Towards Excellence in *Quality, Service & Innovation*

ASJ

DATA SHEET

Anti-Surge Thick Film Chip Resistor

APS Series (Automotive Grade)

5%, TCR ±200 To ±400

SIZE: 0402, 0603, 0805, 1206, 1210, 2010, and 2512

RoHS-Compliant

Product Specification – August 04, 2023 V5

1. SCOPE

1.1 This specification is applicable to Lead-free and Halogen-free of RoHS Directive for APS series anti-surge thick film chip resistors for automotive grade.

1.2 This product is for automotive electronic application.

1.3 AEC-Q200 qualified , grade 0

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

APS	21	-	100			-	J	L
Series	Size		Nominal Resistance				Tolerance	Packaging
Anti-Surge Thick Film Chip Resistors (Automotive Grade)	10(0402/1005) 16(0603/1608) 21(0805/2012) 32(1206/3216) 40(1210/3225) 50(2010/5025) 63(2512/6432)		Resistor	3-Digit	Ex. 10Ω = 100 47Ω = 470		J = ±5%	E = 4000 pcs L = 5000 pcs K = 10000 pcs Y = 20000 pcs N = 50000 pcs

3. RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

Type	Rated Power	Max. Working Voltage	Max. Overload Voltage
APS10 (0402)	$\frac{1}{8}$W	50V	100V
APS16 (0603)	$\frac{1}{4}$W	75V	150V
APS21 (0805)	$\frac{2}{5}$W	150V	200V
APS32 (1206)	$\frac{1}{2}$W	200V	400V
APS40 (1210)	$\frac{3}{4}$W	200V	400V
APS50 (2010)	$\frac{3}{4}$W	200V	400V
APS63 (2512)	1W	200V	400V

3.2 Power Derating Curve:

Operating Temperature Range：- 55 ~ 155 ℃

For resistors operated in ambient temperatures above 70℃, power rating shall be derated in accordance with figure below。

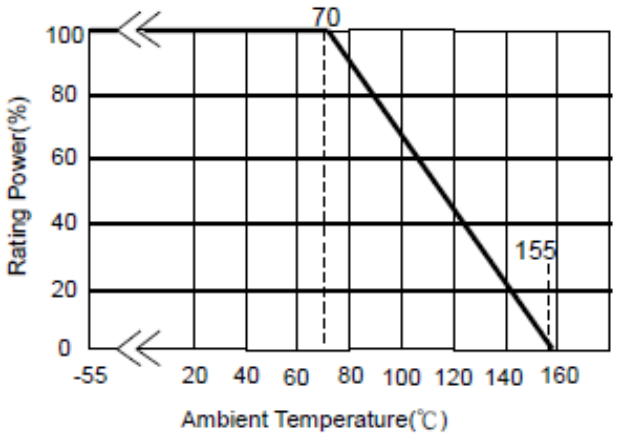


Fig.1 Power Derating Characteristics

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

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	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm/℃)	Resistance Range J(±5%) E-24
APS10 (0402)	1/8W	50V	100V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS16 (0603)	1/4W	75V	150V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS21 (0805)	2/5W	150V	200V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS32 (1206)	1/2W	200V	400V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS40 (1210)	3/4W	200V	400V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS50 (2010)	3/4W	200V	400V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
APS63 (2512)	1W	200V	400V	±200	10Ω＜R≦10MΩ
				±400	1Ω≦R≦10Ω
Operating Temperature Range				-55℃ ~ +155℃	

3.11 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 3.10, 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

Part Number	Color	Marking on Product
APS10 (0402)	-	No marking
APS16 (0603)	Light Yellow	1) Tolerance; ± 5% (J) Three Numerals Marking
APS21(0805)	Light Yellow	
APS32(1206) APS40(1210)	Light Yellow	
APS50(2010)	Light Yellow	
APS63(2512)	Light Yellow	

4.1 Numeric Numbering

4.1.1 5% Tolerance : ***Three Numerals Marking***

First 2 digits are significant figures, third digit is number of zeros. Letter R is decimal point.

Examples:

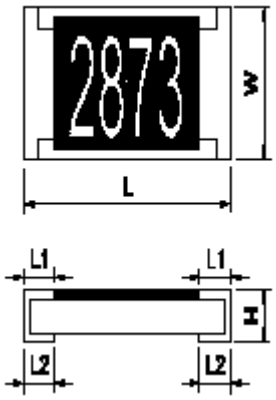
Nominal Resistance	***Marking***	***Remarks***
1 Ω	1R0	1 X 10^0 = 1
10 Ω	100	10 X 10^0 = 1 0
100 Ω	101	10 X 10^1 = 1 00
4.7K Ω	472	47 X 10^2 = 47 00
47K Ω	473	47 X 10^3 = 47 000
470K Ω	474	47 X 10^4 = 47 0000
4.7M Ω	475	47 X 10^5 = 47 00000

E-24 series

10	11	12	13	14	16	18	20	22	24	27	30
33	36	39	43	47	51	56	62	68	75	82	91

5. DIMENSION, CONSTRUCTION AND MATERIAL

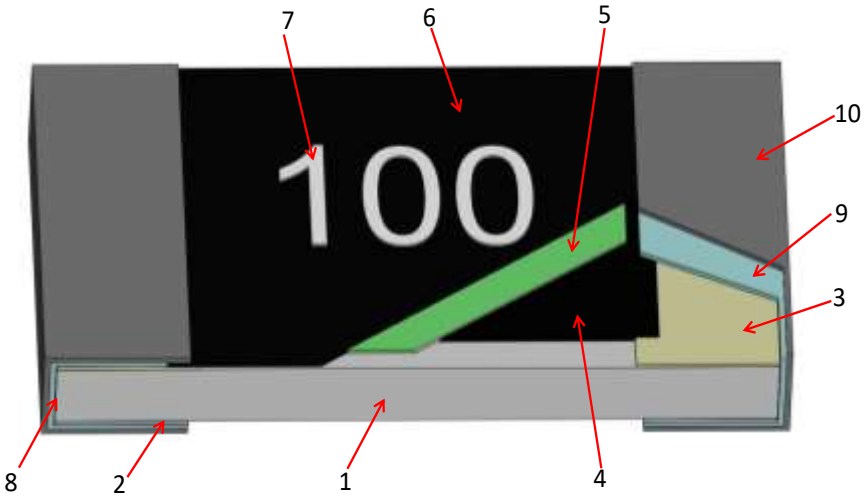
5.1 Dimension



Unit:mm

Type \ Dimension / Size Code		L	W	H	L1	L2
APS10	**0402**	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
APS16	**0603**	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
APS21	**0805**	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
APS32	**1206**	3.05±0.10	1.55±0.10	0.55±0.10	0.45±0.20	0.35±0.15
APS40	**1210**	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
APS50	**2010**	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
APS63	**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

Ni : ≧ 2 µm

Sn (Tin) : ≧ 3 µm

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. 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 voltage for 5 seconds and release the load for about 30 minutes, then measure its resistance variance rate. (Rated voltage refer to item 3.10 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 voltage 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 voltage 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 voltage shall refer to the power de-rating curve (referring to page 3,No.3.2) Experiment evidence: AEC-Q200	△R=±3.0%
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%=±1.0%

