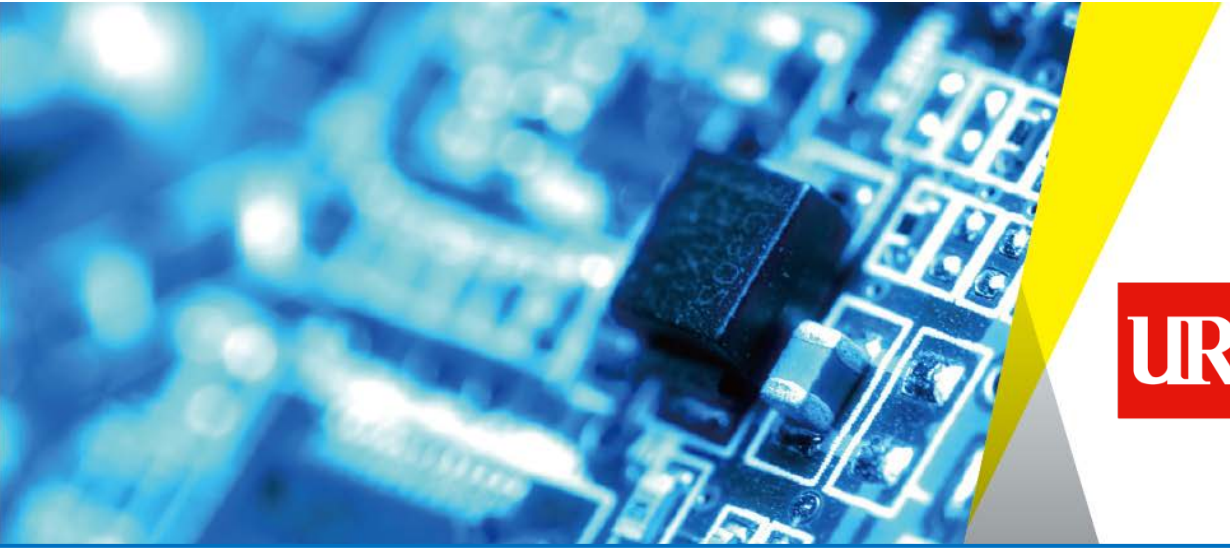

DATA SHEET

Product Name	**Automotive High Power Thick Film Chip Resistors**
Part Name	**HQ Series**
File No.	**SMD-SP -019**

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1. Scope

1.1 This specification for approve relates to the Automotive High Power Thick Film Chip Resistors manufactured by UNI-ROYAL.
1.2 Comply with the relevant provision of AEC-Q200.
1.3 Suitable for reflow & wave soldering.
1.3 Application car.

2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1st~4th codes: Part name. E.g.: HQ02,HQ03,HQ05,HQ06,HQ07,HQ10,HQ12
2.2 5th~6th codes: Power rating.

E.g.: W=Normal Size "1~G" = "1~16"

Wattage	3/4	1/2	1/3	1/5	1/10	1	2
Normal Size	07	W2	W3	W5	WA	1W	2W

If power rating is equal or lower than 1 watt, 5th code would be "W" and 6th code would be a number or letter.
E.g.: WA=1/10W W3=1/3W

