APPROVAL SHEET

WR10, WR12, WR08, WR06, WR04

±1%, ±5%, Jumper

Thick Film General Purpose Chip Resistors

Size 1210, 1206, 0805, 0603, 0402

RoHS 2 Compliant with exemption 7C-I

Halogen free

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

FEATURES

1. High reliability and stability
2. Reduced size of final equipment
3. Lower assembly costs
4. Higher component and equipment reliability
5. RoHS 2 compliant with exemption 7C-I and Halogen free products
6. Flammability against UL94-V0

APPLICATIONS

- Consumer electrical equipment
- EDP, Computer application
- Telecom application

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 within tolerance by laser cutting 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 a Tin (lead free) alloy.

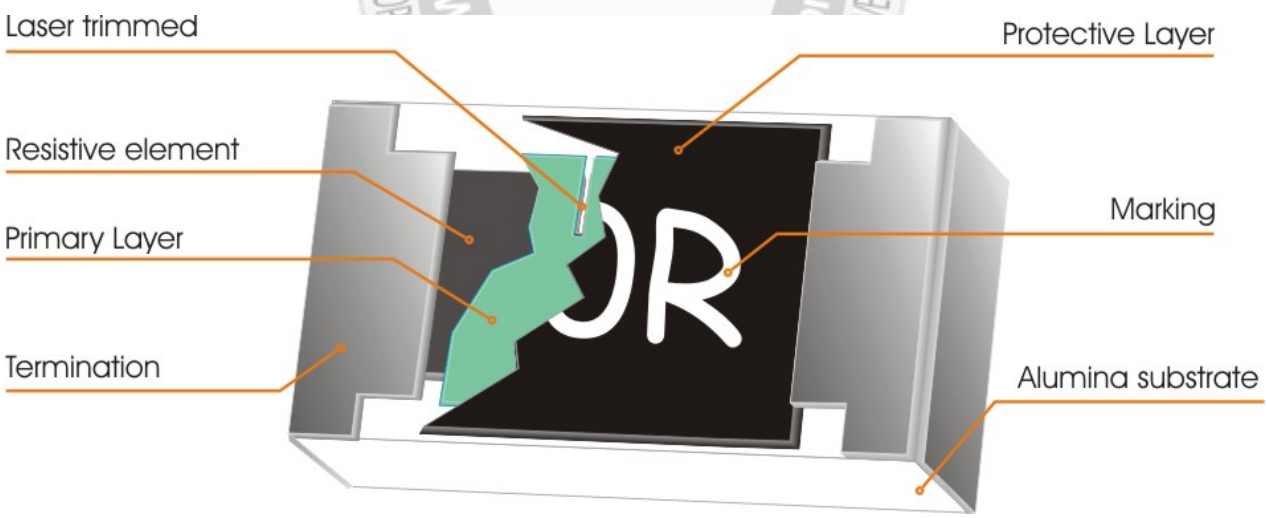


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification				
Series No.	WR10	WR12	WR08	WR06	WR04
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	1Ω~10MΩ (±5% tolerance), 1Ω~10MΩ (±1% tolerance),				
Resistance Tolerance	±1%, E96/E24 ±5%, E24				
TCR (ppm/°C) 10MΩ ≥R＞10Ω R≤10Ω	≤ ± 100 -200~+400				
Max. dissipation @ T_{amb}=70°C	1/2 W	1/4 W	1/8 W	1/10 W	1/16 W
Max. Operation Voltage	200V	200V	150V	75V	50V
Max. Overload Voltage	400V	400V	300V	150V	100V
Operation temperature	-55 ~ +155°C				

Note :

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

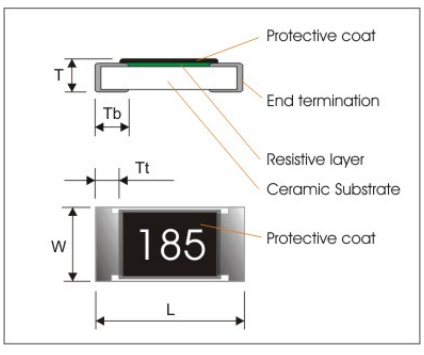
$$RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$$ or Max. RCWV listed above, whichever is lower.

