

THICK FILM CHIP RESISTOR

CAL-CHIP ELECTRONICS INC.



CAL-CHIP SERIES: **RM SERIES**



• INTRODUCTION

SCOPE

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

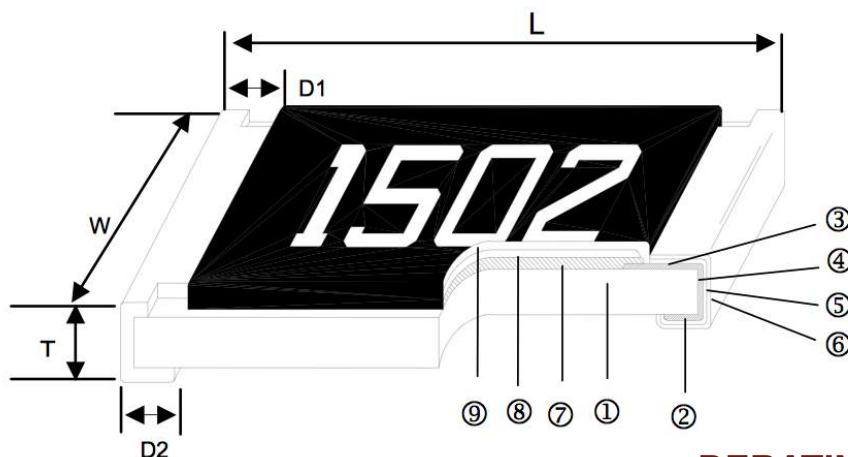
FEATURES

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

APPLICATIONS

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

• CONSTRUCTION



• DERATING CURVE

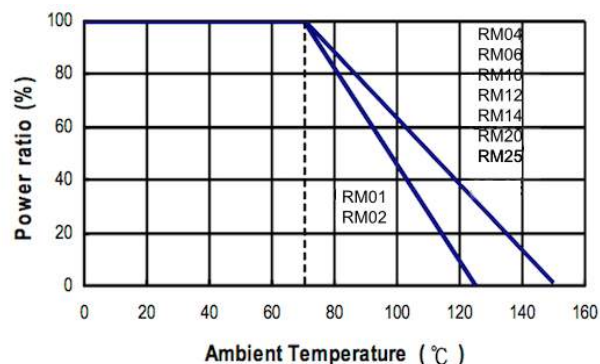


Table 2-2

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)

• DIMENSIONS

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	0.20±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
RM15	1218	3.10±0.10	4.6±0.10	0.55±0.10	0.45±0.20	0.40±0.20	10.124
RM20	2010	5.00±0.10	2.50±0.15	0.55±0.10	0.60±0.25	0.50±0.20	24.241
RM25	2512	6.34±0.10	3.10±0.15	0.55±0.10	0.60±0.25	0.50±0.20	39.448

• 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)

• STANDARD 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%	
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 (<50mΩ)		-
RM04 (0402)	1/16W	-55 ~ + 155°C	50V	100V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 1A				0Ω (<50mΩ)		-
RM06 (0603)	1/10W	-55 ~ + 155°C	75V	150V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 1A				0Ω (<50mΩ)		-
RM10 (0805)	1/8W	-55 ~ + 155°C	150V	300V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 2A				0Ω (<50mΩ)		-
RM12 (1206)	1/4W	-55 ~ + 155°C	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 2A				0Ω (<50mΩ)		-
RM14 (1210)	1/3W	-55 ~ + 155°C	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 2.5A				0Ω (<50mΩ)		-
RM15 (1218)	1W	-55 ~ + 155°C	500V	500V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		-
					0Ω (<50mΩ)		-
RM20 (2010)	1/2W	-55 ~ + 155°C	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 3.5A				0Ω (<50mΩ)		-
RM25 (2512)	1W	-55 ~ + 155°C	250V	500V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02MΩ - 20MΩ 20.5MΩ - 100MΩ		±200 ±100 ±200 ±400
	Jumper: 4A				0Ω (<50mΩ)		-

• 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)	1/16W	-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)	1/3W		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

