Data Sheet

Customer：	
Product :	Automotive Grade Thin Film Precision Chip Resistor – AR..A Series
Size:	0402/0603/0805/1206/1210/2010/2512
Issued Date:	1-Jul-24
Edition :	REV.C2

RoHS Compliant

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1-Jul-24	1-Jul-24	1-Jul-24	1-Jul-24	
Chun	***Ben Chang***	***Ben Chang***		

Automotive Grade Thin Film Precision Chip Resistor



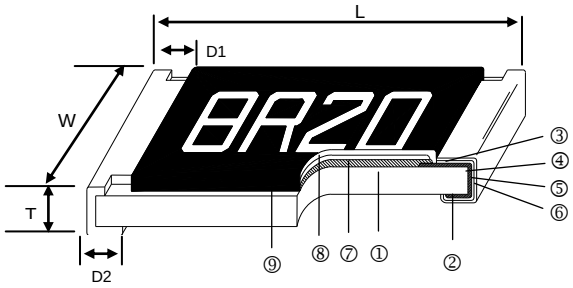
Features

- AEC-Q200 Qualified
- Advanced thin film technology
- RoHS compliant
- Special materials, design, and processing for high sulfur applications
- Test proven immunity to humidity, moisture, and sulfur

Applications

- Automotive
- Medical Equipment
- Testing / Measurement Equipment
- Printer Equipment
- Automatic Equipment Controller
- Converters
- Communication Device, Cell Phone, GPS, PDA

Construction



①	Alumina Substrate	④	Edge Electrode	⑦	Resistor Layer
②	Bottom Electrode	⑤	Barrier Layer	⑧	Overcoat
③	Top Electrode	⑥	External Electrode	⑨	Marking

Dimensions

Unit: mm

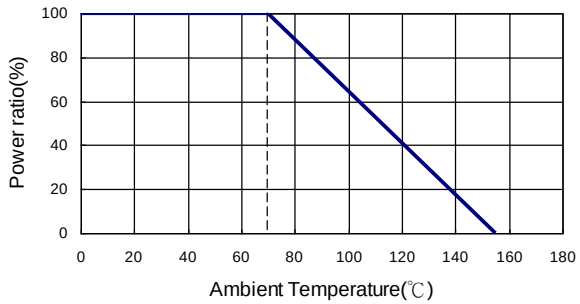
Type	Size (Inch)	L	W	T	D1	D2	Weight (g) (1000pcs)
AR02	0402	1.00±0.05	0.50±0.05	0.30±0.05	0.20±0.10	0.20±0.10	0.54
AR03	0603	1.55±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	1.83
AR05	0805	2.00±0.15	1.25±0.15	0.55±0.10	0.30±0.20	0.40±0.20	4.71
AR06	1206	3.05±0.15	1.55±0.15	0.55±0.10	0.42±0.20	0.35±0.25	9.02
AR13	1210	3.10±0.15	2.40±0.15	0.55±0.10	0.40±0.20	0.55±0.25	10
AR10	2010	4.90±0.15	2.40±0.15	0.55±0.10	0.60±0.30	0.50±0.25	23.61
AR12	2512	6.30±0.15	3.10±0.15	0.55±0.10	0.60±0.30	0.50±0.25	38.06

Part Numbering

AR	03	A	T	C		1001	A
Product Type	Dimensions (L×W)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking Code
	02: 0402 03: 0603 05: 0805 06: 1206 13: 1210 10: 2010 12: 2512	T: ±0.01% A: ±0.05% B: ±0.1% C: ±0.25% D: ±0.5% F: ±1%	T: Taping Reel B: Bulk	S: ±5 B: ±10 N: ±15 C: ±25 D: ±50	: Standard* (See Remark) X: 1/10W W: 1/8W V: 1/4W U: 1/2W O: 1/3W P: 1/5W G: 2/5W	0100: 10Ω 10R2: 10.2Ω 1000:100Ω 1001: 1KΩ 1004: 1MΩ	A: Automotive Grade NA :No Marking Automotive Grade

*Remark: Standard part no need for power rating code.

■Derating Curve



■Standard Electrical Specifications

Item / Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (PPM/°C)
					±0.05%	±0.1%	±0.25%	±0.5%	±1%	
AR02 (0402)	1/16W	-55 ~ +155°C	50V	100V	49.9Ω - 12KΩ	49.9Ω - 221KΩ				±25 ±50
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	10Ω - 49.9KΩ	10Ω -680KΩ				±25 ±50
AR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	10Ω - 100KΩ	10Ω –1MΩ				±25 ±50
AR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	10Ω - 200KΩ	10Ω – 1.5MΩ				±25 ±50
AR13 (1210) AR10 (2010)	1/4W	-55 ~ +155°C	150V	300V	10Ω - 499KΩ	10Ω - 1MΩ				±25 ±50
AR12 (2512)	1/2W	-55 ~ +155°C	150V	300V	10Ω - 499KΩ	10Ω - 1MΩ				±25 ±50

■Special Electrical Specifications

Item / Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range						TCR (PPM/°C)
					±0.01%	±0.05%	±0.1%	±0.25%	±0.5%	±1%	
AR02 (0402)	1/16W	-55 ~ +155°C	50V	100V	49.9Ω - 12KΩ				-		±5
					49.9Ω - 12KΩ		49.9Ω – 69.8KΩ				±10 ±15
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	24.9Ω - 15KΩ				-		±5
					24.9Ω - 15KΩ	10Ω - 49K9Ω	10Ω - 332KΩ				±10 ±15
AR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	24.9Ω - 30KΩ				-		±5
					24.9Ω - 30KΩ	10Ω - 100KΩ	10Ω – 1MΩ				±10 ±15
AR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	24.9Ω - 50KΩ				-		±5
					24.9Ω - 50KΩ-	10Ω - 200KΩ	10Ω - 1MΩ				±10 ±15
AR13 (1210)	1/ 4W	-55 ~ +155°C	150V	300V	-	10Ω- 499KΩ	10Ω - 1MΩ				±10 ±15
AR10 (2010)	1/4W	-55 ~ +155°C	150V	300V	-	10Ω - 499KΩ	10Ω - 1MΩ				±10 ±15
AR12 (2512)	1/2W	-55 ~ +155°C	150V	300V	-	10Ω - 499KΩ	10Ω - 1MΩ				±10 ±15

■High Power Rating Electrical Specifications

Item / Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range						TCR (PPM/°C)
					±0.01%	±0.05%	±0.1%	±0.25%	±0.5%	±1%	
AR02(0402)	1/10W	-55 ~ +155°C	50V	100V	-		49.9Ω - 221KΩ				±25 ±50
AR03(0603)	1/10W	-55 ~ +155°C	75V	150V	24.9Ω - 15KΩ				-		±5
					24.9Ω - 15KΩ	10Ω - 49.9KΩ	10Ω -332KΩ				±10 ±15
					-		10Ω -680KΩ				±25 ±50
	1/8W				-		10Ω -680KΩ				±25 ±50
AR05(0805)	1/8W	-55 ~ +155°C	150V	300V	24.9Ω - 30KΩ				-		±5
					24.9Ω - 30KΩ	10Ω - 100KΩ	10Ω - 1MΩ				±10 ±15
					-						±25 ±50
	1/5W				-		10Ω - 1MΩ				±25 ±50
AR06(1206)	1/4W	-55 ~ +155°C	200V	400V	24.9Ω - 50KΩ				-		±5
					24.9Ω - 50KΩ	10Ω - 200KΩ	10Ω - 1MΩ				±10 ±15
					-		10Ω – 1.5MΩ				±25 ±50
	2/5W				-		10Ω – 1.5MΩ				±25 ±50
AR13(1210)	1/ 3W	-55 ~ +155°C	200V	400V	-	10Ω - 499KΩ	10Ω - 1MΩ				±10 ±15 ±25 ±50
	1/2W				-		10Ω - 1MΩ				±25 ±50
AR10(2010)	1/ 3W	-55 ~ +155°C	200V	400V	-	10Ω - 499KΩ	10Ω - 1MΩ				±10 ±15 ±25 ±50

Operating Voltage=√(P*R) or Max. operating voltage listed above, whichever is lower.
Overload Voltage=2.5*√(P*R) or Max. overload voltage listed above, whichever is lower.
■Viking is capable of manufacturing the optional spec based on customer's requirement.

■Environmental Characteristics

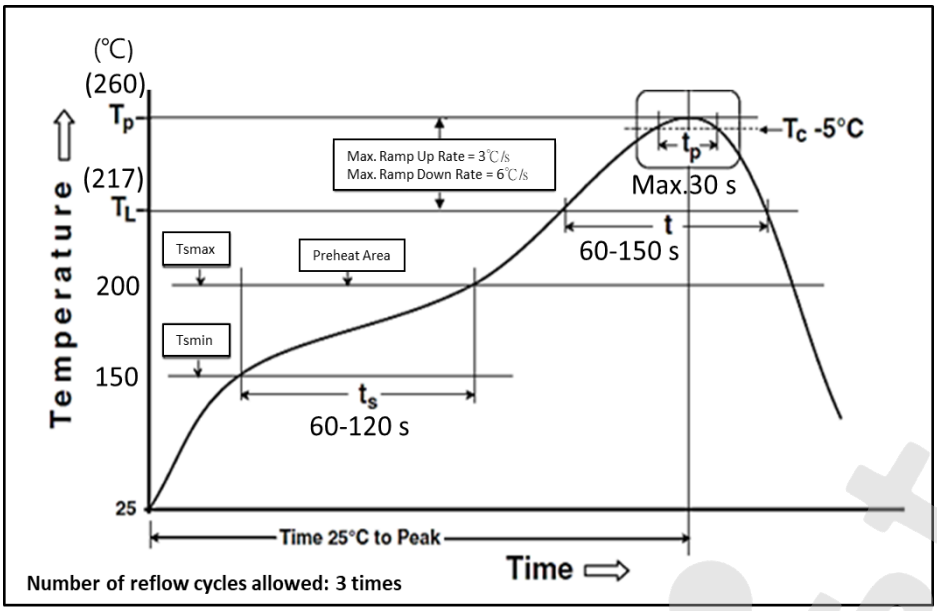
Item	Requirement		Test Method
	Tol. ≦ 0.05%	Tol. > 0.05%	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.		**JIS-C-5201-1 4.8** **IEC-60115-1 4.8** -55℃~+125℃, 25℃ is the reference temperature
Short Time Overload	ΔR±0.05% ΔR±0.1% (0402 1/10W、0603 1/8W、0805 1/5W、1206 2/5W、1210 1/2W)		**JIS-C-5201-1 4.13** RCWV*2.5 or Max. overload voltage whichever is lower for 5 seconds
Insulation Resistance	>1000 MΩ		**JIS-C-5201-1 4.6** **IEC-60115-1 4.6** Apply 100V_{DC} for 1 minute
Operational Life	ΔR±0.05%	ΔR±0.2%	**MIL-STD-202 Method 108** Condition D Steady State T_A=125℃ at derated power. Measurement at 24±4 hours after test conclusion.
	>7kΩ ΔR±0.2%		
	ΔR±0.2% for high power rating		
Biased Humidity	ΔR±0.1%		**MIL-STD-202 Method 103** 1000 hrs 85℃/85%RH 10% of operating power.
High Temperature Exposure	ΔR±0.2%		**MIL-STD-202 Method 108** at +155℃ for 1000 hrs
Temperature Cycling	ΔR±0.1%		**JESD22 Method JA-104** -55℃ to +125℃, 1000 cycles
Bending Strength (Board Flex)	ΔR±0.1%		**JIS-C-5201-1 4.33** Bending once for 60 seconds Bending displacement: 2010 2512 sizes: 2 mm Other sizes: 3 mm
Solderability	95% min. coverage		**JIS-C-5201-1 4.17** **IEC-60115-1 4.17** 245±5℃ for 3 seconds
Resistance to Soldering Heat	ΔR±0.05%		**JIS-C-5201-1 4.18** **IEC-60115-1 4.18** 260±5℃ for 10 seconds
Terminal strength	No broken		**AEC-Q200-006** Force of 1.8kg for 60 seconds.
Mechanical Shock	ΔR±0.05%	ΔR±0.1%	**MIL-STD-202 Method 213** Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	ΔR±0.05%	ΔR±0.1%	**MIL-STD-202 Method 204** 5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz
ESD	ΔR±0.5%		**AEC-Q200-002** Human body model AR02 0.4KV AR03 1KV AR05 1.5KV AR06 、AR10、AR12、AR13 2KV
Resistance to solvents	Marking Unsmeared		**MIL-STD-202 Method 215** Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.
Sulfur Test	ΔR±1%		**ASTM-B-809-95 Modified** 105±2 ℃ no power rating for **1000** hrs.
Flammability	No ignition of the tissue paper or scorching or the pinewood board		**UL-94** V-0 or V-1 are acceptable. Electrical test not required.

