

(Chip Resistor)



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HISTORY

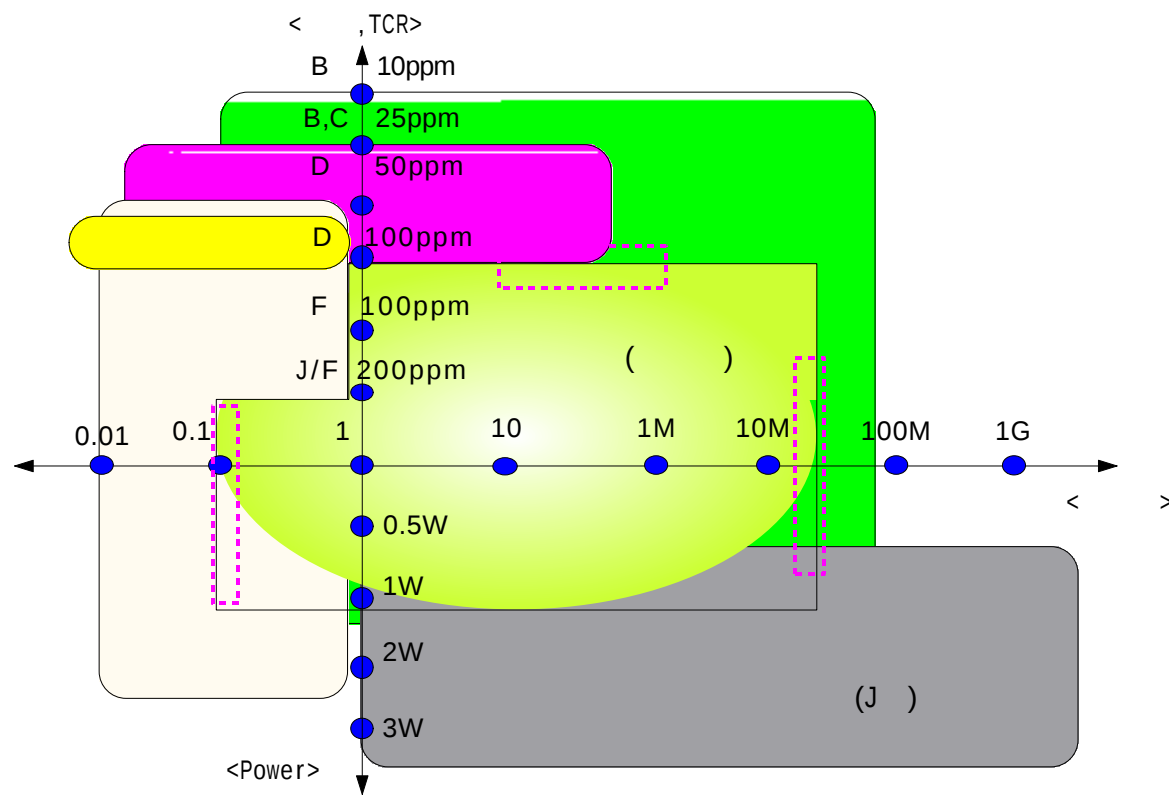
- Jun. 1987 Production began at a capacity of 40 M/month
- Sep. 1989 Production capacity increased to 100M/month
- Sep. 1993 Production capacity increased to 300M/month
- Jun. 1994 Samsung became affiliated to ISO 9001
- Nov. 1995 Production capacity doubled (1 Billion/month)
- Oct. 1996 Mass production of 0402 and R-Array started
- Jun. 1998 Production capacity reached 2 Billion/month
- Jul. 1998 Developed 0402 R-Array and High Power Resistor
- Feb. 1999 Mass production of 0402(F) and Low Ohm Resistor started
- Sep. 2000 Production capacity increased to 4500M/month
- Nov. 2000 Production capacity increased to 6000M/month
- Jan. 2000 Production line shifted to Philippine
- Jan. 2001 Production line shifted to Tian jin, China
- Jun. 2001 Overseas taping center system open (Mexico, Hungary, Thai)

-
- Fixed Thick Film Resistor
- 角板形 チップ 固定抵抗器

- Very small, thin, and light weight.
- Suitable size and packaging for SMD.
- Both Flow and Reflow soldering
- Alumina substrate is manufactured by SEM
- Machinery is manufactured by SEM

System

- ISO-9001 (1994. 6)
- QS-9000 (2001. 8)
- MES (Manufacturing Execution System)
- LOT
- SAP R/3 /
- VOC
- 6-sigma



	()					가
	RuO2	Supptering NiCr				Carbon
	,	,	, TCR	HIGH POWER	TCR,	Volumn chip

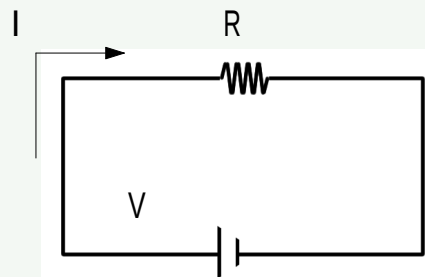
- (ohm's law)

$$V = I \times R$$

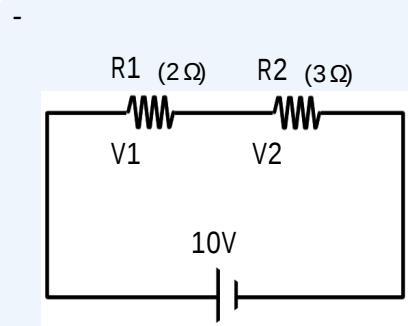
V :

I :

R :



- R(resistor), L(inductor), C(capacitor)가

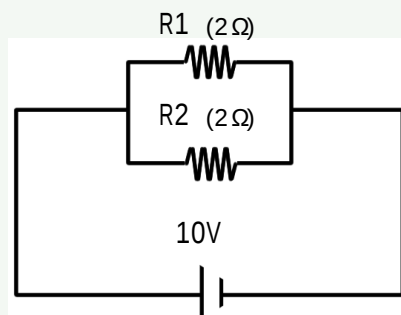


→ 가
 $R = R1 + R2 = 2 + 3$
 $= 5 \Omega$

→
 $I = \frac{V}{R} = 10/5 = 2 \text{ A}$

→
 $V1 = 2\text{A} \times 2\Omega = 4\text{V}$
 $V2 = 2\text{A} \times 3\Omega = 6\text{V}$

