

# WW12X, WW08X, WW06X, WW04X

±1%, ±5%

Thick Film Low Ohm Chip Resistors RoHS Exemption free and Lead free Size 1206, 0805, 0603, 0402

\*Contents in this sheet are subject to change without prior notice.



## FEATURE

- 1. High power rating and compact size
- 2. High reliability and stability
- 3. Reduced size of final equipment
- 4. RoHS exemption free and Lead free products

## APPLICATION

- Power supply
- PDA
- Digital meter
- Computer
- Automotives
- Battery charger
- DC-DC power converter

## DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive paste that is applied to the top surface of the substrate. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to nominated value within tolerance which controlled by laser trimming of this resistive layer.

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For ease of soldering the outer layer of these end terminations is Tin (lead free) alloy.

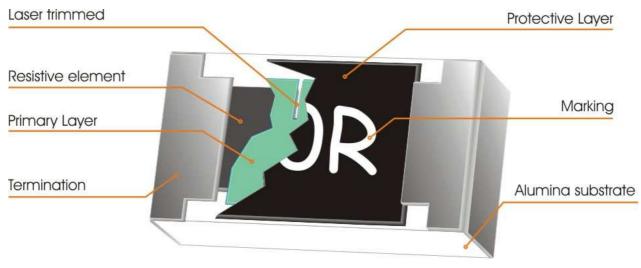


Fig 1. Construction of Chip-R

# QUICK REFERENCE DATA

	Item		General S	pecification		
Series No.		WW12X	WW08X	WW06X	WW04X	
Size code		1206 ( 3216 )	0805 ( 2012 )	0603 (1608) 0402(1005)		
Resistance Toler	ance		±5%	o, ±1%		
Resistance Rang	e	0.010Ω ~ 0.976Ω	0.020Ω ~ 0.976Ω	0.10Ω ~ 0.976Ω		
TCR (ppm/°C)	$0.01\Omega \le Rn < 0.05\Omega$	$\leq$ 2100 ppm/°C	≤ 1500 ppm/°C	N/a N/a		
	$0.05\Omega \le Rn < 0.10\Omega$	$\leq$ 1000 ppm/°C	≤ 1000 ppm/°C			
	$0.10\Omega \le Rn < 0.50\Omega$	$\leq$ 500 ppm/°C	$\leq$ 500 ppm/°C	≤ 500 ppm/°C	≤ 600 ppm/°C	
	$0.50\Omega \le Rn < 1\Omega$	≤ 400 ppm/°C	≤ 300 ppm/°C	≤ 300 ppm/°C	≤ 600 ppm/°C	
Max. dissipation	at T <sub>amb</sub> =70°C	1/4 W	1/8 W	1/10 W 1/16 W		
Max. Operation Voltage (DC or RMS)		200V	100V	50V		
Max. Overload vo	Max. Overload voltage (DC or RMS)		200V	100V		
Climatic category	r (IEC 60068)		55/1	55/56		

Note :

**MECHANICAL DATA** 

- 1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
- 2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

 $RCWV = \sqrt{RatedPower \times ResistanceValue}$  or Max. RCWV listed above, whichever is lower.

# Protective coot T Tb Tb Tb Resistive layer Ceramic Substrate W RO68 Protective coot

Symbol	WW12X	WW08X	WW06X	WW04X
L	$3.10\pm0.10$	$2.00\pm0.10$	$1.60\pm0.10$	$1.00\pm0.05$
W	$1.60\pm0.10$	$1.25\pm0.10$	$0.80\pm0.10$	$0.50\pm0.05$
Т	$0.60\pm0.15$	$0.50\pm0.15$	$0.45\pm0.15$	$0.35\pm0.05$
Tt	$0.50\pm0.20$	$0.40\pm0.20$	$0.30\pm0.10$	$0.20\pm0.10$
Tb	$0.45\pm0.20$	$0.40\pm0.20$	$0.30\pm0.20$	$0.25\pm0.10$

#### MARKING

#### • 4-digits marking for 1206, 0805 size

Each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value.

#### • 3-digits marking for 0603 size

Each resistor is marked with a three -digit code on the protective coating to designate the nominal resistance value.

