Towards Excellence in *Quality, Service & Innovation*

ASJ

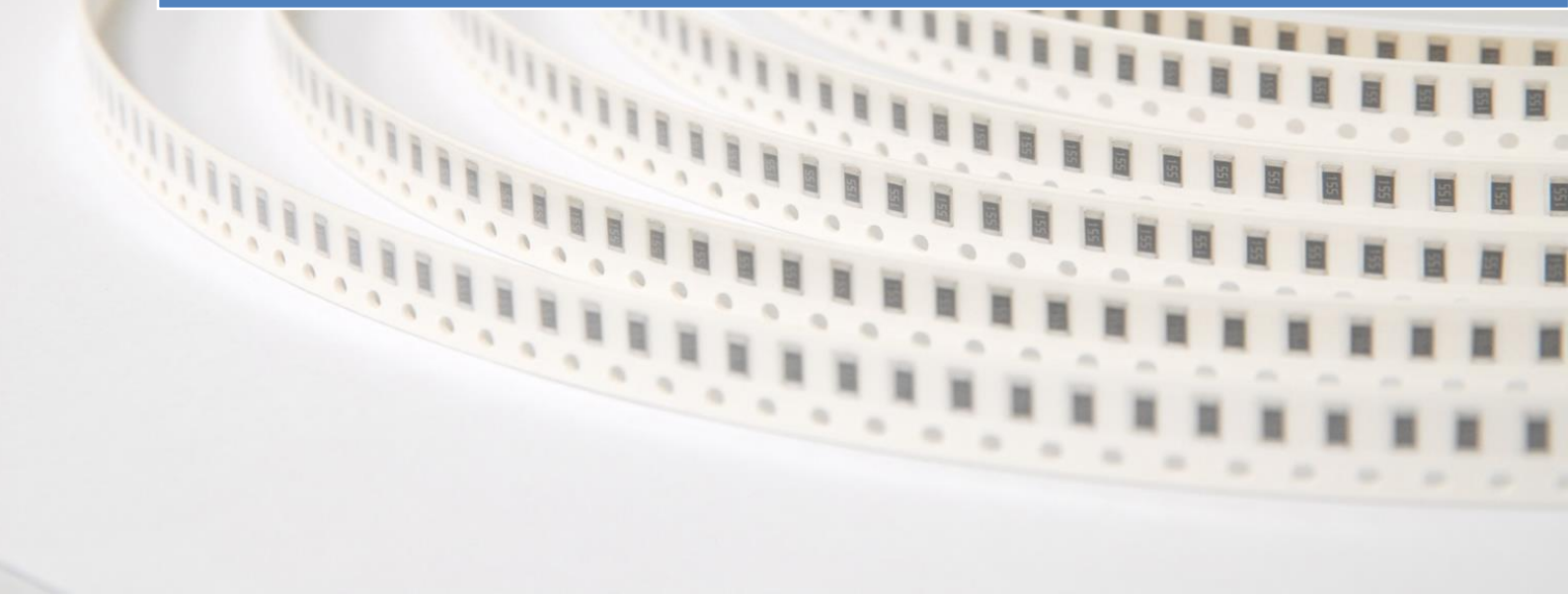
DATA SHEET

Anti-Sulphur Low-Resistance Thick Film Chip Resistor

SAS(A) Series

1% TO 5%, TCR ±200 TO ±1500

SIZE: 0402/0603/0805/1206/1210/2010/2512



Product Specification – April 19, 2023 V.3

1. SCOPE

1.1 This specification is applicable to Lead-free and Halogen-free of RoHS Directive for SAS Series Anti-Sulfur Low-Resistance Thick Film Chip Resistor.

1.2 Superior Sulfur-resistant capability (Refer to ASTM-B-809-95 & EIA977 Sulfur Vapor Test).

1.3 The product is for general electronic purpose.

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

SAS	10	-	R100		-	F	K	-	A
Type	Size (Inch/mm)		Nominal Resistance			Resistance Tolerance	Packaging		FoS Test
Anti - Sulfurated Low Resistance Thick Film Chip Resistors	10(0402/1005) 16(0603/1608) 21(0805/2012) 32(1206/3216) 40(1210/3225) 50(2010/5025) 63(2512/6432)		4-Digit	EX.0.1Ω=R100		F = ±1% J = ±5%	E = 4,000 pcs Lead Free L = 5,000 pcs Lead Free K = 10,000 pcs Lead Free Y = 20,000 pcs Lead Free N = 50,000 pcs Lead Free Refer t item 7.3.2		A : 60℃

3. RATING

3.1 Rated Power

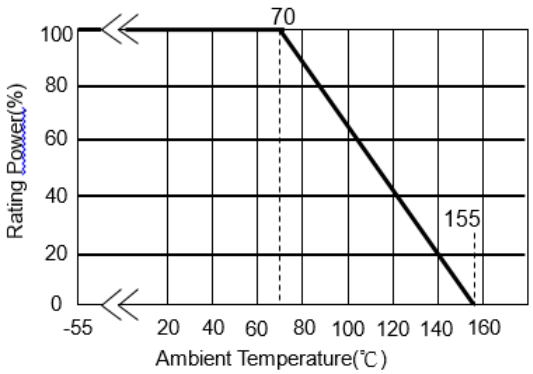
3.1.1 Resistor Rated Power

Type	Rated Power at 70℃	Max. Working Current	Max. Overload Current
SAS10 (0402)	$\frac{1}{16}$ W	1.44A	3.60A
SAS16 (0603)	$\frac{1}{10}$ W	1.82A	4.56A
SAS21 (0805)	$\frac{1}{8}$ W	2.50A	6.25A
SAS32 (1206)	$\frac{1}{3}$ W	4.08A	10.20A
SAS40 (1210)	$\frac{1}{2}$ W	5.00A	12.50A
SAS50 (2010)	$\frac{3}{4}$ W	6.12A	15.31A
SAS63 (2512)	1 W	7.07A	17.67A

3.2 Power Derating Curve

Temperature Range: - 55℃ ~ + 155℃

If the ambient temperature exceeds 70 degrees centigrade to 155 degrees centigrade, the power can be modified by the curve as below.



3.3 Standard Atmospheric Condition

Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests is as follows:

Ambient Temperature = + 5°C to +35°C

Relative Humidity = < 85% RH

Air Pressure = 86 kPa to 106kPa

If there may be any doubt about the results, measurement shall be made within the following limits:

Ambient Temperature = 20 ± 2°C

Relative Humidity = 60 to 70% RH

Air Pressure = 86 kPa to 106kPa

3.4 Operating Temperature Range -55°C to +155°C

3.5 Storage Temperature Range -5°C to + 40°C / < 85% RH

3.6 Flammability Rating Tested in accordance to UL-94, V-0

3.7 Moisture Sensitivity Level Rating: Level 1

3.8 Product Assurance

ASJ resistor shall warranty 24 months from manufacturing date with control conditions.

3.9 ASJ resistors are RoHS-compliant in accordance to RoHS Directive.

3.10 Resistance, Resistance Tolerance and Temperature Coefficient of Resistance.

Type	Rated Power at 70℃	Max. Working Current	Max. Overload Current	T.C.R (ppm/℃)	Resistance Range F(±1%)、J(±5%) E-24、E-96
SAS10 (0402)	$\frac{1}{16}$W	1.44A	3.60A	±1500	30mΩ≦R < 37mΩ
				±1200	37mΩ≦R < 60mΩ
				±600	60mΩ≦R < 100mΩ
				±500	100mΩ≦R < 400mΩ
				±300	400mΩ≦R < 1000mΩ
SAS16 (0603)	$\frac{1}{10}$W	1.82A	4.56A	±1500	30mΩ≦R < 37mΩ
				±1200	37mΩ≦R < 60mΩ
				±600	60mΩ≦R < 100mΩ
				±200	100mΩ≦R < 1000mΩ
SAS21 (0805)	$\frac{1}{8}$W	2.50A	6.25A	±1200	20mΩ≦R < 33mΩ
				±800	33mΩ≦R < 50mΩ
				±600	50mΩ≦R < 100mΩ
				±300	100mΩ≦R < 1000mΩ
SAS32 (1206)	$\frac{1}{3}$W	4.08A	10.20A	±1200	20mΩ≦R < 25mΩ
				±1000	25mΩ≦R < 50mΩ
				±600	50mΩ≦R < 100mΩ
				±300	100mΩ≦R < 1000mΩ
SAS40 (1210)	$\frac{1}{2}$W	5.00A	12.50A	±1000	20mΩ≦R < 25mΩ
				±700	25mΩ≦R < 50mΩ
				±400	50mΩ≦R < 100mΩ
				±300	100mΩ≦R < 1000mΩ
SAS50 (2010)	$\frac{3}{4}$W	6.12A	15.31A	±1200	20mΩ≦R < 25mΩ
				±900	25mΩ≦R < 50mΩ
				±500	50mΩ≦R < 100mΩ
				±300	100mΩ≦R < 1000mΩ
SAS63 (2512)	1W	7.07A	17.67A	±1200	20mΩ≦R < 25mΩ
				±900	25mΩ≦R < 50mΩ
				±500	50mΩ≦R < 100mΩ
				±300	100mΩ≦R < 1000mΩ
Operating Temperature Range				-55℃ ~ +155℃	

3.11 Current Rating

Rated Current: DC current or AC current (rms) based on the rated power.
The current can be calculated by the following formula. If the calculated value exceeds the Max. current specified in the Table 3.1.1, the Max. Voltage rating is set as the voltage rating.

$$I = \sqrt{P/R}$$

I= Rated current (A)
P= Power rating (W)
R= Nominal resistance(Ω)

4. MARKING ON PRODUCT

The nominal resistance shall be marked on the surface of each resistor

Type		Resistance Range	Tolerance≦1%	Tolerance > 1%
Single	**Sizes:** **01005、0201、0402**	All	No Marking	
		Jumper=0Ω		
	Size: **0603**	< 1Ω	4-digits Marking	4-digits Marking
		≧1Ω	3-digits Marking	3-digits Marking
		Jumper=0Ω	3-digits Marking	1-digit Marking
	Sizes: **0805、1206、1210** **1812、2010、2512** **0508、0612、1218** **1020、1225**	< 1Ω	4-digits Marking	4-digits Marking
		≧1Ω	4-digits Marking	3-digits Marking
		Jumper=0Ω	3-digits Marking	1-digit Marking

4.1 Numeric Numbering

4.1.1 Resistance range: < 1Ω

0603、0805、1206、1210、2010、2512、±1%、±5% Tolerance:
Resistance range≧100 mΩ: 4 digits in E-24 series or E-96 series, later three digits are significant figures, first digit is multiplier (10^{-3}).