RCWV(Rated continuous working voltage)= √(P*R) or Max. Operating voltage whichever is lower

■**Storage Temperature: 15~28℃; Humidity < 80%RH**

■**Shelf Life: 2 years from production date.**

■Soldering Condition(IPC/JEDEC J-STD-020)



Reflow Profiles	
Profile Feature	**Pb-Free Assembly**
Preheat Min. Temperature (T_{smin}) Max Temperature (T_{smax}) Preheating time (t_s) from (T_{smin} to T_{smax})	 150 °C 200 °C 60-120 seconds
Ramp-up rate (T_L to Tp)	3 °C/second max.
Liquidous temperature (T_L) Time (t_L) maintained above T_L	217 °C 60-150 seconds
Min. Peak temperature (Tp min)	235°C
Max. Peak temperature (Tp max)	260°C
Time (tp) within 5 °C of the specified classification temperature (Tc)	30 seconds max.
Ramp-down rate (Tp to T_L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

■Marking

0603 3digit marking



3digit marking for Example: 14C=13K7Ω 13C=13K3Ω

68B=4K99Ω 68X=49.9Ω

0603 3digit marking for E24 Example: 101=100Ω 102=1KΩ

E24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91

0805~2512 4digit marking Example

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ
marking	1000	2201	1002	4992	1003

Marking Table

Code	E96	Code	E96	Code	E96	Code	E96
01	100	**25**	178	**49**	316	**73**	562
02	102	**26**	182	**50**	324	**74**	576
03	105	**27**	187	**51**	332	**75**	590
04	107	**28**	191	**52**	340	**76**	604
05	110	**29**	196	**53**	348	**77**	619
06	113	**30**	200	**54**	357	**78**	634
07	115	**31**	205	**55**	365	**79**	649
08	118	**32**	210	**56**	374	**80**	665
09	121	**33**	215	**57**	383	**81**	681
10	124	**34**	221	**58**	392	**82**	698
11	127	**35**	226	**59**	402	**83**	715
12	130	**36**	232	**60**	412	**84**	732
13	133	**37**	237	**61**	422	**85**	750
14	137	**38**	243	**62**	432	**86**	768
15	140	**39**	249	**63**	442	**87**	787
16	143	**40**	255	**64**	453	**88**	806
17	147	**41**	261	**65**	464	**89**	825
18	150	**42**	267	**66**	475	**90**	845
19	154	**43**	274	**67**	487	**91**	866
20	158	**44**	280	**68**	499	**92**	887
21	162	**45**	287	**69**	511	**93**	909
22	165	**46**	294	**70**	523	**94**	931
23	169	**47**	301	**71**	536	**95**	953
24	174	**48**	309	**72**	549	**96**	976

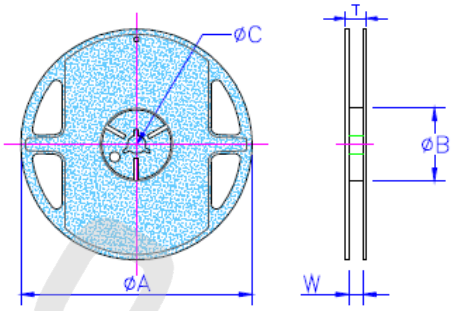
Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