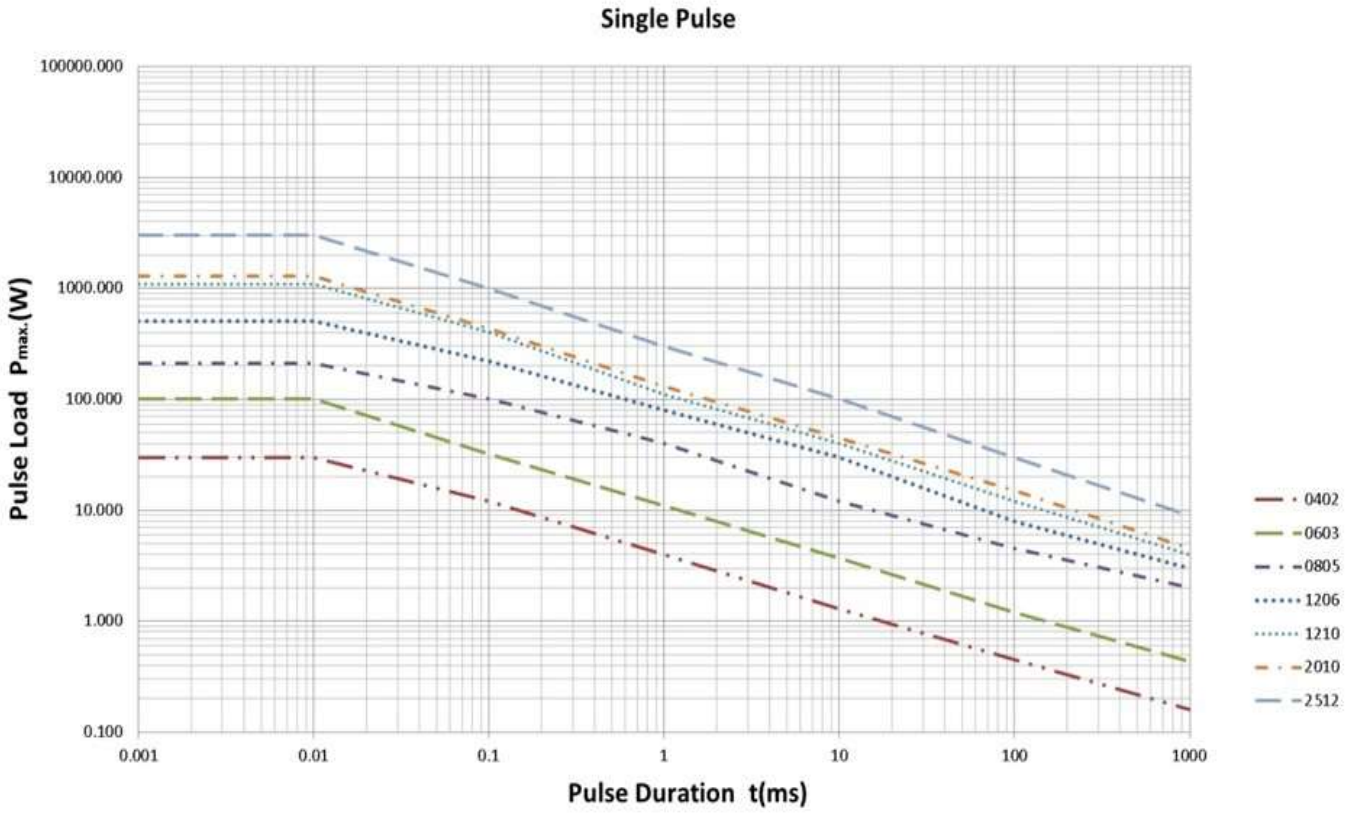
Item	Conditions	Specifications Resistors
ESD	Put the specimens on the test fixture and two (2)discharges (2KVDC) shall be applied to each PUT, one (1) with a positive polarity and one (1) with a negative polarity. Afterwards, the specimens stabilize for 30min or more and measure of its resistance variance 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%
Lightning Surge Test	**Test 1:** 5 pulses of 1.2/50μs with a period of not less than 12s. **Test 2**: 10 pulses of 10/700μs with a period of not less than 1 min. Refer to IEC 60 115-1 4.27	△R=±5.0%
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
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) APS10、16、21=5mm APS32、40=3mm APS50、63=2mm Experiment evidence: AEC-Q200	△R=±1.0% No mechanical damage, peel-off of side end or chip crack.

Item	Conditions	Specifications	
		Resistors	
Sulfuration Test	**Class : A** Put the tested resistor in sulfur vapor, at a temperature of 60±2°Cfor 1000hrs. Refer to ASTM-B-809-95 & EIA977	△R=±4.0%	Refer to item 3.10 general specifications

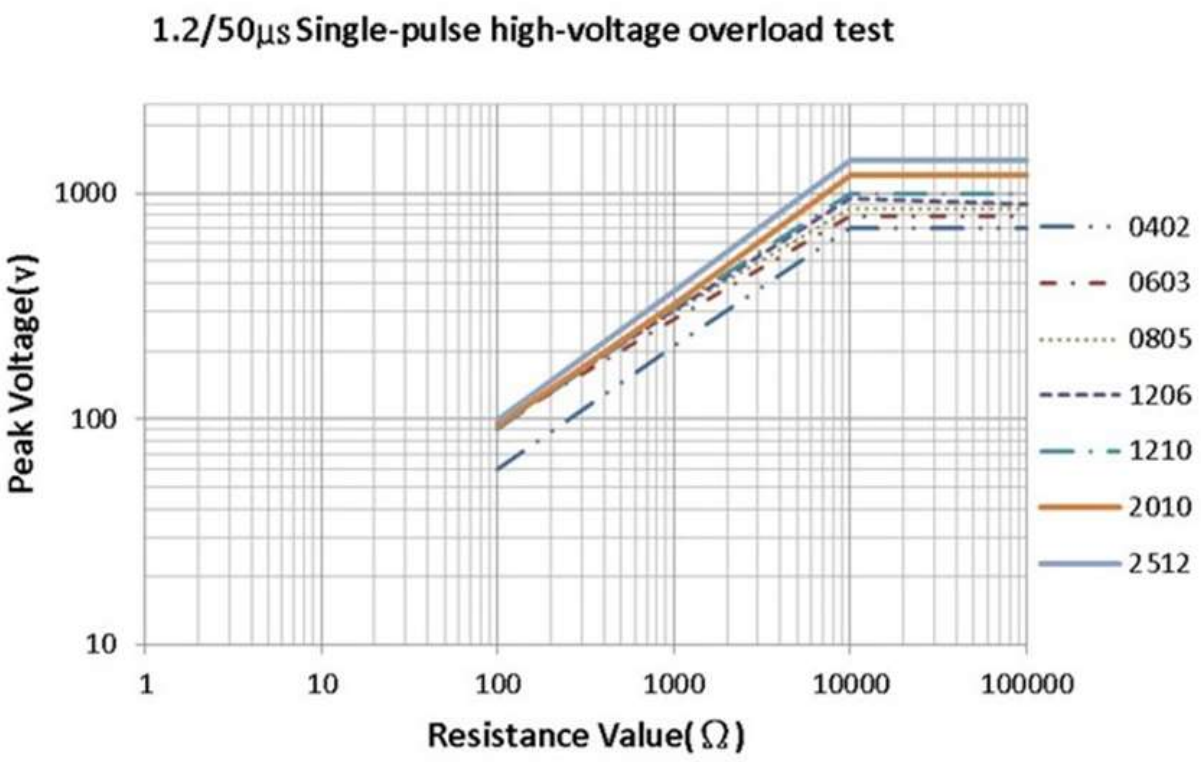
6.1 Pulse Loading Capability

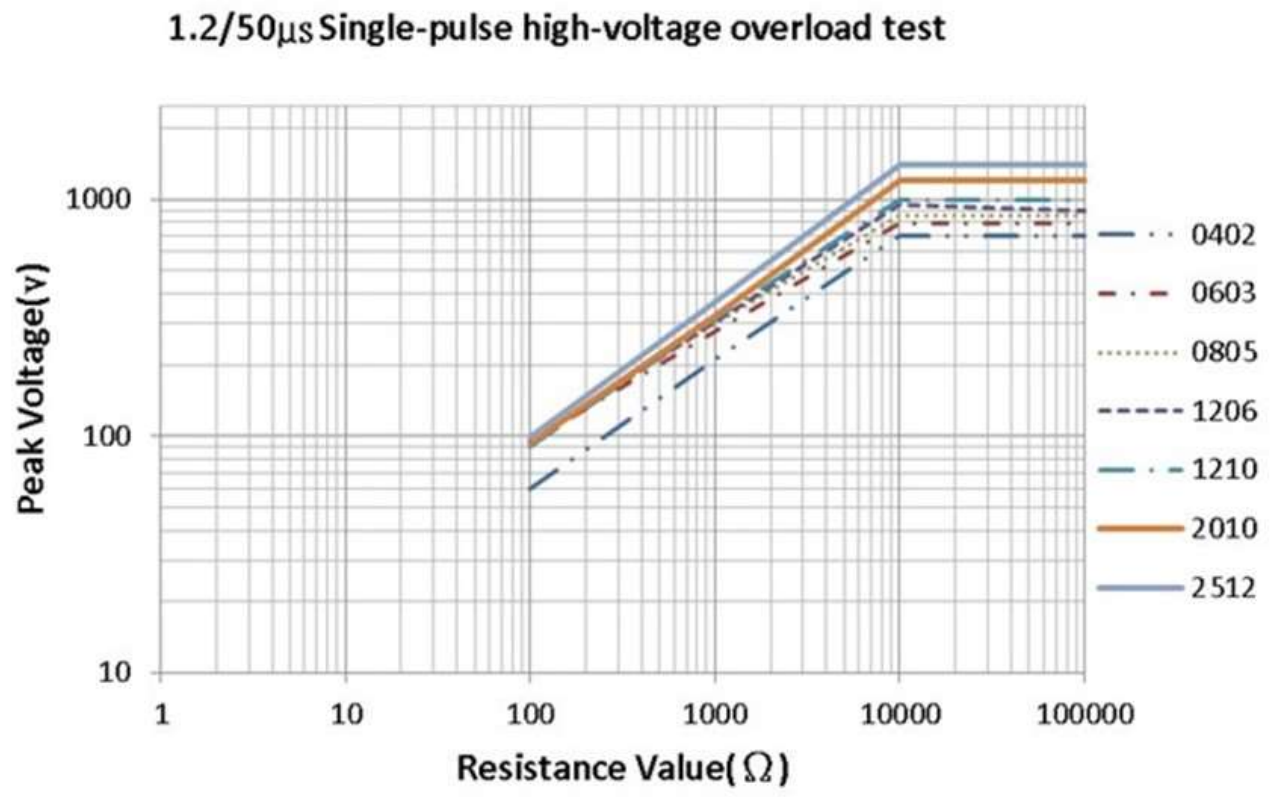
Pulse on a regular basis; maximum permissible peak pulse power (Pmax) as a function of a pulse duration.

