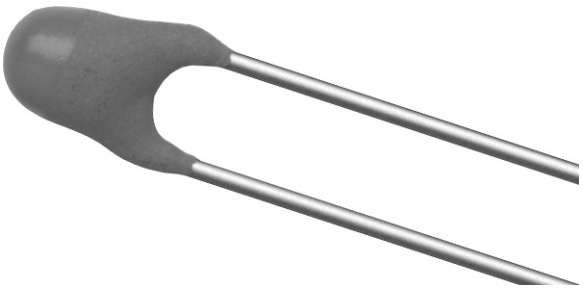
NTC Thermistors, Accuracy Line



FEATURES

- Accuracy over a wide temperature range
- High stability over a long life
- Excellent price/performance ratio
- Old part number was 2322 640 3/4/6....
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

APPLICATIONS

- Temperature sensing and control

These thermistors have a negative temperature coefficient. The device consists of a chip with two tinned solid copper-plated leads. It is grey lacquered and colour coded, but not insulated.

PACKAGING

The thermistors are packed in bulk or tape on reel; see code numbers and relevant packaging quantities.

QUICK REFERENCE DATA

PARAMETER	VALUE
Resistance value at 25 °C	3.3 Ω to 470 kΩ
Tolerance on R_{25}-value	±2%; ±3%; ±5%; ±10%
Tolerance on $B_{25/85}$-value	±0.5% to ±3%
Maximum dissipation	500 mW
Dissipation factor δ (for information only)	7 mW/K 8.5 mW/K (for 640..338 to 689)
Response time	1.2 s
Thermal time constant τ (for information only)	15 s
Operating temperature range: at zero dissipation; continuously at zero dissipation; for short periods at maximum dissipation (500 mW)	 –40 to +125 °C ≤150 °C 0 to 55 °C
Climatic category	40/125/56
Mass	≈0.3 g

ELECTRICAL DATA AND ORDERING INFORMATION

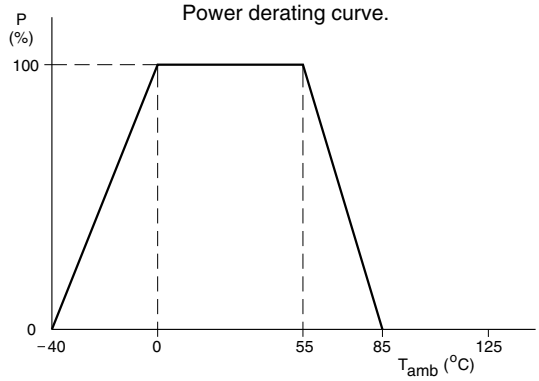
R_{25} (Ω)	$B_{25/85}$-VALUE	CATALOG NUMBER 2381 640 6....				COLOR CODE (see dimensions drawing and note 1)		
		R_{25} ±2%	R_{25} ±3%	R_{25} ±5%	R_{25} ±10%	I	II	III
3.3	2880 K ±3%	4338	6338	3338	2338	orange	orange	gold
4.7	2880 K ±3%	4478	6478	3478	2478	yellow	violet	gold
6.8	2880 K ±3%	4688	6688	3688	2688	blue	grey	gold
10	2990 K ±3%	4109	6109	3109	2109	brown	black	black
15	3041 K ±3%	4159	6159	3159	2159	brown	green	black
22	3136 K ±3%	4229	6229	3229	2229	red	red	black
33	3390 K ±3%	4339	6339	3339	2339	orange	orange	black
47	3390 K ±3%	4479	6479	3479	2479	yellow	violet	black
68	3390 K ±3%	4689	6689	3689	2689	blue	grey	black
100	3560 K ±0.75%	4101	6101	3101	2101	brown	black	brown
150	3560 K ±0.75%	4151	6151	3151	2151	brown	green	brown
220	3560 K ±0.75%	4221	6221	3221	2221	red	red	brown
330	3560 K ±0.75%	4331	6331	3331	2331	orange	orange	brown
470	3560 K ±0.5%	4471	6471	3471	2471	yellow	violet	brown
680	3560 K ±0.5%	4681	6681	3681	2681	blue	grey	brown
1000	3528 K ±0.5%	4102	6102	3102	2102	brown	black	red
1500	3528 K ±0.5%	4152	6152	3152	2152	brown	green	red

R_{25} (Ω)	$B_{25/85}$-VALUE	CATALOG NUMBER 2381 640 6....				COLOR CODE (see dimensions drawing and note 1)		
		R_{25} ±2%	R_{25} ±3%	R_{25} ±5%	R_{25} ±10%	I	II	III
2000	3528 K ±0.5%	4202	6202	3202	2202	red	black	red
2200	3977 K ±0.75%	4222	6222	3222	2222	red	red	red
2700	3977 K ±0.75%	4272	6272	3272	2272	red	violet	red
3300	3977 K ±0.75%	4332	6332	3332	2332	orange	orange	red
4700	3977 K ±0.75%	4472	6472	3472	2472	yellow	violet	red
6800	3977 K ±0.75%	4682	6682	3682	2682	blue	grey	red
10000	3977 K ±0.75%	4103	6103	3103	2103	brown	black	orange
12000	3740 K ±2%	4123	6123	3123	2123	brown	red	orange
15000	3740 K ±2%	4153	6153	3153	2153	brown	green	orange
22000	3740 K ±2%	4223	6223	3223	2223	red	red	orange
33000	4090 K ±1.5%	4333	6333	3333	2333	orange	orange	orange
47000	4090 K ±1.5%	4473	6473	3473	2473	yellow	violet	orange
68000	4190 K ±1.5%	4683	6683	3683	2683	blue	grey	orange
100000	4190 K ±1.5%	4104	6104	3104	2104	brown	black	yellow
150000	4370 K ±2.5%	4154	6154	3154	2154	brown	green	yellow
220000	4370 K ±2.5%	4224	6224	3224	2224	red	red	yellow
330000	4570 K ±1.5%	4334	6334	3334	2334	orange	orange	yellow
470000	4570 K ±1.5%	4474	6474	3474	2474	yellow	violet	yellow

Notes

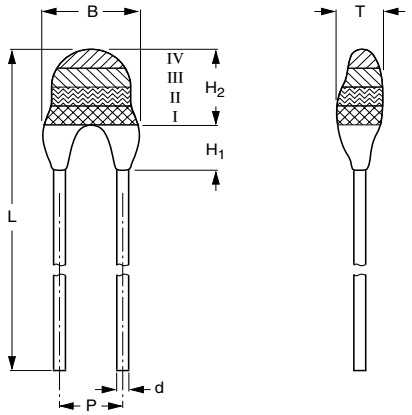
1. Dependent upon R_{25}-tolerance, the band IV is coloured as follows:
   a) for R_{25} ±2%, band IV is coloured red
   b) for R_{25} ±3%, band IV is coloured orange
   c) for R_{25} ±5%, band IV is coloured gold
   d) for R_{25} ±10%, band IV is coloured silver.

DERATING AND TEMPERATURE TOLERANCES



Power derating curve.

DIMENSIONS in millimeters



2381 640 6.338 to 6.474.

PHYSICAL DIMENSIONS FOR RELEVANT TYPE

CODE NUMBER 2381 640	B_{max}	d	H_1		H_2 max	L	P	T_{max}
			MIN.	MAX.				
6.338 to 6.221	5.0	0.6 ±0.06	1.0	4.0	6.0	24 ±1.5	2.54	4.0
6.331 to 6.474	3.3 ±0.5	0.6 ±0.06	–	2.0 ±1.0	6.0	24 ±1.5	2.54	3.0

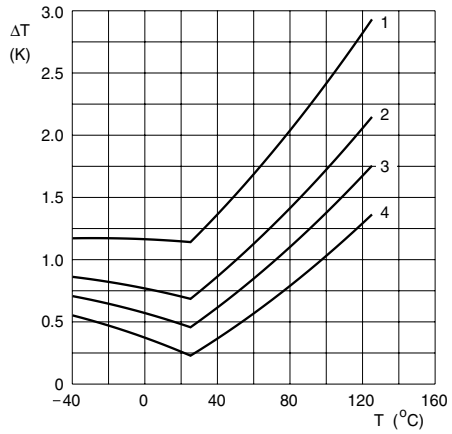
MARKING

The thermistors are marked with coloured bands; see dimensions drawing and “Electrical data and ordering information”.

