Tape and Reel Packaging Specifications

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ON Semiconductor
Tape and Reel Packaging Specifications

In Brief . . .

This booklet has been offered to assist those looking to coordinate packaging specifications with assembly line requirements. Additionally, dimensional and ordering information is supplied for those discrete devices that take the form of axial−leaded parts.

Tape and Reel Packaging Specifications

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the “peel−back” cover tape.

- Two Reel Sizes Available (7″ and 13″)
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481, −1, −2 Series
- 8 mm Tape: 6−Bump, 9−Bump, 10−Bump, MicroLeadless™, ChipFET, DFN/QFN packages ≤ 3.3x3.3, Flip−Chip, SOD−123, SC−59, SC−70, SC−74, SC−74A, SC−75, SC−82, SC−82AB, SC−88, SC−88A, SC−89, SOD−123, SOD−323, SOD−523, SOD−723, SOD−923, SOT−143, SOT−23, SOT−23L, SOT−323, SOT−353, SOT−553/563, SOT−723, TSOP−5, TSOP−6, US8
- 12 mm Tape: DFN/QFN packages > 3.3x3.3 and ≤ 7x7, FCBGA−16, Micro10, Micro8™, PowerFLEX™, POWERMITE™, SMA, SMB, SO−8 (SOIC 8), SOT−223, SOT−89, SSOP−8, TSSOP−8, TSSOP−10, TSSOP−14, TSSOP−16
- 16 mm Tape: DFN/QFN packages > 7x7, DPAK, FCBGA−16, PLCC−20, SMC, SO−14 (SOIC 14), SO−16 (SOIC 16), SO−16 Wide (SOIC 16W), SOEIAJ14, SOEIAJ16, SOP−16, SSOP−14 Wide, TQFP−32, TSSOP−20
- 24 mm Tape: D^2PAK, FCBGA−81, LQFP−52, LQFP−64, PLCC−28, SO−18 Wide (SOIC 18W), SO−20 Wide (SOIC 20W), SO−24 Wide (SOIC 24W), SOEIAJ−20, TQFP−52, TQFP−64, TSSOP−48
- 32 mm Tape: PLCC−44, PLCC−52, SO−28L Wide (SOIC 28W), SO−28 Wide (SOIC 28W), SO−32 Wide (SOIC 32W),
- 44 mm Tape: PLCC−98, PLCC−84
- For Leadless Package Pin 1 Orientation, please see Figure 36 (Effective January 2007).

Use the standard device title and add the required suffix as listed in the option table on the following page. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity.

Embossed Tape and Reel Ordering Information

Package	Tape Width mm	Pitch mm (Dimension P_1) (inch)	Reel Size		Devices Per Reel and Min Order Quantity	Tape and Reel Suffix	Fig No	Page No
			(mm)	(in)				
1006 – MicroLeadless™	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – Discrete, Analog	5	10
1006 – MicroLeadless™	8	4.0 ± 0.1 (0.158 ± 0.004)	330	13	10,000	T3 – Discrete, Analog	5	10
2020 – MicroLeadless™	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – Discrete T3 – Discrete, Analog	6	10
2020 – MicroLeadless™	8	4.0 ± 0.1 (0.158 ± 0.004)	330	13	10,000	T2 – Discrete, Analog T4 – Discrete, Analog	6	10
6–Bump (1.489x0.989)	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – TMOS	6	10
9–Bump (1.489x1.489)	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – TMOS	6	10
10–Bump	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – Discrete	6	10
Axial Leaded	See Axial Leaded package specifications beginning on page 22							
ChipFET	8	4.0 ± 0.1 (0.158 ± 0.004)	178	7	3,000	T1 – TMOS	10	11
D^2PAK 3 Lead	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	800	R4 Analog T4 – Discrete	1	9
D^2PAK 5 Lead	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	800	R4 – Analog T4 – Discrete	1	9
D^2PAK 7 Lead	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	750	R7 – Analog	1	9
DFN/QFN ≤ 3.3x3.3mm	8 8	4.0 ± 0.1 (0.158 ± 0.004) 4.0 ± 0.1 (0.158 ± 0.004)	178 330	7 13	See Data Sheet See Data Sheet	See Data Sheet See Data Sheet	33–36	15,16
DFN/QFN > 3.3x3.3mm and ≤ 7x7mm	12 12	8.0 ± 0.1 (0.315 ± 0.004) 8.0 ± 0.1 (0.315 ± 0.004)	178 330	7 13	See Data Sheet See Data Sheet	See Data Sheet See Data Sheet	33–36	15,16
DFN/QFN 7x7mm	12 12	16.0 ± 0.1 (0.630 ± 0.004) 16.0 ± 0.1 (0.630 ± 0.004)	178 330	7 13	See Data Sheet See Data Sheet	See Data Sheet See Data Sheet	33–36	15,16
DFN/QFN 9x9mm	16 16	12.0 ± 0.1 (0.471 ± 0.004) 12.0 ± 0.1 (0.471 ± 0.004)	178 330	7 13	See Data Sheet See Data Sheet	See Data Sheet See Data Sheet	33–36	15,16
DFN/QFN 10.5x10.5mm	16 16	16.0 ± 0.1 (0.630 ± 0.004) 16.0 ± 0.1 (0.630 ± 0.004)	178 330	7 13	See Data Sheet See Data Sheet	See Data Sheet See Data Sheet	33–36	15,16
DO–41	79	5.08 ± 0.508	356	14	5,000	RL – Discrete	N/A	27
DPAK	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,800	RL – Discrete	4	9
DPAK	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	T4, T5 – Discrete RK, T5 – Analog	2, 3	9
FCBGA–16	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500/500	R2 – Clock & Data Mgmt	32	15
FCBGA–49	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000/500	R2 – Clock & Data Mgmt	32	15
FCBGA–81	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,500/500	R2 – Clock & Data Mgmt	32	15
Flip–Chip	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 – Discrete	N/A	N/A
LQFP – 48	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	R48 – Analog	7	10
LQFP–32	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1800 or 2000	R2 – Analog, Clock & Data Mgmt	7	10
LQFP–52	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	1,500	R2 – Clock & Data Mgmt	7	10
LQFP–64	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	1,500	R2 – Clock & Data Mgmt	7	10
Micro10	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	4,000	R2 – Analog, Discrete	30	14
Micro8™	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2, T – Analog	30	14
Micro8	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	4,000	R2 – Analog, Discrete	30	14
PLCC–20	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R2 – Clock & Data Mgmt	8	10
PLCC–28	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	500	R2 – Clock & Data Mgmt	8	10

Embossed Tape and Reel Ordering Information

Package	Tape Width mm	Pitch mm (Dimension P_1) (inch)	Reel Size		Devices Per Reel and Min Order Quantity	Tape and Reel Suffix	Fig No	Page No
			(mm)	(in)				
PLCC−44	32	24.0 ± 0.1 (0.942 ± 0.004)	330	13	500	R2 − Clock & Data Mgmt, Analog	8	10
PLCC−44	32	24.0 ± 0.1 (0.942 ± 0.004)	330	13	500	R44 − Analog	8	10
PLCC−52	32	24.0 ± 0.1 (0.942 ± 0.004)	330	13	500	R2 − Clock & Data Mgmt, Analog	8	10
PLCC−68	44	32.0 ± 0.1 (1.256 ± 0.004)	330	13	250	R2 − Clock & Data Mgmt, Analog	8	10
PLCC−84	44	36.0 ± 0.1 (1.418 ± 0.004)	330	13	250	R2 − Clock & Data Mgmt, Analog	8	10
PowerFLEX™	12	24.0 ± 0.1 (0.942 ± 0.004)	330	13	2,000	R7 − Analog	1	9
POWERMITE®	12	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, TR7 − Discrete	19	12
POWERMITE	12	4.0 ± 0.1 (0.157 ± 0.004)	330	13	12,000	T3, TR13 − Discrete	19	12
SC−59	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete	12	11
SC−59	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	12	11
SC−70	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	12	11
SC−70	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	12	11
SC−70 5 Lead	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Analog	14	11
SC−70 6 Lead	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Analog	21	13
SC−70 6 Lead	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Analog	21	13
SC−74	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	13	11
SC−74A	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	11	11
SC−75	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	12	11
SC−82	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	TR − Analog	9	11
SC−82AB	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Analog, Discrete	9	11
SC−88	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	21	13
SC−88	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete T1 − Analog	21	13
SC−88A	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete	14	11
SC−88A	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3, T4 − Discrete	14	11
SC−89	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	12	11
SC−89	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	12	11
SMA	12	4.0 ± 0.1 (0.157 ± 0.004)	178	7	1,500	T1 − Discrete	20	12
SMA	12	4.0 ± 0.1 (0.157 ± 0.004)	330	13	5,000	T3 − Discrete	20	12
SMB	12	8.0 ± 0.1 (0.315 ± 0.004)	178	7	1,000	T1 − Discrete	20	12
SMB	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	T3 − Discrete	20	12
SMC	16	8.0 ± 0.1 (0.315 ± 0.004)	178	7	1,000	T1 − Discrete	20	12
SMC	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	T3 − Discrete	20	12
SO−14 (SOIC 14)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R14 − Analog E.G.*	30	14
SO−14 (SOIC 14)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Clock & Data Mgmt, Logic, Analog	30	14
SO−16 (SOIC 16)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Clock & Data Mgmt, Logic, Analog	30	14
SO−16 (SOIC 16)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R16 − Analog E.G.*	30	14
SO−16 Wide (SOIC 16W)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	1,000	R2 − Clock & Data Mgmt, Logic, Analog	30	14
SO−16 Wide (SOIC 16W)	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	1,000	R16 − Analog E.G.*	30	14

* Applies to Analog devices manufactured at the East Greenwich, Rhode Island, USA facility.

Embossed Tape and Reel Ordering Information

Package	Tape Width mm	Pitch mm (Dimension P_1) (inch)	Reel Size		Devices Per Reel and Min Order Quantity	Tape and Reel Suffix	Fig No	Page No
			(mm)	(in)				
SO−18 Wide (SOIC 18W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R2 − Clock & Data Mgmt	30	14
SO−18 Wide (SOIC 18W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R18 − Analog E.G.*	30	14
SO−20 Wide (SOIC 20W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R2 − Analog, Clock & Data Mgmt	30	14
SO−20 Wide (SOIC 20W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R20 − Analog E.G.*	30	14
SO−24 Wide (SOIC 24W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R2 − Analog, Clock & Data Mgmt	30	14
SO−24 Wide (SOIC 24W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R24 − Analog E.G.*	30	14
SO−28 Wide (SOIC 28W)	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R2 − Analog, Clock & Data Mgmt	31	14
SO−28L Wide (SOIC 28W)	32	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R3 − Analog	31	14
SO−28 Wide (SOIC 28W)	32	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R28− Analog E.G.*	31	14
SO−32 Wide (SOIC 32W)	32	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R32− Analog E.G.*	30	14
SO−8 (SOIC 8)	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R8 − Analog E.G.*	30	14
SO−8 (SOIC 8)	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − TMOS, Analog, Clock & Data Mgmt	30	14
SOD−123	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete	25	13
SOD−123	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	25	13
SOD−323	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	25	13
SOD−323	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	25	13
SOD−523	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	27	14
SOD−523	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete	27	14
SOD−723	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete	28	14
SOD−923	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete	28	14
SOEIAJ14	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	EL − Logic	N/A	N/A
SOEIAJ16	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	EL − Logic	N/A	N/A
SOEIAJ20	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	EL − Logic	N/A	N/A
SON−6	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Analog	26	13
SON−8	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Analog	N/A	N/A
SOP−16	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog	30	14
SOT−143	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3, T4 − Discrete	24	13
SOT−143	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2, Discrete T − Analog	24	13
SOT−223	12	8.0 ± 0.1 (0.315 ± 0.004)	178	7	1,000	T1 − Discrete, Analog	29	14
SOT−223	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R3 or T3 − Analog E.G.*	29	14
SOT−223	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	4,000	T3 − Discrete, TMOS T3 − Analog	29	14
SOT−23	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, − Discrete TR, T1 − Analog	12	11
SOT−23	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	12	11
SOT−23 5 Lead	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, TR, T − Analog	11	11
SOT−23 6 Lead	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, R1 − Analog	13	11

* Applies to Analog devices manufactured at the East Greenwich, Rhode Island, USA facility.