《EX》Marking→R220 (E-24series)

$R220 = 220 \times 10^{-3} = 0.22\ \Omega = 220\ m\Omega$

Marking→R102 (E-96series)

$R102 = 102 \times 10^{-3} = 0.102\ \Omega = 102\ m\Omega$

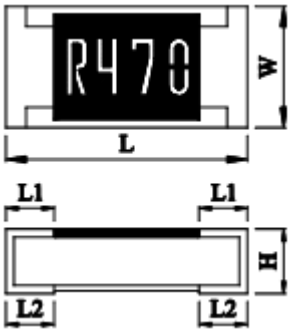
Resistance range < 100 mΩ: 4 digits in E-24 series, later two digits are significant figures, first digit is multiplier (10^{-3})

《EX》Marking→R022

$R022 = 22 \times 10^{-3} = 0.022\ \Omega = 22\ m\Omega$

5. DIMENSION, CONSTRUCTION AND MATERIAL

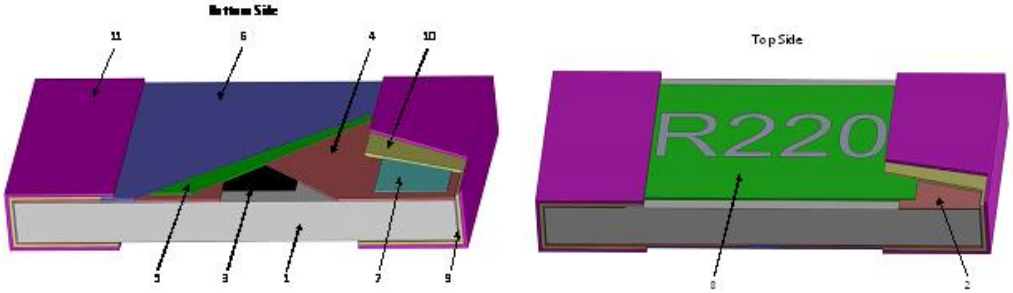
5.1 Dimension



Unit:mm

Type \ Dimension	Size Code	L	W	H	L1	L2
SAS10	0402	1.00±0.10	0.50±0.05	0.30±0.10	0.25±0.10	0.20±0.15
SAS16	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.25±0.15	0.35±0.15
SAS21	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.20
SAS32	1206	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.55±0.25
SAS40	1210	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
SAS50	2010	5.00±0.20	2.50±0.20	0.60±0.10	0.65±0.20	0.65±0.20
SAS63	2512	6.30±0.20	3.20±0.20	0.60±0.10	0.65±0.20	0.65±0.20

5.2 Structure graph



1	Ceramic substrate	7	2nd Bottom inner electrode
2	Top inner electrode	8	G2 layer+Marking
3	Resistive layer	9	Terminal inner electrode
4	1st Bottom inner electrode	10	Ni plating
5	1st Protective coating	11	Sn plating
6	2nd Protective coating		

5.3 Plating Thickness

5.3.1 Ni : ≧ 2 μm

5.3.2 Sn (Tin) : ≧ 3 μm

5.3.3 Sn (Tin) : Matte Sn

6. RELIABILITY TEST

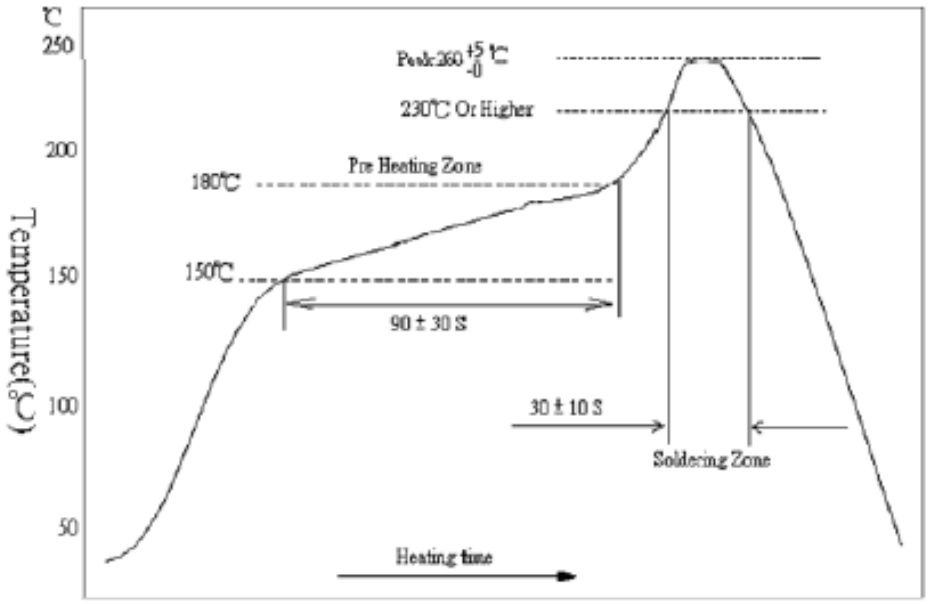
Item	Conditions	Specifications Resistors
High Temperature Exposure (Storage)	Put the specimens in the chamber with temperature of 155±3℃ for 1000 hours. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	△R%=±2.0%
Temperature Cycling	Put the specimens in the High & low temperature test chamber with temperature varies from -55℃ to 125℃ for 15 minutes and total 1000 cycles. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	△R%=±2.0%
Short Time Overload	Applied 2.5 times rated current for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Rated current refers to item 3. general specifications) Refer to JIS-C5201-1 4.13	△R%=±2.0%
Biased Humidity	Solder the specimens on the test PCB and put them into the constant temperature humidity chamber with 85±2℃ and 85±5%RH. Then apply the test current that calculates based on the 10% of rated power for 1000hrs. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	△R%=±3.0%
Operational Life	Solder the specimens on the test PCB and Put them in the chamber with temperature of 125±3℃ and load the current for 1000 hours. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Note: The input current shall refer to the power de-rating curve (referring to page 2,No.3.1) Experiment evidence: AEC-Q200	△R%=±3.0%
Board Flex (Bending Test)	Solder the specimens on the test PCB and put the PCBA onto the Bending Tester. Add force at the central part of PCB, and the duration of the applied forces shall be 60 (+ 5) Sec. Measure of its resistance variance rate in load. Bending depth D: 0402、0603、0805=5mm 1206、1210=3mm 2010、2512=2mm Experiment evidence: AEC-Q200	△R%=±2.0% No mechanical damage, peel-off of side end or chip crack.

Item	Conditions	Specifications Resistors	
Resistance to Soldering Heat	The specimens are fully immersed into the Pb-free solder pot, then take them out to stabilize for 1 hour or more and measure of its resistance variance rate. Temp of solder pot：260±5℃ Soldering duration：10±1sec. Experiment evidence AEC-Q200	△R%=±2.0%	
ESD	Put the specimens on the test fixture and two (2)discharges (2KVDC) shall be applied to each PUT, one (1) with a positive polarity and one (1) with a negative polarity. Afterwards, the specimens stabilize for 30min or more and measure of its resistance variance rate. The test is performed with direct contact and regular discharge mode. The resistor and capacitor used on the spearhead is 2000Ω and 150pF respectively. Experiment evidence AEC-Q200	△R%=±3.0%	
Solderability	**Test method:** **Test item 1 (solder pot test): Method B** Precondition: The specimens are subjected to 155℃ dry bake for 4hrs±15min. The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 235± 5℃ for $5^{+0}_{-0.5}$ sec. Then rinse with water and observe the soldering coverage under the microscope. **Test item 2 (Leaching test): Method D** The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 260±5℃ for $30^{+0}_{-0.5}$sec. Then rinse with water and observe the soldering coverage under the microscope. Experiment evidence AEC-Q200	1.Soldering coverage over 95% 2.At the edge of terminal, the object underneath (e.g. white ceramic) shall not expose.	
Electrical Characterization	$TCR(ppm/^{\circ}C) = \frac{R2-R1}{R1(T2-T1)} x10^6$ R1: Resistance at room temperature (Ω) R2: Resistance at -55℃ or +125℃(Ω) T1: Room temperature (℃) T2: Temperature -55℃ or +125℃ Experiment evidence: AEC-Q200	Refer to item 3.10 General specifications	
Sulfuration Test	Class : A	Put the tested resistor in sulfur vapor, at a temperature of 60±2℃for 1000hrs Refer to ASTM-B-809-95&EIA977	△R=±4.0%	Refer to item 3.10 general specifications

6.1 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application)

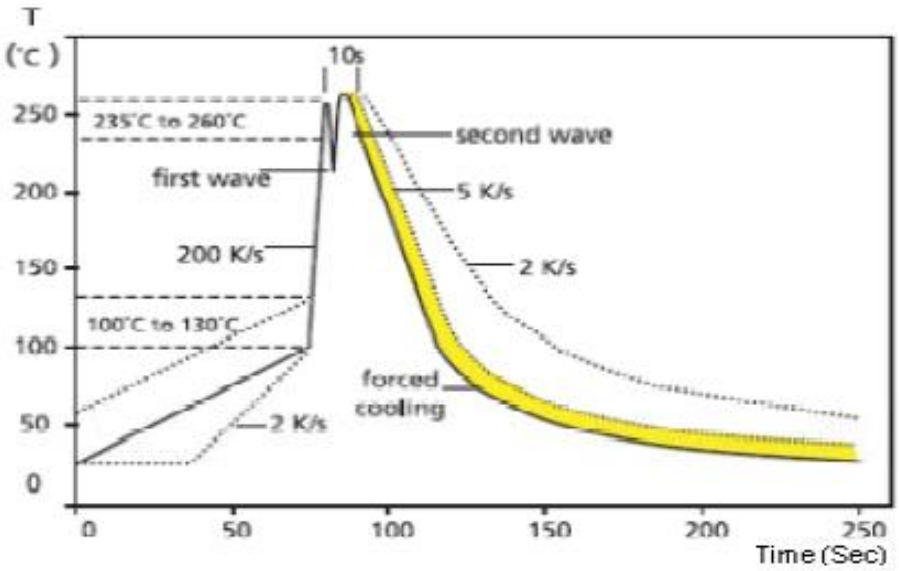
Soldering Profile

6.1.1 Lead-Free IR Re-flow Soldering Profile



Remark: The peak temperature of soldering heat is 260^{+5}_{-0} ºC for 10 seconds.

