Surface Mount, NTC Thermistors

FEATURES

- TCR from 6 to 2 %/K even at high temperatures
- Tolerance on $B_{25/85}$ down to 3 %
- Suitable for wave or reflow soldering
- NiSn terminations
- Fully glass coated
- Old part number was 2322 615 4....
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Temperature compensation, sensing and protection in, for example:
  - Battery chargers
  - Consumer equipment
  - Office equipment

DESCRIPTION

Size 0402 chip thermistors with a negative temperature coefficient. The device has no marking.

PACKAGING

Available in 8 mm punched paper tape on reel package of 10 000 units.

QUICK REFERENCE DATA	
PARAMETER	**VALUE**
Resistance value at 25 °C	4.7 kΩ to 100 kΩ
Tolerance on R_{25} - value	± 1 %; ± 2 %; ± 3 %; ± 5 %; ± 10 %
Tolerance on $B_{25/85}$ - value	see Table below
Maximum dissipation at 25 °C	125 mW
Thermal time constant τ	≈ 8 s
Operating temperature range	- 40 to + 150 °C
R/T values	see Tables
Climatic category	40/125/56
Mass	≈ 0.002 g

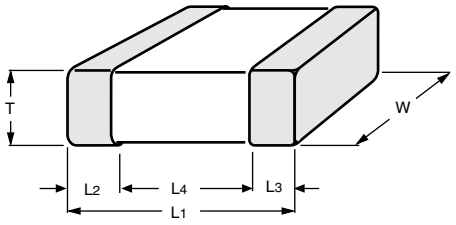
ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} - VALUE (kΩ)	$B_{25/85}$ - VALUE (K)	TOLERANCE ON $B_{25/85}$ (%)	12NC ORDERING CODE 2381 615 4...[1)]	SAP MATERIAL NO. NTCS0402E3...[2)]
4.7	3595	± 3	*472	472*MT
10	3490	± 3	*103	103*LT
15	3600	± 3	*153	153*HT
22	3590	± 3	*223	223*MT
33	3670	± 3	*333	333*MT
47	4075	± 3	*473	473*XT
68	3910	± 3	*683	683*HT
100	3950	± 3	*104	104*HT

Note

1. replace digit * by 5 for tol. on R_{25} °C = 1 %, by 4 for 2 %, 6 for 3 %, by 3 for 5 % and by 2 for 10 %
2. replace digit * by J for 5 %, H for 3 %, G for 2 %, F for 1 % tolerance on R_{25} °C

