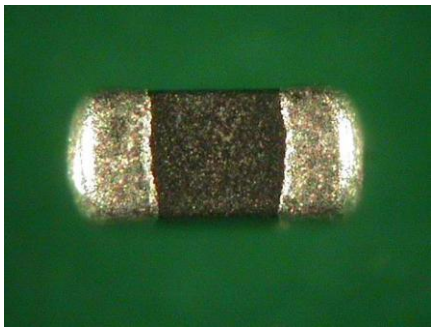
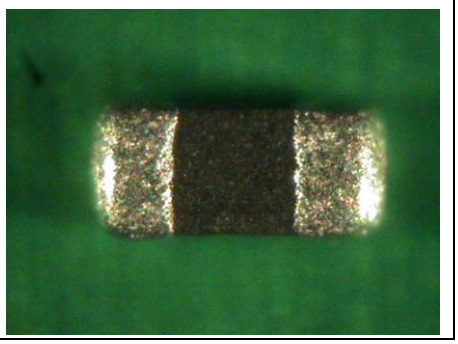
APPROVAL SHEET

Product Name : MULTILAYER CHIP VARISTOR
Part No. : AVLC 18S 02 015

Top view	Bottom view
	

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R & D	QM	SALES

LEAD-FREE

Contents

1. Reversion History

Date	Content	Rev. no	Page
2012.03.14	Initial Version	0	
2012.10.16	Box packaging Specification changes	1	19

2. Parts description

2.1 Introduction

Varistor is a component which acts as a nonconductor on the circuit in normal circumstances. When overvoltage is loaded, it becomes a conductor which diverts over-current from circuits to ground at critical voltage level.

2.2 Features

Multilayer laminated structure

Faster response time to outer overvoltage than diode

High reliability over multi surge

Forward & Reverse (+, -) direction property

Low leakage current and inductance

Easy to control electric capacity

Excellent reliability against ESD (ElectroStatic Discharge)

3. Applications

3.1 Basic theory

Varistor shows a non-linear V-I behavior similar to Si semiconductor. It has high resistance in normal situation but becomes drastically conducting at critical over-voltage level. Varistor normally acts as a nonconductor, but in case overvoltage is loaded, it becomes conductor that diverts current away from circuits to ground protecting equipments. Fig 2 shows how varistor works and protection effect against ESD in short period of time.

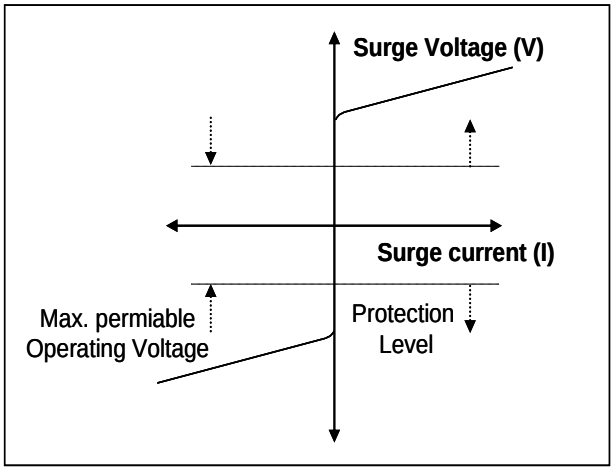


Fig. 1 V-I Characteristic Curve

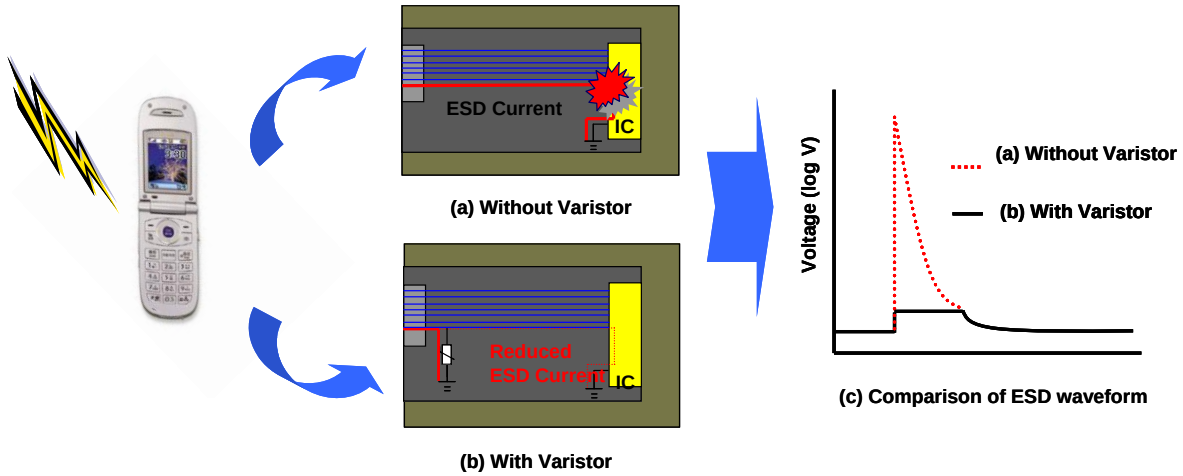


Fig. 2 ESD Protection depending on the equipped varistor

3.2 Main application field

All of the circuits which can be damaged by ESD, surge

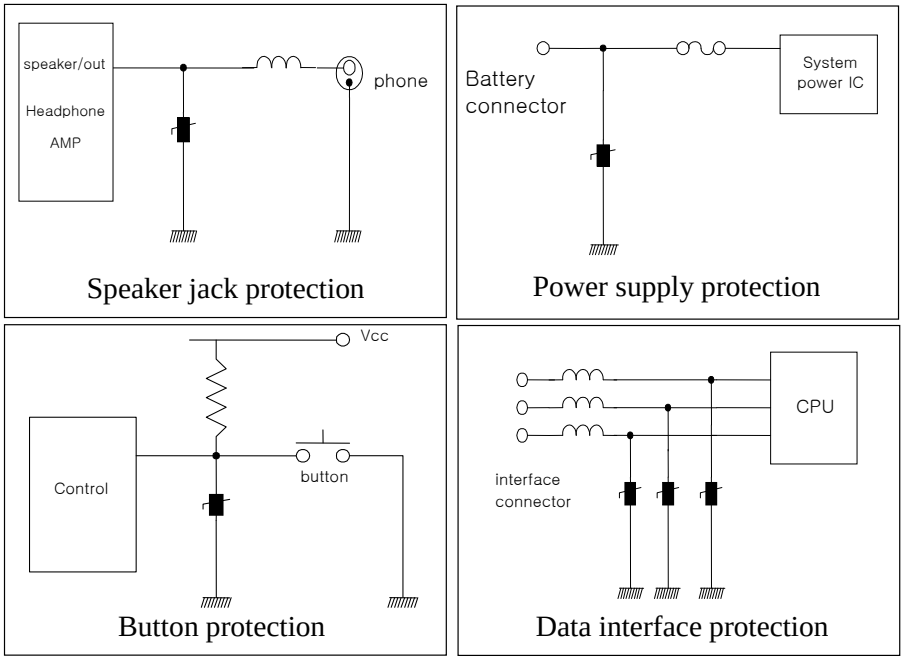


Fig. 3 Applied example in Mobile Phone.

4. Model and Lot description system

Model :

AVLC	18	S	02	015
(1)	(2)	(3)	(4)	(5)

(1) : Series Name : Low Capacitance Type Varistor
(2) : Maximum continuous working voltage – Vdc
(3) : Varistor voltage tolerance – S means " Special Order"
(4) : Chip size, 02means 0402 (1.0 x 0.5 mm)
(5) : Capacitance – 015 means 15pF Typically.

Lot :

X	000	X	X	00	X	00	XXX
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(1) : Display casting facility
(2) : Ceramic Tape product #
(3) : Display printing and stacking facility
(4) : Display Product Type – P : Mass Production
(5) : Produced year
(6) : Produced Month ex) A : Jan. , B : Feb. …
(7) : Produced date
(8) : Amotech Internal code

5. Specifications

5.1 Electrical characteristics

Part No.	Vdc(1)	Varistor voltage (Vn) @1mA dc	Leakage Current (IL) @Vdc	Capacitance (Cp) @ 1kHz, 0.5V_{rms}	Clamping Voltage (VC) @8/20μs, 1A	Peak Current (Imax(2)) @8/20us	Transient Energy (Wmax(3)) @10/1000μs	Insulation Resistance (IR) @3.6V
	(V)	(V)	(μA)	(pF)	(V)	(A)	(J)	(MΩ)
AVLC 18S 02 015	18	28 (24 ~ 32)	20 max.	15 (10.5~19.5)	45 max.	5	0.03	10 min

(1) Maximum continuous DC working voltage

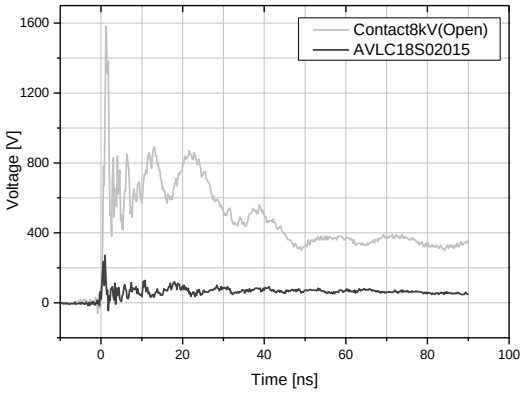
(2) 'Imax' means maximum surge current which this device can withstand.

(3) 'Wmax' means maximum transient energy which this device can withstand.

5.1.1 Temperature range

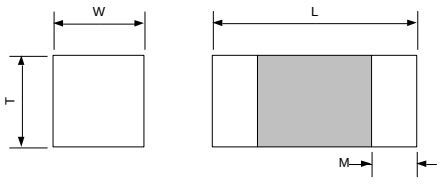
- Operating temperature : - 20 ℃ ~ + 60 ℃
- Storage temperature : - 40 ℃ ~ + 125 ℃

◈ ESD waveform



5.2 Mechanical characteristics

- Appearance and dimension



Size(mm)	L	W	T	M
1005	1.0±0.10	0.5±0.10	Max. 0.6	0.2 ±0.10.

5.3 Measurement method

5.3.1 Cp measure procedure (LCR Meter–Model Name : Agilent 4284A)

Cp is capacitance measured at 1kzHz frequency and Vrms 0.5V biased voltage.

► Test Procedure

1. Turn on power of instrument
2. Press the Meas setup switch
3. Input the value moving arrow

- FUNC : Cp-D
- FREQ : 1 kHZ
- LEVEL : 500mV

4. Measure the both terminal of Varistor with probes

5.3.2 IL measure procedure

IL is a current through varistor when Vdc is loaded.

► Test Procedure

1. Turn on the power of instrument.
2. Press I button of 'V'MEAS section from Source area.
3. Press TRIG button after press CONFIG button.
4. Select 'ARM-LAYER' and press 'ENTER' button, and then select 'ARM-IN', press 'ENTER' button again, select 'MANUAL' and press 'ENTER' button.
5. Press twice consecutively 'EXIT' button to go to Main Menu.
6. Press 'CONFIG' button again, and press 'ON-OFF' button.
7. Select 'AUTO-OFF', PRESS 'ENTER', and select 'ENABLE', press 'ENTER' button, and select 'ALWAYS', and then press 'ENTER'.
8. Press once 'EXIT' button to go to the Main Menu.
9. Press blue color of 'EDIT' button from the far left to set the values for Vsrc = Vdc, and Cmpl = 105 ㎂.
10. Turn "ON" the ON/OFF switch of OUTPUT.

11. Measure +,- terminals of source meter by connecting both sides of chip termination.

5.3.3 IR measure procedure (Standard source meter – Model Name : Keithley 2400)

IR is insulation resistance of varistor when DC 3.6V is loaded.

► Test Procedure

1. Turn 'OFF' the power, and then turn 'ON'.
2. Press 'Ω' of MEAS section.
3. Press 'Ω' of CONFIG section
4. Select SOURCE, press ENTER, select MANUAL, press ENTER, and then press EXIT to go to MAIN MENU.
5. Press 'V' button of Source section.
6. TRIG function is the same procedure with the above step # 3~#8 of 5.3.2.
7. Press EDIT button to set Vsrc value as 3.6V.
8. Measure IN/OUT terminals of Source Meter by connecting both end of varistor.

5.3.4 Vn measure procedure (Standard Source Meter- Model Name : Keithley 2400)

Vn is working voltage of varistor when 1mA is loaded

► Test Procedure

1. Turn 'OFF' the power, and then turn 'ON'.
2. Press 'V' of 'I' MEAS section of SOURCE area.
3. TRIG function is the same procedure with the above step # 3~#8 of 5.3.2.
4. Press blue color of 'EDIT' button from the far left to set the values for Isrc = 1mA, and Cmpl = 50V.
5. Measure IN/OUT terminals of Source Meter by connecting both end of varistor.

5.3.5 VC measure procedure (Surge Network-Model Name: Keytek E504A, Control Center-Model Name: Keytek E-Class Series 100, Oscilloscope – Model Name : Tektronix TDS 640 A)

When overvoltage occurs in the circuit, varistor reduces voltage to send certain one to connected circuit. VC is the upper limit of the reduced voltage.

►Test Procedure

1. Turn "ON" the measuring tester equipments.
2. Connect IN/OUT terminals of Surge Network and measuring point.
3. Press 'F1' button at the Control center to display the initial screen.
4. Change the value of E504A at the Control Center as 8/20μs pulse.
   (On the display, put the cursor on the 'NETWORK', and press ENTER to change its value.)
5. On the oscilloscope, adjust the scale to set proper waveform for CH1 & CH2 at the Vertical Menu, and set the frequency scale as 10μs at the Horizontal Menu.
6. Equip varistor at the measuring point (Jig).
7. On the oscilloscope, enter voltage value for CH2 with the equalized value of 1A at the Control center, and then press ENTER.
8. Press 'F1' at the Control center to charge during 12 seconds.
9. Read the peak value of CH1 waveform displaying on the oscilloscope after press 'F3'.
10. Measured value should be multiplied 1000 times by @ value among the displayed values on the Oscilloscope.
    (V MON : 1KV→ 1V)

5.3.6 Imax measure procedure (Surge Network-Model Name: Keytek E504A, Control Center-Model Name: Keytek E-Class series 100, Oscilloscope-Model Name : Tektronix, TDS640A, Source Meter-Model Name : Keithley 2400)

Imax means the maximum surge current value at which varistor can work. Varistor doesn't work over peak current value acting as a resistor.

► Test Procedure

1. Turn "ON" the measuring tester equipments.
2. Connect IN/OUT terminals of Surge Network and measuring point (Jig).
3. Press 'F1' button at the Control center to display the initial screen.
4. Change the value of E504A at the Control Center as 8/20μs pulse.
   (On the display, put the cursor on the 'NETWORK', and press ENTER to change its value.)
5. On the oscilloscope, adjust the scale to set proper waveform for CH1 & CH2 at the Vertical Menu, and set the frequency scale as 10μs at the Horizontal Menu.

6. Equip varistor at the measuring point (Jig).
7. Measure the initial Vn after it added 1mA at the Source meter.
8. On the oscilloscope, enter voltage value for CH2 with the equalized value of 1A at the Control center, and then press ENTER.
9. Press 'F1' at the Control center to charge during 12 seconds.
10. Read the peak value of CH2 waveform displaying on the oscilloscope after press 'F3'.
11. Measure the Vn after it tested 1mA at the Source meter.
12. Measured value should be multiplied 0.2 times by @ value among the displayed values on the Oscilloscope, and read its unit as [A].
    (I MON : 200A→ 1V)

5.3.7 Transient Energy (Surge Network-Model Name : Keytek E509A, Control Center-Model Name : Keytek E-Class series 100, Oscilloscope-Model Name : Tektronix TDS640A)

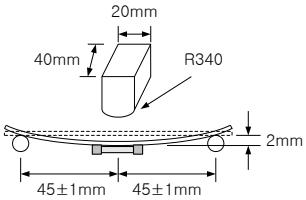
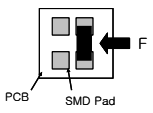
Transient energy is maximum energy against which varistor can sustain.

► Test Procedure

1. Turn "ON" the measuring tester equipments.
2. Connect IN/OUT terminals of Surge Network and measuring point (Jig).
3. Press 'F1' button at the Control center to display the initial screen.
4. Change the value of E509A at the Control Center as 10/1000μs pulse.
   (On the display, put the cursor on the 'NETWORK', and press ENTER to change its value.)
5. On the oscilloscope, adjust the scale to set proper waveform for CH1 & CH2 at the Vertical Menu, and set the frequency scale as 10μs at the Horizontal Menu.
6. Equip varistor at the measuring point (Jig).
7. Measure the initial Vn after it added 1mA at the Source meter.
8. On the oscilloscope, enter voltage value for the same value of 0.01J by formula at the Control center with the peak value of waveform CH1 (Voltage), CH2 (Current), and then press ENTER.
9. Press 'F1' at the Control center to charge during 40 seconds.
10. Measure the Vn after it tested 1mA at the Source meter

6. Reliabilities and Test conditions

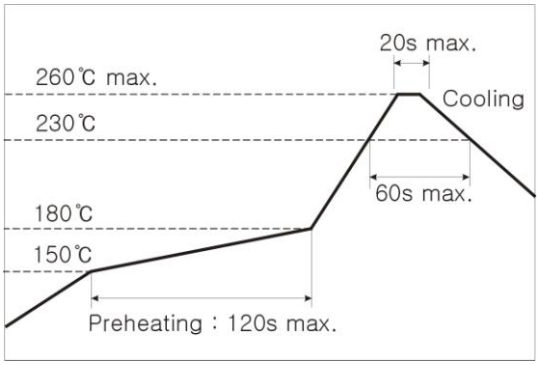
Parameter	Test	Test methods and remarks	Test requirement
Environmental reliability	ESD C=150 pF, R=330Ω	IEC 61000-4-2 1. ESD Level : ±8KV(Contact) , Interval : 1sec 2. Mode : Contact discharge(Level 4) 3. Method : Each 10 times in positive/negative direction	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Thermal Shock	Condition for 1 cycle 1 step : Min. –40℃, 30±3 min. 2 step : Max. +125℃, 30±3 min. Number of cycles : 30 times Place for 48±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Low temp. resistance	1. Temp. : -40 ± 5℃ 2. time : 1000 ± 24 hrs 3. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	High temp. resistance	1. Temp : +125 ± 5℃ 2. Time : 1000 ± 24 hrs 3. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Heat resistance	1. Temp. : +85 ± 5℃ 2. Time : 1000 ± 48 hrs 3. Applied voltage : Vdc 4. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	High Temp. & Humidity resistance	1. Temp. : +85 ± 5℃ 2. Humidity : 85 ± 5 % RH. 3. Time : 1000 ± 24 hrs 4. Applied voltage : Vdc 5. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	PCT (Pressure cooker test)	1. Temp : +121 ± 2℃ 2. Humidity : 100% RH. 3. Atmosphere : 2 atm 4. Time : 60 hrs 5. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Humidity Test	1. Temp. : +60 ± 5℃ 2. Humidity : 90 ± 5 % RH. 3. Time : 1000 ± 48 hrs 4. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.

Parameter	Test	Test methods and remarks	Test requirement
Environmental reliability	Low temperature operating	1. Temp. : -20 ± 5℃ 2. Time : 1000 ± 48 hrs 3. Applied voltage : Vdc 4. Place for 24±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Temperature & Humidity Cycle	Condition for 1 cycle 1 step : +25℃, 2 hrs, 2 step : +60℃, 90%, 2 hrs 3 step : +45℃, 95%, 12 hrs, 4 step : -20℃, 1 hrs 5 step : +25℃, 1 hrs Number of cycles : 5 times Place for 48±2hrs at room temp. condition, then measure	1. d|Vn|/Vn≤10% 2. No visible Damage.
Mechanical Reliability	Solderability	1. Test Machine : Solder Bath 2. Temp. : 230±5℃ 3. Time : 2s	At least 95% of terminal electrode is covered by new solder
	Resistance to soldering heat	1. Test Machine : Solder Bath 2. Temp. : 260 ± 5℃ 3. Time : 10±0.5s	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Bending strength	1. Wrap: 2 mm 2. Speed: 0.5 mm/sec 3. Duration: 10sec  4. The measurement shall be made with board in the bent position	1. d|Vn|/Vn≤10% 2. No visible Damage.
	Adhesive strength	1. Applied force on SMD chip by fracture from PCB  	1. Strength>0.8 Kgf (8N) 2. No visible Damage.

7. Soldering Condition

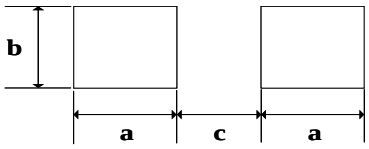
7.1 Soldering condition

A. Lead Free Solder paste



- Our chip varistors are designed for reflow soldering only. Do not use flow soldering.
- Use Sn / Ag / Cu (96.5 / 3.0 / 0.5) or equivalent solder.
- Use non-activated flux (Cl content 0.2% max.).
- Follow the recommended soldering conditions to avoid varistor damage.
- Hand soldering condition : 350 ± 10 ℃, 3 sec

7.2 PCB pattern design condition (recommended)

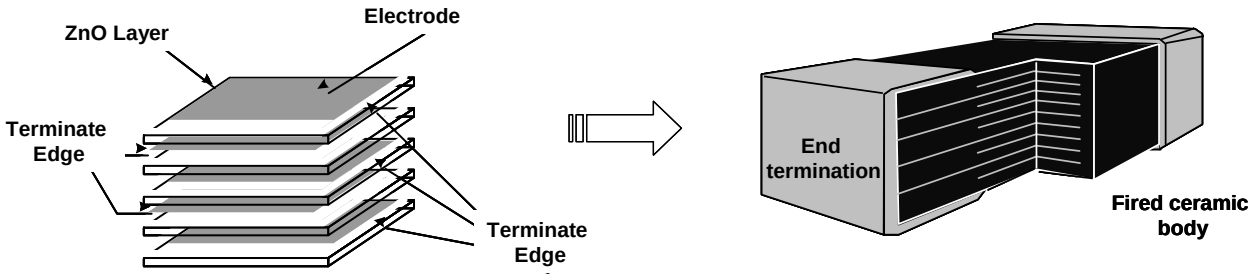


(Unit : mm)

Symbol	a	b	c
Size	0.61	0.51	0.51

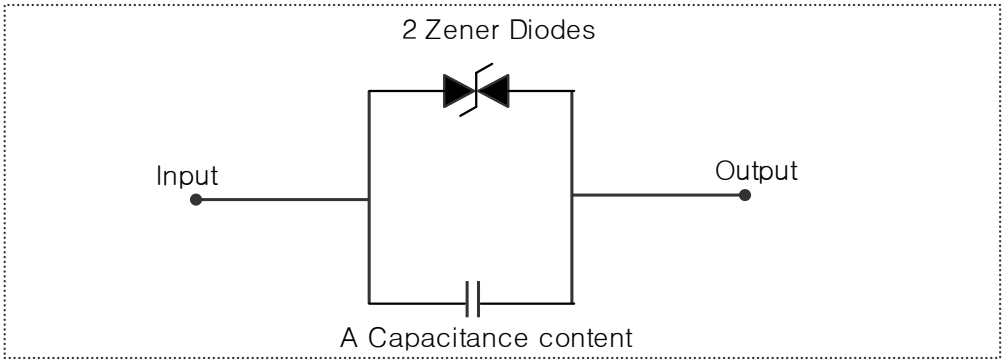
8. Structure and Materials

8.1 Structure and materials specification



Ceramic Body	ZnO System ceramics
Internal Electrode	Ag – Pd
External Electrode	Ag – Ni– Sn
Plating Layer(Thickness)	Ni ≥ 1 μm Sn ≥ 2μm

