APPROVAL SHEET

SR12, SR10, SR08, SR06, SR04

±1%, ±5%

Thick Film High Grade General Purpose Chip Resistors
Size 1206, 1210, 0805, 0603, 0402
Automotive & Military Compliant
Anti-Sulfuration
RoHS 2 Compliant with exemption 7C-I
Halogen free

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FEATURES

1. High reliability and stability ±1%
2. Sulfuration resistant ASTM B-809 105°C 750hrs
3. Automotive AEC Q-200 & Military MIL-STD Compliant
4. 100% CCD inspection
5. RoHS 2 compliant with exemption 7C-I and Halogen free products

APPLICATIONS

- Automotive application
- 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 extra protective metal film is added onto top side electrodes to protect termination from sulfuration. 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.

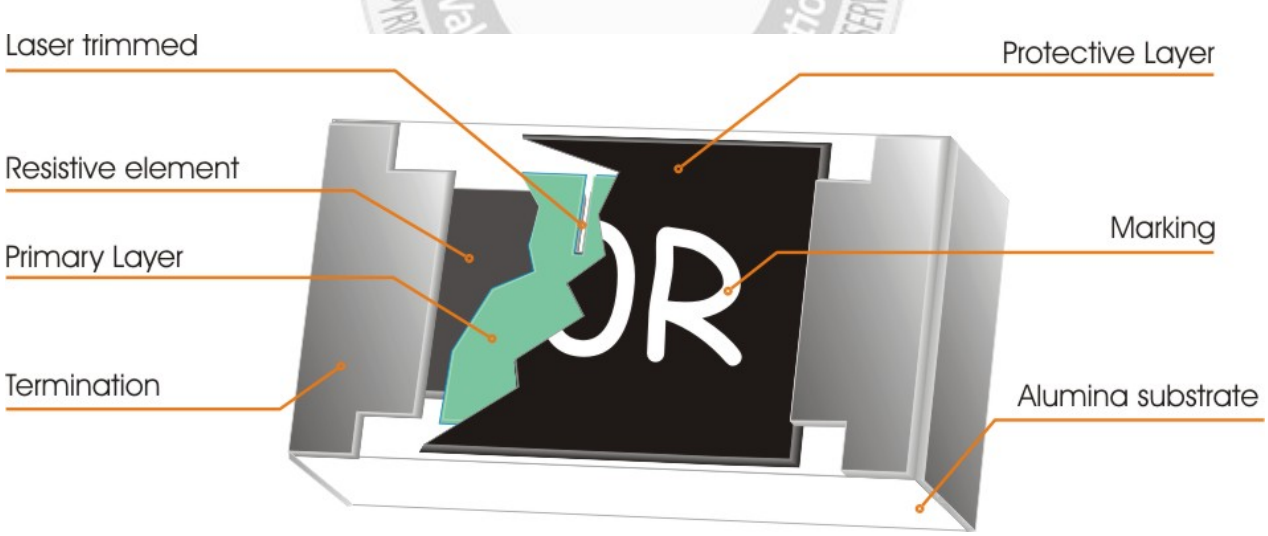


Fig 1. Construction of a Chip-R

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QUICK REFERENCE DATA

Item	General Specification									
Series No.	SR10		SR12		SR08		SR06		SR04	
Size code	1210(3225)		1206(3216)		0805(2012)		0603(1608)		0402(1005)	
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~10MΩ (±1% tolerance)									
Resistance Tolerance	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24
TCR (ppm/°C) R > 1MΩ 10Ω < R ≦ 1MΩ R ≦ 10Ω	 ≤ ± 200 ≤ ± 100 -200~+400		 ≤ ± 200 ≤ ± 100 -200~+400		 ≤ ± 200 ≤ ± 100 -200~+400		 ≤ ± 200 ≤ ± 100 -200~+400		 ≤ ± 200 ≤ ± 100 -200~+400	
Max. dissipation @ T_{amb}=70°C	1/2 W		1/4 W		1/4 W		1/10 W		1/10 W	
Max. Operation Voltage (DC or RMS)	200V		200V		150V		75V		50V	
Max. Overload Voltage (DC or RMS)	400V		400V		300V		150V		100V	
Operation temperature	-55 ~ +155°C									

Note :

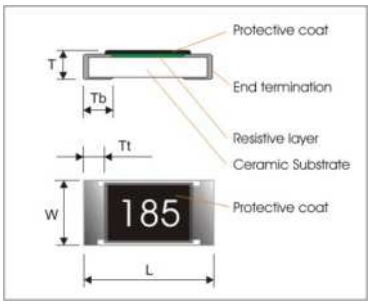
1. This is the maximum voltage that may be continuously supplied to the resistor element, see “IEC publication 60115-8”
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by
   $RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$ or Max. RCWV listed above, whichever is lower.

