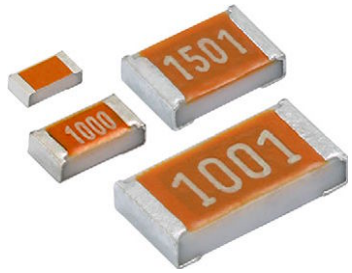
SMD PTC - Nickel Thin Film Linear Thermistors



FEATURES

- Alumina substrate base with nickel based PTC thin film element
- 0402, 0603, 0805, and 1206 sizes available
- Available in tape and reel packaging
- Standard R_{25} tolerances: ± 0.5 %, ± 1 %, ± 5 %
- Operation range -55 °C to +150 °C
- High stability over the entire temperature range
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified (grade 1), except TFPT0402
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb Available

e3 RoHS* Available

HALOGEN FREE

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

ADDITIONAL RESOURCES

Design Tools

APPLICATIONS

Temperature compensation and sensing in

- Automotive
- Motor drives
- Lighting LED drivers
- Test and measuring equipment
- Air-flow sensor

QUICK REFERENCE DATA

PARAMETER	VALUE				UNIT
DESCRIPTION	TFPT0402	TFPT0603	TFPT0805	TFPT1206	
Resistance value at 25 °C (2)	5	100 to 1K	100 to 5K	100 to 10K	Ω
Tolerance on R_{25}-value (2)	± 25	± 0.5; ± 1; ± 5			%
TCR at 25 °C	4110				ppm/K
Tolerance on TCR at 25 °C (1)	± 400				
Operating temperature range: at rated power at zero dissipation (4)	 -55 to +70 -55 to +150				°C
Dissipation factor δ (for information only) (5)	0.8	1.8	2.3	4	mW/K
Maximum rated power at 70 °C (P_{70}) (5)	100 (6)	75	100	125	mW
Maximum working voltage RCWV (3)	1.2	30	40	50	V
Climatic category (LCT/UCT/days)	55/150/56				-
Weight	0.65	2	5.5	10	mg
Failure rate $FIT_{observed}$	≤ 0.1 x 10^{-9}/h				

Notes

(1) Contact Vishay if closer TCR lot tolerance is desired
(2) Other R_{25}-values and tolerances are available upon request
(3) Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less
(4) Zero power or zero dissipation is considered as measuring power max. 1 % of rated power P_{70}
(5) Please refer to APPLICATION INFORMATION
(6) Power levels are depending on way of mounting and substrates used. Higher power up to 200 mW at 25 °C (P_{25}) can be tolerated on uniform layer TFPT0402 5R

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature of 150 °C is not exceeded.

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.

The TFPT0402 uniform layer linear thermistor with low resistance value can be used as an air-flow sensor in a controlled power mode where nickel film temperature changes can be related to air-flow speed.

For technical questions, contact: nlr@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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	

Note

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

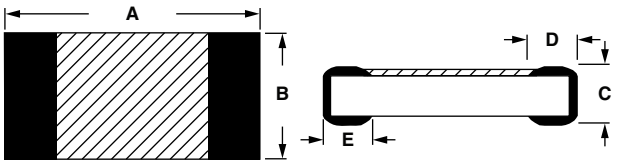
GLOBAL PART NUMBER INFORMATION

Global Part Numbering: TFPT1206L1002FM (preferred part number format)

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

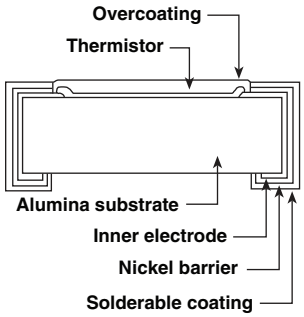
GLOBAL MODEL	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING
TFPT0402 **TFPT0603** **TFPT0805** **TFPT1206**	**L** = linear **U** = uniform linear (0402)	**1002** = 10K **0050** = 5R (0402)	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 % **V** = ± 25 % (0402)	**L** = lead (Pb)-free, T/R (10 000 pcs) 0402 **M** = lead (Pb)-free, T/R (5000 pcs) **V** = lead (Pb)-free, T/R (1000 pcs) **Z** = tin / lead, T/R (5000 pcs) **Y** = tin / lead, T/R (1000 pcs)

DIMENSIONS in millimeters



PART NUMBER	A	B	C	D	E
TFPT 0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.07	0.20 ± 0.10	0.20 ± 0.10
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 (except TFPT0402)

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, P_{70} max biased at 85 °C	0.25 %
Mechanical shock and vibration	MIL-STD 202, method 213 - 204	0.50 %
Resistance to soldering heat	MIL-STD 202, method 210, solder bath dipping 10 s at 260°C	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 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

For technical questions, contact: nlr@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

AGENCY APPROVALS (except TFPT0402)

- cUL certificate
- ULus 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		

For technical questions, contact: nlr@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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:

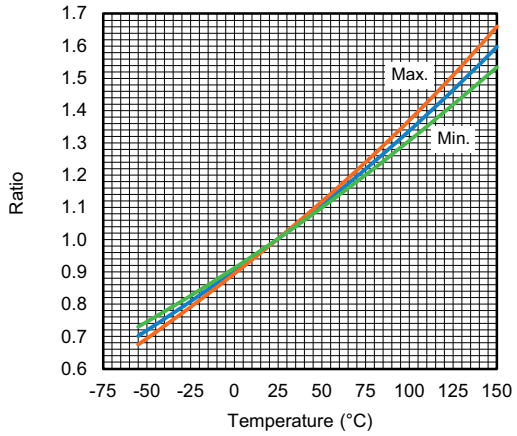
At 40 °C, ratio = 1.063 ± 0.5 % (0.005)
so, ratio = 1.058 to 1.068

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

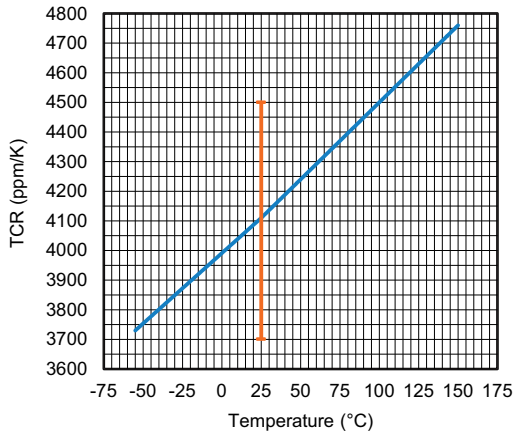
At intermediate temperatures, the ratios can be gradually adapted, for example at 105 °C the ratio tolerance will be ± 2.5 %.

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.

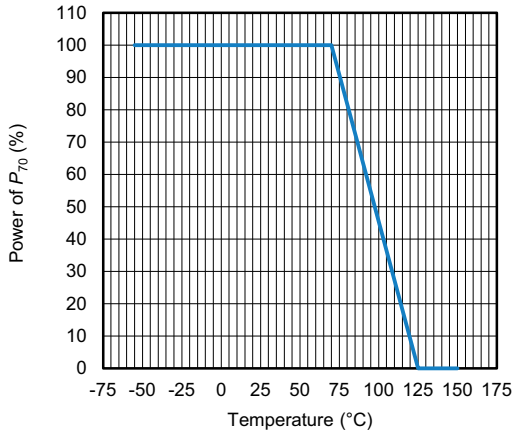
RATIO R_T/R_{25}



TCR TYPICAL VALUE



POWER DERATING



Note

- Zero power is considered as measuring power max. 1 % of rated power P_{70}

For technical questions, contact: nlr@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

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. 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.

© 2023 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED