SPECIFICATIONS

Customer	
Product Name	Multi-layer Chip Ceramic Inductors
Sunlord Part Number	HQ0603H_T01 Series
Customer Part Number	

[☒New Released, ☐Revised] **SPEC No.: HQ0406200000**

Rev.	Effective Date	Changed Contents	Change reasons	Approved By
01	/	New release	/	Xiangdong Zeng

【This SPEC is total 12 pages including specifications and appendix. 】

【ROHS, Halogen-Free and SVHC Compliant Parts】

Approved By	Checked By	Issued By

Shenzhen Sunlord Electronics Co., Ltd.

Address: Sunlord Industrial Park, Dafuyuan Industrial Zone, Baoan, Shenzhen, China 518110

Tel: 0086-755-29832333 Fax: 0086-755-82269029 E-Mail: sunlord@sunlordinc.com

【For Customer approval Only】 Date:_____

Qualification Status: ☐ Full ☐ Restricted ☐ Rejected

Approved By	Verified By	Re-checked By	Checked By

Comments:

_____

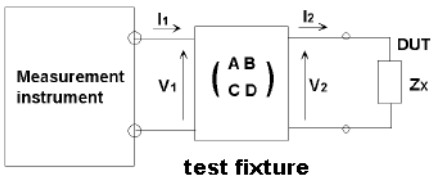
Caution

All products listed in this specification are developed, designed and intended for use in general electronics equipment. The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require especially high reliability, or whose failure, malfunction or trouble might directly cause damage to society, person, or property. Please understand that we are not responsible for any damage or liability caused by use of the products in any of the applications below. Please contact us for more details if you intend to use our products in the following applications.

1. Aircraft equipment
2. Aerospace equipment
3. Undersea equipment
4. nuclear control equipment
5. military equipment
6. Power plant equipment
7. Medical equipment
8. Transportation equipment (automobiles, trains, ships,etc.)
9. Traffic signal equipment
10. Disaster prevention / crime prevention equipment
11. Data-processing equipment
12. Applications of similar complexity or with reliability requirements comparable to the applications listed in the above

Measuring Method of Inductance

a. Residual elements and stray elements of test fixture can be described by F-parameter as shown in the following:



$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ I_2 \end{bmatrix}$$

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} AV_2 + BI_2 \\ CV_2 + DI_2 \end{bmatrix}$$

Measured open impedance: $Zom = \frac{A}{C}$

Measured short impedance: $Zsm = \frac{B}{D} \approx -Zsc$ (when uses short chip to short)

Measured short ship impedance: Zsc

Measured value: $Zxm=V_1/I_1$

Impedance of DUT: $Zx=V_2/I_2$

b. The relation between Zx and Zom, Zsm, Zxm is shown in the following:

$$Zx = \frac{V_2}{I_2} = \frac{D}{A} * \frac{\frac{V_1}{I_1} - \frac{B}{D}}{1 - \frac{V_1}{I_1} * \frac{C}{A}} = \frac{D}{A} * \frac{Zxm - \frac{B}{D}}{1 - Zxm * \frac{C}{A}} = \frac{D}{A} * \frac{Zxm - Zsm}{1 - Zxm / Zom}$$

c. Lx should be calculated with the following equation:

$$Lx = \frac{\mathrm{Im}(Zx)}{2\pi f} = \frac{\mathrm{Im}(Zxm + Zsc)}{2\pi f} = \frac{\mathrm{Im}(Zxm)}{2\pi f} + \frac{\mathrm{Im}(Zsc)}{2\pi f} = Lxm + Lsc$$

Lxm：Measured chip inductor inductance

Lsc：Measured short chip inductance

Lx：Nominal Inductance of chip inductor

Compensation Value（Lsc）of Short Chip

Series	Compensation Value
HQ0603H_T01	0.48nH

1. Scope

This specification applies to HQ0603H_T01 series of multi-layer ceramic chip inductors.

