

THICK FILM CHIP RESISTOR

- RM SERIES -

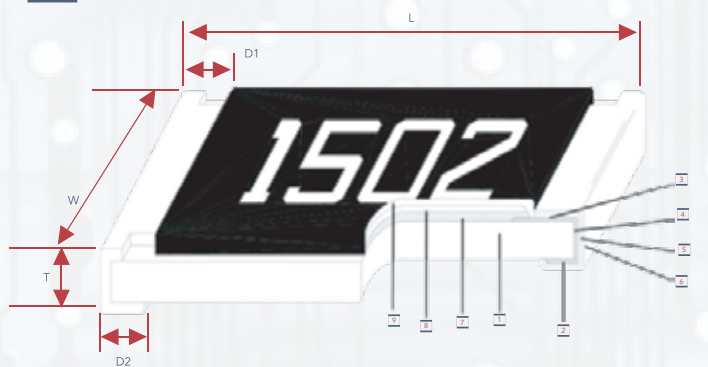
APPLICATIONS

- Telecommunication Equipments
- Radio and Tape Recorders, TV Tuners
- Digital Cameras, Watches, Pocket Calculators
- Computers, Instruments
- Medical and Military Equipment

SCOPE

Applies to all sizes of rectangular-type fixed chip resistors with Ruthenium base as material.

CONSTRUCTION

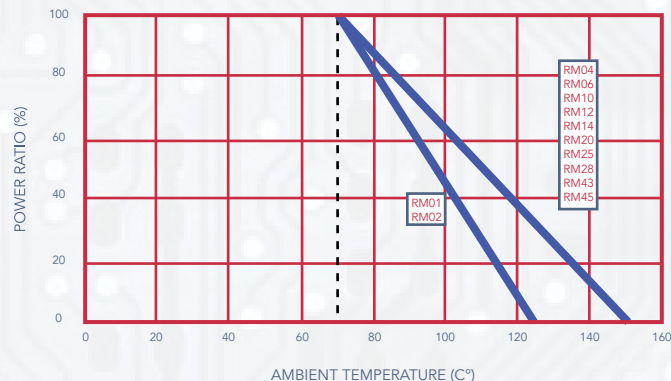


- | | | |
|-------------------------|---------------------------|------------------------------|
| 1 Alumina Substrate | 4 Edge Electrode (NiCr) | 7 Resistor Layer |
| 2 Bottom Electrode (Ag) | 5 Barrier Layer (Ni) | 8 Primary Overcoat (glass) |
| 3 Top Electrode (Ag-pd) | 6 External Electrode (Sn) | 9 Secondary Overcoat (Epoxy) |

FEATURES

- Small size and light weight
- Highly reliable multilayer electrode construction
- Compatible with all soldering process