Embossed Tape and Reel Ordering Information

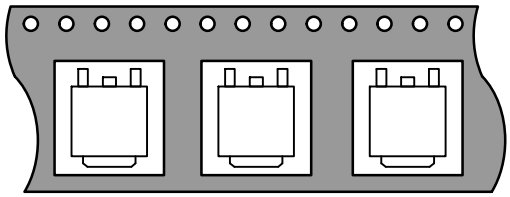
Package	Tape Width mm	Pitch mm (Dimension P_1) (inch)	Reel Size		Devices Per Reel and Min Order Quantity	Tape and Reel Suffix	Fig No	Page No
			(mm)	(in)				
SOT−23L	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	4,000	R2− Analog	12	11
SOT−323	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1 − Discrete	12	11
SOT−323	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	12	11
SOT−353	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete	14	11
SOT−353	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3, T4 − Discrete	14	11
SOT−553/563	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	4,000	T1 − Discrete, Logic	15,16	12
SOT−553/563	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	4,000	T2 − Discrete, Logic, Analog	15,16	12
SOT−553/563	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete, Logic	15,16	12
SOT−553/563	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T6 − Discrete, Logic	15,16	12
SOT−723	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete	12	11
SOT−89	12	8.0 ± 0.1 (0.315 ± 0.004)	178	7	1,000	T1, R1 − Discrete T1 − Analog	22	13
SOT−953/963	8	2.0 ± 0.05 (0.079 ± 0.002)	178	7	8,000	T5 − Discrete, Logic	17,18	12
SSOP−14	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	R14 − Analog E.G.*	30	14
SSOP−16	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	1,000	R16 − Analog E.G.*	30	14
SSOP−24 Wide	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	R24 − Analog E.G.*	30	14
SSOP−8	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	3,000	T1− Analog	30	14
TO−92	See TO−92 and other Axial Leaded package specifications beginning on page 22							
TQFP−32	16	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,000	R2 − Analog, Clock & Data Mgmt	7	10
TQFP−52	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	1,500	R2 − Clock & Data Mgmt	7	10
TQFP−64	24	16.0 ± 0.1 (0.630 ± 0.004)	330	13	1,500	R2 − Clock & Data Mgmt	7	10
TSOP−5	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Discrete T1, T2, TR − Analog	11	11
TSOP−5	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Discrete	11	11
TSOP−6	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	T1, T2 − Analog, Discrete	13	11
TSOP−6	8	4.0 ± 0.1 (0.157 ± 0.004)	330	13	10,000	T3 − Analog, Discrete	13	11
TSSOP−10	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Clock & Data Mgmt	30	14
TSSOP−14	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog, Clock & Data Mgmt	30	14
TSSOP−16	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog, Clock & Data Mgmt	30	14
TSSOP−20	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog, Clock & Data Mgmt	30	14
TSSOP−24	16	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog, Clock & Data Mgmt	30	14
TSSOP−48	24	12.0 ± 0.1 (0.471 ± 0.004)	330	13	2,500	R2 − Clock & Data Mgmt	30	14
TSSOP−8	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	2,500	R2 − Analog, Clock & Data Mgmt	30	14
TSSOP−8	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	4,000	R2 − Discrete, MOS	30	14
TSSOP−8	12	8.0 ± 0.1 (0.315 ± 0.004)	330	13	3,000	R3 − Discrete, MOS	30	14
US8	8	4.0 ± 0.1 (0.157 ± 0.004)	178	7	3,000	US − Logic	23	13

* Applies to Analog devices manufactured at the East Greenwich, Rhode Island, USA facility.

Product Orientation

Direction of Feed

Figure 1. D²PAK
24 mm (Tape Width, Typical)

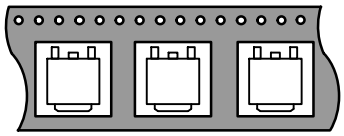


5 Lead – T4 Discrete
R4, R5 Analog

7 Lead – R7 Analog
PowerFLEX–7 – R7 Analog

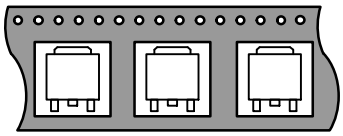
3 Lead – T4 Discrete
R3, R4 Analog

Figure 2. DPAK
16 mm



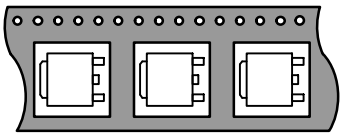
Discrete Suffix – T4
Analog Suffix – R or RK

Figure 3. DPAK
16 mm



Discrete, Analog
Suffix – T5

Figure 4. DPAK
16 mm

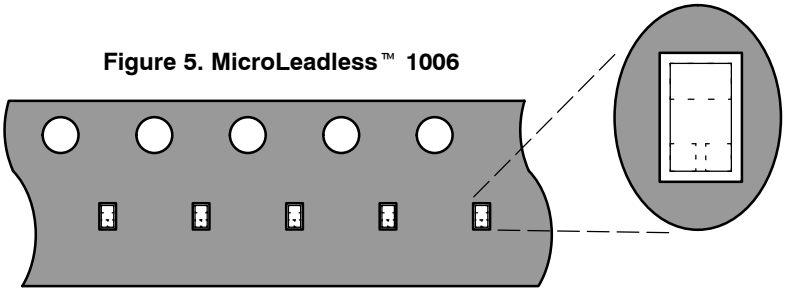


Discrete Suffix – RL

Product Orientation (continued)

Direction of Feed

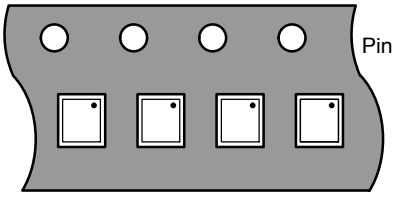
Figure 5. MicroLeadless™ 1006



Die orientation in tape with pads down
“T1” Pin One Opposing Sprocket Hole (3k Reel)
“T3” Pin One Opposing Sprocket Hole (10k Reel)

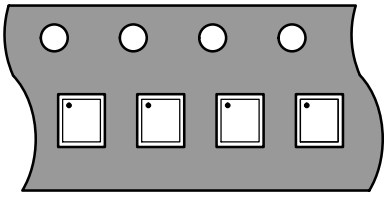
Figure 6. 6−Bump, 9−Bump, 10−Bump, MicroLeadless™ 2020
Flip−Chip/DCA

Option 1, 3



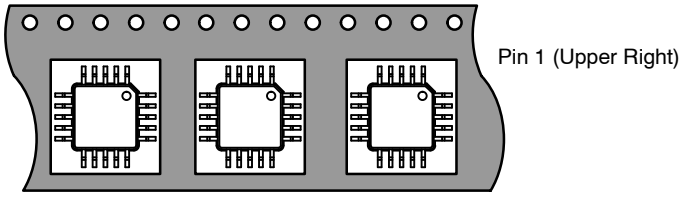
Die orientation in tape with bumps down
“T1” Pin One Towards Sprocket Hole (3k Reel)
“T3” Pin One Towards Sprocket Hole (10k Reel)

Option 2, 4



Die orientation in tape with bumps down
“T2” Pin One Towards Sprocket Hole (3k Reel)
“T4” Pin One Towards Sprocket Hole (10k Reel)

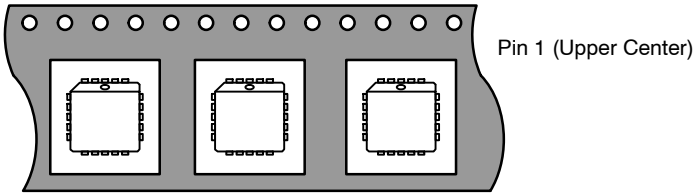
Figure 7. LQFP, TQFP



R2, R48 − Analog
R2 − Clock & Data Mgt.

Figure 8. PLCC

PLCC−20	**PLCC−28**	**PLCC−44, PLCC−52**	**PLCC−68, PLCC−84**
16 mm	24 mm	32 mm	44 mm

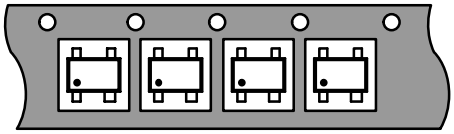


R2, R28, R44 − Analog
R2 − Clock & Data Mgt.

Product Orientation (continued)

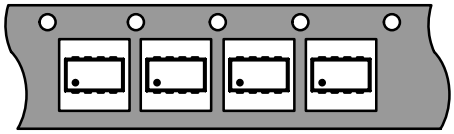
Direction of Feed

Figure 9. SC82 / SC82−AB
"TR" Suffix − Option 1, 3



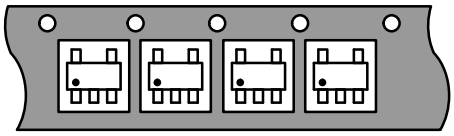
"T1" Pin One Opposing Sprocket Hole (3k Reel)
"T3" Pin One Opposing Sprocket Hole (10k Reel)

Figure 10. ChipFET (8−Lead)
"T1" Suffix − Option 1



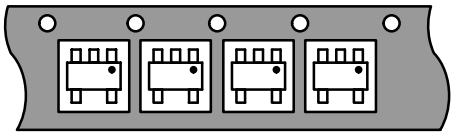
"T1" Pin One Opposing Sprocket Hole (3k Reel)

Figure 11. TSOP−5 / SOT23−5 / SC−74A
"T" or "TR" Suffix − Option 1, 3



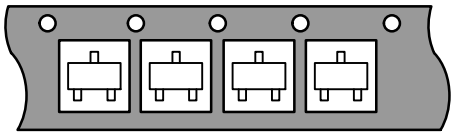
"T1" Pin One Opposing Sprocket Hole (3k Reel)
"T3" Pin One Opposing Sprocket Hole (10k Reel)

Option 2



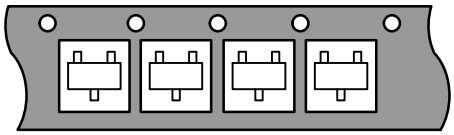
"T2" Pin One Toward Sprocket Hole (3k Reel)

Figure 12. SOT−23 / SOT−23L / SOT−323 / SOT−723 / SC−59 / SC−70 / SC−75 / SC−89
"T5", "TR" or "R2" Suffix − Option 1, 3



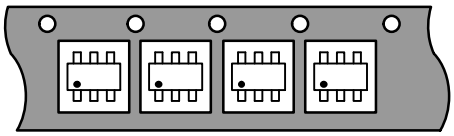
"T1" Single Lead Toward Sprocket Hole (3k Reel)
"T5" Single Lead Toward Sprocket Hole (8k Reel)
"T3" Single Lead Toward Sprocket Hole (10k Reel)

Option 2



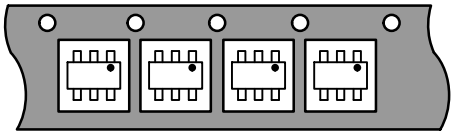
"T2" Single Lead Opposing Sprocket Hole (3k Reel)
(This Orientation Applies to SC−59 Only)

Figure 13. TSOP−6 / SOT23−6 / SC−74
"T" or "TR" Suffix − Option 1, 3



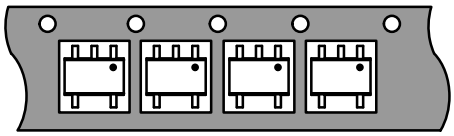
"T1" Pin One Opposing Sprocket Hole (3k Reel)
"T3" Pin One Opposing Sprocket Hole (10k Reel)

Option 2



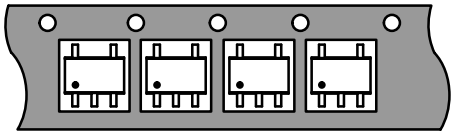
"T2" Pin One Toward Sprocket Hole (3k Reel)

Figure 14. SC−88A / SC70−5 / SOT−353
Option 1, 3



"T1" Pin One Toward Sprocket Hole (3k Reel)
"T3" Pin One Toward Sprocket Hole (10k Reel)

Option 2, 4



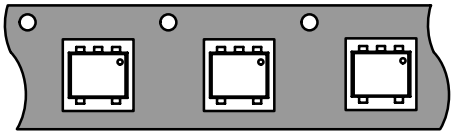
"T2" Pin One Opposing Sprocket Hole (3k Reel)
"T4" Pin One Opposing Sprocket Hole (10k Reel)

Product Orientation (continued)

Direction of Feed

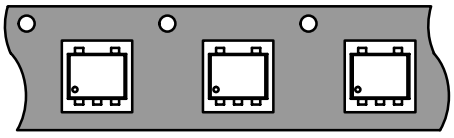
Figure 15. SOT−553

Option 1



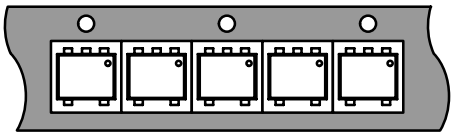
“T1” Pin One Toward Sprocket Hole (4k Reel)

Option 2



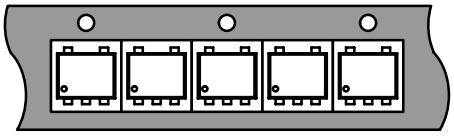
“T2” Pin One Opposing Sprocket Hole (4k Reel)