6.1.2 Lead-Free Double-Wave Soldering Profile (This applies to 0603 size inclusive above products)

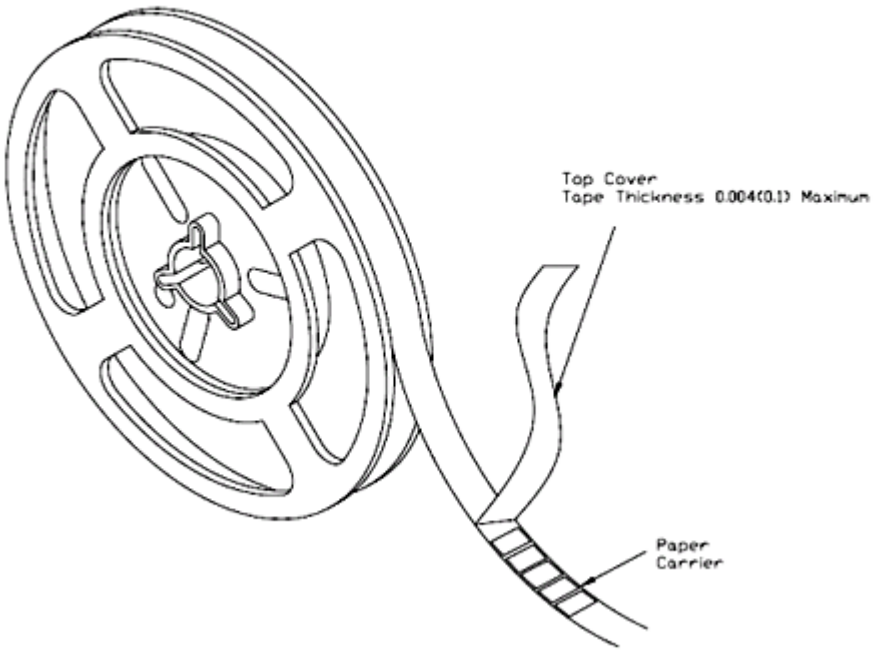


6.1.3 Soldering Iron : Temperature 350ºC±10ºC, dwell time shall be less than 3 sec.

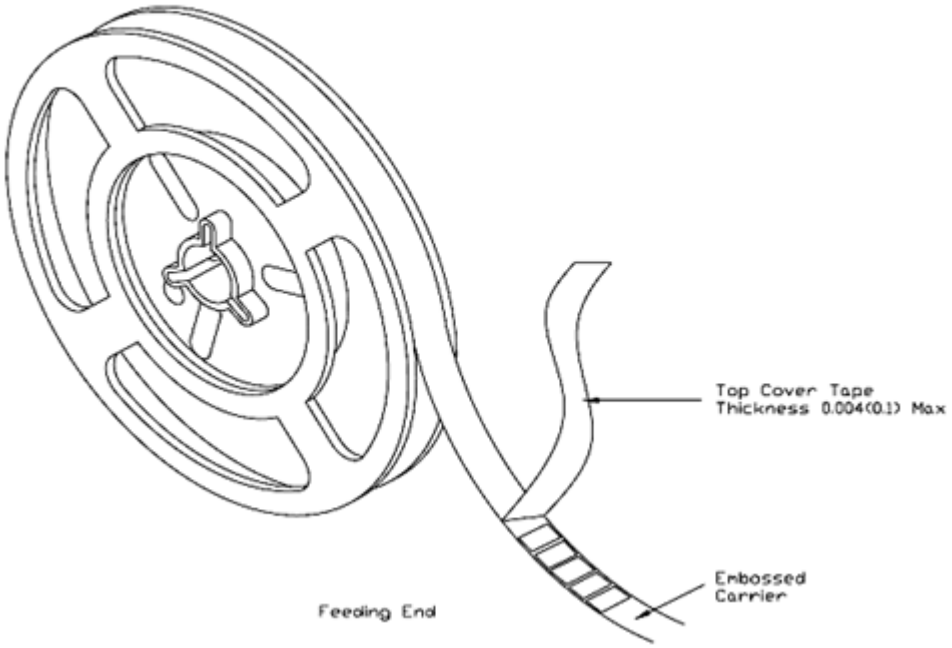
7. TAPING

7.1 Structure of Taping

Paper Carrier

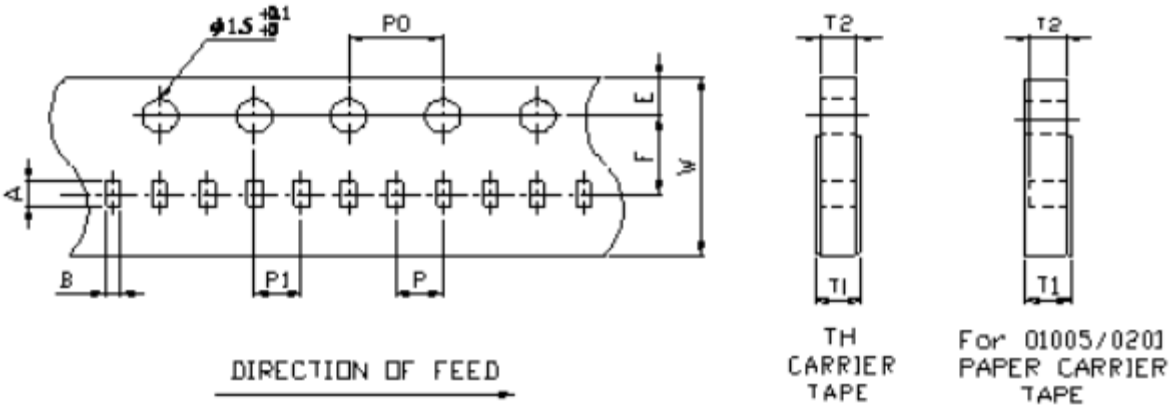


Embossed Plastic Carrier



7.2 Dimension

7.2.1 Dimension of Punched Paper Tape Carrier System (SAS05, SAS10)



Remark: Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

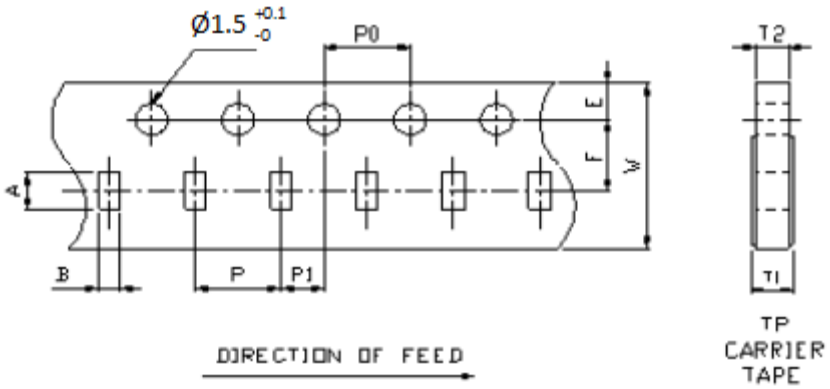
Dimension of Punched Paper Tape Carrier System (SAS05, 10)

(unit : mm)

Code	A	B	W	E	F	T_1
SAS10	1.15±0.05	0.65±0.05	8.00±0.20	1.75±0.10	3.50±0.05	$0.42^{+0.2}_{-0}$

Code	T_2	P	P0	10 x P0	P1
SAS10	0.40±0.05	2.00±0.10	4.00±0.05	40.0±0.20	2.00±0.05

7.2.2 Dimension of Punched Paper Tape Carrier System /Plastic Embossed Carrier System (SAS16, 21, 32, 40)

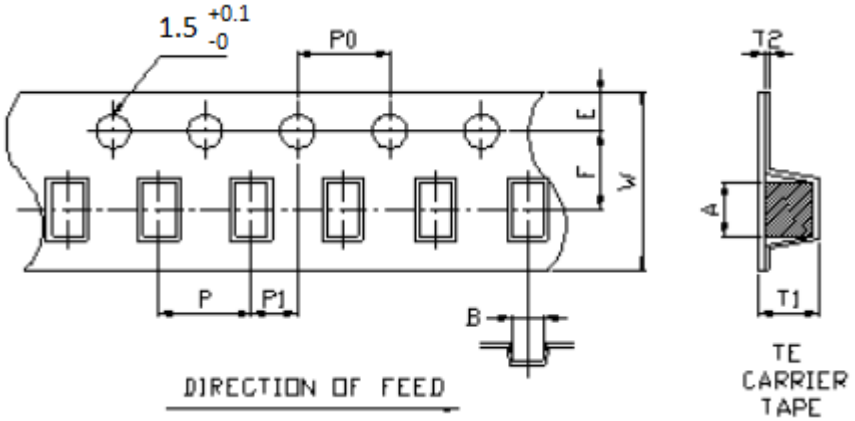


Remark: Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

Dimension of Punched Paper Tape Carrier System (SAS - 16, 21, 32, 40)

Code	A	B	W	E	F	T1	T2	P	P0	P1
SAS16	1.8±0.10	1.0±0.10	8.0±0.20	1.75±0.10	3.50±0.05	$0.60^{+0.2}_{-0}$	0.60±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS21	2.3±0.10	1.55±0.1	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS32	3.5±0.20	1.9±0.20	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS40	3.5±0.20	2.8±0.20	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05

Dimension of Plastic Embossed Carrier System (SAS - 50, 63)



Code	A	B	W	E	F	T1	T2	P	P0	P1
SAS50	5.5±0.20	2.8±0.20	12.0±0.20	1.75±0.10	5.50±0.05	1.10±0.15	0.23±0.15	4.0±0.10	4.0±0.05	2.0±0.05
SAS63	6.7±0.20	3.4±0.20	12.0±0.20	1.75±0.10	5.50±0.05	1.10±0.15	0.23±0.15	4.0±0.10	4.0±0.05	2.0±0.05

