

SMD 0603, Glass Protected NTC Thermistors



FEATURES

- TCR ranging from - 7 %/K at - 40 °C to - 2 %/K at 150 °C
- Tolerance on R_{25} down to 1 %, and on $B_{25/85}$ down to 1 %
- Suitable for wave or reflow soldering
- NiSn terminations
- Fully glass coated and protected
- cUL recognized for safety applications (file E148885)
- AEC-Q200 qualified
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21 definition

AUTOMOTIVE GRADE



RoHS COMPLIANT
HALOGEN FREE

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	2.2 to 100	k Ω
Tolerance on R_{25} -value	± 1 ; ± 2 ; ± 3 ; ± 5	%
$B_{25/85}$ -value	3420 to 4100	K
Tolerance on $B_{25/85}$ -value	± 1 ; ± 3	%
Maximum dissipation at 25 °C	125	mW
Thermal time constant τ	≈ 8	s
Dissipation factor D	3.0	mW/K
Operating temperature range at zero power	- 40 to + 150	°C
Weight	≈ 0.006	g

APPLICATIONS

- Temperature sensing, protection and compensation in automotive, industrial, telecom and consumer applications. Examples are:
 - Battery chargers
 - Power suppliers
 - Office equipment
 - LCD compensation
 - In-car entertainment

DESCRIPTION

Size 0603 chip thermistors with a negative temperature coefficient. The device has no marking.

PACKAGING

Available in 8 mm punched paper tape on reel package of 4000 units.

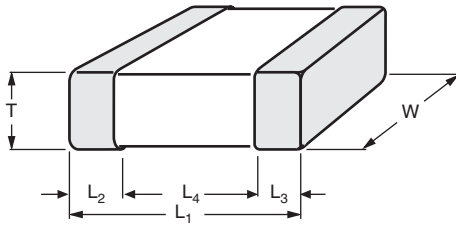
DESIGN-IN SUPPORT

For complete Curve Computation, visit:
www.vishay.com/thermistors/curve-computation-list/

ELECTRICAL DATA AND ORDERING INFORMATION				
R_{25} -VALUE (k Ω)	$B_{25/85}$ -VALUE (K)	TOLERANCE ON $B_{25/85}$ (%)	SAP MATERIAL AND ORDERING NUMBER NTCS0603E3... ⁽¹⁾	12NC 2381 615 3... ⁽²⁾
2.0	3420	± 1	202*LT	*202
2.2	3520	± 1	222*MT	*222
2.7	3600	± 1	272*MT	*272
4.7	3830	± 1	472*HT	*472
10	3435	± 3	103*LT	-
10	3610	± 1	103*MT	*103
10	3960	± 1	103*HT	-
15	3600	± 1	153*MT ⁽³⁾	*153
22	3730	± 1	223*MT	*223
33	3860	± 1	333*HT	*333
47	3960	± 1	473*HT	*473
68	3985	± 1	683*HT	*683
100	4100	± 1	104*XT	*104

Notes

- (1) Replace * in SAP by J for ± 5 %, H for ± 3 %, G for ± 2 %, F for ± 1 % tolerance on R_{25}
 (2) Replace * in 12NC by 3 for ± 5 %, 6 for ± 3 %, 4 for ± 2 %, 5 for ± 1 % tolerance on R_{25}
 (3) Type NTCS0603E3153*MT is not UL recognized

DIMENSIONS in millimeters


L ₁	W	T	L ₂ AND L ₃ MIN.	L ₄ MIN.
1.6 ± 0.15	0.8 ± 0.15	0.8 ± 0.15	0.2	0.4

 For complete Curve Computation, visit: www.vishay.com/thermistors/curve-computation-list/
RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R₂₅ AT 2.0 kΩ, 2.2 kΩ AND 2.7 kΩ