→
 $R = \frac{1}{\frac{1}{R1} + \frac{1}{R2}} = 1\Omega$



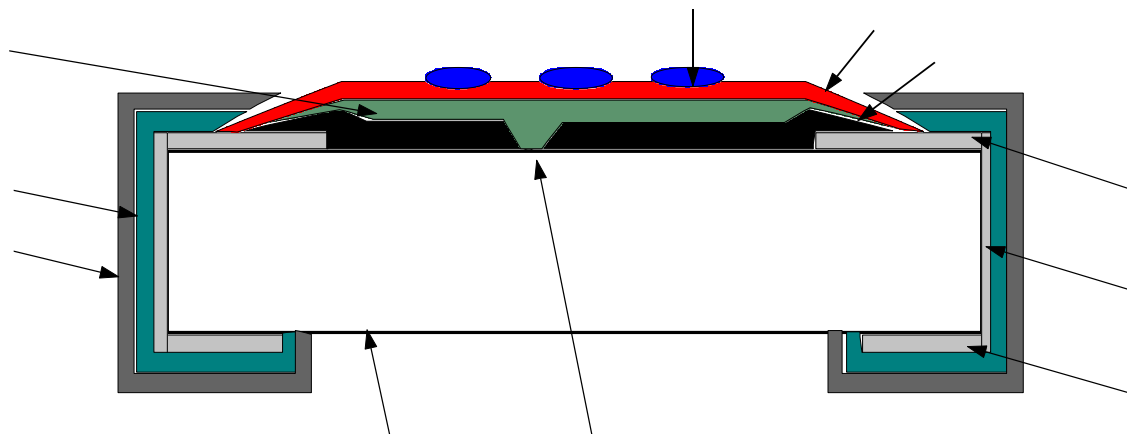
→
 $R1 = 10/2 = 5\text{A}$

-

- (test < 200MHz)
 L, C
 Block
 R
 가

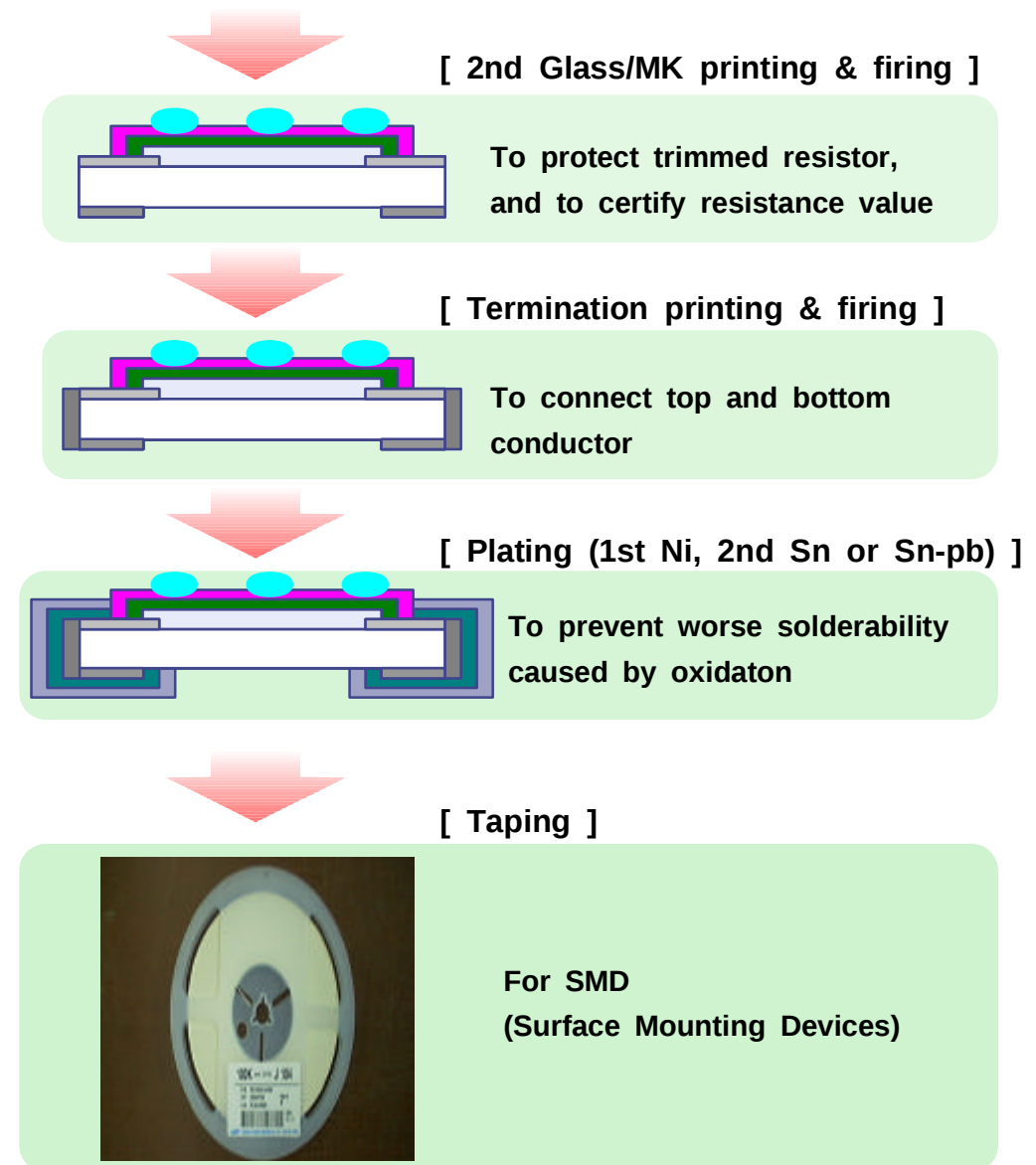
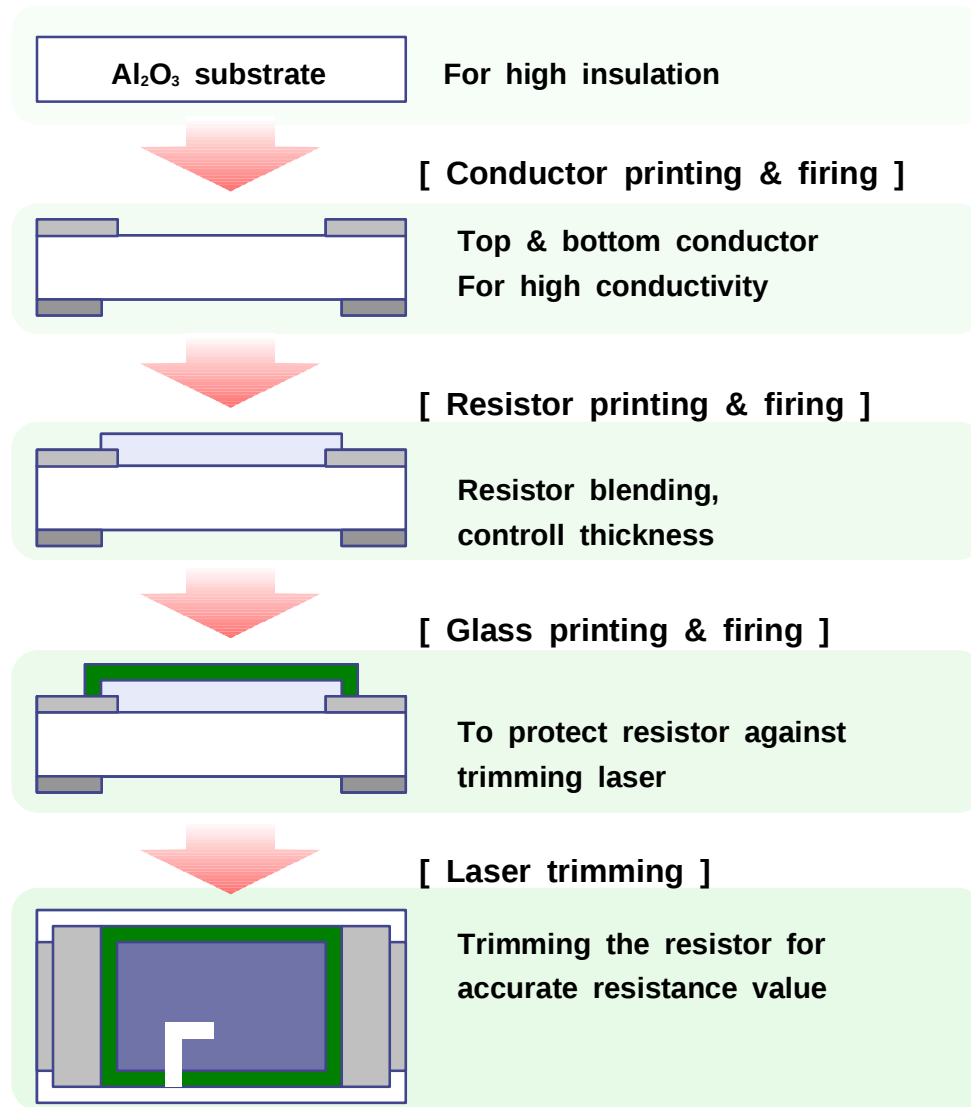
- JUMPER
 0ohm JUMPER가