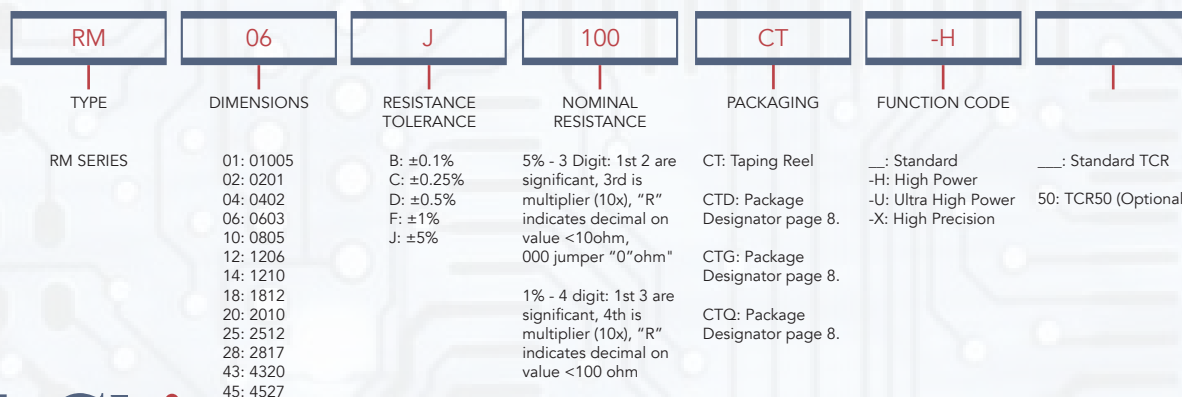
DERIVATIVE CURVE



DIMENSIONS

TYPE	SIZE (INCH)	L (MM)	W (MM)	T (MM)	D1 (MM)	D2 (MM)	WEIGHT (G) (1000PCS)
RM01	01005	0.40±0.02	0.20±0.02	0.13±0.02	0.10±0.03	0.10±0.03	0.037
RM02	0201	0.60±0.03	0.30±0.03	0.23±0.03	0.15±0.05	0.15±0.05	0.150
RM04	0402	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10	0.620
RM06	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	2.042
RM10	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.40±0.20	4.368
RM12	1206	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.25	0.50±0.20	8.947
RM14	1210	3.10±0.10	2.60±0.15	0.55±0.10	0.50±0.25	0.50±0.20	15.959
RM18	1812	4.50±0.20	3.20±0.20	0.55±0.20	0.55±0.20	0.50±0.20	18.126
RM20	2010	5.00±0.10	2.50±0.15	0.55±0.10	0.60±0.25	0.50±0.20	24.241
RM20 ULTRA-HIGH POWER	2010	5.00±0.10	2.50±0.15	1.10±0.10	0.60±0.25	0.50±0.20	35.325
RM25	2512	6.34±0.10	3.10±0.15	0.55±0.10	0.60±0.25	0.50±0.20	39.448
RM25 ULTRA-HIGH POWER	2512	6.35±0.10	3.20±0.15	1.10±0.10	0.60±0.25	1.80±0.20	45.328
RM28 ULTRA-HIGH POWER	2817	7.10±0.20	4.20±0.20	1.10±0.10	0.60±0.20	1.80±0.20	43.258
RM-43 ULTRA-HIGH POWER	4320	11.00±0.30	5.00±0.25	1.10±0.10	0.80±0.20	2.40±0.20	48.698
RM45 ULTRA-HIGH POWER	4527	11.60±0.30	6.85±0.25	1.10±0.10	1.10±0.20	2.50±0.20	53.987

PART NUMBERING GUIDE



STANDARD ELECTRICAL SPECIFICATIONS

TYPE/ ITEM	POWER RATING AT 70° JUMPER RATED CURRENT	OPERATING TEMP. RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE		TCR (PPM/°C)
					±1%	±5%	
RM01 (01005)	1/32W	-55 ~ + 125°C	15V	30V	10Ω - 1MΩ		±300
	Jumper: 0.5A				0Ω (<50mΩ)		-
RM02 (0201)	1/20W	-55 ~ + 125°C	25V	50V	10Ω - 10MΩ		±200
	Jumper: 1A				0Ω		-
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	1Ω - 10Ω 10.5Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 1A				0Ω		-
RM06 (0603)	1/10W	-55 ~ + 155°C	75V	150V	0.01Ω ≤ R ≤ 0.03Ω 0.03Ω < R ≤ 0.05Ω 0.05Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 1A				0Ω		-
RM10 (0805)	1/8W	-55 ~ + 155°C	150V	300V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 2A				0Ω		-
RM12 (1206)	1/4W	-55 ~ + 155°C	200V	400V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω R 20Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 2A				0Ω		-
RM14 (1210)	1/2W	-55 ~ + 155°C	200V	500V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5Ω - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 2.5A				0Ω		-
RM18 (1812)	3/4W	-55 ~ + 155°C	200V	500V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω >10Ω		±1500 ±1000 ±800 ±200 ±100
	Jumper: 3.5A				0Ω		-
RM20 (2010)	3/4W	-55 ~ + 155°C	200V	500V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 3.5A				0Ω		-
RM25 (2512)	1W	-55 ~ + 155°C	250V	500V	0.01Ω ≤ R ≤ 0.015Ω 0.015Ω < R ≤ 0.03Ω 0.03Ω < R < 1Ω 1Ω ≤ R ≤ 10Ω 10.1Ω - 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±1500 ±1000 ±800 ±200 ±100 ±200 ±400
	Jumper: 4A				0Ω		-
					L50 MΩ		