T _{OPER} (°C)	PART NUMBER NTCS0603E3202*MT		PART NUMBER NTCS0603E3222*MT		PART NUMBER NTCS0603E3272*MT		ΔR/R DUE TO B _{tol} . (± %)
	R _T (Ω)	TCR (%/K)	R _T (Ω)	TCR (%/K)	R _T (Ω)	TCR (%/K)	
-40	44 297	- 5.93	53 503	- 6.11	65 247	- 6.26	7.58
-35	33 114	- 5.71	39 637	- 5.89	48 436	- 6.03	6.83
-30	25 010	- 5.51	29 680	- 5.68	36 340	- 5.82	6.13
-25	19 076	- 5.32	22 451	- 5.48	27 539	- 5.61	5.45
-20	14 687	- 5.14	17 149	- 5.29	21 069	- 5.42	4.80
-15	11 410	- 4.96	13 221	- 5.11	16 265	- 5.23	4.18
-10	8940.4	- 4.80	10 283	- 4.94	12 664	- 5.06	3.58
-5	7062.8	- 4.64	8066.2	- 4.77	9940.1	- 4.89	3.01
0	5623.4	- 4.48	6378.5	- 4.62	7862.7	- 4.72	2.46
5	4510.9	- 4.34	5083.1	- 4.47	6265.2	- 4.57	1.93
10	3644.4	- 4.20	4080.7	- 4.32	5027.3	- 4.42	1.42
15	2964.6	- 4.06	3299.2	- 4.18	4060.9	- 4.28	0.93
20	2427.4	- 3.94	2685.5	- 4.05	3301.2	- 4.14	0.46
25	2000.0	- 3.81	2200.0	- 3.93	2700.0	- 4.02	0.00
30	1657.7	- 3.70	1813.5	- 3.80	2221.1	- 3.89	0.22
35	1382.0	- 3.58	1503.7	- 3.69	1837.3	- 3.77	0.43
40	1158.4	- 3.48	1253.9	- 3.58	1528.0	- 3.66	0.64
45	976.12	- 3.37	1051.3	- 3.47	1277.2	- 3.55	0.84
50	826.68	- 3.27	886.05	- 3.37	1072.8	- 3.45	1.03
55	703.51	- 3.18	750.49	- 3.27	905.29	- 3.35	1.22
60	601.48	- 3.09	638.72	- 3.18	767.40	- 3.25	1.40
65	516.53	- 3.00	546.09	- 3.09	653.33	- 3.16	1.58
70	445.49	- 2.92	468.95	- 3.00	558.52	- 3.07	1.75
75	385.79	- 2.84	404.41	- 2.92	479.37	- 2.99	1.92
80	335.42	- 2.76	350.18	- 2.84	413.02	- 2.90	2.08
85	292.73	- 2.69	304.40	- 2.76	357.17	- 2.83	2.23
90	256.40	- 2.61	265.61	- 2.69	309.97	- 2.75	2.54
95	225.37	- 2.55	232.60	- 2.62	269.92	- 2.68	2.85
100	198.77	- 2.48	204.39	- 2.55	235.83	- 2.61	3.14
105	175.88	- 2.42	180.22	- 2.49	206.70	- 2.54	3.43
110	156.11	- 2.35	159.41	- 2.42	181.72	- 2.48	3.71
115	138.98	- 2.29	141.44	- 2.36	160.24	- 2.41	3.98
120	124.09	- 2.24	125.88	- 2.3	141.70	- 2.35	4.24
125	111.11	- 2.18	112.35	- 2.25	125.65	- 2.30	4.50
130	99.757	- 2.13	100.55	- 2.19	111.72	- 2.24	4.76
135	89.796	- 2.08	90.239	- 2.14	99.589	- 2.19	5.00
140	81.033	- 2.03	81.192	- 2.09	88.997	- 2.13	5.25
145	73.304	- 1.98	73.235	- 2.04	79.724	- 2.08	5.48
150	66.468	- 1.94	66.218	- 2.04	71.585	- 2.04	5.71

For complete Curve Computation, visit: www.vishay.com/thermistors/curve-computation-list/