JUMP



	PROCESS	MATERIAL	PROPERTIES
1	3rd CONDUCTOR	Ag PASTE	Ag, Pd, Ni
2	1st CONDUCTOR	Ag/Pd PASTE	
3	RESISTOR	RuO ₂ PASTE	, ,
4	1st GLASS	GLASS PASTE	, ,
5	TRIMMING	BY LASER	Power, Trimming
6	2nd GLASS	GLASS PASTE	, ,
7	MARKING	GLASS PASTE	, ,
8	2nd CONDUCTOR	Ag PASTE	, Ni
9	Ni PLATING	Ni	, Ag migration
10	Sn/Pb PLATING	Sn/Pb(90/10)	, PCB matching
11	SUBSTRATE	Al ₂ O ₃	, ,

PROCESS



RESISTOR FOR

- ◆ [General purpose](#)
- ◆ [Precision](#)
- ◆ [Low ohms](#)
- ◆ [Trimmable chip](#)
- ◆ [Array](#)
- ◆ [Array-precision](#)
- ◆ [Packaging](#)
- ◆ [Standard Resistance Value](#)

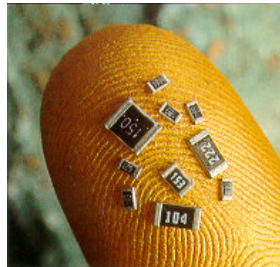
APPLICATION

- ◆ [Operating notes](#)
- ◆ [Example of land pattern design](#)
- ◆ [Recommended soldering](#)
- ◆ [About production process](#)

TECHNOLOGY TREND

- ◆ [Pb-free](#)

SPECIFICATION



INTRODUCTION

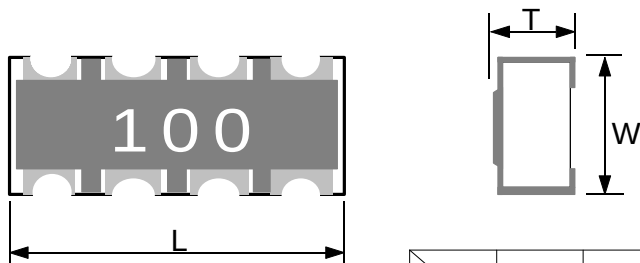
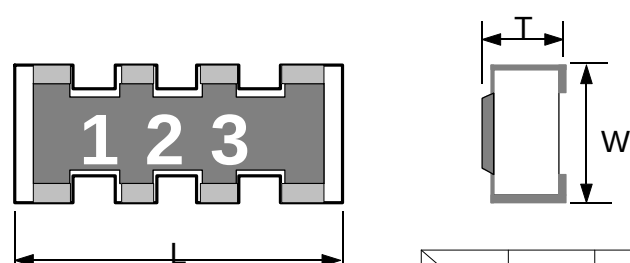
Thick Film Chip Resistor is general passive component which is useful for derating voltage, current controlling in circuit. Surface Mounting is available. Production is increasing with demand for small size & light weight of Set product. We provide Ultra-small, High-Reliability, High-stability Resistors.

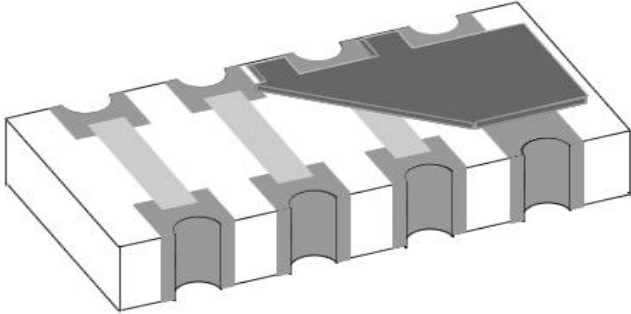
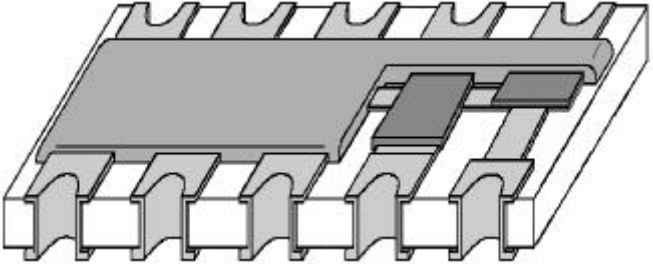
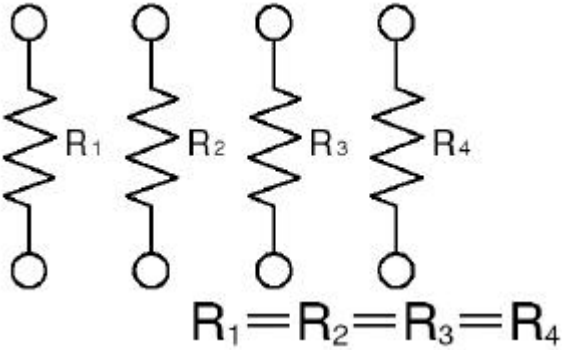
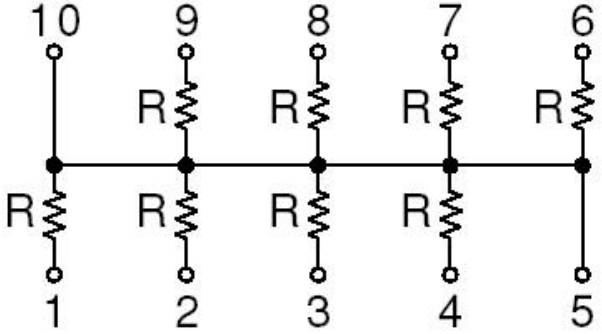
GENERAL FEATURES

- Very small, thin, and light weight.
- Suitable size and packaging for surface mount assembly.
- Both flow and reflow soldering are applicable.

APPLICATIONS

- Home Appliances (DVD, Digital TV, CAMCODER, VTR, Digital Camera, Audio ,Tunner)
- Computers & Communications (PC, Memory Module, Mobile, Network Equipment, TCXO, etc)

	RN type (Through-hole)	RP type (Dipping)																								
Dimension	Concave  <table><tr><td></td><td>L</td><td>W</td><td>T</td></tr><tr><td>104P</td><td>2.0</td><td>1.0</td><td>0.40</td></tr><tr><td>164P</td><td>3.2</td><td>1.6</td><td>0.60</td></tr></table>		L	W	T	104P	2.0	1.0	0.40	164P	3.2	1.6	0.60	Convex  <table><tr><td></td><td>L</td><td>W</td><td>T</td></tr><tr><td>104P</td><td>2.0</td><td>1.0</td><td>0.35</td></tr><tr><td>164P</td><td>3.2</td><td>1.5</td><td>0.60</td></tr></table>		L	W	T	104P	2.0	1.0	0.35	164P	3.2	1.5	0.60
	L	W	T																							
104P	2.0	1.0	0.40																							
164P	3.2	1.6	0.60																							
	L	W	T																							
104P	2.0	1.0	0.35																							
164P	3.2	1.5	0.60																							
	- 2 / → 가 - 2 가 850 -	- 2 dipping → 가 - 2 가 600 -																								
/	- - (850) 2 dipping type	- - Soldering																								

	Array	Network
		
	 $R_1 = R_2 = R_3 = R_4$	
	- IC Board , / / - 1 Mounting → - 가 (ex) 1608 X 4 → 164P X 1	- , 1 - → - 가

(Nominal Resistance Value)

(Critical Resistance Value)

(Working Temperature)

1608, 2012, 3216 : -55 ~ 155
: -55 ~ 125

(Rated Ambient Temperature)

가 가
.(70)

(Rated Power or Power Rating)

가 가
W 1/16, 1/10, 1/8, 1/4, 1/2, 1

(Rated Voltage)

가 가 ()

$$= \sqrt{(W) \times (\Omega)}$$

(Maximum Working Voltage)

가 가

() , 가 가

(Maximum Overload Voltage)

가 ()

2

(Dielectric Withstanding Voltage)

