SMD PTC - Nickel Thin Film Linear Thermistors

FEATURES

- Alumina substrate base with nickel based PTC thin film element
- 0603, 0805, and 1206 sizes available
- Available in tape and reel packaging
- Standard R_{25} tolerances: ± 0.5 %, ± 1 %, ± 5 %
- Operating temperature range: -55 °C to +150 °C
- High stability over the entire temperature range
- C-UL-US recognized, file E148885
- AEC-Q200 qualified (grade 1)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES

Design Tools

SPICE Models

APPLICATIONS

Temperature compensation and sensing in

- Automotive
- Motor drives
- Lighting LED drivers
- Test and measuring equipment

QUICK REFERENCE DATA				
PARAMETER	VALUE			UNIT
DESCRIPTION	TFPT0603	TFPT0805	TFPT1206	
Resistance value at 25 °C (1)	100 to 1K	100 to 5K	100 to 10K	Ω
Tolerance on R_{25}-value	± 0.5; ± 1; ± 5			%
TCR at 25 °C	4110			ppm/K
Tolerance on TCR at 25 °C (2)	± 400			
Operating temperature range: at rated power at derated power (3)	 -55 to +70 -55 to +150			°C
Storage temperature range	-55 to +150			°C
Dissipation factor δ (for information only) (4)	1.8	2.3	4	mW/K
Maximum rated power at 70 °C (P_{70}) (3)(4)	75	100	125	mW
Maximum working voltage RCWV (5)	30	40	50	V
Weight	2	5.5	10	mg
Failure rate $FIT_{observed}$	≤ 0.1 x 10^{-9}/h			

Notes

(1) Other R_{25}-values are available upon request

(2) Contact Vishay if closer TCR lot tolerance is desired

(3) Derated power curve can be found in section “Power Derating”. Power applied at maximum temperature should not let increase the film temperature by more than 1 K (1 °C)

(4) Valid for sensor element only in low dissipative mode. For dissipative mounting, please refer to APPLICATION INFORMATION

(5) Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less

APPLICATION INFORMATION

When the TFPT dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled thermistor together with the mounting substrate. The (de)-rated power dissipation applies only if the long term permitted film temperature of 150 °C is not exceeded by more than 1 °C. Typically the thermal resistance (R_{thFA}) of a FR4 mounted TFPT0603 is around 250 K/W.

Please consider the application note “Thermal Management in Surface-Mounted Resistor Applications” (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

STANDARD RESISTANCE VALUES at 25 °C in Ω

100	180	330	560	1.0K	1.8K	3.3K	5.0K	8.2K
120	220	390	680	1.2K	2.2K	3.9K	5.6K	10.0K
150	270	470	820	1.5K	2.7K	4.7K	6.8K	

GLOBAL PART NUMBER INFORMATION

Global Part Numbering: TFPT1206L1002FM (preferred part number format)

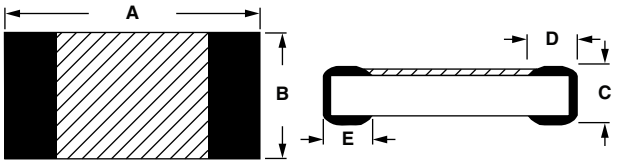
T	F	P	T	1	2	0	6	L	1	0	0	2	F	M

GLOBAL MODEL	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING (1)
TFPT0603 **TFPT0805** **TFPT1206**	**L** = linear	**1002** = 10K **1001** = 1K **1000** = 100R	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 %	**M** = paper tape on reel, code ET1 (5000 pcs) **V** = paper tape on reel, code E52 (1000 pcs)

Note

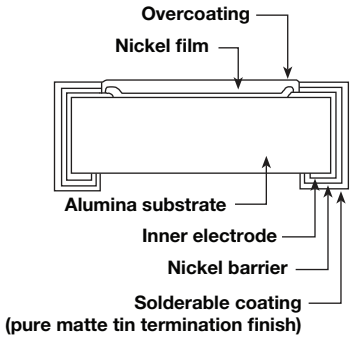
(1) According IEC 60286-3: 8 mm paper tape on Ø 180 mm / 7" reel

DIMENSIONS in millimeters



PART NUMBER	A	B	C	D	E
TFPT 0603	1.55 ± 0.10	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
TFPT 0805	2.00 ± 0.15	1.25 ± 0.15	0.45 ± 0.10	0.40 ± 0.20	0.40 ± 0.20
TFPT 1206	3.05 ± 0.15	1.50 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.25

