

# THICK FILM CHIP RESISTOR

## - RM SERIES -

### APPLICATIONS

- Telecommunication Equipment
- 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.

### FEATURES

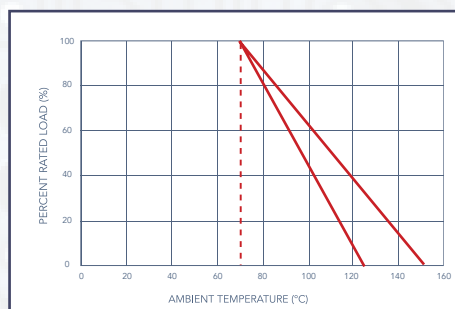
- Small size and light weight
- Highly reliable multilayer electrode construction
- Compatible with all soldering processes

### PART NUMBERING GUIDE

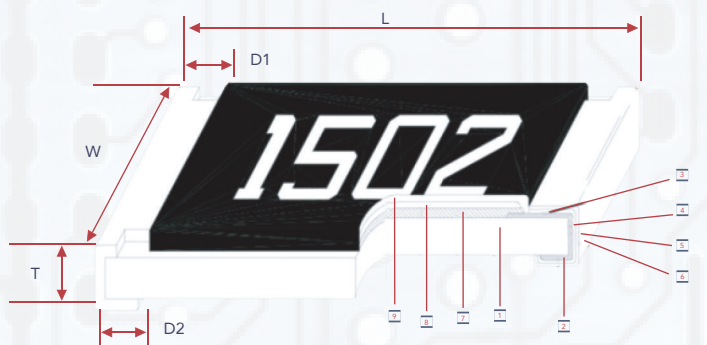
RM	06	J	100	CT	-H	
TYPE	DIMENSIONS	RESISTANCE TOLERANCE	NOMINAL RESISTANCE	PACKAGING	FUNCTION CODE	
RM SERIES	01: 01005 02: 0201 04: 0402 06: 0603 10: 0805 12: 1206 14: 1210 15: 1218 20: 2010 25: 2512	B: ±0.1% C: ±0.25% D: ±0.5% F: ±1% J: ±5%	5% - 3 Digit: 1st 2 are significant, 3rd is multiplier (10x), "R" indicates decimal on value <10ohm, 000 jumper "0" ohm " ".1%, .25%, .5%, 1% - 4 digit: 1st 3 are significant, 4th is multiplier (10x), "R" indicates decimal on value <100 ohm	CT: Taping Reel CTD: Package Designator page 9. CTG: Package Designator page 9. CTQ: Package Designator page 9.	_ (Standard) H (High Power) U (Ultra High Power) X (High Precision)	___: Standard TCR 50: TCR50 (Optional)



### DERATING CURVE



### CONSTRUCTION AND DIMENSIONS



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

TYPE	SIZE (INCH)	L (MM)	W (MM)	T (MM)	D1 (MM)	D2 (MM)	WEIGHT (g / 1000 pcs)
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	0.55±0.10	0.40±0.10	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	0.55±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±0.20	1.10±0.10	0.60±0.25	0.50±0.20	35.325
RM25	2512	6.35±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
RM43 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	4527	11.60±0.30	6.85±0.25	1.10±0.10	1.10±0.20	2.50±0.20	53.987