Option 5



“T5” Pin One Toward Sprocket Hole (8k Reel)

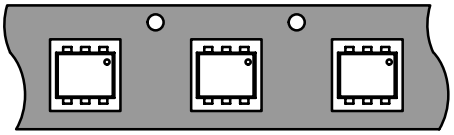
Option 6



“T6” Pin One Opposing Sprocket Hole (8k Reel)

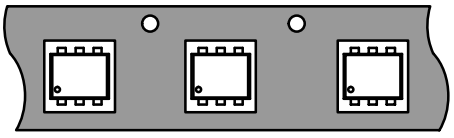
Figure 16. SOT−563

Option 1



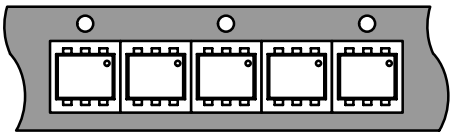
“T1” Pin One Toward Sprocket Hole (4k Reel)

Option 2



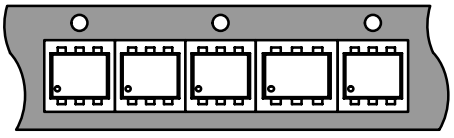
“T2” Pin One Opposing Sprocket Hole (4k Reel)

Option 5



“T5” Pin One Toward Sprocket Hole (8k Reel)

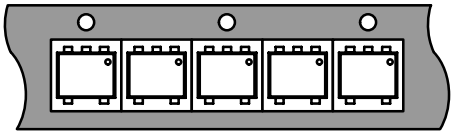
Option 6



“T6” Pin One Opposing Sprocket Hole (8k Reel)

Figure 17. SOT−953

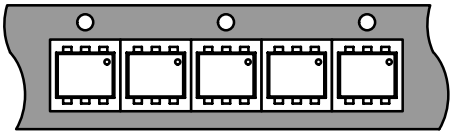
Option 5



“T5” Pin One Toward Sprocket Hole (8k Reel)

Figure 18. SOT−963

Option 5



“T5” Pin One Toward Sprocket Hole (8k Reel)

Figure 19. POWERMITE®

“T1” Suffix − Option 1

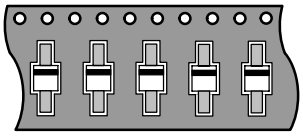
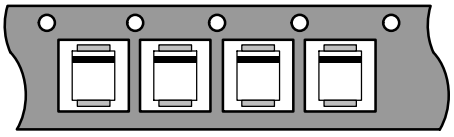


Figure 20. SMA, SMB, SMC

“TR” or “R2” Suffix − Option 1, 3



Unidirectional

SMA: “T1” Cathode Toward Sprocket Hole (1.5k Reel)
“T3” Cathode Toward Sprocket Hole (5k Reel)

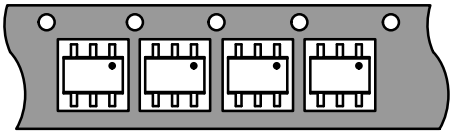
SMB/SMC: “T1” Cathode Toward Sprocket Hole (1k Reel)
“T3” Cathode Toward Sprocket Hole (2.5k Reel)

Bidirectional

Same as above except no orientation

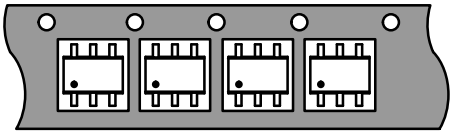
Direction of Feed

Figure 21. SC−88 / SC70−6 / SOT−363
Option 1, 3



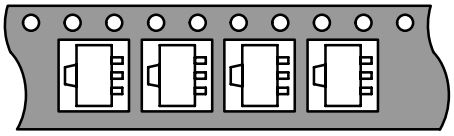
“T1” Pin One Toward Sprocket Hole (3k Reel)
“T3” Pin One Toward Sprocket Hole (10k Reel)

Option 2



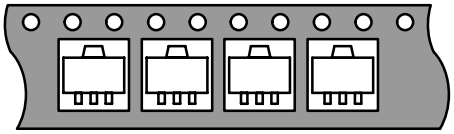
“T2” Pin One Opposing Sprocket Hole (3k Reel)

Figure 22. SOT−89
“R1” Suffix



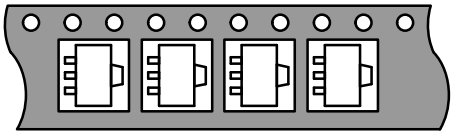
“R1” Pin One Opposing Sprocket Hole (1k Reel)

“T1” Suffix



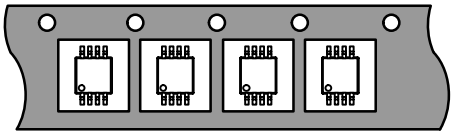
“T1” Single Lead Toward Sprocket Hole (1k Reel)

“T2” Suffix



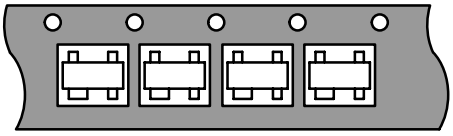
“T2” Single Lead Opposing Sprocket Hole (1k Reel)

Figure 23. ULTRA SMALL 8



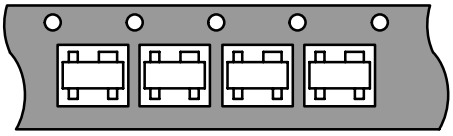
Pin One Opposing Sprocket Hole (3k Reel)

Figure 24. SOT−143
“T” or “TR” Suffix − Option 1, 3



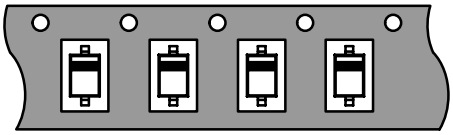
“T1” Wide Lead Tape Opposing Sprocket Hole (3k Reel)
“T3” Wide Lead Tape Opposing Sprocket Hole (10k Reel)

Option 2, 4



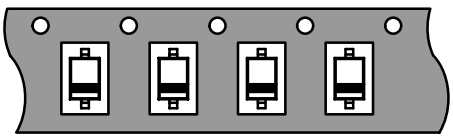
“T2” Wide Lead Tape Toward Sprocket Hole (3k Reel)
“T4” Wide Lead Tape Toward Sprocket Hole (10k Reel)

Figure 25. SOD−123 / SOD−323
Option 1, 3



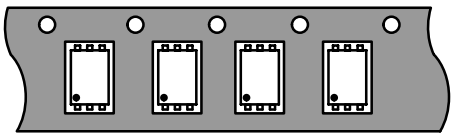
“T1” Cathode Lead Toward Sprocket Hole (3k Reel)
“T3” Cathode Lead Toward Sprocket Hole (10k Reel)

Option 2



“T2” Cathode Lead Opposing Sprocket Hole (3k Reel)

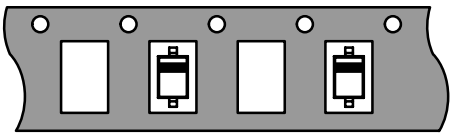
Figure 26. SON−6



Direction of Feed

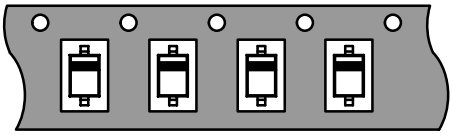
Figure 27. SOD−523

Option 1



"T1" Cathode Lead Toward Sprocket Hole (3k Reel)

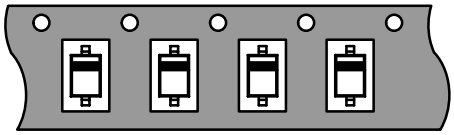
Option 5



"T5" Cathode Lead Toward Sprocket Hole (8k Reel)

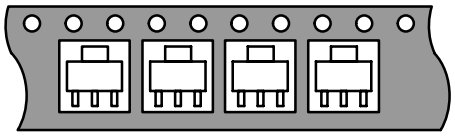
Figure 28. SOD−723, SOD−923

Option 5



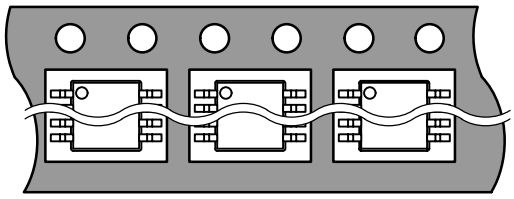
"T5" Cathode Lead Toward Sprocket Hole (8k Reel)

Figure 29. SOT−223



"T1" Single Lead Toward Sprocket Hole (1k Reel)
"T3" Single Lead Toward Sprocket Hole (4k Reel)
"R3" Single Lead Toward Sprocket Hole (2.5k Reel)

Figure 30. Micro8™ / Micro10 / SOIC / SO / TSSOP / SOP / SSOP

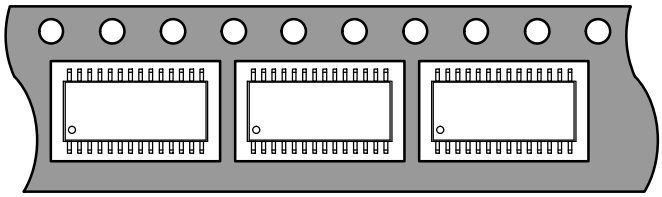


Pin 1 (Upper Left)

R2 − Clock & Data Mgt.
R or R2 − Analog

Figure 31. SO−28W

32 mm



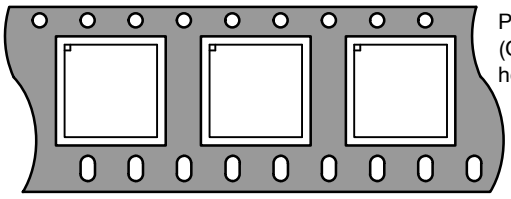
R3 − Analog

Product Orientation (continued)

Direction of Feed

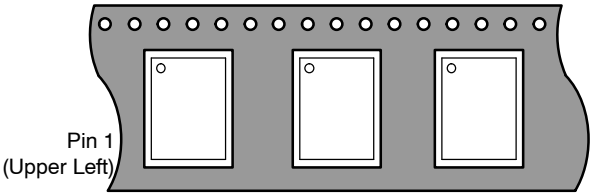
Leadless Packages

Figure 32. FCBGA (BGA)



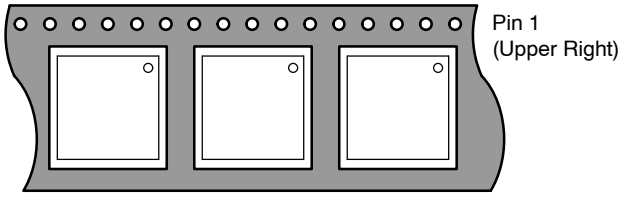
TA, TW

Figure 33. DFN/QFN



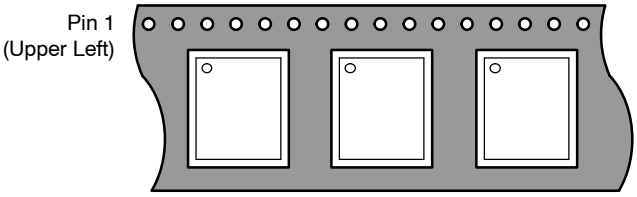
TA, TW

Figure 34. DFN/QFN (LPCC)
(square, equal sides)



TB, TX

Figure 35. DFN/QFN (LPCC)
(rectangular, unequal sides)



TA, TW

Package	Pre Jan 2007	Post Jan 2007
DFN / QFN Square (LPCC)	T1	TB, TX
	T4	TB, TX
	R2	TB, TX
DFN / QFN Rectangular (LPCC)	T1	TA, TW
	R2	TA, TW
DFN / QFN	T2	TA, TW
	R2	TA, TW
FCBGA / BGA	R2	TA, TW

Leadless Package Pin 1 Orientation for Tape and Reel (QFN, DFN, FCBGA, BGA, LPCC)

