

THICK FILM AUTOMOTIVE CHIP RESISTORS

(RMF / RPF / RPFH SERIES)

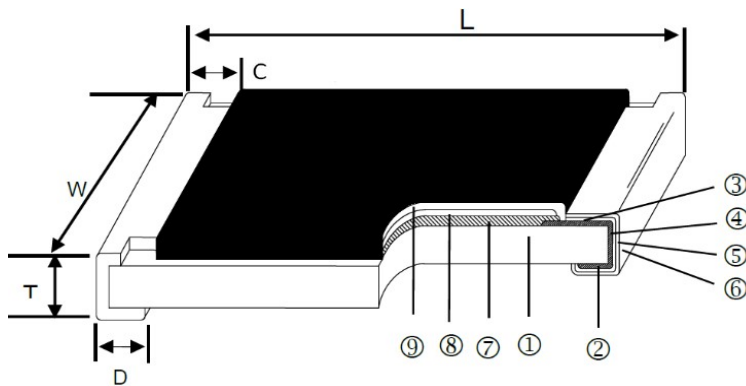
Applications:

- * Automotive Industry
- * Telecommunication Equipments
- * Navigation equipment, Air conditioning.
- * Computers, Instruments
- * Indoor Light, Central door locking, Wiper module

Features:

- * AEC-Q200 Compliance
- * Compatible with all soldering process
- * 100% CCD inspection
- * Highly reliable multilayer electrode construction

Contruction:



1	Alumina Substrate	6	External Electrode
2	Bottom Inner Electrode	7	Resistive Layer
3	Top Inner Electrode	8	Primary Overcoat
4	Edge Electrode	9	Secondary Overcoat
5	Barrier Layer		

Dimensional Specifications

Style				Dimensions				mm
				L	W	T	C	D
RMF-02	--	--	0201	0.60±0.03	0.30 ±0.03	0.23±0.03	0.15 ±0.05	0.15 ±0.05
RMF-04	RPF-04	RPFH-04 *	0402	1.00 ±0.05	0.50 ±0.05	0.35 ±0.05 * 0.30 ±0.05	0.20 ±0.10 * 0.15 ±0.10	0.20 ±0.10
RMF-06	RPF-06	RPFH-06 *	0603	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10 * 0.40 ±0.10	0.30 ±0.20	0.30 ±0.20
RMF-10	RPF-10	RPFH-10	0805	2.00 ±0.10	1.25 ±0.10	0.50 ±0.15	0.35 ±0.20	0.40 ±0.20
RMF-18	RPF-18	RPFH-18 *	1206	3.10 ±0.10	1.55±0.15	0.55 ±0.15	0.50 ±0.25 * 0.40 ±0.20	0.50 ±0.20
RMF-20	--	RPFH-20 *	1210	3.10 ±0.10	2.60 ±0.15 * 2.50 ±0.15	0.55 ±0.15	0.50 ±0.25	0.50 ±0.20
RMF-22	RPF-22	RPFH-22 *	2010	5.00 ±0.20	2.50 ±0.15	0.55 ±0.10	0.60 ±0.25 * 0.60 ±0.20	0.50 ±0.20 * 0.60 ±0.20
RMF-24	RPF-24	RPFH-24 *	2512	6.35 ±0.10	3.10 ±0.15 * 3.20 ±0.15	0.55 ±0.10 * 0.68 ±0.15	0.60 ±0.25 * 0.60 ±0.20	0.50 ±0.20 * 0.60 ±0.20



RMF SERIES (Standard Electrical Specification)