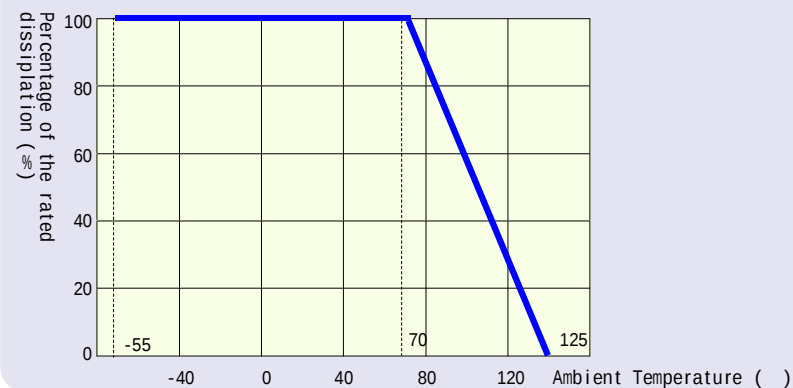
body 1 가가
.()

(T.C.R. - Temperature Coefficient of Resistance)

, 1

()

(Power Derating Curve)



Chip-R Marking

- KS / JIS / IEC
(가 ,)
- Marking : 3 , 4 marking, code marking

Marking system (IEC, JIS, KS)

- / E , E3, E6, E12, E24, E48, E96, E192 .
-) E24 : $10^{n/24}$ $n = 1 \sim 24$
E24, E96 series .

Marking

- 3 marking : $10^3 = 10 \times 10^3 = 10000 = 10k\Omega$
R22 = 0.22
- 4 marking : $5621 = 562 \times 10^1 = 5620 = 5.62k\Omega$
3R48 = 3.48
('R' 'Round' →)

Marking

	0603	1005	1608	2012~6432, array
3	X	X	O	O
4	X	X	X	O

: (yageo, ralec...) code marking

Marking

Flow

Code Marking

- 2 : E24 (- , -10)
) $C2 = C(1.2) \times 10^2 = 120\Omega$
- 3 : E96 (- , -10)
) $51B = 332 \times 10^1 = 3320 = 3.32k\Omega$

1) 1 10

2)

3)

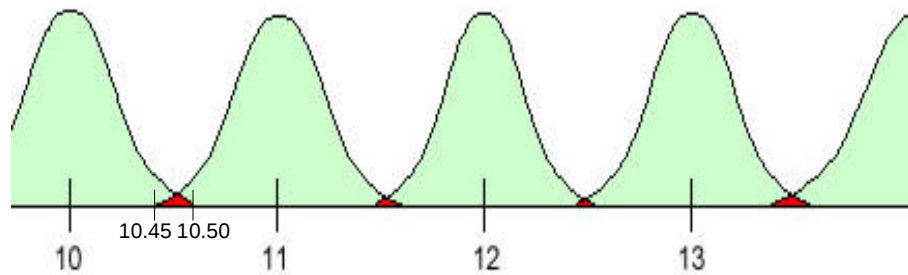
→

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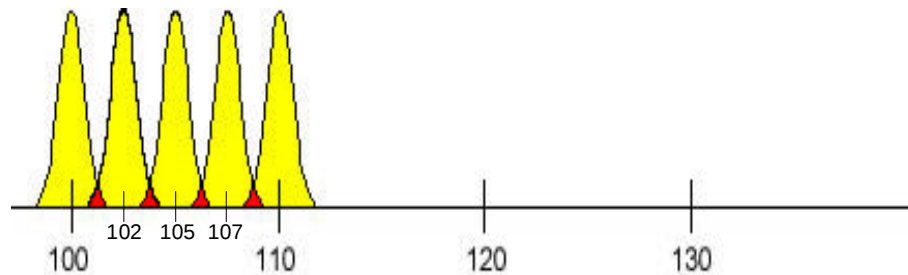
?

E-24, E-96 series

1) E-24 series



2) E-96 series



E-24 series Table

	R	0	1	2	3	4	5	6
10	1R0	100	101	102	103	104	105	106
11	1R1	110	111	112	113	114	115	
12	1R2	120	121	122	123	124	125	
13	1R3	130	131	132	133	134	135	
15	1R5	150	151	152	153	154	155	
16	1R6	160	161	162	163	164	165	
18	1R8	180	181	182	183	184	185	
20	2R0	200	201	202	203	204	205	
22	2R2	220	221	222	223	224	225	
24	2R4	240	241	242	243	244	245	
27	2R7	270	271	272	273	274	275	
30	3R0	300	301	302	303	304	305	
33	3R3	330	331	332	333	334	335	
36	3R6	360	361	362	363	364	365	
39	3R9	390	391	392	393	394	395	
43	4R3	430	431	432	433	434	435	
47	4R7	470	471	472	473	474	475	
51	5R1	510	511	512	513	514	515	
56	5R6	560	561	562	563	564	565	
62	6R2	620	621	622	623	624	625	
68	6R8	680	681	682	683	684	685	
75	7R5	750	751	752	753	754	755	
82	8R2	820	821	822	823	824	825	
91	9R1	910	911	912	913	914	915	

0Ω : JUMPER (000) 가

E-24 series

: 0Ω, 0.1Ω ~ 10MΩ (194)

E-96 series

: 0Ω, 0.1Ω ~ 10MΩ (769)

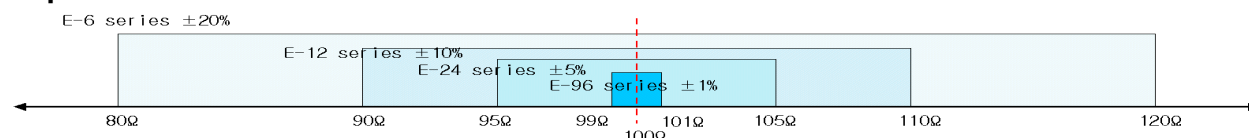
Tolerance code table

Tolerance code	D	F	G	J	K	M
IEC-code system	E-192	E-96	E-48	E-24	E-12	E-6
Digit number	4 digit			3 digit		
Specification	±0.5%	±1%	±2%	±5%	±10%	±20%