- WW04X series has no marking on the product overcoat for both 5% & 1%.
- Marking code list.
- 1. Material No. :WW series
- 2. Type & Digital code

3

1003060											
Туре	R		4 +E96 series	)	Тур	2	Res. < 1R (E24 +E96 series			is)	
1210		-	al code		201		4 digital code				
1206	Ű.		al code		121		4 digital code				
0805	8		al code		060	2 - 2 - 2 - 2 - 2	3 digital code				
2512			al code		040	02	No marking				
	:<1R runnin rule for E24 s		St. 141, 153								
1210/1206 "R" follo	/0805/2512/20 wed by 3 signi .002R=R002	10/1218 typ ficant digits	oe (1% & 5%		for runni 0.200R=		of E24 &	t E96 serie	s.		
0603 type	(1% & 5%) :	3 digits for	running value	of E24 &E	96 series	5.					
Item			Rule			Series	Res	. limit	Example	Remar	
1.	R" followed by	2 significan		4th digit is "	'0"	E24	100mR-		220mR: R22	Table6.1	
	he 1st two dig ble, the 3rd coo	git codes ar	e referring to	the CODE	on the	E96	100mR~	976mR	178mR: 25Z 221mR: 34Z	Table6.2	
1 1 2 3 1	he 31d code is 1 s. "M" equals '1			ue : "M"		2	1mR ~9	9mR	75mR: 75M 2mR: 02M	Table6.3	
(4) Or	thers are no ma	arking printe	ed.								
E24 series	standard Res 1	ist:									
Item	R_value	Item	R_value	Item	R_Va	lue	Item	R_value	Item	R_valu	
1	100	6	160	11	270	0	16	430	21	680	
2	110	7	180	12	30	0	17	470	22	750	
	110	100 M 11		140							
3	120	8	200	12	330		18	510	23	820	
	1.5	- 2020 - I	1	13	A	0		510		820	
3 4 5	120	8 9 10	200 220 240		330	0	18		23	1000 2001	
3 4 5 (1) 0603 : r (2) Others:	120 130 150 standard Res. 8 efer to the CO refer to the R	8 9 k CODE tab DE and R va value only.	200 220 240 sle: alue.	13 14 15	33) 36) 39)	0	18 19 20	510 560 620	23 24	820 910	
3 4 5 (1) 0603 : r (2) Others: CODE	120 130 150 standard Res. & efer to the CO refer to the R R_value	8 9 10 & CODE tab DE and R va value only. CODE	200 220 240 ole: slue. <b>R_value</b>	13 14 15 CODE	331 361 391 R_Va	0 0 0	18 19 20 CODE	510 560 620 R_value	23 24 - CODE	820 910 - R_valu	
3 4 5 (1) 0603 : r (2) Others: <u>CODE</u> 01	120           130           150           standard Res. &           efer to the CO           refer to the R           R_value           100	8 9 10 & CODE tab DE and R va value only. CODE 21	200 220 240 ole: alue. <b>R_value</b> 162	13 14 15 <u>CODE</u> 41	33( 36( 39) R_Va 26	0 0 0 due	18 19 20 CODE 61	510 560 620 <u>R_value</u> 422	23 24 -	820 910 - R_valu 681	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02	120           130           150           standard Res. &           efer to the CO           refer to the R           R_value           100           102	8 9 10 & CODE tab DE and R va value only. CODE 21 22	200 220 240 ole: alue. <b>R_value</b> 162 165	13 14 15 <u>CODE</u> 41 42	33( 36( 39) R_Va 26 26	0 0 0 1 1 7	18 19 20 CODE 61 62	510 560 620 <u>R_value</u> 422 432	23 24 - - - - - - - - - - - - - - - - - -	820 910 - R_valu 681 698	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03	120           130           150           standard Res. J           efer to the CO           refer to the CO           refer to the R           00           100           102           105	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23	200 220 240 ole: alue.	13 14 15 <u>CODE</u> 41 42 43	330 360 390 <u>R_Va</u> 26 26 27	0 0 0 1 1 7 4	18 19 20 CODE 61 62 63	510 560 620 <u>R_value</u> 422 432 442	23 24 - - - - - - - - - - - - - - - - - -	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04	120           130           150           standard Res. &           efer to the CO           refer to the CO           refer to the R           100           102           105           107	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23 23 24	200 220 240 ole: alue. <b>R_value</b> 162 165 169 174	13 14 15 <u>CODE</u> 41 42 43 44	33()           36()           39()           R_Va           26           26           27           28	0 0 0 1 7 4 0	18 19 20 CODE 61 62 63 64	510 560 620 <u>R_value</u> 422 432 442 453	23 24 - - - - - - - - - - - - - - - - - -	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05	120           130           150           standard Res. &           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23 24 25	200 220 240 ole: alue.	13 14 15 <u>CODE</u> 41 42 43 44 45	330 360 390 26 26 27 28 28 28	0 0 1 7 4 0 7	18 19 20 61 62 63 64 65	510 560 620 <u>R_value</u> 422 432 442 453 464	23 24 - - - - - - - - - - - - - - - - - -	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06	120           130           150           standard Res. &           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23 24 25 26	200 220 240 ole: alue.	13 14 15 <u>CODE</u> 41 42 43 44 45 46	330 36 39 26 26 26 26 26 27 28 28 28 29	0 0 0 1 7 4 0 7 4	18 19 20 61 62 63 64 65 66	510 560 620 <u>R_value</u> 422 432 442 453 464 475	23 24 - - 81 82 83 84 85 86	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07	120           130           150           standard Res. J           efer to the CO           refer to the R           100           102           105           107           110           113           115	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23 24 25 26 27	200 220 240 ole: alue.	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47	330 36 39 26 26 26 26 26 27 28 28 28 28 29 30	0 0 0 1 7 4 0 7 4 1 2	18 19 20 61 62 63 64 65 66 66 67	510 560 620 <u>R_value</u> 422 432 442 453 464 475 487	23 24 - - 81 82 83 84 85 86 87	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08	120           130           150           standard Res. &           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113           115           118	8 9 10 & CODE tab DE and R va value only. 21 22 23 24 25 26 27 28	200 220 240 ole: alue.	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48	330           360           390           R_Va           26           26           26           26           26           270           280           290           300           300	0 0 0 1 7 4 0 7 4 1 9	18 19 20 61 62 63 64 65 66 67 68	510 560 620 <u>R_value</u> 422 432 442 453 464 475 487 499	23 24 - - - - - - - - - - - - - - - - - -	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08 09	120           130           150           standard Res. J           efer to the CO           refer to the R           100           102           105           107           110           113           115           118           121	8 9 10 & CODE tab DE and R va value only. CODE 21 22 23 24 25 26 27 28 29	200 220 240 ole: alue.	