Type	Power Rating at 70 °C	Max. Working Voltage	Max. Overload Voltage	T.C.R (PPM/°C)	Resistance Range(Ω)		
					D (±0.5%) E-96 & E-24	F (±1%) E-96 & E-24	J (±5%) E-24
RMF-02 0201	1/20W	25V	50V	±200	---	1Ω - 10MΩ	
RMF-04 0402	1/16W	50V	100V	±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
				±100	10Ω ~ 1MΩ		
RMF-06 0603	1/10W	75V	150V	±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
				±100	10Ω ~ 1MΩ		
RMF-10 0805	1/8W	150V	300V	±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
				±100	10Ω ~ 1MΩ		
RMF-18 1206	1/4W	200V	400V	±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
RMF-20 1210	1/2W			±100	10Ω ~ 1MΩ		
				±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
				±100	---	10Ω ~ 1MΩ	
				±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
RMF-22 2010	3/4W			±100	10Ω ~ 1MΩ		
RMF-24 2512	1W	250V	500V	±200	---	1Ω - 9.76Ω, 1.02M~10MΩ	
				±100	10Ω ~ 1MΩ		

* Operating Temperature Range: -55°C ~ +155°C

Type	0201, 0402, 0603	0805, 1206	1210	2010	2512
Jumper Resistance Value	0Ω (< 50mΩ)				
Juice Rated Current	1A	2A	2.5A	3.5A	4A

RPF SERIES (High Power Rating Electrical Specification)

Type	Power Rating at 70 °C	Max. Working Voltage	Max. Overload Voltage	T.C.R (PPM/°C)	Resistance Range(Ω)		
					D (±0.5%) E-96 & E-24	F (±1%) E-96 & E-24	J (±5%) E-24
RPF-04 0402	1/8W	50V	100V	±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		
RPF-06 0603	1/4W	75V	150V	±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		
RPF-10 0805	1/3W	150V	300V	±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		
RPF-18 1206	1/2W	200V	400V	±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		
RPF-22 2010	1W			±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		
RPF-24 2512	2W	250V	500V	±200	---	1Ω - 9.76Ω	
				±100	10Ω ~ 1MΩ		

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.

The power rating depends on the maximum temperature of the resistive element. Due to the power dissipation of the resistor, the temperature of the resistive element will rise depending on the condition of heat dissipation from PCB.

The maximum power rating in application only applies if the temperature of the resistive element is not exceed 155 °C.

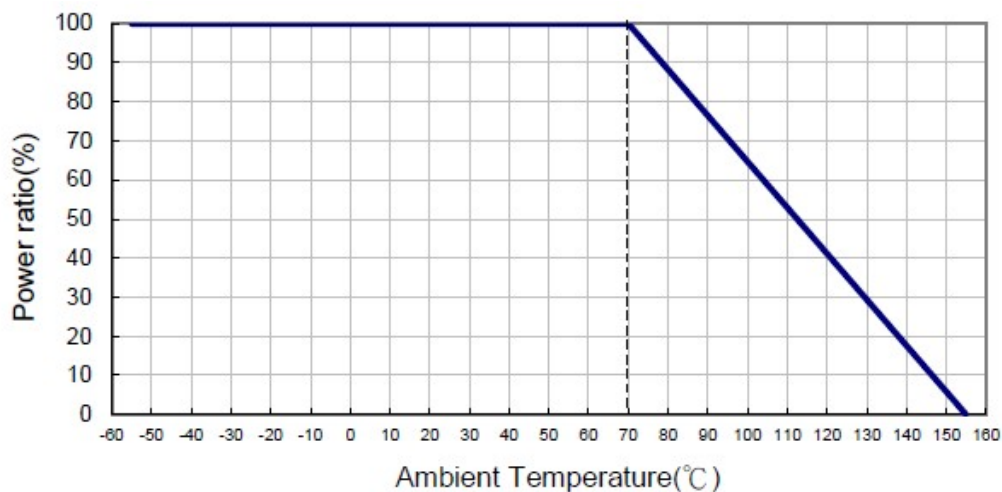


RPFH SERIES (Ultra High Power Rating Electrical Specification)

Type	Power Rating at 70 °C	Max. Working Voltage	Max. Overload Voltage	T.C.R (PPM/° C)	Resistance Range(Ω)		
					D (±0.5%) E-96 & E-24	F (±1%) E-96 & E-24	J (±5%) E-24
RPFH-04 0402	1/5W	50V	100V	±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-06 0603	1/3W	150V	200V	±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-10 0805	1/2W	200V	300V	±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-18 1206	3/4W	200V	400V	±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-20 1210	1W			±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-22 2010	1.5W			±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	
RPFH-24 2512	3W	250V	500V	±400	---	1Ω - 10Ω	
				±100	10Ω ~ 1MΩ	10 ~ 10MΩ	

