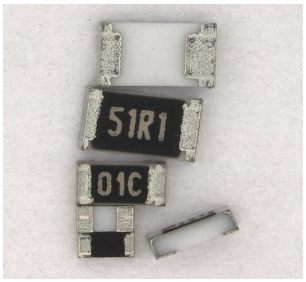
Thin Film Technology Corp.

Product Family: Precision Thin Film Chip Resistor

Part Number Series: TF Series Low TCR & High Power



Construction:

- High purity alumina substrate
- Ni alloy thin-film resistive element
- Wrap around electrodes
- 100% matte tin over Ni terminations
- RoHS compliant and Pb free

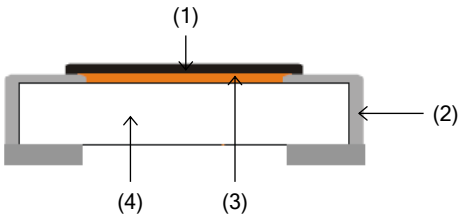
Features:

- 0402, 0603, 0805, 1206, 1210, 2010 & 2512 English case sizes
- Resistances from 4.7Ω to 1.5MΩ
- Tolerances down to ±0.05%
- TCR's down to ±5ppm/°C
- High volume production suitable for commercial and special applications

Description:

These precision chip resistors offer excellent performance and tolerance in TCR, current noise, and linearity for high frequency circuit applications and other applications requiring precision and stability. High volume manufacturing allows for lower costs for the customer.

Product Construction:



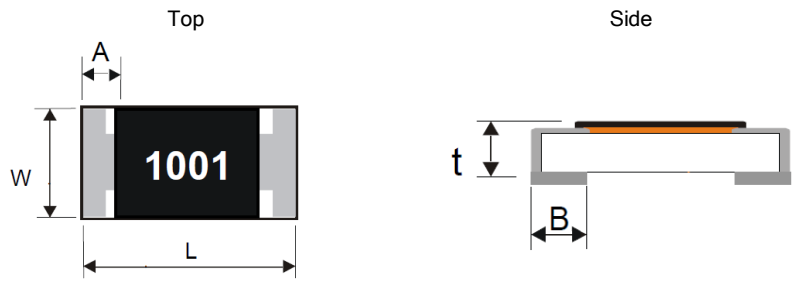
Number	Description
1	Protective coat
2	End termination (Ni)
3	Resistive layer
4	Ceramic substrate (Al_2O_3)

Part Numbering: Ex: TF0603HM2002D-T5

Series Name	English Size (Metric Size)	Power Code	Temp. Coefficient of Resistance (TCR)	Resistance Value	Resistance Tolerance	T&R Packaging Quantity
TF	**0402** (1005) **0603** (1608) **0805** (2012) **1206** (3216) **1210** (3225) **2010** (5025) **2512** (6432)	H	**M** = ±5ppm/°C **Y** = ±10ppm/°C **X** = ±15ppm/°C	For all sizes, use 4 digit code for all values. "R" denotes decimal position as necessary. Ex. 16R4 = 16.4Ω 1001= 1kΩ	**A** = ±0.05%* **B** = ±0.10% **C** = ±0.25% **D** = ±0.50% **F** = ±1.00%	**-T4** = 4,000 **-T5** = 5,000 **-T10** = 10,000 (Refer to electrical tables)

* Note: Confirm availability of ±0.05% tolerance with TFT prior to ordering.

Product Dimensions:



All dimensions in inches, mm in parentheses.