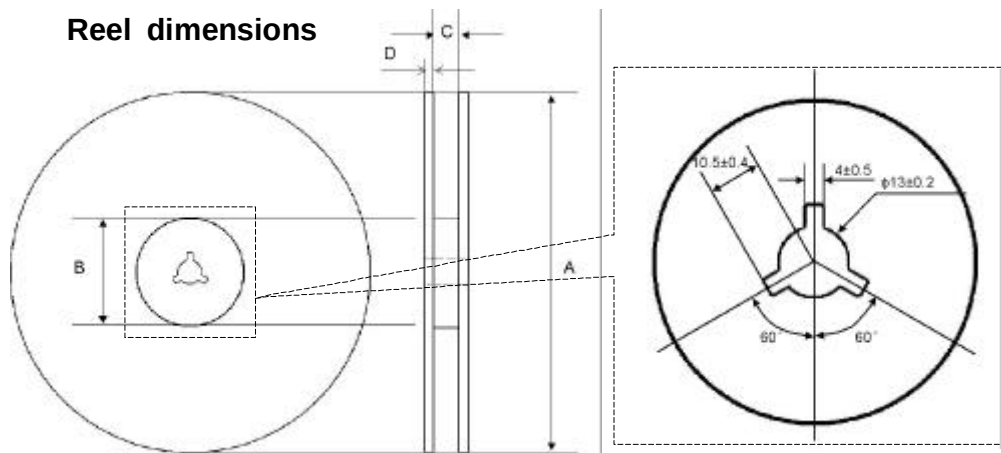
Significant figure of resistance value

E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24	E-192	E-96	E-48	E-24
100	100	100	10	178	178	178		316	316	316		562	562	562	56
101				180			18	320				569			
102	102			182	182			324	324			576	576		
104				184				328				583			
105	105	105		187	187	187		332	332	332	33	590	590	590	
106				189				336				597			
107	107			191	191			340	340			604	604		
109				193				344				612			
110	110	110	11	196	196	196		348	348	348		619	619	619	
111				198				352				626			62
113	113			200	200		20	357	357			634	634		
114				203				361			36	642			
115	115	115		205	205	205		365	365	365		649	649	649	
117				208				370				657			
118	118			210	210			374	374			665	665		
120			12	213				379				673			
121	121	121		215	215	215		383	383	383		681	681	681	68
123				218				388				690			
124	124			221	221		22	392	392		39	698	698		
126				223				397				706			
127	127	127		226	226	226		402	402	402		715	715	715	
129				229				407				723			
130	130		13	232	232			412	412			732	732		
132				234				417				741			
133	133	133		237	237	237		422	422	422		750	750	750	75
135				240			24	427				759			
137	137			243	243			432	432		43	768	768		
138				246				437				777			
140	140	140		249	249	249		442	442	442		787	787	787	
142				252				448				796			
143	143			255	255			453	453			806	806		
145				258				459				816			
147	147	147		261	261	261		464	464	464		825	825	825	82
149				264				470			47	835			
150	150		15	267	267			475	475			845	845		
152				271			27	481				856			
154	154	154		274	274	274		487	487	487		866	866	866	
156				277				493				876			
158	158			280	280			499	499			887	887		
160			16	284				505				898			
162	162	162		287	287	287		511	511	511	51	909	909	909	
164				291				517				920			91
165	165			294	294			523	523			931	931		
167				298				530				942			
169	169	169		301	301	301	30	536	536	536		953	953	953	
172				305				542				965			
174	174			309	309			549	549			976	976		
176				312				556				988			

Example

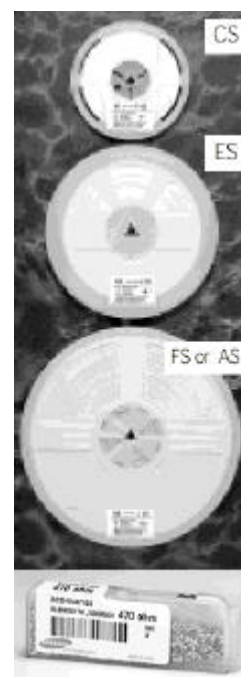


Reel dimensions



[: mm]

	CODE	A	B	C	D
7"	C S	178	Φ 70	9.5(13.0) ± 0.1	1.2 ± 0.1
10"	E S	258	Φ 80	9.5 ± 0.1	2.0 ± 0.1
13"	F S, A S	330	Φ 80	9.5 ± 0.1	2.0 ± 0.1



Packaging table

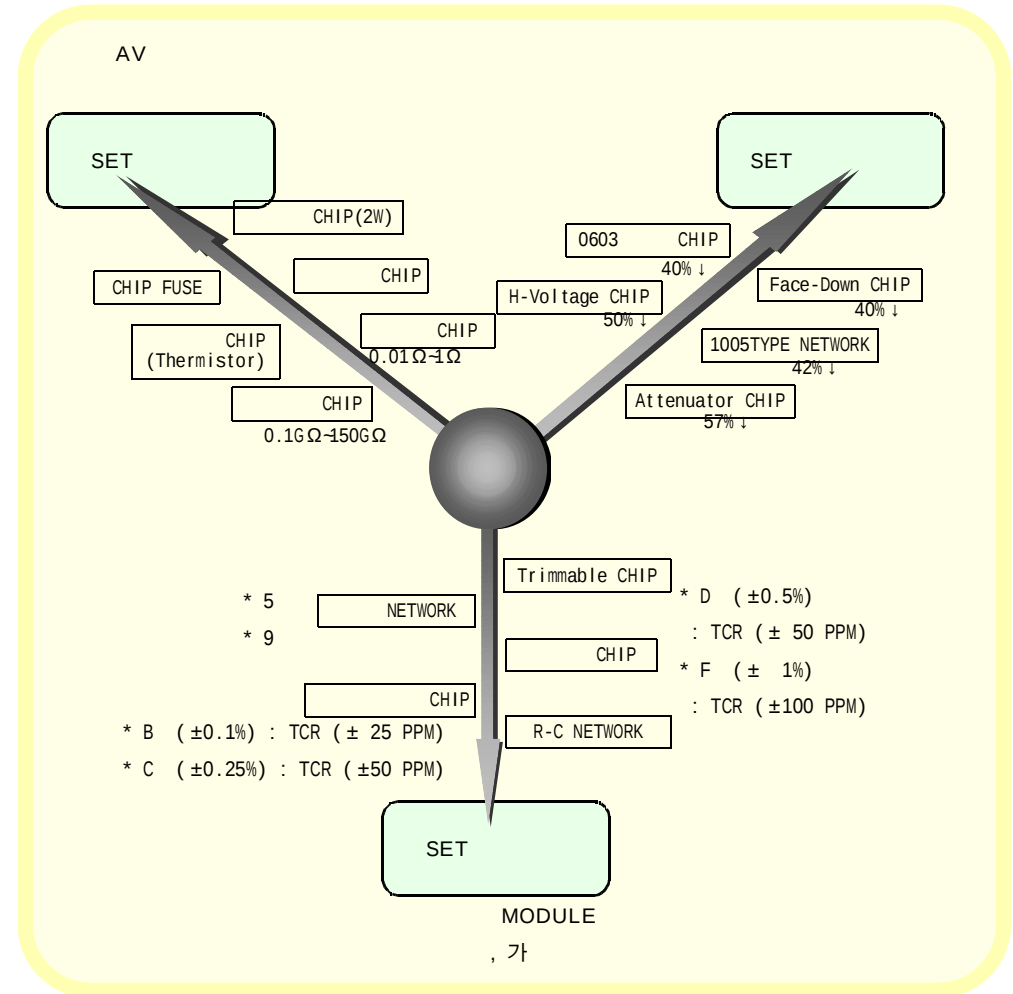
TYPE	inch	Taping Packaging					Box Packaging								
		Pakaging code	Reels	Tape	Quantity	Weight (g)	Inner box				Outer box				
							Reels	Quantity	Weight (Kg)	Volume	Inner box	Quantity	Weight (Kg)	Volume	
0603	0201	CS	7"	Press Porket	10,000	104	5	50,000	0.60	2.197	4	200,000	2.67	10.396	
1005	0402	CS	7"		10,000	109	5	50,000	0.62	2.197	12	600,000	7.84	32.616	
		ES	10"	30,000	379	5	150,000	2.03	4.394	6	900,000	12.72	34.265		
1608	0603	CS	7"	Punched Paper	5,000	132	5	25,000	0.73	2.197	4	100,000	3.22	10.396	
		ES	10"		10,000	351	5	50,000	1.88	4.394	6	300,000	11.85	34.265	
		FS	13"		15,000	505	4	60,000	2.20	7.293	5	300,000	11.69	39.639	
		AS			20,000	600	4	80,000	2.58	7.293	5	400,000	13.60	39.639	
2012	0805	CS	7"	Punched Paper	5,000	155	5	25,000	0.85	2.197	4	100,000	3.69	10.396	
		ES	10"		10,000	397	5	50,000	2.12	4.394	6	300,000	13.26	34.265	
		FS	13"		15,000	565	4	60,000	2.44	7.293	5	300,000	12.89	39.639	
		AS			20,000	684	4	80,000	2.92	7.293	5	400,000	15.27	39.639	
3216	1206	CS	7"	Punched Paper	5,000	165	5	25,000	0.90	2.197	4	100,000	3.89	10.396	
		ES	10"		10,000	417	5	50,000	2.22	4.394	6	300,000	13.85	34.265	
		FS	13"		15,000	605	4	60,000	2.60	7.293	5	300,000	13.69	39.639	
		AS			20,000	734	4	80,000	3.12	7.293	5	400,000	16.27	39.639	
3225	1210	CS	7"	Punched Paper	5,000	188	5	25,000	1.02	2.197	4	100,000	4.35	10.396	
		ES	10"		10,000	463	5	50,000	2.44	4.394	6	300,000	15.23	34.265	
		FS	13"		15,000	674	4	60,000	2.88	7.293	5	300,000	15.07	39.639	
		AS			20,000	826	4	80,000	3.48	7.293	5	400,000	18.11	39.639	
5025	2010	CS	7"	Embosse d Tape	4,000	201	5	20,000	1.08	2.197	4	80,000	4.61	10.396	
6432	2512	CS	7"		4,000	259	5	20,000	1.37	2.197	12	240,000	13.65	32.616	
		AS	13"	15,000	1,042	5	75,000	5.34	4.394	5	375,000	27.25	34.265		
104P	-	CS	7"	Punched Paper	10,000	141	5	50,000	0.78	2.197	4	200,000	3.41	10.396	
164P	-	CS	7"		Punched Paper	5,000	259	5	25,000	1.37	2.197	12	600,000	10.07	32.616
												4	100,000	5.77	10.396
												12	300,000	17.13	32.616
				5								375,000	27.25	34.265	
		FS	13"	Punched Paper	15,000	1,042	5	75,000	5.34	4.394	5	375,000	27.25	34.265	
		AS	13"		20,000	826	4	80,000	3.48	7.293	5	400,000	18.11	39.639	