For Jumper (0Ω) :

Item		General Specification				
Series No.		WR10	WR12	WR08	WR06	WR04
Size code		1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range		≤50mΩ for P tolerance ≤30mΩ for F tolerance				
TCR (ppm/°C)		TCR is not applicable for Jumper product				
Max. dissipation @ T_{amb}=70°C		1/2 W	1/4 W	1/8 W	1/10 W	1/16 W
P tolerance	Rated Current	3A	2A	1.6A	1A	1A
	Peak Current	7.5A	5A	3.2A	3A	2A
F tolerance	Rated Current	4A	2.9A	2A	1.8A	1A
	Peak Current	10A	5.8A	4A	3.6A	2A
Operation temperature		-55 ~ +155°C				

DIMENSIONS (unit : mm)

	WR10	WR12	WR08	WR06	WR04
L	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.50 ± 0.20	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
Tt	0.50 ± 0.20	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10



CATALOGUE NUMBERS

The resistors have a catalogue number starting with

WR12	X	472_	J	T	L
Size code	**Type code**	**Resistance code**	**Tolerance code**	**Packaging code**	**Termination code**
WR10 : 1210 **WR12** : 1206 **WR08** : 0805 **WR06** : 0603 **WR04 :** 0402	**X :** Jumper ±5%. 1Ω ~ 10MΩ ±1% 10Ω ~ 1MΩ **W** : ±1% 1Ω<R<10Ω ±1% 1MΩ<R<10MΩ	±5%,E24: 2 significant digits followed by no. of zeros and a blank 4.7Ω=**4R7_** 10Ω=**100_** 220Ω=**221_** Remark: "_" means a blank ±1%,E24+E96: 3 significant digits followed by no. of zeros 102Ω=**1020** 37.4KΩ=**3742** 82Ω=**82R0** **For Jumper (0Ω)** P tol. ≤ 50mΩ=**000_** F tol. ≤ 30mΩ=**0000** Remark: "_" means a blank	**F** : ±1% **J** : ±5% **For Jumper (0Ω)** **P** : ≤ 50mΩ **F** : ≤ 30mΩ	**T** :7" Reeled taping **Q** :10" Reeled taping **G** :13" Reeled taping **H** :13" reel 50Kpcs only for 0402 **B** :Bulk **D** :7" reel 20Kpcs only for 0402 **A** :7" reel 15Kpcs only for 0402	**L:**Sn base (lead-free)

Remark:

1210, 1206, 0805, 0603:

1. 8mm width paper taping 5000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

0402:

1. 8mm width paper taping 10,000pcs per 7" reel, 70kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

MARKING

Size \ Nr. Of digit of code\tolerance	±5% & Jumper (0Ω)	±1%
1210 (3225)	3 digits marking	4 digits marking
1206 (3216)	3 digits marking	4 digits marking
0805 (2012)	3 digits marking	4 digits marking
0603 (1608)	3 digits marking	3 digits marking
0402 (1005)	NO MARKING	

3 digits marking【±5% : 1210,1206, 0805, 0603 & Jumper (0Ω) 】

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

3 digits marking（±1% : 0603）

Nominal resistance	Description
1.E24 series	2 significant digits followed by No. of zeros .As *0603 WR06X* ±5% Example

RESISTANCE	4.7Ω	47Ω	470Ω	4K70	47K0	470K	4M70
3 digits marking	4R7	470	471	472	473	474	475

2.E96 series

The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value.
Repeat values between E24 and E96 series, whose marking are based on the E96 CODE table.

Code	Z	Y	X	A	B	C	D	E	F	G
Multiplier	10^{-3}	10^{-2}	10^{-1}	10^{0}	10^{1}	10^{2}	10^{3}	10^{4}	10^{5}	10^{6}

Example

RESISTANCE	1.78Ω	17.8Ω	178Ω	1K78	17K8	178K	1M78
3 digits marking	25Y	25X	25A	25B	25C	25D	25E

3. Remark: There is no marking for the items not under E24 and E96 series.

E96 CODE table:

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**

4 digits marking（±1% : 1210,1206,0805）

Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For values below 97Ω6 the R is used as a digit. For values of 100Ω or greater, the first 3 digits are significant, and the fourth digit indicates the number of multiple to follow.

