ROYALOHM

C O N F I D E N T I A L D O C U M E N T

SPECIFICATION FOR APPROVAL

OZDISAN ELEKTRONIK A.S.

Description : High Power Thick Film Chip Resistors (HP Series) AEC-Q200 Compliant

Royalohm Part no.:

HPxxxxxxxxxTxE (HP Series +/- 1%, 5%)

Approved by

RoHS V3 Compliant (EU) 2015/863

REACH Compliant

Royal Electronic Factory (Thailand) Co., Ltd.
20/1-2 Moo 2 Klong-Na, Muang
Chachoengsao 24000, Thailand
Tel: +66-38-822404-8
Fax: +66 38-981190 / 823765
E-mail Address: Export sales: Export@royalohm.com
Local sales: Local@royalohm.com
http:// www.royalohm.com

Approved	Checked	Prepared
Mr. XP Hong	Mr. S. Polthanasan	Ms. P.Supatta

Issue Date: 2021/10/05

Customer:			
Version	**Date of Version**	**History**	**Remark**
1	2021/10/05	1. HP Series (HP02, HP03, HP05, HP06,	
		HP07, HP10, HP11, HP12)	
		2. Resistance tolerance: ±1%, ±5%	

High Power Thick Film Chip Resistors AEC-Q200 Compliant

1. Scope:

This specification for approval relates to High Power Thick Film Chip Resistors manufactured by ROYALOHM 's specifications.

2. Type designation:

The type designation shall be in the following form:

	Type	Power Rating	Resistance tolerance	Nominal Resistance
Ex.	HP06	1/2W (0.5W)	F,J	75Ω

3. Ratings:

Type	HP02	HP03	HP05	HP06	HP07	HP10	HP11	HP12
Power Rating @70℃	1/10W	1/5W	1/3W	1/2W	3/4W	1W	1.25W	2W
Max. Working Voltage	50V	75V	150V	200V	200 V	200 V	200 V	250V
Max. Overload Voltage	100 V	150 V	300 V	400 V	500 V	500 V	500 V	500 V
Dielectric Withstanding Voltage	100 V	300 V	500 V	500 V	500 V	500 V	500 V	500 V
Temperature Range	-55℃～ +155℃							
Ambient Temperature	70 ℃							
Resistance Range	1Ω ~ 10MΩ	0.1Ω ~ 10MΩ	10mΩ ~ 10MΩ		0.1Ω ~ 10MΩ	10mΩ ~ 10MΩ	0.1Ω ~ 10MΩ	10mΩ ~ 10MΩ

3.1 Nominal Resistance

Effective figures of nominal resistance shall be in accordance :

E-24 values – these are preferred and will have standard MOQ

E-96 values – are available on case by case basis and availability and MOQ need to be confirmed with factory first

3.2 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 :

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

Note : Max. Working Voltage or $\sqrt{P \times R}$ whichever is lesser

Max. Overload Voltage or $2.5\sqrt{P \times R}$ whichever is lesser

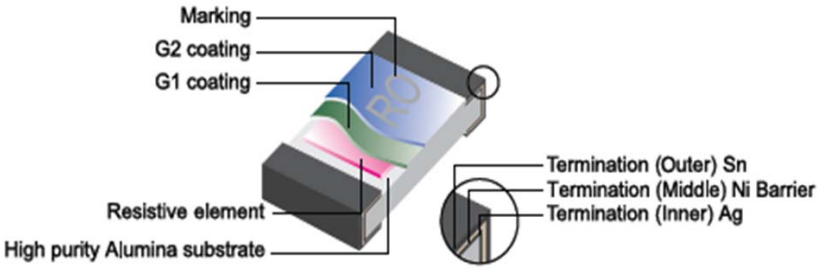
Where : RCWV = Rated DC or RMS AC continuous working voltage at commercial-line frequency and waveform (volt)

P = Power Rating (watt)

R = Nominal Resistance (ohm)