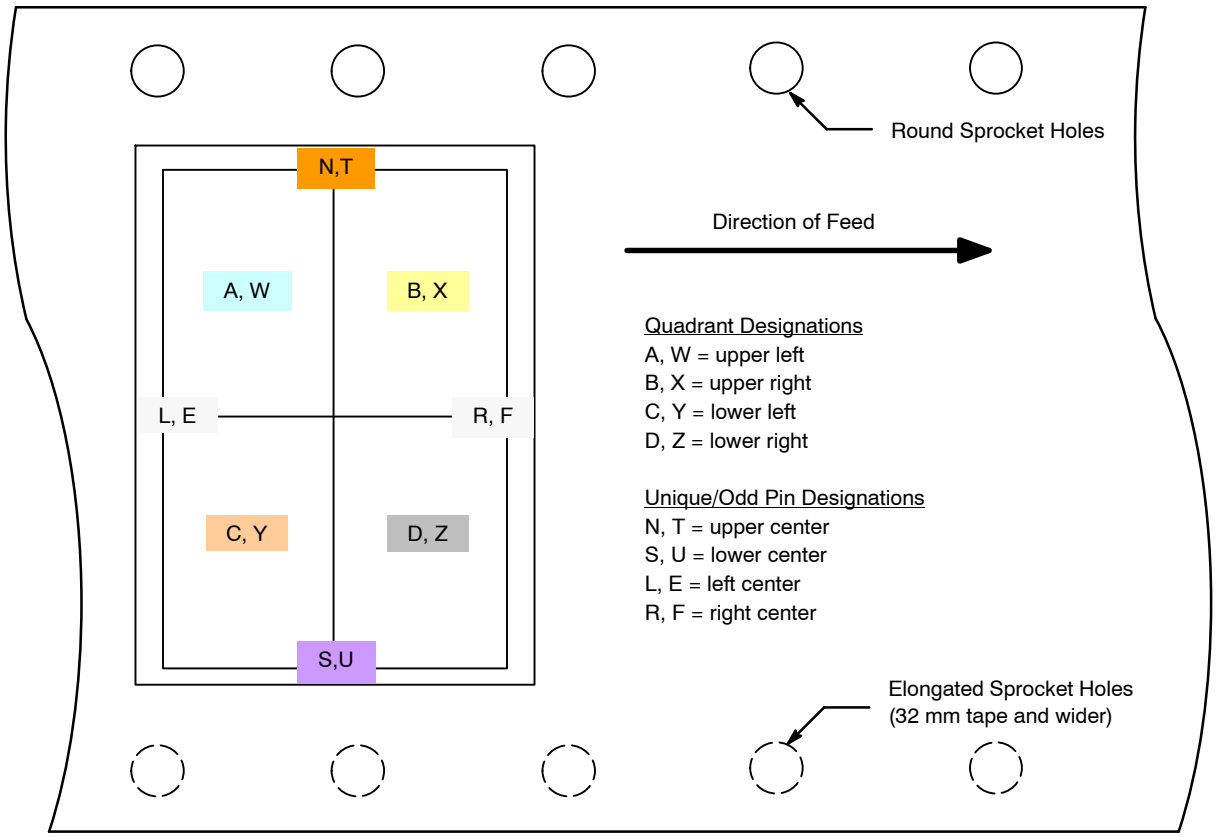
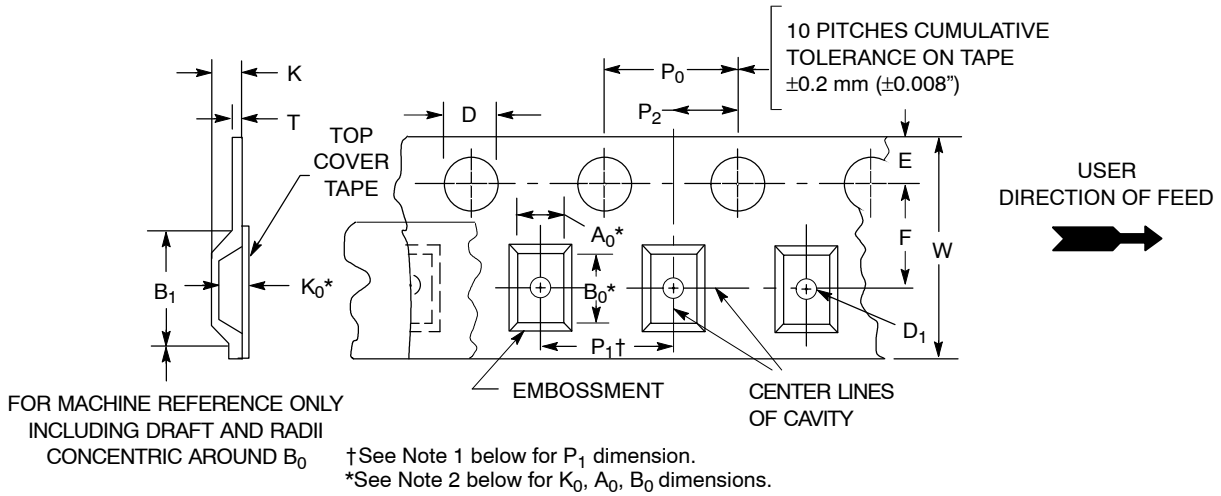


Figure 36. Leadless Package Pin 1 Orientation for Tape and Reel (Effective January 2007)

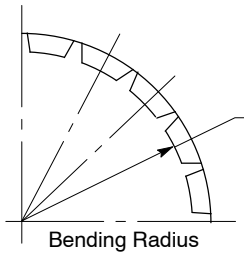
Part Number Suffix				
Shipping Type*	**Pin1 Location**	**Blank or Pb−Free**	**Remark:**	**Reel Size (mm) diameter**
T	A	G	Quadrant 1−upper left	177
T	B	G	Quadrant 2−−upper right	178
T	C	G	Quadrant 3−−lower left	178
T	D	G	Quadrant 4−−lower right	178
T	W	G	Quadrant 1−upper left	330
T	X	G	Quadrant 2−−upper right	330
T	Y	G	Quadrant 3−−lower left	330
T	Z	G	Quadrant 4−−lower right	330
T	N	G	North (upper center)	178
T	S	G	South (lower center)	178
T	T	G	Top (upper center)	330
T	U	G	Under (lower center)	330
T	L	G	Left center	178
T	R	G	Right center	178
T	E	G	Left center	330
T	F	G	Right center	330

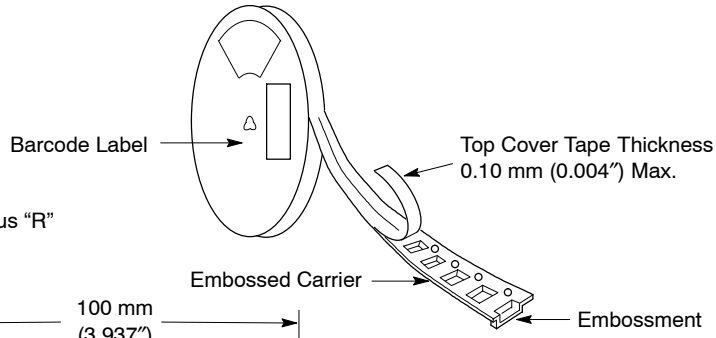
*T = Tape

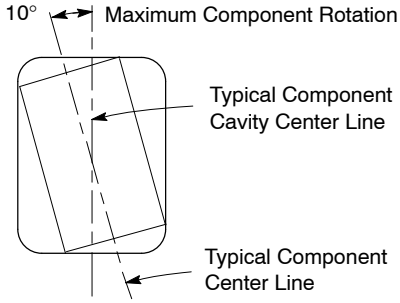
Embossed Tape and Reel Data Carrier Tape Specifications

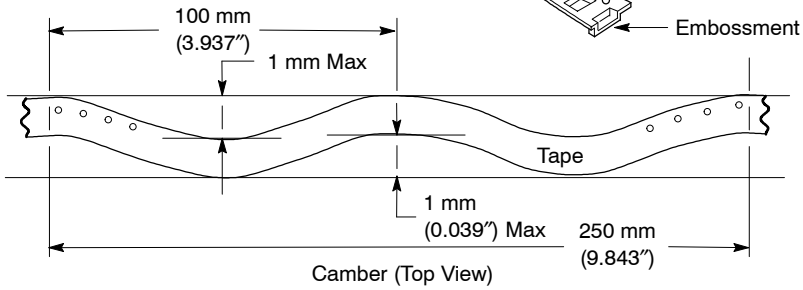


†See Note 1 below for P_1 dimension.
*See Note 2 below for K_0, A_0, B_0 dimensions.









Camber (Top View)
Allowable Camber To Be 1 mm/100 mm Nonaccumulative Over 250 mm

DIMENSIONS

Tape Size (W)	B_1 Max (Note 1)	D	D_1	E	F	K	P_0	P_2	R Min	T Max	W Max
8 mm	4.55 mm (0.179″)	1.5 + 0.1 mm − 0.0 (0.059 + 0.004″ − 0.0)	1.0 Min (0.039″) or 0.5 mm Min (0.020″)	1.75 ± 0.1 mm (0.069 ± 0.004″)	3.5 ± 0.05 mm (0.138 ± 0.002″)	2.4 mm Max (0.094″)	4.0 ± 0.1 mm (0.157 ± 0.004″)	2.0 ± 0.1 mm (0.079 ± 0.002″)	25 mm (0.98″)	0.6 mm (0.024″)	8.3 mm (0.327″)
12 mm	8.2 mm (0.323″)		1.5 mm Min (0.060″)		5.5 ± 0.05 mm (0.217 ± 0.002″)	6.4 mm Max (0.252″)			30 mm (1.18″)		12 ± 0.30 mm (0.470 ± 0.012″)
16 mm	12.1 mm (0.476″)				7.5 ± 0.10 mm (0.295 ± 0.004″)	7.9 mm Max (0.311″)					16.3 mm (0.642″)
24 mm	20.1 mm (0.791)				11.5 ± 0.1 mm (0.453 ± 0.004″)	11.9 mm Max (0.468″)					24.3 mm (0.957″)

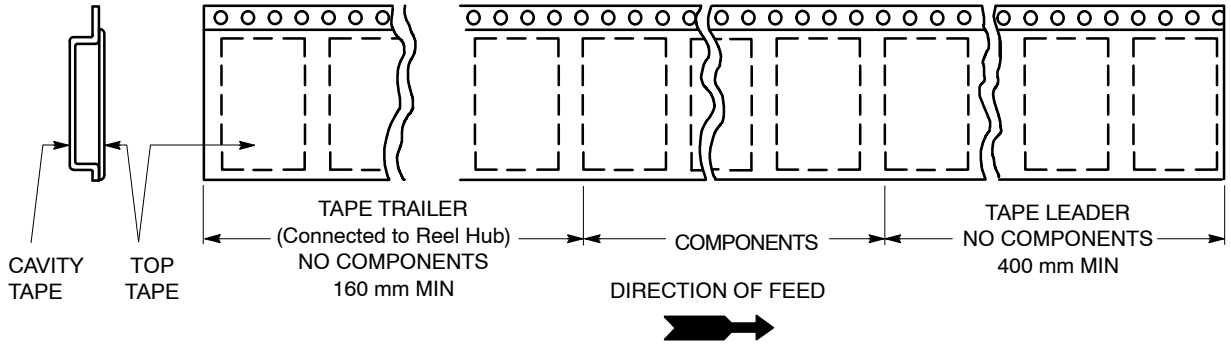
Metric dimensions govern − English are in parentheses for reference only.

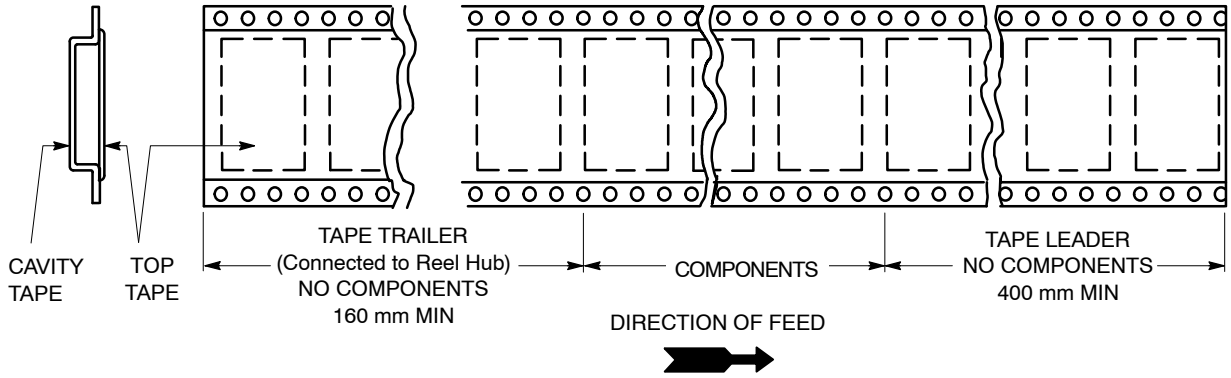
1. Pitch information (dimension P_1) is contained in the embossed tape and reel ordering information beginning on Page 7.
2. A_0, B_0, and K_0 are determined by component size. The clearance between the components and the cavity must be within 0.05 mm min to 0.50 mm max. The component cannot rotate more than 10° within the determined cavity.