HIGH PRECISION ELECTRICAL SPECIFICATIONS

TYPE/ ITEM	POWER RATING AT 70° JUMPER RATED CURRENT	OPERATING TEMP. RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE			TCR (PPM/°C)
					±0.1%	±0.25%	±0.5%	
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	-		10Ω - 1MΩ	±100
					-		1.02Ω - 10MΩ	±200
RM06 (0603)	1/10W		75V	150V	10Ω - 1MΩ			±100
					-	1.02Ω - 10MΩ		±200
RM10 (0805)	1/8W		150V	300V	10Ω - 1MΩ			±100
					-	1.02Ω - 10MΩ		±200
RM12 (1206)	1/4W		200V	400V	10Ω - 1MΩ			±100
					-	1.02Ω - 10MΩ		±200
RM14 (1210)	1/2W		200V	400V	10Ω - 1MΩ			±100
					-	1.02Ω - 10MΩ		±200
RM20 (2010)	3/4W	200V	400V	10Ω - 1MΩ			±100	
				-	1.02Ω - 10MΩ		±200	
RM25 (2512)	1W	250V	500V	10Ω - 1MΩ			±100	
				-	1.02Ω - 10MΩ		±200	

HIGH POWER & ULTRA HIGH POWER RATING ELECTRICAL SPECIFICATIONS

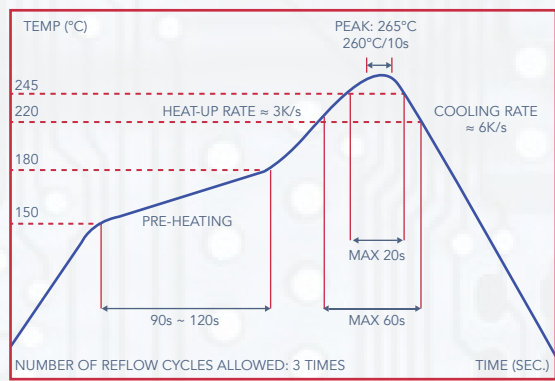
TYPE/ ITEM	POWER RATING AT 70° JUMPER RATED CURRENT	OPERATING TEMP. RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE		TCR (PPM/°C)
					±1%	±5%	
RM04 (0402)	1/10W HIGH POWER 1/8W ULTRA HIGH POWER	-55 ~ + 155°C	50V	100V	1Ω ≤ R ≤ 10Ω 10Ω ≤ R ≤ 100Ω 100Ω ≤ R ≤ 10M		±400 ±200 ±100
					0.1Ω ≤ R ≤ 0.2Ω 0.2Ω ≤ R ≤ 10M		±200 ±100
RM06 (0603)	1/4W		75V	150V	10mΩ ≤ R ≤ 15mΩ 15mΩ < R ≤ 25mΩ 25mΩ < R ≤ 50mΩ 50mΩ < R < 0.1Ω 0.1Ω ≤ R ≤ 10M		±800 ±600 ±400 ±200 ±100
					10mΩ ≤ R ≤ 15mΩ 15mΩ < R ≤ 25mΩ 25mΩ < R ≤ 50mΩ 50mΩ < R < 0.1Ω 0.1Ω ≤ R ≤ 10M		±700 ±400 ±300 ±150 ±100
RM10 (0805)	1/3W		150V	300V	0.1Ω - 10MΩ		±100
RM12 (1206)	1/3W HIGH POWER 1/2W ULTRA HIGH POWER		200V	400V	1Ω ≤ R ≤ 9.76Ω 10Ω ≤ R ≤ 10M		±200 ±100
					10mΩ ≤ R < 15mΩ 15mΩ ≤ R < 50mΩ 50mΩ ≤ R < 10M		±800 ±600 ±100
RM14 (1210)	3/4W HIGH POWER		200V	400V	10mΩ ≤ R < 20mΩ 20mΩ ≤ R ≤ 50mΩ 50mΩ < R ≤ 10M		±800 ±400 ±100
RM18 (1812)	1 1/4W HIGH POWER		200V	400V	0.1Ω - 10MΩ		±50
RM20 (2010)	1W HIGH POWER 2W ULTRA HIGH POWER		250V	500V	0.1Ω - 10MΩ		±100
					0.1Ω - 10MΩ		±100
RM25 (2512)	2W HIGH POWER 3W ULTRA HIGH POWER		300V	600V	0.1Ω - 10MΩ		±100
		0.1Ω - 10MΩ			±100		
RM28 (2817)	4W HIGH POWER	300V	600V	0.1Ω - 10MΩ		±100	
RM43 (4320)	4W HIGH POWER	300V	600V	0.1Ω - 10MΩ		±100	
RM45 (4527)	6W HIGH POWER	300V	600V	0.1Ω - 10MΩ		±100	

