

Data Sheet

Customer :

Product : Automotive Grade Thin Film Precision Chip Resistor
– AR..A Series

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

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Edition : REV.C



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Automotive Grade Thin Film Precision Chip Resistor



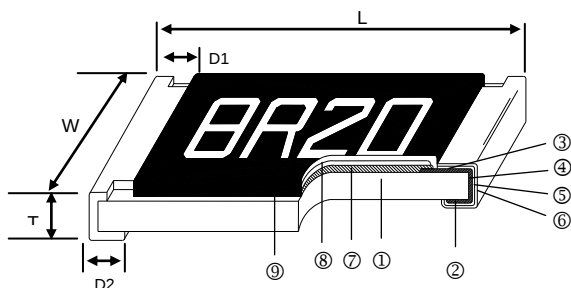
■ Features

- AEC-Q200 Compliance
- 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

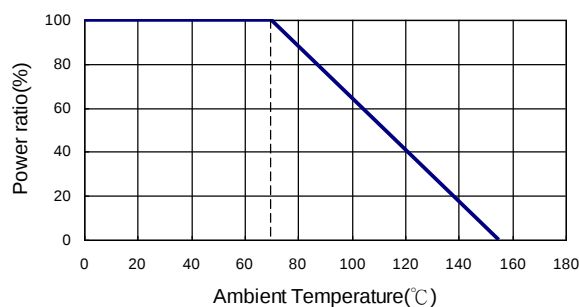
Unit: mm

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	025
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 X: 1/10W W: 1/8W V: 1/4W O: 1/3W	0100: 10Ω 10R2: 10.2Ω 1000: 100Ω 1001: 1KΩ 1004: 1MΩ	A: Automotive Grade	

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	25V	50V	49.9Ω - 12KΩ	49.9Ω - 100KΩ				±25 ±50
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	10Ω - 49.9KΩ	10Ω - 332KΩ				±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 - 1MΩ				±25 ±50
AR13 (1210)	1/4W	-55 ~ +155°C	150V	300V	10Ω - 499KΩ	10Ω - 1MΩ				±25 ±50
AR10 (2010)										
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	25V	50V	49.9Ω - 12KΩ				-		±5
					49.9Ω - 12KΩ		49.9Ω – 69.8KΩ				±10 ±15
AR03 (0603)	1/16W	-55 ~ +155°C	50V	100V	-	10Ω - 49K9Ω	10Ω - 332KΩ				±10 ±15
AR05 (0805)	1/10W	-55 ~ +155°C	100V	200V	-	10Ω - 100KΩ	10Ω – 1MΩ				±10 ±15
AR06 (1206)	1/8W	-55 ~ +155°C	150V	300V	-	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%	
AR03(0603)	1/10W	-55 ~ +155°C	75V	150V	24.9Ω - 15KΩ				-		±5
					24.9Ω - 15KΩ	10Ω - 49.9KΩ	10Ω - 332KΩ		±10		
					-				±25		
AR05(0805)	1/8W	-55 ~ +155°C	150V	300V	24.9Ω - 30KΩ				-		±5
					24.9Ω - 30KΩ	10Ω - 100KΩ	10Ω - 1MΩ		±10		
					-				±25		
AR06(1206)	1/4W	-55 ~ +155°C	200V	400V	24.9Ω - 50KΩ				-		±5
					24.9Ω - 50KΩ	10Ω - 200KΩ	10Ω - 1MΩ		±10		
					-				±25		
AR13(1210)	1/ 3W	-55 ~ +155°C	200V	400V	-	10Ω - 499KΩ	10Ω - 1MΩ		±10		
AR10(2010)									±25		
										±50	

Operating Voltage= $\sqrt{P \cdot R}$ or Max. operating voltage listed above, whichever is lower.

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$ 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°C~+125°C, 25°C is the reference temperature
Short Time Overload	Δ R±0.05%		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°C at derated power. Measurement at 24±4 hours after test conclusion.
	>7kΩ ΔR±0.2%		
	ΔR±0.2% for high power rating		
Biased Humidity	Δ R±0.1%		MIL-STD-202 Method 103 1000 hrs 85°C/85%RH 10% of operating power.
High Temperature Exposure	ΔR±0.2%		MIL-STD-202 Method 108 at +155°C for 1000 hrs
Temperature Cycling	Δ R±0.1%		JESD22 Method JA-104 -55°C to +125°C, 1000 cycles
Bending Strength (Board Flex)	Δ R±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°C for 3 seconds