CONSTRUCTION



TESTS AND REQUIREMENTS

TEST	CONDITIONS (1)	REQUIREMENTS MAX. $\lvert\Delta R_{25}/R_{25}\rvert$
High temperature exposure (storage)	AEC-Q200, 1000 h at 150 °C	0.25 %
Temperature cycling	AEC-Q200, 1000 cycles -55 °C / +125 °C	0.25 %
Biased humidity	1000 h, 1 mA biased at 85 °C / 85 % RH	0.25 %
	1000 h, 1 mA biased at 40 °C / 95 % RH	0.25 %
Operational life	1000 h, 10 % of P_{70} max biased at 85 °C	0.25 %
Mechanical shock	MIL-STD 202, method 213	0.25 %
Mechanical vibration	MIL-STD 202, method 204	0.25 %
Resistance to soldering heat	MIL-STD 202, method 210, condition K (reflow soldering)	0.25 %
ESD (2)	AEC-Q200-002, HBM (CD) 0.5 kV (0603), 1.0 kV (0805), 1.0 kV (1206)	0.25 %
Board flex	AEC-Q200-005, 2 mm during 60 s	0.25 %
Terminal strength	AEC-Q200-006, shear test 17.7 N (0805, 1206) and 10 N (0603) during 60 s	0.25 %

Notes

(1) Environmental performance specifications use test procedures as outlined in MIL-R23648D, MIL-STD 202 and AEC-Q200

(2) TFPTs are ESD sensitive

AGENCY APPROVALS

- C-UL certificate
- UL-US certificate

Note

- Agency approval documents, please see: www.vishay.com/ppg?33017&documents

AVERAGE RATIO R/R_{25} TFPT ALL SIZES AND VALUES

TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}
		-20	0.825	20	0.980	60	1.150	100	1.337	140	1.541
		-19	0.828	21	0.984	61	1.155	101	1.342	141	1.547
		-18	0.832	22	0.988	62	1.159	102	1.347	142	1.552
		-17	0.836	23	0.992	63	1.164	103	1.352	143	1.557
		-16	0.839	24	0.996	64	1.168	104	1.357	144	1.563
-55	0.702	-15	0.843	**25**	**1.000**	65	1.173	105	1.362	145	1.568
-54	0.705	-14	0.847	26	1.004	66	1.177	106	1.367	146	1.574
-53	0.708	-13	0.851	27	1.008	67	1.182	107	1.372	147	1.579
-52	0.712	-12	0.854	28	1.012	68	1.186	108	1.377	148	1.584
-51	0.715	-11	0.858	29	1.017	69	1.191	109	1.382	149	1.590
-50	0.719	-10	0.862	30	1.021	70	1.196	110	1.387	150	1.595
-49	0.722	-9	0.866	31	1.025	71	1.200	111	1.392		
-48	0.725	-8	0.869	32	1.029	72	1.205	112	1.397		
-47	0.729	-7	0.873	33	1.033	73	1.209	113	1.402		
-46	0.732	-6	0.877	34	1.037	74	1.214	114	1.407		
-45	0.736	-5	0.881	35	1.042	75	1.219	115	1.412		
-44	0.739	-4	0.885	36	1.046	76	1.223	116	1.417		
-43	0.743	-3	0.889	37	1.050	77	1.228	117	1.422		
-42	0.746	-2	0.892	38	1.054	78	1.232	118	1.427		
-41	0.749	-1	0.896	39	1.059	79	1.237	119	1.432		
-40	0.753	0	0.900	40	1.063	80	1.242	120	1.437		
-39	0.756	1	0.904	41	1.067	81	1.246	121	1.442		
-38	0.760	2	0.908	42	1.071	82	1.251	122	1.448		
-37	0.763	3	0.912	43	1.076	83	1.256	123	1.453		
-36	0.767	4	0.916	44	1.080	84	1.261	124	1.458		
-35	0.771	5	0.920	45	1.084	85	1.265	125	1.463		
-34	0.774	6	0.924	46	1.089	86	1.270	126	1.468		
-33	0.778	7	0.927	47	1.093	87	1.275	127	1.473		
-32	0.781	8	0.931	48	1.097	88	1.280	128	1.478		
-31	0.785	9	0.935	49	1.102	89	1.284	129	1.484		
-30	0.788	10	0.939	50	1.106	90	1.289	130	1.489		
-29	0.792	11	0.943	51	1.110	91	1.294	131	1.494		
-28	0.796	12	0.947	52	1.115	92	1.299	132	1.499		
-27	0.799	13	0.951	53	1.119	93	1.303	133	1.505		
-26	0.803	14	0.955	54	1.124	94	1.308	134	1.510		
-25	0.806	15	0.959	55	1.128	95	1.313	135	1.515		
-24	0.810	16	0.963	56	1.133	96	1.318	136	1.520		
-23	0.814	17	0.967	57	1.137	97	1.323	137	1.526		
-22	0.817	18	0.971	58	1.141	98	1.328	138	1.531		
-21	0.821	19	0.975	59	1.146	99	1.333	139	1.536		