MOUNTING

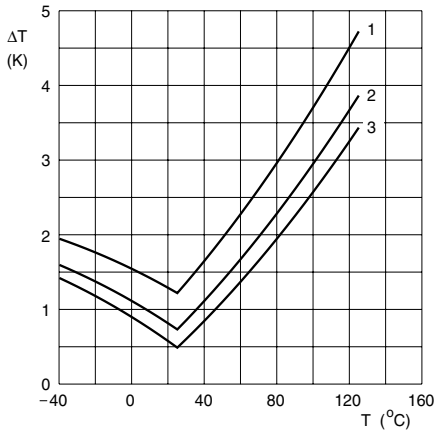
By soldering in any position.

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



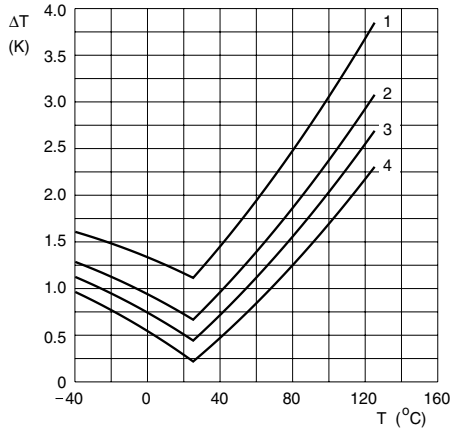
Curves valid for 2.2 to 10 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.
Curve 4: $\Delta R_{25}/R_{25}$ = 1%
(for 2381 640 5.... series only).

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



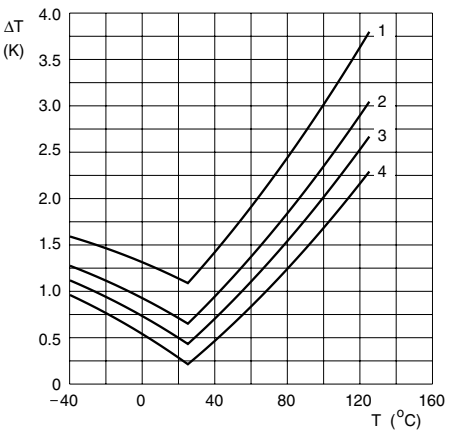
Curves valid for 12 to 22 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



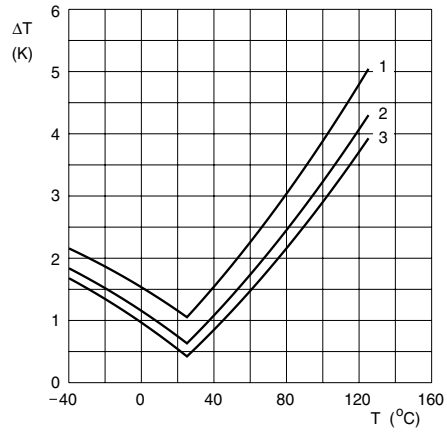
Curves valid for 33 to 47 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.
Curve 4: $\Delta R_{25}/R_{25}$ = 1%
(for 2381 640 5.... series only).

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



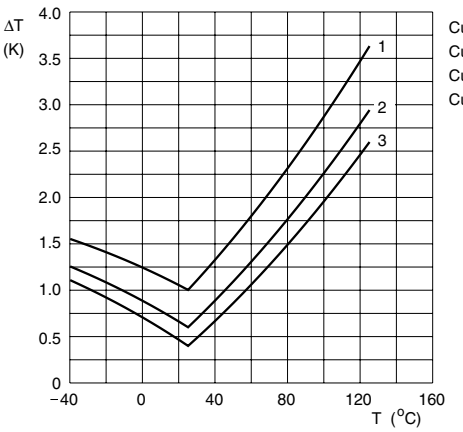
Curves valid for 68 to 100 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.
Curve 4: $\Delta R_{25}/R_{25}$ = 1%
(for 2381 640 5.... series only).

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



Curves valid for 150 to 220 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE.



Curves valid for 330 to 470 kΩ.
Curve 1: $\Delta R_{25}/R_{25}$ = 5%.
Curve 2: $\Delta R_{25}/R_{25}$ = 3%.
Curve 3: $\Delta R_{25}/R_{25}$ = 2%.

R_T VALUE AND TOLERANCE

These thermistors have a narrow tolerance on the B-value, the result of which provides a very small tolerance on the nominal resistance value over a wide temperature range. For this reason the usual graphs of R = f(T) are replaced by Resistance Values at Intermediate Temperatures Tables, together with a formula to calculate the characteristics with a high precision.

FORMULAE TO DETERMINE NOMINAL RESISTANCE VALUES

The resistance values at intermediate temperatures, or the operating temperature values, can be calculated using the following interpolation laws
(extended *"Steinhart and Hart"*):

$$R\ (T) = R_{ref} \times e^{(A + B/T + C/T^2 + D/T^3)} \quad (1)$$

$$T\ (R) = \left(A_1 + B_1 \ln\frac{R}{R_{ref}} + C_1 \ln^2\frac{R}{R_{ref}} + D_1 \ln^3\frac{R}{R_{ref}}\right)^{-1} \quad (2)$$

where:

A, B, C, D, A_1, B_1, C_1 and D_1 are constant values depending on the material concerned; see table below.

R_{ref} is the resistance value at a reference temperature (in this event 25 °C).

T is the temperature in K.

Formulae numbered (1) and (2) are interchangeable with an error of max. 0.005 °C in the range 25 °C to 125 °C and max. 0.015 °C in the range –40 °C to +25 °C.

DETERMINATION OF THE RESISTANCE/TEMPERATURE DEVIATION FROM NOMINAL VALUE

The total resistance deviation is obtained by combining the 'R_{25}-tolerance' and the 'resistance deviation due to B-tolerance'.

When:

X = R_{25}-tolerance

Y = resistance deviation due to B-tolerance

Z = complete resistance deviation,

then: $Z = \left[\left(1 + \frac{X}{100}\right) \times \left(1 + \frac{Y}{100}\right) - 1\right] \times 100\%$ or $Z \approx X + Y$.

When:

TC = temperature coefficient

ΔT = temperature deviation,

then: $\Delta T = \frac{Z}{TC}$

The temperature tolerances are plotted in the graphs on the previous page.

Example: at 0 °C, assume X = 5%, Y = 0.89% and TC = 5.08%/K (see Table), then:

$$Z = \left\{\left[1 + \frac{5}{100}\right] \times \left[1 + \frac{0.89}{100}\right] - 1\right\} \times 100\%$$

$$= \{1.05 \times 1.0089 - 1\} \times 100\% = 5.9345\%\ (\approx 5.93\%)$$

$$\Delta T = \frac{Z}{TC} = \frac{5.93}{5.08} = 1.167\ °C\ (\approx 1.17\ °C)$$

A NTC with a R_{25}-value of 10 kΩ has a value of 32.56 kΩ between –1.17 and +1.17 °C.