Example

RESISTANCE	Jumper (0Ω)	4.7Ω	10Ω	12Ω	100Ω	6800Ω	47000Ω	470000Ω
3 digits marking (1210, 1206, 0805, 0603 ±5% & Jumper)	000	4R7	100	120	101	682	473	474
4 digits marking	-	4R70	10R0	12R0	1000	6801	4702	4703

FUNCTIONAL DESCRIPTION

Product characterization

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

Derating

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

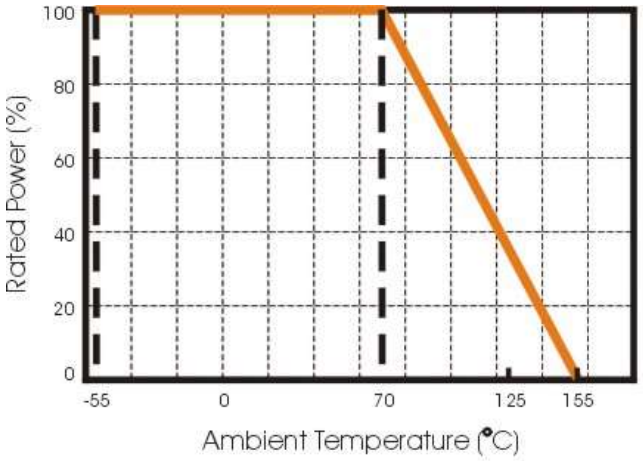


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
2. To store products with following condition:

   Temperature :5 to 40°C

   Humidity :20 to 70% relative humidity
3. Caution:

   a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.

   It may cause oxdization of electrode, which easily be resulted in poor soldering.

   b. To store products on the shelf and avoid exposure to moisture.

c. Don't expose products to excessive shock, vibration, direct sunlight and so on

SOLDERING CONDITION follows J-STD-020D

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.

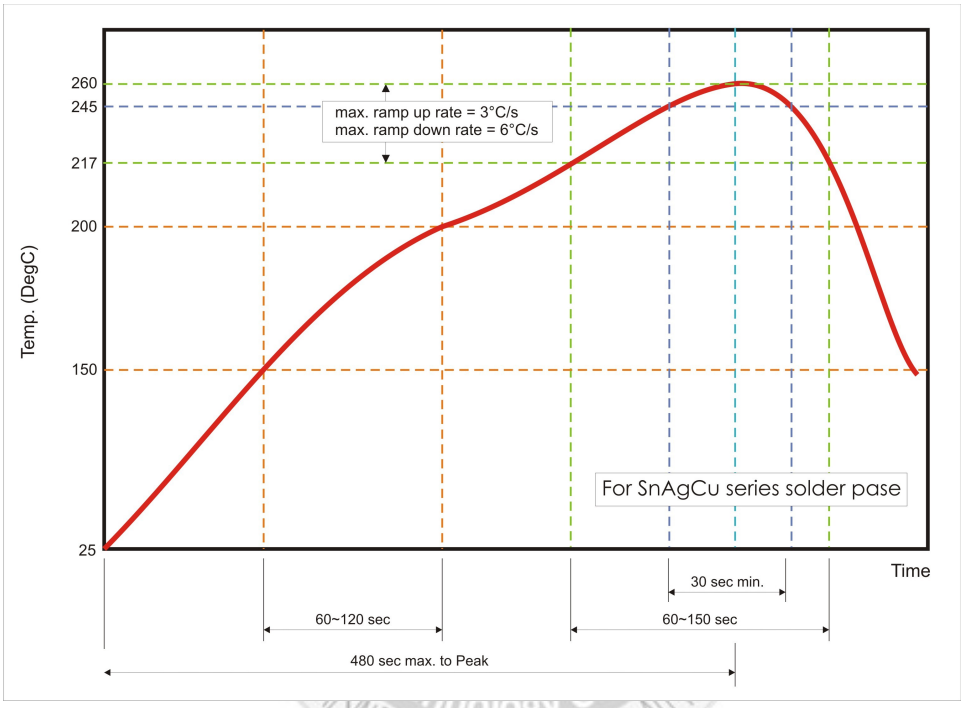


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

TESTS AND REQUIREMENTS

Essentially all tests are carried out according to the schedule of IEC publication 115-8, category **LCT**/**UCT**/56(rated temperature range : **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; damp heat, long term, 56 days). The testing also meets the requirements specified by EIA, EIAJ and JIS.