DIMENSIONS in millimeters



L_1	W	T	L_2 and L_3 MIN.	L_4 MIN.
1.0 ± 0.15	0.5 ± 0.15	0.5 ± 0.15	0.1	0.3

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 4.7 kΩ

T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X472 OR SAP NO. NTCS0402E3472YMT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	117 851.65	- 6.08	11.22
- 35	87 377.07	- 5.89	10.14
- 30	65 414.86	- 5.69	9.10
- 25	49 435.13	- 5.51	8.11
- 20	37 699.56	- 5.33	7.15
- 15	29 002.73	- 5.16	6.24
- 10	22 501.16	- 4.99	5.35
- 5	17 599.41	- 4.83	4.50
0	13 873.45	- 4.68	3.68
5	11 018.80	- 4.53	2.89
10	8814.97	- 4.39	2.13
15	7101.03	- 4.26	1.40
20	5758.62	- 4.13	0.69
25	4700.00	- 4.00	0.00
30	3859.67	- 3.88	0.66
35	3188.38	- 3.76	1.31
40	2648.86	- 3.65	1.93
45	2212.67	- 3.55	2.53
50	1858.03	- 3.44	3.11
55	1568.12	- 3.34	3.68
60	1329.87	- 3.25	4.23
65	1133.09	- 3.16	4.76
70	969.76	- 3.07	5.28
75	833.56	- 2.98	5.78
80	719.47	- 2.90	6.27
85	623.48	- 2.83	6.74
90	542.38	- 2.75	7.20
95	473.58	- 2.68	7.65
100	414.98	- 2.61	8.09
105	364.89	- 2.54	8.51
110	321.91	- 2.47	8.93
115	284.90	- 2.41	9.33
120	252.92	- 2.35	9.73
125	225.20	- 2.29	10.11
130	201.09	- 2.24	10.48
135	180.07	- 2.18	10.85
140	161.67	- 2.13	11.20
145	145.53	- 2.08	11.55
150	131.33	- 2.03	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 10 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X103 OR SAP NO. NTCS0402E3103YLT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	214 063.67	- 5.72	11.22
- 35	161 527.01	- 5.55	10.14
- 30	122 938.33	- 5.38	9.10
- 25	94 353.48	- 5.21	8.11
- 20	73 003.30	- 5.05	7.15
- 15	56 927.91	- 4.90	6.24
- 10	44 729.13	- 4.75	5.35
- 5	35 401.63	- 4.61	4.50
0	28 217.00	- 4.47	3.68
5	22 643.44	- 4.33	2.89
10	18 289.86	- 4.21	2.13
15	14 866.53	- 4.08	1.40
20	12 157.35	- 3.96	0.69
25	10 000.00	- 3.85	0.00
30	8271.77	- 3.74	0.66
35	6879.27	- 3.63	1.31
40	5751.02	- 3.53	1.93
45	4831.94	- 3.43	2.53
50	4079.35	- 3.34	3.11
55	3459.99	- 3.25	3.68
60	2947.82	- 3.16	4.23
65	2522.30	- 3.08	4.76
70	2167.17	- 2.99	5.28
75	1869.50	- 2.92	5.78
80	1618.94	- 2.84	6.27
85	1407.18	- 2.77	6.74
90	1227.51	- 2.70	7.20
95	1074.48	- 2.63	7.65
100	943.67	- 2.56	8.09
105	831.46	- 2.50	8.51
110	734.86	- 2.44	8.93
115	651.44	- 2.38	9.33
120	579.17	- 2.32	9.73
125	516.36	- 2.27	10.11
130	461.60	- 2.22	10.48
135	413.73	- 2.16	10.85
140	371.77	- 2.11	11.20
145	334.88	- 2.07	11.55
150	302.36	- 2.02	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 15 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X153 OR SAP NO. NTCS0402E3153YHT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	347 696.43	- 5.86	11.22
- 35	260 574.24	- 5.68	10.14
- 30	197 003.50	- 5.51	9.10
- 25	150 213.26	- 5.34	8.11
- 20	115 481.81	- 5.18	7.15
- 15	89 488.82	- 5.02	6.24
- 10	69 880.15	- 4.87	5.35
- 5	54 973.10	- 4.73	4.50
0	43 555.42	- 4.59	3.68

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 15 kΩ

T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X153 OR SAP NO. NTCS0402E3153YHT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
5	34 746.94	- 4.45	2.89
10	27 903.80	- 4.32	2.13
15	22 551.53	- 4.20	1.40
20	18 338.00	- 4.08	0.69
25	15 000.00	- 3.96	0.00
30	12 339.53	- 3.85	0.66
35	10 206.62	- 3.74	1.31
40	8486.97	- 3.64	1.93
45	7092.93	- 3.54	2.53
50	5956.89	- 3.44	3.11
55	5026.40	- 3.35	3.68
60	4260.51	- 3.26	4.23
65	3627.13	- 3.18	4.76
70	3100.93	- 3.09	5.28
75	2661.84	- 3.01	5.78
80	2293.88	- 3.94	6.27
85	1984.26	- 3.86	6.74
90	1722.68	- 2.79	7.20
95	1500.85	- 2.72	7.65
100	1312.03	- 2.66	8.09
105	1150.72	- 2.59	8.51
110	1012.43	- 2.53	8.93
115	893.49	- 2.47	9.33
120	790.85	- 2.41	9.73
125	702.01	- 2.36	10.11
130	624.86	- 2.30	10.48
135	557.68	- 2.25	10.85
140	499.00	- 2.20	11.20
145	447.62	- 2.15	11.55
150	402.49	- 2.10	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 22 kΩ