PARAMETERS FOR DETERMINING NOMINAL RESISTANCE VALUES

	$B_{25/85}$ (K)	NAME	TOL.B VALUE %	A	B (K)	C (10^5K^2)	D	A_1 (10^{-3})	B_1 ($10^{-4}K^{-1}$)	C_1 ($10^{-6}K^{-2}$)	D_1 ($10^{-7}K^{-3}$)
1	2880	mat O. with Bn = 2880K	3	-9.094	2251.74	229098	-27448200	3.354016	3.495020	2.09596E-06	4.26062E-07
2	2990	mat P. with Bn = 3990K	3	-10.2296	2887.62	132336	-25025100	3.354016	3.415560	4.95546E-06	4.36424E-07
3	3041	mat Q. with Bn = 3041K	3	-11.1334	3658.73	-102895	516652 616652	3.354016	3.349290	3.68384E-06	7.05046E-08
4	3136	mat R. with Bn = 3136K	3	-12.4493	4702.74	-402687	3196830	3.354016	3.243880	2.65801E-06	-2.70156E-0
5	3390	mat S. with Bn = 3390K	3	-12.6814	4391.97	-232807	1509643	3.354016	2.993410	2.13513E-06	-8.05672E-0
6	3528(1	mat I. with Bn = 3528K	0.5	-12.0596	3687.667	-7617.13	-5914730	3.354016	2.909670	1.63214E-06	7.1922E-08
	3528(2			-21.0704	11903.95	-2504699	247033800	3.354016	2.933910	3.49431E-06	-7.71269E-0
7	3560	mat H. with Bn = 3560K	0.75	-13.0723	4190.574	-47158.40	-11992560.	3.354016	2.884190	4.11803E-06	1.78679E-07
8	3740	mat B. with Bn = 3740K	2	-13.8973	4557.725	-98275	-7522357	3.354016	2.744030	3.66694E-06	1.37549E-07
9	3977	mat A. with Bn = 3977K	0.75	-14.6337	4791.842	-115334	-3730535	3.354016	2.569850	2.62013E-06	6.38309E-08
10	4090	mat C. with Bn = 4090K	1.5	-15.5322	5229.973	-160451	-5414091	3.354016	2.519110	3.51094E-06	1.10518E-07
11	4190	mat D. with Bn = 4190K	1.5	-16.0349	5459.339	-191141	-3328322	3.354016	2.460380	3.40538E-06	1.03424E-07
12	4370	mat E. with Bn = 4370K	2.5	-16.8717	5759.15	-194267	-6869149	3.354016	2.367720	3.58514E-06	1.25535E-07
13	4570	mat F. with Bn = 4570K	1.5	-17.6439	6022.726	-203157	-7183526	3.354016	2.264100	3.27818E-06	1.09763E-07

Notes

1. Temperature < 25 °C.
2. Temperature ≥25 °C.

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)		
				2381 640 .....; see note 1 at end of tables		
				6.338	**6.478**	**6.688**
–40	13.6364	8.08	–4.97	45.00	64.09	92.73
–35	10.6806	7.30	–4.80	35.25	50.20	72.63
–30	8.4350	6.55	–4.64	27.84	39.64	57.36
–25	6.7148	5.84	–4.48	22.16	31.56	45.66
–20	5.3866	5.15	–4.33	17.78	25.32	36.63
–15	4.3532	4.49	–4.19	14.37	20.46	29.60
–10	3.5432	3.85	–4.05	11.69	16.65	24.09
–5	2.9035	3.24	–3.92	9.58	13.65	19.74
0	2.3950	2.65	–3.79	7.90	11.26	16.29
5	1.9880	2.08	–3.66	6.56	9.34	13.52
10	1.6602	1.54	–3.55	5.48	7.80	11.29
15	1.3944	1.01	–3.43	4.60	6.55	9.48
20	1.1777	0.49	–3.32	3.89	5.54	8.01
25	1.0000	0.00	–3.22	3.30	4.70	6.80
30	0.8534	0.48	–3.12	2.82	4.01	5.80
35	0.7319	0.94	–3.02	2.42	3.44	4.98
40	0.6307	1.39	–2.93	2.08	2.96	4.29
45	0.5459	1.82	–2.84	1.80	2.57	3.71
50	0.4746	2.24	–2.76	1.57	2.23	3.23
55	0.4143	2.65	–2.68	1.37	1.95	2.82
60	0.3631	3.04	–2.60	1.20	1.71	2.47
65	0.3194	3.43	–2.52	1.05	1.50	2.17
70	0.2820	3.80	–2.45	0.93	1.33	1.92
75	0.2499	4.16	–2.38	0.82	1.17	1.70
80	0.2222	4.51	–2.32	0.73	1.04	1.51
85	0.1982	4.85	–2.25	0.65	0.93	1.35
90	0.1774	5.19	–2.19	0.59	0.83	1.21
95	0.1592	5.51	–2.13	0.53	0.75	1.08
100	0.1433	5.82	–2.07	0.47	0.67	0.97
105	0.1294	6.13	–2.02	0.43	0.61	0.88
110	0.1171	6.43	–1.97	0.39	0.55	0.80
115	0.1063	6.72	–1.92	0.35	0.50	0.72
120	0.0967	7.00	–1.87	0.32	0.45	0.66
125	0.0882	7.28	–1.82	0.29	0.41	0.60
130	0.0806	7.55	–1.77	0.27	0.38	0.55
135	0.0739	7.81	–1.73	0.24	0.35	0.50
140	0.0678	8.07	–1.69	0.22	0.32	0.46
145	0.0624	8.32	–1.65	0.21	0.29	0.42
150	0.0575	8.56	–1.61	0.19	0.27	0.39

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.109
–40	13.675	8.39	–4.86	136.75
–35	10.763	7.58	–4.72	107.63
–30	8.5318	6.81	–4.58	85.32
–25	6.8097	6.06	–4.44	68.10
–20	5.4717	5.35	–4.31	54.72
–15	4.4253	4.66	–4.18	44.25
–10	3.6017	4.00	–4.06	36.02
–5	2.9494	3.37	–3.94	29.49
0	2.4295	2.75	–3.82	24.30

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.109
5	2.0128	2.16	–3.71	20.13
10	1.6767	1.59	–3.60	16.77
15	1.4042	1.04	–3.50	14.04
20	1.1821	0.51	–3.39	11.82
25	1.0000	0.00	–3.30	10.00
30	0.8500	0.50	–3.20	8.50
35	0.7259	0.98	–3.11	7.26
40	0.6226	1.44	–3.03	6.23
45	0.5363	1.89	–2.94	5.36
50	0.4639	2.33	–2.86	4.64
55	0.4029	2.75	–2.78	4.03
60	0.3512	3.16	–2.71	3.51
65	0.3073	3.56	–2.64	3.07
70	0.2698	3.95	–2.57	2.70
75	0.2377	4.32	–2.50	2.38
80	0.2101	4.69	–2.43	2.10
85	0.1864	5.04	–2.37	1.86
90	0.1658	5.38	–2.31	1.66
95	0.1479	5.72	–2.25	1.48
100	0.1323	6.05	–2.20	1.32
105	0.1187	6.36	–2.14	1.19
110	0.1068	6.67	–2.09	1.07
115	0.0964	6.98	–2.04	0.96
120	0.0871	7.27	–1.99	0.87
125	0.0790	7.56	–1.94	0.79
130	0.0717	7.84	–1.90	0.72
135	0.0653	8.11	–1.85	0.65
140	0.0596	8.37	–1.81	0.60
145	0.0545	8.63	–1.77	0.55
150	0.0500	8.89	–1.73	0.50

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.159
–40	17.042	8.53	–5.54	255.63
–35	12.993	7.71	–5.31	194.90
–30	10.017	6.92	–5.10	150.26
–25	7.8037	6.17	–4.90	117.06
–20	6.1382	5.44	–4.71	92.07
–15	4.8719	4.74	–4.53	73.08
–10	3.8996	4.07	–4.37	58.49
–5	3.1461	3.42	–4.22	47.19
0	2.5571	2.80	–4.07	38.36
5	2.0930	2.20	–3.94	31.40
10	1.7245	1.62	–3.81	25.87
15	1.4298	1.06	–3.69	21.45
20	1.1924	0.52	–3.57	17.89
25	1.0000	0.00	–3.47	15.00
30	0.8431	0.50	–3.36	12.65
35	0.7144	0.99	–3.26	10.72
40	0.6083	1.47	–3.17	9.12
45	0.5203	1.92	–3.08	7.80

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.159
50	0.4470	2.37	–3.00	6.70
55	0.3856	2.80	–2.92	5.78
60	0.3339	3.21	–2.84	5.01
65	0.2903	3.62	–2.76	4.35
70	0.2533	4.01	–2.69	3.80
75	0.2218	4.39	–2.62	3.33
80	0.1948	4.77	–2.56	2.92
85	0.1717	5.13	–2.50	2.58
90	0.1518	5.48	–2.44	2.28
95	0.1346	5.82	–2.38	2.02
100	0.1196	6.15	–2.32	1.79
105	0.1067	6.47	–2.27	1.60
110	0.0954	6.79	–2.22	1.43
115	0.0855	7.09	–2.17	1.28
120	0.0768	7.39	–2.12	1.15
125	0.0691	7.69	–2.07	1.04
130	0.0624	7.97	–2.03	0.94
135	0.0565	8.25	–1.98	0.85
140	0.0512	8.52	–1.94	0.77
145	0.0465	8.78	–1.90	0.70
150	0.0423	9.04	–.86	0.63