Tape Ends for Finished Goods

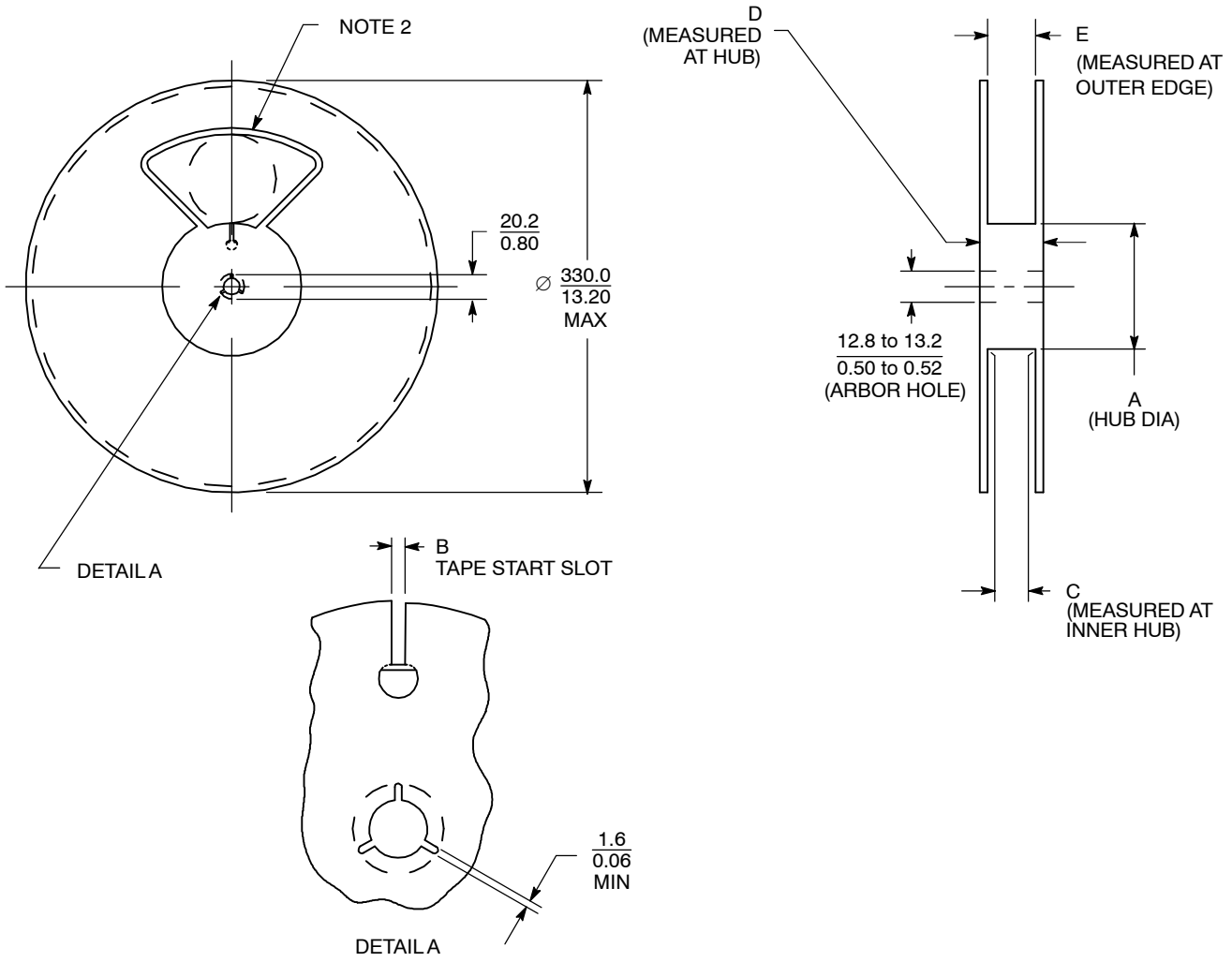
Leader and Trailer

The TRAILER is a minimum of 160 mm in length and it consists of empty cavities with sealed cover tape.
The LEADER is a minimum of 400 mm in length and it consists of empty cavities with sealed cover tape.





Reel Dimensions



Reel Diameter	Tape Size	A mm (inches)		B mm (inches)		C mm (inches)		D	E
		Min	Max	Min	Max	Min	Max	(Max)	(Max)
178.0 (7.01)	16.0 (0.63)		50.0 (1.97)	6.5 (0.26)	7.5 (0.30)	16.4 (0.65)	18.4 (0.72)	22.4 (0.88)	19.4 (0.76)
330.0 (12.99)	12.0 (0.47)	178.0 (7.01)		4.5 (0.18)	5.5 (0.22)	12.4 (0.49)	14.4 (0.57)	18.4 (0.72)	15.4 (0.61)
330.0 (12.99)	56.0 (2.20)	150.0 (5.91)		10.0 (0.39)	11.0 (0.43)	56.4 (2.22)	58.4 (2.30)	62.4 (2.46)	59.4 (2.34)
330.0 (12.99)	44.0 (1.73)	100.0 (3.94)		10.0 (0.39)	11.0 (0.43)	44.4 (1.75)	46.4 (1.83)	62.4 (2.46)	47.4 (1.87)
330.0 (12.99)	32.0 (1.26)	100.0 (3.94)		10.0 (0.39)	11.0 (0.43)	32.4 (1.28)	34.4 (1.35)	38.4 (1.51)	35.4 (1.39)
330.0 (12.99)	24.0 (0.94)	60.0 (2.36)		9.5 (0.37)	10.5 (0.41)	24.4 (0.96)	26.4 (1.04)	30.4 (1.51)	27.4 (1.08)
330.0 (12.99)	16.0 (0.63)			6.5 (0.26)	7.5 (0.30)	16.4 (0.65)	18.4 (0.72)	22.4 (0.88)	19.4 (0.76)
330.0 (12.99)	12.0 (0.47)			4.5 (0.18)	5.5 (0.22)	12.4 (0.49)	14.4 (0.57)	18.4 (0.72)	15.4 (0.61)
330.0 (12.99)	8.0 (0.31)	50.0 (1.97)		2.5 (0.10)	3.5 (0.14)	8.4 (0.33)	9.9 (0.39)	14.4 (0.57)	10.9 (0.43)
178.0 (7.01)	12.0 (0.47)	50.0 (1.97)		4.5 (0.18)	5.5 (0.22)	12.4 (0.49)	14.4 (0.57)	18.4 (0.72)	15.4 (0.61)
178.0 (7.00)	8.0 (0.31)	50.0 (1.97)		2.5 (0.10)	3.5 (0.14)	8.4 (0.33)	9.9 (0.39)	14.4 (0.47)	10.9 (0.43)
330.0 (12.99)	8.0 (0.31)	50.0 (1.97)		4.0 (0.16)	5.0 (0.20)	8.4 (0.33)	9.9 (0.39)	14.4 (0.57)	10.9 (0.43)
178.0 (7.00)	8.0 (0.31)	50.0 (1.97)		4.0 (0.16)	5.0 (0.20)	8.4 (0.33)	9.9 (0.39)	14.4 (0.57)	10.9 (0.43)

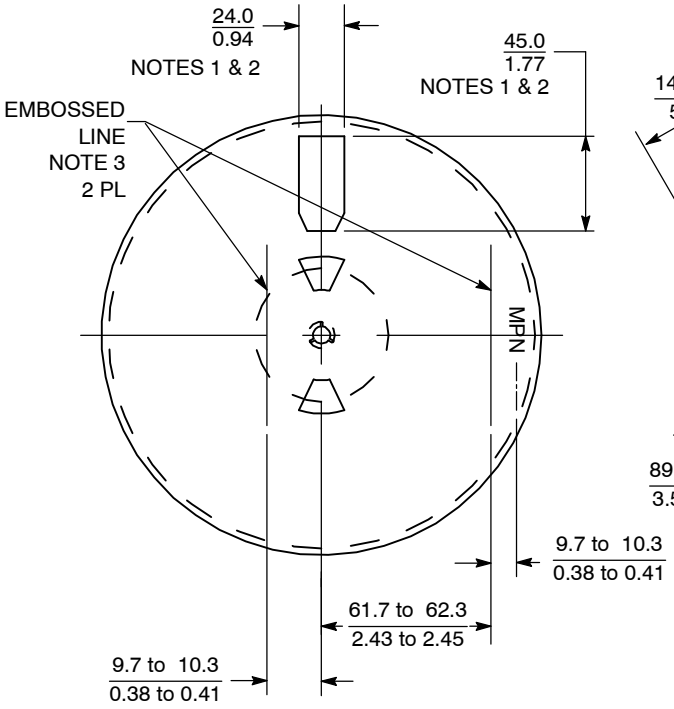


Figure 37. Front View of 178 mm (7.0 in) Reel

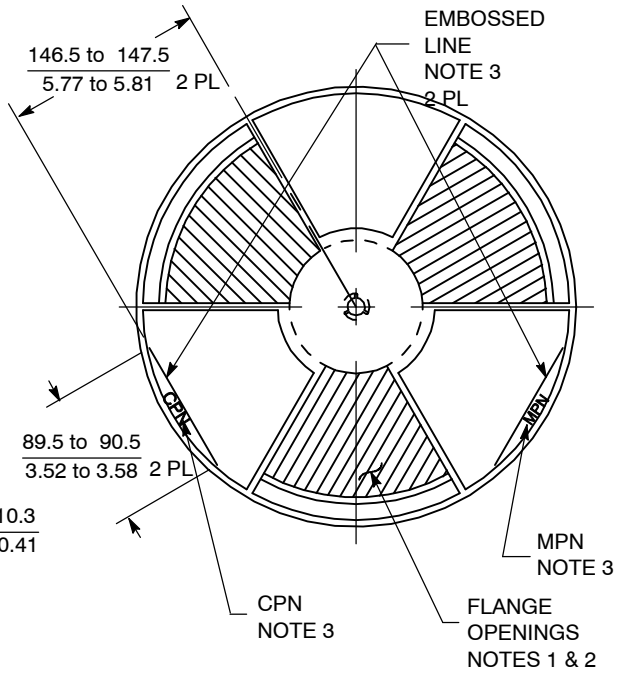


Figure 38. Front View of 330 mm (12.99 in) Reel

NOTES:

1. LABEL PLACEMENT AREA:
   - All reels must have flat area on the front flange of the reel that will fit two 41.3 mm (1.65 in) by 125 mm (4.90 in) ON Semiconductor barcode labels.
   - If there are any flange openings on the front side of the 178 mm (7.00 in) reel they must be designed in locations so that two of the 41.3 mm (1.65 in) ON Semiconductor barcode labels can be applied parallel to each other as in Figure 37.
   - If there are any flange opening on the front flange of the 330 mm (13.0 in) reel they must be designed in locations so that two of the 41.3 mm (1.65 in) by 125 mm (4.90 in) ON Semiconductor barcode labels can be applied parallel to each other as in Figure 38.
2. FLANGE OPENINGS
   - Flange opening on the front and the back of the reel are a supplier option but must meet all of the requirements in Note 1. The preferred size for the 176 mm (7.0 in) reel is shown in Figure 37.
   - The tape loading opening must be as in Detail A.
3. GRAPHICS:
   - The letters MPN and CPN are a option. The size and thickness of the letters are the manufacturer's option and are not to be used for inspection criteria.
   - The embossed lines on the reel are a option. If the lines are used they must be located as in Figure 37 and 38. They must be a minimum 38 mm (1.50 in) long. The thickness is a manufacturer's option and not to be used for inspection criteria.

Reel Labeling

Place the reel on an ESD protective surface so that the round sprocket holes are on the bottom. The direction of travel when unwound should be from the top right quadrant. See illustration below.