2. Product Description and Identification (Part Number)

1) Description

HQ0603H_T01 series of multi-layer ceramic chip inductors.

2) Product Identification (Part Number)

HQ	0603	H	XXX	□	◎	01
①	②	③	④	⑤	⑥	⑦

① Type	
HQ	High Q Ceramic Chip Inductor

② External Dimensions (L X W) (mm)	
0603 [0201]	0.6 X 0.3

③ Applications and Characteristics Code	
H	High Q

④ Nominal Inductance	
Example	Nominal Value
3N9	3.9nH
10N	10nH

⑤ Inductance Tolerance	
B、C、S	±0.1、±0.2、±0.3nH
G、H、J	±2%、±3%、±5%

⑥ Packing	
T	Tape Carrier Package

⑦ Serial Code
01

3. Electrical Characteristics

Please refer to **Appendix A** (Page9-12).

1) Operating and storage temperature range (individual chip without packing): -55℃~ +125℃,

2) Storage temperature range (packaging conditions): -10℃~+40℃ and RH 70% (Max.)

4. Shape and Dimensions

1) Dimensions and recommended PCB pattern for reflow soldering: See **Fig.4-1**, **Fig.4-2** and **Table 4-1**.

2) Structure: See **Fig. 4-3** and **Fig. 4-4**.

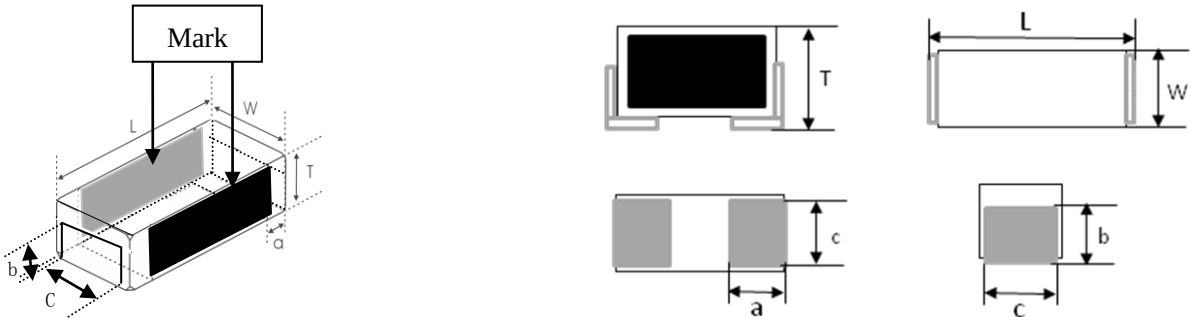


Fig. 4-1

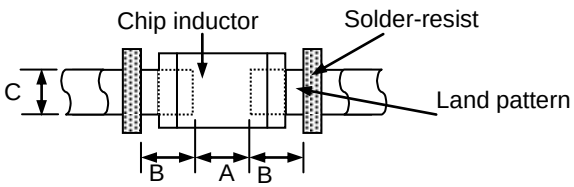
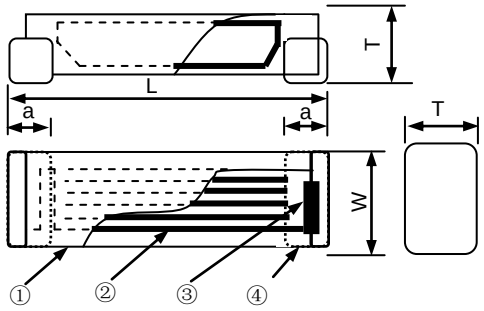


