

## 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
- Old part number was 2322 615 3...
- Compliant to RoHS directive 2002/95/EC and in accordance to WEEE 2002/96/EC


**RoHS**  
COMPLIANT

### QUICK REFERENCE DATA

PARAMETER	VALUE
Resistance value at 25 °C	2.2 k $\Omega$ to 100 k $\Omega$
Tolerance on $R_{25}$ - value	$\pm 1 \%$ ; $\pm 2 \%$ ; $\pm 3 \%$ ; $\pm 5 \%$
$B_{25/85}$ value	3420K to 4100K
Tolerance on $B_{25/85}$ - value	$\pm 1 \%$
Maximum dissipation at 25 °C	125 mW
Thermal time constant $\tau$	$\approx 8$ s
Dissipation factor D	3.0 mW/K
Operating temperature range at zero power	- 40 °C to + 150 °C
R/T values	See tables
Climatic category	40/125/56
Weight	$\approx 0.006$ 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/](http://www.vishay.com/thermistors/curve-computation-list/)

### ELECTRICAL DATA AND ORDERING INFORMATION

$R_{25}$ - VALUE (k $\Omega$ )	$B_{25/85}$ - VALUE (K)	TOLERANCE ON $B_{25/85}$ (%)	12 NC ORDERING CODE 2381 615 3... <sup>(1)</sup>	SAP MATERIAL NO. NTCS0603E3... <sup>(2)</sup>
2.0	3420	$\pm 1$	*202	202*LT
2.2	3520	$\pm 1$	*222	222*MT
2.7	3600	$\pm 1$	*272	272*MT
4.7	3830	$\pm 1$	*472	472*HT
10	3610	$\pm 1$	*103	103*MT
15	3600	$\pm 1$	*153	153*MT
22	3730	$\pm 1$	*223	223*MT
33	3860	$\pm 1$	*333	333*HT
47	3960	$\pm 1$	*473	473*HT
68	3985	$\pm 1$	*683	683*HT
100	4100	$\pm 1$	*104	104*XT

#### Notes

<sup>(1)</sup> Replace \* in 12 NC by 3 for  $\pm 5 \%$ , 6 for  $\pm 3 \%$ , 4 for  $\pm 2 \%$ , 5 for  $\pm 1 \%$  tolerance on  $R_{25}$

<sup>(2)</sup> Replace \* in SAP by J for  $\pm 5 \%$ , H for  $\pm 3 \%$ , G for  $\pm 2 \%$ , F for  $\pm 1 \%$  tolerance on  $R_{25}$

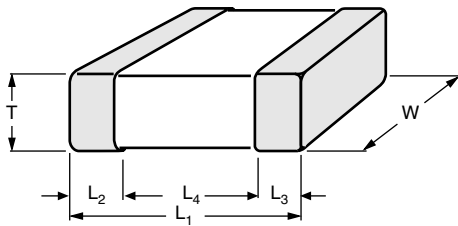
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## DIMENSIONS in millimeters



L <sub>1</sub>	W	T	L <sub>2</sub> and L <sub>3</sub> MIN.	L <sub>4</sub> MIN.
1.6 ± 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/](http://www.vishay.com/thermistors/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R <sub>25</sub> AT 2.0, 2.2 AND 2.7 kΩ							
T <sub>OPER</sub> [°C]	PART NUMBER 2381 615 3*202/ NTCS0603E3202*MT		PART NUMBER 2381 615 3*222/ NTCS0603E3222*MT		PART NUMBER 2381 615 3*272/ NTCS0603E3272*MT		ΔR/R DUE TO B <sub>tol</sub> [± %]
	R <sub>T</sub> [Ω]	TCR [%/K]	R <sub>T</sub> [Ω]	TCR [%/K]	R <sub>T</sub> [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	- 2.30	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