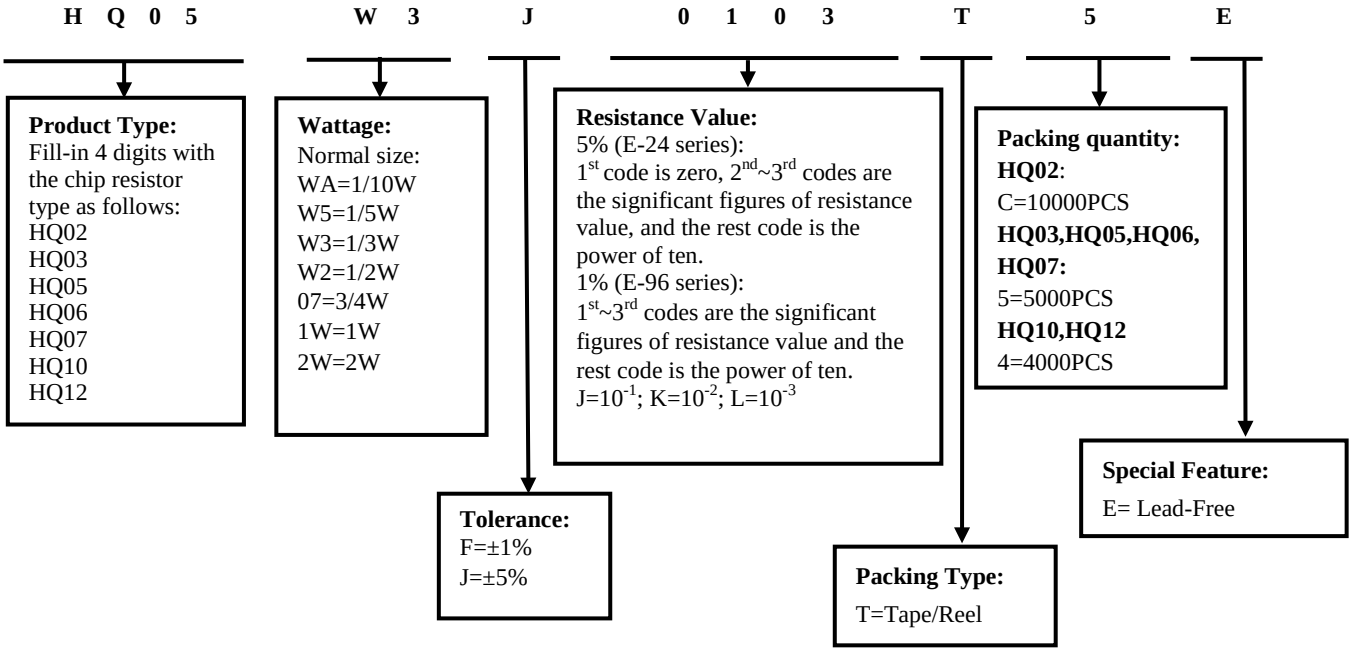
2.3 7th code: Tolerance. E.g.: D=±0.5% F=±1% G=±2% J=±5% K= ±10%
2.4 8th~11th codes: Resistance Value.
2.4.1 If value belongs to standard value of E-24 series, the 8th code is zero, 9th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.2 If value belongs to standard value of E-96 series, the 8th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.311th codes listed as following:

$0=10^0$ $1=10^1$ $2=10^2$ $3=10^3$ $4=10^4$ $5=10^5$ $6=10^6$ $J=10^{-1}$ $K=10^{-2}$ $L=10^{-3}$ $M=10^{-4}$

2.5 12th~14th codes.
2.5.1 12th code: Packaging Type. E.g.: C=Bulk T=Tape/Reel
2.5.2 13th code: Standard Packing Quantity.
4=4,000pcs 5=5,000pcs C=10,000pcs D=20,000pcs E=15,000pcs
Chip Product: BD=B/B-20000pcs TC=T/R-10000pcs
2.5.3 14th code: Special features.
E = Environmental Protection, Lead Free, or Standard type.

3. Ordering Procedure

(Example: HQ05 1/3W ±5% 10KΩ T/R-5000)



4. Marking

4.1 For HQ02 size. Due to the very small size of the resistor's body, there is no marking on the body.

4.2 Normally, the marking of 0Ω HQ03, 0Ω HQ05, 0Ω HQ06, 0Ω HQ07, 0Ω HQ10, 0Ω HQ12 resistors as following

0 → 0

4.3±5% tolerance products (E-24 series):
3 codes.
1st~2nd codes are the significant figures of resistance value, and the rest code is the power of ten.