# 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)	1/32 W	-55 ~ + 125°C	15 V	30 V	10Ω - 1MΩ	±300	
	Jumper: 0.5 A				0Ω (<50mΩ)		
RM02 (0201)	1/20 W	-55 ~ + 155°C	25 V	50 V	1Ω ≤ R < 10Ω	-200 ~ +600	
	Jumper: 1 A				100Ω ≤ R < 100Ω	±300	
RM04 (0402)	1/16 W	-55 ~ + 155°C	50 V	100 V	100Ω ≤ R ≤ 10MΩ	±200	
	Jumper: 1 A				1Ω - 10Ω	±100	
RM06 (0603)	1/10 W	-55 ~ + 155°C	75 V	150 V	10.5Ω 10MΩ	±200	
	Jumper: 1 A				10.2MΩ - 20MΩ	±200	
RM10 (0805)	1/8 W	-55 ~ + 155°C	150 V	300 V	20.5MΩ - 100MΩ	±400	
	Jumper: 2 A				0Ω	-	
RM12 (1206)	1/4 W	-55 ~ + 155°C	200 V	400 V	L50 MΩ	-	
	Jumper: 2 A				0.01Ω ≤ R ≤ 0.03Ω	±1500	
RM14 (1210)	1/2 W	-55 ~ + 155°C	200 V	500 V	0.015Ω < R ≤ 0.03Ω	±1000	
	Jumper: 2.5 A				0.03Ω < R < 1Ω	±800	
RM18 (1812)	3/4 W	-55 ~ + 155°C	200 V	500 V	1Ω ≤ R ≤ 10Ω	±200	
	Jumper: 3.5 A				10.1Ω - 10MΩ	±100	
RM20 (2010)	3/4 W	-55 ~ + 155°C	200 V	500 V	10.2MΩ - 20MΩ	±200	
	Jumper: 4 A				20.5MΩ - 100MΩ	±400	
RM25 (2512)	1 W	-55 ~ + 155°C	250 V	500 V	0Ω	-	
	Jumper: 4 A				L50 MΩ	-	



## HIGH PRECISION ELECTRICAL SPECIFICATIONS

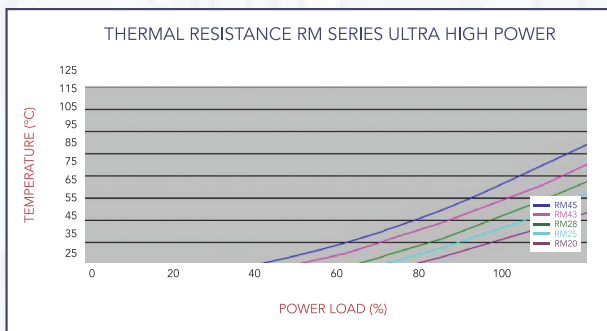
TYPE	ITEM	POWER RATING AT 70°C JUMPER RATED CURRENT	OPERATING TEMP RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE			TCR (PPM/°C)
						±0.1%	±0.25%	±0.5%	
RM04	0402	1/16 W	-55 ~ +155°C	50 V	100 V	-	-	10Ω - 1MΩ	±100
						-	-	1.02Ω - 10MΩ	±200
RM06	0603	1/10 W		75 V	150 V	10Ω - 1MΩ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

## HIGH POWER & ULTRA HIGH POWER RATING ELECTRICAL SPECIFICATIONS

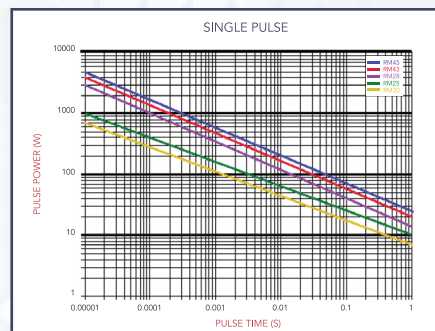
TYPE	ITEM	POWER RATING AT 70°C JUMPER RATED CURRENT	OPERATING TEMP RANGE	MAX OPERATING VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE		TCR (PPM/°C)
						±1%	±5%	
RM04	0402	1/10W HIGH POWER 1/8W ULTRA HIGH POWER	-55 ~ +155°C	50V	100V	1Ω ≤ R ≤ 10Ω 10Ω ≤ R ≤ 100Ω 100Ω ≤ R ≤ 10M		±400 ±200 ±100
						0.1Ω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