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<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R<sub>25</sub> AT 4.7, 10 AND 15 kΩ</b>							
T <sub>OPER</sub> [°C]	PART NUMBER 2381 615 3*472/ NTCS0603E3472*HT		PART NUMBER 2381 615 3*103/ NTCS0603E3103*MT		PART NUMBER 2381 615 3*153/ NTCS0603E3153*MT		ΔR/R DUE TO B <sub>tol</sub> [± %]
	R <sub>T</sub> [Ω]	TCR [%/K]	R <sub>T</sub> [Ω]	TCR [%/K]	R <sub>T</sub> [Ω]	TCR [%/K]	
-40	152 832	- 6.66	243 448	- 6.06	362 484	- 6.07	7.58
-35	110 192	- 6.43	180 772	- 5.85	269 089	- 5.85	6.83
-30	80 369	- 6.20	135 623	- 5.65	201 888	- 5.64	6.13
-25	59 267	- 5.98	102 751	- 5.46	152 997	- 5.45	5.45
-20	44 170	- 5.78	78 576	- 5.28	117 051	- 5.26	4.80
-15	33 252	- 5.58	60 623	- 5.10	90 361	- 5.09	4.18
-10	25 276	- 5.39	47 168	- 4.94	70 354	- 4.92	3.58
-5	19 392	- 5.21	36 995	- 4.78	55 223	- 4.76	3.01
0	15 009	- 5.04	29 240	- 4.63	43 682	- 4.61	2.46
5	11 716	- 4.87	23 280	- 4.49	34 807	- 4.47	1.93
10	9219.5	- 4.71	18 664	- 4.35	27 929	- 4.33	1.42
15	7311.4	- 4.56	15 064	- 4.22	22 561	- 4.20	0.93
20	5841.3	- 4.42	12 236	- 4.10	18 340	- 4.08	0.46
25	4700.0	- 4.28	10 000	- 3.98	15 000	- 3.96	0.00
30	3807.5	- 4.15	8220.3	- 3.86	12 340	- 3.85	0.22
35	3104.5	- 4.02	6795.2	- 3.75	10 207	- 3.74	0.43
40	2547.2	- 3.90	5647.3	- 3.65	8488.7	- 3.64	0.64
45	2102.4	- 3.78	4717.5	- 3.55	7095.4	- 3.54	0.84
50	1745.3	- 3.67	3960.3	- 3.45	5959.8	- 3.44	1.03
55	1456.8	- 3.56	3340.4	- 3.36	5029.4	- 3.35	1.22
60	1222.4	- 3.46	2830.3	- 3.27	4263.3	- 3.26	1.40
65	1030.9	- 3.36	2408.6	- 3.18	3629.6	- 3.18	1.58
70	873.61	- 3.26	2058.4	- 3.10	3102.9	- 3.10	1.75
75	743.79	- 3.17	1766.2	- 3.02	2663.2	- 3.02	1.92
80	636.11	- 3.08	1521.4	- 2.95	2294.6	- 2.94	2.08
85	546.36	- 3.00	1315.4	- 2.87	1984.3	- 2.87	2.23
90	471.22	- 2.92	1141.4	- 2.80	1722.0	- 2.80	2.54
95	408.03	- 2.84	993.91	- 2.73	1499.6	- 2.73	2.85
100	354.67	- 2.77	868.35	- 2.67	1310.2	- 2.67	3.14
105	309.43	- 2.69	761.11	- 2.61	1148.3	- 2.61	3.43
110	270.91	- 2.62	669.19	- 2.54	1009.6	- 2.55	3.71
115	238.01	- 2.56	590.14	- 2.48	890.23	- 2.49	3.98
120	209.79	- 2.49	521.94	- 2.43	787.23	- 2.43	4.24
125	185.50	- 2.43	462.92	- 2.37	698.07	- 2.38	4.50
130	164.53	- 2.37	411.68	- 2.32	620.67	- 2.32	4.76
135	146.36	- 2.31	367.08	- 2.27	553.27	- 2.27	5.00
140	130.57	- 2.26	328.14	- 2.22	494.43	- 2.22	5.25
145	116.80	- 2.20	294.05	- 2.17	442.91	- 2.18	5.48
150	104.76	- 2.15	264.12	- 2.12	397.69	- 2.13	5.71

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<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH <math>R_{25}</math> AT 22, 33 AND 47 k<math>\Omega</math></b>							
$T_{OPER}$ [°C]	PART NUMBER 2381 615 3*223/ NTCS0603E3223*MT		PART NUMBER 2381 615 3*333/ NTCS0603E3333*HT		PART NUMBER 2381 615 3*473/ NTCS0603E3473*HT		$\Delta R/R$ DUE TO $B_{tol}$ [± %]
	$R_T$ [ $\Omega$ ]	TCR [%/K]	$R_T$ [ $\Omega$ ]	TCR [%/K]	$R_T$ [ $\Omega$ ]	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