For Jumper (0Ω) :

Item	General Specification				
Series No.	SR10	SR12	SR08	SR06	SR04
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	≤50mΩ for P tolerance				
TCR (ppm/°C)	TCR is not applicable for Jumper product				
Max. dissipation @ T_{amb}=70°C	1/2 W	1/4 W	1/4 W	1/10 W	1/10 W
Rated Current	2.5A	2A	1.5A	1A	1A
Peak Current	6A	5A	3.5A	3A	2A
Operation temperature	-55 ~ +155°C				

DIMENSIONS (unit : mm)

Series No.	SR10	SR12	SR08	SR06	SR04
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	0.60 ± 0.15	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



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CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

SR12	X	472_	J	T	L
Automotive code SR10 : 1210 SR12 : 1206 SR08 : 0805 SR06 : 0603 SR04: 0402	**Type code** **X :** Jumper ±5%, 1Ω ~ 10MΩ ±1%, 10Ω ~ 1MΩ **W** : ±1%, < 10Ω; >1MΩ	**Resistance code** ±5%, E24: 2 significant digits followed by no. of zeros and a blank 220Ω = 221_ ("_" means a blank) ±1%, E24+E96: 3 significant digits followed by no. of zeros E24: 100Ω = 1000 E96: 37.4KΩ = 3742	**Tolerance** F : ±1% J : ±5% P : Jumper	**Packaging code** T : 7" Reeled taping Q : 10" Reeled taping G : 13" Reeled taping B : Bulk	**Termination code** L = Sn base (lead free)

SR10, SR12,SR08,SR06:

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

SR04:

1. Reeled tape packaging : 8mm width paper taping 10,000pcs per reel,
2. Bulk packaging : 10,000pcs 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.

2 significant digits followed by No. of zeros.

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3 digits marking（±1% : 0603）

Nominal resistance	Description
1.E24 series	2 significant digits followed by No. of zeros 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

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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

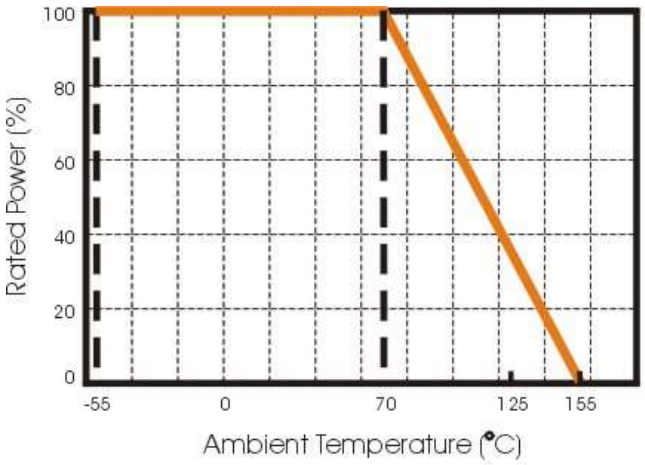


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

The end terminations guarantee a reliable contact.

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.

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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.