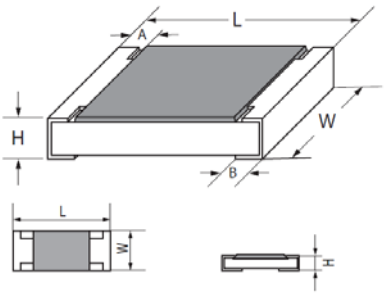
333 → 33KΩ

4.4 ±1% tolerance products (E-96 series):
4 codes.
1st~3rd codes are the significant figures of resistance value, and the rest code is the power of ten.
Letter "R" in mark means decimal point.

2701 → 2.7KΩ

5. Dimension

Type	Dimension(mm)				
	L	W	H	A	B
HQ02(0402)	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
HQ03(0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20
HQ05(0805)	2.00±0.15	1.25+0.15/-0.10	0.55±0.10	0.40±0.20	0.40±0.20
HQ06(1206)	3.10±0.15	1.55+0.15/-0.10	0.55±0.10	0.45±0.20	0.45±0.20
HQ07(1210)	3.10±0.10	2.60±0.20	0.55±0.10	0.50±0.25	0.50±0.20
HQ10(2010)	5.00±0.10	2.50±0.20	0.55±0.10	0.60±0.25	0.50±0.20
HQ12(2512)	6.35±0.10	3.20±0.20	0.55±0.10	0.60±0.25	0.50±0.20



6. Resistance Range

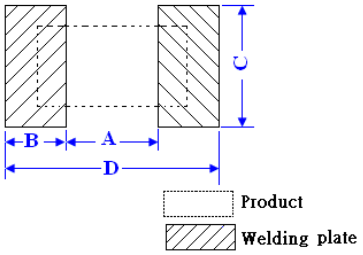
Type	Power Rating	Resistance Range	
		1.0%	5.0%
HQ02	1/10W	1Ω~10M	1Ω~10M
HQ03	1/5W	1Ω~10M	1Ω~10M
HQ05	1/3W	1Ω~10M	1Ω~10M
HQ06	1/2W	1Ω~10M	1Ω~10M
HQ07	3/4W	1Ω~10M	1Ω~10M
HQ10	1W	1Ω~10M	1Ω~10M
HQ12	2W	1Ω~10M	1Ω~10M

7. Ratings

Type	Max. Working Voltage	Max. Overload Voltage	Dielectric withstanding Voltage	Resistance Value of Jumper	Rated Current of Jumper	Max. Overload Current of Jumper	Operating Temperature
HQ02	50V	100V	100V	<50mΩ	1A	2A	-55℃~155℃
HQ03	75V	150V	300V	<50mΩ	1A	2A	-55℃~155℃
HQ05	150V	300V	500V	<50mΩ	2A	5A	-55℃~155℃
HQ06	200V	400V	500V	<50mΩ	2A	10A	-55℃~155℃
HQ07	200V	500V	500V	<50mΩ	2A	10A	-55℃~155℃
HQ10	200V	500V	500V	<50mΩ	2A	10A	-55℃~155℃
HQ12	250V	500V	500V	<50mΩ	2A	10A	-55℃~155℃

