

# Chip Resistors

## How to Order

WR	06	X	1000	F	T	L
<b>Type code</b> R : Discrete 1-10MR	<b>Size code</b> 25 : 2512 (6432) 20 : 2010 (5025) 18 : 1218 (3248) 12 : 1206 (3216) 10 : 1210 (3225) 06 : 0603 (1608) 08 : 0805 (2012) 04 : 0402 (1005) 02 : 0201 (0603)	<b>Functional code</b> X : Normal W : 1% for < 10ohm and >1Mohm	<b>Resistance</b> E24 : 2 significant digits followed by No. of zeros and a blank e.g. : 3ohm=3R0_ 10ohm=100_ 220ohm=221_ 56Kohm=563_ ("_" means blank) E96 : 3 significant digits followed by No. of zeros	<b>Tolerance</b> F : +/- 1% J : +/- 5% P : Jumper	<b>Packaging code</b> T : 7" reel taping Q : 10" reel taping G : 13" reel taping R : 0603 2mm pitch taping B : Bulk K : Bulkcase	<b>Termination code</b> _ = SnPb base ("_" means blank) L = Sn base (Lead free) R = Pb 100 ppm (total)
WW	25	M	R002	F	T	L
<b>Type code</b> W : < 1ohm	<b>Size code</b> 25 : 2512 (6432) 20 : 2010 (5025) 18 : 1218 (3248) 12 : 1206 (3216) 10 : 1210 (3225) 08 : 0805 (2012) 06 : 0603 (1608) 04 : 0402 (1005)	<b>Functional code</b> X : Normal M : Sensing type L : Sensing type, wide termination W : Thick film low TCR type P : Power ( 2010 size=0.75 watt, 1206 size 0.5 watt, 0805 size 0.25 watt, 0603 size 0.125 watt )	<b>Resistance</b> "R" followed by 3 significant digits e.g.: 0.1ohm=R100 0.033ohm=R033 0.56ohm=R560	<b>Tolerance</b> F : +/- 1% G : +/- 2% J : +/- 5%	<b>Packaging code</b> T : 7" reel taping Q : 10" reel taping G : 13" reel taping B : Bulk K : BulkcaseK = Ni base	<b>Termination code</b> _ = SnPb base ("_" means blank) L = Sn base (Lead free) G = Au base S = Ag base
WF	04	H	1001	B	T	L
<b>Type code</b> F : Special function	<b>Size code</b> 25 : 2512 (6432) 20 : 2010 (5025) 18 : 1218 (3248) 12 : 1206 (3216) 10 : 1210 (3225) 08 : 0805 (2012) 06 : 0603 (1608) 04 : 0402 (1005)	<b>Functional code</b> G : High ohmic (>10Mohm) H : Thick film, Precision tolerance <1% K : Thick film, TCR50ppm M : Trimmable P : Power (> WR and WW series) S : Surge T : Thin film, TCR50ppm U : Thin film, TCR25ppm V : High voltage W : Filet less X : Special resistance Y : E24/E96 resistance with special termination (non SnPb or Sn base), 1%	<b>Resistance</b> E24 : 2 significant digits followed by No. of zeros and a blank e.g.: 3ohm=3R0_ 10ohm=100_ 220ohm=221_ 56Kohm=563_ ("_" means blank) E96 : 3 significant digits followed by No. of zeros	<b>Tolerance</b> B : +/- 0.1% C : +/- 0.25% D : +/- 0.5% F : +/- 1% G : +/- 2% J : +/- 5% M : 0/- 20% K : 0/-30% P : Jumper	<b>Packaging code</b> T : 7" reel taping Q : 10" reel taping G : 13" reel taping B : Bulk K : BulkcaseK = Ni base	<b>Termination code</b> _ = SnPb base ("_" means blank) L = Sn base (Lead free) G = Au base S = Ag base
WA	04	Y	103_	J	T	L
<b>Type code</b> A : Isolated Resistor Array	<b>Size code</b> 06 : 0603 (1608) 04 : 0402 (1005)	<b>No. of element, term, style</b> X : *4, convex Y : *2, convex W : *8, convex T : *4, concave U : *2, concave P : *3, convex (Attenuator)	<b>Resistance</b> E24 : 2 significant digits followed by No. of zeros and a blank e.g.: 3ohm=3R0_ 10ohm=100_ 220ohm=221_ 56Kohm=563_ ("_" means blank) E96 : 3 significant digits followed by No. of zeros	<b>Tolerance</b> F : +/- 1% J : +/- 5% P : Jumper	<b>Packaging code</b> T : 7" reel taping B : Bulk	<b>Termination code</b> _ = SnPb base ("_" means blank) L = Sn base (Lead free)
WT	04	X	103_	J	T	L
<b>Type code</b> T : Bussed/Network Resistors	<b>Size per elements</b> 04: total package size 1206 (3216)	<b>No. of element, term, style</b> X : *8, convex	<b>Resistance</b> E24 : 2 significant digits followed by No. of zeros e.g.: 3ohm=3R0_ 10ohm=100_ 220ohm=221_ 56Kohm=563_ ("_" means blank)	<b>Tolerance</b> J : +/- 5%	<b>Packaging code</b> T : 7" reel taping B : Bulk	<b>Termination code</b> _ = SnPb base ("_" means blank) L = Sn base (Lead free)

**Remark:** 1. Detail product part number, functional code, tolerance combination,...please refer to specific data sheet.  
 2. Example: ("\_" means blank)

- Chip-R 0805 size, 4.3ohm, 5% Normal type, SnPb termination, 5000pcs taped in reel: WR08X4R3\_JT\_
- Chip-R 0805 size, 4.3ohm, 5% Normal type, Sn Lead free termination, 5000pcs taped in reel: WR08X4R3\_JTL
- Chip-R 0603 size, 100ohm, 5% Normal type, SnPb termination, 5000pcs taped in reel: WR06X101\_JT\_
- Chip-R 0603 size, 100ohm, 1% Normal type, Sn termination, 5000pcs taped in reel: WR06X1000FTL
- Low ohmic Chip-R 2512 size, 0.1ohm, 1% Normal type, SnPb termination, 4000pcs taped in reel: WW25XR100FT\_
- Low ohmic Chip-R 2512 size, 0.1ohm, 1% Normal type, Sn Lead free termination, 4000pcs taped in reel: WW25XR100FTL
- Chip-R array 0603x4, 10Kohm, 5% convex with SnPb termination, 5000pcs taped in reel: WA06X103\_JT\_
- Chip-R 0402 size, 220ohm, Normal type, Gold termination, 5% 10,000pcs taped in reel: WF04Y221\_JTG
- Chip-R 0603 size, 0ohm, Normal type, SnPb termination, 5000pcs taped in reel: WR06X000\_PT\_

# Chip Resistors

## Low Ohmic Chip Resistors (0.02Ω~1Ω)

### Function For Low Ohmic Chip Resistors

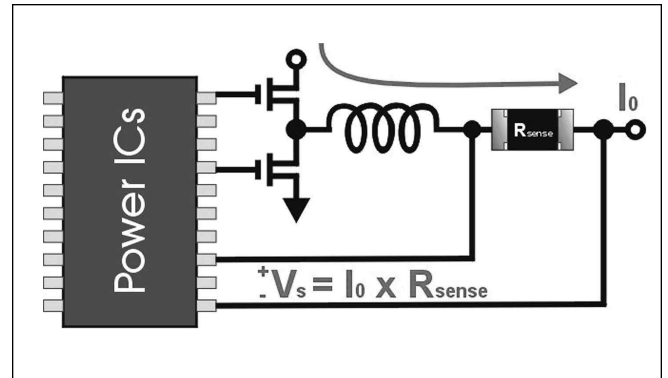
The low ohmic resistors are used to sense output current in power supply, automotive and engine control management system, and other power sensing application. As shows in figure below, the typical function of low ohmic (power) chip resistor is to be a current sensor ( $R_{sense}$ ) to generate the sensing voltage ( $V_s$ ) for the purpose of feedback control when output current ( $I_o$ ) passed on it. The sensing voltage be treated as a signal to trigger the switches (CMOS) ON/OFF duration so that to monitor and/or adjust the output current from inductor.

Simplify to say,  $V_s = I_o \times R_{sense}$ .

On general case, this feedback voltage is setting around 100mV for considering both on power saving and noise robustness. To sense a 5 ampere average output current, the  $R_{sense}$  resistance value therefore be required as  $100mV / 5A = 20m\Omega$ , the power dissipation will be :

$$P = I^2 \times R = 5A^2 \times 20m\Omega = 0.5 \text{ Watt}$$

A low ohmic chip resistor with a power rating of 1.0 watt is recommended on this application in case the power safety margin is taken into account.