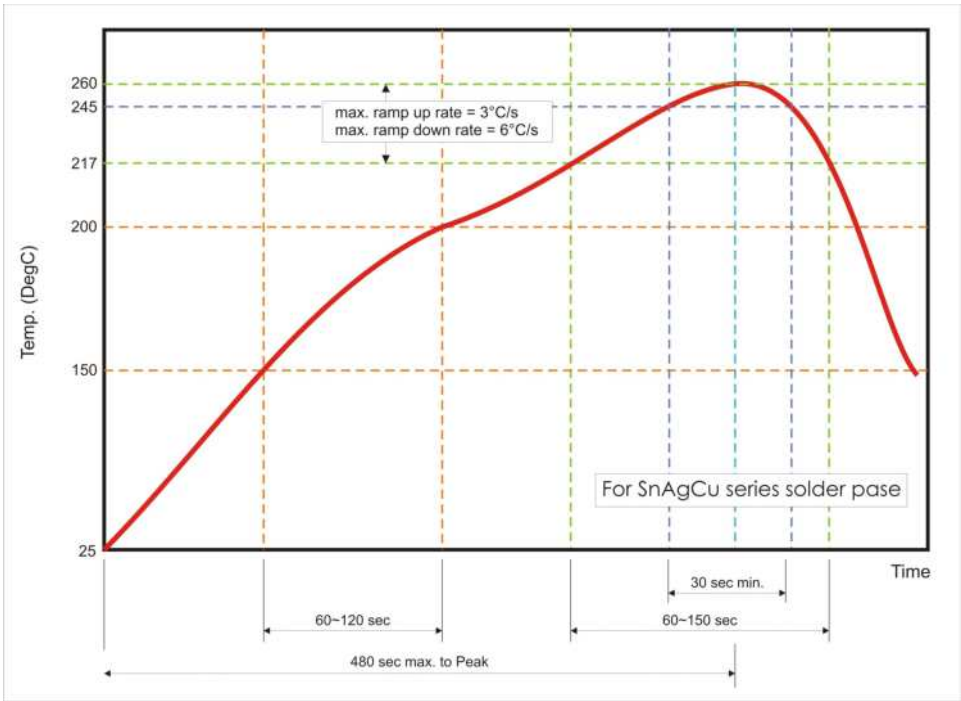


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

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TEST 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, sub-clause 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 R_1 : Resistance at reference temperature R_2 : Resistance at test temperature	Within the specified tolerance Refer to "QUICK REFERENCE DATA"	
Resistance to soldering heat (R.S.H) **MIL-STD-202 method 210**	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 270°C ±5°C	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Solderability **J-STD-002**	a) Bake the sample for 155℃ dwell time 4hrs/ solder dipping 235°C / 5sec. b) Steam the sample dwell time 1 hour/ solder dipping 215°C / 5sec. c) Steam the sample dwell time 1 hour/ solder dipping 260°C / 7sec.	95% coverage min., good tinning No visible damage	
Temperature cycling **JESD22 method JA-104**	1000 cycles, -55°C ~ +155°C, dwell time 5~10min	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance **MIL-STD-202 method 106**	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Bias Humidity **MIL-STD-202 method 103**	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Operational Life **MIL-STD-202 method 108**	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ

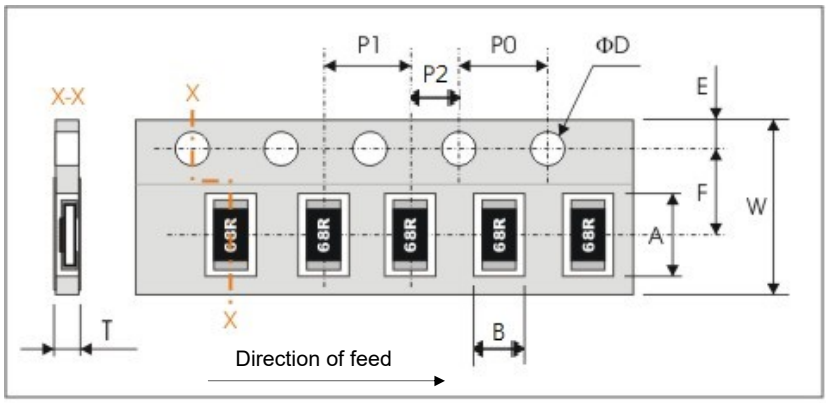
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TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
High Temperature Exposure **MIL-STD-202 method 108**	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Mechanical Shock **MIL-STD-202 method 213**	1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec	Within the specified tolerance No visible damage	<50mΩ
Board Flex **AEC-Q200-005**	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 60sec	ΔR/R max.±(1.0%+0.05Ω) . No visible damage	<50mΩ
Terminal strength **AEC-Q200-006**	Pressurizing force: 1Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations	
Vibration **MIL-STD-202 method 204**	Test 5g's for 20min., 12 cycles each of 3 orientations	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Thermal shock **MIL-STD-202 method 107**	Test –55 to 155°C / dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
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
ESD **AEC-Q200-002**	Test contact 1.0KV (0.5KV for 0402 only)	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Sulfuration test	ASTM B-809 105°C, 750hrs	ΔR/R max. ±(2.0%+0.05Ω) No visible damage	<50mΩ

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PACKAGING

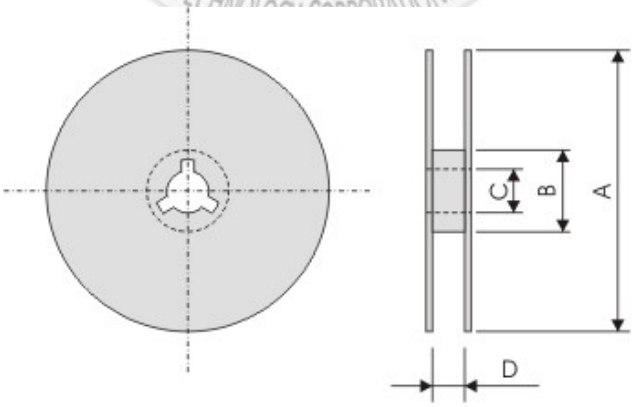
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
SR10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
SR12	3.60±0.20	2.00±0.20			
SR08	2.40±0.20	1.65±0.20			
SR06	1.90±0.20	1.10±0.20			
SR04	1.20±0.10	0.70±0.10			

Series No.	P1	P0	P2	ΦD	T
SR10/12/08	4.00±0.10	4.00±0.10	P2=1/2P0	$\Phi 1.50^{+0.1}_{-0.0}$	0.80±0.1
SR06					0.70±0.05
SR04	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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