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 4.7 k Ω , 10 k Ω AND 15 k Ω											
T_{OPER} (°C)	PART NUMBER NTCS0603E3472*HT		PART NUMBER NTCS0603E3103*LT		PART NUMBER NTCS0603E3103*MT		PART NUMBER NTCS0603E3103*HT		PART NUMBER NTCS0603E3153*MT		$\Delta R/R$ DUE TO $B_{tol.}$ (± %)
	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	
-40	152 832	- 6.66	170 762	- 5.03	243 448	- 6.06	347 116	- 6.66	362 484	- 6.07	7.58
-35	110 192	- 6.43	133 132	- 4.93	180 772	- 5.85	250 089	- 6.45	269 089	- 5.85	6.83
-30	80 369	- 6.20	104 307	- 4.83	135 623	- 5.65	182 023	- 6.25	201 888	- 5.64	6.13
-25	59 267	- 5.98	82 140	- 4.73	102 751	- 5.46	133 804	- 6.06	152 997	- 5.45	5.45
-20	44 170	- 5.78	65 020	- 4.62	78 576	- 5.28	99 313	- 5.87	117 051	- 5.26	4.80
-15	33 252	- 5.58	51 737	- 4.52	60 623	- 5.10	74 408	- 5.68	90 361	- 5.09	4.18
-10	25 276	- 5.39	41 385	- 4.41	47 168	- 4.94	56 257	- 5.50	70 354	- 4.92	3.58
-5	19 392	- 5.21	33 277	- 4.31	36 995	- 4.78	42 910	- 5.33	55 223	- 4.76	3.01
0	15 009	- 5.04	26 896	- 4.21	29 240	- 4.63	33 009	- 5.16	43 682	- 4.61	2.46
5	11 716	- 4.87	21 851	- 4.10	23 280	- 4.49	25 602	- 5.00	34 807	- 4.47	1.93
10	9219.5	- 4.71	17 841	- 4.00	18 664	- 4.35	20 015	- 4.85	27 929	- 4.33	1.42
15	7311.4	- 4.56	14 639	- 3.91	15 064	- 4.22	15 767	- 4.70	22 561	- 4.20	0.93
20	5841.3	- 4.42	12 071	- 3.81	12 236	- 4.10	12 512	- 4.55	18 340	- 4.08	0.46
25	4700.0	- 4.28	10 000	- 3.72	10 000	- 3.98	10 000	- 4.41	15 000	- 3.96	0.00
30	3807.5	- 4.15	8323.0	- 3.63	8220.3	- 3.86	8046.8	- 4.28	12 340	- 3.85	0.22
35	3104.5	- 4.02	6958.5	- 3.54	6795.2	- 3.75	6517.6	- 4.15	10 207	- 3.74	0.43
40	2547.2	- 3.90	5843.4	- 3.45	5647.3	- 3.65	5312.5	- 4.03	8488.7	- 3.64	0.64
45	2102.4	- 3.78	4928.1	- 3.37	4717.5	- 3.55	4356.6	- 3.91	7095.4	- 3.54	0.84
50	1745.3	- 3.67	4173.5	- 3.28	3960.3	- 3.45	3593.6	- 3.79	5959.8	- 3.44	1.03
55	1456.8	- 3.56	3548.8	- 3.20	3340.4	- 3.36	2981.0	- 3.68	5029.4	- 3.35	1.22
60	1222.4	- 3.46	3029.5	- 3.13	2830.3	- 3.27	2486.2	- 3.58	4263.3	- 3.26	1.40
65	1030.9	- 3.36	2596.1	- 3.05	2408.6	- 3.18	2084.3	- 3.48	3629.6	- 3.18	1.58
70	873.61	- 3.26	2233.0	- 2.98	2058.4	- 3.10	1756.2	- 3.38	3102.9	- 3.10	1.75
75	743.79	- 3.17	1927.6	- 2.91	1766.2	- 3.02	1486.9	- 3.28	2663.2	- 3.02	1.92
80	636.11	- 3.08	1669.8	- 2.84	1521.4	- 2.95	1264.7	- 3.19	2294.6	- 2.94	2.08
85	546.36	- 3.00	1451.3	- 2.77	1315.4	- 2.87	1080.6	- 3.10	1984.3	- 2.87	2.23
90	471.22	- 2.92	1265.7	- 2.71	1141.4	- 2.80	927.23	- 3.02	1722.0	- 2.80	2.54
95	408.03	- 2.84	1107.3	- 2.64	993.91	- 2.73	798.94	- 2.94	1499.6	- 2.73	2.85
100	354.67	- 2.77	971.68	- 2.58	868.35	- 2.67	691.16	- 2.86	1310.2	- 2.67	3.14
105	309.43	- 2.69	855.26	- 2.52	761.11	- 2.61	600.23	- 2.78	1148.3	- 2.61	3.43
110	270.91	- 2.62	754.99	- 2.47	669.19	- 2.54	523.20	- 2.71	1009.6	- 2.55	3.71
115	238.01	- 2.56	668.36	- 2.41	590.14	- 2.48	457.68	- 2.64	890.23	- 2.49	3.98
120	209.79	- 2.49	593.29	- 2.36	521.94	- 2.43	401.76	- 2.57	787.23	- 2.43	4.24
125	185.50	- 2.43	528.06	- 2.30	462.92	- 2.37	353.85	- 2.51	698.07	- 2.38	4.50
130	164.53	- 2.37	471.21	- 2.25	411.68	- 2.32	312.65	- 2.44	620.67	- 2.32	4.76
135	146.36	- 2.31	421.53	- 2.20	367.08	- 2.27	277.10	- 2.38	553.27	- 2.27	5.00
140	130.57	- 2.26	378.00	- 2.16	328.14	- 2.22	246.34	- 2.32	494.43	- 2.22	5.25
145	116.80	- 2.20	339.77	- 2.11	294.05	- 2.17	219.62	- 2.27	442.91	- 2.18	5.48
150	104.76	- 2.15	306.11	- 2.06	264.12	- 2.12	196.35	- 2.21	397.69	- 2.13	5.71