T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X223 OR SAP NO. NTCS0402E3223YMT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	501 411.70	- 5.84	11.22
- 35	376 174.12	- 5.66	10.14
- 30	284 753.94	- 5.48	9.10
- 25	217 416.83	- 5.31	8.11
- 20	167 385.72	- 5.15	7.15
- 15	129 899.74	- 4.99	6.24
- 10	101 585.03	- 4.84	5.35
- 5	80 030.20	- 4.70	4.50
0	63 497.49	- 4.56	3.68
5	50 724.55	- 4.43	2.89
10	40 787.18	- 4.30	2.13
15	33 003.71	- 4.17	1.40
20	26 867.64	- 4.06	0.69
25	22 000.00	- 3.94	0.00
30	18 115.28	- 3.83	0.66
35	14 996.99	- 3.73	1.31
40	12 479.89	- 3.62	1.93
45	10 437.10	- 3.53	2.53
50	8770.63	- 3.43	3.11

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 22 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X223 OR SAP NO. NTCS0402E3223YMT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
55	7404.33	- 3.34	3.68
60	6278.71	- 3.25	4.23
65	5347.05	- 3.17	4.76
70	4572.46	- 3.09	5.28
75	3925.65	- 3.01	5.78
80	3383.28	- 2.94	6.27
85	2926.64	- 2.86	6.74
90	2540.69	- 2.79	7.20
95	2213.23	- 2.73	7.65
100	1934.40	- 2.66	8.09
105	1696.12	- 2.60	8.51
110	1491.82	- 2.54	8.93
115	1316.06	- 2.48	9.33
120	1164.37	- 2.42	9.73
125	1033.06	- 2.37	10.11
130	919.03	- 2.31	10.48
135	819.74	- 2.26	10.85
140	733.03	- 2.21	11.20
145	657.10	- 2.16	11.55
150	590.44	- 2.12	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 33 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X333 OR SAP NO. NTCS0402E3333YMT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	831 938.59	- 6.14	11.22
- 35	615 448.56	- 5.92	10.14
- 30	460 193.66	- 5.71	9.10
- 25	347 596.17	- 5.51	8.11
- 20	265 065.49	- 5.33	7.15
- 15	20 3963.61	- 5.15	6.24
- 10	158 295.25	- 4.99	5.35
- 5	123 853.56	- 4.83	4.50
0	97 655.81	- 4.68	3.68
5	77 566.21	- 4.54	2.89
10	62 041.07	- 4.40	2.13
15	49 954.62	- 4.27	1.40
20	40 478.91	- 4.15	0.69
25	33 000.00	- 3.03	0.00
30	27 059.17	- 3.91	0.66
35	22 311.10	- 3.81	1.31
40	18 493.97	- 3.70	1.93
45	15 407.98	- 3.60	2.53
50	12 899.59	- 3.51	3.11
55	10 850.13	- 3.41	3.68
60	9167.30	- 3.33	4.23
65	7778.91	- 3.24	4.76
70	6628.18	- 3.16	5.28
75	5670.21	- 3.08	5.78
80	4869.32	- 3.01	6.27
85	4197.00	- 2.94	6.74
90	3630.40	- 2.87	7.20
95	3151.06	- 2.80	7.65
100	2744.06	- 2.73	8.09

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 33 kΩ

T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X333 OR SAP NO. NTCS0402E3333YMT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
105	2397.26	- 2.67	8.51
110	2100.74	- 2.61	8.93
115	1846.38	- 2.55	9.33
120	1627.48	- 2.50	9.73
125	1438.51	- 2.44	10.11
130	1274.91	- 2.39	10.48
135	1132.84	- 2.34	10.85
140	1009.14	- 2.29	11.20
145	901.13	- 2.24	11.55
150	806.58	- 2.19	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 47 kΩ