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.229
–40	17.042	8.80	–5.54	374.92
–35	12.993	7.95	–5.31	285.85
–30	10.017	7.14	–5.10	220.38
–25	7.8037	6.36	–4.90	171.68
–20	6.1382	5.61	–4.71	135.04
–15	4.8719	4.89	–4.53	107.18
–10	3.8996	4.20	–4.37	85.79
–5	3.1461	3.53	–4.22	69.21
0	2.5571	2.89	–4.07	56.26
5	2.0930	2.27	–3.94	46.05
10	1.7245	1.67	–3.81	37.94
15	1.4298	1.10	–3.69	31.45
20	1.1924	0.54	–3.57	26.23
25	1.0000	0.00	–3.47	22.00
30	0.8431	0.52	–3.36	18.55
35	0.7144	1.02	–3.26	15.72
40	0.6083	1.51	–3.17	13.38
45	0.5203	1.98	–3.08	11.45
50	0.4470	2.44	–3.00	9.83
55	0.3856	2.88	–2.92	8.48
60	0.3339	3.32	–2.84	7.35
65	0.2903	3.73	–2.76	6.39
70	0.2533	4.14	–2.69	5.57
75	0.2218	4.53	–2.62	4.88
80	0.1948	4.91	–2.56	4.29
85	0.1717	5.29	–2.50	3.78
90	0.1518	5.65	–2.44	3.34

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)
				2381 640 .....; see note 1 at end of tables
				6.229
95	0.1346	6.00	–2.38	2.96
100	0.1196	6.34	–2.32	2.63
105	0.1067	6.68	–2.27	2.35
110	0.0954	7.00	–2.22	2.10
115	0.0855	7.32	–2.17	1.88
120	0.0768	7.62	–2.12	1.69
125	0.0691	7.93	–2.07	1.52
130	0.0624	8.22	–2.03	1.37
135	0.0565	8.50	–1.98	1.24
140	0.0512	8.78	–1.94	1.13
145	0.0165	9.06	–1.90	1.02
150	0.0423	9.32	–1.86	0.93

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)		
				2381 640 .....; see note 1 at end of tables		
				6.339	**6.479**	**6.689**
–40	21.4241	9.51	–5.94	707.00	1006.93	1456.84
–35	16.0147	8.59	–5.70	528.48	752.69	1089.00
–30	12.1074	7.72	–5.49	399.54	569.05	823.30
–25	9.2511	6.87	–5.28	305.29	434.80	629.07
–20	7.1395	6.06	–5.09	235.60	335.56	485.49
–15	5.5619	5.29	–4.90	183.54	261.41	378.21
–10	4.3715	4.54	–4.73	144.26	205.46	297.26
–5	3.4647	3.82	–4.57	114.33	162.84	235.60
0	2.7678	3.12	–4.42	91.34	130.09	188.21
5	2.2276	2.45	–4.27	73.51	104.70	151.48
10	1.8057	1.81	–4.13	59.59	84.87	122.79
15	1.4735	1.18	–4.00	48.63	69.26	100.20
20	1.2102	0.58	–3.88	39.94	56.88	82.29
25	1.0000	0.00	–3.76	33.00	47.00	68.00
30	0.8311	0.56	–3.64	27.43	39.06	56.51
35	0.6946	1.11	–3.54	22.92	32.64	47.23
40	0.5835	1.63	–3.43	19.26	27.42	39.68
45	0.4927	2.14	–3.34	16.26	23.16	33.50
50	0.4180	2.64	–3.24	13.79	19.65	28.42
55	0.3563	3.12	–3.15	11.76	16.74	24.23
60	0.3050	3.58	–3.07	10.06	14.33	20.74
65	0.2622	4.03	–2.98	8.65	12.32	17.83
70	.02263	4.47	–2.90	7.47	10.64	15.39
75	0.1961	4.90	–2.83	6.47	9.22	13.33
80	0.1705	5.31	–2.76	5.63	8.02	11.60
85	0.1489	5.71	–2.69	4.91	7.00	10.12
90	0.1304	6.11	–2.62	4.30	6.13	8.86
95	0.1146	6.49	–2.55	3.78	5.38	7.79
100	0.1010	6.86	–2.49	3.33	4.75	6.87
105	0.0893	7.22	–2.43	2.95	4.20	6.07
110	0.0792	7.57	–2.37	2.61	3.72	5.38
115	0.0704	7.91	–2.32	2.32	3.31	4.79
120	0.0628	8.24	–2.26	2.07	2.95	4.27
125	0.0561	8.57	–2.21	1.85	2.64	3.82
130	0.0503	8.88	–2.16	1.66	2.37	3.42
135	0.0452	9.19	–2.11	1.49	2.13	3.07

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)		
				2381 640 .....; see note 1 at end of tables		
				6.339	**6.479**	**6.689**
140	0.0407	9.49	−2.07	1.34	1.91	2.77
145	0.0368	9.79	−2.02	1.21	1.73	2.50
150	0.0333	10.08	−1.98	1.10	1.56	2.26

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)					
				2381 640 .....; see note 1 at end of tables					
				6.101	**6.151**	**6.221**	**6.331**	**6.471**	**6.681**
−40	21.9261	2.50	−5.75	2192.6	2388.9	4823.7	7236	10503	14910
−35	16.5224	2.26	−5.57	1652.2	2478.4	3634.9	5452	7766	11235
−30	12.5583	2.03	−5.40	1255.8	1883.7	2762.8	4144	5902	8540
−25	9.62492	1.80	−5.24	962.5	1443.7	2117.5	3176	4524	6545
−20	7.43618	1.59	−5.08	743.6	1115.4	1636.0	2454	3495	5057
−15	5.78976	1.39	−4.93	579.0	868.5	1273.7	1911	2721	3937
−10	4.54158	1.19	−4.78	454.2	681.2	999.1	1499	1235	3088
−5	3.58813	1.00	−4.64	358.8	538.2	789.4	1184	1686	2440
0	2.85449	0.82	−4.51	285.4	428.2	628.0	942.0	1342	1941
5	2.28599	0.64	−4.38	228.6	342.9	502.9	754.4	1074	1554
10	1.84245	0.47	−4.25	184.2	276.4	405.3	608.0	865.9	1253
15	1.49414	0.31	−4.13	149.4	224.1	328.7	493.1	702.2	1016
20	1.21887	0.15	−4.01	121.9	182.8	268.2	402.2	572.9	828.8
25	1.000	0.00	−3.90	100.0	150.0	220.0	330.0	470.0	680.0
30	0.82494	0.15	−3.80	82.5	123.7	181.5	272.2	387.7	561.0
35	0.68413	0.29	−3.69	68.4	102.6	150.5	225.8	321.5	465.2
40	0.57025	0.43	−3.59	57.0	85.5	125.5	188.2	268.0	387.8
45	0.47765	0.56	−3.50	47.8	71.6	105.1	157.6	224.5	324.8
50	0.40198	0.69	−3.40	40.2	60.3	88.4	132.7	188.9	273.3
55	0.33984	0.82	−3.31	34.0	51.0	74.8	112.1	159.7	231.1
60	0.28856	0.94	−3.23	28.9	43.3	63.5	95.23	135.6	196.2
65	0.24606	1.06	−3.15	24.6	36.9	54.1	81.20	115.6	167.3
70	0.21067	1.17	−3.07	21.1	31.6	46.3	69.52	99.00	143.3
75	0.18108	1.29	−2.99	18.1	27.2	39.8	59.76	85.11	123.1
80	0.15623	1.39	−2.91	15.6	23.4	34.4	51.56	73.43	106.2
85	0.13529	1.50	−2.84	13.5	20.3	29.8	44.65	63.59	92.00
90	0.11757	1.60	−2.77	11.8	17.6	25.9	38.80	55.26	79.95
95	0.10251	1.70	−2.71	10.3	15.4	22.6	33.83	48.18	69.71
100	0.08968	1.80	−2.64	8.97	13.5	19.7	29.59	42.15	60.98
105	0.07871	1.89	−2.58	7.87	11.8	17.3	25.97	36.99	53.52
110	0.06928	1.99	−2.52	6.93	10.4	15.2	22.86	32.56	47.11
115	0.06117	2.08	−2.46	6.12	9.18	13.5	20.19	28.75	41.60
120	0.05416	2.16	−2.41	5.42	8.12	11.9	17.87	25.46	36.83
125	0.04809	2.25	−2.35	4.81	7.21	10.6	15.87	22.60	32.70
130	0.04282	2.33	−2.30	4.28	6.42	9.42	14.13	20.12	29.11
135	0.03822	2.41	−2.25	3.82	5.73	8.41	12.61	17.96	25.99
140	0.03420	2.49	−2.20	3.42	5.13	7.52	11.29	16.07	23.25
145	0.03068	2.57	−2.15	3.07	4.60	6.75	10.12	14.42	20.86
150	0.02758	2.65	−2.10	2.76	4.14	6.07	9.10	12.96	18.76

