

## 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.

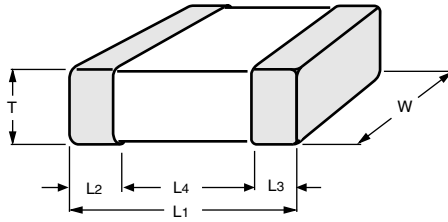
QUICK REFERENCE DATA	
PARAMETER	VALUE
Resistance value at 25 °C	4.7 k $\Omega$ to 100 k $\Omega$
Tolerance on $R_{25}$ - value	$\pm 1 \%$ ; $\pm 2 \%$ ; $\pm 3 \%$ ; $\pm 5 \%$ ; $\pm 10 \%$
Tolerance on $B_{25/85}$ - value	see Table below
Maximum dissipation at 25 °C	125 mW
Thermal time constant $\tau$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

ELECTRICAL DATA AND ORDERING INFORMATION				
$R_{25}$ - VALUE (k $\Omega$ )	$B_{25/85}$ - VALUE (K)	TOLERANCE ON $B_{25/85}$ (%)	12NC ORDERING CODE 2381 615 4... <sup>1)</sup>	SAP MATERIAL NO. NTCS0402E3... <sup>2)</sup>
4.7	3595	$\pm 3$	*472	472*MT
10	3490	$\pm 3$	*103	103*LT
15	3600	$\pm 3$	*153	153*HT
22	3590	$\pm 3$	*223	223*MT
33	3670	$\pm 3$	*333	333*MT
47	4075	$\pm 3$	*473	473*XT
68	3910	$\pm 3$	*683	683*HT
100	3950	$\pm 3$	*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 <sub>1</sub>	W	T	L <sub>2</sub> and L <sub>3</sub> MIN.	L <sub>4</sub> MIN.
1.0 ± 0.15	0.5 ± 0.15	0.5 ± 0.15	0.1	0.3

<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 4.7 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X472 OR SAP NO. NTCS0402E3472YMT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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



<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 10 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X103 OR SAP NO. NTCS0402E3103YLT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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

<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 15 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X153 OR SAP NO. NTCS0402E3153YHT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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<sub>25</sub> AT 15 kΩ**

T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X153 OR SAP NO. NTCS0402E3153YHT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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<sub>25</sub> AT 22 kΩ**

T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X223 OR SAP NO. NTCS0402E3223YMT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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



<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 22 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X223 OR SAP NO. NTCS0402E3223YMT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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

<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 33 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X333 OR SAP NO. NTCS0402E3333YMT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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<sub>25</sub> AT 33 kΩ**

T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X333 OR SAP NO. NTCS0402E3333YMT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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<sub>25</sub> AT 47 kΩ**

T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X473 OR SAP NO. NTCS0402E3473YXT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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



<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 68 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X683 OR SAP NO. NTCS0402E3683YHT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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

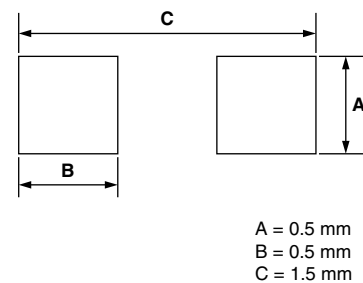
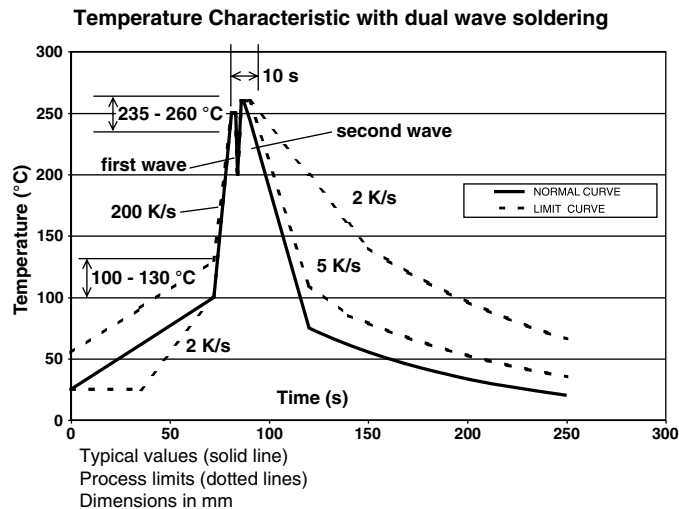
<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 100 kΩ</b>			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X104 OR SAP NO. NTCS0402E3104YHT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/R DUE TO B-TOLERANCE (%)
-40	3 238 142.11	- 6.57	11.22
-35	2 344 881.64	- 6.35	10.14
-30	1 716 473.25	- 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 <sub>25</sub> AT 100 kΩ			
T <sub>OPER</sub> (°C)	CATALOG NUMBER 2381 615 4X104 OR SAP NO. NTCS0402E3104YHT		
	R <sub>T</sub> (Ω)	TCR (%/K)	ΔR/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