# 2381 615 3..../NTCS0603E3.....T

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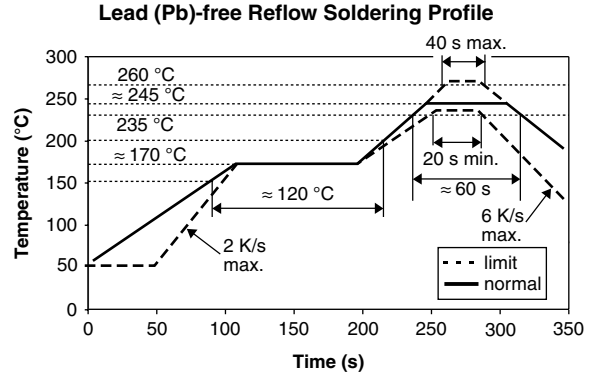
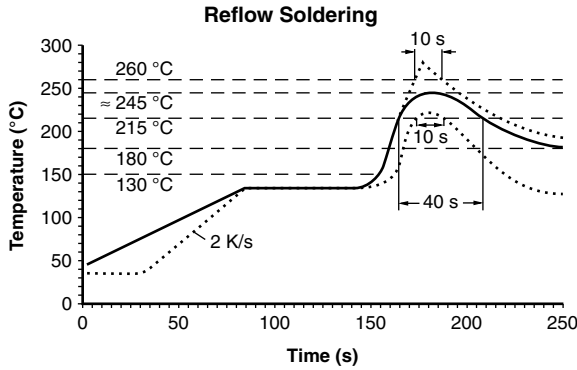
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<b>RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH <math>R_{25}</math> AT 68 AND 100 k<math>\Omega</math></b>					
$T_{OPER}$ [°C]	PART NUMBER 2381 615 3*683/ NTCS0603E3683*HT		PART NUMBER 2381 615 3*104/ NTCS0603E3104*XT		$\Delta R/R$ DUE TO $B_{tot}$ [± %]
	$R_T$ [ $\Omega$ ]	TCR [%/K]	$R_T$ [ $\Omega$ ]	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

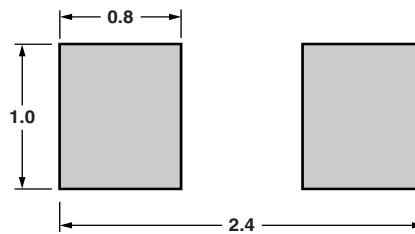
**SOLDERING CONDITIONS**

This SMD thermistor is only suitable for wave or reflow soldering, in accordance with "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.



Dimensions of the solder lands



**TESTS AND REQUIREMENTS**

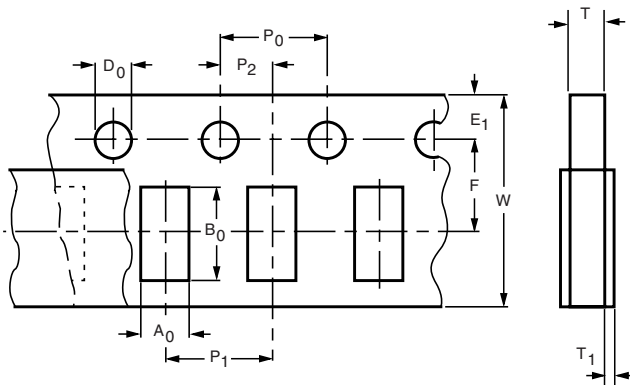
SOLDERABILITY AND RESISTANCE TO SOLDERING HEAT				
IEC 60068-2-58	TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
6	T <sub>C</sub>	Solderability	2 s at 235 °C	Min. 95 % of surface wetted
		Resistance to soldering heat	10 s at 260 °C	$\Delta R/R < 5 \%$

**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 <sub>0</sub> <sup>(1)</sup>	1.15	± 0.1
B <sub>0</sub> <sup>(1)</sup>	1.9	± 0.1
W	8.0	± 0.2
E <sub>1</sub>	1.75	± 0.1
F	3.5	± 0.05
D <sub>0</sub>	1.55	± 0.05
P <sub>0</sub> <sup>(2)</sup>	4.0	± 0.1
P <sub>1</sub>	4.0	± 0.1
P <sub>2</sub>	2.0	± 0.05
T tape thickness	1.1	max.
T <sub>1</sub> cover tape	< 0.1	-

**Notes**

<sup>(1)</sup> Measured 0.3 mm above base pocket

<sup>(2)</sup> P<sub>0</sub> pitch cumulative error over any 10 pitches ± 0.2 mm



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