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (Ω)		
				2381 640 .....; see note 1 at end of tables		
				6.102	**6.152**	**6.202**
–40	23.3402	1.65	–6.06	23342	35013	46684
–35	17.3347	1.49	–5.84	17336	26004	34672
–30	13.0166	1.34	–5.62	13018	19526	26035
–25	9.8764	1.19	–5.42	9877	14816	19754
–20	7.5682	1.05	–5.23	7569	11353	15138
–15	5.8541	0.92	–5.05	5855	8782	11709
–10	4.5688	0.79	–4.87	4569	6854	9138
–5	3.5961	0.66	–4.71	3596	5395	7193
0	2.8533	0.54	–4.55	2854	4280	5707
5	2.2815	0.43	–4.40	2282	3422	4563
10	1.8376	0.31	–4.26	1838	2457	3675
15	1.4904	0.21	–4.12	1491	2236	2981
20	1.2169	0.10	–3.99	1217	1826	2434
25	1.0000	0.00	–3.87	1000	1500	2000
30	0.8266	0.10	–3.75	826.7	1240	1653
35	0.6873	0.19	–3.63	687.4	1031	1375
40	0.5746	0.28	–3.53	574.6	861.9	1149
45	0.4827	0.37	–3.42	482.7	724.1	965.0
50	0.4073	0.46	–3.32	407.4	611.0	814.7
55	0.3452	0.54	–3.23	345.2	517.8	690.5
60	0.2937	0.62	–3.14	293.7	440.6	587.5
65	0.2508	0.70	–3.05	250.8	376.2	501.7
70	0.2149	0.78	–2.97	214.9	322.4	429.8
75	0.1847	0.85	–2.89	184.8	277.1	369.5
80	0.1593	0.92	–2.81	159.3	238.9	318.6
85	0.1377	0.99	–2.73	137.7	206.6	275.5
90	0.11942	1.06	–2.66	119.4	179.1	238.9
95	0.10380	1.13	–2.59	103.8	155.7	207.6
100	0.09045	1.19	–2.53	90.46	135.7	180.9
105	0.07900	1.25	–2.46	79.00	118.5	158.0
110	0.06915	1.31	–2.40	69.16	103.7	138.3
115	0.06066	1.37	–2.34	60.66	90.99	121.3
120	0.05332	1.43	–2.29	53.32	79.98	106.6
125	0.04696	1.49	–2.23	46.96	70.44	93.9
130	0.04143	1.54	–2.18	41.44	62.15	82.9
135	0.03662	1.60	–2.13	36.63	54.94	73.3
140	0.03243	1.65	–2.08	32.43	48.65	64.9
145	0.02877	1.70	–2.03	28.77	43.16	57.5
150	0.02556	1.75	–1.98	25.56	38.34	51.1

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)					
				2381 640 .....; see note 1 at end of tables					
				6.222	**6.272**	**6.332**	**6.472**	**6.682**	**6.103**
–40	33.21	2.66	6.57	73.06	89.67	109.6	156.1	225.8	332.1
–35	23.99	2.41	6.36	52.78	64.77	79.17	112.8	163.1	240.0
–30	17.52	2.17	6.15	38.55	47.31	57.82	82.35	119.1	175.2
–25	12.93	1.94	5.95	28.44	34.91	42.67	60.77	87.92	129.3
–20	9.636	1.71	5.76	21.20	26.02	31.80	45.30	65.53	96.36
–15	7.250	1.50	5.58	15.95	19.58	23.93	34.08	49.30	72.50
–10	5.505	1.29	5.40	12.11	14.86	18.16	25.87	37.43	55.05

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)					
				2381 640 .....; see note 1 at end of tables					
				6.222	**6.272**	**6.332**	**6.472**	**6.682**	**6.103**
–5	4.216	1.08	5.24	9.275	11.38	13.91	19.81	28.67	42.16
0	3.255	0.89	5.08	7.162	8.790	10.74	15.30	22.14	32.56
5	2.534	0.70	4.92	5.575	6.842	8.362	11.91	17.23	25.34
10	1.987	0.52	4.78	4.372	5.366	6.558	9.340	13.51	19.87
15	1.570	0.34	4.64	3.454	4.239	5.181	7.378	10.67	15.70
20	1.249	0.17	4.50	2.747	3.372	4.121	5.869	8.492	12.49
25	1.000	0.00	4.37	2.200	2.700	3.300	4.700	6.800	10.00
30	0.8059	0.16	4.25	1.773	2.176	2.660	3.788	5.480	8.059
35	0.6535	0.32	4.13	1.438	1.764	2.156	3.072	4.444	6.535
40	0.5330	0.47	4.02	1.173	1.439	1.759	2.505	3.624	5.330
45	0.4372	0.62	3.91	0.9618	1.180	1.443	2.055	2.972	4.372
50	0.3605	0.77	3.80	0.7932	0.973	1.190	1.694	2.451	3.606
55	0.2989	0.91	3.70	0.6575	0.807	0.9863	1.405	2.032	2.989
60	0.2490	1.05	3.60	0.5478	0.672	0.8217	1.170	1.693	2.490
65	0.2084	1.18	3.51	0.4586	0.562	0.6879	0.9797	1.417	2.084
70	0.1753	1.31	3.42	0.3857	0.473	0.5785	0.8239	1.192	1.753
75	0.1481	1.44	3.33	0.3258	0.399	0.4887	0.6960	1.007	1.481
80	0.1256	1.57	3.25	0.2764	0.339	0.4146	0.5905	0.8544	1.256
85	0.1070	1.69	3.16	0.2355	0.289	0.3532	0.5031	0.7278	1.070
90	0.09154	1.81	3.09	0.2014	0.247	0.3021	0.4303	0.6225	0.9154
95	0.07860	1.93	3.01	0.1729	0.212	0.2594	0.3694	0.5345	0.7860
100	0.06773	2.04	2.94	0.1490	0.182	0.2235	0.3183	0.4607	0.6773
105	0.05858	2.15	2.87	0.1289	0.158	0.1933	0.2753	0.3983	0.5858
110	0.05083	2.26	2.80	0.1118	0.137	0.1677	0.2389	0.3457	0.5083
115	0.04426	2.37	2.73	0.0974	0.1195	0.1461	0.2080	0.3010	0.4426
120	0.03866	2.47	2.67	0.0851	0.1044	0.1276	0.1817	0.2629	0.3866
125	0.03387	2.57	2.61	0.0745	0.0915	0.1118	0.1592	0.2303	0.3387
130	0.02977	2.67	2.55	0.0655	0.0804	0.0982	0.1399	0.2024	0.2977
135	0.02624	2.77	2.49	0.0577	0.0709	0.0866	0.1233	0.1784	0.2624
140	0.02319	2.86	2.43	0.0510	0.0626	0.0765	0.1090	0.1577	0.2319
145	0.02055	2.96	2.38	0.0452	0.0555	0.0678	0.0966	0.1398	0.2055
150	0.01826	3.05	2.33	0.0402	0.0493	0.0603	0.0858	0.1242	0.1826