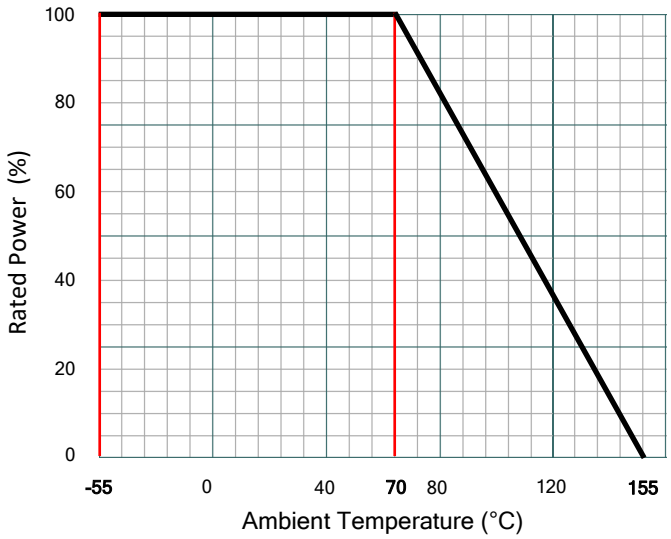
Dimension (Metric)	L	W	A	B	t
TF0402 (1005)	0.039 ±0.004 (1.00 ±0.10)	0.020 ±0.002 (0.50 ±0.05)	0.012 ±0.006 (0.30 ±0.15)	0.012 ±0.006 (0.30 ±0.15)	0.014 ±0.002 (0.35 ±0.05)
TF0603 (1608)	0.061 ±0.004 (1.55 ±0.10)	0.031 ±0.004 (0.80 ±0.10)	0.010 ±0.006 (0.25 ±0.15)	0.012 ±0.006 (0.30 ±0.15)	0.018 ±0.006 (0.45 ±0.15)
TF0805 (2012)	0.079 ±0.004 (2.00 ±0.10)	0.049 ±0.004 (1.25 ±0.10)	0.010 ±0.008 (0.25 ±0.20)	0.016 ±0.008 (0.40 ±0.20)	0.020 ±0.006 (0.50 ±0.15)
TF1206 (3216)	0.120 ±0.006 (3.05 ±0.15)	0.061 ±0.006 (1.55 ±0.15)	0.016 ±0.008 (0.40 ±0.20)	0.016 ±0.008 (0.40 ±0.20)	0.022 ±0.006 (0.55 ±0.15)
TF1210 (3225)	0.122 ±0.004 (3.10 ±0.10)	0.102 ±0.006 (2.60 ±0.15)	0.020 ±0.008 (0.50 ±0.20)	0.020 ±0.008 (0.50 ±0.20)	0.022 ±0.004 (0.55 ±0.10)
TF2010 (5025)	0.197 ±0.004 (5.00 ±0.10)	0.098 ±0.006 (2.50 ±0.15)	0.024 ±0.008 (0.60 ±0.20)	0.024 ±0.010 (0.60 ±0.25)	0.022 ±0.004 (0.55 ±0.10)
TF2512 (6432)	0.250 ±0.004 (6.35 ±0.10)	0.126 ±0.006 (3.20 ±0.15)	0.024 ±0.008 (0.60 ±0.20)	0.035 ±0.010 (0.90 ±0.25)	0.022 ±0.004 (0.55 ±0.10)

Electrical Specifications:

Type	TF0402		TF0603		TF0805		TF1206	
Metric Size	1005		1608		2012		3216	
Power Rating	1/10W		1/10W		1/8W		1/4W	
Resistance Range (Ω)	10~ 10K	10~ 100K	4.7~ 50K	4.7~ 200K	4.7~ 100K	4.7~ 400K	4.7~ 150K	4.7~ 500K
Tolerance % (code)	±0.05(A), ±0.10(B), ±0.25(C), ±0.50(D), ±1.00(F)							
TCR ppm/°C (code)	±5(M)	±10(Y) ±15(X)	±5(M)	±10(Y) ±15(X)	±5(M)	±10(Y) ±15(X)	±5(M)	±10(Y) ±15(X)
Max. Operating Voltage	50V		75V		150V		200V	
Max. Overload Voltage	100V		150V		300V		400V	
Operating Temp. Range	-55°C~ +155°C							
Packaging (code)	10,000 pcs/reel (T10)		5,000 pcs/reel (T5)					

Type	TF1210		TF2010		TF2512	
Metric Size	3225		5025		6432	
Power Rating	2/5W		3/4W		1W	
Resistance Range (Ω)	4.7~ 150K	10~ 600K	4.7~ 360K	10~ 1M	4.7~ 600K	10~ 1.5M
Tolerance % (code)	±0.05(A), ±0.10(B), ±0.25(C), ±0.50(D), ±1.00(F)					
TCR ppm/°C (code)	±5(M)	±10(Y) ±15(X)	±5(M)	±10(Y) ±15(X)	±5(M)	±10(Y) ±15(X)
Max. Operating Voltage	200V					
Max. Overload Voltage	400V					
Operating Temp. Range	-55°C~ +155°C					
Packaging (code)	5,000 pcs/reel (T5)		4,000 pcs/reel (T4)			