For complete Curve Computation, visit: www.vishay.com/thermistors/curve-computation-list/

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 22 k Ω , 33 k Ω AND 47 k Ω							
T_{OPER} (°C)	PART NUMBER NTCS0603E3223*MT		PART NUMBER NTCS0603E3333*HT		PART NUMBER NTCS0603E3473*HT		$\Delta R/R$ DUE TO B_{tol} . (\pm %)
	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	
-40	603 212	- 6.28	1 061 183	- 6.70	1 643 693	- 6.85	7.58
-35	443 043	- 6.06	764 125	- 6.44	1 174 859	- 6.59	6.83
-30	328 858	- 5.86	557 158	- 6.20	850 461	- 6.34	6.13
-25	246 572	- 5.66	411 058	- 5.97	623 018	- 6.11	5.45
-20	186 661	- 5.47	306 646	- 5.75	461 557	- 5.89	4.80
-15	142 608	- 5.29	231 157	- 5.55	345 583	- 5.69	4.18
-10	109 910	- 5.12	175 977	- 5.36	261 354	- 5.49	3.58
-5	85 420	- 4.96	135 223	- 5.18	199 536	- 5.31	3.01
0	66 919	- 4.80	104 827	- 5.01	153 714	- 5.13	2.46
5	52 827	- 4.66	81 946	- 4.84	119 427	- 4.97	1.93
10	42 007	- 4.51	64 569	- 4.69	93 541	- 4.81	1.42
15	33 638	- 4.38	51 262	- 4.54	73 832	- 4.66	0.93
20	27 117	- 4.25	40 989	- 4.40	58 703	- 4.52	0.46
25	22 000	- 4.12	33 000	- 4.27	47 000	- 4.38	0.00
30	17 958	- 4.00	26 741	- 4.14	37 881	- 4.25	0.22
35	14 746	- 3.89	21 804	- 4.02	30 726	- 4.13	0.43
40	12 176	- 3.77	17 884	- 3.91	25 073	- 4.01	0.64
45	10 109	- 3.67	14 751	- 3.80	20 579	- 3.89	0.84
50	8435.9	- 3.57	12 234	- 3.69	16 984	- 3.79	1.03
55	7075.0	- 3.47	10 198	- 3.59	14 092	- 3.68	1.22
60	5962.1	- 3.38	8543.9	- 3.49	11 751	- 3.58	1.40
65	5047.4	- 3.29	7191.9	- 3.40	9847.6	- 3.49	1.58
70	4292.0	- 3.20	6081.4	- 3.31	8290.7	- 3.40	1.75
75	3665.1	- 3.12	5164.9	- 3.22	7011.4	- 3.31	1.92
80	3142.6	- 3.04	4405.0	- 3.14	5955.0	- 3.22	2.08
85	2705.2	- 2.96	3772.0	- 3.06	5078.7	- 3.14	2.23
90	2337.6	- 2.88	3242.6	- 2.99	4348.7	- 3.07	2.54
95	2027.3	- 2.81	2797.8	- 2.91	3737.8	- 2.99	2.85
100	1764.3	- 2.74	2422.8	- 2.84	3224.6	- 2.92	3.14
105	1540.7	- 2.68	2105.3	- 2.78	2791.8	- 2.85	3.43
110	1349.9	- 2.61	1835.5	- 2.71	2425.3	- 2.87	3.71
115	1186.4	- 2.55	1605.4	- 2.65	2113.9	- 2.72	3.98
120	1045.9	- 2.49	1408.5	- 2.59	1848.4	- 2.65	4.24
125	924.73	- 2.43	1239.5	- 2.53	1621.2	- 2.59	4.50
130	819.95	- 2.38	1093.9	- 2.47	1426.1	- 2.54	4.76
135	729.04	- 2.32	968.07	- 2.42	1258.1	- 2.48	5.00
140	649.93	- 2.27	859.04	- 2.36	1112.9	- 2.42	5.25
145	580.89	- 2.22	764.28	- 2.31	987.19	- 2.37	5.48
150	520.48	- 2.17	681.69	- 2.26	877.91	- 2.32	5.71