### Quick Reference Data

Series No.	WW25X	WW20X	WW18X	WW10X	WW12X	WW08X	WW06X	WW04X	
Size code	2512 (6432)	2010 (5025)	1218 (3248)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)	
Resistance Tolerance	±5%, ±1%			±1%, ±5%	±5%, ±2%, ±1%			±5%, ±1%	
Resistance Range	0.015 ~ 0.976			0.100 ~ 0.976	0.020 ~ 0.976		0.100 ~ 0.976		
TCR (ppm/°C)				Ditto					
0.02 Rn < 0.05	±1500			-	±1500		-	-	
0.05 Rn < 0.10	±1000			-	±1000		-	-	
0.10 Rn < 0.50	±500			±200	±500		± 500	± 600	
0.50 Rn < 1	±300			±200	±300		± 300	± 600	
Max. dissipation at $T_{amb}=70^\circ\text{C}$	1 Watt	0.5 Watt	1 Watt	1/3 Watt	1/4 Watt	1/8 Watt	1/10 Watt	1/16 Watt	
Max. Operation Voltage <sub>E</sub> (DC or RMS)	250V	200V	200V	200V	200V	100V	50V	50V	
Climatic category (IEC 60068)	55/155/56							55/125/56	
Basic Specification	JIS C 5202 / IEC 60115-1								

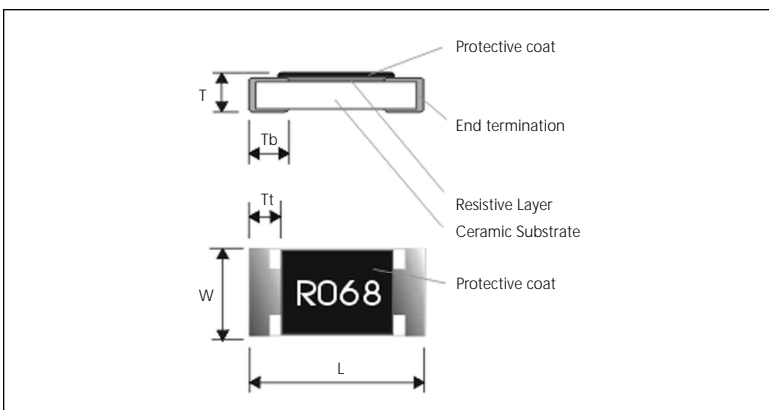
Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Tolerance of  $TCR=\pm 200ppm/^\circ\text{C}$
3. Power derating curve, and detail specification please refer to specific data sheets.
4. Lead Free (Pb free) products are available upon customer's request.

### Physical Dimensions

Unit: mm

Size	2512(6432)	2010(5025)	1218(3248)	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
L	6.40 ± 0.20	5.00 ± 0.20	3.05 ± 0.15	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	3.20 ± 0.20	2.50 ± 0.20	4.60 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.90 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.20	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
Tt	0.65 ± 0.25	0.65 ± 0.25	0.45 ± 0.25	0.50 ± 0.20	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10



# Chip Resistors

## Test and Requirements

### For WR Series, WA Series, and WT Series

(Detail please refer to specific data sheet)