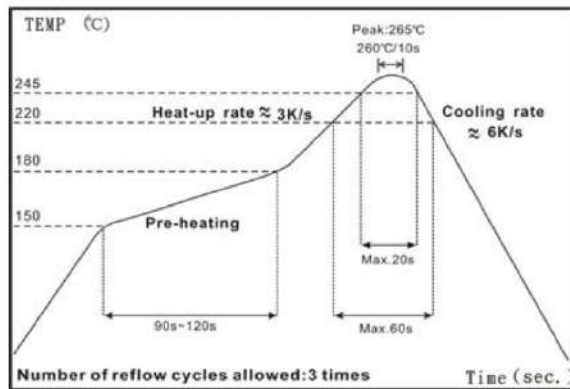
Type / Item	Power Rating at 70°C Jumper Rated Current	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range		TCR (PPM/°C)
					±1%	±5%	
RM04 (0402)	1/10 *1/8W	-55 ~ + 155°C	50V	100V	10Ω - 9.76Ω 10Ω - 1MΩ		±200 ±100
RM06 (0603)	1/4W		75V	150V			
RM10 (0805)	1/3W		150V	300V			
RM12 (1206)	1/3 *1/2W		200V	400V			
RM14 (1210)	1/2 *3/4W		200V	400V			
RM20 (2010)	3/4 *1W		200V	400V			
RM25 (2512)	2W		300V	600V			

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

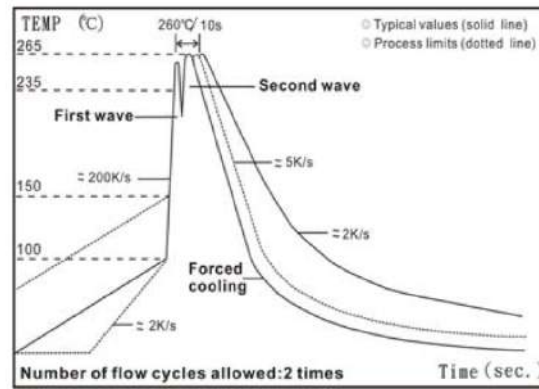
• TC50 ELECTRICAL SPECIFICATIONS

Type / Item	Power Rating at 70°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)	1/16W	-55 ~ +155°C	50V	100V	-		100Ω - 1MΩ		±50
RM06 (0603)	1/10W		75V	150V	10Ω - 1MΩ	10Ω - 10MΩ			
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



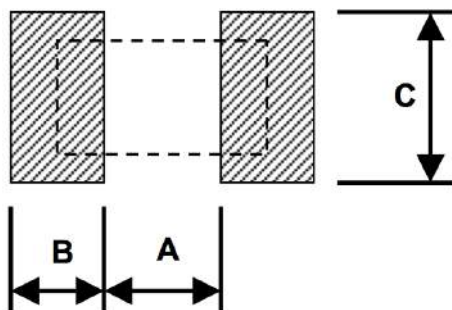
IR Reflow Soldering



Wave Soldering (Flow Soldering)

1. Time of IR Reflow soldering at maximum temperature point 260°C : 10s
2. Time of wave soldering at maximum temperature point 260°C : 10s
3. Time of soldering iron at maximum temperature point 410°C : 5s

• RECOMMENDED LAND PATTERN



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
RM15	2.20	1.00	4.80
RM20	3.80	0.90	2.80
RM25	3.80	1.60	3.50

• 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	≥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 / 2010 / 2512 : 4 digit marking

Ex:

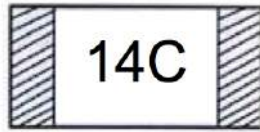
Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ
Marking	1000	2201	1002	4992	1003

5% for 0603 / 0805 / 1206 / 1210/ 2010 / 2512 : 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
68B = 4K99Ω