Operating Voltage = $\sqrt{P \cdot R}$ or Max. operating voltage listed above, whichever is lower
 Overload Voltage = $2.5 \cdot \sqrt{P \cdot R}$ or Max. overload voltage listed above, whichever is lower
 Cal-Chip is capable of manufacturing the optional spec based on customer's requirement

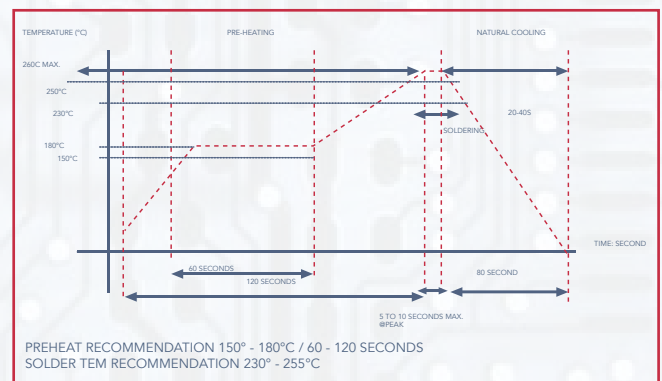
TC50 ELECTRICAL SPECIFICATIONS

TYPE/ ITEM	POWER RATING AT 70° JUMPER RATED CURRENT	OPERATING TEMP. RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE				TCR (PPM/°C)
					±0.1%	±0.25%	±0.5%	±1%	
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	-		100Ω - 1MΩ		±50
RM06 (0603)	1/10W		75V	150V					
RM10 (0805)	1/8W		150V	300V					
RM12 (1206)	1/4W		200V	400V	10Ω - 1MΩ	10Ω - 1MΩ			
RM14 (1210)	1/3W		200V	400V					
RM20 (2010)	3/4W		200V	400V					
RM25 (2512)	1W		250V	500V					

SOLDERING CONDITION



IR REFLOW SOLDERING



WAVE SOLDERING (FLOW SOLDERING)

- Time of IR Reflow soldering at maximum temperature point 260°C : 10s
- Time of wave soldering at maximum temperature point 260°C : 10s
- Time of soldering iron at maximum temperature point 410°C : 5s

RECOMMENDED LAND PATTERN

Recommended Solder Pad

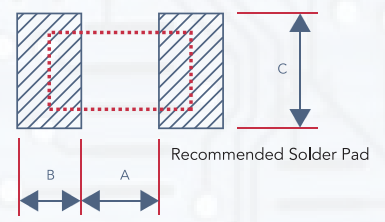
TYPE	A (MM)	B (MM)	C (MM)
RM01	0.14	0.18	0.25
RM02	0.30	0.25	0.30
RM04	0.50	0.45	0.60
RM06	0.90	0.60	0.90
RM10	1.20	0.70	1.30
RM12	2.00	0.90	1.60
RM14	2.00	0.90	2.80
RM20	3.80	0.90	2.80
RM25	3.80	1.60	3.50

High Power Recommended Solder Pad

TYPE	A (MM)	B (MM)	C (MM)
RM04-H	0.5	0.6	0.6
RM06-H	0.6	1.0	1.0
RM10-H	1.0	1.2	1.3
RM12-H	2.2	1.2	1.8
RM14-H	2.1	1.2	2.8
RM20-H	3.8	1.5	3.0
RM25-H	5.0	1.5	3.0