7.3 Packaging

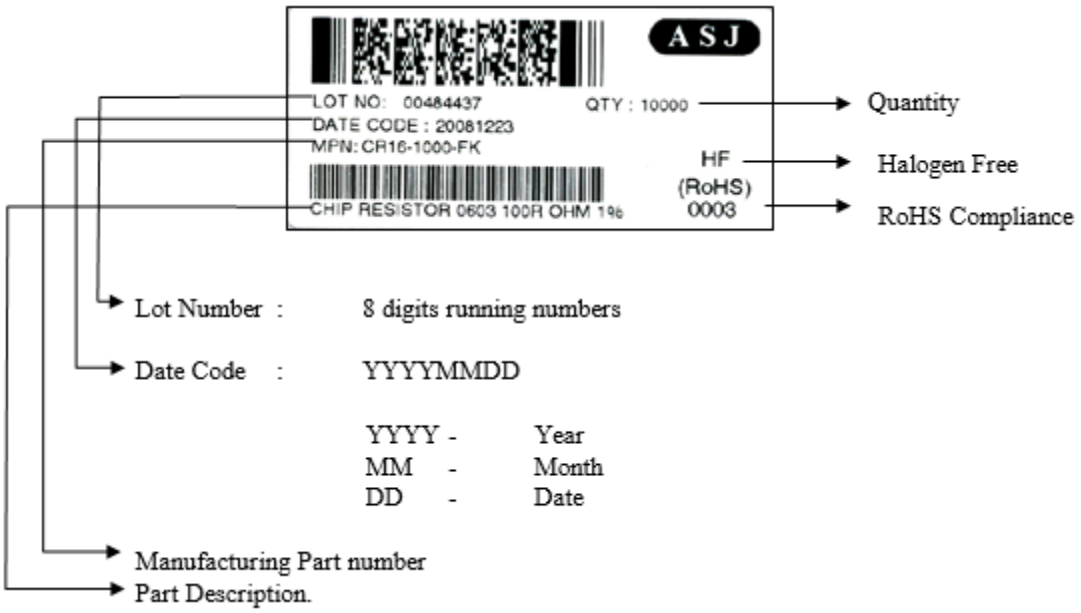
7.3.1 Taping

7.3.2 Quantity – Tape and Reels

Code	Quantity	Model	Remarks
SAS10	10,000 pcs	7" Reel	2mm pitch (Paper Carrier)
	20,000 pcs	7" Reel	2mm pitch (Paper Carrier)
	50,000 pcs	13" Reel	2mm pitch (Paper Carrier)
SAS16	5,000 pcs	7" Reel	4mm pitch (Paper Carrier)
SAS21	10,000 pcs	10" Reel	4mm pitch (Paper Carrier)
SAS32 SAS40	20,000 pcs	13" Reel	4mm pitch (Paper Carrier)
SAS50	4,000 pcs	7" Reel	4mm pitch (Embossed Carrier)
SAS63	4,000 pcs	7" Reel	4mm pitch (Embossed Carrier)

7.3.3 Identification

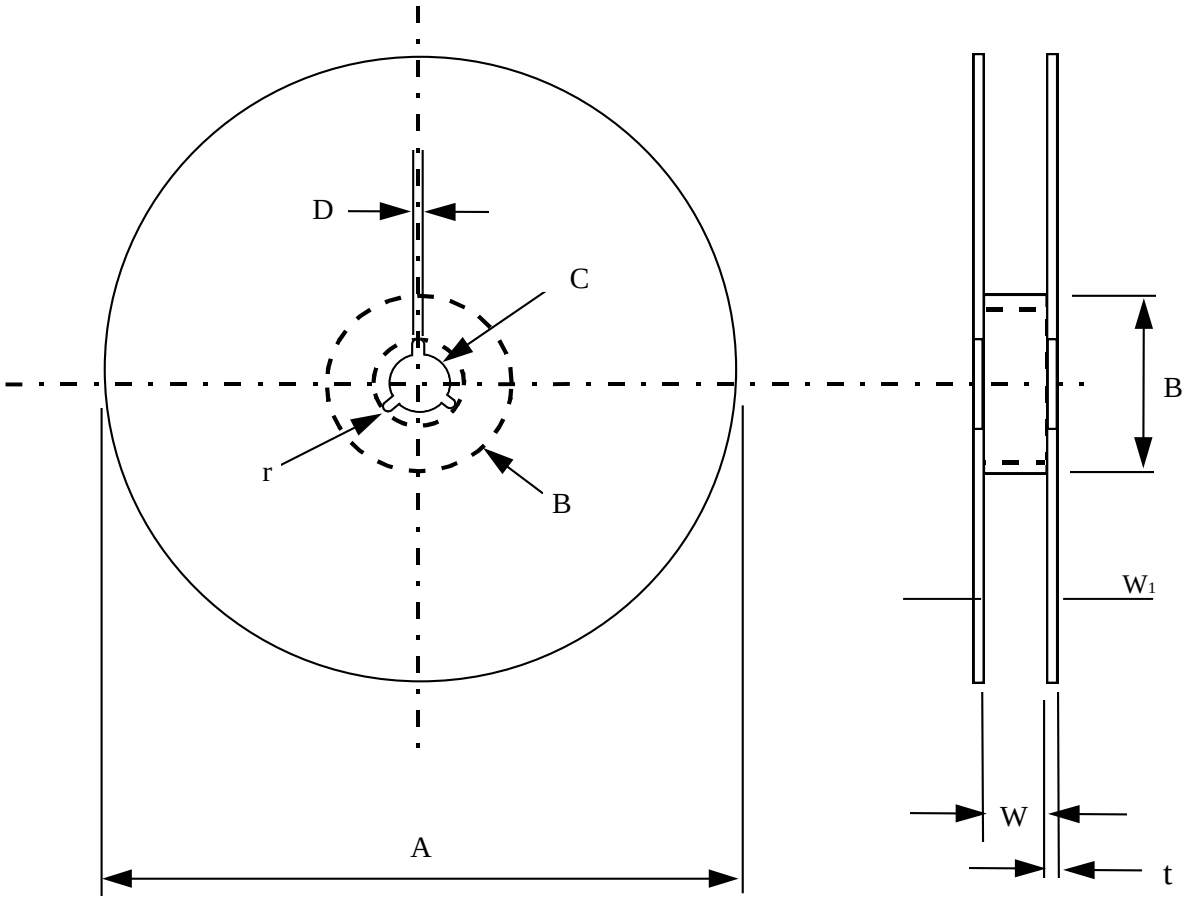
Production label that indicates the 8 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.3.4 Packaging Reel Box

Dimension	Reel Box	Number of Reels
185 × 60 × 186 mm	25K Box	5
185 × 120 × 186 mm	50K Box	10

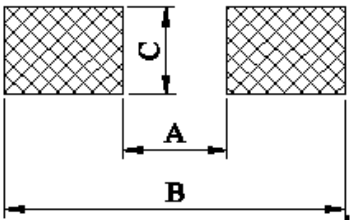
7.3.5 Reel Dimensions



Model	A	B	C	D	W	W_1	t	r
7"Reel (5K) (except 0402 10K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 0.1	14.4 max	1.0± 0.1	1.0
7"Reel (4K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	13±1.0	14.4 max	1.2± 0.1	1.0
7''Reel (10K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 0.1	14.4 max	1.0± 0.1	1.0
10"Reel (10K)	ϕ254±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 1.0	14.4 max	1.5± 0.1	1.0
13"Reel (20K)	ϕ330±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 1.0	14.4 max	2.1± 0.1	-
13"Reel (20K)	ϕ330±1.0	ϕ100±1	13.5±0.5	2~3±0.5	10±0.5	-	-	-

8. SURFACE MOUNT LAND PATTERNS (FOR RE-FLOW SOLDERING)

When a component is soldered, the resistance after soldering changes slightly depending on the size of the soldering area and the amount of soldering. When designing a circuit, it is necessary to consider the effect of a decrease or increase in its resistance.

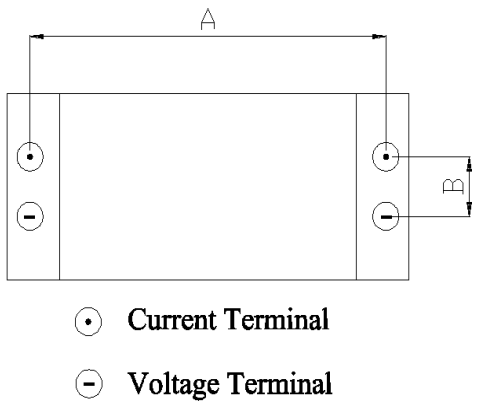


Unit:mm

TYPE \ DIM	A	B	C
SAS10	0.5	1.5	0.6
SAS16	0.8	2.1	0.9
SAS21	1.2	3.0	1.3
SAS32	2.2	4.2	1.6
SAS40	2.2	4.2	2.8
SAS50	3.5	6.1	2.8
SAS63	3.8	8.0	3.5

9. MEASUREMENT POINT

Bottom electrode



Unit : mm

TYPE \ DIM	A	B
SAS10	**0.80±0.05**	**0.24±0.05**
SAS16	**1.35±0.05**	**0.35±0.05**
SAS21	**1.80±0.05**	**0.35±0.05**
SAS32	**2.90±0.05**	**0.35±0.05**
SAS40	**2.90±0.05**	**0.35±0.05**
SAS50	**4.50±0.05**	**1.15±0.05**
SAS63	**5.90±0.05**	**1.60±0.05**

10. REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version.1	03.09.2020		Initial release
Version.2	15.10.2021		Revise clause 6 item Temperature Cycling from 5 minute to 15 minute
Version 3	19.04.2023		Revise clause 3.8 Product Assurance