Test	Procedure / Test Method	Requirement	
		Resistor	Jumper
DC resistance	<b>JIS C 5202 5.1 / IEC 60115-1 4.5</b> DC resistance values measured at the test voltages specified below : <10 @0.1V, <100 @0.3V, <1K @1.0V, <10K @3V, <100K @10V, <1M @25V, <10M @30V	Within the specified tolerance	< 50m
Temperature Coefficient of Resistance	<b>JIS C 5202 5.2 / IEC 60115-1 4.8.4.2</b> $\frac{R_2 - R_1}{R_1 (t_2 - t_1)} \times 10^6 \quad (\text{ppm}/^\circ\text{C})$ R1 : Resistance at reference temperature R2 : Resistance at test temperature t1 : room temperature; t2 : LCT or UCT	Within the specified TCR	N/a
Short Time Overload	<b>JIS C 5202 5.5 / IEC 60115-1 4.13</b> Permanent resistance change after a 5sec application of a voltage 2.5xU <sub>R</sub> or max. overload voltage, whichever is less.	R/R max ±(2%+0.10 )	< 50m
Resistance to Solder Heat	<b>JIS C 5202 6.4 / IEC 60115-1 4.18</b> Unmounted chip with a solder bath, 260°C±5°C, 10±1 sec	R/R max. ±(1%+0.05 )	< 50m
Solderability	<b>JIS C 5202 6.5 / IEC 60115-1 4.17</b> Termination SnPb base : Unmounted chips completely immersed for 2±0.5 sec. in a solder bath at 230±5°C Termination Sn base (lead free) : Unmounted chip completely immersed in a lead free solder bath, 245°C±5°C, 3±1 sec	95% coverage min., good tinning and no visible damage	
Leaching Test	<b>JIS C 5202 6.4 / IEC 60115-1 4.18</b> Unmounted chip with a solder bath, 260°C±5°C, 60±1 sec	Ditto	
Temperature Cycling	<b>JIS C 5202 7.4 / IEC 60115-1 4.19</b> 30min at LCT, 30min at UCT, 5 cycles	R/R max. ±(1%+0.05 )	< 50m
Damp heat (Humidity loaded in steady state)	<b>JIS C 5202 7.9</b> 1000+48/-0 hours@40±2°C, 90~95% RH; loaded with Pn or Vmax; 1.5 hours ON, 0.5 hours OFF	10 R<1M : R/R max. ±(3%+0.10 ) R<10 , R 1M : R/R max. ±(5%+0.10 )	< 50m
Load Life (Endurance)	<b>JIS C 5202 7.10 / IEC 60115-1 4.25.1</b> 1000+48/-0 hours@70±2°C; loaded with Pn or Vmax; 1.5 hours ON, 0.5 hours OFF	Ditto	Ditto
Bending	<b>JIS C 5202 6.1.4 / IEC 115-1 4.33</b> Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once or 10sec : >2mm for 2512 and 2010; >3mm for 1206, 0805, 0603, and 0402	No visual damaged, R/R max. ±(1%+0.05 )	< 50m

### For WWxxX Series

(Detail please refer to specific data sheet.)

Test	Procedure / Test Method	Requirement	
		Resistor	Jumper
Temperature Coefficient of Resistance	<b>JIS C 5202 5.2 / IEC 60115-1 4.8.4.2</b> $\frac{R_2 - R_1}{R_1 (t_2 - t_1)} \times 10^6 \quad (\text{ppm}/^\circ\text{C})$ R1 : Resistance at reference temperature R2 : Resistance at test temperature t1 : room temperature; t2 : LCT or UCT	Within the specified TCR	
Short Time Overload	<b>JIS C 5202 5.5 / IEC 60115-1 4.13</b> Permanent resistance change after a 5sec application of a voltage 2.5xU <sub>R</sub> or max. overload voltage, whichever is less.	R/R max. ±(2%+0.005 )	
Resistance to Solder Heat	<b>JIS C 5202 6.4 / IEC 60115-1 4.18</b> Unmounted chip with a solder bath, 260°C±5°C, 10±1 sec	R/R max. ±(1%+0.005 )	
Solderability	<b>JIS C 5202 6.5 / IEC 60115-1 4.17</b> Termination SnPb base : Unmounted chips completely immersed for 2±0.5 sec. in a solder bath at 230±5°C Termination Sn base (lead free) : Unmounted chip completely immersed in a lead free solder bath, 245°C±5°C, 3±1 sec	95% coverage min., good tinning and no visible damage	
Leaching Test	<b>JIS C 5202 6.4 / IEC 60115-1 4.18</b> Unmounted chip with a solder bath, 260°C±5°C, 60±1 sec	Ditto	
Temperature Cycling	<b>JIS C 5202 7.4 / IEC 60115-1 4.19</b> 30min at LCT, 30min at UCT, 5 cycles	R/R max. ±(1%+0.005 )	
Damp heat (Humidity loaded in steady state)	<b>JIS C 5202 7.9</b> 1000+48/-0 hours@40±2°C, 90~95% RH; loaded with Pn or Vmax; 1.5 hours ON, 0.5 hours OFF	R/R max. ±(3%+0.005 )	
Load Life (Endurance)	<b>JIS C 5202 7.10 / IEC 60115-1 4.25.1</b> 1000+48/-0 hours@70±2°C; loaded with Pn or Vmax; 1.5 hours ON, 0.5 hours OFF	Ditto	
Bending	<b>JIS C 5202 6.1.4 / IEC 115-1 4.33</b> Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once for 10sec : >2mm for 2512 and 2010; >3mm for 1206, 0805, 0603	No visual damaged, R/R max. ±(1%+0.005 )	