High Power Thick Film Chip Resistors AEC-Q200 Compliant

4. Construction :

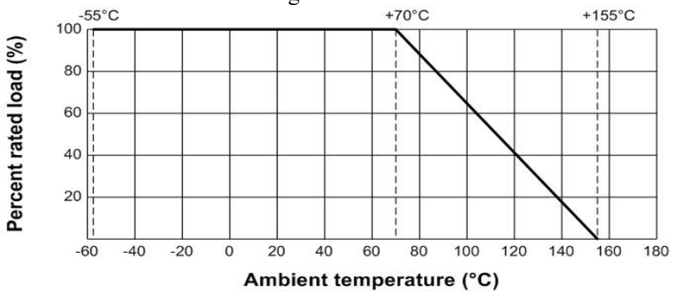


5. Power rating and dimensions

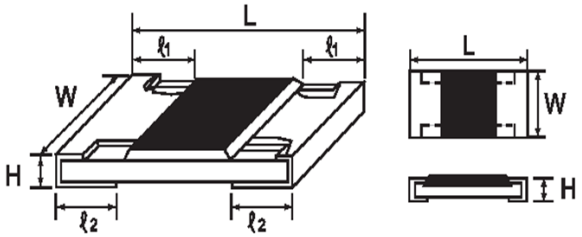
5.1 Power rating:

Resistors shall have a power rating based on continuous load operation at an ambient temperature of 70 ℃ . For temperature in excess of 70 ℃ , The load shall be derate as shown in figure 1.

Figure 1



5.2 Dimension :



Type	Dimension (mm)				
	L	W	H	ℓ1	ℓ2
HP02 (0402)	1.00 ± 0.10	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.25 ± 0.10
HP03 (0603)	1.60 ± 0.10	0.80 + 0.15 - 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
HP05 (0805)	2.00 ± 0.15	1.25 + 0.15 - 0.10	0.55 ± 0.10	0.40 ± 0.20	0.40 ± 0.20
HP06 (1206)	3.10 ± 0.15	1.55 + 0.15 - 0.10	0.55 ± 0.10	0.45 ± 0.20	0.45 ± 0.20
HP07 (1210)	3.10 ± 0.10	2.60 ± 0.20	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.20
HP10 (2010)	5.00 ± 0.10	2.50 ± 0.20	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20
HP11 (1812)	4.50 ± 0.20	3.20 ± 0.20	0.55 ± 0.20	0.50 ± 0.20	0.50 ± 0.20
HP12 (2512)	6.35 ± 0.10	3.20 ± 0.20	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20

High Power Thick Film Chip Resistors AEC-Q200 Compliant

Power Rating Resistance range and T.C.R.:

Type	Power Rating at 70 ℃	Tolerance %	Resistance Range	TCR PPM/℃	Standard Series
HP02 (0402)	1/10W	± 1 ,± 5	1Ω ≤ R ≤10Ω	±400	E-96, E-24
			10Ω <R ≤ 100Ω	±200	
			100Ω < R ≤ 10MΩ	±100	
HP03 (0603)	1/5W	± 1 ,± 5	0.1Ω≤R≤0.2Ω	±200	E-96, E-24
			0.2Ω≤R≤10MΩ	±100	
HP05 (0805)	1/3W	± 1 ,± 5	0.01Ω≤R≤ 0.015Ω	±800	E-96, E-24
			0.015Ω<R≤ 0.025Ω	±600	
			0.025Ω<R≤ 0.05Ω	±400	
			0.05Ω<R≤0.1Ω	±200	
			0.1Ω<R≤10MΩ	±100	
HP06 (1206)	1/2W	± 1 ,± 5	0.01Ω≤R≤ 0.015Ω	±700	E-96, E-24
			0.015Ω<R< 0.03Ω	±400	
			0.03Ω≤R< 0.05Ω	±300	
			0.05Ω≤R<0.1Ω	±150	
			0.1Ω<R≤10MΩ	±100	
HP07 (1210)	3/4W	± 1 ,± 5	0.1Ω≤R≤ 10MΩ	±100	E-96, E-24
HP10 (2010)	1W	± 1 ,± 5	0.01Ω≤R< 0.015Ω	±800	E-96, E-24
			0.015Ω≤R< 0.05Ω	±600	
			0.05Ω≤R≤ 10MΩ	±100	
HP11 (1812)	1.25W	± 1 ,± 5	0.1Ω≤R≤ 10MΩ	±100	E-96, E-24
HP12 (2512)	2W	± 1 ,± 5	0.01Ω≤R< 0.02Ω	±800	E-96, E-24
			0.020Ω≤R≤ 0.05Ω	±400	
			0.05Ω<R≤ 10MΩ	±100	