Ultra High Power Recommended Solder Pad

TYPE	A (MM)	B (MM)	C (MM)
RM12-U	2.10	2.00	1.9
RM20-U	3.90	2.00	3.00
RM25-U	2.70	2.80	3.70
RM28-U	3.40	3.30	4.70
RM43-U	6.10	3.90	5.50
RM45-U	6.50	4.00	7.20





ENVIRONMENTAL CHARACTERISTICS

ITEM	REQUIREMENT			TEST METHOD
	±1% AND BELOW	±5%	JUMPER	
TEMPERATURE COEFFICIENT OF RESISTANCE (T.C.R.)	AS SPEC.			JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
SHORT TIME OVERLOAD	±(1.0%+0.05Ω)	±(2.0%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWW*2.5 or Max. Overload voltage; whichever is lower for 5 seconds, 2 seconds for high power series
INSULATION RESISTANCE	≥10G			JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute
ENDURANCE	±(1.0%+0.10Ω)	±(2.0%+0.10Ω)	<100mΩ	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWW for 1000 hours with 1.5 hrs "ON" and 0.5 hrs "OFF"
DAMP HEAT WITH LOAD	±(1.0%+0.10Ω)	±(2.0%+0.10Ω)	<100mΩ	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H., RCWW for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
DRY HEAT	±(1.0%+0.05Ω)	±(1.50%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 at +125/+155°C for 1000 hrs
BENDING STRENGTH	±(1.0%+0.05Ω)	±(1.00%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm
SOLDERABILITY	95% MIN. COVERAGE			JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
RESISTANCE TO SOLDERING HEAT	±(0.5%+0.05Ω)	±(1.00%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
VOLTAGE PROOF	NO BREAKDOWN OR FLASHOVER			JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
LEACHING	INDIVIDUAL LEACHING AREA ≤5% TOTAL LEACHING AREA ≤10%			JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
RAPID CHANGE OF TEMPERATURE	±(0.5%+0.05Ω)	±(1.00%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +125/+155°C, 5 cycles

RCWW (Rated continuous working voltage)=√(P*R) or Max. Operating voltage whichever is lower.
Storage Temperature: 25±3°C, Humidity < 80%RH



MARKING

- No marking for 01005, 0201 and 0402
- Jumper for all: Letter "0"

1% for 0805 / 1206 / 1210 / 1812 / 2010 / 2512 / 2817 / 4320 / 4527 : 4 digit marking

EX:

RESISTANCE	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ
MARKING	1000	2201	1002	4992	1003

5% for 0603 / 0805 / 1206 / 1210 / 1812 / 2010 / 2512 / 2817 / 4320 / 4527 : 3 digit marking in E24

Example: 101 = 100Ω 102 = 1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)

E24 CODE	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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1% for 0603: 3 digit marking in E96

Example:

14C = 13K7Ω

13C = 13K3Ω

68B = 4K99Ω

68X = 49.9Ω



Please note: 1% E24 values will be marked the same as 5% E24

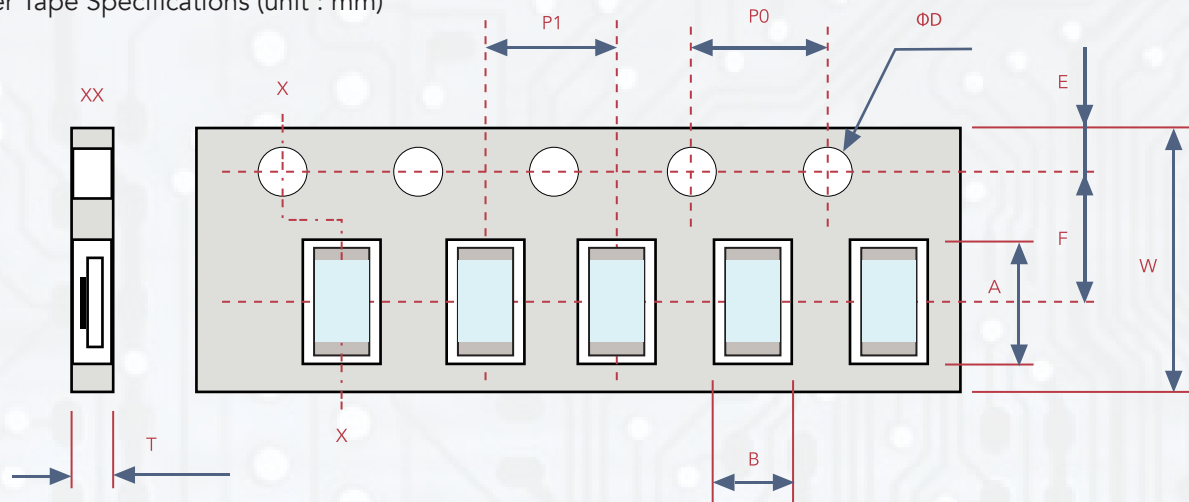
MARKING TABLE

CODE	E96	CODE	E96	CODE	E96	CODE	E96		
01	100	25	178	49	316	73	562		
02	102	26	182	50	324	74	576		
03	105	27	187	51	332	75	590		
04	107	28	191	52	340	76	604		
05	110	29	196	53	348	77	619		
06	113	30	200	54	357	78	634		
07	115	31	205	55	365	79	649		
08	118	32	210	56	374	80	665		
09	121	33	215	57	383	81	681		
10	124	34	221	58	392	82	698		
11	127	35	226	59	402	83	715		
12	130	36	232	60	412	84	732		
13	133	37	237	61	422	85	750		
14	137	38	243	62	432	86	768		
15	140	39	249	63	442	87	787		
16	143	40	255	64	453	88	806		
17	147	41	261	65	464	89	825		
18	150	42	267	66	475	90	845		
19	154	43	274	67	487	91	866		
20	158	44	280	68	499	92	887		
21	162	45	287	69	511	93	909		
22	165	46	294	70	523	94	931		
23	169	47	301	71	536	95	952		
24	174	48	309	72	549	96	976		
CODE	A	B	C	D	E	F	G	X	Y
MULTIPLIER	10	10	10	10	10	10	10	10	10



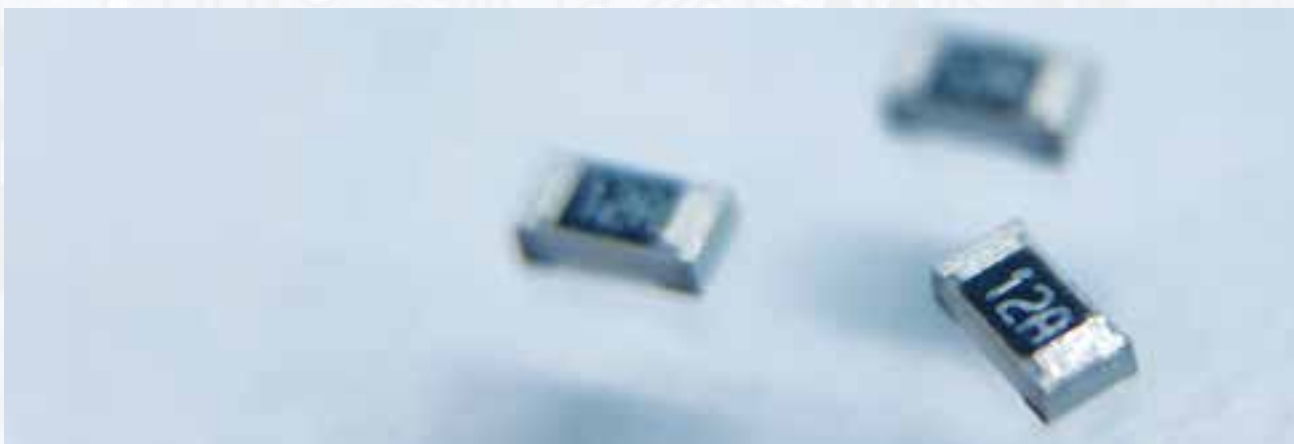
PACKAGING

- Paper Tape Specifications (unit : mm)