Fig. 4-2

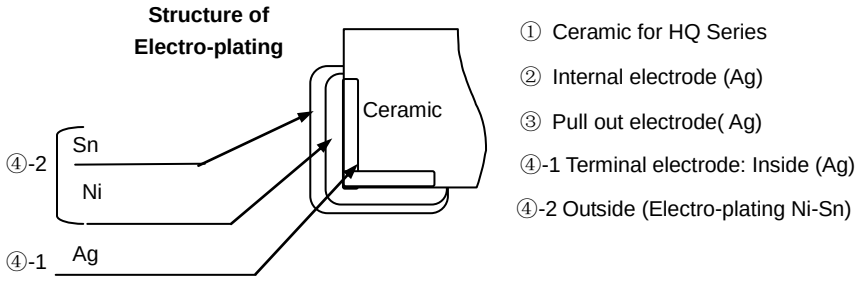
[Table 4-1]

Unit: mm [inch]

Type	L	W	T	a	b	c	A	B	C
0603 [0201]	0.6±0.03 [.024±.0012]	0.3±0.03 [.012±.0012]	0.3±0.02 [.012±.0008]	0.15±0.03 [.006±.0012]	0.2±0.03 [.008±.0012]	0.22±0.03 [.0088±.0012]	0.2~0.3	0.25~0.35	0.25~0.35



[Fig 4-3]



[Fig 4-4]

3) Material Information: See **Table 4-2**

Code	Part Name	Material Name
①	Ceramic Body	Ceramic Powder
②	Inner Coils	Silver Paste
③	Pull-out Electrode (Ag)	Silver Paste
④-1	Terminal Electrode: Inside Ag	Silver Paste
④-2	Electro-Plating: Ni/Sn plating	Plating Chemicals

4) Soldering Notice: The surface with the mark should be on the two beside when soldering

5. Test and Measurement Procedures

5.1 Test Conditions

Unless otherwise specified, the standard atmospheric conditions for measurement/test as:

a. Ambient Temperature: 20±15℃
b. Relative Humidity: 65±20%
c. Air Pressure: 86 KPa to 106 KPa

If any doubt on the results, measurements/tests should be made within the following limits:

a. Ambient Temperature: 20±2℃
b. Relative Humidity: 65±5%
c. Air Pressure: 86KPa to 106 KPa

5.2 Visual Examination

a. Inspection Equipment: 60 X magnifier

5.3 Electrical Test

5.3.1 DC Resistance (DCR)

a. Refer to **Appendix A**.
b. Test equipment (Analyzer): High Accuracy Milliohmmeter-HP4338B or equivalent.

5.3.2 Inductance (L)

a. Refer to **Appendix A**.
b. Test equipment: High Accuracy RF Impedance /Material Analyzer-E4991A+16197A or equivalent.
c. Test signal: -20dBm or 50mV
d. Test frequency refers to Appendix A.
e. Short bar residual inductance=0.48nH

5.3.3 Q Factor (Q)

a. Refer to **Appendix A**.
b. Test equipment: High Accuracy RF Impedance /Material Analyzer-E4991A+16197A or equivalent.
c. Test signal: -20dBm or 50mV
d. Test frequency refers to Appendix A.

5.3.4 Self-Resonant Frequency (SRF)

a. Refer to **Appendix A**.
b. Test equipment: Agilent 8719ES or equivalent.
c. Test signal: -20 dBm or 50 mV

5.3.5 Rated Current

a. Refer to **Appendix A**.
b. Test equipment (see **Fig. 5.3.5-1**): Electric Power, Electric current meter, Thermometer.
c. Measurement method (see **Fig. 5.3.5-1**):
   1. Set test current to be 0 mA.
   2. Measure initial temperature of chip surface.
   3. Gradually increase voltage and measure chip temperature for corresponding current.
d. Definition of Rated Current(Ir): Ir is direct electric current as chip surface temperature rose just 20℃ against chip initial surface temperature(Ta) (see **Fig. 5.3.5-2**).