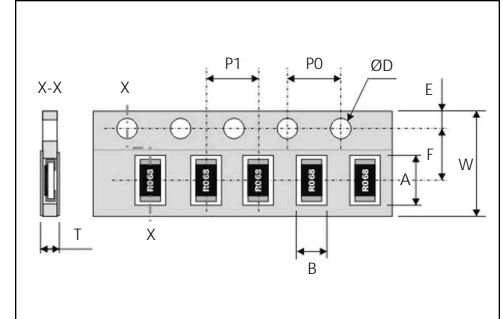
# Chip Resistors

## Packing on Tape and Reel

### Paper Tape Specifications for WR, WF, WW Series and WA, WT Series

Unit: mm

Component Size / Series	W	F	E	P0	ØD
1206, 0805, 0603, 0402, WA06X, WA06T, WA04X, WA04Y, WA04P, WT04X	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	Ø1.50 <sup>+0.1</sup> <sub>-0.0</sub>
WA06W	12.0±0.10	5.50±0.05			
WR02W	8.00±0.20	3.50±0.05			

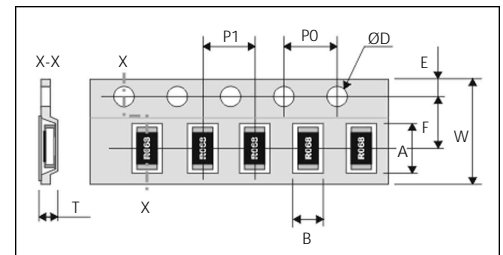


Component Size / Series	A	B	P1	T
1206 (3216), WA06X, WA06T	3.60±0.20	2.00±0.20	4.00±0.10	Max. 1.0
0805 (2012)	2.40±0.20	1.65±0.20		
0603 (1608)	1.90±0.20	1.10±0.20		
0402 (1005)	1.20±0.10	0.70±0.10	2.00±0.10	0.40±0.05
WA04X	2.20±0.20	1.20±0.20	2.00±0.05	Max. 0.6
WA04Y, WA04P	1.15±0.10	1.15±0.10	2.00±0.05	0.45±0.05
WT04X	3.45+0.20/-0	1.85+0.20/-0	4.00±0.10	0.85±0.05
WA06W	1.80+0.2/-0	4.20+0.2/-0	4.00±0.10	0.65±0.05
WR02X	0.70±0.05	0.40±0.05	2.00±0.05	0.30±0.05

### Plastic Tape Specifications for WR, WF, WW Series of Chip-R

Unit: mm

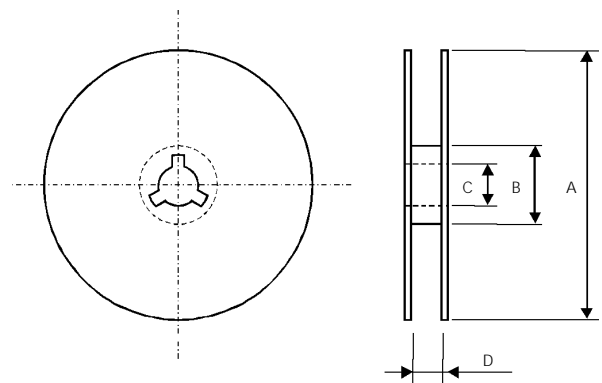
Component Size	2512 (6432)	2010 (5025)	1218 (3248)
A	6.90±0.20	5.50±0.20	3.55±0.30
B	3.60±0.20	2.80±0.20	4.90±0.20
W	12.00±0.30		
F	5.50±0.1		
E	1.75±0.10		
P1	4.00±0.10		
P0	4.00±0.10		
ØD	Ø1.50 <sup>+0.1</sup> <sub>-0.0</sub>		
T	Max. 1.2		



### Reel Dimensions

Unit: mm

Reel / Tape	A	B	C	D
7" reel for 8mm tape	Ø178.0±2.0	Ø60.0±1.0	13.0±0.2	9.0 ± 0.50
7" reel for 12mm tape				12.4 ± 1.00
10" reel for 8mm tape	Ø254.0±2.0	Ø100.0±1.0	13.0±0.2	9.0 ± 0.50
10" reel for 12mm tape				14.0 ± 0.20
13" reel for 8mm tape	Ø330.0±2.0	Ø100.0±1.0	13.0±0.2	9.0 ± 0.50