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48 49	330           360           390           R_Va           26           26           26           26           26           26           26           26           26           26           26           26           26           26           26           270           280           290           300           300           301	0 0 0 1 7 4 0 7 4 1 9 6	18 19 20 61 62 63 64 65 66 67 68 69	510 560 620 <u>R_value</u> 422 432 442 453 464 475 487 499 511	23 24 - - 81 82 83 84 85 86 87 88 89	820 910 - - - - - - - - - - - - - - - - - - -	
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3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15	120           130           150           standard Res. 8           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113           115           118           121           124           127           130           133           137           140	8 9 10 & CODE tab DE and R va value only. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35	200 220 240 ble: alue. <b>R_value</b> 162 165 169 174 178 182 187 191 196 200 205 210 215 221 226	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	333           364           399           R_Va           26           26           26           26           26           26           26           26           270           280           290           300           310           320           331           344           35'           36:	0 0 0 1 7 4 0 7 4 1 9 6 4 2 0 8 7 5	18 19 20 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75	510 560 620 <b>R_value</b> 422 432 442 453 464 475 487 499 511 523 536 549 562 576 590	23 24 - - 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16	120           130           150           standard Res. 8           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113           115           118           121           124           127           130           133           137           140           143	8 9 10 & CODE tab DE and R va value only. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	200 220 240 ble: alue. <b>R_value</b> 162 165 169 174 178 182 187 191 196 200 205 210 215 221 226 232	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56	333           366           399           R_Va           26           26           26           26           26           26           26           26           270           280           290           300           310           320           331           344           35'           360           37'	0 0 0 1 7 4 0 7 4 1 9 6 4 2 0 8 7 5 4 4 1 9 6 4 2 0 8 7 5 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1	18 19 20 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76	510 560 620 <b>R_value</b> 422 432 442 453 464 475 487 499 511 523 536 549 562 576 590 604	23 24 - - 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 E96 series s (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17	120           130           150           standard Res. 8           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113           115           118           121           124           127           130           133           137           140           143           147	8 9 10 & CODE tab DE and R va value only. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	200           220           240           ole:           alue.           R_value           162           165           169           174           178           182           187           191           196           200           205           210           215           221           226           232           237	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48 49 50 51 52 53 51 52 53 54 55 56 57	333           364           399           R_Va           26           26           26           26           26           26           26           26           270           280           290           300           310           320           331           344           35'           360           37'           38:	0 0 0 1 7 4 0 7 4 1 9 6 4 2 0 8 7 5 4 3 1 1 1 1 1 1 1 1 1 1 1 1 1	18 19 20 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77	510 560 620 <b>R_value</b> 422 432 442 453 464 475 487 499 511 523 536 549 562 576 590 604 619	23 24 - - 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 -	820 910 - - - - - - - - - - - - - - - - - - -	
3 4 5 (1) 0603 : r (2) Others: CODE 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16	120           130           150           standard Res. 8           efer to the CO           refer to the CO           refer to the R           100           102           105           107           110           113           115           118           121           124           127           130           133           137           140           143	8 9 10 & CODE tab DE and R va value only. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	200 220 240 ble: alue. <b>R_value</b> 162 165 169 174 178 182 187 191 196 200 205 210 215 221 226 232	13 14 15 <b>CODE</b> 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56	333           364           399           R_Va           26           26           26           26           26           26           26           26           270           280           290           300           310           320           331           344           35'           360           37'	0 0 0 1 7 4 0 7 4 1 9 6 4 2 0 8 7 5 4 3 2	18 19 20 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76	510 560 620 <b>R_value</b> 422 432 442 453 464 475 487 499 511 523 536 549 562 576 590 604	23 24 - - 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96	820 910 - - - - - - - - - - - - - - - - - - -	