High Power Thick Film Chip Resistors AEC-Q200 Compliant

6. Marking :

6.1 Resistors

A. Chip Resistors type HP02 No marking

B. ± 1% Tolerance HP03 E-96 series use below decoding method:

Mutiplier Code :

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

Coding

XX

Resistance Code

Formula

X

Multiplier Code

Example : 10.2K Ω = 102 (02) X 10^{2} (C) Ω = 02C

33.2 Ω = 332 (51) X 10^{-1} (X) Ω = 51X

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

B. Marking for HP03 E-24 series 1% tolerance, the value that no have multiplier code indicate marking follow this:
The first two digits are significant figures of resistance and the third one denoted number of zeros and under line the marking letters.

Ex. | | 122 | | 1.2K Ω

C. ± 5% Tolerance HP03, HP05, HP06, HP07, HP10, HP11, HP12: the first two digits are significant figures of resistance and the third onedenoted number of zeros.

Ex. | | 333 | | 33KΩ

D. For ohmic values below 10 Ω

Ex. | | 2R2 | | 2.2Ω

E. For E-96 series [±1% (F) tolerance] in HP03 size 3 digit system (due to space restrictions) please refer to page 4 for coding formula

Ex. | | 02C | | 10.2KΩ

F. ±1% Tolerance HP05, HP06, HP07, HP11, HP10, HP12 : 4 Digits, the first three digits are singnificant figures of resistance and the fourth digit denoted number of zeros.Letter"R" is for decimal point.

Ex. | | 2701 | | 2.7KΩ

G. Chip Resistors type HP02 No marking

H. Marking for ±1%,±5% Tolerance HP05, HP06, HP07, HP10, HP11, HP12 (Only for 0.01Ω ~ 0.099Ω) : 4 Digits

Ex. | | R091 | | 0.091Ω

Ex. | | R010 | | 0.01Ω

6.2 Labels

Label shall be marked with the following item :

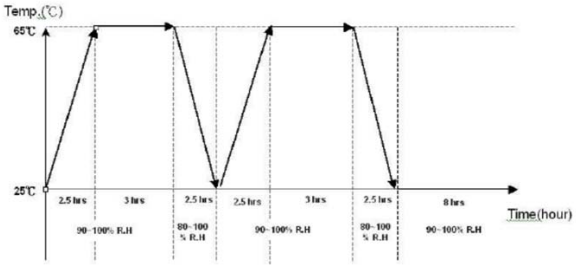
A. Nominal Resistance and Resistance Tolerance
B. Power Rating and Size
C. Quantity
D. Part No.
E. P.O.No.
F. Lot No.

Ex.

ROYALOHM
CHIP RESISTOR

RESISTANCE: 75 Ω ± 1 %
WATTAGE: 1/5W SIZE: HP03
QUANTITY: 5,000 PCS Pb-Free
PART NO.:
P.O.NO.:
LOT NO. : 825723 HP03W5F750JT5E