ASJ

DATA SHEET

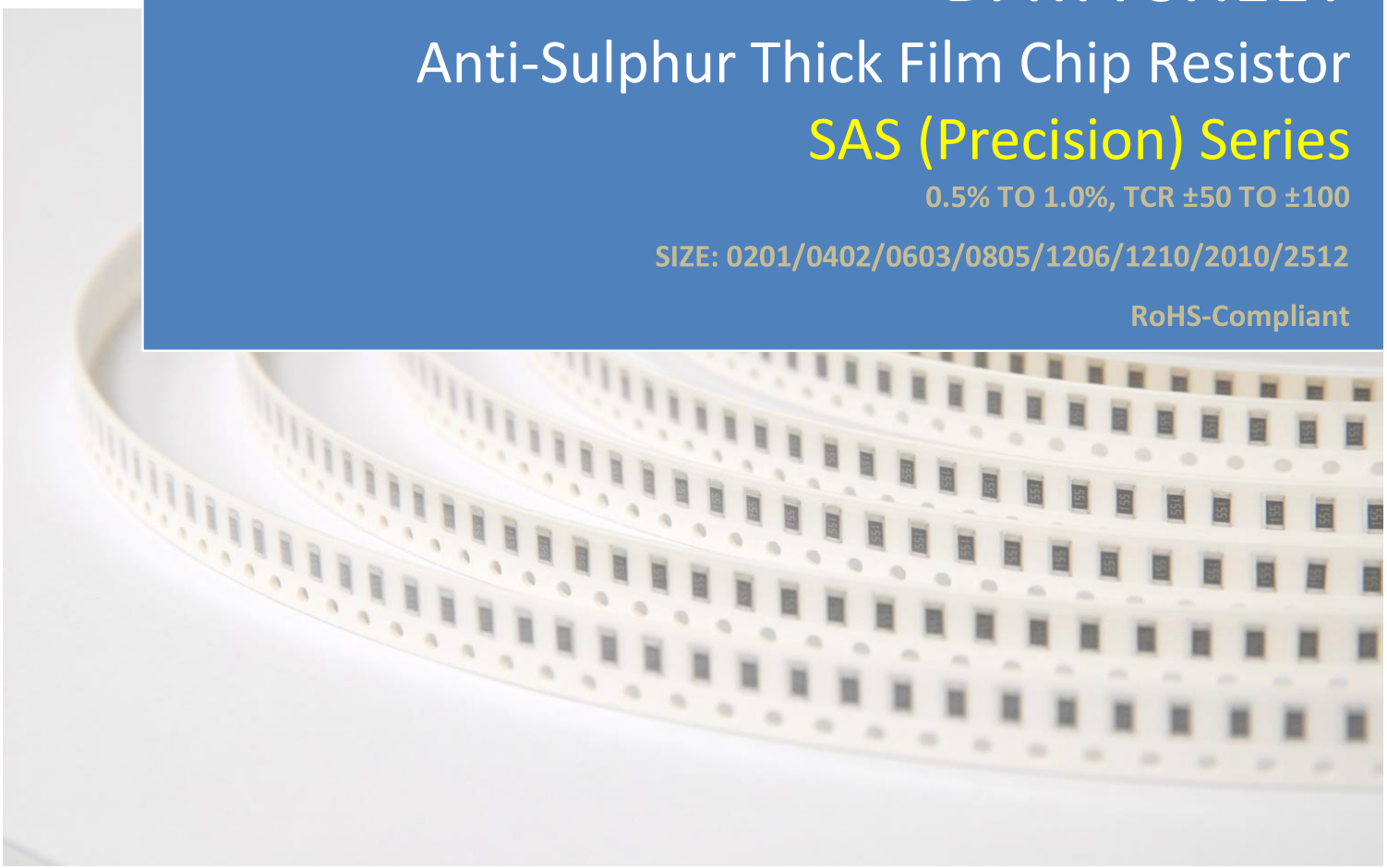
Anti-Sulphur Thick Film Chip Resistor

SAS (Precision) Series

0.5% TO 1.0%, TCR ±50 TO ±100

SIZE: 0201/0402/0603/0805/1206/1210/2010/2512

RoHS-Compliant



1. SCOPE

1.1 This specification is applicable to Lead-free and Halogen-free of RoHS Directive for SAS Series Anti-Sulfurated Precision Thick Film Chip Resistor.

1.2 Superior Sulfur-resistant capability (Refer to ASTM-B-809-95 & EIA977 Sulfur vapor test).

1.3 The product is for general electronic purpose.

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

SAS	21	-	1002		-	F	K	-	E
Type	Size (Inch/mm)		Nominal Resistance			Resistance Tolerance	Packaging		ppm/°c
Anti - Sulfurated Precision Thick Film Chip Resistors	05(0201) 10(0402) 16(0603) 21(0805) 32(1206) 40(1210) 50(2010) 63(2512)		4-Digit	EX. 10.2Ω = 10R2 10KΩ = 1002		D = ±0.5% F = ±1%	E = 4,000 pcs Lead Free L = 5,000 pcs Lead Free K = 10,000 pcs Lead Free Y = 20,000 pcs Lead Free N = 50,000 pcs Lead Free		E : ±50 F : ±100

3. RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage
SAS05 (0201)	$\frac{1}{20}$ W	30V	60V
SAS10 (0402)	$\frac{1}{16}$ W	50V	100V
SAS16 (0603)	$\frac{1}{10}$ W	75V	150V
SAS21 (0805)	$\frac{1}{8}$ W	150V	300V
SAS32 (1206)	$\frac{1}{4}$ W	200V	400V
SAS40 (1210)	$\frac{1}{2}$ W	200V	400V
SAS50 (2010)	$\frac{3}{4}$ W	200V	400V
SAS63 (2512)	1W	200V	400V

3.2 Power Derating curve:

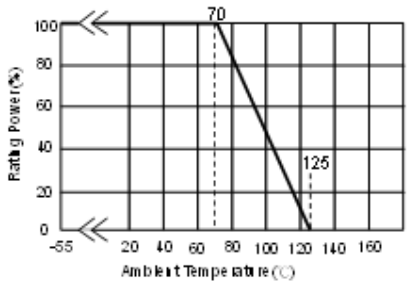
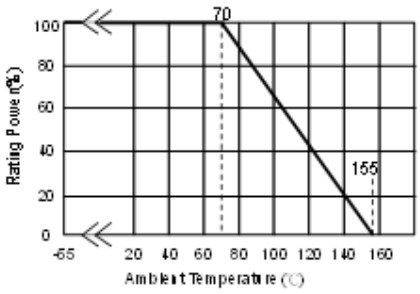
Type	SAS05(0201/0603)	Other
Operating Temperature Range	-55°C to +125°C	-55°C to +155°C
Explain	If the ambient temperature exceeds 70 degrees centigrade to 125 degrees centigrade, the power can be modified by the curve as below.	If the ambient temperature exceeds 70 degrees centigrade to 155 degrees centigrade, the power can be modified by the curve as below.
Figure		

Fig.1 Power Derating Characteristics

3.3 Standard Atmospheric Condition

Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests is as follows:

Ambient Temperature = + 5°C to +35°C

Relative Humidity = < 85% RH

Air Pressure = 86 kPa to 106kPa

If there may be any doubt about the results, measurement shall be made within the following limits:

Ambient Temperature = 20 ± 2°C

Relative Humidity = 60 to 70% RH

Air Pressure = 86 kPa to 106kPa

3.4 Operating Temperature Range -55°C to +155°C (SAS05 -55°C to +125°C)

3.5 Storage Temperature Range -5°C to + 40°C / < 85% RH

3.6 Flammability Rating Tested in accordance to UL-94, V-0

3.7 Moisture Sensitivity Level Rating: Level 1

3.8 Product Assurance
ASJ resistor shall warranty 24 months from manufacturing date with control conditions.

3.9 ASJ resistors are RoHS-compliant in accordance to RoHS Directive.

3.10 Resistance, Resistance Tolerance and Temperature Coefficient of Resistance.

Type	Rated Power at 70℃	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm / ℃)	Resistance Range D(±0.5%) 、F(±1%) E-24 、E-96
SAS05 (0201)	1/20 W	30V	60V	±100	100Ω≦R < 1MΩ
SAS10 (0402)	1/16 W	50V	100V	±50	100Ω≦R < 1MΩ
SAS16 (0603)	1/10 W	75V	150V	±50	100Ω≦R < 1MΩ
SAS21 (0805)	1/8 W	150V	300V	±50	10Ω≦R < 1MΩ
SAS32 (1206)	1/4 W	200V	400V	±50	10Ω≦R < 1MΩ
SAS40 (1210)	1/2 W	200V	400V	±50	10Ω≦R < 1MΩ
SAS50 (2010)	3/4 W	200V	400V	±50	100Ω≦R < 1MΩ
SAS63 (2512)	1W	200V	400V	±50	10Ω≦R < 1MΩ
Operating Temperature Range				-55℃ ~ +155℃(0201: - 55℃ ~ + 125℃)	

3.11 Rated Voltage

Rated Voltage: DC voltage or AC voltage (rms) based on the rated power.
The voltage can be calculated by the following formula. If the calculated value exceeds the Max. voltage specified in the Table 3.1.1, the Max. Voltage rating is set as the voltage rating.

$$E = \sqrt{R \times P}$$

E= Voltage rating (v)
P= Power rating (w)
R= Nominal resistance(Ω)

4. MARKING ON PRODUCT

The nominal resistance shall be marked on the surface of each resistor

Type	Resistance Range	Tolerance≦1%	Tolerance > 1%
SAS05 SAS10	All Jumper = 0Ω	No Marking	
SAS16, SAS21, SAS32, SAS40, SAS50, SAS63	All	Marked as a square	
SAS21, SAS32, SAS40, SAS50, SAS63	< 1Ω	4-digits Marking	4-digits Marking
	≧1Ω	4-digits Marking	3-digits Marking
	Jumper=0Ω	3-digits Marking	1-digit Marking

4.1 Numeric Numbering

4.1.1 ≦1% Tolerance : ***Four Numerals Marking***

First 3 digits are significant figures; fourth digit is number of zeros.

Examples:

Nominal Resistance	***Marking***	***Remarks***
1 Ω	1R00	1 X 10^0 = 1
10 Ω	10R0	10 X 10^0 = 10
100 Ω	1000	100 X 10^0 = 100
4.7K Ω	4701	470 X 10^1 = 470 0
47K Ω	4702	470 X 10^2 = 470 00
470K Ω	4703	470 X 10^3 = 470 000
1M Ω	1004	100 10^4 = 100 0000

4.1.2 0603 1% Tolerance : ***Three Character E-96 Marking Standard.***

The first 2 digits for the 3 digits E-96 part marking standard.