SET

1. SET
→ (SMD , CHIP)
2. SET
→ (CHIP, CHIP)
3. SET
→ (CHIP, CHIP)
ex) "F"
→ "J" 가

CHIP

1. SET , USER
2. (Pb)
LEAD FREE, 樹指硬化(POLYMER)
GLASS (1), (2), R PASTE (3)
3. SMT (CHIP)
Pattern , GLASS PASTE, Carrier tape
4. CHIP ()
(, , GAS , NOISE)



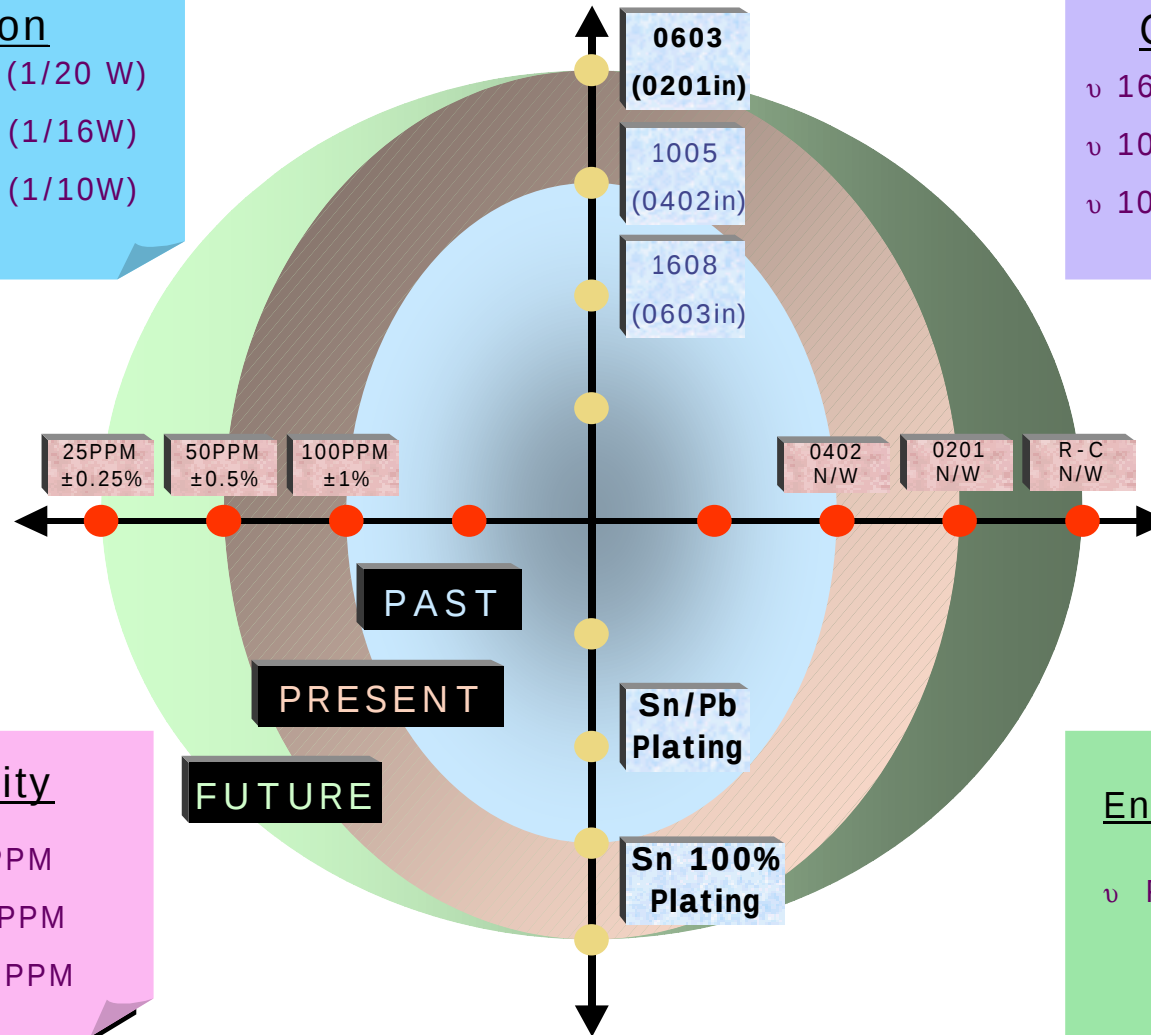
Technical trends

Miniaturization

- υ 0603(0201in) TYPE (1/20 W)
- υ 1005(0402in) TYPE (1/16W)
- υ 1608(0603in) TYPE (1/10W)

Complex Network

- υ 1608(0603in) 4R ARRAY
- υ 1005(0402in) 4R ARRAY
- υ 1005(0402in) R-C NETWORK



High Reliability

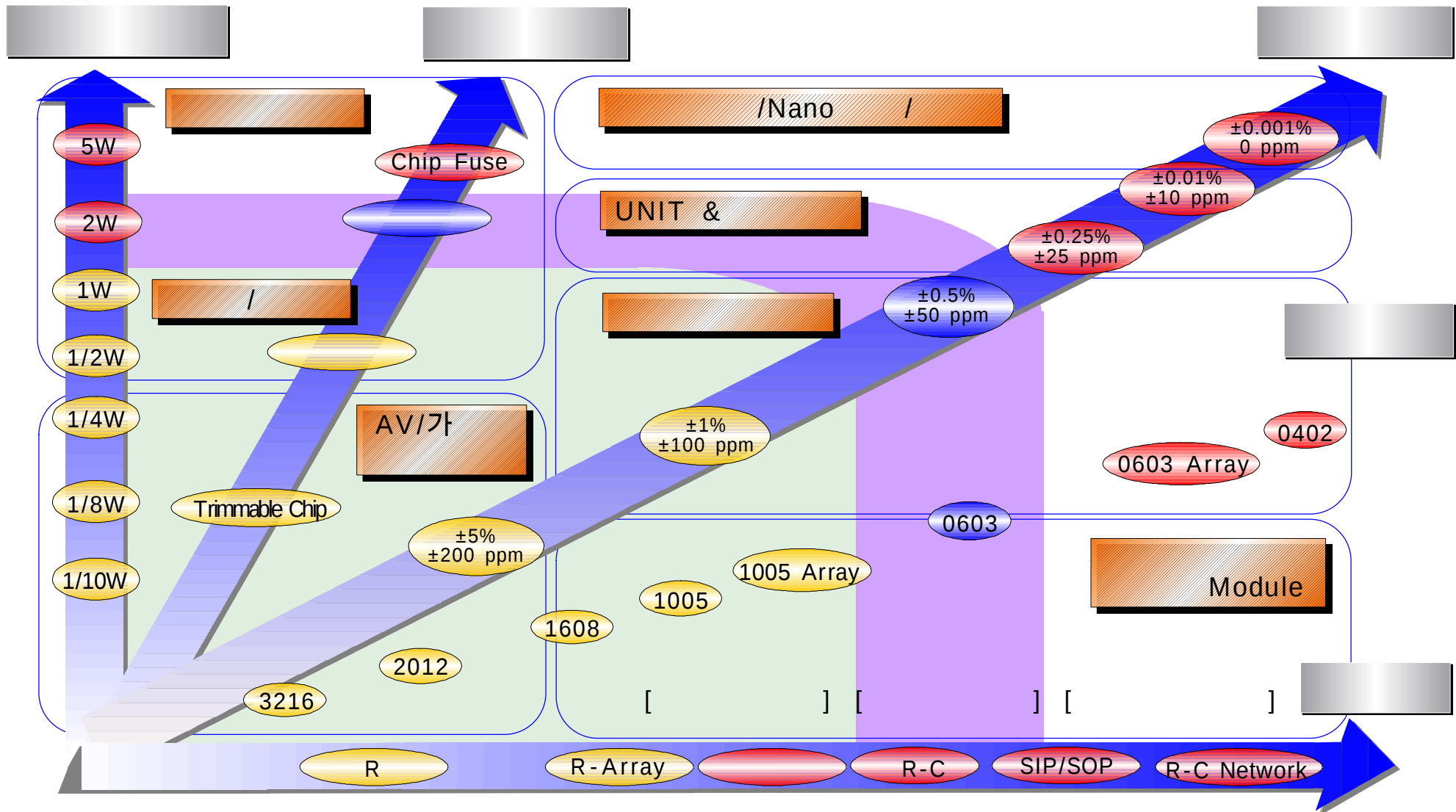
- υ ± 1 % : ±100 PPM
- υ ±0.5 % : ± 50 PPM
- υ ±0.25% : ± 25 PPM