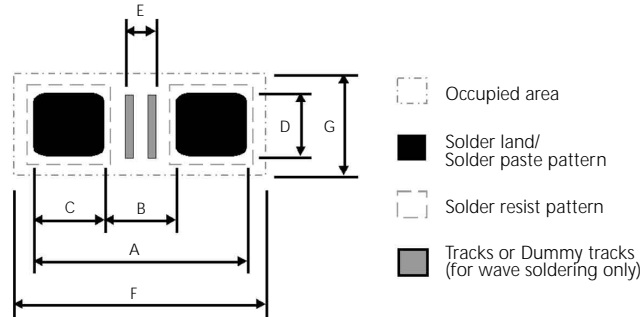
### Typical Taping Quantity

Component Size / Series	Q'ty per reel	Reel diameter
1210, 1206, 0805, 0603, WA06X, WA06T, WT04X	5,000 pcs	7" reel
0201, 0402, WA04X, WA04Y, WA04P	10,000 pcs	7" reel
WA06W	5,000 pcs	7" reel
2512, 2010	4,000 pcs	7" reel
1218	3,000 pcs	10" reel
1206, 0805, 0603	10,000 pcs	10" reel
0402, WA04X, WA04Y	20,000 pcs	10" reel
0402	70,000 pcs	13" reel
WA04X, WA04Y	40,000 pcs	13" reel
1206, 0805, 0603	20,000 pcs	13" reel

# Chip Resistors

## Footprint Design

### Footprint Design for WRxx Series, WFxx Series, WWxx Series :



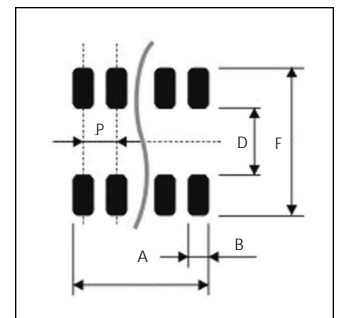
Unit: mm

Size	Reflow Soldering							Processing remarks	Placement Accuracy
	A	B	C	D	E	F	G		
0201	0.75	0.30	0.30	0.30	0.20	1.10	0.50	IR or hot plate soldering	± 0.05
0402	1.50	0.50	0.50	0.60	0.10	1.90	1.00		± 0.15
0603	2.10	0.90	0.60	0.90	0.50	2.35	1.45		± 0.25
0805	2.60	1.20	0.70	1.30	0.75	2.85	1.90		± 0.25
1206	3.80	2.00	0.90	1.60	1.60	4.05	2.25		± 0.25
1218	3.80	2.00	0.90	4.80	1.40	4.20	5.50		± 0.25
2010	5.60	3.80	0.90	2.80	3.40	5.85	3.15		± 0.25
2512	7.00	3.80	1.60	3.50	3.40	7.25	3.85		± 0.25
Size	Wave Soldering							Proposed number & Dimensions of dummy tracks	Placement Accuracy
A	B	C	D	E	F	G			
0603	2.70	0.90	0.90	0.80	0.15	3.40	1.90	1x (0.15x0.80)	± 0.25
0805	3.40	1.30	1.05	1.30	0.20	4.30	2.70	1x (0.20x1.30)	± 0.25
1206	4.80	2.30	1.25	1.70	1.25	5.90	3.20	3x (0.25x1.70)	± 0.25
1218	4.80	2.30	1.25	4.80	1.30	5.90	5.60	3x (0.25x4.80)	± 0.25
2010	6.30	3.50	1.40	2.50	3.00	7.00	3.60	3x (0.75x2.50)	± 0.25
2512	8.50	4.50	2.00	3.20	3.00	9.00	4.30	3x (1.00x3.20)	± 0.25

### Footprint Design for Array Resistor/Attenuator :

Unit: mm

Symbol	0603*4 array	0402*4 array	WA04Y, WA04P	WA06W
A	2.85 +0.10/-0.05	1.80 +0.15/-0.05	1.20 ± 0.05	3.85 +0.20/-0.05
B	0.45 ± 0.05	0.30 ± 0.05	0.40 +0/-0.05	0.28 +0/-0.05
D	0.80 ± 0.10	0.50 ± 0.1	0.50 ± 0.05	1.00 +0.10/-0.20
P	0.80	0.50	0.65	0.50
F	3.10 ± 0.30	2.00 +0.40/-0.20	1.50 +0.20/-0.10	3.20 ± 0.40



### Footprint Design for 10P8R Network Resistor :

Unit: mm

Symbol	WT04X
W1	0.35 ± 0.05
W2	0.50 ± 0.05
H2	0.80 ± 0.10
P1	0.70 ± 0.05
P2	0.65 ± 0.05
A	3.20 ± 0.10
F	2.80 +0.40/-0.20