■Packaging

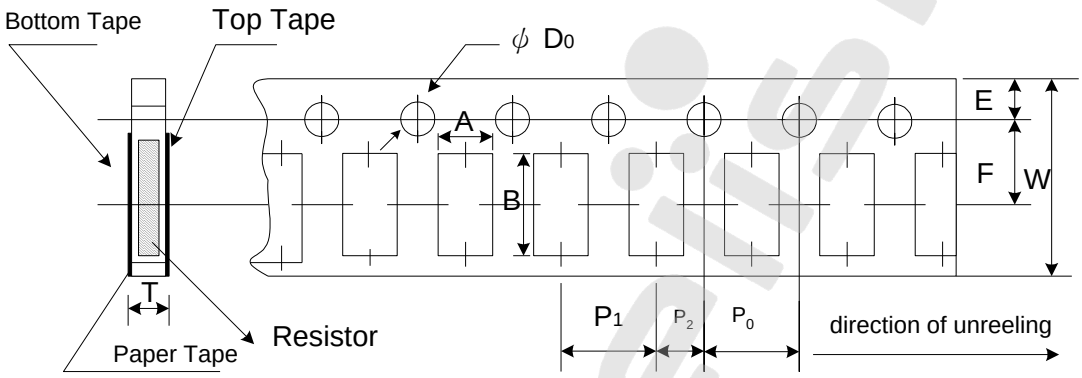
Packing Quantity & Reel Specifications

Unit :mm

Type	ØA	ØB	ØC	W	T	Paper Tape (EA)	Emboss Plastic Tape (EA)
AR02	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
AR03	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR05	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR06	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR13	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
AR10	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
AR12	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000



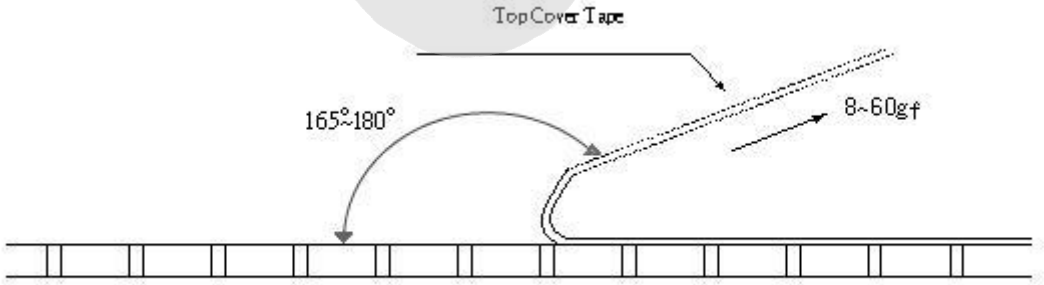
Paper Tape Specifications



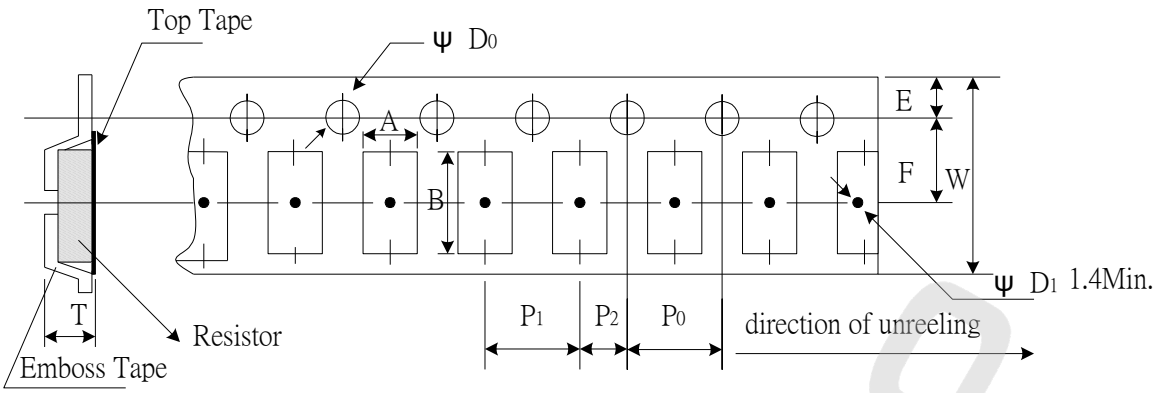
Unit: mm

Type	A	B	W	E	F	P_0	P_1	P_2	ΦD_0	T
AR02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.40±0.03
AR03	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
AR05	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
AR06	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
AR13	2.75±0.05	3.40±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.60±0.10	0.75±0.05

■ Peel force of top cover tape
■ The peel speed shall be about 300mm/min±5%
■ The peel force of top cover tape shall be between 8gf to 60gf