REEL WINDING DIRECTION

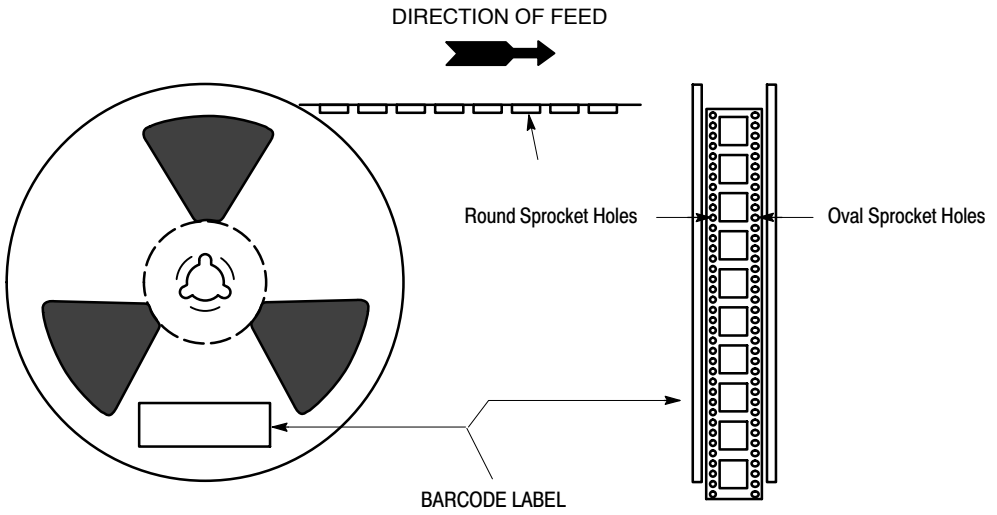


Figure 39. Round and Oval Sprocket Holes Used with 32 mm, 42 mm, 44 mm and 52 mm Tape (holes on both sides)

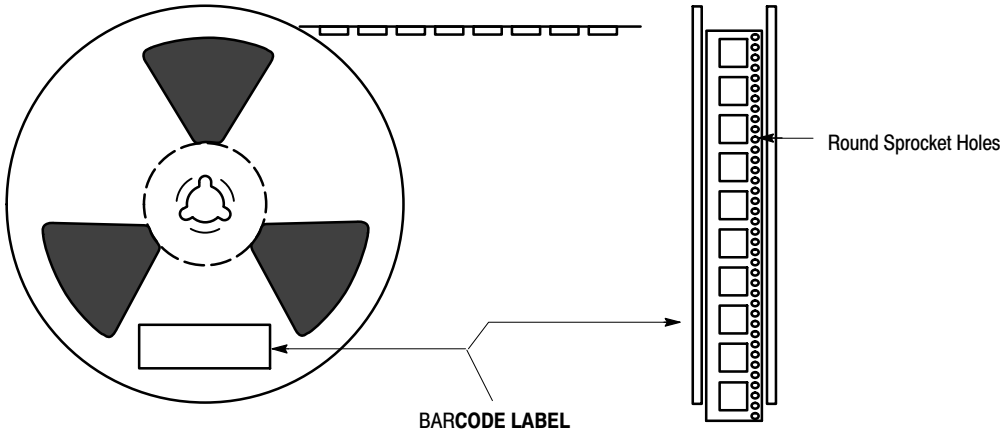
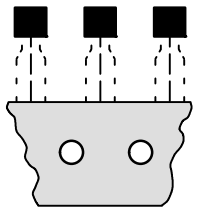


Figure 40. Round Sprocket Holes Used with 8 mm, 12 mm,16 mm and 24 mm Tape (holes on one side only)

TO−92 EIA, IEC, EIAJ Radial Tape in Fan Fold Box or On Reel

TO−92 RADIAL TAPE IN FAN FOLD BOX OR ON REEL



Radial tape in fan fold box or on reel of the reliable TO−92 package are the best methods of capturing devices for automatic insertion in printed circuit boards. These methods of taping are compatible with various equipment for active and passive component insertion.

- Available in Fan Fold Box
- Available on 365 mm Reels
- Accommodates All Standard Inserters
- Allows Flexible Circuit Board Layout
- 2.5 mm Pin Spacing for Soldering
- EIA−468, IEC 286−2, EIAJ RC1008B

Ordering Notes:

When ordering radial tape in fan fold box or on reel, specify the style per Figures 42, 43, 49 and 50. Add the suffix “RLR” and “Style” to the device title, i.e. 2N5060RLRA. This will be a standard 2N5060 radial taped and supplied on a reel.

- Fan Fold Box Information − Minimum order quantity 1 Box. Order in increments of 2000.
- Reel Information − Minimum order quantity 1 Reel. Order in increments of 2000.

US/EUROPEAN SUFFIX CONVERSIONS

U.S.	Europe	Package Style
RLRA	RL	Reel
RLRE	RL1	Reel
RLRM	ZL1	Fan Fold
RLRP	–	Fan Fold

TO−92 EIA RADIAL TAPE IN FAN FOLD BOX OR ON REEL

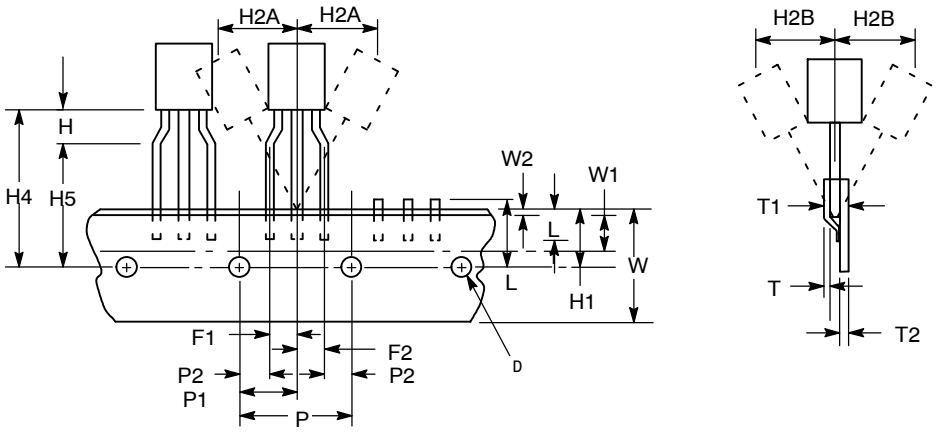


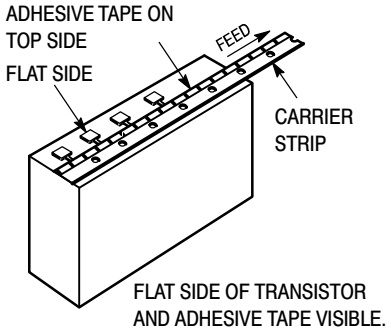
Figure 41. Device Positioning on Tape

Symbol	Item	Specification			
		Inches		Millimeter	
		Min	Max	Min	Max
D	Tape Feedhole Diameter	0.1496	0.1653	3.8	4.2
D2	Component Lead Thickness Dimension	0.015	0.020	0.38	0.51
F1, F2	Component Lead Pitch	0.0945	0.110	2.4	2.8
H	Bottom of Component to Seating Plane	0.059	0.156	1.5	4.0
H1	Feedhole Location	0.3346	0.3741	8.5	9.5
H2A	Deflection Left or Right	0	0.039	0	1.0
H2B	Deflection Front or Rear	0	0.051	0	1.0
H4	Feedhole to Bottom of Component	0.7086	0.768	18	19.5
H5	Feedhole to Seating Plane	0.610	0.649	15.5	16.5
L	Defective Unit Clipped Dimension	0.3346	0.433	8.5	11
L1	Lead Wire Enclosure	0.09842	–	2.5	–
P	Feedhole Pitch	0.4921	0.5079	12.5	12.9
P1	Feedhole Center to Center Lead	0.2342	0.2658	5.95	6.75
P2	First Lead Spacing Dimension	0.1397	0.1556	3.55	3.95
T	Adhesive Tape Thickness	0.06	0.08	0.15	0.20
T1	Overall Taped Package Thickness	–	0.0567	–	1.44
T2	Carrier Strip Thickness	0.014	0.027	0.35	0.65
W	Carrier Strip Width	0.6889	0.7481	17.5	19
W1	Adhesive Tape Width	0.2165	0.2841	5.5	6.3
W2	Adhesive Tape Position	0.0059	0.01968	0.15	0.5

3. Maximum alignment deviation between leads not to be greater than 0.2 mm.
4. Defective components shall be clipped from the carrier tape such that the remaining protrusion (L) does not exceed a maximum of 11 mm.
5. Component lead to tape adhesion must meet the pull test requirements established in Figures 45, 46 and 47.
6. Maximum non−cumulative variation between tape feed holes shall not exceed 1 mm in 20 pitches.
7. Hold down tape not to extend beyond the edge(s) of carrier tape and there shall be no exposure of adhesive.
8. No more than 1 consecutive missing component is permitted.
9. A tape trailer and leader, having at least three feed holes is required before the first and after the last component.
10. Splices will not interfere with the sprocket feed holes.

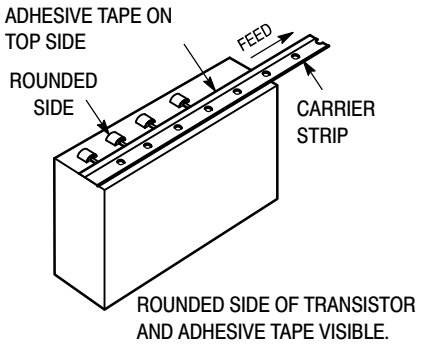
TO−92 EIA RADIAL TAPE IN FAN FOLD BOX OR ON REEL

FAN FOLD BOX STYLES



Style M fan fold box is equivalent to styles E and F of reel pack dependent on feed orientation from box.

Figure 42. Style RLRM



Style P fan fold box is equivalent to styles A and B of reel pack dependent on feed orientation from box.

Figure 43. Style RLRP

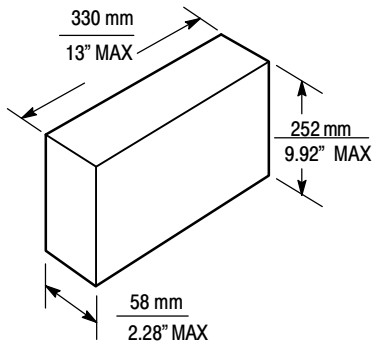
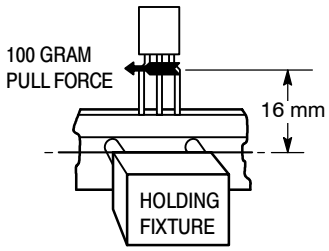


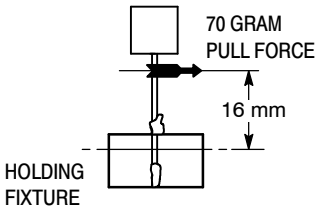
Figure 44. Fan Fold Box Dimensions

ADHESION PULL TESTS



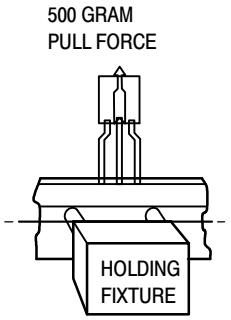
The component shall not pull free with a 300 gram load applied to the leads for 3 ± 1 second.

Figure 45. Test #1



The component shall not pull free with a 70 gram load applied to the leads for 3 ± 1 second.

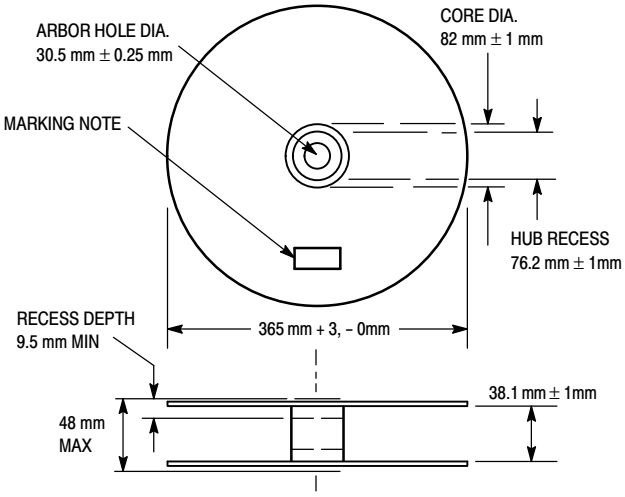
Figure 46. Test #2



There shall be no deviation in the leads and no component leads shall be pulled free of the tape with a 500 gram load applied to the component body for 3 ± 1 second.

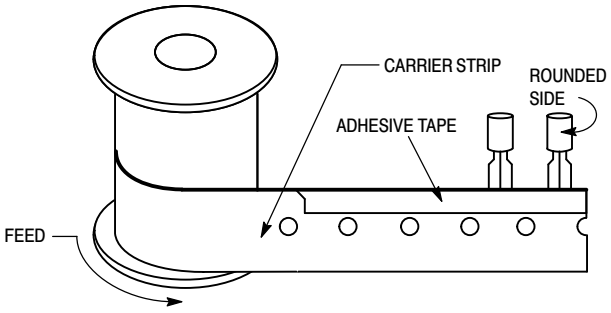
Figure 47. Test #3

TO−92 EIA RADIAL TAPE IN FAN FOLD BOX OR ON REEL: REEL STYLES



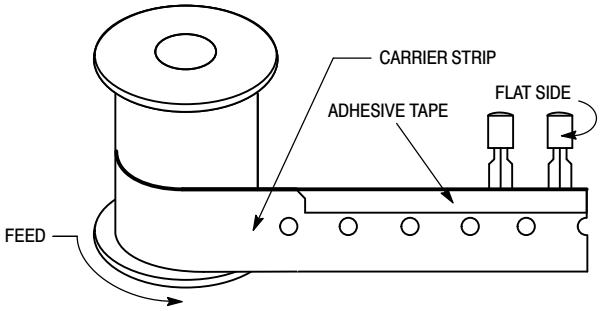
Material used must not cause deterioration of components or degrade lead solderability

Figure 48. Reel Specifications



Rounded side of transistor and adhesive tape visible.