T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X473 OR SAP NO. NTCS0402E3473YXT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	1 514 773.04	- 6.19	11.22
- 35	1 114 828.57	- 6.07	10.14
- 30	825 416.78	- 5.95	9.10
- 25	615 030.13	- 5.82	8.11
- 20	461 300.34	- 5.69	7.15
- 15	348 340.37	- 5.55	6.24
- 10	264 846.40	- 5.41	5.35
- 5	202 753.02	- 5.27	4.50
0	156 284.67	- 5.14	3.68
5	121 288.05	- 5.00	2.89
10	94 762.48	- 4.87	2.13
15	74 529.09	- 4.74	1.40
20	58 997.38	- 4.61	0.69
25	47 000.00	- 4.48	0.00
30	37 675.36	- 4.36	0.66
35	30 383.98	- 4.24	1.31
40	24 648.51	- 4.13	1.93
45	20 110.62	- 4.01	2.53
50	16 499.77	- 3.90	3.11
55	13 610.61	- 3.80	3.68
60	11 286.36	- 3.69	4.23
65	9406.70	- 3.59	4.76
70	7878.79	- 3.50	5.28
75	6630.61	- 3.40	5.78
80	5605.99	- 3.31	6.27
85	4760.94	- 3.22	6.74
90	4060.80	- 3.14	7.20
95	3478.15	- 3.06	7.65
100	2991.19	- 2.98	8.09
105	2582.50	- 2.90	8.51
110	2238.12	- 2.83	8.93
115	1946.79	- 2.75	9.33
120	1699.40	- 2.68	9.73
125	1488.54	- 2.62	10.11
130	1308.18	- 2.55	10.48
135	1153.38	- 2.49	10.85
140	1020.05	- 2.43	11.20
145	904.86	- 2.37	11.55
150	805.02	- 2.31	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 68 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X683 OR SAP NO. NTCS0402E3683YHT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	2 179 611.50	- 6.65	11.22
- 35	1 573 199.63	- 6.40	10.14
- 30	1 149 311.24	- 6.16	9.10
- 25	849 224.01	- 5.94	8.11
- 20	634 230.72	- 5.74	7.15
- 15	478 461.46	- 5.54	6.24
- 10	364 399.28	- 5.35	5.35
- 5	280 036.50	- 5.18	4.50
0	217 045.88	- 5.01	3.68
5	169 588.77	- 4.86	2.89
10	133 528.58	- 4.71	2.13
15	105 905.55	- 4.56	1.40
20	84 581.95	- 4.43	0.69
25	68 000.00	- 4.30	0.00
30	55 014.80	- 4.18	0.66
35	44 778.07	- 4.06	1.31
40	36 656.44	- 3.95	1.93
45	30 173.47	- 3.84	2.53
50	24 968.25	- 3.74	3.11
55	20 765.51	- 3.64	3.68
60	17 353.94	- 3.54	4.23
65	14 570.33	- 3.45	4.76
70	12 287.85	- 3.36	5.28
75	10 407.39	- 3.28	5.78
80	8851.06	- 3.20	6.27
85	7557.32	- 3.12	6.74
90	6477.32	- 3.05	7.20
95	5572.07	- 2.98	7.65
100	4810.32	- 2.91	8.09
105	4166.88	- 2.84	8.51
110	3621.41	- 2.77	8.93
115	3157.34	- 2.71	9.33
120	2761.19	- 2.65	9.73
125	2421.90	- 2.59	10.11
130	2130.39	- 2.54	10.48
135	1879.16	- 2.48	10.85
140	1662.00	- 2.43	11.20
145	1473.74	- 2.38	11.55
150	1310.08	- 2.33	11.89

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 100 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X104 OR SAP NO. NTCS0402E3104YHT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
- 40	3 238 142.11	- 6.57	11.22
- 35	2 344 881.64	- 6.35	10.14
- 30	1 716 473.25	- 6.13	9.10
- 25	1 269 492.61	- 5.93	8.11
- 20	948 194.33	- 5.74	7.15
- 15	714 901.46	- 5.56	6.24
- 10	543 869.12	- 5.38	5.35
- 5	417 320.14	- 5.21	4.50
0	322 854.97	- 5.05	3.68
5	251 740.95	- 4.90	2.89
10	197 770.62	- 4.75	2.13