Environmental Product

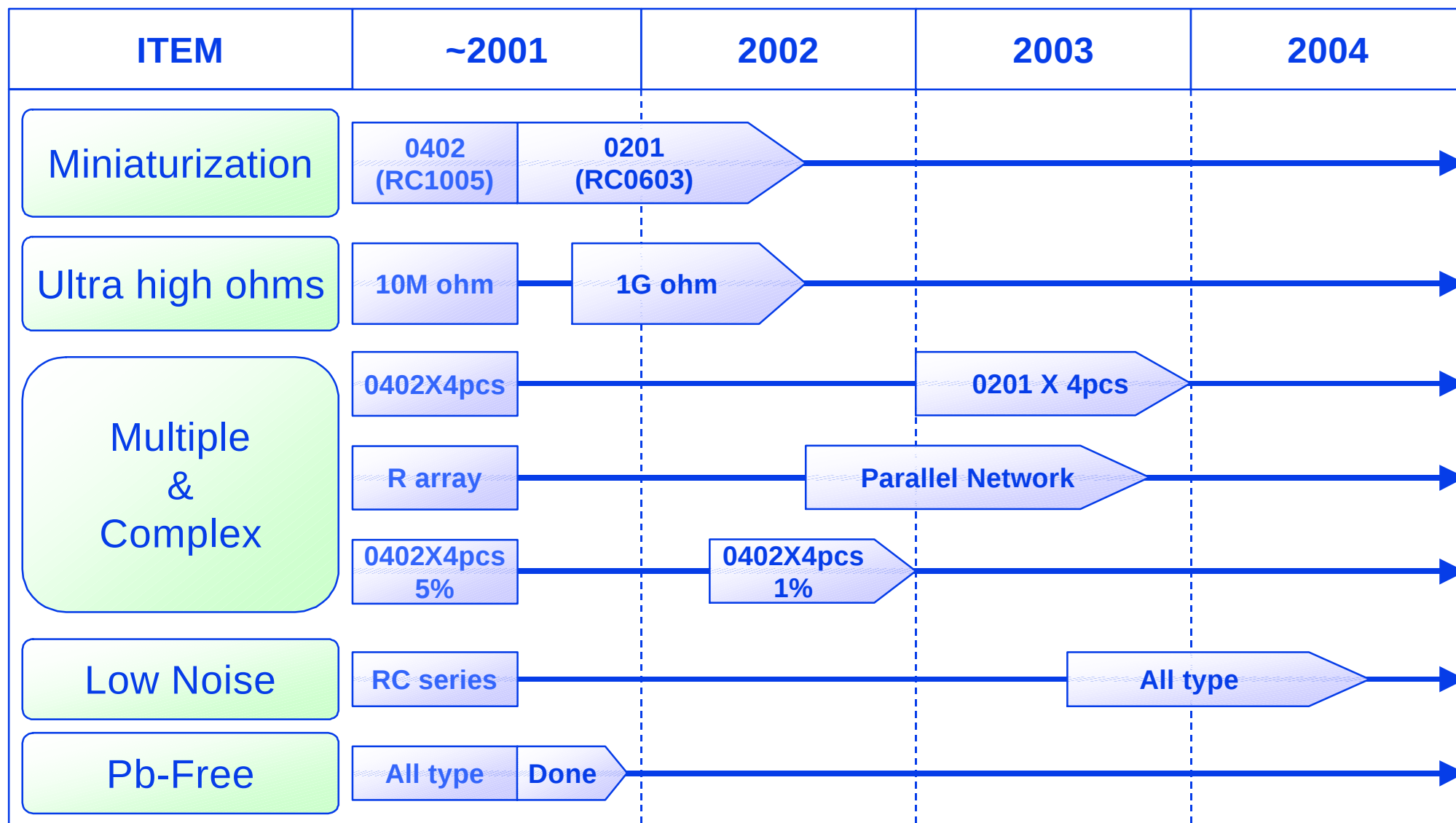
- υ Pb-free plating

Technical trends

● : Already ● : 2002 plan ● : Future plan



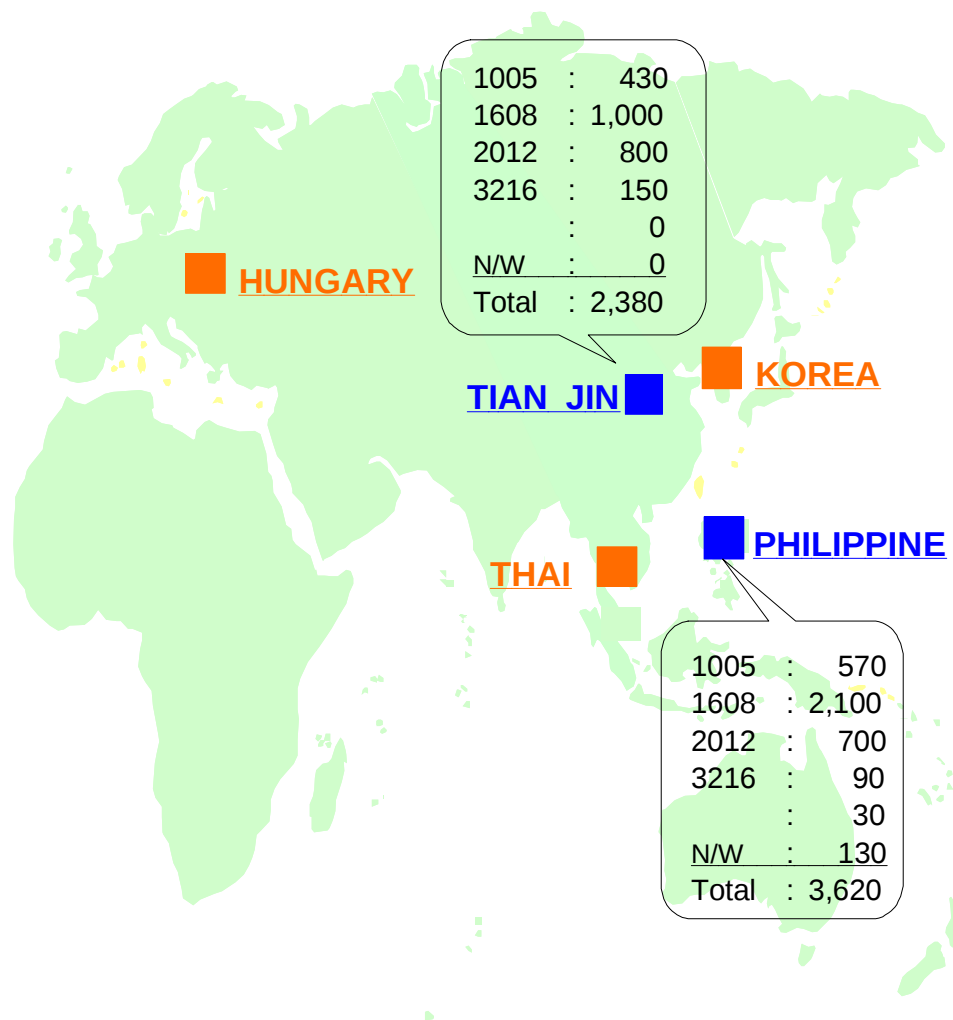
ROAD MAP



World wide logistics

■ Full process

■ Taping process & Warehouse



World Wide Chip Resistor	CAPA (Mpcs/month)	
	Taping Capa	Bulk Capa
Korea	100	-
Philippine	3,200	3,600
Tian jin (China)	2,000	2,400
Mexico	200	-
Thai	300	-
Hungary	200	-
Total	6,000	6,000

Pb-free

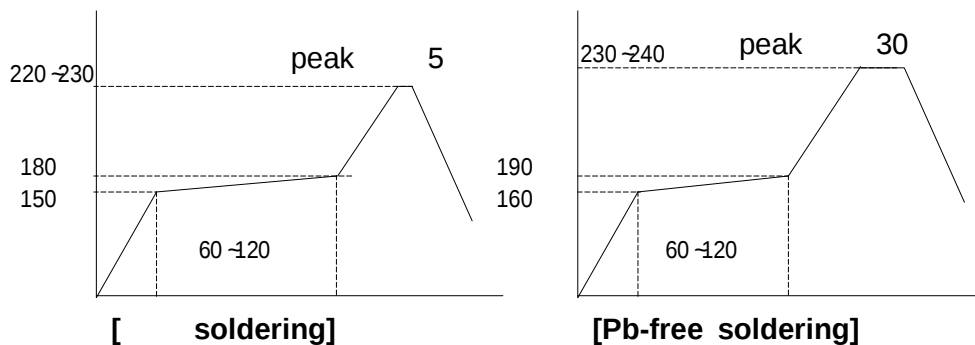
Pb-free

- (Pb)
- Marketing力
(: 2001 가 Recycle)
- Pb-free solder
(Sn/Pb → Sn)

Pb-free

	(Sn/Pb)	Pb-free (Sn)
	Ag → Ni → Sn/Pb	Ag → Ni → Sn
Solder	185 (Sn63/Pb37)	220 (Sn/Ag/Cu)
Soldering	(230)	(240)

Soldering (reflow)



Pb-free

1. Pb-free T/F : '01. 01.
2. Pb-free : '01. 09.
3. SONY (CR, MLCC) : '01. 10.
4. Pb-free line Setup (SEMPHIL) : '01. 11. ()
5. Pb-free (4 /月, CR) : '01. 12.

Pb-free

1. /
 - Delphi :
 - Motorola : 2001
 - Ericsson : 2001末 80%
 - Siemens : 2001
 - Philips : 1998
2.
 - NEC : 2002 12
 - Sanyo : 2004 3
 - Sharp : 2001
 - Hitachi : 2002 3
 - Fujitsu : 2002末
 - Mastushita : 2003 3
 - Mitsubishi : 2002 3 가 Pb-free solder

NO	TEST ITEM	TEST CONDITON	CYCLE (months)	SPL Q'TY (pcs)	REFERENCE
1	Vibration	Frequency : 10 ~ 55 ~ 10Hz Amplitude : 1.5mm Frequency : 1oct/min Time : 2hr each of 3axis	6	6	JIS C 5202 6.3
2	Bending Strength	Bending force : 3mm Time : 10sec	6	6	JIS C 5202 6.1.4(3)
3	Termination Strength	Force: 2012,3216,3225 = more then 0.5kg 1005,1608,RC164P= more then 0.3kg	6	6	JIS C 5202 6.1.2(1)
4	Resistance To Soldering Heat	Temp.: 260 ± 5 Time : 10 ± 1sec. solder: H63A(JIS Z 3282) / S63A(KSD 6704) Flux: rosin 25% + methanol 75%	3	6	JIS C 5202 6.10
5	High Temperature Storage	Temp.: 125 ± 2 Time : 1000Hr	6	6	JIS C 5202 7.2
6	Low Temperature Storage	Temp.: -55 ± 2 Time : 1000Hr	6	6	JIS C 5202 7.1