* Operating Temperature Range: -55°C ~ +155°C

Derating Curve



Reliability test and Requirements

Test Item	Test Method	Condition of Test	Requirements	
			RMF, RPF Series	RPFH Series
Temperature Coefficient of Resistance	IEC 60115-1 4.8 JIS-C-5201-1 4.8	AT +25/-55°C and +25/+125°C 25 °C is the reference temperature	As spec	
Short Time Overload	IEC 60115-1 4.13 JIS-C-5201-1 4.13	RCWV*2.5 or Max. Overload Voltage Ultra Power : Rated power or Max Overload Voltage whichever is lower for 5 seconds	±0.5%,1% :±(1%+0.05Ω) ±5%:±(1.5%+0.10Ω) 0Ω : < 50mΩ	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(2.0%+0.05Ω)
High Temperature Exposure	MIL-STD-202 Method 108	at +155 °C for 1000 hrs	±0.5%,1% :±(1%+0.05Ω) ±5%:±(1.5%+0.10Ω) 0Ω : < 50mΩ	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(2.0%+0.05Ω)
Insulation Resistance	IEC 60115-1 4.6 JIS-C-5201-1 4.6	Max. Overload Voltage for 1 minute	≥10G	≥10G
Biased Humidity	MIL-STD-202 Method 103	1000 hrs 85 °C/85%RH 10% of operating power	±0.5%,1% :±(1%+0.05Ω) ±5%:±(2.0%+0.10Ω) 0Ω : < 100mΩ	±0.5%,1% :±(1.0%+0.05Ω) ±5%:±(3.0%+0.05Ω)
Operational Life	MIL-STD-202 Method 108	Condition D Steady State TA=125°C at derated power. Measurement at 24±4 hours after test conclusion.	±0.5%,1% :±(1%+0.10Ω) ±5%:±(2.0%+0.10Ω) 0Ω : < 100mΩ	±0.5%,1% :±(1.0%+0.05Ω) ±5%:±(3.0%+0.10Ω)
Voltage Proof	IEC 60115-1 4.7 JIS-C-5201-1 4.7	1.42 times Max.Operating Voltage for 1minute	No breakdown or flashover	-----
Leaching	IEC-60068-2-58 8.2.1 JIS-C-5201-1 4.18	260±5 °C for 30 seconds	Individual leaching area ≤ 5% Total leaching area ≤ 10%	
Resistance to Solvents	MIL-STD-202 Method 215	Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking.	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(0.5%+0.05Ω)
Mechanical Shock	MIL-STD-202 Method 213	Wave Form: Tolerance for half sine shock Pluse.Peak value is 100g's. Normal duration(D) is 6(ms)	±0.5%,1%:±(0.25%+0.05Ω) ±5%:±(1.0%+0.05Ω) 0Ω : < 50mΩ	±0.5%,1% :±(1.0%+0.05Ω) ±5%:±(2.0%+0.10Ω)
Vibration	MIL-STD-202 Method 204	5 g's for 20 min., 12 cycles each of 3 orientations. Note: Test from 10-2000Hz.	±0.5%,1% :±(1%+0.05Ω) ±5%:±(1.0%+0.05Ω) 0Ω : < 50mΩ	±0.5%,1% :±(1.0%+0.05Ω) ±5%:±(2.0%+0.10Ω)
Resistance to Soldering Heat	MIL-STD-202 Method 210 Ultra Power : JIS-C-5201-1 4.18 IEC-60115-1 4.18	260±5 °C for 10±1 seconds	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(1.0%+0.10Ω) 0Ω : < 50mΩ	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(1.0%+0.05Ω)
Temperature Crycling	JESD22 Method JA-104	-55°C to +125°C, 1000 cycles	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(1.5%+0.05Ω) 0Ω : < 50mΩ	±0.5%,1% :±(0.5%+0.10Ω) ±5%:±(1.0%+0.05Ω)
ESD	AEC-Q200-002 or ISO/DIS 10605	Human body model 0201: 0.5KV 0402/0603: 1KV ; 0805 and above: 2KV	±(3% + 0.05Ω)	
Solderability	JIS-C-5201-1 4.17 IEC-60115-1 4.17 J-STD-002	245±5 °C for 3 seconds	95% min. covered	±0.5%,1% :±(0.5%+0.05Ω) ±5%:±(1.0%+0.05Ω)
Flammability	UL-94	V-0 or V-1 are acceptable. Electrical test not required.	No ignition of the tissue paper or scorching or the pinewood board	-----
Board Flex	AEC-Q200-005	Bending once for 60 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm	±0.5%,1% :±(1%+0.05Ω) ±5%:±(1.0%+0.05Ω) 0Ω : < 50mΩ	±0.5%,1% :±(1.0%+0.05Ω) ±5%:±(1.0%+0.05Ω)
Terminal Strength	AEC-Q200-006	Force of 1.8kg for 60 seconds Ultra Power : 0402/0603: 8N ; 0805 and above: 17.7N	No broken	
Sulfuration Test	EIA-977 (Condition A) Ultra Power:ASTM-B-809-95	60±2 °C, no power rating for 500 hrs. Ultra Power :10±2 °C, no rating power for	△R: ±1% 0Ω : < 50mΩ	△R: ±(2.0%+0.05Ω)