The third character is a letter multiplier :

Nominal resistance	*Marking*	*Remark*
33.2 Ω	51 X	332 X 10^{-1} Ω
150 Ω	18 A	150 X 10^0 Ω
4.99K Ω	68 B	499 X 10^1 Ω
1 0.2K Ω	02 C	102 X 10^2 Ω
100K Ω	01 D	100 X 10^3 Ω

4.1.3 Marking Table

E24 Series

10	11	12	13	15	16	18	20	22	24	27	30
33	36	39	43	47	51	56	62	68	75	82	91

E96 Series

100	102	105	107	110	113	115	118	121	124	127	130
133	137	140	143	147	150	154	158	162	165	169	174
178	182	187	191	196	200	205	210	215	221	226	232
237	243	249	255	261	267	274	280	287	294	301	309
316	324	332	340	348	357	365	374	383	392	402	412
422	432	442	453	464	475	487	499	511	523	536	549
562	576	590	604	619	634	649	665	681	698	715	732
750	768	787	806	825	845	866	887	909	931	953	976

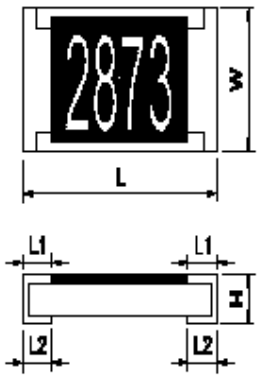
EIAJ-96

Code	Ω	Code	Ω	Code	Ω	Code	Ω	Code	Ω	Code	Ω	Code	Ω	Code	Ω
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

Y = 10^{-2} **X** = 10^{-1} **A** = 10^{0} **B** = 10^{1} **C** = 10^{2} **D** = 10^{3} **E** = 10^{4} **F** = 10^{5}

5. DIMENSION, CONSTRUCTION AND MATERIAL

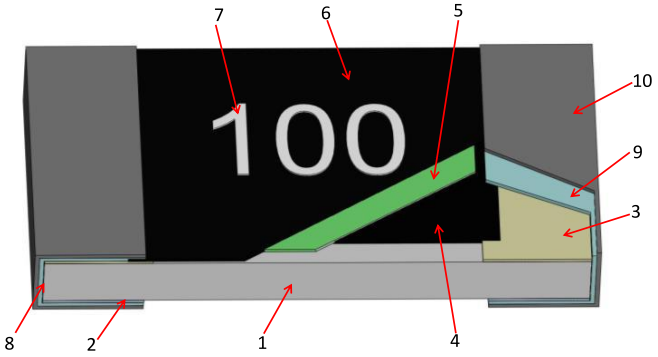
5.1 Dimension



Unit:mm

Type \ Dimension / Size Code	L	W	H	L1	L2
SAS05 / 0201	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.15±0.05
SAS10 / 0402	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
SAS16 / 0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
SAS21 / 0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.20
SAS32 / 1206	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.35±0.20
SAS40 / 1210	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
SAS50 / 2010	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
SAS63 / 2512	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20

5.2 Structure Graph



1	Ceramic substrate	6	2nd Protective coating
2	Bottom inner electrode	7	Marking
3	Top inner electrode	8	Terminal inner electrode
4	Resistive layer	9	Ni plating
5	1st Protective coating	10	Sn plating

5.3 Plating Thickness

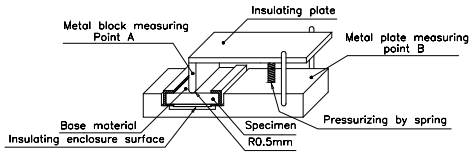
5.3.1 Ni: ≧ 2 µm

5.3.2 Sn(Tin): ≧ 3 µm

5.3.3 Sn(Tin): Matte Sn

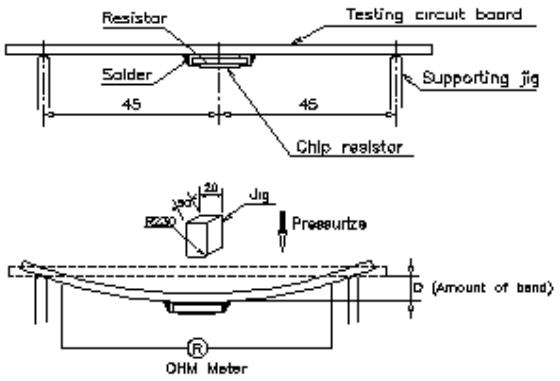
6. RELIABILITY TEST

6.0.1 Electrical Performance Test

Item	Conditions	Specifications Resistors
Temperature Coefficient of Resistance	***Refer to JIS-C5201-1 4.8*** $TCR(ppm/^{\circ}C) = \frac{(R2-R1)}{R1(T2-T1)} x10^6$ R1: Resistance at room temperature R2: Resistance at -55℃ or +125℃ T1: Room temperature T2: Temperature -55℃ or +125℃	Refer to item 3.10
Short Time Overload	***Refer to JIS-C5201-1 4.13*** Applied 2.5 times rated voltage for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Rated voltage refer to item 3. general specifications)	△R%=±1.0%
Insulation Resistance	***Refer to JIS-C5201-1 4.6*** Put the resistor in the fixture, add 100 VDC in + ,- terminal for 60 sec then measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base material.  	≧10^9Ω
Dielectric Withstand Voltage	***Refer to JIS-C5201-1 4.7*** Put the resistor in the fixture, add VAC (see spec. below) in +,- terminal for. SAS21、32、40、50、63 apply 500 VAC 1 minute. SAS05、10、16 apply 300 VAC 1 minute.	No short or burned on the appearance.

6.0.2 Mechanical Performance Test

Item	Conditions	Specifications Resistors
Terminal Strength	***Refer to JIS-C5201-1 4.16*** Test1:The resistor mounted on the board applied 5N pushing force on the sample rear for 10 sec. (SAS05:3N) Test2:The resistor mounted on the board slowly add force on the sample rear until the sample termination is breakdown.	Test 1:No evidence of mechanical damage. Test 2: SAS05≧3N Other≧5N
Resistance to Solvent	***Refer to JIS-C5201-1 4.29*** The tested resistor be immersed into isopropyl alcohol of 20~25℃ for 5 minutes, then the resistor is left in the room for 48 hrs., and measured its resistance variance rate.	SAS05 ： △R%=±1.0% Other ： △R%=±0.5%
Solderability	***Refer to JIS-C5201-1 4.17*** Preconditioning: Put the tested resistor in the apparatus of PCT, at a temperature of 105℃, humidity of 100% RH, and pressure of 1.22×10^5 Pa for a duration of 4 hours. Then after left the tested resistor in room temperature for 2 hours or more. Test method: The resistor be immersed into solder pot in temperature 235±5℃ for 2 sec, then the resistor is left as placed under microscope to observed its solder area.	Solder coverage over 95%
Resistance to Soldering Heat	***Refer to JIS-C5201-1 4.18*** ◎Test method 1 (solder pot test): The tested resistor be immersed into molten solder of 260^{+5}_{-0} ℃ for 10 seconds. Then the resistor is left in the room for 1 hour. ◎Test method 2 (solder pot test): The tested resistor be immersed into molten solder of 260^{+5}_{-0} ℃ for 30 seconds. Then the resistor is left as placed under microscope to observe its solder area. ◎Test method 3 (Electric iron test): Preheating temperature : 350±10℃ Electric iron preheating time : 3^{+1}_{-0} sec Preheating the electric iron on electrode termination, as after that step placed the iron over 60 min. and measured its resistance variance rate.	Test item 1: (1).Variance rate on resistance △R%=±1.0% (2).No evidence of electrode damage. No side conductive peeling off. Test item 2: (1).Solder coverage over 95%. (2).The underlying material (such as ceramic) shall not be visible at the crest corner area of the electrode. Test item 3: (1).Variance rate on resistance △R%=±1.0% (2).No evidence of electrode damage. No side conductive peeling off.

Item	Conditions	Specifications Resistors
Joint Strength of Solder	***Refer to JIS-C5201-1 4.33*** Bending Strength: Solder tested resistor on to PC board. Add force in the middle down, and under load measured its resistance variance rate. D:SAS10、16、21=5mm SAS05、32、40=3mm SAS50、63=2mm 	1).Variance rate on resistance △R%=±1.0% (2).No evidence of mechanical damage. No terminal peeling off and core body cracked.

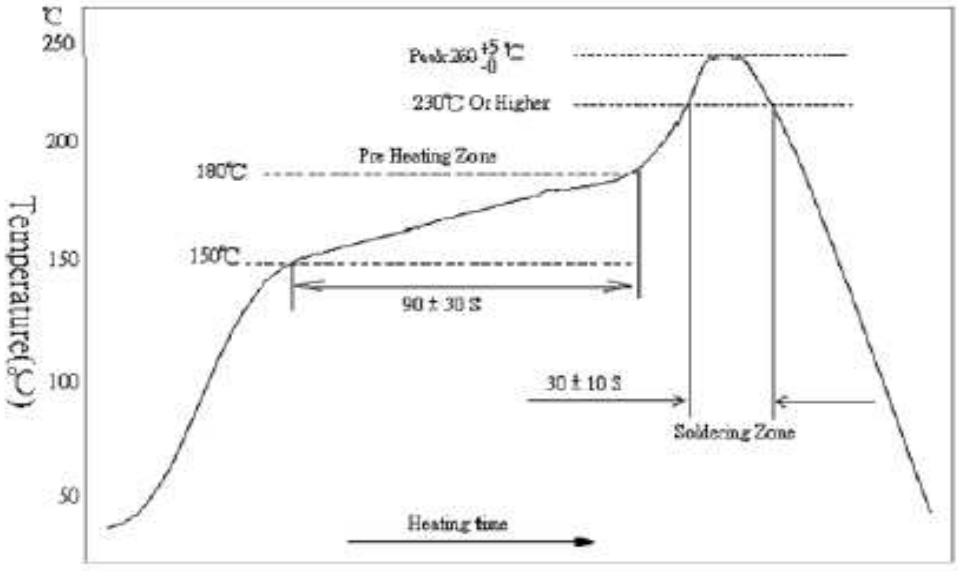
6.0.3 Environmental Test

<table>
<tr><th rowspan="2">Item</th><th rowspan="2">Conditions</th><th>Specifications</th></tr>
<tr><th>Resistors</th></tr>
<tr><td>Resistance to Dry Heat</td><td>Refer to JIS-C5201-1 4.25
Put tested resistor in chamber under temperature 155±5℃ for 1000^{+48}_{-0} hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate.</td><td>△R%=±1.0%</td></tr>
<tr><td>Thermal Shock</td><td>Refer to MIL-STD 202 Method 107
Put the tested resistor in the chamber under the Thermal Shock which shown in the following table shall be repeated 300 times consecutively. Then leaving the tested resistor in the room temperature for 1 hours, and measure its resistance variance rate.
<table>
<tr><th colspan="2">Testing Condition</th></tr>
<tr><td>Lowest Temperature</td><td>-55±5℃</td></tr>
<tr><td>Highest Temperature</td><td>125±5℃</td></tr>
<tr><td>Temperature-retaining time</td><td>15 minutes each</td></tr>
</table></td><td>△R%=±0.5%</td></tr>
<tr><td>Loading Life in Moisture</td><td>Refer to JIS-C5201-1 4.24
Put the tested resistor in the chamber under temperature 40±2℃, relative humidity 90~95% and load the rated voltage for 90 minutes on, 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate.</td><td>△R%=±2.0%</td></tr>
<tr><td>Load Life</td><td>Refer to JIS-C5201-1 4.25
Put the tested resistor in chamber under temperature 70±2℃ and load the rated voltage for 90 minutes on, 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate..</td><td>△R%=±2.0%</td></tr>
<tr><td>Sulfuration Test</td><td>Put the tested resistor in sulfur vapor, at a temperature of 105±2℃for 750hrs
Refer to ASTM-B-809-95&EIA977</td><td>△R=±4.0%</td></tr>
</table>

6.1 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application).