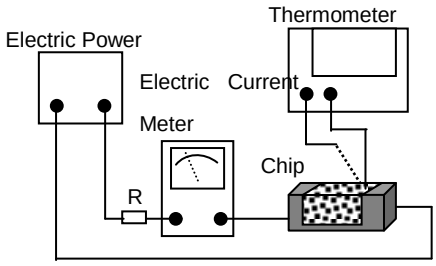


Fig. 5.3.5-1

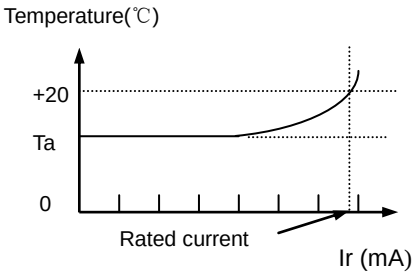
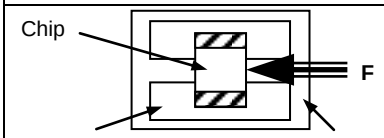
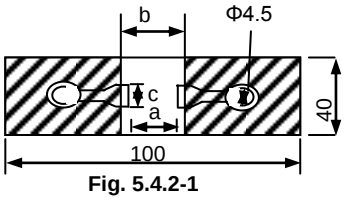
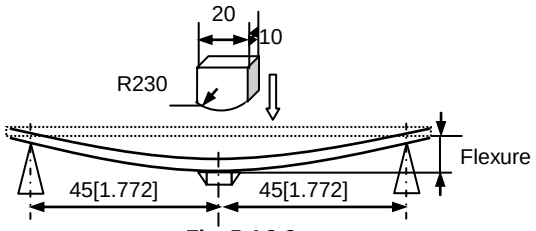
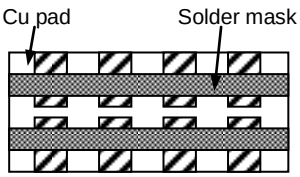
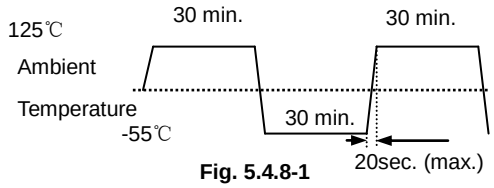


Fig. 5.3.5-2

5.4 Reliability Test

Items	Requirements	Test Methods and Remarks
5.4.1 Terminal Strength	No removal or split of the termination or other defects shall occur.  **Fig.5.4.1-1**	① Solder the inductor to the testing jig (glass epoxy board shown in **Fig. 5.4.1-1**) using leadfree solder. Then apply a force in the direction of the arrow. ② 2N force for HQ0603H_T01 series. ③ Keep time: 10±1s ④ Speed: 1.0mm/s.
5.4.2 Resistance to Flexure	No visible mechanical damage. Type | a | b | c 0603[0201] | 0.25 | 0.8 | 0.3 Unit: mm [inch]  **Fig. 5.4.2-1**	① Solder the inductor to the test jig (glass epoxy board shown in **Fig. 5.4.2-1**) Using a leadfree solder. Then apply a force in the direction shown **Fig. 5.4.2-2.** ② Flexure: 2mm. ③ Pressurizing Speed: 0.5mm/sec. ④ Keep time: 30 sec.  **Fig. 5.4.2-2**
5.4.3 Vibration	① No visible mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.  Glass Epoxy Board **Fig. 5.4.3-1**	① Solder the inductor to the testing jig (glass epoxy board shown in **Fig. 5.4.3-1**) using leadfree solder. ② The inductor shall be subjected to a simple harmonic motion having total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55 Hz. ③ The frequency range from 10 to 55 Hz and return to 10 Hz shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3mutually perpendicular directions (total of 6 hours).
5.4.4 Dropping	① No visible mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	Drop chip inductor 10 times on a concrete floor from a height of 100 cm.
5.4.5 Temperature	Inductance change should be within ±10% of initial value measuring at 20℃.	Temperature range: HQ0603H_T01: -55℃ to +125℃, Reference temperature: +20℃
5.4.6 Solderability	① No visible mechanical damage. ② Wetting shall exceed 75% coverage.	① Solder temperture:240±2℃ ② Duration: 3 sec. ③ Solder: Sn/3.0Ag/0.5Cu. ④ Flux: 25% Resin and 75% ethanol in weight.
5.4.7 Resistance to Soldering Heat	① No visible mechanical damage. ② Wetting shall exceed 75% coverage. ③ Inductance change: Within ±10%. ④ Q factor change: Within ±20%.	① Solder temperature: 260±3℃ ② Duration: 5 sec. ③ Solder: Sn/3.0Ag/0.5Cu. ④ Flux: 25% Resin and 75% ethanol in weight. ⑤ The chip shall be stabilized at normal condition for 1~2 hours before measuring.