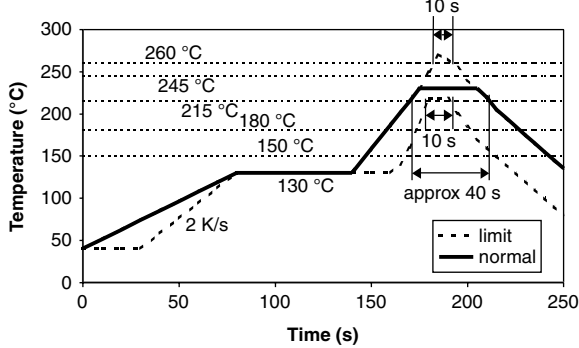
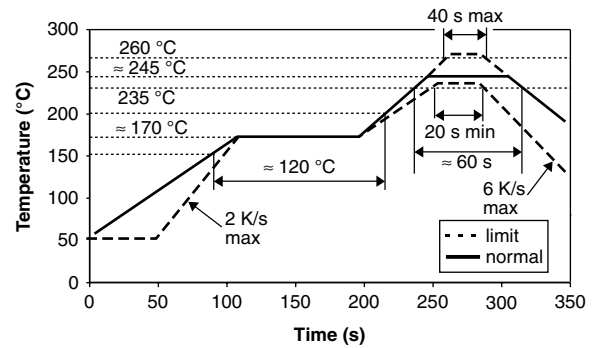
**SOLDERING CONDITIONS**

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.





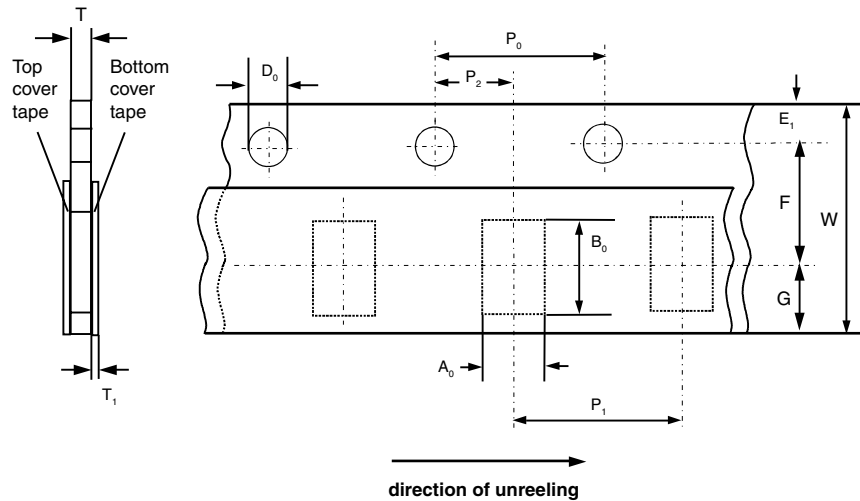
**Temperature Characteristic with infrared soldering**

**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



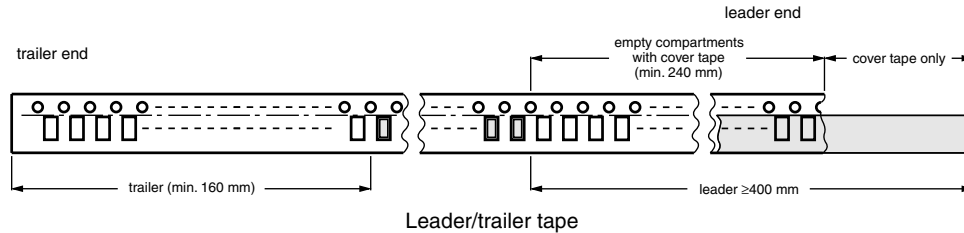
### DIMENSIONS OF PAPER TAPE in millimeters

PARAMETER	DIMENSION	TOLERANCE
$A_0^{1)}$	0.65	$\pm 0.1$
$B_0^{1)}$	1.15	$\pm 0.1$
$D_0$	1.55	$\pm 0.05$
$P_0^{2)}$	2.00	$\pm 0.10$
$E_1$	1.75	$\pm 0.10$
CUMULATIVE PITCH OVER 10 POSITIONS	0.00	$\pm 0.1$
$P_2$	1.00	$\pm 0.05$
	3.5	$\pm 0.05$
$T_1$	$< 0.1$	-
$W$	8	$\pm 0.2$
$T$	0.8 max	-

#### Notes

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

## LEADER/TRAILER TAPE SPECIFICATION



## 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	T <sub>c</sub>	solderability	2 s at 235 °C	min. 95 % of surface wetted
		resistance to soldering heat	10 s at 260 °C	$\Delta R/R < 5 \%$



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