RATIO FORMULA

$R_T = R_{25}$ x (9.0014 x 10^{-1} + 3.87235 x 10^{-3} (°C)$^{-1}$ x T + 4.86825 x 10^{-6} (°C)$^{-2}$ x T^2 + 1.37559 x 10^{-9} (°C)$^{-3}$ x T^3)
$T_{(°C)}$ = 28.54 x $(R_T/R_{25})^3$ - 158.5 x $(R_T/R_{25})^2$ + 474.8 x (R_T/R_{25}) - 319.85)

RATIO TOLERANCES		
LOW TEMP.	HIGH TEMP.	TOL.
-55 °C	+150 °C	± 4 %
-40 °C	+125 °C	± 3 %
-20 °C	+85 °C	± 2 %
0 °C	+55 °C	± 1 %
+12 °C	+40 °C	± 0.5 %

RATIO TOLERANCE EXAMPLES:

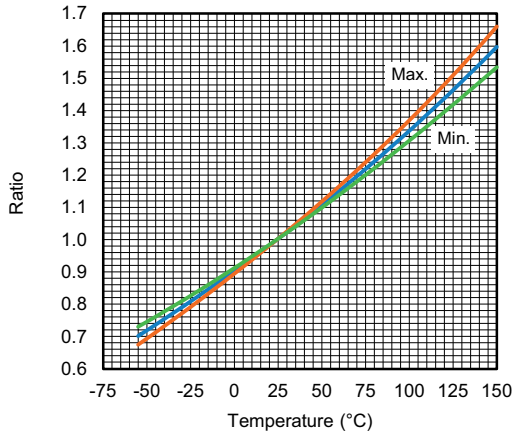
At 40 °C, ratio = 1.063 ± 0.5 % (0.005)
so, ratio = 1.058 to 1.068

At 125 °C, ratio = 1.460 ± 3 % (0.044)
so, ratio = 1.416 to 1.504

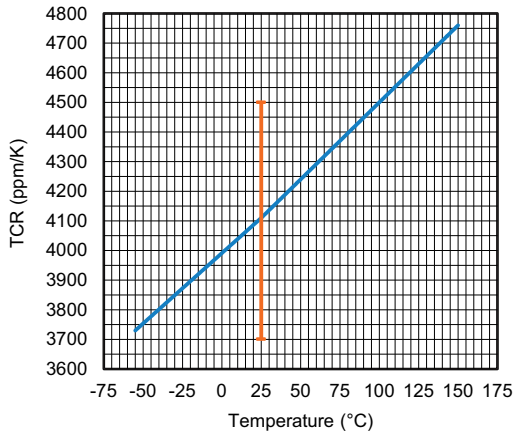
At intermediate temperatures, the ratios can be gradually adapted, for example at 105 °C the ratio tolerance will be ± 2.5 %.

For total resistance tolerance, the specific R_{25} tolerance needs to be multiplied with the ratio tolerance, for example a 100R 1 % at 25 °C will have a maximum resistance at 125 °C of 100R x 1.463 x 1.03 x 1.01 = 152.2 Ω.

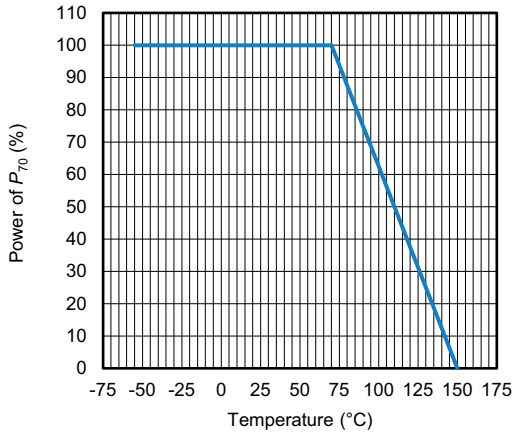
RATIO R_T/R_{25}



TCR TYPICAL VALUE



POWER DERATING



Note

- Zero (0 %) power is considered as measuring power that will generate a maximum film temperature increase of 1 °C

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