The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to IEC 60068-1, subclause 5.3. Unless otherwise specified, the following value supplied :

Temperature: 15°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

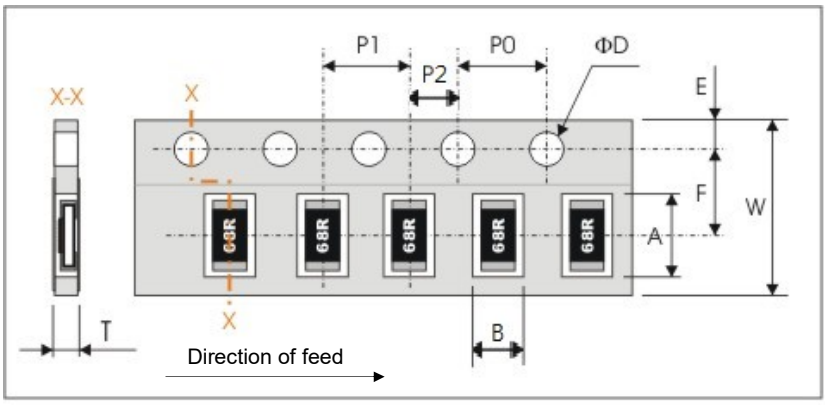
All soldering tests are performed with midly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Electrical Characteristics JISC5201-1: 1998 Clause 4.8	- DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20°C+5°C-1°C; t_2 : -55°C or +155°C R_1 : Resistance at reference temperature (20°C+5°C/-1°C) R_2 : Resistance at test temperature (-55°C or +155°C)	Within the specified tolerance Refer to "QUICK REFERENCE DATA"	<50mΩ
Resistance to soldering heat(R.S.H) JISC5201-1:1998 Clause 4.18	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260°C ±5°C	±5%:ΔR/Rmax.±(1%+0.05Ω) ±1%:ΔR/Rmax.±(0.5%+0.05Ω) no visible damage	<50mΩ
Solderability JISC5201-1:1998 Clause 4.17	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235°C±5°C	95% coverage min., good tinning and no visible damage	
Temperature cycling JISC5201-1:1998 Clause 4.19	30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C-1°C, 30 minutes at +155°C±3°C, 2~3 minutes at 20°C+5°C-1°C, total 5 continuous cycles	±5%: ΔR/R max. ±(1%+0.05Ω) ±1%:ΔR/Rmax.±(0.5%+0.05Ω) No visible damage	<50mΩ
High Temperature Exposure MIL-STD-202 method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	±5%:ΔR/Rmax.±(2%+0.1Ω) ±1%:ΔR/Rmax.±(1%+0.1Ω) No visible damage	<50mΩ

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Bending strength JISC5201-1:1998 Clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 3mm for 10sec, 5mm for WR04	±5%:ΔR/Rmax.±(1%+0.05Ω) ±1%:ΔR/Rmax.±(1%+0.05Ω) No visual damaged	<50mΩ
Adhesion JISC5201-1:1998 Clause 4.32	Pressurizing force: 5N, Test time: 10±1sec.	No remarkable damage or removal of the terminations	
Short Time Overload (STOL) JISC5201-1:1998 Clause 4.13	2.5 times RCWV or max. overload voltage, for 5seconds	±5%: ΔR/R max. ±(2%+0.05Ω) ±1%: ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Load life in Humidity JISC5201-1:1998 Clause 4.24	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off	±5%: ΔR/R max. ±(2%+0.1Ω) ±1%: ΔR/R max. ±(1%+0.1Ω) No visible damage	<50mΩ
Load life (endurance) JISC5201-1:1998 Clause 4.25	1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off	±5%: ΔR/R max. ±(3%+0.1Ω) ±1%: ΔR/R max. ±(1%+0.1Ω) No visible damage	<50mΩ
Insulation Resistance JISC5201-1:1998 Clause 4.6	Apply the maximum overload voltage (DC) for 1minute	R≧10GΩ	
Dielectric Withstand Voltage JISC5201-1:1998 Clause 4.7	Apply the maximum overload voltage (AC) for 1 minute	No breakdown or flashover	

