

THICK FILM CHIP RESISTOR

- RM SERIES -

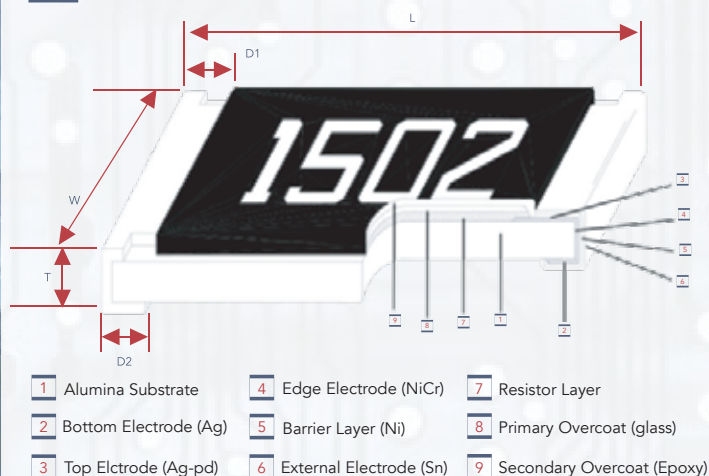
APPLICATIONS

- 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.

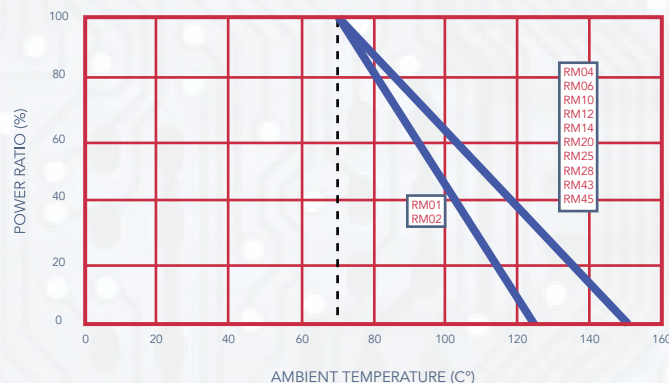
CONSTRUCTION



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	0.20±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

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 18: 1812 20: 2010 25: 2512 28: 2817 43: 4320 45: 4527	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 8. CTG: Package Designator page 8. CTQ: Package Designator page 8.	_: Standard -H: High Power -U: Ultra High Power -X: High Precision	_: Standard TCR 50: TCR50 (Optional)



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 - 1MΩ		±200
	Jumper: 1A				0Ω L50 MΩ		-
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	1Ω - 10Ω 1MΩ 10MΩ 10.2MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 1A				0Ω L50 mΩ		-
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 L50 mΩ		-
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 L50 MΩ		-
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 L50 MΩ		-
RM14 (1210)	1/3W	-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 L50 MΩ		-
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 L50 MΩ		-
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
75V	150V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
150V	300V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
200V	400V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
200V	400V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
200V	400V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
250V	500V		10Ω - 1MΩ			±100		
			-	1.02Ω - 10MΩ		±200		
RM06 (0603)	1/10W	75V	150V	10Ω - 1MΩ			±100	
RM10 (0805)	1/8W			1.02Ω - 10MΩ			±200	
RM12 (1206)	1/4W	200V	400V	10Ω - 1MΩ			±100	
RM14 (1210)	1/3W			1.02Ω - 10MΩ			±200	
RM20 (2010)	3/4W	200V	400V	10Ω - 1MΩ			±100	
RM25 (2512)	1W			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
RM06 (0603)	1/4W		75V	150V	0.1Ω ≤ R ≤ 0.2Ω 0.2Ω ≤ R ≤ 10M		±200 ±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 ±600 ±400 ±200 ±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)	1/2W HIGH POWER 3/4W ULTRA 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	500V	10mΩ ≤ R < 15mΩ 15mΩ ≤ R < 50mΩ 50mΩ ≤ R < 10M		±800 ±600 ±100
RM25 (2512)	2W HIGH POWER 3W ULTRA HIGH POWER		250V	500V	10mΩ ≤ R < 20mΩ 20mΩ ≤ R ≤ 50mΩ 50mΩ < R ≤ 10M		±800 ±400 ±100
RM28 (2817)	4W HIGH POWER		250V	500V	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