V_{peak}≦0402(100V)、0603(150V)、0805(300V)、1206(400V)、1210(400V)、2010(400V)、2512(400V)



Lightning Surge Load:

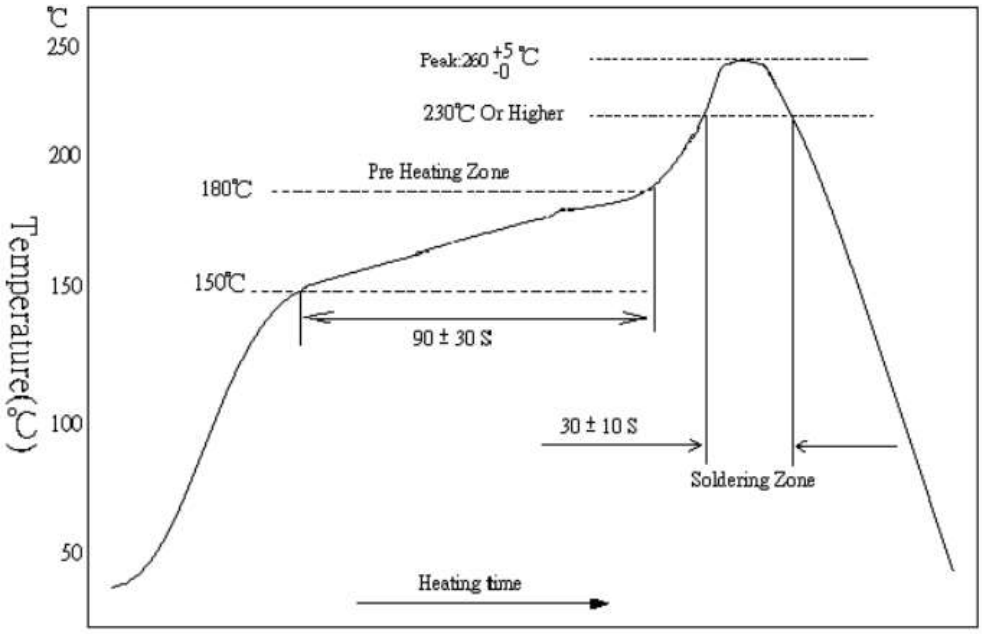




6.2 Technical application notes: (This is for recommendation, customer please perform adjustment according to the actual application)

Soldering Profile

6.2.1 Lead-Free IR Reflow Soldering Profile

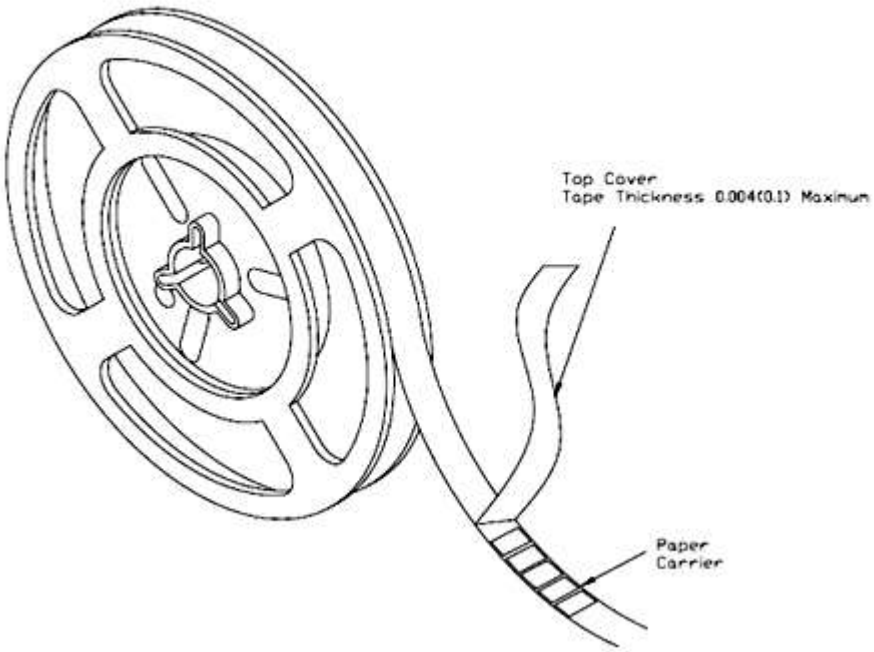


6.2.2 Soldering Iron: Temperature 350°C ± 10°C , dwell time shall be less than 3 sec.

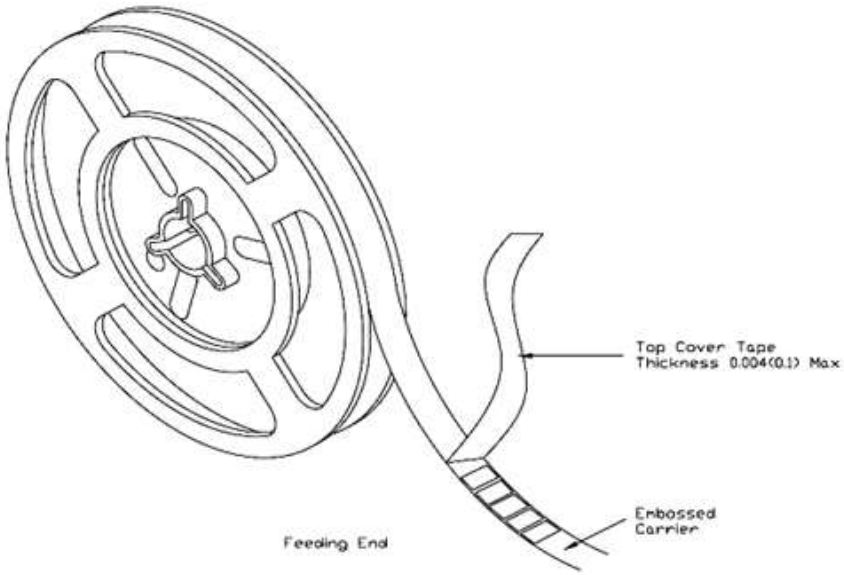
7. TAPING

7.1 Structure of Taping

Paper Carrier

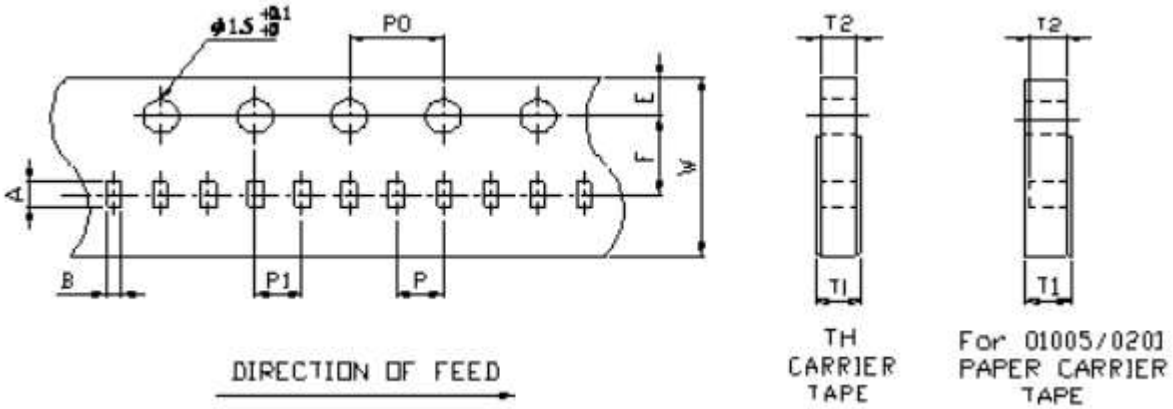


Embossed Plastic Carrier



7.2 Dimension

7.2.1 Dimension of Punched Paper Tape Carrier System(APS10)



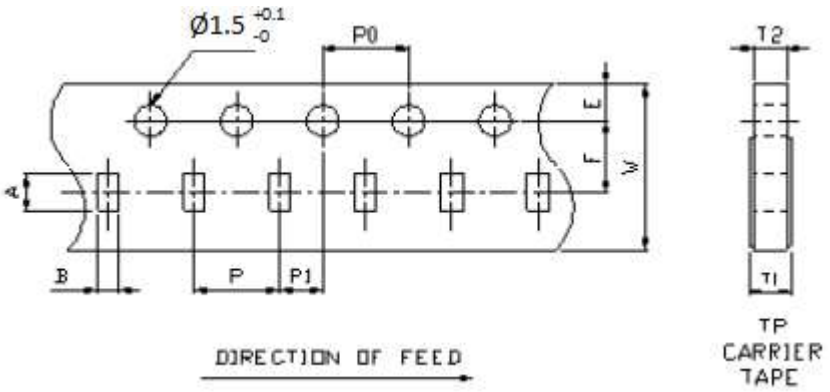
Remark : Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