8.2 Equivalent circuit



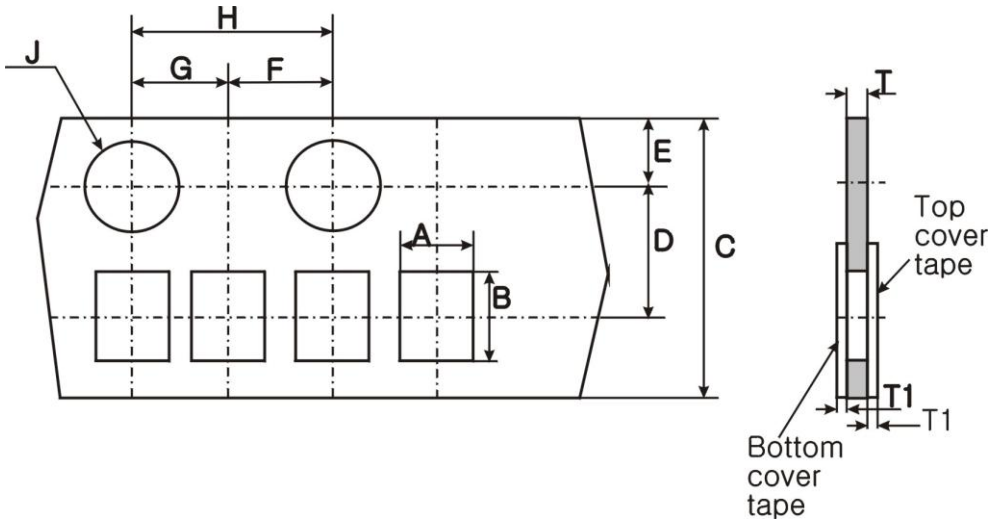
9. Caution

1. Storage environment : -5~40℃ temperature, 70% humidity (MSL Level 1)
2. Do not use in high temperature/high humidity and a corrosive atmosphere like sulfide, chloride gas which could damage the solderability.
3. Do not expose varistor to mechanical shock to avoid crack.
4. Use chips within 6 months. If over 6 months, check solderability before use.

10. Packaging specification

10.1 Carrier tape Specification

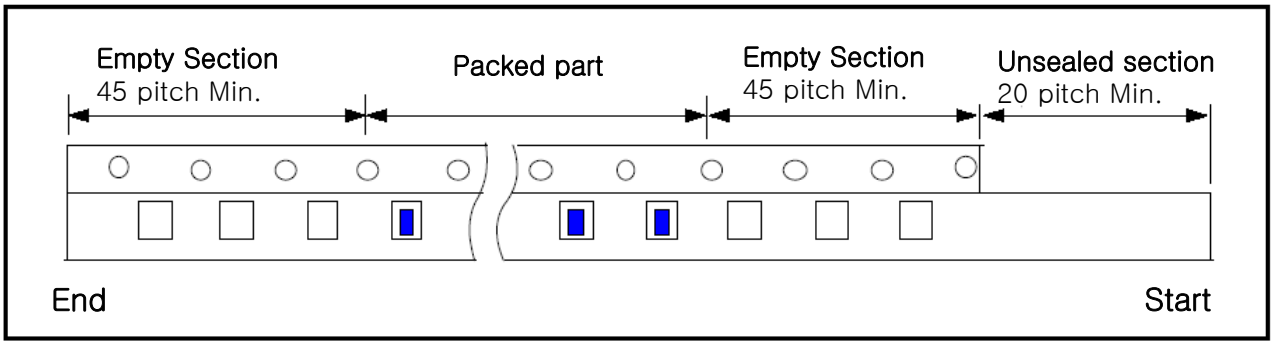
10.1.1 Size



unit :mm

	A	B	C	D	E	F	G	H	J	T	T1
Spec.	0.62	1.12	8.00	3.50	1.75	2.00	2.00	4.00	1.50	0.60	0.1
Tolerance	±0.04	±0.04	±0.10	±0.05	±0.10	±0.05	±0.05	±0.10	+0.10 -0.00	±0.05	Max

10.1.2 Chip Locations



10.1.3 Materials

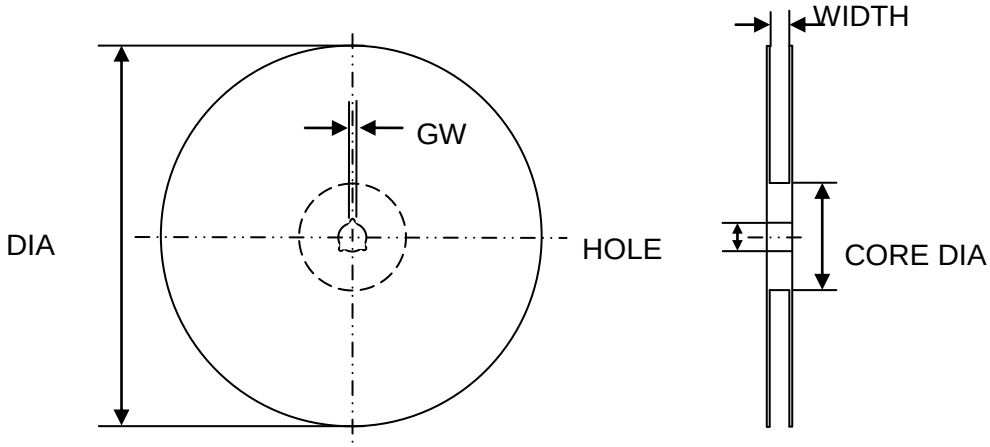
1) Paper carrier tape : Laminated virgin pulp