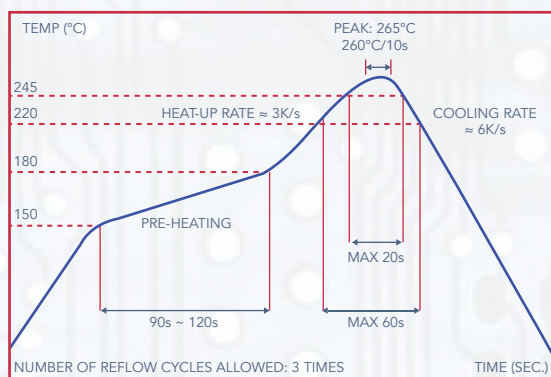


TC50 ELECTRICAL SPECIFICATIONS

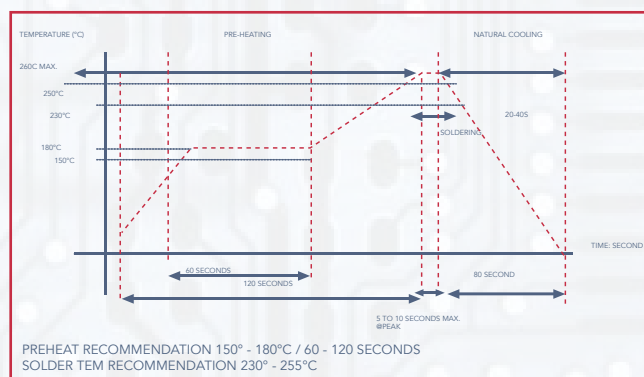
TYPE/ ITEM	POWER RATING AT 70° JUMPER RATED CURRENT	OPERATING TEMP. RANGE	MAX OPERATING G VOLTAGE	MAX OVERLOAD VOLTAGE	RESISTANCE RANGE				TCR (PPM/°C)
					±0.1%	±0.25%	±0.5%	±1%	
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	-		100Ω - 1MΩ		±50
RM06 (0603)	1/10W		75V	150V	10Ω - 1MΩ	10Ω - 1MΩ			
RM10 (0805)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

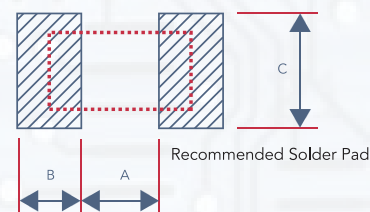
TYPE	A (MM)	B (MM)	C (MM)
RM01	0.14	0.18	0.25
RM02	0.30	0.25	0.30
RM04	0.50	0.45	0.60
RM06	0.90	0.60	0.90
RM10	1.20	0.70	1.30
RM12	2.00	0.90	1.60
RM14	2.00	0.90	2.80
RM20	3.80	0.90	2.80
RM25	3.80	1.60	3.50

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





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	≥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, RCWV 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., RCWV 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

RCWV (Rated continuous working voltage)= $\sqrt{P \cdot R}$ 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
----------	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

1% for 0603: 3 digit marking in E96

Example:

14C = 13K7Ω

13C = 13K3Ω

68B = 4K99Ω

68X = 49.9Ω



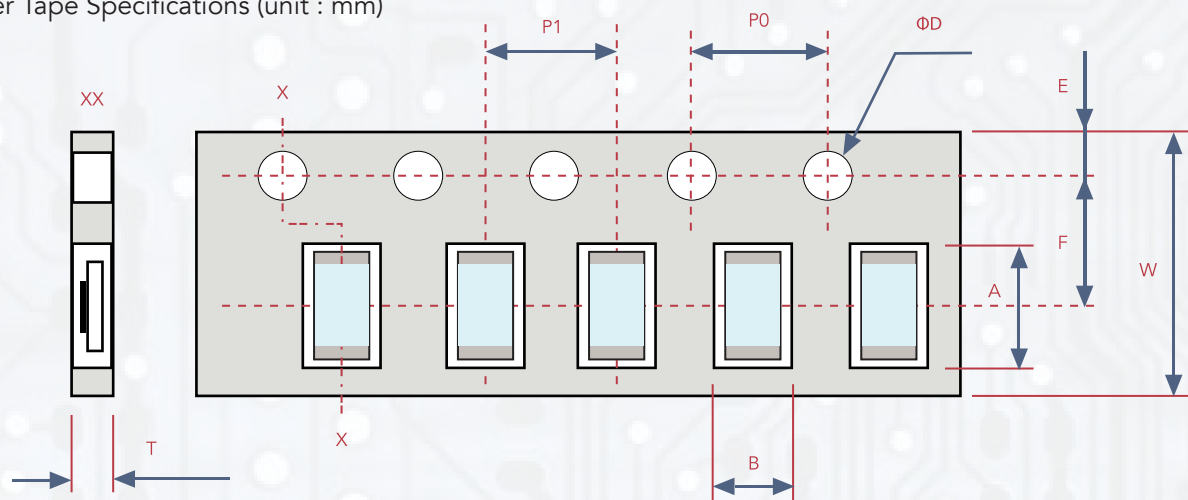
Please note: 1% E24 values will be marked the same as 5% E24