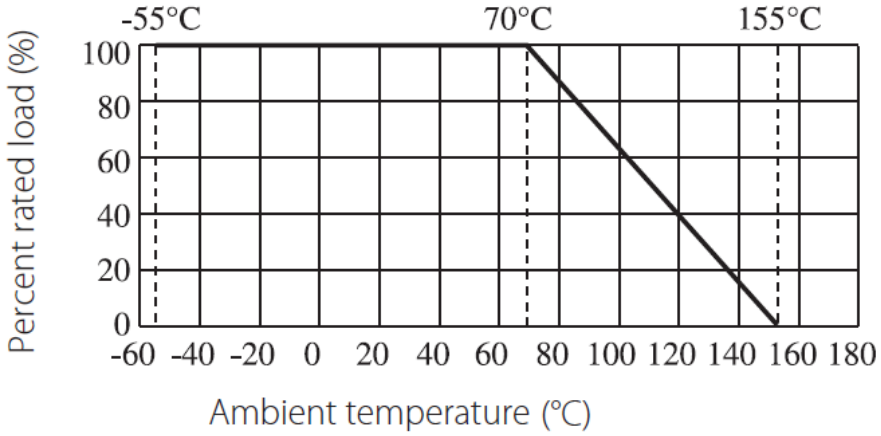
8. Soldering pad size recommended

Type	Dimension(mm)			
	A	B	C	D
HQ02	0.5±0.05	0.5±0.05	0.6±0.05	1.5±0.05
HQ03	0.8±0.05	0.8±0.05	0.9±0.05	2.4±0.05
HQ05	1.0±0.1	1±0.1	1.4±0.1	3±0.1
HQ06	2.0±0.1	1.1±0.1	1.8±0.1	4.2±0.1
HQ07	2.0±0.1	1.1±0.1	2.9±0.1	4.2±0.1
HQ10	3.6±0.1	1.4±0.1	3±0.1	6.4±0.1
HQ12	4.9±0.1	1.35±0.1	3.7±0.1	7.6±0.1



9. Derating Curve

Power rating will change based on continuous load at ambient temperature from -55 to 155℃.
It is constant between -55 to 70℃, and derate to zero when temperature rise from 70℃ to 155℃.

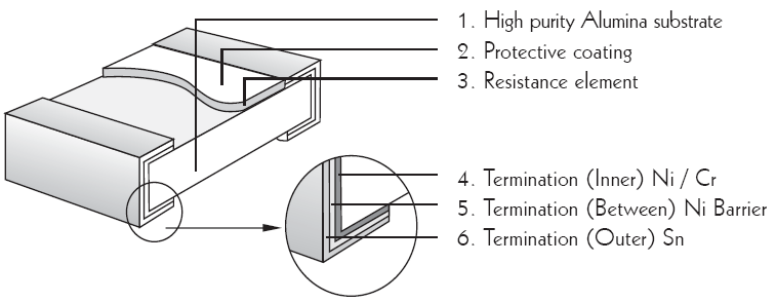


Voltage rating:
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

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

Remark: RCWV: Rating Continuous Working Voltage (Volt.) P: power rating (Watt) R: nominal resistance (Ω)
In no case shall the rated DC or RMS AC continuous working voltage be greater than the applicable maximum value.
The overload voltage is 2.5 times RCWV or Max. Overload voltage whichever is lower.