## ULTRA HIGH POWER THERMAL RESISTANCE



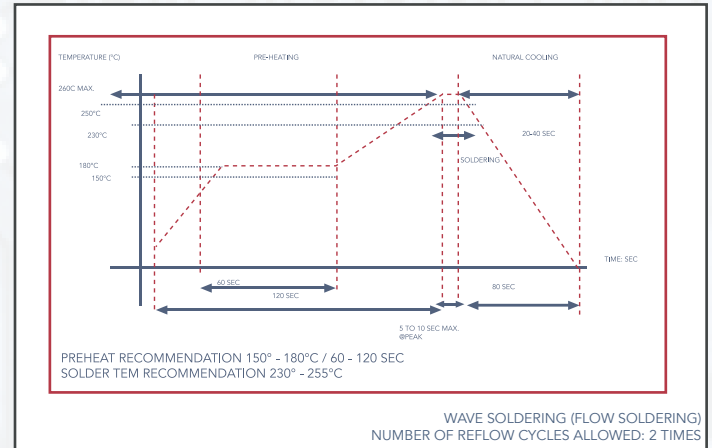
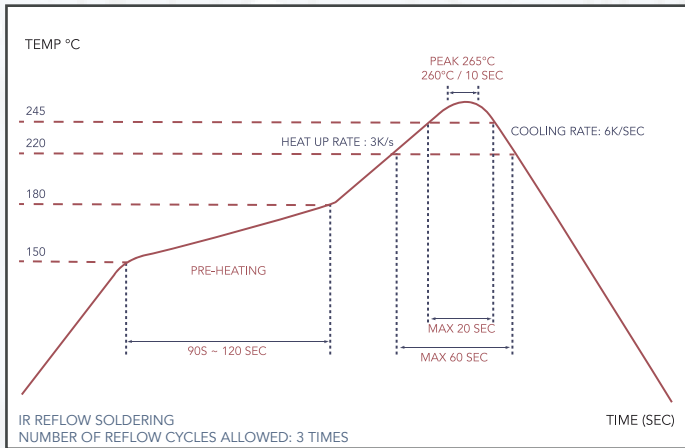
## PULSE PERFORMANCE



## TC50 ELECTRICAL SPECIFICATIONS

TYPE	ITEM	POWER RATING AT 70°C 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	1/16 W	-55 ~ +155°C	50 V	100 V	10Ω - 1MΩ	10Ω - 1MΩ	10Ω - 1MΩ	±50	
RM06	0603	1/10 W		75 V	150 V					
RM10	0805	1/8 W		150 V	300 V					
RM12	1206	1/4 W		200 V	400 V					
RM14	1210	1/3 W		200 V	400 V					
RM20	2010	3/4 W		200 V	400 V					
RM25	2512	1 W		250 V	500 V					

## SOLDERING CONDITION



- Time of IR Reflow soldering at maximum temperature point 260°C : 10 sec
- Time of wave soldering at maximum temperature point 260°C : 10 sec
- Time of soldering iron at maximum temperature point 410°C : 5 sec
- Storage (25 ± 3 °C, <60% RH)

## RECOMMENDED LAND PATTERN

Recommended Solder Pad

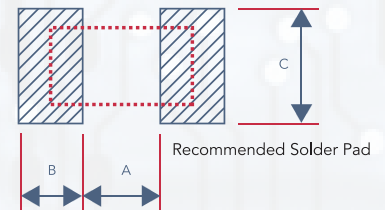
TYPE	A (MM)	B (MM)	C (MM)
RM01	0.14	0.18	0.25
RM02	0.30	0.25	0.30
RM04	0.50	0.45	0.60
RM06	0.90	0.60	0.90
RM10	1.20	0.70	1.30
RM12	2.00	0.90	1.60
RM14	2.00	0.90	2.80
RM20	3.80	0.90	2.80
RM25	3.80	1.60	3.50

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	1.8
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
RM42-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 RCWV*2.5 or Max. Overload voltage; whichever is lower for 5 seconds, 2 seconds for high power series
INSULATION RESISTANCE	≥10GΩ			JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload voltage; whichever is lower for 5 seconds, 2 seconds for high power series
ENDURANCE	±(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., RCWV for 1000 hrs 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 4.23 IEC-60115-1 4.23.2 at +125/+155°C for 1000 hrs
DRY HEAT	±(1.0%+0.05Ω)	±(1.50%+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
BENDING STRENGTH	±(1.0%+0.05Ω)	±(1.00%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
SOLDERABILITY	95% MIN. Coverage			JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
RESISTANCE TO SOLDERING HEAT	±(0.5%+0.05Ω)	±(1.00%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
VOLTAGE PROOF	No Breakdown or Flashover			JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
LEACHING	Individual Leaching Area ≤5% total leaching area ≤10%			JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +125/+155°C, 5 cycles
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

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

## WASHING

1. Confirm the ionic residues in solder do not remain after washing for moisture resistance and corrosion. Resistance may cause deterioration when these substances are attached to the products.
2. Confirm the reliability in advance when using no washing solder, water or soluble agent.
3. Wash thoroughly after soldering to remove ionic substances like sweat and salinity.
4. The ultrasonic washing may destruct the products due to resonance by vibration. High hydraulic pressure may also damage the products.
5. Dry the products sufficiently after washing.