Remark : **For HP03** ± 1 % : Label is 75R, value is 75Ω, marking is 85X

High Power Thick Film Chip Resistors AEC-Q200 Compliant		
7. Performance specification :		
Characteristics	Limits	Test Methods (AEC - Q200)
Operational Life	Resistance change rate is ±1%: ±(1.0%+0.1Ω)max ±5%: ±(3.0%+0.1Ω)Max.	125℃, at35% of operating power, 1000H(1.5 hours “ON”, 0.5 hour “OFF”). (MIL-STD-202 Method 108)
Temperature Coefficient	Resistance change rate is 1Ω≤ R ≤10Ω : ±400PPM/°C 10Ω< R ≤100Ω : ±200PPM/°C 100Ω< R ≤10MΩ : ±100PPM/°C	Natural resistance change per temp. degree centigrade. $\frac{R2-R1}{R1(t2-t1)}$ R1: Resistance value at room temperature (T1) R2: Resistance value at room temp. plus 100 ℃(T2) Test pattern: room temp. (T1), room temp. +100℃(T2)
Short Time Overload	Resistance change rate is ±1%: ±(1.0%+0.1Ω)Max ±5%: ±(2.0%+0.1Ω)Max	2.5x Rated voltage or Max. Overload Voltage whichever is lower for 5 seconds, then check the resistance.
External Visual	No Mechanical Pamage	Electrical test not required.Inspect device construction, marking and workmanship (MIL-STD-883 Method 2009)
Physical Dimension	Reference 2.0 Dimension Standards	Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers spec. Electrical test not required. (JESD22 MH Method JB-100)
Resistance to Solvent	Marking Unsmeared	Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents. (MIL-STD-202 Method 215)
Terminal Strength	Not broken	Force of 1.8kg for 60 seconds. (JIS-C-6429)
High Temperature Exposure (Storage)	Resistance change rate is ±(1.0%+0.1Ω)max	1000hrs. @T=155℃.Unpowered. Measurement at 24±2 hours after test conclusion. (MIL-STD-202 Method 108)
Temperature Cycling	Resistance change rate is 1%: ± (0.5%+0.1Ω) Max. 5%: ± (1.0%+0.1Ω) Max.	1000 Cycles (-55℃ to +155℃). Measurement at 24±2 hours after test conclusion. (JESD22 Method JA-104)
Moisture Resistance	Resistance change rate is 1%: ± (0.5%+0.1Ω) Max. 5%: ± (3.0%+0.1Ω) Max.	 T=24 hours /cycle. Unpowered. Measurement at 24±2 hours after test conclusion. (MIL-STD-202 Method 106)
Biased Humidity	Resistance change rate is 1%: ± (1.0%+0.1Ω) Max. 5%: ± (3.0%+0.1Ω) Max.	10% rated power, 85℃/85%RH, 1000H,Measurement at 24 hours after test conclusion. (MIL-STD-202 Method 103)

High Power Thick Film Chip Resistors AEC-Q200 Compliant

7. Performance specification :

Characteristics	Limits	Test Methods (AEC - Q200)
Mechanical Shock	Resistance change rate is ±(1.0%+0.1Ω)max	Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6. (MIL-STD-202 Method 213)
Vibration	Resistance change rate is ±(1.0%+0.1Ω)max	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. (MIL-STD-202 Method 204)
Thermal Shock	Resistance change rate is ±(1.0%+0.1Ω)max	-55℃/+155℃,Note: Number of cycles required -300, Maximum transfer time -20 seconds, Dwell time -15 minutes. Air-Air. (MIL-STD-202 Method 107)
ESD	Resistance change rate is ±(10%+0.1Ω)max	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of ±500V,±1KV, ±2KV, ±4KV,±8KV, The electrometer reading shall be within ±10% for voltages from 500V to ≦800V. (AEC-Q200-002)
Solderability	95% coverage Min.	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 B: at 215℃,5s. c) Method D: at 260℃, 60s. (J-STD-002)
Flammability	No ignition of the tissue paper or scorching or the pinewood board	V-0 or V-1 are acceptable. Electrical test not required. (UL-94)
Board Flex	Resistance change rate is ±(1.0%+0.05Ω)max	2mm (Min) (JIS-C-6429)
Flame Retardance	No flame	Temperature sensing at 500℃, Voltage power subjected to 32VDC current clamped up to 500ADC and decreased in 1.0VDC/hour. (AEC-Q200-001)
Resistance to Soldering Heat	Resistance change rate is ±(1.0%+0.05Ω)max.	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. (MIL-STD-202 Method 210)