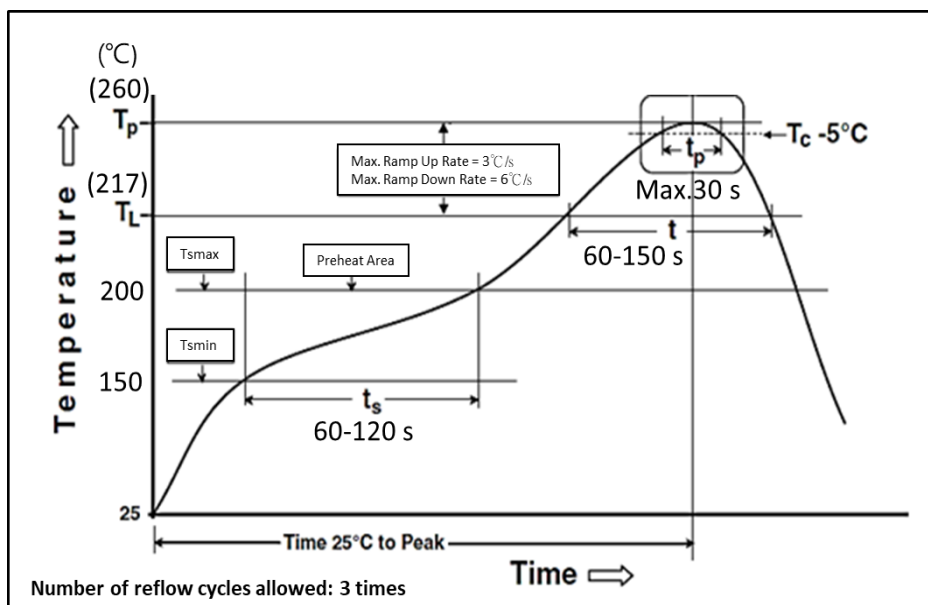
Resistance to Soldering Heat	$\Delta R \pm 0.05\%$		JIS-C-5201-1 4.18 IEC-60115-1 4.18 260 $\pm$ 5°C for 10 seconds
Terminal strength	No broken		AEC-Q200-006 Force of 1.8kg for 60 seconds.
Mechanical Shock	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.1\%$	MIL-STD-202 Method 213 Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.1\%$	MIL-STD-202 Method 204 5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz
ESD	$\Delta R \pm 0.5\%$		AEC-Q200-002 Human body model AR02 0.4KV AR03 1KV AR05 1.5KV AR06 、AR10 、AR12 、AR13 2KV
Resistance to solvents	Marking Unsmearred		MIL-STD-202 Method 215 Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.
Sulfur Test	$\Delta R \pm 1\%$		ASTM-B-809-95 Modified 105 $\pm$ 2 °C 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)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower

■ **Storage Temperature: 15~28°C; 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_{min})	150 °C
Max Temperature (T_{max})	200 °C
Preheating time (t_s) from (T_{min} to T_{max})	60-120 seconds
Ramp-up rate (T_L to T_p)	3 °C/second max.
Liquidous temperature (T_L)	217 °C
Time (t_L) maintained above T_L	60-150 seconds
Min. Peak temperature (T_p min)	235°C
Max. Peak temperature (T_p max)	260°C
Time (t_p) within 5 °C of the specified classification temperature (T_c)	30 seconds max.
Ramp-down rate (T_p 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
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0805~2512 4digit marking

Example

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

Marking Table

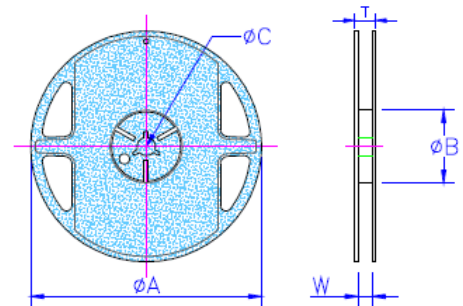
Code	E96		Code	E96		Code	E96		Code	E96	
01	100		25	178		49	316		73	562	
02	102		26	182		50	324		74	576	
03	105		27	187		51	332		75	590	
04	107		28	191		52	340		76	604	
05	110		29	196		53	348		77	619	
06	113		30	200		54	357		78	634	
07	115		31	205		55	365		79	649	
08	118		32	210		56	374		80	665	
09	121		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