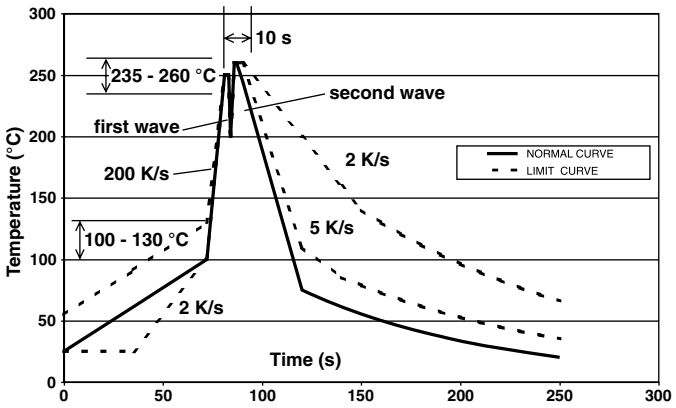
RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 100 kΩ			
T_{OPER} (°C)	CATALOG NUMBER 2381 615 4X104 OR SAP NO. NTCS0402E3104YHT		
	R_T (Ω)	TCR (%/K)	$\Delta R/R$ DUE TO B-TOLERANCE (%)
15	156 492.00	- 4.61	1.40
20	124 684.71	- 4.48	0.69
25	100 000.00	- 4.35	0.00
30	80 711.25	- 4.22	0.66
35	65 539.50	- 4.11	1.31
40	53 530.39	- 3.99	1.93
45	43 966.79	- 3.88	2.53
50	36 306.14	- 3.78	3.11
55	30 135.26	- 3.68	3.68
60	25 137.53	- 3.58	4.23
65	21 068.83	- 3.48	4.76
70	17 739.85	- 3.39	5.28
75	15 002.94	- 3.31	5.78
80	12 742.32	- 3.22	6.27
85	10 866.72	- 3.14	6.74
90	9303.84	- 3.07	7.20
95	7996.08	- 2.99	7.65
100	6897.40	- 2.92	8.09
105	5970.77	- 2.85	8.51
110	5186.31	- 2.78	8.93
115	4519.80	- 2.72	9.33
120	3951.51	- 2.66	9.73
125	3465.32	- 2.60	10.11
130	3048.01	- 2.54	10.48
135	2688.67	- 2.48	10.85
140	2378.30	- 2.43	11.20
145	2109.44	- 2.37	11.55
150	1875.84	- 2.32	11.89

SOLDERING CONDITIONS

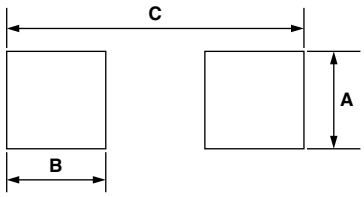
This SMD thermistor is only suitable for wave or reflow soldering, in accordance with “CECC 00802”. The maximum temperature of 260 °C during 40 s should not be exceeded.

Typical examples of a soldering processes that will provide reliable joints without damage, are shown below.