## FUNCTIONAL DESCRIPTION

#### Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of  $\pm 5\%$  &  $\pm 1\%$ . The values of the E24/E96 series are in accordance with "IEC publication 60063".

#### **Derating curve**

The power that the resistor can dissipate depends on the operating temperature; see Fig.2

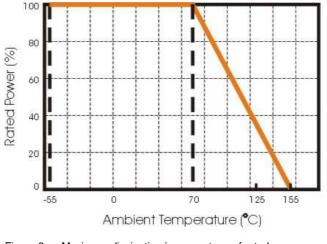


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

## MOUNTING

Due to their rectangular shapes and small tolerances, Surface Mountable Resistors are suitable for handling by automatic placement systems.

Chip placement can be on ceramic substrates and printed-circuit boards (PCBs).

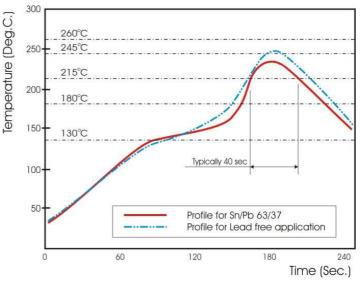
Electrical connection to the circuit is by individual soldering condition.

The end terminations guarantee a reliable contact.

## **SOLDERING CONDITION**

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 235°C during 2 seconds. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.





# **CATALOGUE NUMBERS**

The resistors have a catalogue number starting with .

WW12	х	R020	F	т	L
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code
WW12 : 1206 WW08 : 0805 WW06 : 0603 WW04 : 0402	X : Normal	E96 +E24: R is first digit followed by 3 significant digits. $0.020\Omega = R020$ $0.510\Omega = R510$	J : ±5% G : ±2% F : ±1%	T : 7" Reel taping Q : 10" Reel taping G : 13" Reel taping	L = Sn base (lead free)
		$0.025\Omega = R025$ $0.400\Omega = no marking$			

Tape packaging WW12,WW08, WW06 : 8mm width paper taping 5,000pcs per 7" reel; 10,000pcs per 10" reel; 20,000pcs per 13" reel.

WW04: 8mm width paper taping 10,000pcs per 7" reel; 20,000pcs per 10" reel; 70,000pcs per 13" reel.