Dimension of Punched Paper Tape Carrier System

(unit: mm)

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
APS10	1.15±0.03	0.65±0.05	8.00±0.20	1.75±0.10	3.50±0.05	$0.40^{+0.2}_{-0}$	0.40±0.05	2.00±0.10	4.00±0.05	2.00±0.05	40.0±0.20

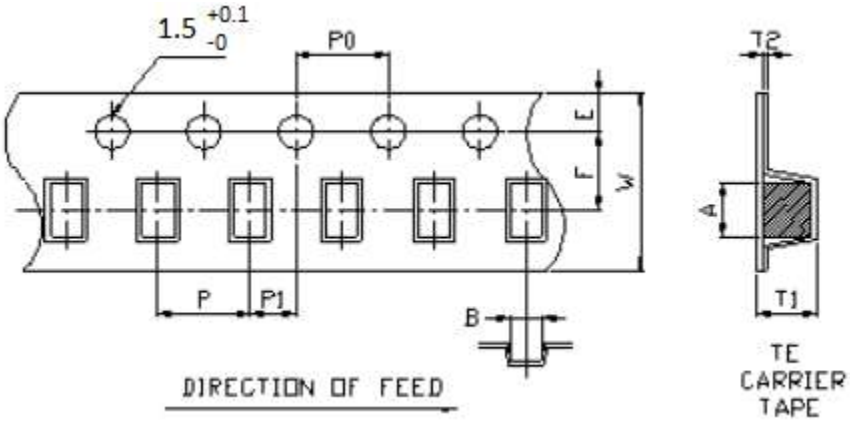
7.2.2 Dimension of Punched Paper Tape Carrier System (APS16, 21, 32, 40)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1
APS16	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
APS21	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
APS32	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
APS40	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

7.2.3 Dimension of Punched Paper Tape Carrier System (APS50, 63)



Dimension of Punched Paper Tape Carrier System (CPS – 50, 63)

Code	A	B	W	E	F	T1	T2	P	P0	P1
APS50	5.50 ± 0.20	2.80 ± 0.20	12.00 ± 0.20	1.75 ± 0.10	5.50 ± 0.05	1.10 ± 0.15	0.23 ± 0.15	4.0 ± 0.10	4.00 ± 0.05	2.00 ± 0.05
APS63	6.70 ± 0.20	3.40 ± 0.20	12.00 ± 0.20	1.75 ± 0.10	5.50 ± 0.05	1.10 ± 0.15	0.23 ± 0.15	4.0 ± 0.10	4.00 ± 0.05	2.00 ± 0.05

7.3 Packaging

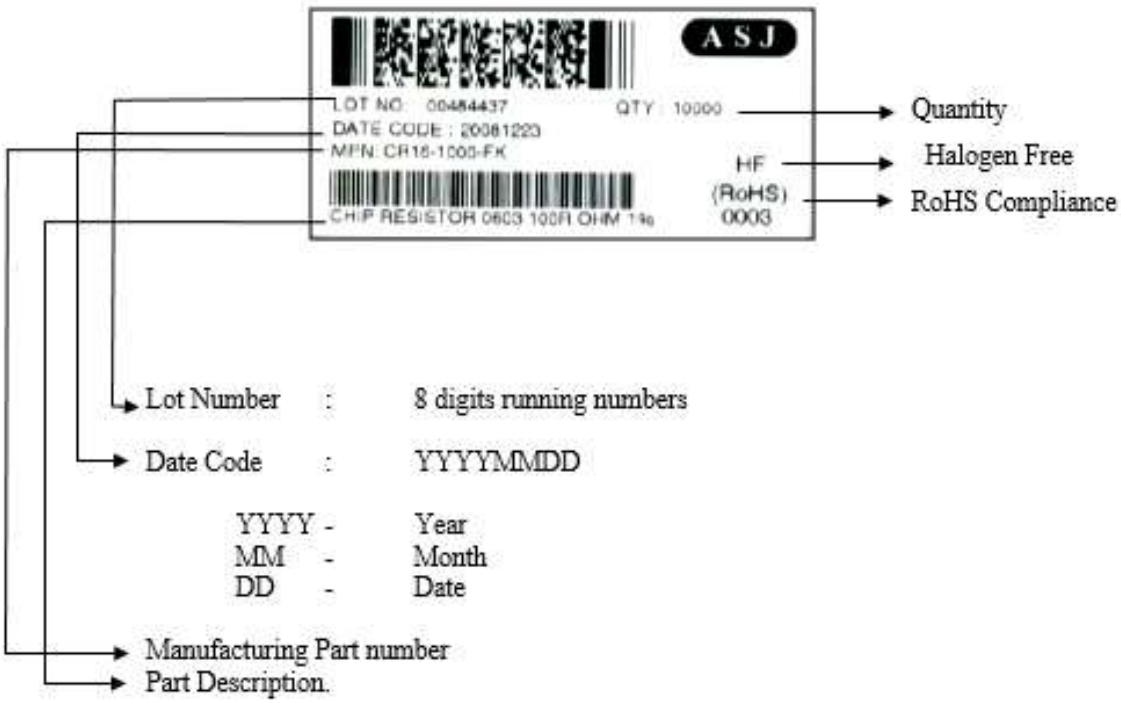
7.3.1 Taping

Quantity – Tape and Reels

Type	Qty(pcs/reel)	Reel	Remark
APS10	10,000	7”	2mm pitch
	20,000	7”	2mm pitch
	50,000	13”	2mm pitch
APS16	5,000	7”	4mm pitch
APS21	10,000	10”	4mm pitch
APS32 APS40	20,000	13”	4mm pitch
APS50	4,000	7”	Embossed 4mm pitch
APS63	4,000	7”	Embossed 4mm pitch

7.4 Identification

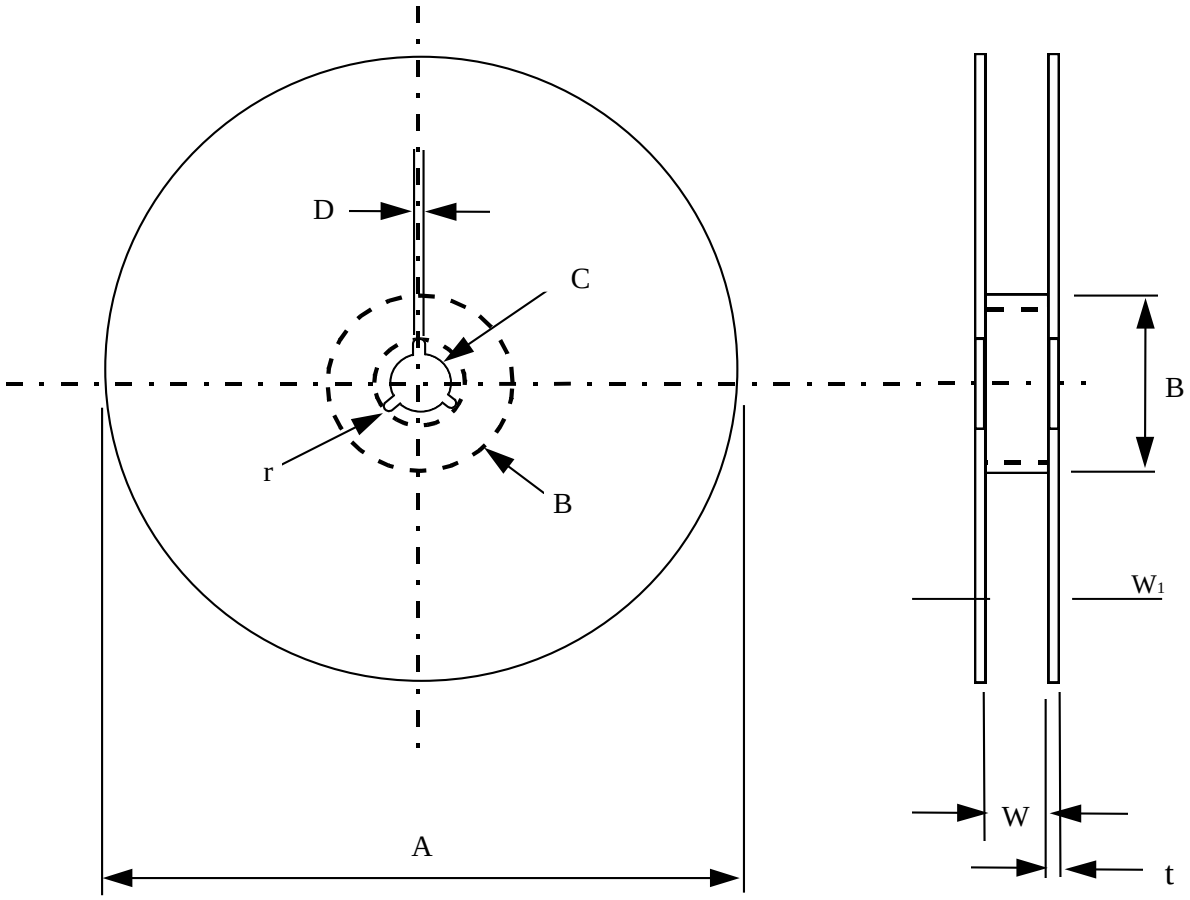
Production label that indicates the 8 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.4.1 Packaging Reel Box