10. Structure



11. Performance Specification

Characteristic	Limits	Ref. Standards	Test Method
Operational life	±5%: ±(3.0%+0.1Ω) ±1%: ±(1.0%+0.1Ω)	MIL-STD-202 Method 108	1,000 hours at 125°C, applied de-rated (36%) power of continuous working voltage, 1.5 hours on, 0.5 hour off.
	<100mΩ		Apply to rate current for 0 Ω
Electrical Characterization	1Ω<R≤10Ω : ±200PPM/°C 10Ω<R≤10MΩ : ±100PPM/°C	User Spec	Parametrically test per lot and sample size requirements, summary to show Min, Max, Mean and Standard deviation at room as well as Min and Max operating temperatures.
Short-time overload	±1%: ±(1.0%+0.05Ω) ±5%: ±(2.0%+0.05Ω)	JIS-C-5201	4.13 Permanent resistance change after the application of a potential of 2.5 times RCWV or Max. Overload Voltage whichever less for 5 seconds..
External Visual	No Mechanical Damage	MIL-STD-883 Method 2009	Electrical test not required. Inspect device construction, marking and workmanship
Physical Dimension	Reference 5. Dimension Standards	JESD22 MH Method JB-100	Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers spec. Electrical test not required.
Resistance to Solvent	Marking Unsmeared	MIL-STD-202 Method 215	Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	Not broken	JIS-C-6429	Force of 1.8kg for 60 seconds.
High Temperature Exposure (Storage)	±(1.0%+0.1Ω)	MIL-STD-202 Method 108	1000hrs. @T=155℃.Unpowered. Measurement at 24±2 hours after test conclusion.
	<50mΩ		Apply to rate current for 0 Ω
Temperature Cycling	±(1.0%+0.1Ω)	JESD22 Method JA-104	1000 Cycles (-55℃ to +155℃). Measurement at 24±2 hours after test conclusion.
	<50mΩ		Apply to rate current for 0 Ω
Biased Humidity	±5%: ±(3.0%+0.05Ω) ±1%: ±(1.0%+0.05Ω)	MIL-STD-202 Method 103	1000 hours 85℃,85%RH. Note: Specified conditions: 10% of operating power. Measurement at 24±2 hours after test conclusion.
	<100mΩ		Apply to rate current for 0 Ω
Mechanical Shock	±(1.0%+0.1Ω)	MIL-STD-202 Method 213	Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	±(1.0%+0.1Ω)	MIL-STD-202 Method 204	5g's for 20 min., 12cycle each of 3 orientations. Note: Use 8"*5"PCB. 031" thick 7 secure points onone long side and 2 secure points at corners of opposite sides. Parts mounted within 2' from any secure point. Test from 10-2000Hz.
ESD	±(1.0%+0.1Ω)	AEC-Q200-002	Test condition: HQ02: 0.5KV; HQ03: 1KV; HQ05:2KV; HQ06: 3KV; HQ07、HQ10、HQ12: 5KV
Soldrability	Coverage must be over 95%.	J-STD-020E	For both leaded & SMD. Electrical test not required. Magnification 50X. Conditions: a) Method B 4hrs at 155℃ dry heat, the dip in bath with 245℃,5s. b) Method D: at 260℃, 30±0.5s..
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.

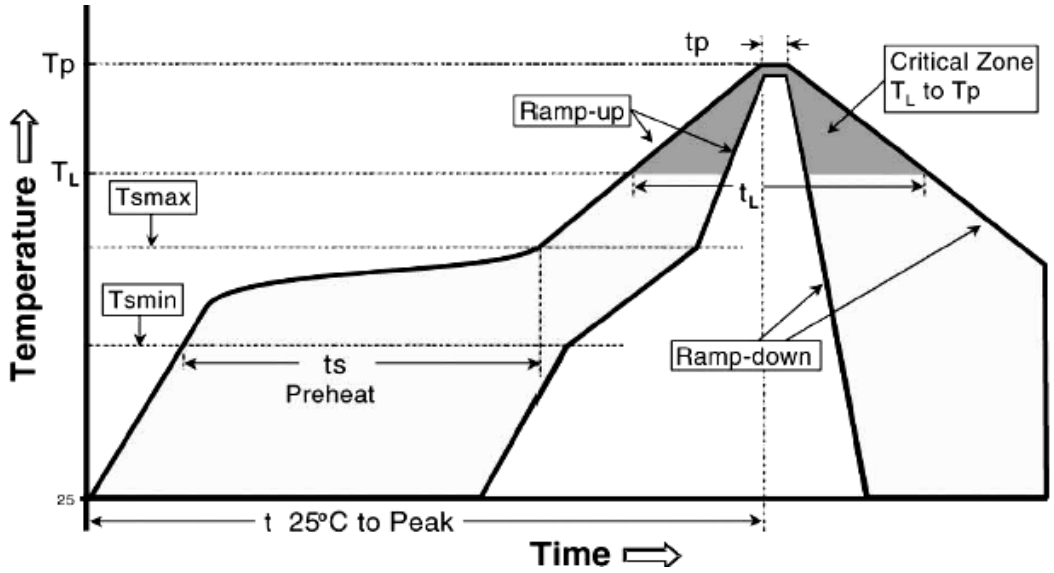
Board Flex	±(1.0%+0.05Ω)	JIS-C-6429	2mm (Min)
	<50mΩ		Apply to rate current for 0 Ω
Flame Retardance	No flame	AEC-Q200-001	Only requested, when voltage/power will increase the surface temp to 350℃.Apply voltage from 9V to 32V. No flame; No explosion.
Resistance to Soldering Heat	±(1.0%+0.05Ω)	MIL-STD-202 Method 210	Condition B No per-heat of samples. Note: Single Wave Solder-Procedure 2 for SMD and Procedure 1 for Leaded with solder within 1.5mm of device body.
	<50mΩ		Apply to rate current for 0 Ω
Sulfuration test	±(1.0%+0.05Ω)	ASTM B-809-95	sulfur(saturated vapor) , Temperature：50±2℃ Humidity：86 ~ 90%RH, 1000H .