RCWV(Rated Continuous Working Voltage)=√(P*R) or Max. Operating Voltage whichever is lower.

※ Ref. Standards: IEC 60115-1, 60068-2-58; JIS-C 5201-1; ACE-Q200; MIL-STD-202; JESD22; UL-94; EIA-977

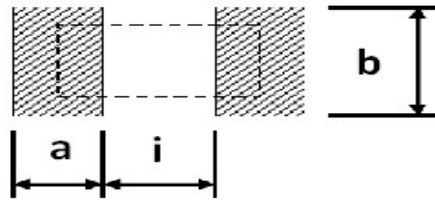
※ Storage Temperature: 15~28°C; Humidity < 80%RH

※ Shelf Life: 2 years from production date.



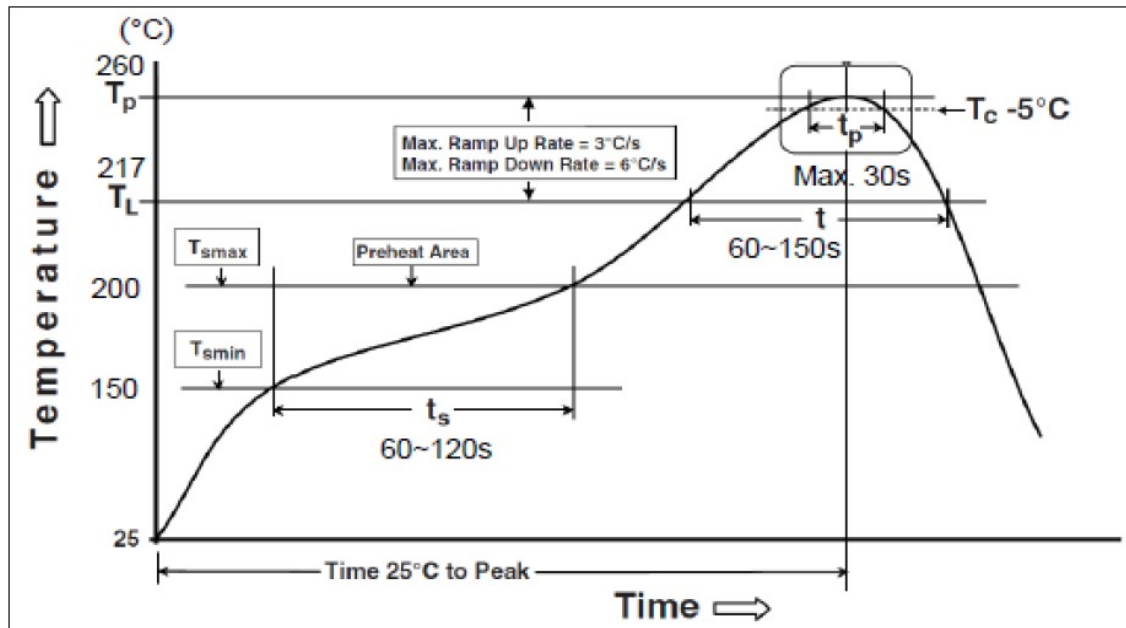
General information

* Recommend Land Pattern Design



Type	0201	0402	0603	0805	1206	1210	2010	2512
i	0.30	0.50	0.90	1.20	2.00	2.00	3.80	4.90
a	0.25	0.45	0.60	0.70	0.90	0.90	0.90	1.60
b	0.30	0.60	0.90	1.30	1.60	2.80	2.80	3.50

※ RMF/RPF Series : Soldering Condition (Ref. IPC/JEDEC J-STD-020 & J-STD-002)