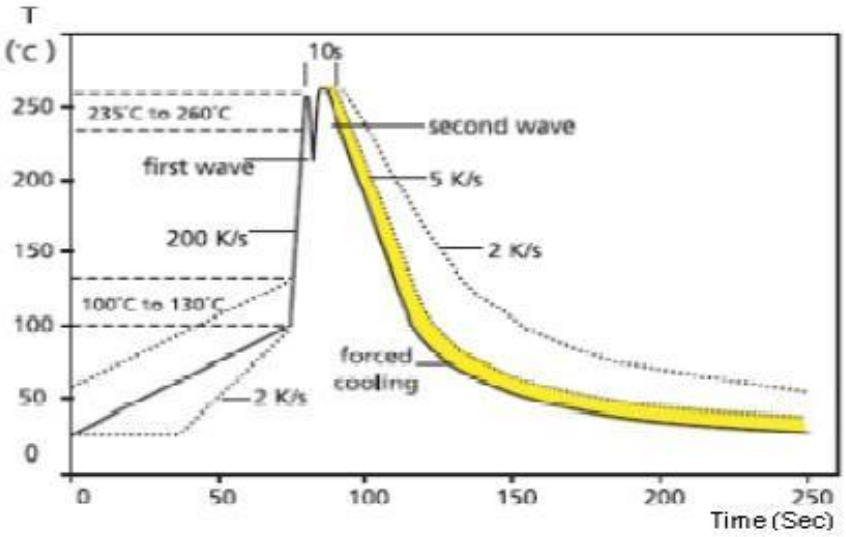
Soldering Profile

6.1.1 Lead Free IR Reflow Soldering Profile



Remark: The peak temperature of soldering heat is 260^{+5}_{-0} ºC for 10 seconds.

6.1.2 Lead-Free Double-Wave Soldering Profile(This applies to 0603 size inclusive above products)

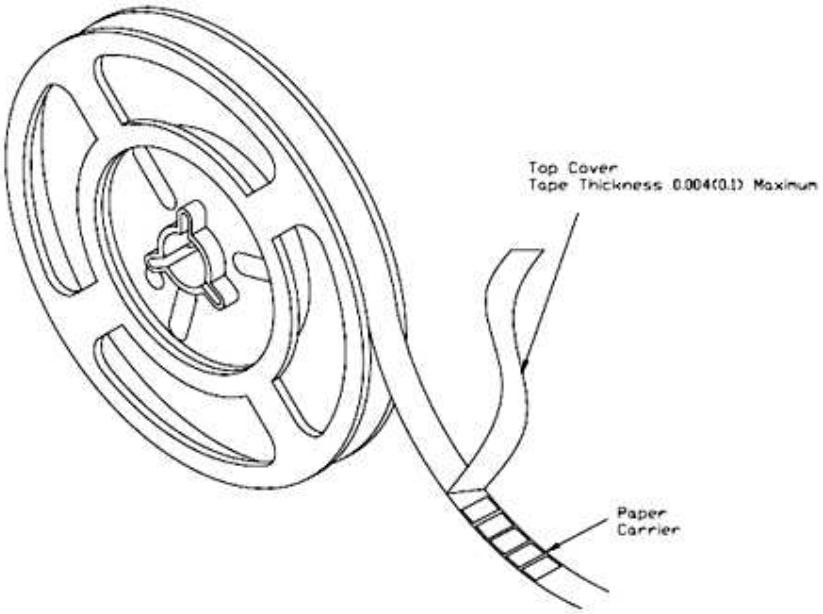


6.1.3 Soldering Iron : Temperature 350ºC±10ºC, dwell time shall be less than 3 sec.

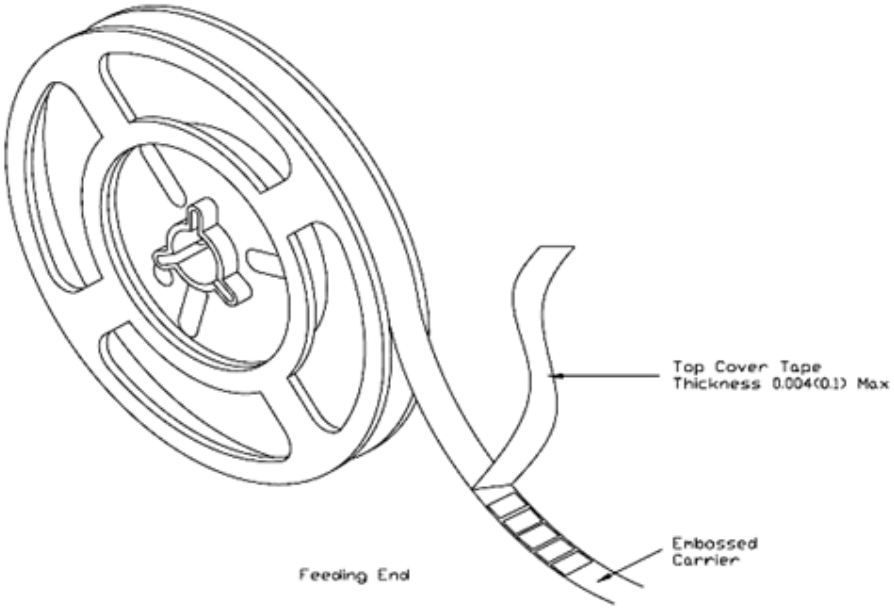
7. TAPING

7.1 Structure of Taping

Paper Carrier

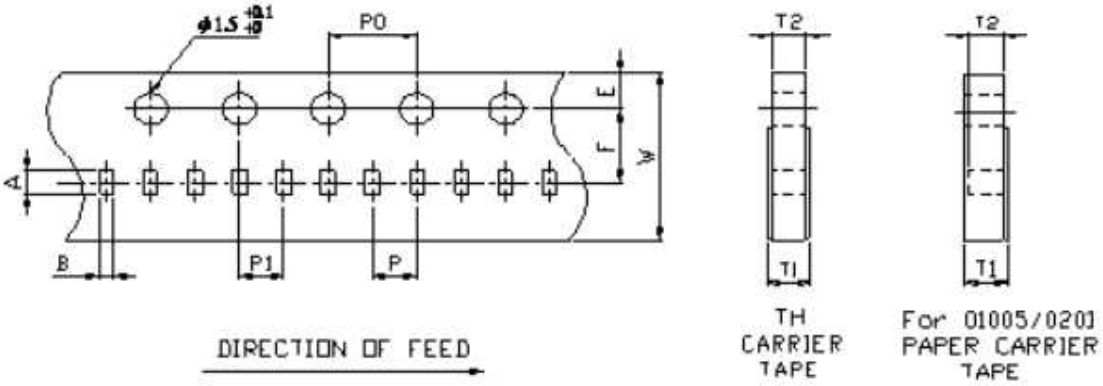


Embossed Plastic Carrier



7.2 Dimension

7.2.1 Dimension of Punched Paper Tape Carrier System (SAS05,SAS10)



Remark: Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

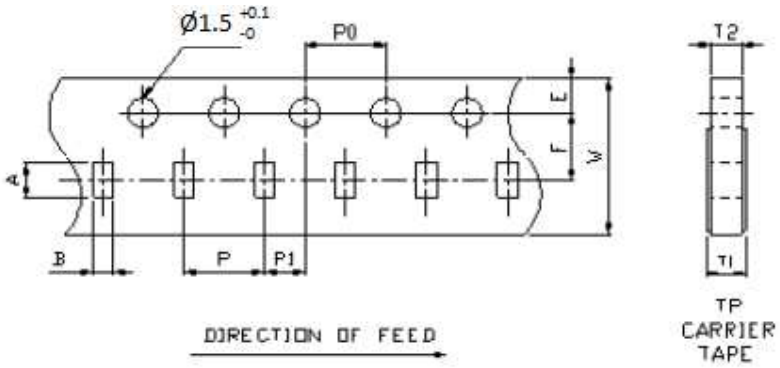
Dimension of Punched Paper Tape Carrier System (SAS05, 10)

(unit : mm)

Code	A	B	W	E	F	T_1
SAS05	0.68±0.05	0.38±0.03	8.00±0.10	1.75±0.10	3.50±0.05	$0.42^{+0.1}_{-0}$
SAS10	1.15±0.05	0.65±0.05	8.00±0.20	1.75±0.10	3.50±0.05	$0.42^{+0.2}_{-0}$

Code	T_2	P	P0	10 x P0	P1
SAS05	0.28±0.02	2.00±0.05	4.00±0.05	40.0±0.20	2.00±0.05
SAS10	0.40±0.05	2.00±0.10	4.00±0.05	40.0±0.20	2.00±0.05

7.2.2 Dimension of Punched Paper Tape Carrier System /Plastic Embossed Carrier System (SAS16, 21, 32, 40)

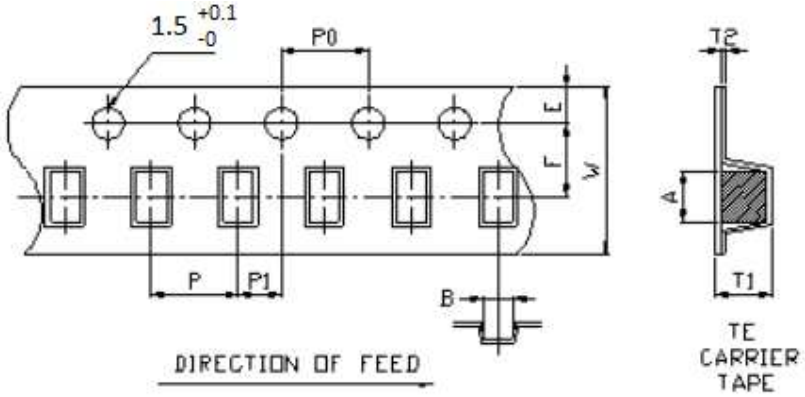


Remark: Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

Dimension of Punched Paper Tape Carrier System (SAS - 16, 21, 32, 40)