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)		
				2381 640 .....; see note 1 at end of tables		
				6.123	**6.153**	**6.223**
–40	25.78	6.81	6.09	309.4	386.8	567.2
–35	19.13	6.16	5.89	229.5	286.9	420.8
–30	14.32	5.53	5.70	171.8	214.8	315.0
–25	10.82	4.93	5.52	129.8	162.3	238.0
–20	8.245	4.35	5.35	98.93	123.7	181.4
–15	6.335	3.80	5.19	76.02	95.03	139.4
–10	4.907	3.26	5.03	58.88	73.60	107.9
–5	3.830	2.74	4.88	45.95	57.44	84.25
0	3.011	2.24	4.73	36.13	45.16	66.24
5	2.384	1.76	4.60	28.60	35.76	52.45
10	1.900	1.30	4.46	22.80	28.50	41.81
15	1.525	0.85	4.34	18.30	22.87	33.55
20	1.231	0.42	4.21	14.77	18.47	27.09
25	1.000	0.00	4.10	12.00	15.00	22.00
30	0.8170	0.41	3.98	9.804	12.26	17.97

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)		
				2381 640 .....; see note 1 at end of tables		
				6.123	**6.153**	**6.223**
35	0.6712	0.80	3.88	8.054	10.07	14.77
40	0.5543	1.19	3.77	6.652	8.315	12.20
45	0.4602	1.57	3.67	5.522	6.903	10.12
50	0.3839	1.94	3.57	4.607	5.759	8.447
55	0.3219	2.30	3.48	3.862	4.828	7.081
60	0.2710	2.65	3.39	3.252	4.067	5.963
65	0.2293	2.99	3.30	2.751	3.439	5.044
70	0.1947	3.33	3.22	2.337	2.921	4.284
75	0.1661	3.66	3.14	1.993	2.492	3.654
80	0.1422	3.98	3.06	1.707	2.134	3.129
85	0.1223	4.29	2.99	1.467	1.834	2.690
90	0.1055	4.60	2.92	1.266	1.583	2.321
95	0.09135	4.90	2.85	1.096	1.370	2.010
100	0.07937	5.19	2.78	0.9524	1.190	1.746
105	0.06919	5.48	2.71	0.8302	1.038	1.522
110	0.06050	5.76	2.65	0.7260	0.9075	1.331
115	0.05307	6.04	2.59	0.6369	0.7961	1.168
120	0.04670	6.31	2.53	0.5604	0.7005	1.027
125	0.04121	6.57	2.47	0.4945	0.6181	0.9065

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.333	**6.473**
–40	33.81	5.55	6.55	1116	1589
–35	24.50	5.02	6.34	808.6	1151
–30	17.93	4.52	6.15	591.7	842.8
–25	13.25	4.03	5.96	437.1	622.6
–20	9.875	3.56	5.78	325.9	464.1
–15	7.425	3.10	5.61	245.0	349.0
–10	5.630	2.67	5.45	185.8	264.6
–5	4.304	2.24	5.29	142.0	202.3
0	3.315	1.84	5.14	109.4	155.8
5	2.573	1.44	4.99	84.91	120.9
10	2.011	1.07	4.85	66.37	94.53
15	1.583	0.70	4.72	52.24	74.40
20	1.254	0.34	4.59	41.39	58.95
25	1.000	0.00	4.46	33.00	47.00
30	0.8024	0.33	4.34	26.47	37.71
35	0.6474	0.66	4.23	21.37	30.43
40	0.5255	0.98	4.12	17.34	24.70
45	0.4288	1.28	4.01	14.15	20.15
50	0.3518	1.59	3.91	11.61	16.53
55	0.2901	1.88	3.81	9.572	13.63
60	0.2403	2.17	3.71	7.931	11.30
65	0.2001	2.45	3.62	6.603	9.404
70	0.1674	2.72	3.53	5.522	7.865
75	0.1406	2.99	3.44	4.639	6.607
80	0.1186	3.25	3.36	3.913	5.573
85	0.1004	3.51	3.28	3.315	4.721
90	0.08542	3.76	3.20	2.819	4.015
95	0.07292	4.00	3.13	2.406	3.427
100	0.06248	4.24	3.06	2.062	2.936

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.333	**6.473**
105	0.05372	4.47	2.98	1.773	2.525
110	0.04635	4.70	2.92	1.530	2.179
115	0.04013	4.93	2.85	1.342	1.886
120	0.03485	5.15	2.79	1.150	1.638
125	0.03037	5.36	2.73	1.002	1.427
130	0.02654	5.57	2.67	0.8757	1.247
135	0.02326	5.78	2.61	0.7675	1.093
140	0.02044	5.98	2.55	0.6746	0.9608
145	0.01802	6.18	2.50	0.5945	0.8468
150	0.01592	6.37	2.44	0.5254	0.7483

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.683	**6.104**
–40	36.66	5.69	6.70	2493	3666
–35	26.38	5.15	6.49	1794	2638
–30	19.17	4.63	6.29	1303	1917
–25	14.06	4.13	6.10	956.2	1406
–20	10.41	3.65	5.92	708.0	1041
–15	7.779	3.18	5.74	528.9	777.9
–10	5.861	2.73	5.57	398.5	586.1
–5	4.453	2.30	5.41	302.8	445.3
0	3.409	1.88	5.26	231.8	340.9
5	2.631	1.48	5.11	178.9	263.1
10	2.044	1.09	4.97	139.0	204.4
15	1.600	0.72	4.83	108.8	160.0
20	1.261	0.35	4.70	85.74	126.1
25	1.000	0.00	4.57	68.00	100.0
30	0.7981	0.34	4.45	54.27	79.81
35	0.6408	0.67	4.35	43.57	64.08
40	0.5175	1.00	4.22	35.19	51.74
45	0.4202	1.32	4.11	28.57	42.02
50	0.3431	1.63	4.00	23.33	34.31
55	0.2816	1.93	3.90	19.15	28.16
60	0.2322	2.22	3.80	15.79	23.22
65	0.1925	2.51	3.71	13.09	19.25
70	0.1602	2.79	3.62	10.90	16.03
75	0.1340	3.06	3.53	9.114	13.40
80	0.1126	3.33	3.45	7.655	11.26
85	0.09496	3.59	3.36	6.457	9.496
90	0.08042	3.85	3.28	5.469	8.042
95	0.06837	4.10	3.21	4.649	6.837
100	0.05835	4.35	3.13	3.968	5.835
105	0.04998	4.59	3.06	3.399	4.998
110	0.04296	4.82	2.99	2.921	4.296
115	0.03705	5.05	2.92	2.519	3.705
120	0.03206	5.28	2.86	2.180	3.206
125	0.02783	5.50	2.80	1.892	2.783

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.154	**6.224**
−40	41.02	10.10	6.89	6153	9024
−35	29.29	9.12	6.68	4394	6444
−30	21.12	8.18	6.48	3168	4646
−25	15.37	7.28	6.29	2305	3381
−20	11.28	6.42	6.11	1693	2483
−15	8.358	5.59	5.93	1254	1839
−10	6.242	4.80	5.76	936.4	1373
−5	4.700	4.03	5.60	705.0	1034
0	3.567	3.30	5.44	535.0	784.7
5	2.727	2.59	5.29	409.1	600.0
10	2.101	1.90	5.15	315.1	462.1
15	1.629	1.25	5.01	244.4	358.4
20	1.272	0.61	4.88	190.8	279.9
25	1.000	0.00	4.75	150.0	220.0
30	0.7910	0.59	4.62	118.6	174.0
35	0.6295	1.18	4.51	94.42	138.5
40	0.5039	1.74	4.39	75.58	110.9
45	0.4056	2.30	4.28	60.85	89.24
50	0.3283	2.84	4.17	49.25	72.24
55	0.2672	3.37	4.07	40.08	58.78
60	0.2185	3.89	3.97	32.78	48.08
65	0.1796	4.40	3.87	26.94	39.51
70	0.1483	4.90	3.78	22.25	32.63
75	0.1231	5.39	3.69	18.46	27.07
80	0.1025	5.86	3.60	15.38	22.56
85	0.08582	6.33	3.52	12.87	18.88
90	0.07213	6.79	3.44	10.82	15.87
95	0.06086	7.24	3.36	9.129	13.39
100	0.05155	7.68	3.28	7.732	11.34
105	0.04383	8.11	3.21	6.574	9.642
110	0.03740	8.53	3.14	5.610	8.228
115	0.03203	8.94	3.07	4.804	7.046
120	0.02752	9.35	3.00	4.128	6.054
125	0.02372	9.75	2.94	3.559	5.219