※ Reflow Profiles

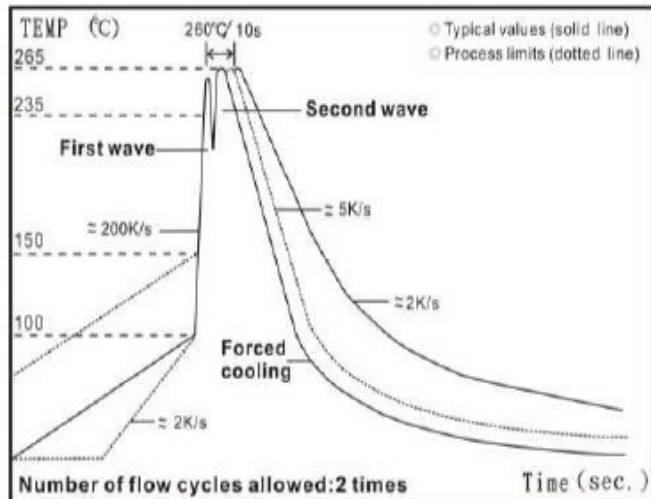
Profile Feature	Pb-Free Assembly
Preheat	
Min. Temperature (T _{min})	150 °C
Max Temperature (T _{max})	200 °C
Preheating time (t _s) from (T _{min} to T _{max})	60-120 seconds
Ramp-up rate (T _L to T _p)	3 °C/second max.
Liquidous temperature (T _L)	217 °C
Time (t _L) maintained above T _L	60-150 seconds
Min. Peak temperature (T _p min)	235°C
Max. Peak temperature (T _p max)	260°C
Time (t _p) within 5 °C of the specified classification	30 seconds max.
Ramp-down rate (T _p to T _L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.



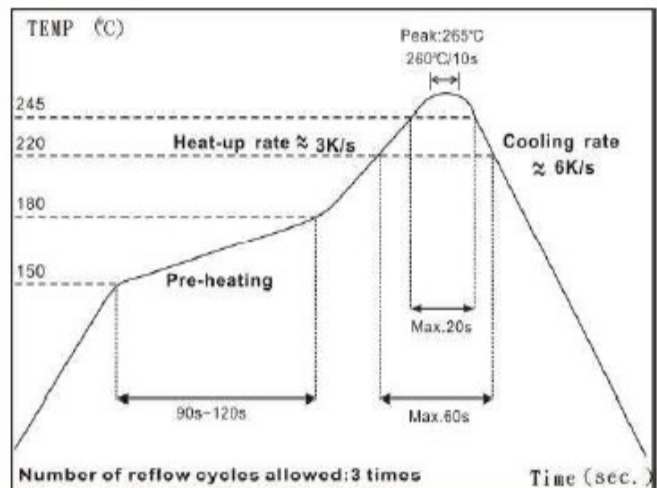
Recommended Customer Soldering Parameters