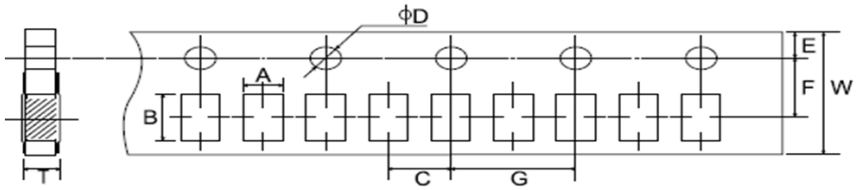
* Sulfuration test: H_2S 3~5PPM 50℃±2℃ 91%~93%RH 1000H

High Power Thick Film Chip Resistors AEC-Q200 Compliant

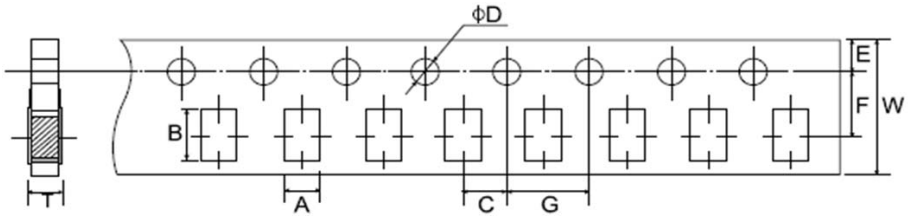
8. Packing specification :

* Taping Dimension (mm)

A. Paper taping

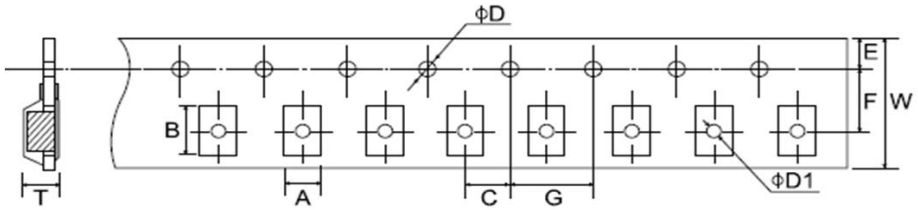


Type	A ± 0.1	B ± 0.1	C ± 0.05	ϕ D +0.1 - 0	E ± 0.1	F ± 0.05	G ± 0.1	W ± 0.2	T ± 0.05
HP02	0.65	1.2	2.0	1.5	1.75	3.5	4.0	8.0	0.42



Type	A ± 0.2	B ± 0.2	C ± 0.05	ϕ D +0.1 - 0	E ± 0.1	F ± 0.05	G ± 0.1	W ± 0.2	T ± 0.1
HP03	1.10	1.90	2.0	1.5	1.75	3.5	4.0	8.0	0.67
HP05	1.65	2.40	2.0	1.5	1.75	3.5	4.0	8.0	0.81
HP06	2.00	3.60	2.0	1.5	1.75	3.5	4.0	8.0	0.81
HP07	2.80	3.50	2.0	1.5	1.75	3.5	4.0	8.0	0.75