5.4.8 Thermal Shock	① No mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.  **Fig. 5.4.8-1**	① Temperature, Time: (See **Fig. 5.4.8-1**) HQ0603H_T01: -55℃for 30±3 min→125℃ for 30±3min, ② Transforming interval: Max. 20 sec. ③ Tested cycle: 100 cycles. ④ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.9 Resistance to Low Temperature	① No mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	① Temperature: -55±2℃, ② Duration: 1000^{+24} hours. ③ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.10 Resistance to High Temperature	① No mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	① Temperature: 125±2℃, ② Duration: 1000^{+24} hours. ③ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.11 Damp Heat (Steady States)	① No visible mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	① Temperature: 60±2℃ ② Humidity: 90% to 95% RH. ③ Duration: 1000^{+24} hours. ④ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.12 Loading Under Damp Heat	① No visible mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	① Temperature: 60±2℃ ② Humidity: 90% to 95% RH. ③ Duration: 1000^{+24} hours. ④ Applied current: Rated current. ⑤ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.13 Loading at High Temperature (Life Test)	① No visible mechanical damage. ② Inductance change: Within ±10%. ③ Q factor change: Within ±20%.	① Temperature: 125±2℃, ② Duration: 1000^{+24} hours. ③ Applied current: Rated current. ④ The chip shall be stabilized at normal condition for 1~2 hours before measuring.

6. Packaging and Storage

6.1 Packaging

Tape Carrier Packaging:

Packaging code: T

a. Tape carrier packaging are specified in attached figure **Fig.6.1-1~3**

b. Tape carrier packaging quantity please see the following table:

Type	0603[0201]
Thickness (mm)	0.4±0.02
Tape	Paper Tape
Quantity	15K

(1) Taping Drawings (Unit: mm)

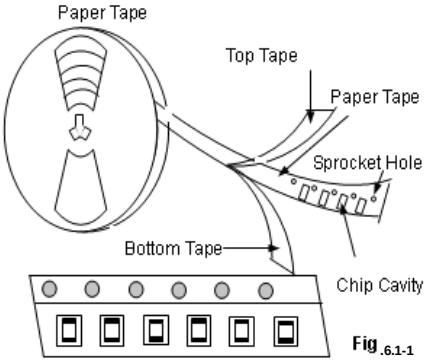


Fig .6.1-1

Remark: The sprocket holes are to the right as the tape is pulled toward the user.

(2) Taping Dimensions (Unit: mm)

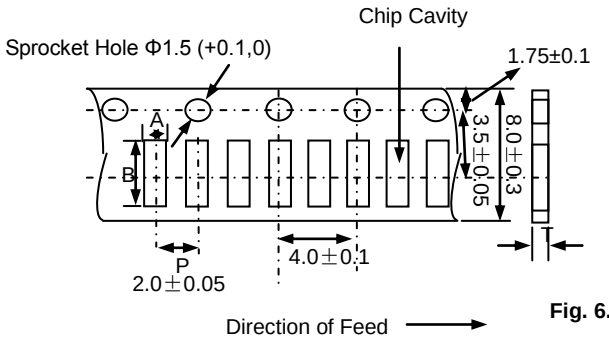


Fig. 6.1-2

Paper Tape

Type	A	B	P	T max
0603[0201]	0.36±0.02	0.66±0.02	2.0±0.05	0.42

(3) Reel Dimensions (Unit: mm)