Sulfuration test： H_2S 3~5PPM 50℃±2℃ 91% ~93% RH 1000H ±5%:(5.0%+0.05Ω)；±1%:(1.0%+0.05Ω)

11. Soldering Condition

(This is for recommendation, please customer perform adjustment according to actual application)

11.1 Recommend Reflow Soldering Profile：(solder : Sn96.5 / Ag3 / Cu0.5)

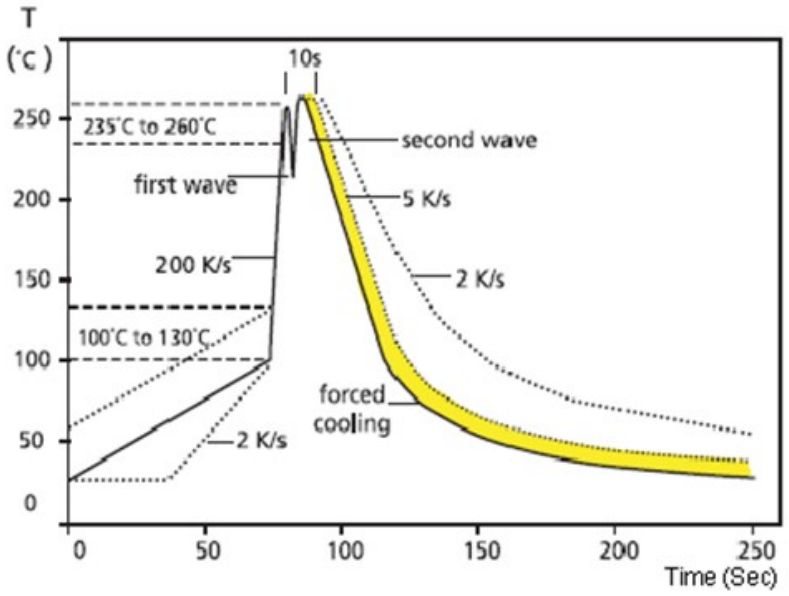


Profile Feature	Lead (Pb)-Free solder
Preheat： Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (Ts_{min} to Ts_{max}) (ts)	 150℃ 200℃ 60 -120seconds
Average ramp-up rate： (Ts max to Tp)	 3℃ / second max.
Time maintained above : Temperature (T_L) Time (t_L)	 217℃ 60-150 seconds
Peak Temperature (Tp)	260℃
Time within $^{+0}_{-5}$℃ of actual peak Temperature $(tp)^2$	10 seconds
Ramp-down Rate	6℃/second max.
Time 25℃ to Peak Temperature	8minutes max.

Allowed Re-flow times : 2 times

Remark : To avoid discoloration phenomena of chip on terminal electrodes, please use N2 Re-flow furnace .