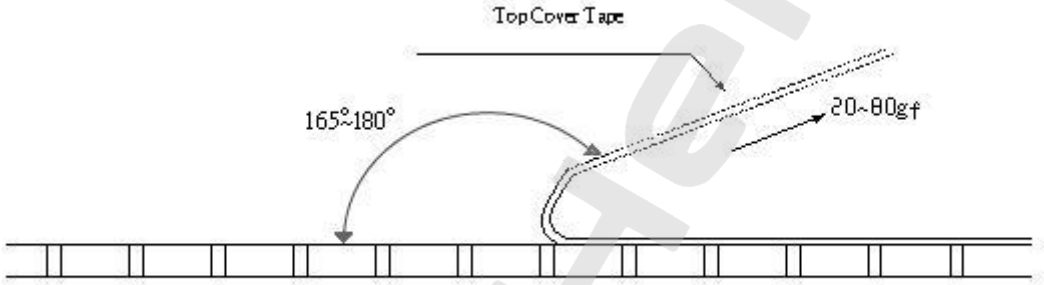
Emboss Plastic Tape Specifications



Unit: mm

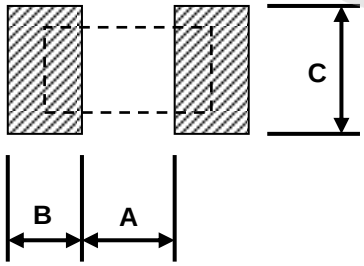
Type	A	B	W	E	F	P_0	P_1	P_2	ØD0	T
AR10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20
AR12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20

- Peel force of top cover tape
- The peel speed shall be about 300mm/min±5%
- The peel force of top cover tape shall be between 20gf to 80gf



■Recommend Land Pattern

Unit: mm



Type	A	B	C
AR02	0.50	0.50	0.60±0.2
AR03	0.80	1.00	0.90±0.2
AR05	1.00	1.00	1.35±0.2
AR06	2.00	1.15	1.70±0.2
AR13	2.00	1.15	2.50±0.2
AR10	3.60	1.40	2.50±0.2
AR12	4.90	1.60	3.10±0.2

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version A5	May 07.2013	-	- Correct the scheme.
Version A6	Aug 20.2013	-	- Delete Thermal Shock & Moisture Resistance Tests (Follow AEC-Q200 Rev.D)
Version A7	Oct 24.2013	-	- Update product features description and add a reliability test item.
Version A8	May 21.2014	-	- Correct the scheme.
Version A9	Sep 25 ,2014	-	- Correct the specification of top cover tape peel force.
Version B	Apr 24 ,2015	-	- Add TCR ±10ppm and ±15ppm products specification. - Revise reliability specification. - Correct the element of Top Electrode.
Version B1	Jan 08 ,2016	-	- Modify Storage Temperature.
Version B2	May 02 ,2016	-	- Remove Material Description.
Version B3	Dec 14 ,2016	-	- Revise the requirements of Environmental Characteristics.
Version B4	Oct 27 ,2017	-	- Correct the reference standard in Environmental Characteristics. - Add Soldering Condition.
Version B5	Dec 25 ,2017	-	- Correct the reference standard in Environmental Characteristics.
Version B6	Jan 10 ,2018	-	- Correct the reference standard in Environmental Characteristics.

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version B7	Aug 01 ,2020	-	- Change the reference standard in Environmental Characteristics.
Version B8	Sep 30 ,2021	-	- Add Safety Precautions.
Version B9	Jan 26 ,2022	-	- Add shelf life description. - Modify IR reflow profile to comply IPC/JEDEC J-STD-020.
Version C	Dec 29 ,2022	-	- Extend the Resistance Range of AR02 ±0.05% in Standard Electrical Specifications. - Extend the Resistance Range and add ±0.01% of AR02 in Special Electrical Specifications. - Extend the Resistance Range and add ±0.01% of AR03, AR05, AR06 in High Power Rating Electrical Specifications. -Update Environmental Characteristics requirement of Operational Life and ESD. -Add Reflow Profiles table. -Delete Safety Precautions.
Version C1	May 16 ,2024	-	- Add Part Numbering codes for 1/5W, 2/5W power rating and no marking. - Extend the resistance range for AR02/AR03/AR06 Standard Electrical Specifications. - Add TCR ±5 PPM/°C and ±0.01% tolerance for AR03/AR05/AR06 Special Electrical Specifications. - Add High Power Rating Electrical Specifications as below: • 1/10W for AR02 • 1/8W for AR03

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version C1	May 16 ,2024	-	• 1/5W for AR05 • 2/5W for AR06 • 1/2W for AR13
Version C2	Jul 01 ,2024	-	- Modify the description in Features from “AEC-Q200 Compliance” to “AEC-Q200 Qualified”.