Code	A	B	W	E	F	T1	T2	P	P0	P1
SAS16	1.8±0.10	1.0±0.10	8.0±0.20	1.75±0.10	3.50±0.05	$0.60^{+0.2}_{-0}$	0.60±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS21	2.3±0.10	1.55±0.1	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS32	3.5±0.20	1.9±0.20	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05
SAS40	3.5±0.20	2.8±0.20	8.0±0.20	1.75±0.10	3.50±0.05	$0.75^{+0.2}_{-0}$	0.75±0.10	4.0±0.10	4.0±0.05	2.0±0.05

Dimension of Plastic Embossed Carrier System (SAS - 50, 63)



Code	A	B	W	E	F	T1	T2	P	P0	P1
SAS50	5.5±0.20	2.8±0.20	12.0±0.20	1.75±0.10	5.50±0.05	1.10±0.15	0.23±0.15	4.0±0.10	4.0±0.05	2.0±0.05
SAS63	6.7±0.20	3.4±0.20	12.0±0.20	1.75±0.10	5.50±0.05	1.10±0.15	0.23±0.15	4.0±0.10	4.0±0.05	2.0±0.05

7.3 Packaging

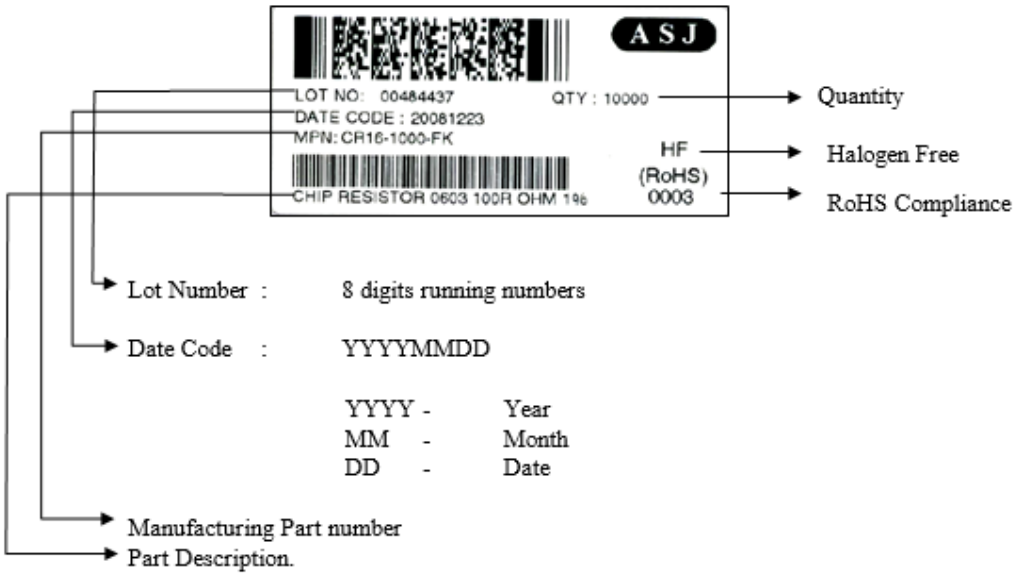
7.3.1 Taping

7.3.2 Quantity – Tape and Reels

Code	Quantity	Model	Remarks
SAS05 SAS10	10,000 pcs	7" Reel	2mm pitch (Paper Carrier)
	20,000 pcs	7" Reel	2mm pitch (Paper Carrier)
	50,000 pcs	13" Reel	2mm pitch (Paper Carrier)
SAS16 SAS21 SAS32 SAS40	5,000 pcs	7" Reel	4mm pitch (Paper Carrier)
	10,000 pcs	10" Reel	4mm pitch (Paper Carrier)
	20,000 pcs	13" Reel	4mm pitch (Paper Carrier)
SAS50	4,000 pcs	7" Reel	4mm pitch (Embossed Carrier)
SAS63	4,000 pcs	7" Reel	4mm pitch (Embossed Carrier)

7.3.3 Identification

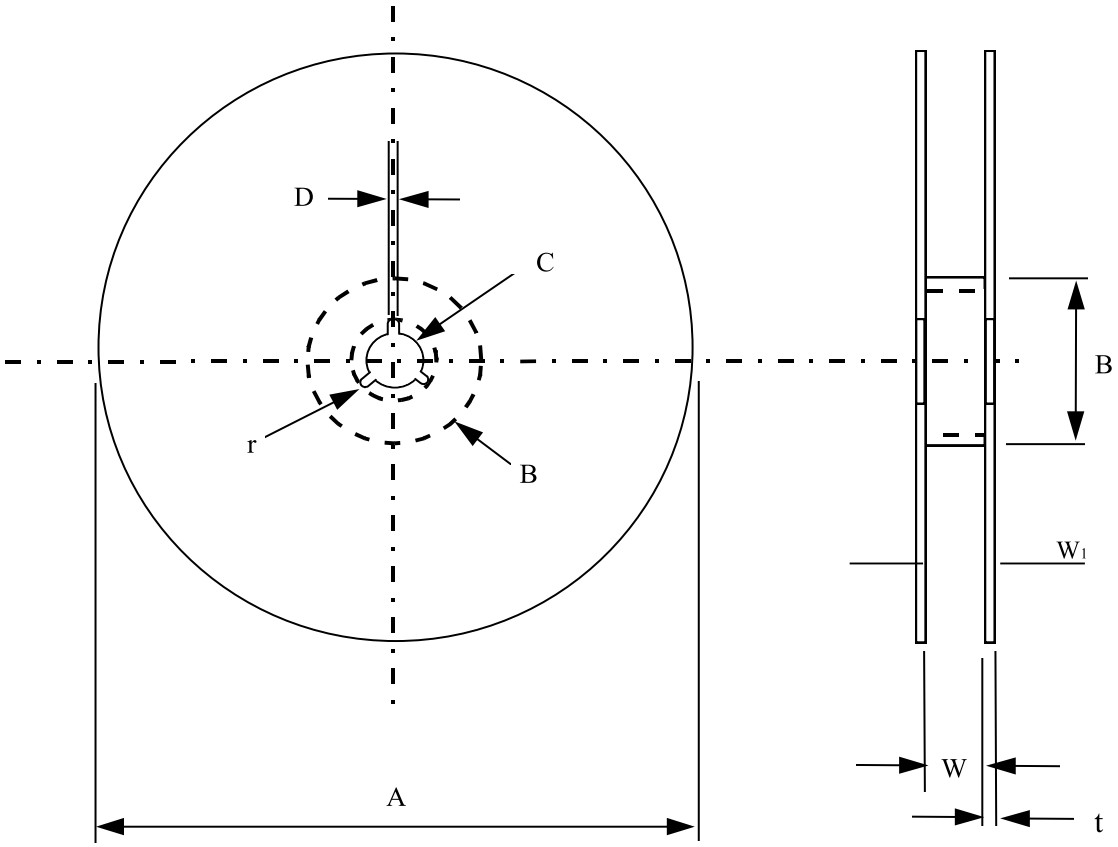
Production label that indicates the 8 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.3.4 Packaging Reel Box

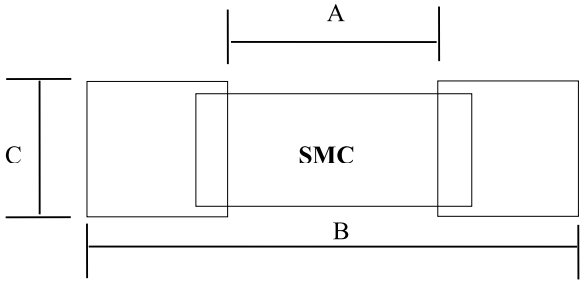
Dimension	Reel Box	Number of Reels
185 × 60 × 186 mm	25K Box	5
185 × 120 × 186 mm	50K Box	10

7.3.5 Reel Dimensions



Model	A	B	C	D	W	W_1	t	r
7"Reel (5K) (except 0402 10K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 0.1	14.4 max	1.0± 0.1	1.0
7"Reel (4K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	13±1.0	14.4 max	1.2± 0.1	1.0
7''Reel (10K)	ϕ178±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 0.1	14.4 max	1.0± 0.1	1.0
10"Reel (10K)	ϕ254±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 1.0	14.4 max	1.5± 0.1	1.0
13"Reel (20K)	ϕ330±2.0	ϕ60min	13± 0.2	ϕ2.0± 0.5	11± 1.0	14.4 max	2.1± 0.1	-
13"Reel (20K)	ϕ330±1.0	ϕ100±1	13.5±0.5	2~3±0.5	10±0.5	-	-	-

8. SURFACE MOUNT LAND PATTERNS

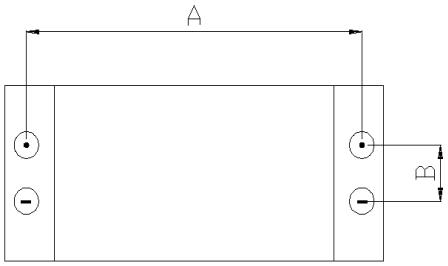


Unit: mm

Product (Type)	Land Dimension		
	A	B	C
SAS05	0.3	1.0	0.4
SAS10	0.5	1.5	0.6
SAS16	0.8	2.1	0.9
SAS21	1.2	3.0	1.3
SAS32	2.2	4.2	1.6
SAS40	2.2	4.2	2.8
SAS50	3.5	6.1	2.8
SAS63	3.8	8.0	3.5

9. MEASUREMENT POINT

Bottom electrode



Unit : mm

TYPE \ DIM	A	B
SAS05	0.44±0.05	0.22±0.05
SAS10	0.80±0.05	0.24±0.05
SAS16	1.35±0.05	0.35±0.05
SAS21	1.80±0.05	0.35±0.05
SAS32	2.90±0.05	0.35±0.05
SAS40	2.90±0.05	0.35±0.05
SAS50	4.50±0.05	1.15±0.05
SAS63	5.90±0.05	1.60±0.05

10. REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version. 1	18.12.2018		Initial Release
Version.2	13.11.2019		Revise clause 1.2 Revise clause 2 Part Numbering System Revise clause 3.2 Power derating curve Revise clause 3.9 Revise clause 6.0.3 sulfuration test
Version.3	14.10.2020		Revise clause 3.5 Storage temp. range
Version.4	04.03.2021		Revise clause 2 Part Numbering System
Version 5	14.04.2023		Revise clause 3.8 Product Assurance