B. Embossed taping

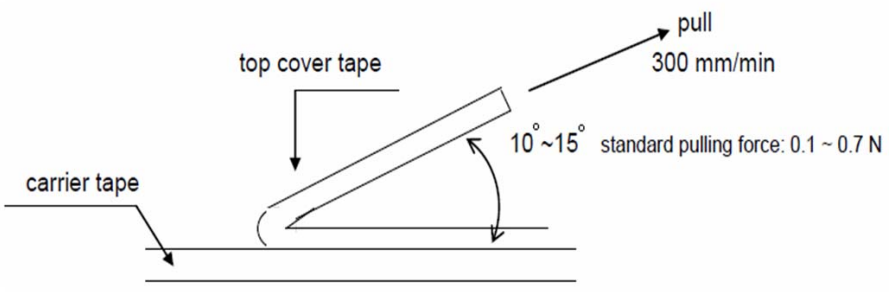


Type	A ±0.2	B ±0.2	C ±0.05	ϕ D+0.1 -0	ϕ D1+0.1 -0	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ± 0.1
HP10	2.90	5.60	2.0	1.5	1.5	1.75	5.5	4.0	12.0	1.0
HP11	3.50	4.80	2.0	1.5	1.5	1.75	5.5	4.0	12.0	1.0
HP12	3.50	6.70	2.0	1.5	1.5	1.75	5.5	4.0	12.0	1.0

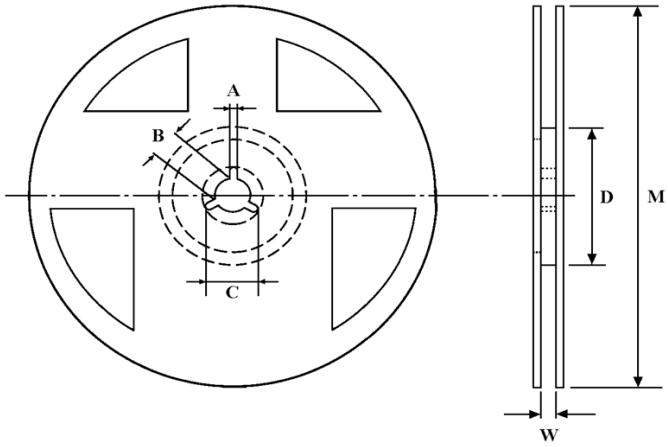
High Power Thick Film Chip Resistors AEC-Q200 Compliant

* Peeling Strength of Top Cover Tape

Test Condition: 0.1 to 0.7 N at a peel-off speed of 300 mm / min.



* Reel Dimension (mm)