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

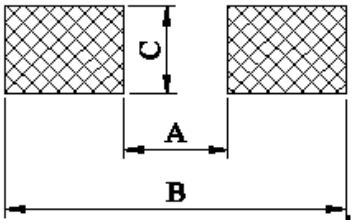
7.4.2 Reel Dimensions



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, 50K)	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 DESIGN (FOR REFLOW 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.

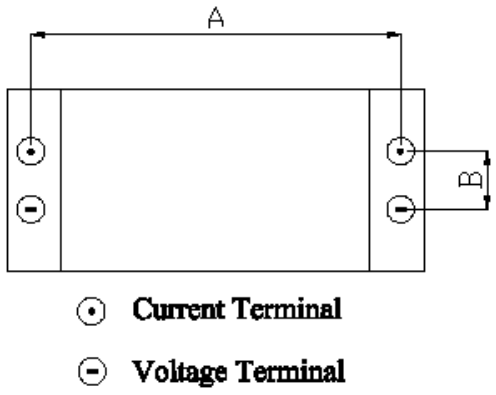


Unit:mm

TYPE \ DIM	A	B	C
APS10	0.5	1.5	0.6
APS16	0.8	2.1	0.9
APS21	1.2	3.0	1.3
APS32	2.2	4.2	1.6
APS40	2.2	4.2	2.8
APS50	3.5	6.1	2.8
APS63	3.8	8.0	3.5

9. MEASUREMENT POINT

Measure from bottom electrodes



Unit : mm

TYPE \ DIM	A	B
APS10	**0.80±0.05**	**0.24±0.05**
APS16	**1.35±0.05**	**0.35±0.05**
APS21	**1.80±0.05**	**0.35±0.05**
APS32	**2.90±0.05**	**0.35±0.05**
APS40	**2.90±0.05**	**0.35±0.05**
APS50	**4.50±0.05**	**1.15±0.05**
APS63	**5.90±0.05**	**1.60±0.05**

10. REVISION HISTORY

REVISION	DATE	CHANGE NOTICE	DESCRIPTION
Version.1	27.12.2018		Initial Release
Version.2	14.10.2020		Revise clause 3.5 Storage temp. range Revise clause 3.9
Version.3	12.03.2021		Revise clause 1.3, grade 1 to grade 0 Revise clause 3.10, TCR table
Version.4	09.12.2021		Revise clause 6 Reliability test item Temperature Cycling from 5 minute to 15 minute
Version 5	04.08.2023		Revise clause 3.1.1 type 0402 Rated Power Revise clause 3.8 Product Assurance Revise clause 3.10 type 0402 Rated Power Add clause 6 Item Sulfuration Test

ASJ

DATA SHEET

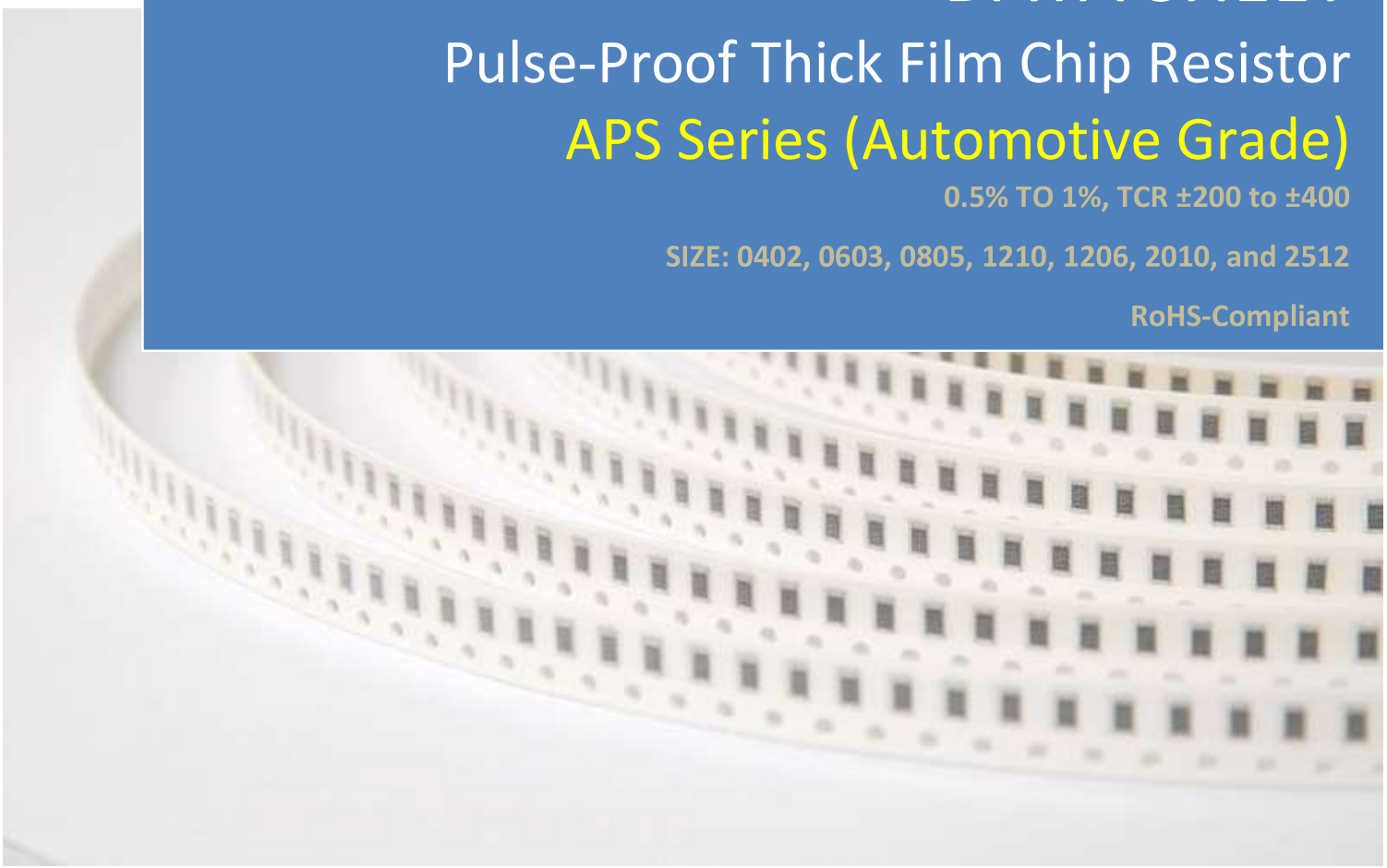
Pulse-Proof Thick Film Chip Resistor

APS Series (Automotive Grade)

0.5% TO 1%, TCR ±200 to ±400

SIZE: 0402, 0603, 0805, 1210, 1206, 2010, and 2512

RoHS-Compliant



1. SCOPE

1.1 This specification is applicable to Lead-free and Halogen-free of RoHS Directive for APS series pulse-proof thick film chip resistors.