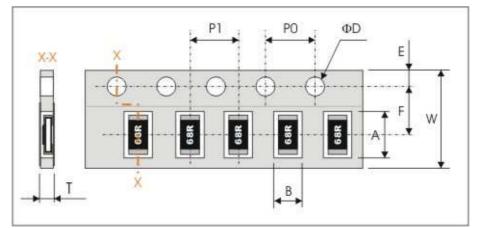
# TEST AND REQUIREMENTS(JIS C 5201-1 : 1998)

TEST	PROCEDURE	REQUIREMENT
Temperature Coefficient of Resistance(T.C.R) <b>Clause 4.8</b>	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}  t_1 : 20^{\circ} \text{C} + 5^{\circ} \text{C} - 1^{\circ} \text{C}$	Refer to "QUICK REFERENCE DATA"
	R <sub>1</sub> : Resistance at reference temperature R <sub>2</sub> : Resistance at test temperature	
Short time overload (S.T.O.L) Clause 4.13	Permanent resistance change after a 5second application of a voltage 2.5 times RCWV or the maximum overload voltage specified in the above list, whichever is less.	ΔR/R max. ±(2%+0.005Ω) WW04X max ±(2%+0.010Ω)
Resistance to soldering heat(R.S.H) <b>Clause 4.18</b>	Un-mounted chips completely immersed for 10±1 second in a SAC solder bath at $260^{\circ}C \pm 5 \circ C$	no visible damage $\Delta$ R/R max. ±(1%+0.005 $\Omega$ ) WW04X max ±(1%+0.010 $\Omega$ )
Solderability Clause 4.17	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235 $^\circ\!C$ ±5 $^\circ\!C$	good tinning (>95% covered) no visible damage
Temperature cycling Clause 4.19	30 minutes at -55°C±3°C, 2~3 minutes at 20℃+5℃-1℃, 30 minutes at +155°C±3°C, 2~3 minutes at 20℃+5℃-1℃, total 5 continuous cycles	no visible damage $\Delta$ R/R max. ±(1%+0.005 $\Omega$ ) WW04X max ±(1%+0.010 $\Omega$ )
Load life (endurance) Clause 4.25	1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller $70\pm2^{\circ}$ C, 1.5 hours on and 0.5 hours off	$\Delta$ R/R max. ±(3%+0.005 $\Omega$ ) WW04X max ±(5%+0.010 $\Omega$ )
Load life in Humidity <b>Clause 4.24</b>	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C $\pm$ 2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off	ΔR/R max. ±(3%+0.005Ω) WW04X max ±(5%+0.010Ω)
Bending strength <b>Clause 4.33</b>	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 2 mm, once for 10 seconds	ΔR/R max. ±(1%+0.005Ω) WW04X max ±(1%+0.010Ω)
Adhesion Clause 4.32	Pressurizing force: 5N, Test time: 10±1sec.	No remarkable damage or removal of the terminations
Insulation Resistance Clause 4.6	Apply the maximum overload voltage (DC) for 1 minute	R≥10GΩ
Dielectric Withstand Voltage Clause 4.7	Apply the maximum overload voltage (AC) for 1 minute	No breakdown or flashover

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# PACKAGING

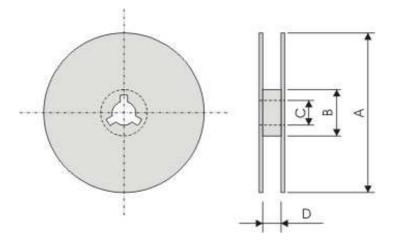
Paper Tape specifications (unit :mm)



Series No.	А	В	W	F	E
WW12X	3.60±0.20	2.00±0.20			
WW08X	2.40±0.20	1.65±0.20	8.00±0.30	0.50.0.00	1.75±0.10
WW06X	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WW04X	1.20±0.10	0.70±0.10			

Series No.	P1	P0	ΦD	Т
WW12X / WW08X	4.00±0.10	4.00±0.10		Max. 1.0
WW06X	4.00±0.10	4.00±0.10	$\Phi$ 1.50 $^{+0.1}_{-0.0}$	0.65±0.05
WW04X	2.00±0.10	4.00±0.10		0.40±0.05

#### **Reel dimensions**



Symbol	А	В	С	D
7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5
10" reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5
13: reel	Ф330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5