※ RPFH Series:

* Wave solder Temperature condition



* Solder reflow Temperature condition

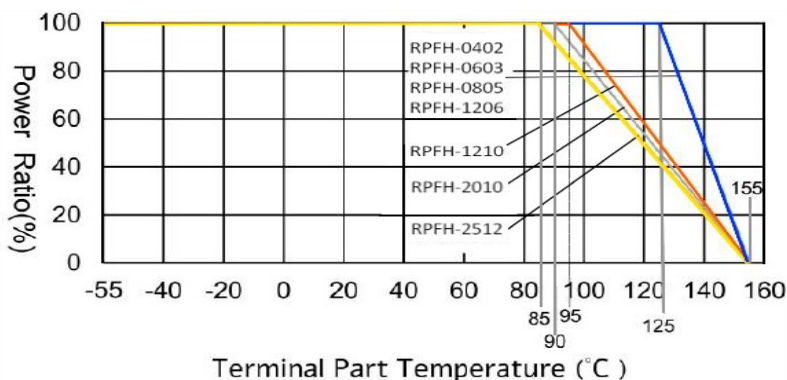


* Rework temperature (hot air equipment): 350°C, 3~5seconds

* Recommended reflow methods

- IR, vapor phase oven, hot air oven
- If reflow temperatures exceed the recommended profile, devices may not meet the performance

* Terminal part temperature



Parts Number System

RMF -

Type

Automotive
Gade Chip
Resistor
RME/RPF Type
High Power
RPFH type
Ultra High
Power

18 -

Size

02=0201
04=0402
06=0603
10=0805
18=1206
20=1210
22=2010
24=2512

1004

Resistance

0R = 0000
1R = 1R00
9R7 = 9R70
10R = 10R0
100R = 1000
1KR = 1001
1MR = 1004

F

Tolerance

D=0.5%
J = ±5%
F = ±1%

R

**Standard
Packing**

R=Paper tape reel
10Kpcs/Reel
size: 0201-0402
5Kpcs/Reel
size: 0603-1210
K=Embossed
plastic tape reel
4Kpcs/Reel
size: 2010-2512



Marking

* 5%: marking code: 3 digits in E24 for 0603/0805/1206/1210/2010/2512

- First two digits are significant figure,
- Third digit is number of zeros.
- Letter R is decimal point.

EX: 120K, the marking code is 124 in E24



Value=10K Ω

* 1%: Marking code: 4 digits in E24 and E96 for 0805/1206/1210/2010/2512

- First three digits are significant figure,
- Forth digit is number of zeros.
- Letter R is decimal point.

EX: 120K, the marking code is 1203 in E24

121K, The marking code is 1213 in E96



Value=10K Ω

* 0201, 0402 no marking



* 0603 1%: E24 Marking.

3 digits marking in E24,

When the E24 and E96 are the same resistance, this marking in E96

EX : 01A= 100 Ω 05C=11K Ω

* 0603 1%: E96 Marking.



EX : 13C=13K3 Ω

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

This table shows the first two digits for the three-digit EIA-96 part marking scheme. The third character is a letter multiplier:

⁻²Y=10 ⁻¹X=10 ⁰A=10 ¹B=10 ²C=10 ³D=10 ⁴E=10 ⁵F=10⁵

* E24 & E96 data form

E24		E96							
10	33	100	178	316	562	133	237	422	750
11	36	102	182	324	576	137	243	432	768
12	39	105	187	332	590	140	249	442	787
13	43	107	191	340	604	143	255	453	806
15	47	110	196	348	619	147	261	464	825
16	51	113	200	357	634	150	267	475	845
18	56	115	205	365	649	154	274	487	866
20	62	118	210	374	665	158	280	499	887
22	68	121	215	383	681	162	287	511	909
24	75	124	221	392	698	165	294	523	931
27	82	127	226	402	715	169	301	536	953
30	91	130	232	412	732	174	309	549	976