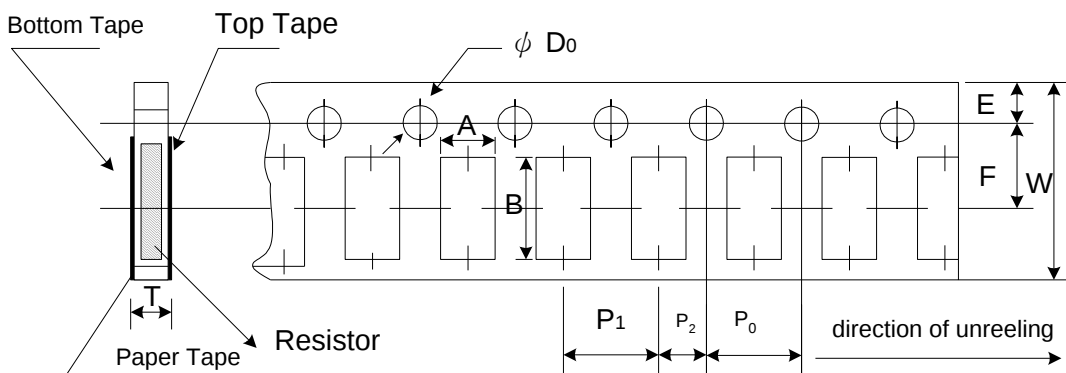
Packing Quantity & Reel Specifications

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



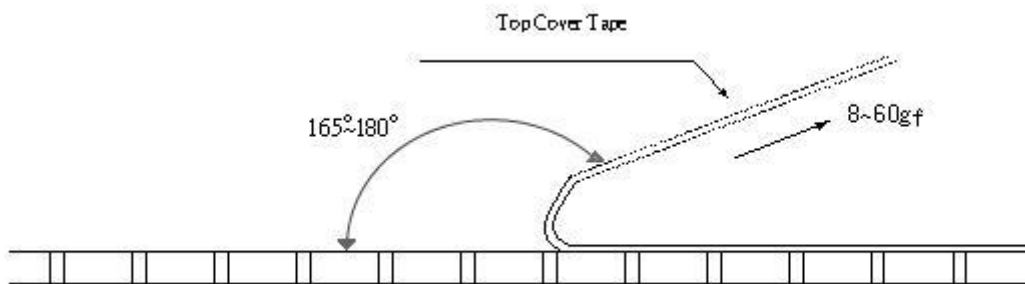
Paper Tape Specifications



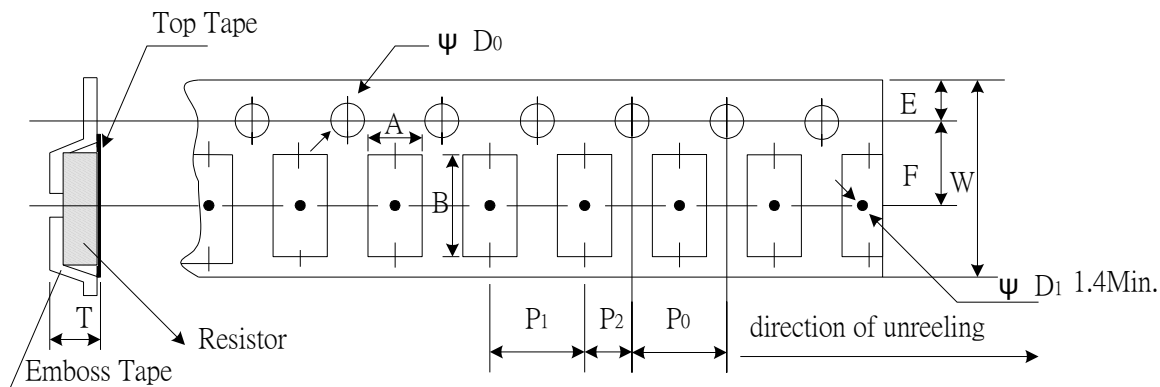
Unit: mm

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



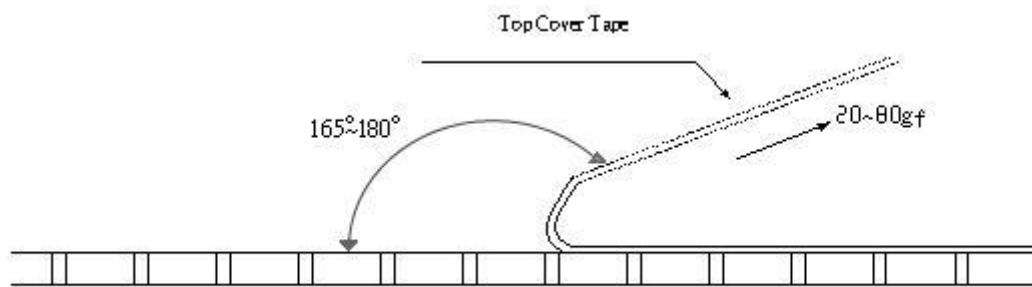
Emboss Plastic Tape Specifications



Unit: mm

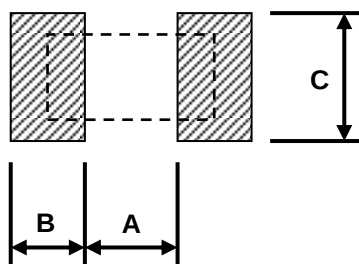
Type	A	B	W	E	F	P ₀	P ₁	P ₂	ØD ₀	T
AR10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
AR12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20

- 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 $\pm 10\text{ppm}$ and $\pm 15\text{ppm}$ 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 $\pm 0.05\%$ in Standard Electrical Specifications. - Extend the Resistance Range and add $\pm 0.01\%$ of AR02 in Special Electrical Specifications. - Extend the Resistance Range and add $\pm 0.01\%$ 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.