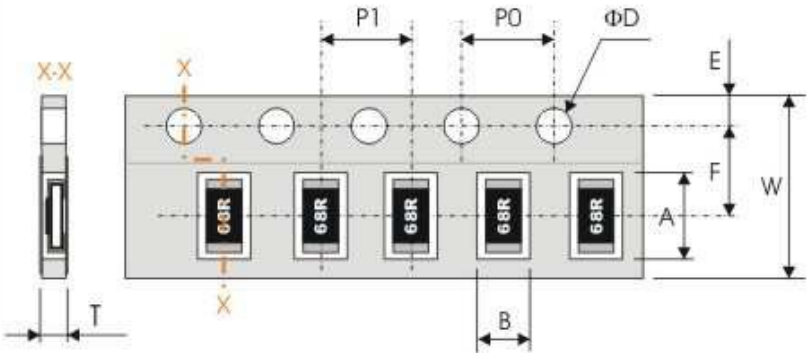
Power Derating Curve:



Reliability Specifications:

Test	Procedure	Specifications
Temperature Coefficient of Resistance JIS C 5201-1 clause 4.8	Natural resistance change per in degree centigrade. $\frac{R2 - R1}{R_1(t_2 - t_1)}$ X 10^6 (ppm/°C) R_1 : Resistance at reference temperature R_2 : Resistance at test temperature t_1 : 20°C+5°C-1°C t_2 : 125°C+5°C-1°C	Refer to electrical tables
Short Time Overload JIS C 5201-1 clause 4.13	Applied voltage: 2.5X rated voltage or 2X maximum operating voltage, whichever is less. Test duration: 5 seconds	±(0.10%+0.05Ω)
Solderability Sony SS-00254-9	Un-mounted chips completely immersed for 2 ±0.5 seconds in a SAC solder bath at 235°C ±5°C	Good tinning (>95% covered) No visible damage
Resistance to Soldering Heat JIS C 5201-1 clause 4.18	Un-mounted chips completely immersed for 10 ±1 second in a SAC solder bath at 260°C ±5°C	No visible damage ±(0.10%+0.05Ω)
Temperature Cycling JIS C 5201-1 clause 4.19	30 minutes at -55°C ±3°C, 2~3 minutes at 20°C+5°C - 1°C, 30 minutes at +155 °C ±3°C, 2~3 minutes at 20°C+5°C - 1°C, total 5 continuous cycles	No visible damage ±(0.25%+0.05Ω)
Load Life in Humidity JIS C 5201-1 clause 4.24	Test Condition: 40°C ±2°C/90~ 95% RH Applied voltage: rated voltage Test period: 1000 hours with power cycling as follows: 90 min. power ON/30 min power OFF	±(0.25%+0.05Ω)
Load Life (Endurance) JIS C 5201-1 clause 4.25	Test Temperature: 70°C ±2°C Applied voltage: rated voltage Test period: 1000 hours with power cycling as follows: 90 min power ON/30 min power OFF	±(0.25%+0.05Ω)
Terminal Bending Strength JIS C 5201-1 clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending: 3mm, once for 10 seconds	±(0.10%+0.05Ω)
Adhesion JIS C 5201-1 clause 4.32	Pressurizing force: 5N, Test time: 10 ±1sec.	No visible damage

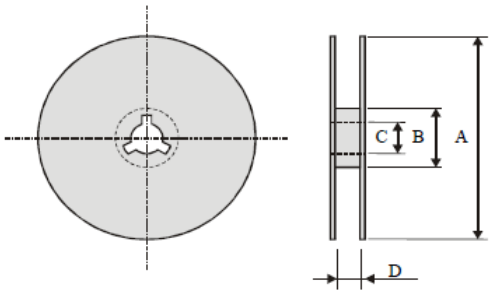
Paper Tape Dimensions:



All dimensions in mm.

Size	A	B	W	F	E	P1	P0	ΦD	T
0402	1.20 ±0.10	0.70 ±0.10	8.00 ±0.30	3.50 ±0.05	1.75 ±0.10	2.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	0.40 ±0.05
0603	1.90 ±0.20	1.10 ±0.20	8.00 ±0.30	3.50 ±0.20	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	0.65 ±0.05
0805	2.40 ±0.20	1.65 ±0.20	8.00 ±0.30	3.50 ±0.20	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	Max. 1.00
1206	3.60 ±0.20	2.00 ±0.20	8.00 ±0.30	3.50 ±0.20	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	Max. 1.00
1210	3.60 ±0.20	3.00 ±0.20	8.00 ±0.30	3.50 ±0.20	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	Max. 1.00
2010	5.50 ±0.20	2.80 ±0.20	12.0 ±0.30	5.50 ±0.10	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	Max. 1.20
2512	6.90 ±0.20	3.60 ±0.20	12.0 ±0.30	5.50 ±0.10	1.75 ±0.10	4.00 ±0.10	4.00 ±0.10	1.50 +0.10/-0.00	Max. 1.20

