	34	1156	0.635	BAW–2	11–464	A
47.50	37	1369	0.000	BAY–1	11–464	A	36	1296	0.635	BAY–2	11–464	A
50.00	39	1521	0.000	BBA–1	11–464	A	38	1444	0.635	BBA–2	11–464	A
Notes:	4	5,13	12				4	5,13	12			
	1, 3, 15											

TABLE 7: VARIATIONS – 1.50 PITCH

D / E	e = 1.50											
	M1	N1	S1	VARIATION	REF	ISSUE	M2	N2	S2	VARIATION	REF	ISSUE
7.00	4	16	0.750	CAA–1	11–464	A	3	9	0.000	CAA–2	11–464	A
8.00	5	25	0.000	CBB–1	11–556	B	4	9	0.750	CBB–2	11–556	B
9.00	6	36	0.750	CAB–1	11–464	A	5	25	0.000	CAB–2	11–464	A
10.00	6	36	0.750	CBC–1	11–556	B	5	25	0.000	CBC–2	11–556	B
11.00	7	49	0.000	CAC–1	11–464	A	6	36	0.750	CAC–2	11–464	A
12.00	8	64	0.750	CBD–1	11–556	B	7	49	0.000	CBD–2	11–556	B
13.00	8	64	0.750	CAD–1	11–464	A	7	49	0.000	CAD–2	11–464	A
14.00	9	81	0.000	CBE–1	11–556	B	8	64	0.750	CBE–2	11–556	B
15.00	10	100	0.750	CAE–1	11–464	A	9	81	0.000	CAE–2	11–464	A
17.00	11	121	0.000	CAF–1	11–464	A	10	100	0.750	CAF–2	11–464	A
19.00	12	144	0.750	CAG–1	11–464	A	11	121	0.000	CAG–2	11–464	A
21.00	14	196	0.750	CAH–1	11–464	A	13	169	0.000	CAH–2	11–464	A
23.00	15	225	0.000	CAJ–1	11–464	A	14	196	0.750	CAJ–2	11–464	A
25.00	16	256	0.750	CAK–1	11–464	A	15	225	0.000	CAK–2	11–464	A
27.00	18	324	0.750	CAL–1	11–464	A	17	289	0.000	CAL–2	11–464	A
29.00	19	361	0.000	CAM–1	11–464	A	18	324	0.750	CAM–2	11–464	A
31.00	20	400	0.750	CAN–1	11–464	A	19	361	0.000	CAN–2	11–464	A
33.00	22	484	0.750	CAP–1	11–464	A	21	441	0.000	CAP–2	11–464	A
35.00	23	529	0.000	CAR–1	11–464	A	22	484	0.750	CAR–2	11–464	A
37.50	25	625	0.000	CAT–1	11–464	A	24	576	0.750	CAT–2	11–464	A
40.00	26	676	0.750	CAU–1	11–464	A	25	625	0.000	CAU–2	11–464	A
42.50	28	784	0.750	CAV–1	11–464	A	27	729	0.000	CAV–2	11–464	A
45.00	30	900	0.750	CAW–1	11–464	A	29	841	0.000	CAW–2	11–464	A
47.50	31	961	0.000	CAY–1	11–464	A	30	900	0.750	CAY–2	11–464	A
50.00	33	1089	0.000	CBA–1	11–464	A	32	1024	0.750	CBA–2	11–464	A
Notes:	4	5,13	12				4	5,13	12			
	1, 3, 15											

JEDEC SOLID STATE PRODUCT OUTLINE	TITLE S-LBGA-B/LBGA LOW PROFILE SQUARE BALL GRID ARRAY FAMILY REGISTRATION	ISSUE F	DATE AUG 03	MO-192	SHEET 7 OF 9

MO-192.DWG

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. SOLDER BALL POSITION DESIGNATION PER JESD 95–1, SPP–010.
3. "e" REPRESENTS THE SOLDER BALL GRID PITCH.
4. "M1" REPRESENTS THE MAXIMUM SOLDER BALL MATRIX SIZE.
   M2 = (M1–1)
5. N1 AND N2 REPRESENT THE MAXIMUM NUMBER OF SOLDER BALLS FOR MATRIX SIZE M1 AND M2.

6. 22 X 22 MATRIX SIZE IS SHOWN FOR ILLUSTRATION ONLY.

7. LID MAY EXTEND TO PERIPHERY OF PACKAGE AND MAY CONSIST OF MOLDING COMPOUND, METAL, CERAMIC OR OTHER MATERIAL. LID MAY EXTEND ABOVE/BELOW PACKAGE BODY SURFACE OR MAY BE INCORPORATED WITHIN PACKAGE BODY, e.g., COMPLETE OVERBODY MOLD.

8. THIS DIMENSION INCLUDES STAND–OFF HEIGHT "A1", PACKAGE BODY THICKNESS AND LID HEIGHT, BUT DOES NOT INCLUDE ATTACHED FEATURES, e.g., EXTERNAL HEATSINK OR CHIP CAPACITORS. AN INTEGRAL HEATSLUG IS NOT CONSIDERED AN ATTACHED FEATURE.

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

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

11. A1 CORNER MUST BE IDENTIFIED BY CHAMFER, INK MARK, METALIZED MARKINGS, INDENTATION OR OTHER FEATURE OF PACKAGE BODY, LID OR INTEGRAL HEATSLUG, ON THE TOP SURFACE OF THE PACKAGE. IF THE OPTIONAL CHAMFERED CORNER IS USED, THE MAXIMUM NUMBER OF SOLDER BALLS N MAY BE REDUCED.

12. $\boxed{Sx}$ IS MEASURED WITH RESPECT TO DATUM A AND DATUM B AND DEFINES THE POSITION OF THE CENTER SOLDER BALL IN THE OUTER ROW. WHEN THERE IS AN ODD NUMBER OF SOLDER BALLS IN THE OUTER ROW $\boxed{Sx}$ = .000; WHEN THERE IS AN EVEN NUMBER OF SOLDER BALLS IN THE OUTER ROW, $\boxed{Sx}$ = $\boxed{e/2}$.
   $\boxed{Sx}$ = $\boxed{S1}$ OR $\boxed{S2}$ CORRESPONDING TO M1 OR M2.

13. SOLDER BALL DEPOPULATION IS ALLOWED. DEPOPULATION IS THE OMISSION OF BALLS FROM A FULL MATRIX (M1 OR M2).

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

15. ALL DIMENSIONS ARE IN MILLIMETERS.

16. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL

17. Q IS THE MINIMUM CLEARANCE BETWEEN THE LID EDGE AND THE INNER ROW OF SOLDER BALLS ON CAVITY–DOWN CONFIGURATIONS.

NOTES (Continued)

18. A4 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE LID FOR CAVITY DOWN CONFIGURATIONS.

PATENT CLAIMS:

19. NATIONAL SEMICONDUCTOR HAS STATED THAT U.S. PATENT NUMBERS 4688152, 4778641 AND 4868349 MAY RELATE TO A CERTAIN IMPLEMENTATION OF THIS PACKAGE OUTLINE. CITIZEN WATCH COMPANY HAS STATED THAT U.S. PATENT NUMBERS 4822550 AND 4935581 MAY RELATE TO A CERTAIN IMPLEMENTATION OF THIS PACKAGE OUTLINE.