## 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	4.9KΩ	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

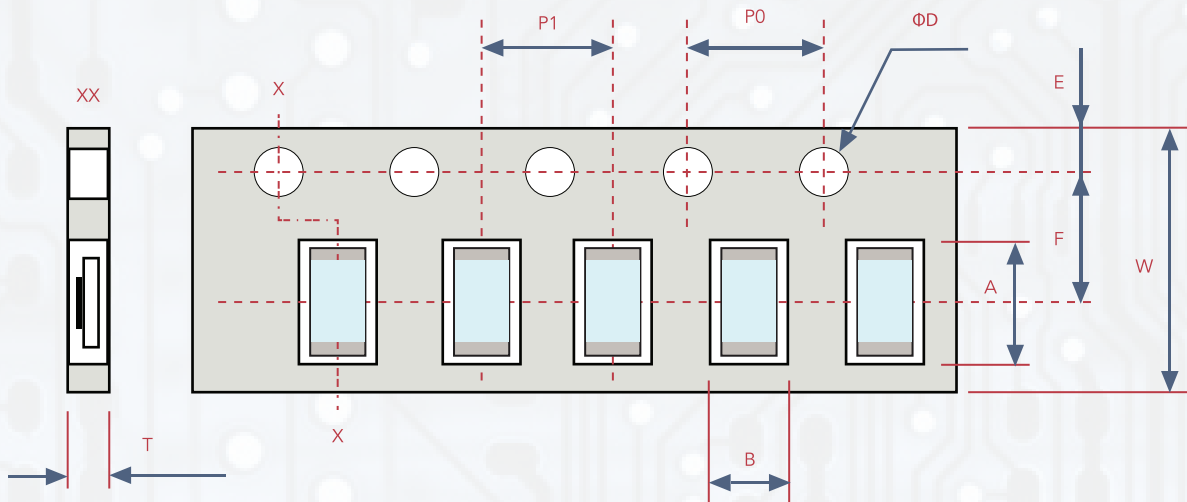
### - MARKING TABLE

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		
506	113	30	200	54	357	78	634		
07	115	31	205	55	36	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