1.2 This product is for automotive electronic application.

1.3 AEC-Q200 qualified, grade 0.

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

APS	21	-	1002			-	F	L
Series	Size		Nominal Resistance				Tolerance	Packaging
Pulse-Proof Thick Film Chip Resistors (Automotive Grade)	10(0402/1005) 16(0603/1608) 21(0805/2012) 32(1206/3216) 40(1210/3225) 50(2010/5025) 63(2512/6432)		Resistor	4-Digit	Ex. 10.2Ω = 10R2 10KΩ = 1002		D = ±0.5% F = ±1%	E = 4000 pcs L = 5000 pcs K = 10000 pcs Y = 20000 pcs N = 50000 pcs

3. RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

Type	Rated Power at	Max. Working Voltage	Max. Overload Voltage
APS10 (0402)	$\frac{1}{16}$W	50V	100V
APS16 (0603)	$\frac{1}{4}$W	75V	150V
APS21 (0805)	$\frac{2}{5}$W	150V	200V
APS32 (1206)	$\frac{1}{2}$W	200V	400V
APS40 (1210)	$\frac{3}{4}$W	200V	400V
APS50 (2010)	$\frac{3}{4}$W	200V	400V
APS63 (2512)	1W	200V	400V

3.2 Power Derating Curve:

Operating Temperature Range：- 55 ~ 155 ℃

For resistors operated in ambient temperatures above 70℃, power rating shall be derated in accordance with figure below。

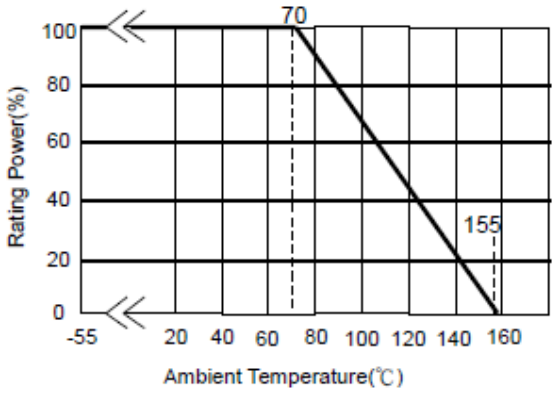


Fig.1 Power Derating Characteristics

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

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	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm/℃)	Resistance Range	
					D(±0.5%) E-96	F(±1%) E-96
APS10 (0402)	1/16W	50V	100V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS16 (0603)	1/4W	75V	150V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS21 (0805)	2/5W	150V	200V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS32 (1206)	1/2W	200V	400V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS40 (1210)	3/4W	200V	400V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS50 (2010)	3/4W	200V	400V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
APS63 (2512)	1W	200V	400V	±200	10Ω≦R≦1MΩ	10Ω≦R≦1MΩ
				±400	1Ω≦R≦10Ω	1Ω≦R≦10Ω
Operating Temperature Range				-55℃ ~ +155℃		

3.11 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, 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

Part Number	Color	Marking on Product
APS10 (0402)	-	No marking
APS16 (0603)	Light Yellow	1) Tolerance; ± 0.5% (D), ±1.0% (F) Four Numerals Marking
APS21(0805)	Light Yellow	
APS32(1206) APS40(1210)	Light Yellow	
APS50(2010)	Light Yellow	
APS63(2512)	Light Yellow	

4.1 Numeric Numbering

4.1.1 0.5% & 1% Tolerance : ***Four Numerals Marking***

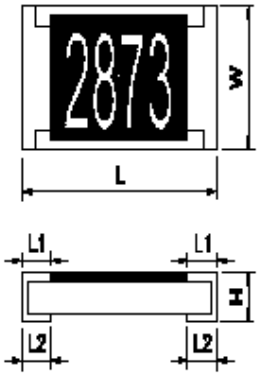
First 3 digits are significant figures, fourth digit is number of zeros.

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 X 10^4 = 100 0000

5. DIMENSION, CONSTRUCTION AND MATERIAL

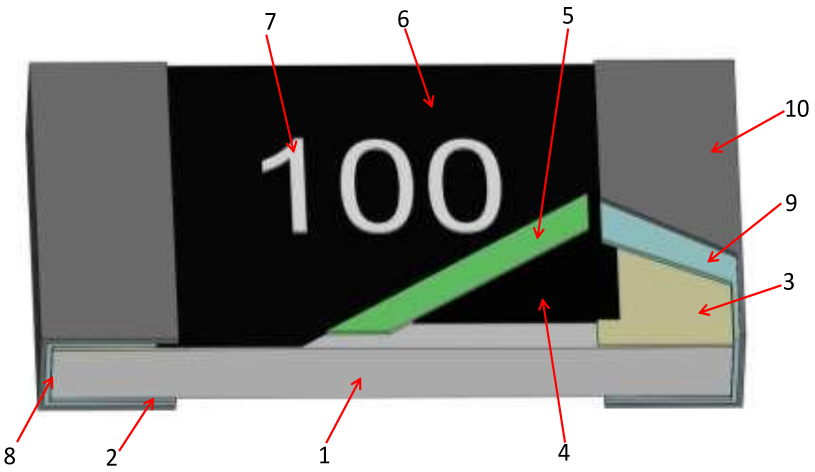
5.1 Dimension



Unit:mm

Type \ Dimension / Size Code	L	W	H	L1	L2
APS10 **0402**	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
APS16 **0603**	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
APS21 **0805**	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
APS32 **1206**	3.05±0.10	1.55±0.10	0.55±0.10	0.45±0.20	0.35±0.15
APS40 **1210**	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
APS50 **2010**	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
APS63 **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

Ni : ≧ 2 μm

Sn (Tin) : ≧ 3 μm

Sn (Tin) : Matte Sn

6. RELIABILITY TEST

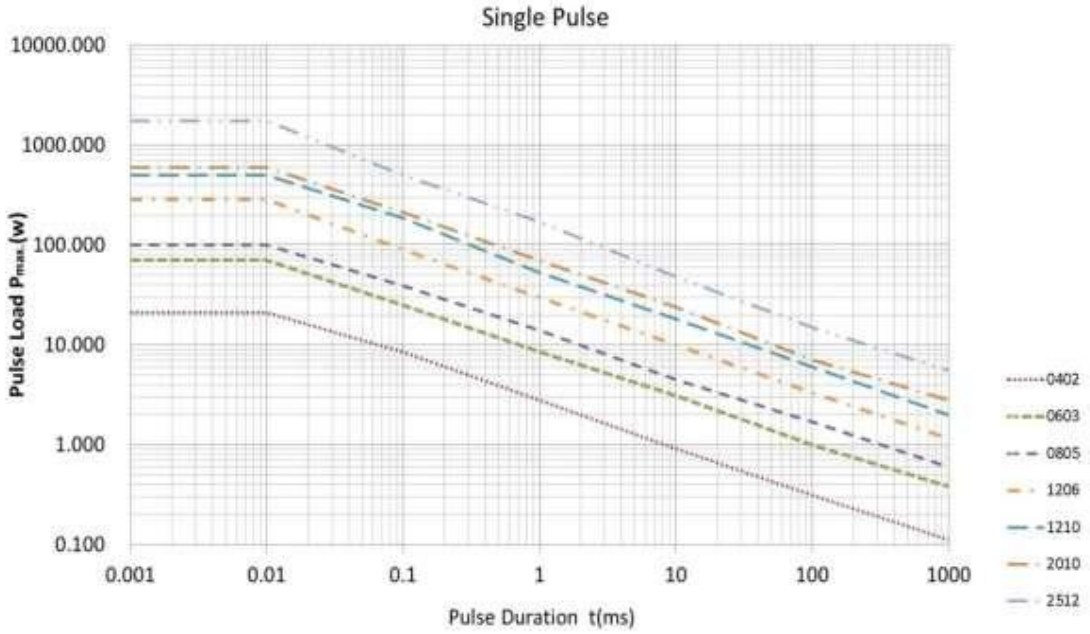
Item	Conditions	Specifications
		Resistors
High Temperature Exposure (Storage)	Put the specimens in the chamber with temperature of 155±3℃ for 1000 hours. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	△R=±1.0%
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. 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=±1.0%
Short Time Overload	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 3.10 general specifications) Refer to JIS-C5201-1 4.13	△ R=±1.0%
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 voltage 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=±2.0%
Operational Life	Solder the specimens on the test PCB and put them in the chamber with temperature of 125±3℃ and load the voltage 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 voltage shall refer to the power de-rating curve (referring to page 3,No.3.2) Experiment evidence: AEC-Q200	△R=±2.0%
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%=±1.0%
ESD	Put the specimens on the test fixture and two (2)discharges (3KVDC) 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%

Item	Conditions	Specifications Resistors	
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	
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) APS10、16、21=5mm APS32、40=3mm APS50、63=2mm Experiment evidence: AEC-Q200	△R=±1.0% No mechanical damage, peel-off of side end or chip crack.	
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 Pulse Loading Capability

Pulse on a regular basis; maximum permissible peak pulse power (Pmax) as a function of a pulse duration.