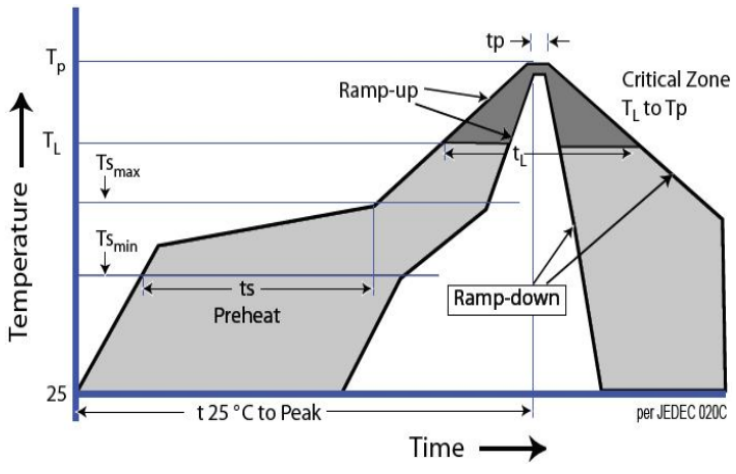
Reel Dimensions:



All dimensions in mm.

Size	Quantity	A	B	C	D
0402	10,000 pcs/reel	Φ178 ±2.00	Φ60.0 ±1.00	13.0 ±0.20	9.00 ±0.50
0603, 0805, 1206, 1210,	5,000 pcs/reel				
2010, 2512	4,000 pcs/reel				

Soldering Profile:



Profile Feature	Pb-Free Assembly
Average Ramp-Up Rate (Ts_{max} to Tp)	3 °C/second max.
Preheat	
- Temperature Min (Ts_{min})	150 °C
- Temperature Max (Ts_{max})	200 °C
- Time (ts_{min} to ts_{max})	60-180 seconds
Time maintained above:	
- Temperature (T_L)	217 °C
- Time (t_L)	60-150 seconds
Peak Temperature (T_p)	260 +0 °C
Time within 5 °C of actual Peak Temperature (tp)	20-40 seconds
Ramp-Down Rate	6 °C/second max.
Time 25 °C to Peak Temperature	8 minutes max.

Marking Information:

0402: no marking

0603: 3 digits code

0805~2512: 4 digits code

Standard E96 Values and 0603 Resistance Codes																								
R-Value	100	102	105	107	110	113	115	118	121	124	127	130	133	137	140	143	147	150	154	158	162	165	169	174
Code	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
R-Value	178	182	187	191	196	200	205	210	215	221	226	232	237	243	249	255	261	267	274	280	287	294	301	309
Code	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
R-Value	316	324	332	340	348	357	365	374	383	392	402	412	422	432	442	453	464	475	487	499	511	523	536	549
Code	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
R-Value	562	576	590	604	619	634	649	665	681	698	715	732	750	768	787	806	825	845	866	887	909	931	953	976
Code	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96

E96 Multiplier Code								
Code	A	B	C	D	E	F	X	Y
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^{-1}	10^{-3}

Examples of 0603 Resistance Codes for E96 Values						
R-Value	4.99Ω	33.2Ω	475Ω	2.21KΩ	10.2KΩ	604KΩ
Code	68Y	51X	66A	34B	02C	76D

Examples of 0603 Resistance Codes for E24 Values						
R-Value	4.7Ω	33Ω	470Ω	5.6KΩ	62KΩ	680KΩ
Code	4R7	330	471	562	623	684

Examples of 4 Digit Resistance Codes for 0805 ~ 2512								
R-Value	5.6Ω	10Ω	22.6Ω	100Ω	1.1KΩ	10KΩ	332KΩ	1MΩ
Code	5R60	10R0	22R6	1000	1101	1002	3323	1004

Storage Conditions:

Environment Conditions:

Products should be stored under the following environmental conditions.

- Temperature: +5 to +35°C
- Humidity: 45 to 85% relative humidity
- Do not keep products in environments where they may be subject to particulate contamination or harmful gases such as sulfuric acid or hydrogen chloride as it may cause oxidization on electrodes, resulting in poor solderability.
- Products should be stored in a space that does not expose it to high temperatures, vibration, or direct sunlight.
- Products should be stored in the original airtight packaging until use.