13C = 13K3Ω
68X = 49.9Ω

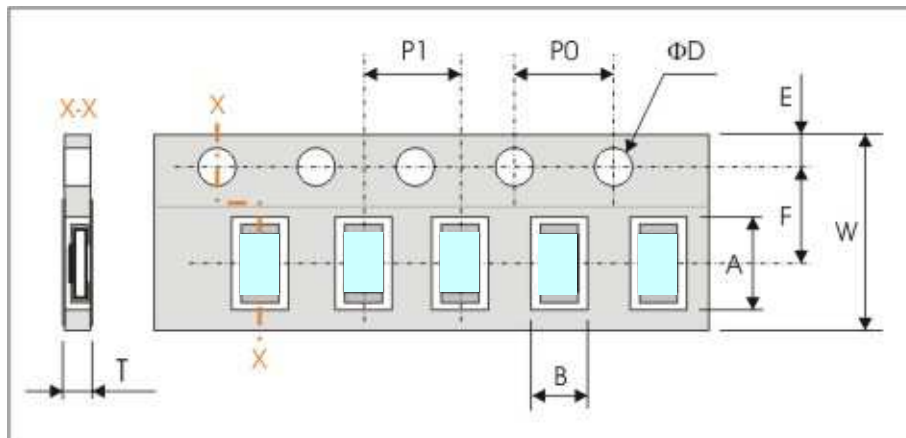
Please Note: 1% E24 values will be marked the same as 5% E24

MARKING TABLE

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

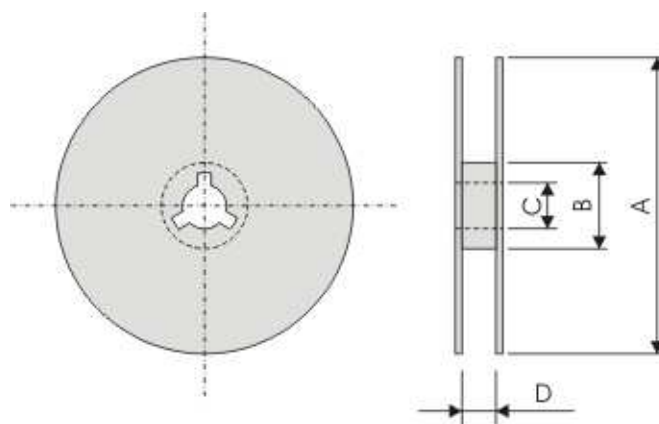
Paper Tape specifications (unit :mm)



Size	B	A	W	F	E	P1	P2	P0	D
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	2.00±0.05	4.00±0.10	1.50+0.10/-0
0402	0.70±0.10	1.20±0.10	8.00±0.30	3.50±0.05	1.75±0.10	2.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
0603	1.10±0.20	1.90±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
0805	1.65±0.20	2.40±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
1206	2.00±0.20	3.60±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
1210	3.00±0.20	3.60±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
2010	2.80±0.20	5.50±0.20	12.00±0.30	5.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
2512	3.50±0.20	6.70±0.20	12.00±0.30	5.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0

(unit: mm)

7" Reel dimensions

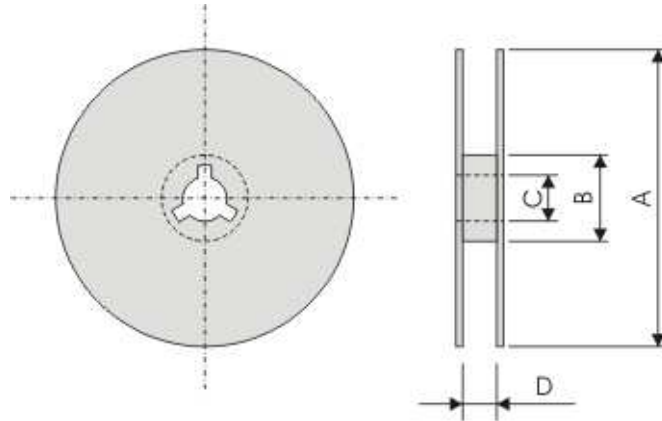


Symbol	A	B	C	D
(unit : mm)	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5

PACKAGING

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

RM PACKAGING DESIGNATORS

Type	D	G	Q
RM01			
RM02			
RM04			
RM06	10K	20K	
RM10	10K	20K	
RM12	10K	20K	
RM14			
RM20			
RM25			