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.334	**6.474**
−40	48.62	6.22	7.13	16044	22850
−35	34.19	5.63	6.91	11282	16068
−30	24.28	5.06	6.71	8013	11413
−25	17.42	4.51	6.52	5747	8185
−20	12.61	3.98	6.33	4161	5926
−15	9.211	3.47	6.15	3040	4329
−10	6.788	2.98	5.98	2240	3190
−5	5.045	2.51	5.82	1665	2371
0	3.781	2.06	5.66	1248	1776
5	2.855	1.62	5.50	942.3	1342
10	2.173	1.19	5.36	717.1	1021
15	1.666	0.78	5.22	549.8	783.0
20	1.286	0.38	5.08	424.5	604.6

T_{oper} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.334	**6.474**
25	1.000	0.00	4.95	330.0	470.0
30	0.7825	0.37	4.82	258.2	367.8
35	0.6163	0.74	4.70	203.4	289.6
40	0.4883	1.09	4.59	161.1	229.5
45	0.3892	1.44	4.47	128.4	182.9
50	0.3120	1.77	4.36	103.0	146.7
55	0.2515	2.10	4.26	83.00	118.2
60	0.2038	2.43	4.15	67.26	95.80
65	0.1660	2.74	4.06	54.79	78.03
70	0.1359	3.05	3.96	44.86	63.88
75	0.1118	3.35	3.87	36.90	52.55
80	0.09240	3.64	3.78	30.49	43.43
85	0.07670	3.93	3.69	25.31	36.05
90	0.06395	4.21	3.61	21.10	30.06
95	0.05354	4.48	3.53	17.67	25.16
100	0.04501	4.75	3.45	14.85	21.15
105	0.03798	5.01	3.37	12.53	17.85
110	0.03218	5.27	3.30	10.70	15.12
115	0.02736	5.52	3.23	9.029	12.86
120	0.02335	5.77	3.16	7.704	10.97
125	0.01999	6.01	3.09	6.597	9.396

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 68 KΩ AND 100 KΩ

T_{amb} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.683	**6.104**
–40	36.66	5.69	6.70	2493	3666
–35	26.38	5.15	6.49	1794	2638
–30	19.17	4.63	6.29	1303	1917
–25	14.06	4.13	6.10	956.2	1406
–20	10.41	3.65	5.92	708.0	1041
–15	7.779	3.18	5.74	528.9	777.9
–10	5.861	2.73	5.57	398.5	586.1
–5	4.453	2.30	5.41	302.8	445.3
0	3.409	1.88	5.26	231.8	340.9
5	2.631	1.48	5.11	178.9	263.1
10	2.044	1.09	4.97	139.0	204.4
15	1.600	0.72	4.83	108.8	160.0
20	1.261	0.35	4.70	85.74	126.1
25	1.000	0.00	4.57	68.00	100.0
30	0.7981	0.34	4.45	54.27	79.81
35	0.6408	0.67	4.35	43.57	64.08
40	0.5175	1.00	4.22	35.19	51.74
45	0.4202	1.32	4.11	28.57	42.02
50	0.3431	1.63	4.00	23.33	34.31
55	0.2816	1.93	3.90	19.15	28.16
60	0.2322	2.22	3.80	15.79	23.22
65	0.1925	2.51	3.71	13.09	19.25
70	0.1602	2.79	3.62	10.90	16.03
75	0.1340	3.06	3.53	9.114	13.40
80	0.1126	3.33	3.45	7.655	11.26
85	0.09496	3.59	3.36	6.457	9.496

T_{amb} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)	
				2381 640 .....; see note 1 at end of tables	
				6.683	**6.104**
90	0.08042	3.85	3.28	5.469	8.042
95	0.06837	4.10	3.21	4.649	6.837
100	0.05835	4.35	3.13	3.968	5.835
105	0.04998	4.59	3.06	3.399	4.998
110	0.04296	4.82	2.99	2.921	4.296
115	0.03705	5.05	2.92	2.519	3.705
120	0.03206	5.28	2.86	2.180	3.206
125	0.02783	5.50	2.80	1.892	2.783

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 470 KΩ

T_{amb} (°C)	R_T/R_{25}	ΔR DUE TO B-TOLERANCE (%)	TC (%/K)	R_{25} (kΩ)
				2381 640 .....; see note 1 at end of tables
				5.474
–40	48.62	6.22	7.13	22850
–35	34.19	5.63	6.91	16068
–30	24.28	5.06	6.71	11413
–25	17.42	4.51	6.52	8185
–20	12.61	3.98	6.33	5926
–15	9.211	3.47	6.15	4329
–10	6.788	2.98	5.98	3190
–5	5.045	2.51	5.82	2371
0	3.781	2.06	5.66	1776
5	2.855	1.62	5.50	1342
10	2.173	1.19	5.36	1021
15	1.666	0.78	5.22	783.0
20	1.286	0.38	5.08	604.6
25	1.000	0.00	4.95	470.0
30	0.7825	0.37	4.82	367.8
35	0.6163	0.74	4.70	289.6
40	0.4883	1.09	4.59	229.5
45	0.3892	1.44	4.47	182.9
50	0.3120	1.77	4.36	146.7
55	0.2515	2.10	4.26	118.2
60	0.2038	2.43	4.15	95.80
65	0.1660	2.74	4.06	78.03
70	0.1359	3.05	3.96	63.88
75	0.1118	3.35	3.87	52.55
80	0.09240	3.64	3.78	43.43
85	0.07670	3.93	3.69	36.05
90	0.06395	4.21	3.61	30.06
95	0.05354	4.48	3.53	25.16
100	0.04501	4.75	3.45	21.15
105	0.03798	5.01	3.37	17.85
110	0.03218	5.27	3.30	15.12
115	0.02736	5.52	3.23	12.86
120	0.02335	5.77	3.16	10.97
125	0.01999	6.01	3.09	9.396

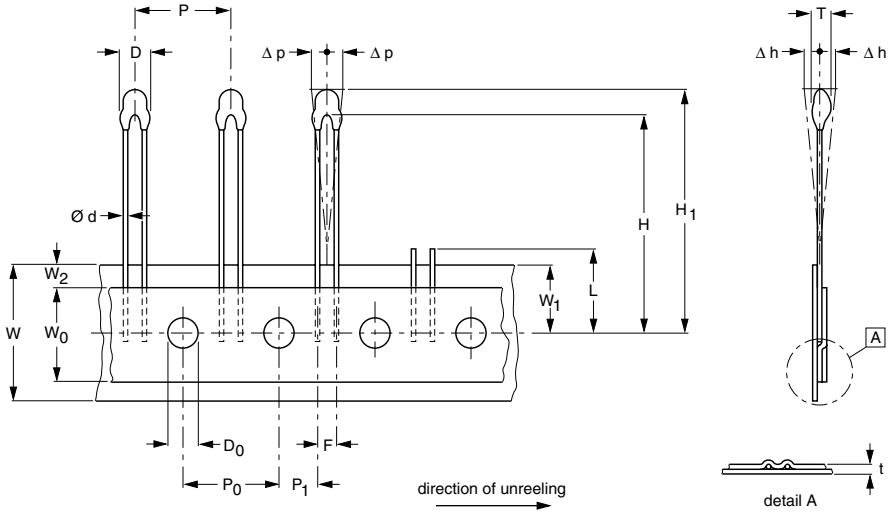
Note to Resistance Values At Intermediate Temperature Tables

1. Replace dot in last 5 digits of catalog number by a number according to the following details and depending on tolerance on required R_{25}-value: 4 for a tolerance of ±2%; 6 for a tolerance of ±3%; 3 for a tolerance of ±5%; 2 for a tolerance of ±10%.

PACKAGING

TAPE SPECIFICATIONS

Thermistors on tape.