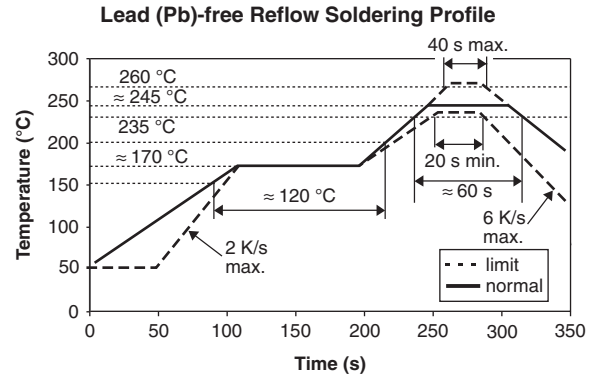
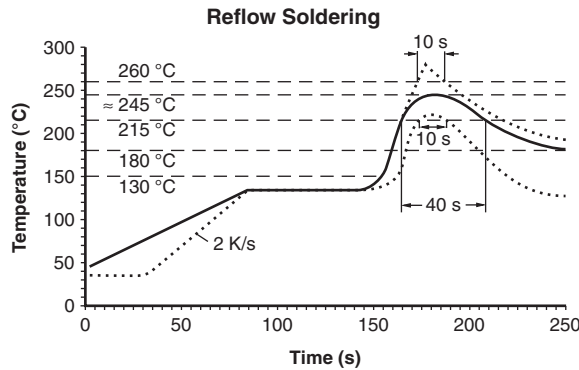
For complete Curve Computation, visit: www.vishay.com/thermistors/curve-computation-list/