7	Temperature Cycle	Temp.: -55 (30min) → 20 (15min) → 125 (30min) → 20 (15min) Cycle: 5	6	18	JIS C 5202 7.4
8	Load Life	Temp.: 70 ± 3 Load : Rate voltage (on for 90min and off for 30min) Time : 1000Hr	3	18	JIS C 5202 7.10
9	Humidity Load	Temp.: 40 ± 3 Humi.: 90~95%RH Load : Rate voltage (ON for 90min and OFF for 30min) Time : 1000Hr	3	18	JIS C 5202 7.9
10	Short-time Over Load	Load : 2.5 times of the rate voltage Time : 5sec.	3	6	JIS C 5202 5.5
11	Intermittent Over Load	Load : 2.5 times of the rate voltage Time : ON for 1sec and OFF for 25sec Cycle: 10,000 cycle	3	6	JIS C 5202 5.8
12	T. C. R	Temp.: 20 → -55 → 20 → 125 → 20 Time : 30min Computation : $TCR(PPM /) = \frac{R - R_o}{R_o} \times \frac{1}{T - T_o} \times 10^6$ Hear, R =resistance value for -55 or 125 Ro=resistance value for 20 T =-55 or 125 To= 20	6	6	JIS C 5202 5.2
13	Solderability	Temp.: 235 ± 5 Time : 2 ± 0.5sec solder: H63A(JIS Z 3282) / S63A(KSD 6704) Flux: rosin 25% + methanol 75%	6	6	JIS C 5202 6.5
14	V. C. R	Apply Voltage: 1/10times of Rate voltage(V2) → Rate voltage(V1) Computation : $V_c(PPM / V) = \frac{R1 - R2}{R2} \times \frac{1}{V1 - V2} \times 10^6$ Hear, R1=resistance value for V1(Ω) R2=resistance value for V2(Ω)	EVT MVT	6	SEMCO 50-S-SCR001 JIS C 5202 6.5
15	Withstanding Voltage	Apply Voltage : - AC 500V for more then 2012 size - AC 100V for low then 1608 size Time : 1min	EVT MVT	6	SEMCO 50-S-SCR001 JIS C 5202 5.7
16	NOISE		EVT MVT	6	SEMCO 50-S-SCR001 JIS C 5202 5.9
17	Insulation Resistance	Apply Voltage : - AC 500V for more then 2012 size - AC 100V for low then 1608 size Time : 1min Measurement pressure : 1.0 ± 0.2N	EVT MVT	6	SEMCO 50-S-SCR001 JIS C 5202 5.6
18	Body Strength	Compress speed: 100mm/min	EVT MVT	6	SEMCO 50-S-SCR001 JIS C 5202
19	Leaching	Temp.: 260 ± 5 Time : 30 ± 1sec. solder: H63A(JIS Z 3282) / S63A(KSD 6704) Flux: rosin 25% + methanol 75%	EVT MVT	6	SEMCO 50-S-SCR001