Figure 49. Style RLRA



Flat side of transistor and adhesive tape visible.

Figure 50. Style RLRE

Lead Tape Packaging Standards for Axial−Lead Components

1.0 SCOPE

This section covers packaging requirements for the following axial-lead component's use in automatic testing and assembly equipment: ON Semiconductor Case 17-02, Case 41A-02, Case 51-02 (DO-7), Case 59-03 (DO-41), Case 59-04, Case 194-04 and Case 299-02 (DO-35). Packaging, as covered in this section, shall consist of axial-lead components mounted by their leads on pressure sensitive tape, wound onto a reel.

2.0 PURPOSE

This section establishes ON Semiconductor standard practices for lead-tape packaging of axial-lead components and meets the requirements of EIA Standard RS-296-D "Lead-taping of Components on Axial Lead Configuration for Automatic Insertion," level 1.

3.0 REQUIREMENTS

3.1 Component Leads

3.1.1 – Component leads shall not be bent beyond dimension E from their normal position. See Figure 52.

3.1.2 – The "C" dimension shall be governed by the overall length of the reel packaged component. The distance between flanges shall be 0.059 inch to 0.315 inch greater than the overall component length. See Figures 52 and 53.

3.1.3 – Cumulative dimension "A" tolerance shall not exceed 0.059 over 6 in consecutive components.

3.2 Orientation

All polarized components must be oriented in one direction. The cathode lead tape shall be any color except white and the anode tape shall be white. See Figure 51.

3.3 Reeling

3.3.1 – Components on any reel shall not represent more than two date codes when date code identification is required.

3.3.2 – Component's leads shall be positioned perpendicularly between pairs of 0.250 inch tape. See Figure 52.

3.3.3 – A minimum 12 inch leader of tape shall be provided before the first and last component on the reel.

3.3.4 – 50 lb. Kraft paper is wound between layers of components as far as necessary for component protection.

3.3.5 – Components shall be centered between tapes such that the difference between D1 and D2 does not exceed 0.055.

3.3.6 – Staples shall not be used for splicing. No more than four layers of tape shall be used in any splice area and no tape shall be offset from another by more than 0.031 inch noncumulative. Tape splices shall overlap at least 6 inches for butt joints and at least 3 inches for lap joints and shall not be weaker than unspliced tape.

3.3.7 – Quantity per reel shall be as indicated in Table 1. Orders for tape and reeled product will only be processed and shipped in full reel increments. Scheduled orders must be in releases of full reel increments or multiples thereof.

3.3.8 – A maximum of 0.25% of the components per reel quantity may be missing without consecutive missing per level 1 of RS-296-D.

3.3.9 – The single face roll pad shall be placed around the finished reel and taped securely. Each reel shall then be placed in an appropriate container.

3.4 Marking

Minimum reel and carton marking shall consist of the following (see Figure 53):

ON Semiconductor part number

Quantity

Manufacturer's name

Date codes (when applicable; see note **3.3.1**)

4.0

Requirements differing from this ON Semiconductor standard shall be negotiated with the factory.

The packages indicated in the following table are suitable for lead tape packaging. Table 1 indicates the specific devices (transient voltage suppressors and/or Zeners) that can be obtained from ON Semiconductor in reel packaging and provides the appropriate packaging specification.

Lead Tape Packaging Standards for Axial−Lead Components

Table 1. PACKAGING DETAILS (all dimensions in inches)

Case Type	Product Category	Device Title Suffix	MPQ Quantity Per Reel	Component Spacing A Dimension	Tape Spacing B Dimension	Reel Dimension C	Reel Dimension D (Max)	Max Off Alignment E
Case 17	Surmetic 40 & 600 Watt TVS	RL	4000	0.2 ± 0.015	2.062 ± 0.059	3	14	0.047
Case 41A	1500 Watt TVS	RL4	1500	0.4 ± 0.02	2.062 ± 0.059	3	14	0.047
Case 59	DO−41 Glass & DO−41 Surmetic 30	RL	6000	0.2 ± 0.015	2.062 ± 0.059	3	14	0.047
	Rectifier							
Case 59	500 Watt TVS	RL	500	0.2 ± 0.02	2.062 ± 0.059	3	14	0.047
	Rectifier							
Case 194	110 Amp TVS (Automotive)	RL	800	0.4 ± 0.02	1.875 ± 0.059	3	14	0.047
	Rectifier							
Case 267	Rectifier	RL	1500	0.4 ± 0.02	2.062 ± 0.059	3	14	0.047
Case 299	DO−35 Glass	RL	5000	0.2 ± 0.02	2.062 ± 0.059	3	14	0.047
Case 267	Schottky & Ultrafast Rectifiers	RL	1500	0.4 ± 0.02	2.062 ± 0.059	3	14	0.047
Case 267	Fast Recovery & General Purpose Rectifiers	RL	1200	0.4 ± 0.02	2.062 ± 0.059	3	14	0.047

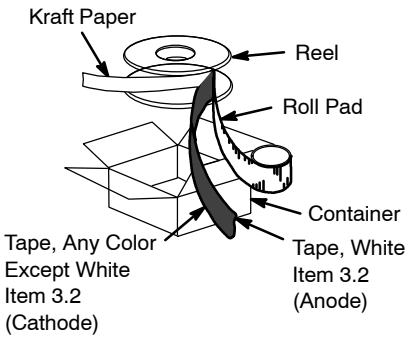


Figure 51. Reel Packing

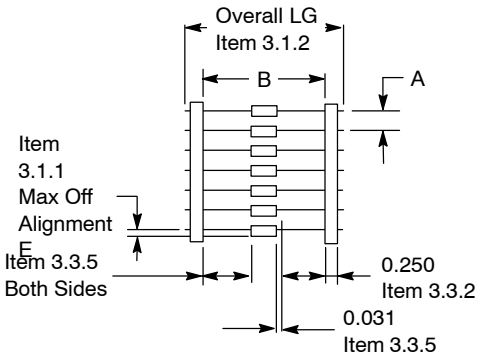


Figure 52. Component Spacing

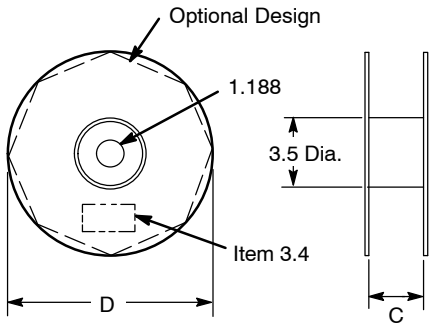


Figure 53. Reel Dimensions (Item references appear on Page 26)

INFORMATION FOR USING SURFACE MOUNT PACKAGES

RECOMMENDED FOOTPRINTS FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.

POWER DISSIPATION FOR A SURFACE MOUNT DEVICE

The power dissipation for a surface mount device is a function of the drain/collector pad size. These can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating ambient temperature, T_A. Using the values provided on the data sheet, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device. For example, for a SOT−223 device, P_D is calculated as follows.

$$P_D = \frac{150°C - 25°C}{156°C/W} = 800 \text{ milliwatts}$$

The 156°C/W for the SOT−223 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 800 milliwatts. There are other alternatives to achieving higher power dissipation from the surface mount packages. One is to increase the area of the drain/collector pad. By increasing the area of the drain/collector pad, the power dissipation can be increased. Although the power dissipation can almost be doubled with this method, area is taken up on the printed circuit board which can defeat the purpose of using surface mount technology. For example, a graph of $R_{\theta JA}$ versus drain pad area is shown in Figures 54, 55 and 56.

Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

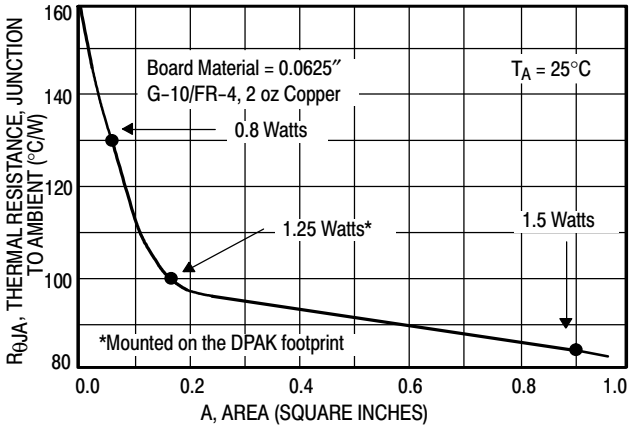


Figure 54. Thermal Resistance versus Drain Pad Area for the SOT−223 Package (Typical)

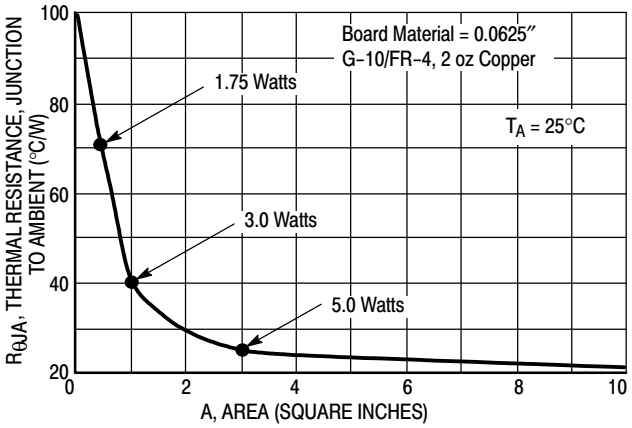


Figure 55. Thermal Resistance versus Drain Pad Area for the DPAK Package (Typical)

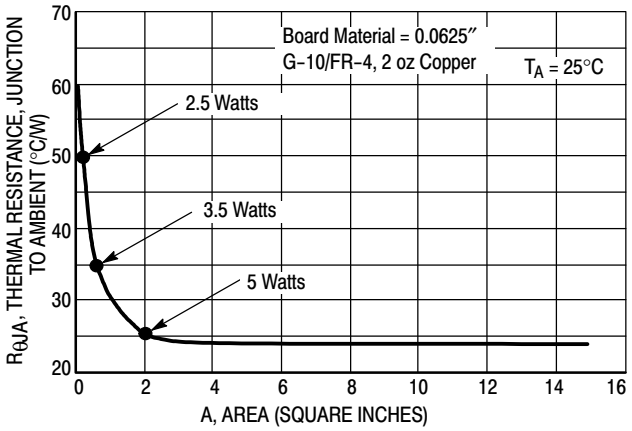


Figure 56. Thermal Resistance versus Drain Pad Area for the D²PAK Package (Typical)

SOLDER STENCIL GUIDELINES

Prior to placing surface mount components onto a printed circuit board, solder paste must be applied to the pads. Solder stencils are used to screen the optimum amount. These stencils are typically 0.008 inches thick and may be made of brass or stainless steel. For packages such as the SC−59, SC−70/SOT−323, SOD−123, SOT−23, SOT−143, SOT−223, SO−8, SO−14, SO−16, and SMB/SMC diode packages, the stencil opening should be the same as the pad size or a 1:1 registration. This is not the case with the DPAK and D^2PAK packages. If a 1:1 opening is used to screen solder onto the drain pad, misalignment and/or "tombstoning" may occur due to an excess of solder. For these two packages, the opening in the stencil for the paste should be approximately 50% of the tab area. The opening for the leads is still a 1:1 registration. Figure 57 shows a typical stencil for the DPAK and D^2PAK packages. The pattern of the opening in the stencil for the drain pad is not critical as long as it allows approximately 50% of the pad to be covered with paste.

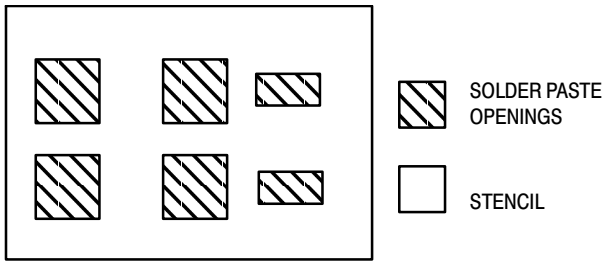


Figure 57. Typical Stencil for DPAK and D^2PAK Packages

SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference should be a maximum of 10°C.
- For wave soldering, the soldering temperature and time should not exceed 260°C for more than 10 seconds. For other reflow methods such as convection and IR ovens, refer to the reflow profiles on the following pages.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used since the use of forced cooling will increase the temperature gradient and will result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

* Due to shadowing and the inability to set the wave height to incorporate other surface mount components, the D^2PAK is not recommended for wave soldering.