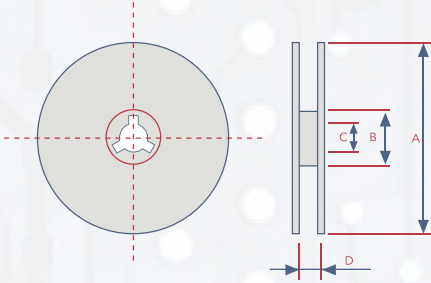
SIZE	B	A	W	F	E	P1	P0	ΦD	T
01005	0.24±0.03	0.45±0.03	8.00±0.20	3.50±0.05	1.75±0.10	2.00±0.05	4.0±0.05	1.50±0.05	0.36±0.03
0201	0.37±0.05	0.67±0.05	8.00±0.20	3.50±0.05	1.75±0.10	2.00±0.05	4.0±0.10	1.50±0.10/-0	0.45±0.5
0402	0.70±0.10	1.20±0.10	8.00±0.30	3.50±0.2	1.75±0.10	2.00±0.10	4.0±0.10	1.50±0.10/-0	1.40±0.05
0603	1.10±0.20	1.90±0.20	8.00±0.30	3.50±0.2	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	0.55±0.05
0805	1.65±0.20	2.40±0.20	8.00±0.30	3.50±0.2	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	0.65±0.05
1206	2.00±0.20	3.60±0.20	8.00±0.30	3.50±0.2	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	0.65±0.05
1210	3.00±0.20	3.60±0.20	8.00±0.30	3.50±0.2	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	0.75±0.01
1812	3.50±0.20	4.80±0.20	12.00±0.30	5.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.0±0.1
2010	2.80±0.20	5.50±0.20	12.00±0.30	5.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.30±0.20
2512	3.50±0.20	6.70±0.20	12.00±0.30	5.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.30±0.20
2817	4.50±0.10	7.40±0.10	16.00±0.30	7.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.35±0.10
4320	5.40±0.10	11.50±0.10	24.00±0.30	11.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.35±0.10
4527	7.20±0.10	11.90±0.10	24.00±0.30	11.50±0.15	1.75±0.10	4.0±0.10	4.0±0.10	1.50±0.10/-0	1.35±0.10

(UNIT : MM)



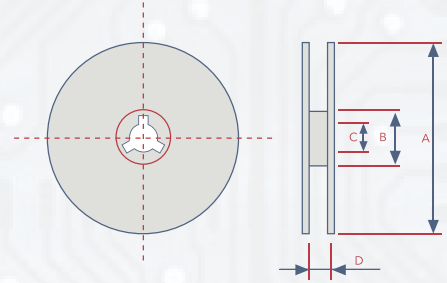
PACKAGING

- 7" Reel Dimensions - 8mm Tape



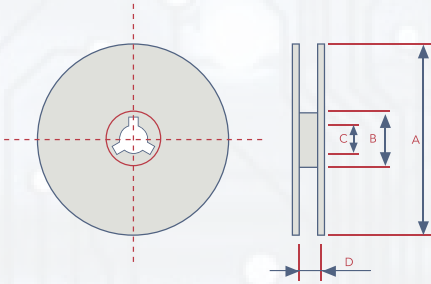
SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	9.0 ± 0.5

- 7" Reel Dimensions - 12mm Tape



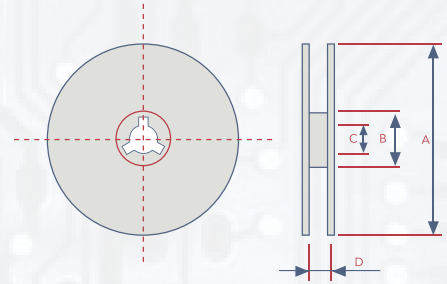
SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	13.5 ± 1.0

- 7" Reel Dimensions - 16mm Tape



SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	15.5 ± 1.0

- 7" Reel Dimensions - 24mm Tape



SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	24.5 ± 1.0

- RM Packaging Designators

SIZE	CT	CTD	CTG	CTQ
RM01	20K			
RM02	10K/15K	20K	50K	70K
RM04	10K	20K	50K	70K
RM06	5K	10K	20K	
RM10	5K	10K	20K	
RM12	5K	10K	20K	
RM14	5K	10K		
RM18	4K			
RM20	4K			
RM25	2K/4k			
RM28	2K			
RM43	1K			
RM45	1K			