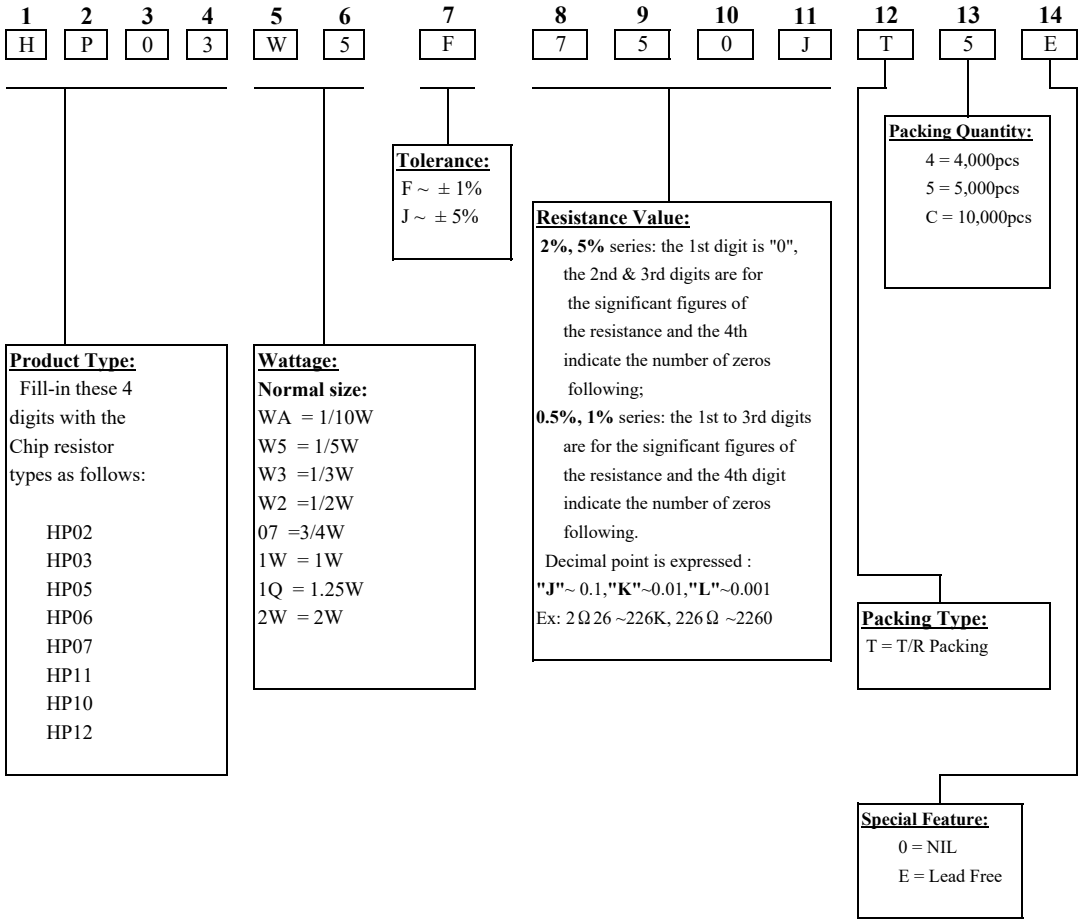


Type	Packaging	Quantity Per Reel	A ± 0.5	B ± 0.5	C ± 0.5	D ± 1	M ± 2	W ± 1
HP02	Paper	10,000 pcs.	2	13	21	60	178	10
HP03	Paper	5,000 pcs.	2	13	21	60	178	10
HP05	Paper	5,000 pcs.	2	13	21	60	178	10
HP06	Paper	5,000 pcs.	2	13	21	60	178	10
HP07	Paper	5,000 pcs.	2	13	21	60	178	10
HP10	Embossed	4,000 pcs.	2	13	21	60	178	13.8
HP11	Embossed	4,000 pcs.	2	13	21	60	178	13.8
HP12	Embossed	4,000 pcs.	2	13	21	60	178	13.8

High Power Thick Film Chip Resistors AEC-Q200 Compliant

Explanation of Part Number System

Thick Film Chip Resistors (Terminal Lead Free) AEC-Q200 Compliant



Sample : HP03 1/5W +/- 1% 75Ω T/R--5,000 → HP03W5F750JT5E

HP03 1/5W +/- 5% 75Ω T/R--5,000 → HP03W5J0750T5E

High Power Thick Film Chip Resistors AEC-Q200 Compliant

Environment Related Substance

This product complies to EU RoHS directive, EU PAHs directive, EU PFOS directive and Halogen free.

Ozone layer depleting substances.

Ozone depleting substances are not used in our manufacturing process of this product.
This product is not manufactured using Chloro fluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Hydrobromofluorocarbons (HBFCs) or other ozone depleting substances in any phase of the manufacturing process.

Storage Condition (MSL1)

The performance of these products, including the solderability, is guaranteed for a year from the date of arrival at your company, provided that they remain packed as they were when delivered and stored at a temperature of 25°C ± 10°C and a relative humidity of 60%RH ± 10%RH, chemical and dust free atmosphere

Even within the above guarantee periods, do not store these products in the following conditions. Otherwise, their electrical performance and/or solderability may be deteriorated, and the packaging materials (e.g. taping materials) may be deformed or deteriorated, resulting in mounting failures.

1. In salty air or in air with a high concentration of corrosive gas, such as Cl_2, H_2S, NH_3, SO_2, or NO_2
2. In direct sunlight

This production is used for automotive electronics, ROYALOHM will not be responsible for any damage, expense or loss caused by the use of this specification in any special environment. This series of product are suitable for automotive electronics applications, as show below, if there are other application, you need to confirm with ROYALOHM whether they are applicable:

a. Control unit for informatiom, entertainment, navigation, audio;
b. Control unit for comfortable doors, windows, seat;
c. Control unit for internal lighting.