TYPICAL SOLDER HEATING PROFILE

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones and a figure for belt speed. Taken together, these control settings make up a heating “profile” for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 58 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems, but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time. The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177−189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

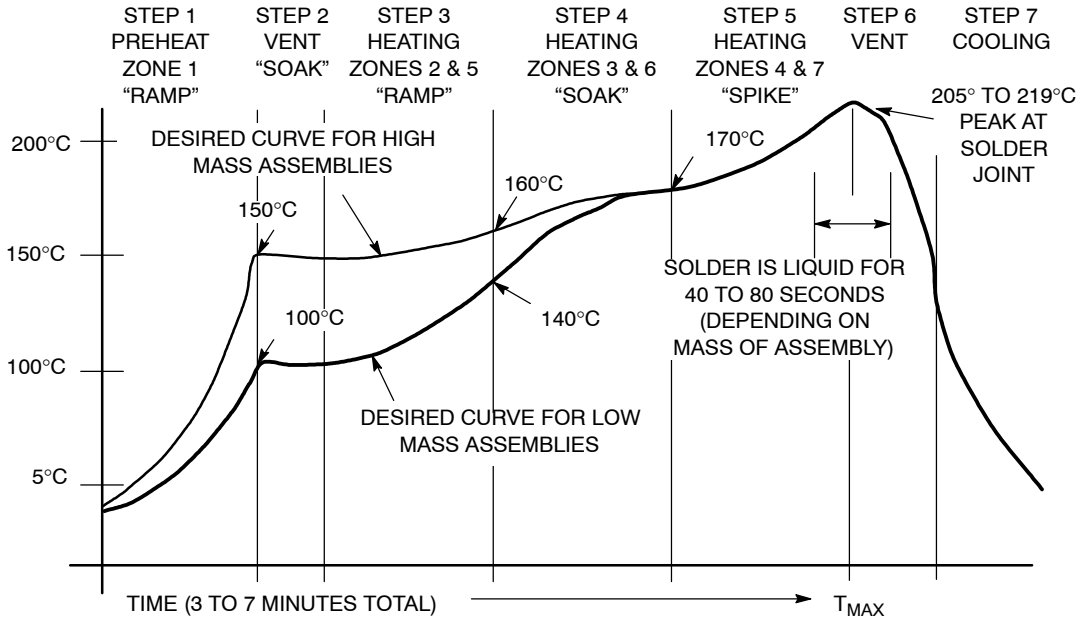


Figure 58. Typical Tin Lead (SnPb) Solder Heating Profile

TYPICAL SOLDER HEATING PROFILE (continued)

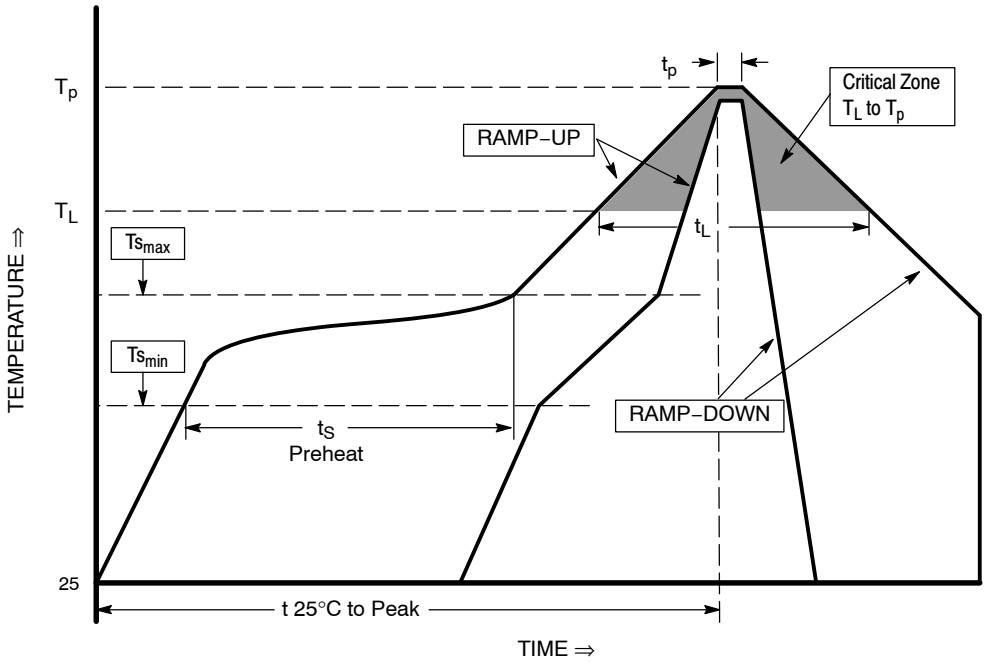


Figure 59. Typical Pb−Free Solder Heating Profile

Profile Feature	Pb−Free Assembly
Average Ramp−Up Rate (Ts_{max} to Tp)	3°C/second max
Preheat Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (ts_{min} to ts_{max})	 150°C 200°C 60−180 seconds
Time maintained above Temperature (T_T) Time (t_T)	 217°C 60−150 seconds
Peak Classification Temperature (Tp)	260°C +5/−0
Time within 5°C of actual Peak Temperature (tp)	20−40 seconds
Ramp−Down Rate	6°C/second max
Time 25°C to Peak Temperature	8 minutes max

AMBIENT MOUNTING DATA

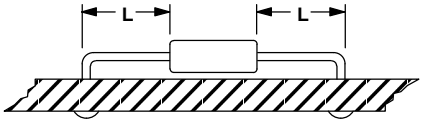
Data shown for thermal resistance junction−to−ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method		Lead Length, L (IN)				Units
		1/8	1/4	1/2	3/4	
1	$R_{\theta JA}$	50	51	53	55	°C/W
2		58	59	61	63	°C/W
3		28				°C/W

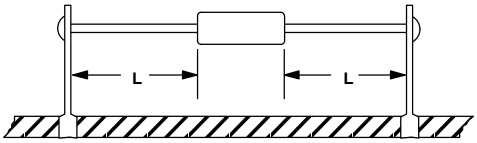
MOUNTING METHOD 1

P.C. Board Where Available Copper Surface area is small.



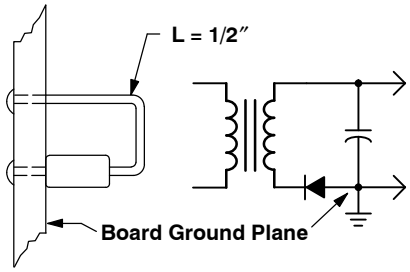
MOUNTING METHOD 2

Vector Push−In Terminals T−28



MOUNTING METHOD 3

P.C. Board with 1−1/2″ x 1−1/2″ Copper Surface



Humidity Indicator Card: Type HIC−0560

Objective

The objective of this information brief is to provide the customer with a general understanding of the humidity indicator cards (HIC) basic functions and a reaction plan based on the level of dryness as indicated on the card.

Introduction

The HIC is printed with moisture sensitive spots which will respond to variations of different levels of humidity with perceptible change in color typically from blue (dry) to pink (wet). The HIC is packed inside moisture barrier bags, which monitor the moisture inside the barrier bag. When the bag is opened, the HIC can be examined to determine the degree of dryness of the parts inside the bag.

Humidity Indicator Cards: HIC-0515 and HIC-0560

Excess humidity in the dry pack is noted by the HIC. It can occur due to misprocessing (e.g. missing or inadequate desiccant), mishandling (e.g. tears or rips in the moisture barrier bag) or improper storage.

The HIC should be read immediately upon removal from the moisture barrier bag. For best accuracy, the HIC should be read at 23±5°C. The following conditions apply regardless of the storage time (whether or not the shelf life has exceeded).

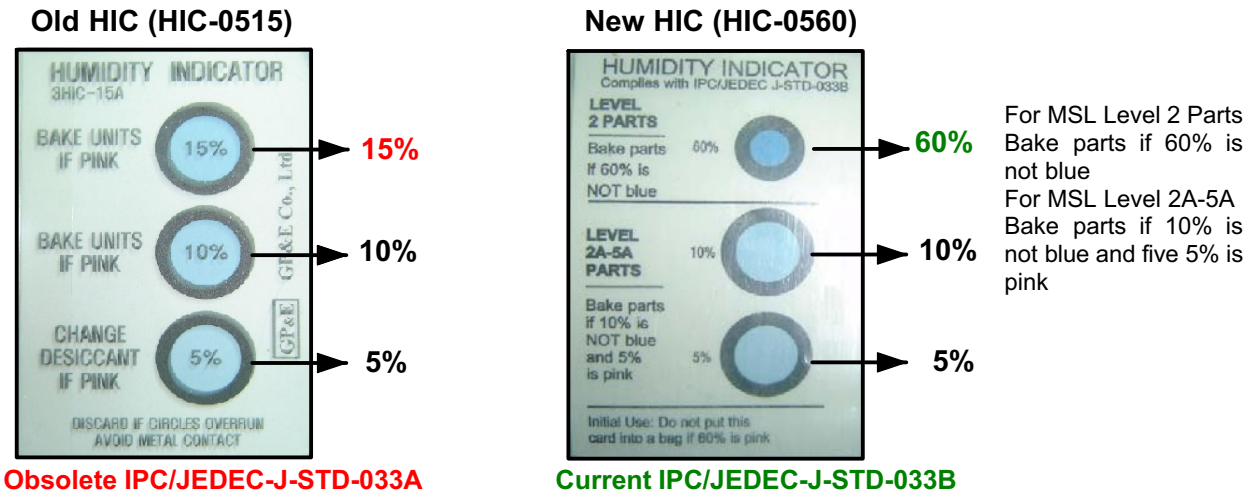


Figure 60. Humidity Indicator Card

Table 2: HIC Conditions and Corresponding Actions for HIC-0560

HIC Conditions	5%	10%	60%	Action	Remarks
Condition 1	Blue	Blue	Blue	No bake	Parts are dry
Condition 2	Pink	Blue	Blue	No bake	Only indicates that parts have 5% level of moisture
Condition 3	Pink	Pink	Blue	Bake required, refer to Table 2	Bake parts MSL levels 2a, 3, 4, 5, and 5a No need to bake MSL level 2
Condition 4	Pink	Pink	Pink	Bake required, refer to Table 2	All were parts were affected by moisture

Bake Duration for Exposed Parts

AMIS recommends that bake duration of exposed parts should comply with the existing provisions as mandated by Joint Industry Standard IPC/JEDEC-STD-033B entitled "Handling, Packing and Use of Moisture/Reflow Sensitive Surface Mount Devices" Bake Duration for Exposed Parts as shown in Table 3.

Table 3: Reference Conditions for Drying Mounted or Unmounted SMD Packages (User bake: floor life beings counting at time = 0 after bake)

Package Body	Level	Bake @ 125°C		Bake @ 90°C ≤ 5% RH		Bake @ 40°C ≤ 5% RH	
		Exceeding Floor Life by > 72 h	Exceeding Floor Life by > 72 h	Exceeding Floor Life by > 72 h	Exceeding Floor Life by > 72 h	Exceeding Floor Life by > 72 h	Exceeding Floor Life by > 72 h
Thickness ≤ 1.4mm	2	5 hours	3 hours	17 hours	11 hours	8 days	5 days
	2a	7 hours	5 hours	23 hours	13 hours	9 days	7 days
	3	9 hours	7 hours	33 hours	23 hours	13 days	9 days
	4	11 hours	7 hours	37 hours	23 hours	15 days	9 days
	5	12 hours	7 hours	41 hours	24 hours	17 days	10 days
	5a	16 hours	10 hours	54 hours	24 hours	22 days	10 days
Thickness > 1.4mm ≤ 2.0mm	2	18 hours	15 hours	63 hours	2 days	25 days	20 days
	2a	21 hours	16 hours	3 days	2 days	29 days	22 days
	3	27 hours	17 hours	4 days	2 days	37 days	23 days
	4	34 hours	20 hours	5 days	3 days	47 days	28 days
	5	40 hours	25 hours	6 days	4 days	57 days	35 days
	5a	48 hours	40 hours	8 days	6 days	79 days	56 days
Thickness > 2.0mm ≤ 4.5mm	2	48 hours	48 hours	10 days	7 days	79 days	67 days
	2a	48 hours	48 hours	10 days	7 days	79 days	67 days
	3	48 hours	48 hours	10 days	8 days	79 days	67 days
	4	48 hours	48 hours	10 days	10 days	79 days	67 days
	5	48 hours	48 hours	10 days	10 days	79 days	67 days
	5a	48 hours	48 hours	10 days	10 days	79 days	67 days
BGA package > 17mm x 17mm or any stacked die package (Note 12)	2-6	96 hours	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level

NOTES:

11. Table 3 is based on worst-case molded lead frame SMD packages. Users may reduce the actual back time if technically justified (e.g. absorption/desorption data, etc.). In most cases it is applicable to other nonhermetic surface mount SMD packages.
12. For BGA packages > 17mm x >17 mm that do not have internal planes that block the moisture diffusion path in the substrate they may use bake times based on the thickness/moisture level portion of the table.