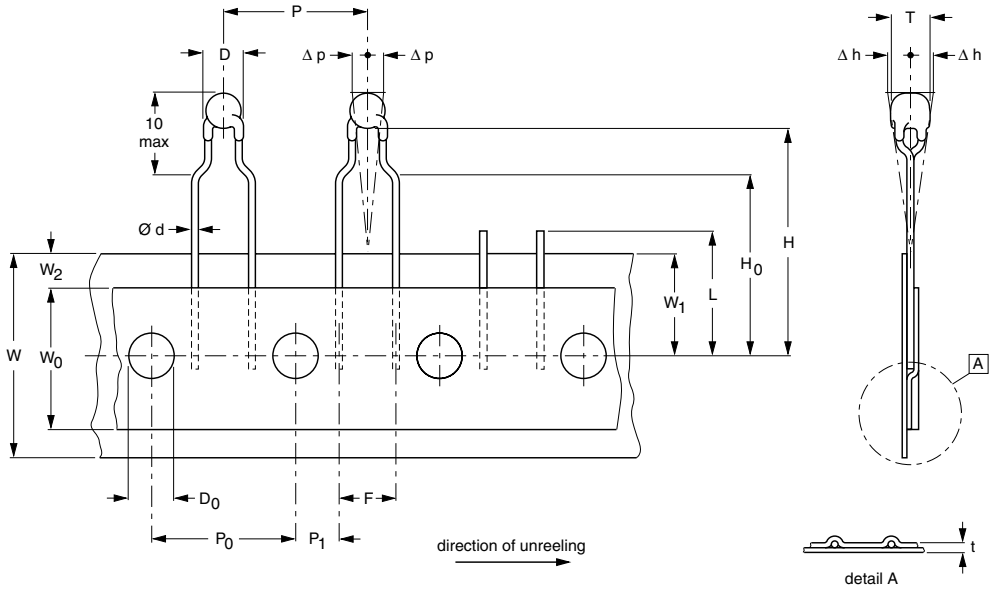
1E pitch
2322 640 4....

DIMENSIONS OF TAPE IN ACCORDANCE WITH *"IEC 60286-2"*			
SYMBOL	**PARAMETER**	**DIMENSIONS (mm)**	
		VALUE	**TOLERANCE**
D	body diameter(2)	3.3	+0.5
T	maximum total thickness	≤3	–
d	lead diameter	0.6	±0.06
P	pitch between thermistors	12.7	±1
P_0	feed-hole pitch (cumulative pitch error ±0.2 mm/20 products)	12.7	±0.3
P_1	feed-hole centre to lead centre	5.08	±0.7
Δp	component alignment	0	±1.3
F	lead-to-lead distance	2.54	±0.3
Δh	component alignment	0	±2
W	tape width	18.0	+1/-0.5
W_0	hold-down tape width	≥12.5	–
W_1	feed-hole position	9.0	±0.5
W_2	hold-down tape position	≤3	–
H	component to tape centre	22(1)	±1
H_1	component height	≤32	–
L	length of snipped lead	≤11	–
D_0	feed-hole diameter	4.0	±0.2
t	total tape thickness with cardboard tape 0.5 ±0.1 mm	0.65	±0.2
	inspection level: S3 mechanical	–	1%

Note

1. Taped products with H= 45±1, are available on request.
2. D ≤5 max for 6404.338 to 221.

Thermistors on tape.



2E pitch
2322 640 3....

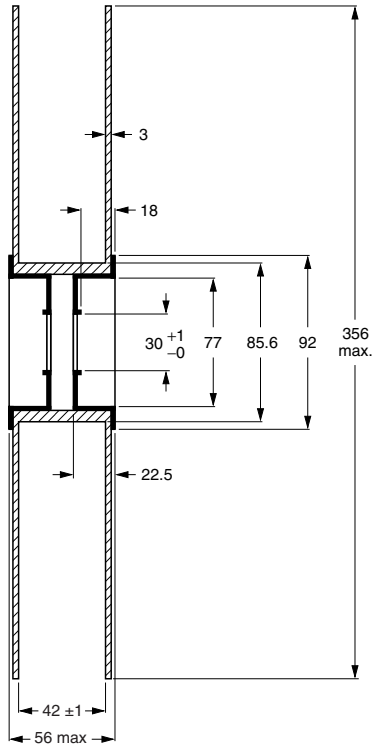
DIMENSIONS OF TAPE IN ACCORDANCE WITH *"IEC 60286-2"*			
SYMBOL	**PARAMETER**	**DIMENSIONS (mm)**	
		VALUE	**TOLERANCE**
D	body diameter(1)	3.3	+0.5
T	maximum total thickness(2)	≤3.2	–
d	lead diameter	0.6	±0.06
P	pitch between thermistors	12.7	±1
P_0	feed-hole pitch (cumulative pitch error ±0.2 mm/20 products)	12.7	±0.3
P_1	feed-hole centre to lead centre	3.85	±0.7
Δp	component alignment	0	±1.3
F	lead-to-lead distance	5.08	±0.3
Δh	component alignment	0	±2
W	tape width	18.0	+1/-0.5
W_0	hold-down tape width	≥12.5	–
W_1	feed-hole position	9.0	+0.75/-0.5
W_2	hold-down tape position	≤3	–
H	component to tape centre	20	+2
H_0	lead wire clinch height	16	±0.5
L	length of snipped lead	≤11	–
D_0	feed-hole diameter	4.0	±0.3
t	total tape thickness with cardboard tape 0.5 ±0.1 mm	0.7	±0.2
	inspection level: S3 mechanical	–	1%

Note

1. D ≤5 max for 640 3. 338 to 640 4. 221.
2. T ≤4 max for 640 3. 338 to 640 4. 221.

REEL SPECIFICATIONS

Dimensions of the reel.



CODE NUMBERS AND RELEVANT PACKAGING QUANTITIES

PARAMETER	BULK	TAPE AND REEL(1) 1e pitch	TAPE AND REEL(1) 2e pitch
	2381 640 6....	2381 640 4....	2381 640 3....
Quantity	500	1500 per reel, 2 reels per box	1500 per reel, 2 reels per box

Note

1. The maximum number of empty places per reel shall not exceed 0.1% of the total number of components per reel. With no consecutive positions empty.

CHARACTERISTICS OF TAPED PRODUCTS

Minimum pull-out force of the component: 5 N.

Minimum peel-off force of adhesive tape: 6N.

Minimum tearing force tape: 15 N.

Minimum pull-off force of tape-reel: 5 N.

STORAGE CONDITIONS

Storage temperature range: −25 to +40 °C.

Maximum relative humidity: 80%.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with *"IEC publication 60068-2; Environmental testing"*, except where indicated.

STABILITY TESTS

CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
D3; 4.20.1		endurance	25 °C; 1000 hours	$\Delta R/R < 1\%$
	1	endurance	−40 °C; 1000 hours	$\Delta R/R < 1\%$
	539	endurance	500 mW; 55 °C; 1000 hours	$\Delta R/R < 3\%$ (note 1)
	2	dry heat,	125 °C; 1000 hours	$\Delta R/R < 3\%$
D1; 4.19	3	damp heat	56 days at 40 °C; 90 to 95% RH	$\Delta R/R < 3\%$
C2; 4.14	14	rapid change of temperature	−40 °C to +125 °C; 50 cycles	$\Delta R/R < 2\%$
Other applicable tests				
	21	robustness of leads: tensile strength bending	 loading force 10 N loading force 5 N	$\Delta R/R \leq 1\%$
	58	soldering: solderability resistance to heat	 240 °C max.; duration 4 s max. 265 °C max.; duration 5 s max.	$\Delta R/R \leq 1\%$ (note 2)
	27	impact	free fall; 1 m	$\Delta R/R \leq 1\%$
	29	shock	490 m/s; half sinewave	$\Delta R/R \leq 1\%$
	45	resistance to solvent	ambient temp for 5 min;	no traces of lacquer on
	6	vibration	1.5 mm peak to peak: 10 to 58 Hz	no visible damage
	2	inflammability	1980, needle flame test	non-flammable

Notes

1. For $R_{25} \geq 100$ kΩ the drift requirement is $\Delta R/R < 5\%$.
2. For R_{25} from 2.2 kΩ to 10 kΩ, requirement is ±2% max.

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.