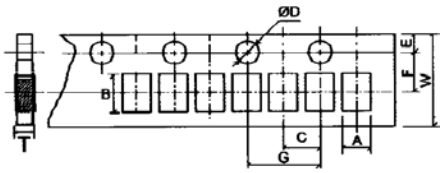
11.2 Recommend Wave Soldering Profile：(Apply to 0603 and above size)



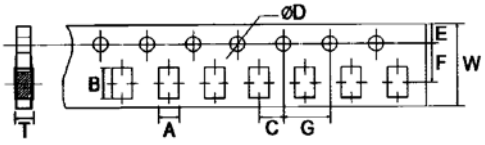
12. Packing

12.1 Dimension of Paper Taping :(Unit: mm)

Type	A ±0.1	B ±0.1	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.05
HQ02	0.65	1.20	2.00	1.50	1.75	3.50	4.00	8.00	0.42

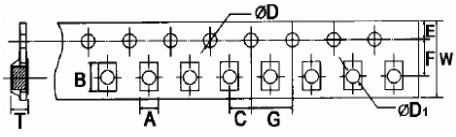


Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
HQ03	1.10	1.90	2.0	1.5	1.75	3.5	4.0	8.0	0.67
HQ05	1.65	2.40	2.0	1.5	1.75	3.5	4.0	8.0	0.81
HQ06	2.00	3.60	2.0	1.5	1.75	3.5	4.0	8.0	0.81
HQ07	2.80	3.50	2.0	1.5	1.75	3.5	4.0	8.0	0.75



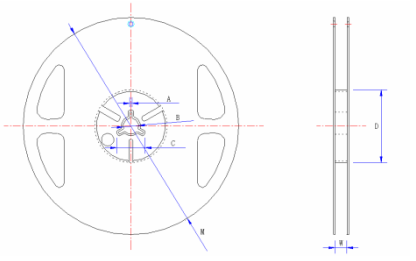
12.2 Dimension of plastic taping：(Unit: mm)

Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	$\Phi D1^{+0.25}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
HQ10	2.90	5.60	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00
HQ12	3.50	6.70	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00



12.3 Dimension of Reel：(Unit: mm)

Type	Taping	Qty/Reel	A±0.5	B±0.5	C±0.5	D±1	M±2	W±1
HQ02	Paper	10,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
HQ03	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
HQ05	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
HQ06	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
HQ07	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
HQ10	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8
HQ12	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8



13. Note

13.1. UNI-ROYAL recommend products store in warehouse with temperature between 15 to 35℃ under humidity between 25 to 75%RH.

Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.

13.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.

13.3. Storage conditions as below are inappropriate:

a. Stored in high electrostatic environment

b. Stored in direct sunshine, rain, snow or condensation.

13.4 This product is used for automotive electronics. UNI-ROYAL will not be responsible for any damage, expense or loss caused by the use of this specification in any special environment. This series of products are suitable for automotive electronics applications, as shown below, If there are other applications, you need to confirm with UNI-ROYAL whether they are applicable:

a. Control unit for information, entertainment, navigation, audio;

b. Control unit for comfortable doors, windows, seat;

c. Control unit for internal lighting.

14. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~7	Mar.20, 2018	Haiyan Chen	Nana Chen
2	1. Modify the product name 2. Modify the Power	1~7	Nov.22, 2018	Haiyan Chen	Nana Chen
3	Modify characteristic	5~6	Feb.16, 2019	Haiyan Chen	Yuhua Xu
4	Experimental method and standard for adding vulcanization	6	Mar.05, 2019	Haiyan Chen	Yuhua Xu
5	Modify the Power	4	May.23, 2019	Haiyan Chen	Yuhua Xu
6	Modify HQ03 Max. Overload Voltage, HQ12 Max .Working Voltage	3	Jan.22, 2020	Haiyan Chen	Yuhua Xu
7	1.Modify the reflow curve and add the wave soldering curve 2. Notes for improvement	6~7 8	Apr.22, 2020	Haiyan Chen	Yuhua Xu
8	Modify the power and derating curve to unify the standards	3~4	Dec.04, 2020	Haiyan Chen	Yuhua Xu