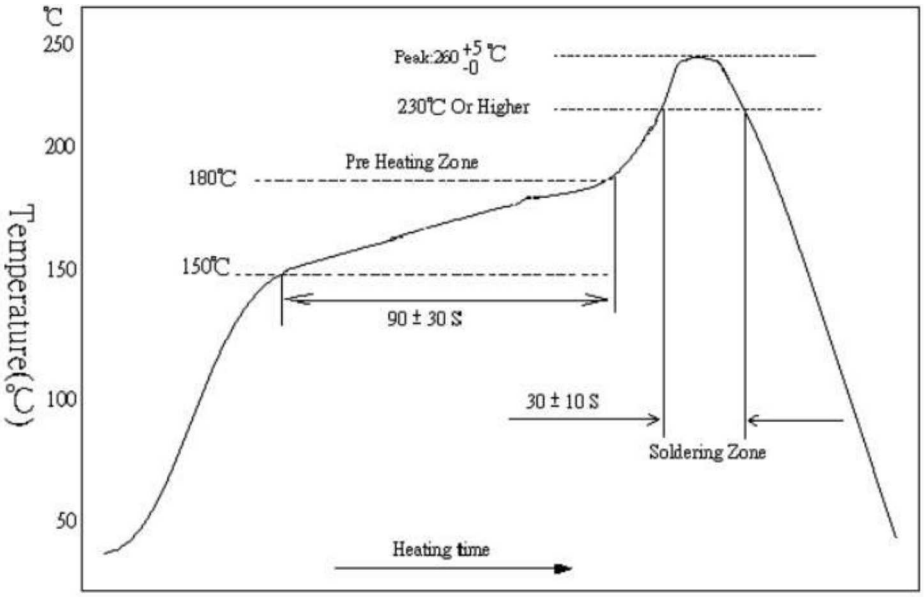
Vpeak ≦ 0402(100V)、0603(150V)、0805(300V)、1206(400V)、2010(400V)、2512(400V)



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

Soldering Profile

6.2.1 Lead-Free IR Reflow Soldering Profile



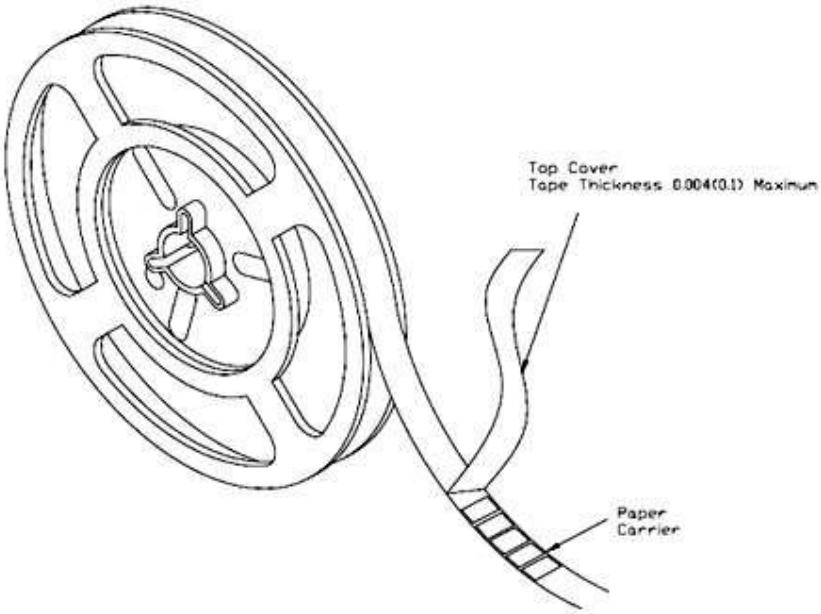
Remark : The peak temperature of soldering heat is 260 +5/-0 °C for 10 seconds.

6.2.2 Soldering Iron: Temperature 350°C ± 10°C , dwell time shall be less than 3 sec.

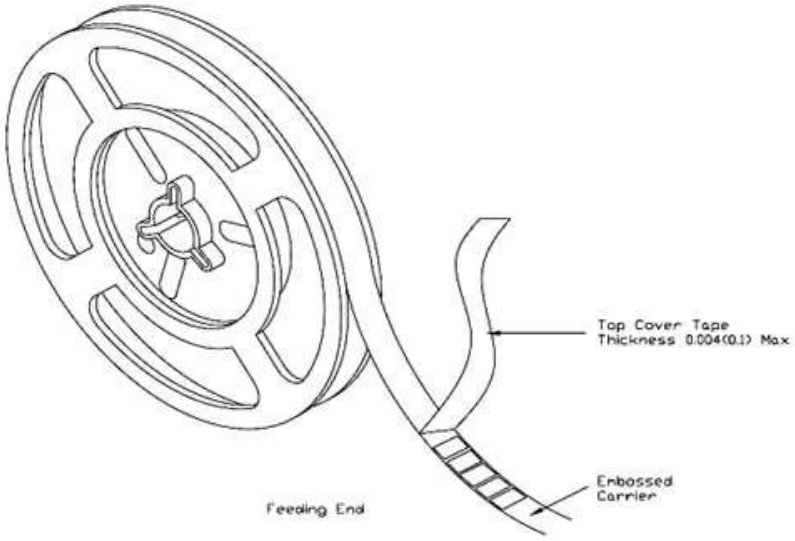
7. TAPING

7.1 Structure of Taping

Paper Carrier

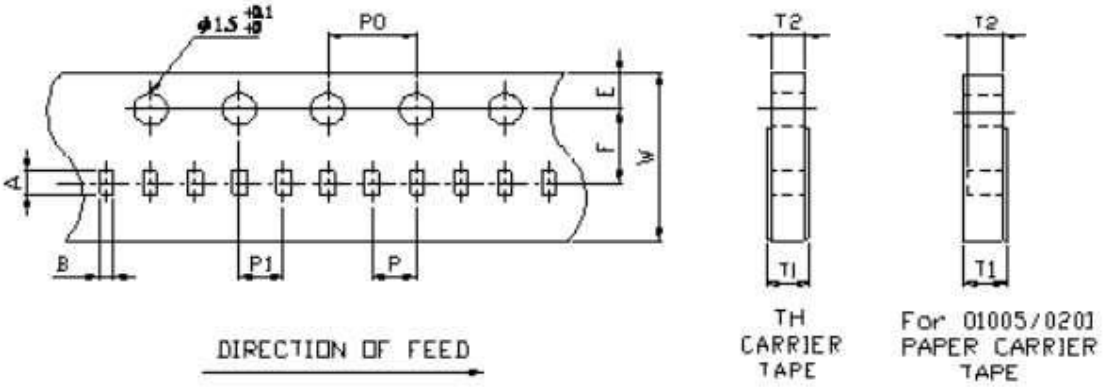


Embossed Plastic Carrier



7.2 Dimension

7.2.1 Dimension of Punched Paper Tape Carrier System(APS10)



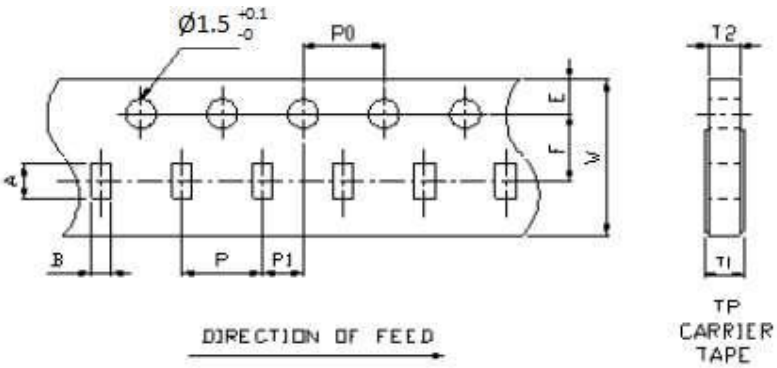
Remark : Pitch tolerance over any 10 pitches of Po is ± 0.2 mm

Dimension of Punched Paper Tape Carrier System

(unit: mm)

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
APS10	1.15±0.03	0.65±0.05	8.00±0.20	1.75±0.10	3.50±0.05	$0.40^{+0.2}_{-0}$	0.40±0.05	2.00±0.10	4.00±0.05	2.00±0.05	40.0±0.20

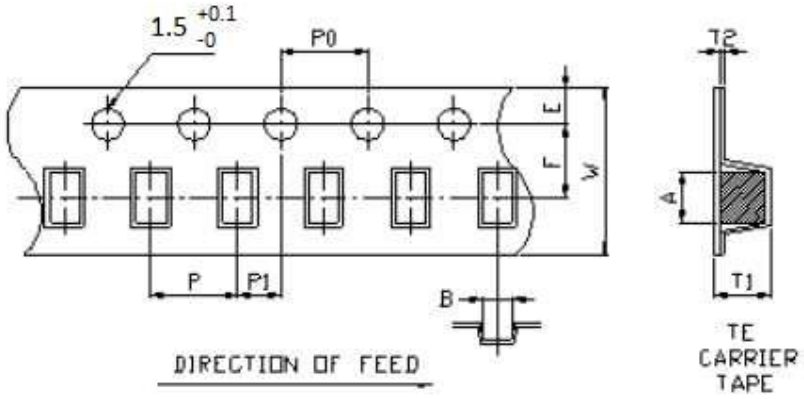
7.2.2 Dimension of Punched Paper Tape Carrier System (APS16, 21, 32, 40)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1
APS16	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
APS21	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
APS32	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
APS40	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