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		

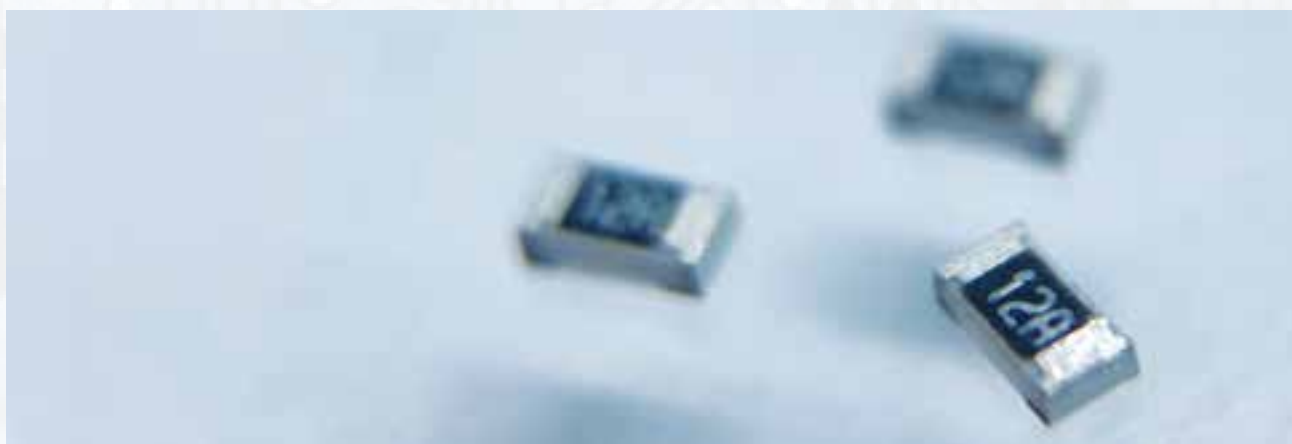
PACKAGING

- 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

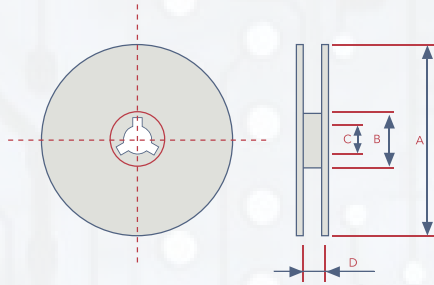
(UNIT : MM)





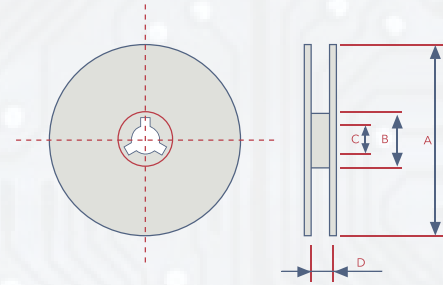
PACKAGING

- 7" Reel Dimensions - 8mm Tape



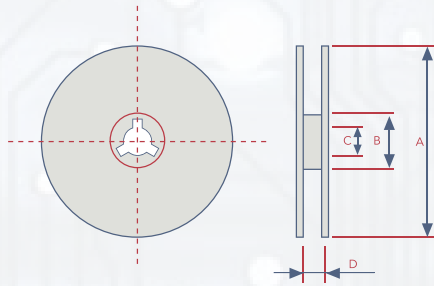
SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	9.0 ± 0.5

- 7" Reel Dimensions - 12mm Tape



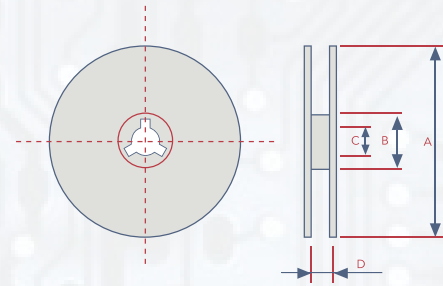
SYMBOL	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	13.5 ± 1.0

- 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			