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 68 k Ω AND 100 k Ω					
T_{OPER} (°C)	PART NUMBER NTCS0603E3683*HT		PART NUMBER NTCS0603E3104*XT		$\Delta R/R$ DUE TO $B_{tol.}$ (\pm %)
	R_T (Ω)	TCR (%/K)	R_T (Ω)	TCR (%/K)	
-40	2 324 376	- 6.77	3 921 252	- 7.03	7.58
-35	1 667 529	- 6.52	2 774 565	- 6.77	6.83
-30	1 211 148	- 6.28	1 988 706	- 6.52	6.13
-25	889 917	- 6.05	1 442 861	- 6.28	5.45
-20	661 047	- 5.84	1 058 901	- 6.06	4.80
-15	496 103	- 5.64	785 573	- 5.85	4.18
-10	375 941	- 5.45	588 793	- 5.65	3.58
-5	287 504	- 5.28	445 602	- 5.47	3.01
0	221 786	- 5.11	340 346	- 5.29	2.46
5	172 502	- 4.95	262 229	- 5.12	1.93
10	135 221	- 4.79	203 723	- 4.96	1.42
15	106 786	- 4.65	159 522	- 4.80	0.93
20	84 928	- 4.51	125 851	- 4.66	0.46
25	68 000	- 4.38	100 000	- 4.52	0.00
30	54 796	- 4.26	80 003	- 4.39	0.22
35	44 427	- 4.14	64 422	- 4.26	0.43
40	36 232	- 4.02	52 200	- 4.14	0.64
45	29 714	- 3.91	42 548	- 4.02	0.84
50	24 499	- 3.81	34 879	- 3.91	1.03
55	20 304	- 3.71	28 749	- 3.80	1.22
60	16 909	- 3.61	23 820	- 3.70	1.40
65	14 149	- 3.52	19 835	- 3.60	1.58
70	11 893	- 3.43	16 597	- 3.51	1.75
75	10 041	- 3.34	13 951	- 3.42	1.92
80	8512.2	- 3.26	11 780	- 3.33	2.08
85	7245.5	- 3.18	9988.4	- 3.25	2.23
90	6191.1	- 3.11	8504.3	- 3.17	2.54
95	5310.0	- 3.03	7269.4	- 3.09	2.85
100	4570.7	- 2.96	6237.5	- 3.02	3.14
105	3948.0	- 2.90	5371.7	- 2.95	3.43
110	3421.5	- 2.83	4642.5	- 2.88	3.71
115	2974.8	- 2.77	4025.9	- 2.81	3.98
120	2594.5	- 2.71	3502.7	- 2.75	4.24
125	2269.6	- 2.65	3057.1	- 2.68	4.50
130	1991.2	- 2.59	2676.4	- 2.62	4.76
135	1751.9	- 2.53	2350.1	- 2.57	5.00
140	1545.5	- 2.48	2069.5	- 2.51	5.25
145	1367.1	- 2.43	1827.4	- 2.46	5.48
150	1212.3	- 2.38	1617.9	- 2.40	5.71

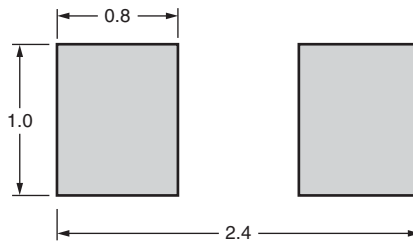
SOLDERING CONDITIONS

This SMD thermistor is only suitable for wave or reflow soldering, in accordance with JEDEC J-STD-020. 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.



Dimensions of the solder lands



TESTS AND REQUIREMENTS

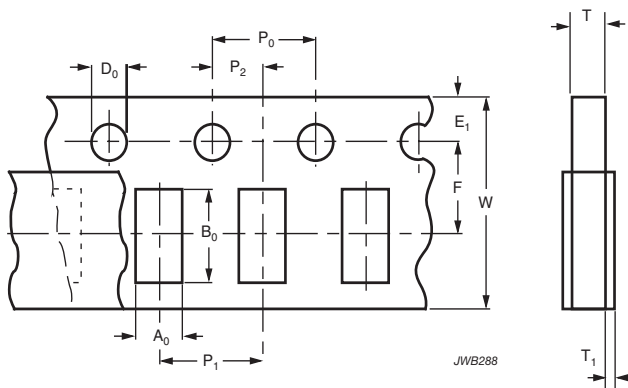
SOLDERABILITY AND RESISTANCE TO SOLDERING HEAT				
IEC 60068-2-58	TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
6	T _C	Solderability	2 s at 235 °C	Min. 95 % of surface wetted
		Resistance to soldering heat	10 s at 260 °C	$\Delta R/R < 5 \%$

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⁾	1.15	± 0.1
B ₀ ⁽¹⁾	1.9	± 0.1
W	8.0	± 0.2
E ₁	1.75	± 0.1
F	3.5	± 0.05
D ₀	1.55	± 0.05
P ₀ ⁽²⁾	4.0	± 0.1
P ₁	4.0	± 0.1
P ₂	2.0	± 0.05
Tape thickness	1.1	Max.
T ₁ cover tape	< 0.1	-

- Notes**
- Measured 0.3 mm above base pocket
 - P₀ pitch cumulative error over any 10 pitches ± 0.2 mm



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.