Temperature Characteristic with dual wave soldering

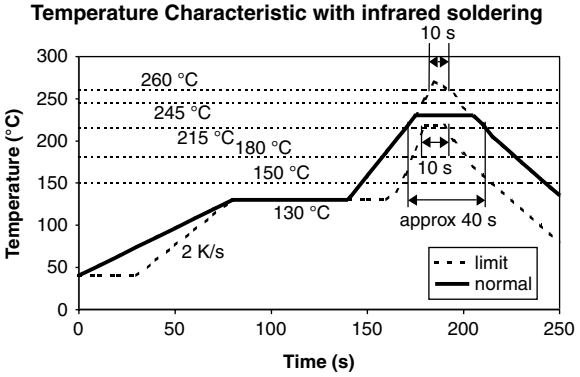


Typical values (solid line)
Process limits (dotted lines)
Dimensions in mm

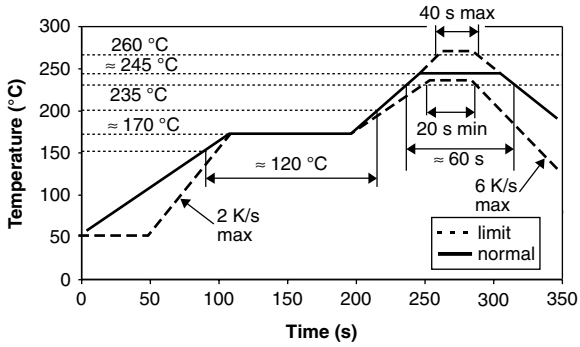


A = 0.5 mm
B = 0.5 mm
C = 1.5 mm

Temperature Characteristic with infrared soldering



Lead (Pb)-free Reflow Soldering Profile

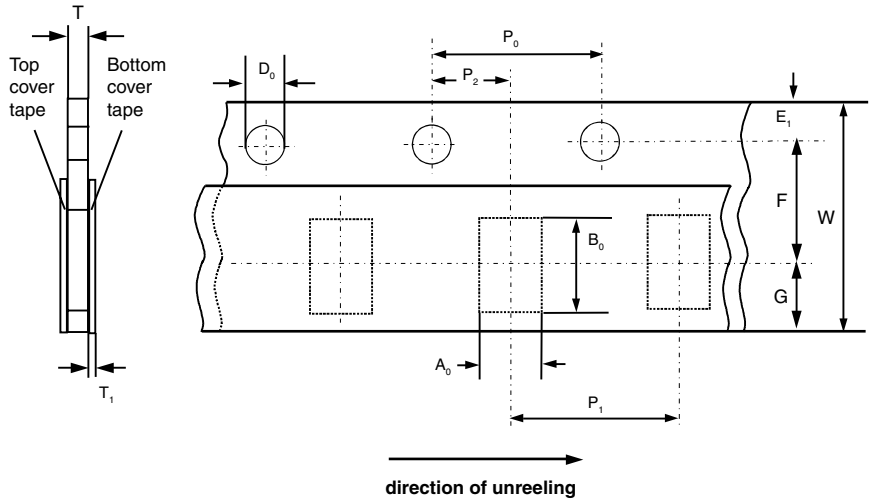


PACKAGING

TAPE SPECIFICATIONS

All tape specifications are in accordance with “IEC 60286-3”. Basic dimensions are given below . Carrier tape material is paper.

PAPER TAPE

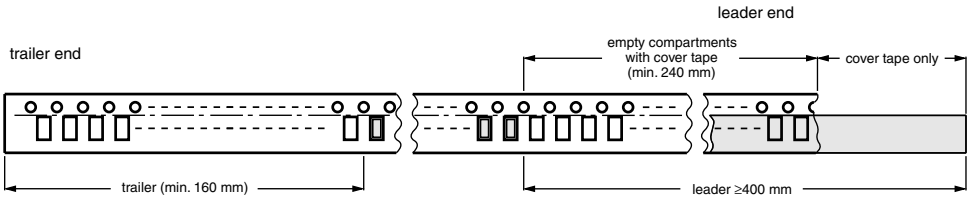


DIMENSIONS OF PAPER TAPE in millimeters		
PARAMETER	**DIMENSION**	**TOLERANCE**
A_0 [1)]	0.65	± 0.1
B_0 [1)]	1.15	± 0.1
D_0	1.55	± 0.05
P_0 [2)]	2.00	± 0.10
E_1	1.75	± 0.10
CUMULATIVE PITCH OVER 10 POSITIONS	0.00	± 0.1
P_2	1.00	± 0.05
	3.5	± 0.05
T_1	< 0.1	-
W	8	± 0.2
T	0.8 max	-

Notes

1. Measured 0.3 mm above base pocket
2. P_0 pitch tolerance over any 10 pitches is ± 1 mm

LEADER/TRAILER TAPE SPECIFICATION



Leader/trailer tape

TAPING PACKAGE REQUIREMENTS

Component is free and not sticking to top and/or bottom tape.
Component should be easy to remove from carrier tape.

TESTS AND REQUIREMENTS

SOLDERABILITY AND RESISTANCE TO SOLDERING HEAT				
IEC 60068-2-58	**TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS**
6	Tc	solderability	2 s at 235 °C	min. 95 % of surface wetted
		resistance to soldering heat	10 s at 260 °C	$\Delta R/R < 5$ %

Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.