2) Top tape : Polyester film

3) Bottom tape : Adhesive coated paper

10.2 Reel Specification

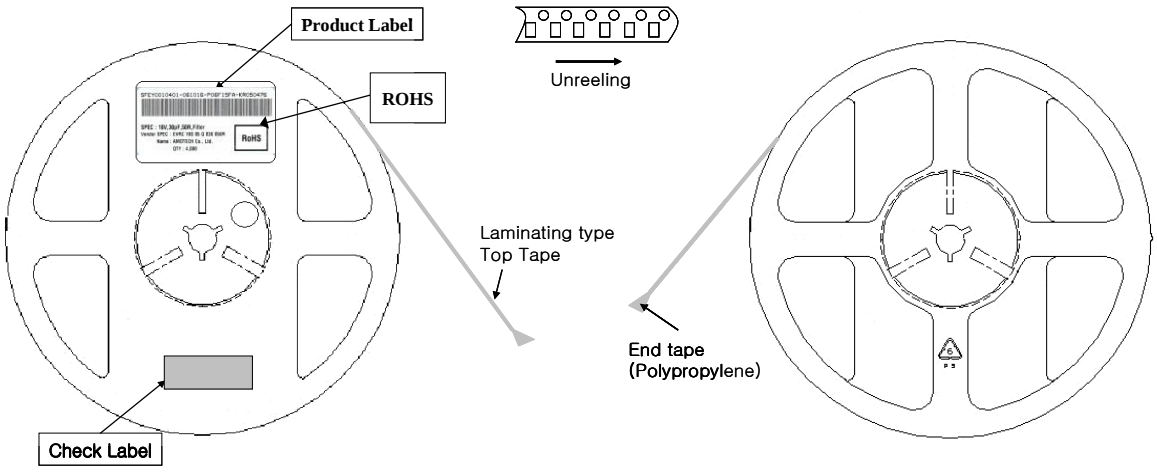
10.2.1 Size



unit : mm

DIA	WIDTH	CORE DIA	HOLE	GW
178.0±0.5	9.0±0.5	60.0±1.0	13.2±0.3	2±0.3

10.2.2 Label adherence and winding direction



10.2.3 Material

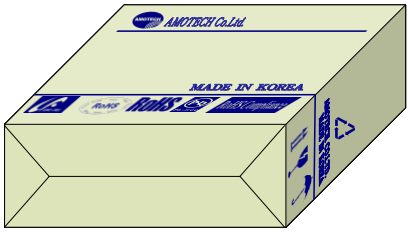
1) Plastic reel : GPPS (General Purpose Poly Styrene) resin

10.3 Box packaging Specification

10.3.1 Small Box

Size : 183 (W) x 185 (D) x 70 (T) (mm)

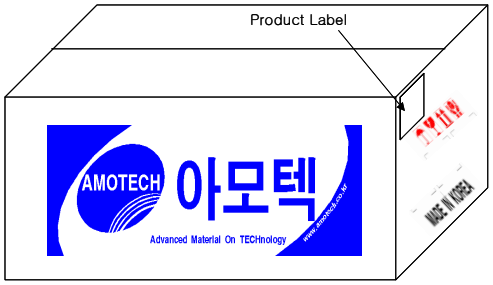
Quantity : 5 reel (12,000 ea/reel × 5 reel = 60,000 ea)



10.3.2 Medium Box

Size : 200 (W) x 375 (D) x 205 (T) (mm)

Quantity : 5 small boxes(60,000 ea/ small boxes × 5 small boxes = 300,000 ea)



10.3.3 Large Box

Size : 375 (W) x 390 (D) x 205 (T) (mm)

Quantity : 10 small boxes (60,000 ea/ small boxes ×10 small boxes = 600,000 ea)