PACKAGING

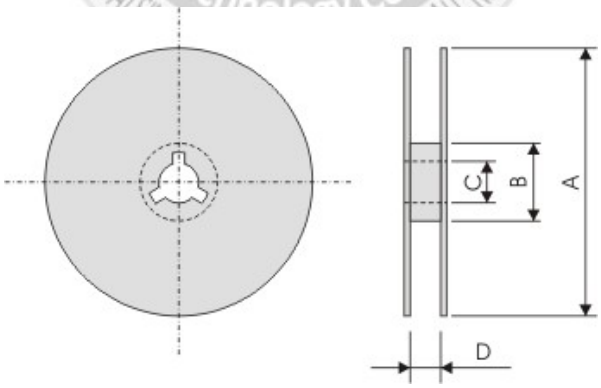
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WR10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WR12	3.60±0.20	2.00±0.20			
WR08	2.40±0.20	1.65±0.20			
WR06	1.90±0.20	1.10±0.20			
WR04	1.20±0.10	0.70±0.10			

Series No.	P1	P0	P2	ΦD	T
WR10/12/08	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.80±0.1
WR06					0.70±0.05
WR04	2.00±0.10				0.50±0.05

Reel dimensions



Symbol	A	B	C	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	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5

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WR04X1001FTL WR04X1002FTL WR04X1003FTL WR04X1004FTL WR04X10R0FTL WR04X1301FTL WR04X4700FTL WR04X4701FTL WR06X1002FTL WR06X1003FTL WR06X4702FTL WR08X1003FTL WR06X1581FTL WR06X6191FTL WR12X000 PTL WR12W1R00FTL WR04X000PTL WR04X1872FTL WR04X7320FTL WR06X3920FTL WR04X823 JTL WR04X2742FTL WR04X6193FTL WR12X3303FTL WR06X33R2FTL WR04X1401FTL WR04X3573FTL WR04X4320FTL WR04X2210FTL WR06X7322FTL WR04X2322FTL WR04X4422FTL WR06X6810FTL WR06X2372FTL WR04X1783FTL WR04X3923FTL WR06X1301FTL WR06X2260FTL WR04X3303FTL WR04X7872FTL WR06X7682FTL WR04X4870FTL WR04X3742FTL WR06X56R2FTL WR04X2743FTL WR04X333 JTL WR04X3001FTL WR06X4700FTL WR25X910 JTL WR12X472JTL WR06X332JTL WR20X101 JTL WR04X2203FTL WR04X2490FTL WR06X3013FTL WR04X2202FTL WR06X1802FTL WR10X103 JTL WR10X182 JTL WR10X151 JTL WR10X2R0 JTL WR10X201 JTL WR10X1R2 JTL WR10X100 JTL WR10X332 JTL WR10X820 JTL WR10X1503FTL WR10X242 JTL WR06X152 JTL WR04X60R4FTL WR04X752 JTL WR06X22R0FTL WR08X8202FTL WR06X1210FTL WR04X3013FTL WR12X204 JTL WR06X824 JTL WR04X154 JTL WR04X5621FTL WR06X17R8FTL WR06X4870FTL WR06X2201FTL WR08X5101FTL WR04X51R0FTL WR04X4703FTL WR04X3010FTL WR04X121 JTL WR06X5623FTL WR12X300 JTL WR12X1000FTL WR06X3R0 JTL WR04X151 JTL WR06X27R4FTL WR06X80R6FTL WR04X3321FTL WR08X1100FTL WR04X61R9FTL WR06X1211FTL WR04X4R7 JTL WR12X20R0FTL