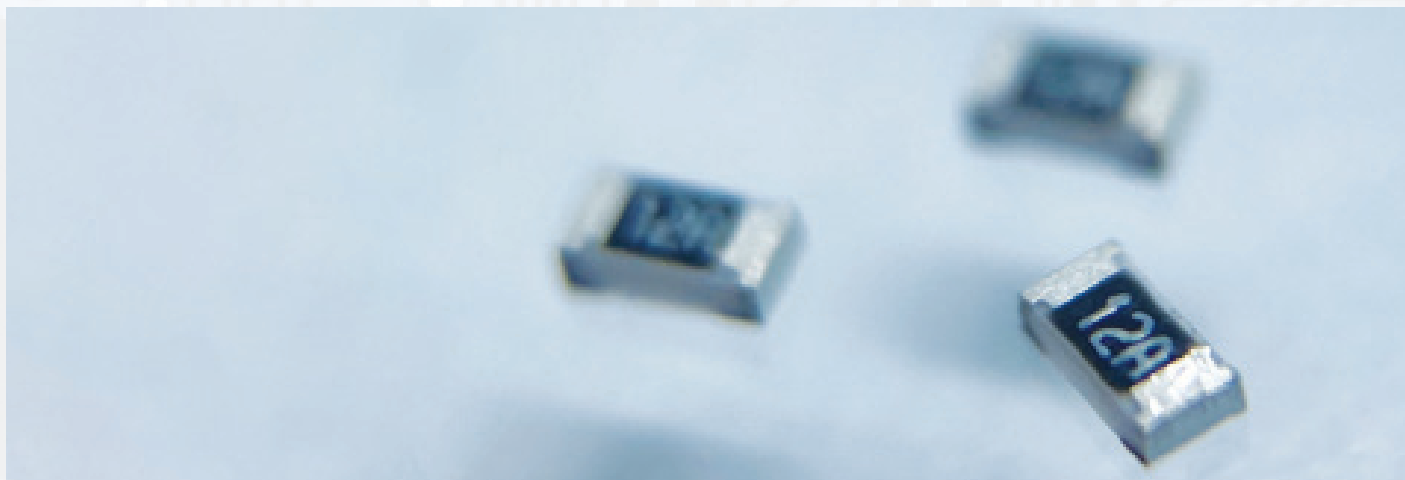


# PACKAGING

- Paper Tape Specifications (unit : mm)

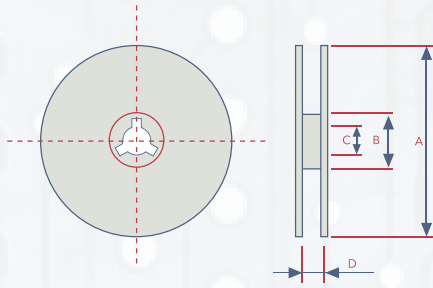


SIZE	B	A	W	F	W	P1	P0	øD	T
1005	0.24±0.03	0.45±0.03	8.00±0.20	3.50±0.05	1.75±0.10	2.00±0.05	4.0±0.05	1.50±0.05	0.36±0.03
0201	0.37±0.05	0.67±0.05	8.00±0.20	3.50±0.05	1.75±0.10	2.00±0.05	4.0±0.10	1.50±0.10/0	0.45±0.5
0402	0.70±0.10	1.20±0.10	8.00±0.30	3.50±0.2	1.75±0.10	2.00±0.10	4.0±0.10	1.50±0.10/0	1.40±0.05
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



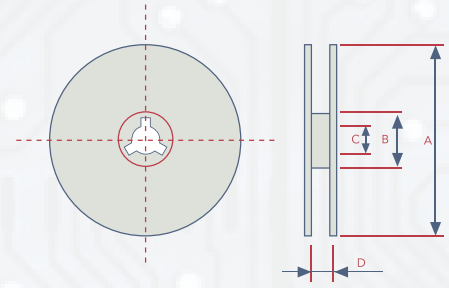
**PACKAGING**

- 7" Reel Dimensions - 8mm Tape



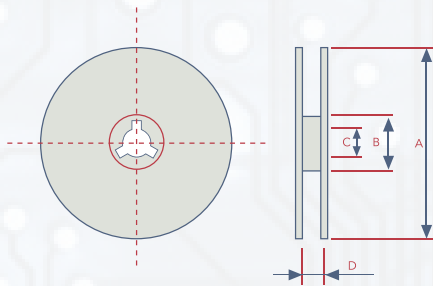
SYMBOL	A	B	C	D
(UNIT : MM)	Ø178.0±2.0	Ø60.0±1.0	13.0±0.2	9.0±0.5

- 7" Reel Dimensions - 12mm Tape



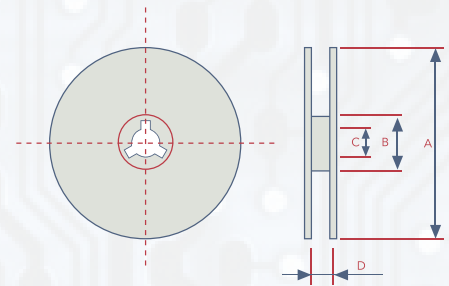
SYMBOL	A	B	C	D
(UNIT : MM)	Ø178.0±2.0	Ø60.0±1.0	13.0±0.2	13.0±1.0

- 7" Reel Dimensions - 16mm Tape



SYMBOL	A	B	C	D
(UNIT : MM)	Ø178.0±2.0	Ø60.0±1.0	13.0±0.2	15.5±1.0

- 7" Reel Dimensions - 24mm Tape



SYMBOL	A	B	C	D
(UNIT : MM)	Ø178.0±2.0	Ø60.0±1.0	13.0±0.2	34.5±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			