7.2.3 Dimension of Punched Paper Tape Carrier System (APS50, 63)



Dimension of Punched Paper Tape Carrier System (APS – 50, 63)

Code	A	B	W	E	F	T1	T2	P	P0	P1
APS50	5.50 ± 0.20	2.80 ± 0.20	12.00 ± 0.20	1.75 ± 0.10	5.50 ± 0.05	1.10 ± 0.15	0.23 ± 0.15	4.0 ± 0.10	4.00 ± 0.05	2.00 ± 0.05
APS63	6.70 ± 0.20	3.40 ± 0.20	12.00 ± 0.20	1.75 ± 0.10	5.50 ± 0.05	1.10 ± 0.15	0.23 ± 0.15	4.0 ± 0.10	4.00 ± 0.05	2.00 ± 0.05

7.3 Packaging

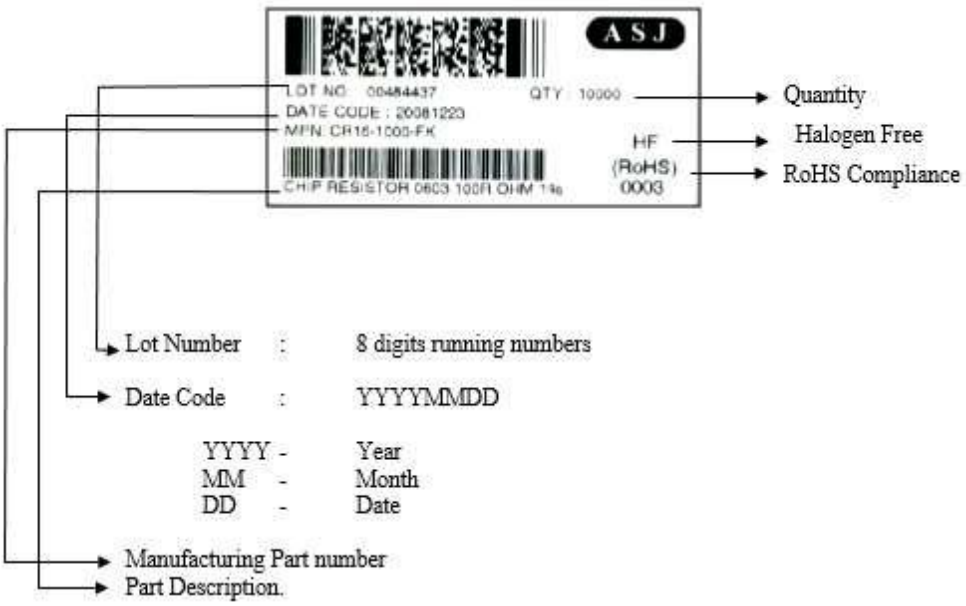
7.3.1 Taping

Quantity – Tape and Reels

Type	Qty(pcs/reel)	Reel	Remark
APS10	10,000	7”	2mm pitch
	20,000	7”	2mm pitch
	50,000	13”	2mm pitch
APS16	5,000	7”	4mm pitch
APS21	10,000	10”	4mm pitch
APS32 APS40	20,000	13”	4mm pitch
APS50	4,000	7”	Embossed 4mm pitch
APS63	4,000	7”	Embossed 4mm pitch

7.4 Identification

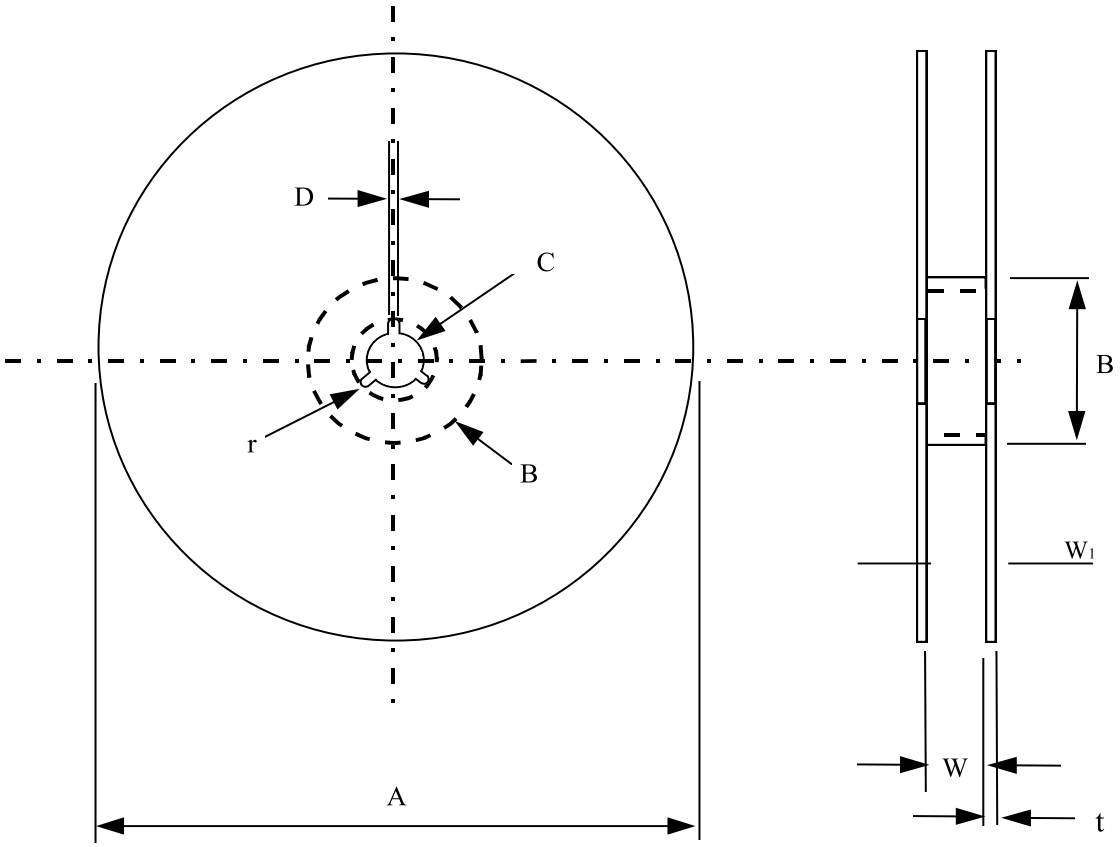
Production label that indicates the 8 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.4.1 Packaging Reel Box

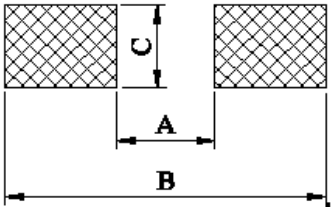
Dimension	Reel Box	Number of Reels
185 × 60 × 186 mm	25K Box	5
185 × 120 × 186 mm	50K Box	10

7.4.2 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, 50K)	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



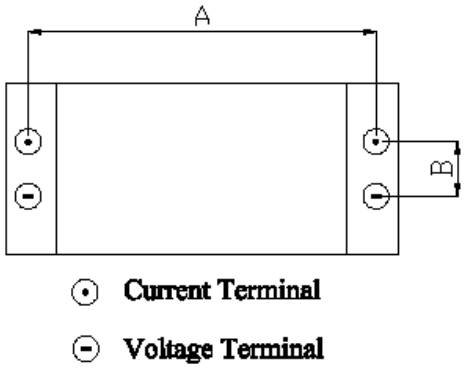
Unit:mm

TYPE \ DIM	A	B	C
APS10	0.5	1.5	0.6
APS16	0.8	2.1	0.9
APS21	1.2	3.0	1.3
APS32	2.2	4.2	1.6
APS40	2.2	4.2	2.8
APS50	3.5	6.1	2.8
APS63	3.8	8.0	3.5

9. MEASUREMENT POINT

Measure from bottom electrodes

Unit : mm



TYPE \ DIM	A	B
APS10	**0.80±0.05**	**0.24±0.05**
APS16	**1.35±0.05**	**0.35±0.05**
APS21	**1.80±0.05**	**0.35±0.05**
APS32	**2.90±0.05**	**0.35±0.05**
APS40	**2.90±0.05**	**0.35±0.05**
APS50	**4.50±0.05**	**1.15±0.05**
APS63	**5.90±0.05**	**1.60±0.05**

10. REVISION HISTORY

REVISION	DATE	CHANGE NOTICE	DESCRIPTION
Version.1	27.12.2018		Initial Release
Version.2	13.10.2020		Revise clause 3.5 Storage temp. range Revise clause 3.9
Version.3	12.03.2021		Revise clause 1.3, grade 1 to grade 0
Version.4	17.01.2022		Revise clause 6 Reliability test item Temperature cycling from 5 minute to 15 minute
Version 5	04.08.2023		Revise clause 3.8 Product Assurance Add clause 6 Item Sulfuration Test