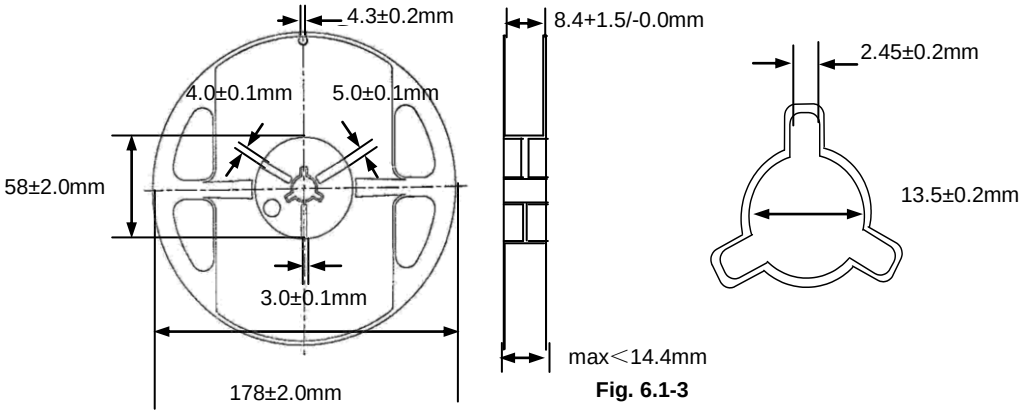


Fig. 6.1-3

6.2 Storage

a. The solderability of the external electrode may be deteriorated if packages are stored where they are exposed to high humidity. Package must be stored at 40℃ or less and 70% RH or less.

b. The solderability of the external electrode may be deteriorated if packages are stored where they are exposed to dust of harmful gas (e.g. HCl, sulfurous gas of H_2S).

c. Packaging material may be deformed if package are stored where they are exposed to heat of direct sunlight.

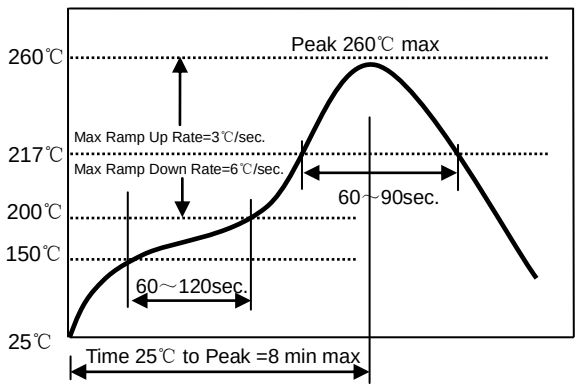
d. Solderability specified in **Clause 5.4.6** shall be guaranteed for 12 months from the date of delivery on condition that they are stored at the environment specified in Clause 3. For those parts, which passed more than 12 months shall be checked solder-ability before use.

7. Recommended Soldering Technologies

7.1 Reflow Profile

△ Preheat condition: 150 ~200℃/60~120sec.
△ Allowed time above 217℃: 60~90sec.
△ Max temp: 260℃
△ Max time at max temp: 10sec.
△ Solder paste: Sn/3.0Ag/0.5Cu
△ Allowed Reflow time: 2x max

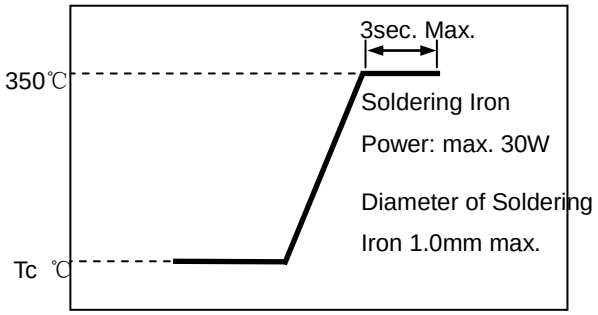
[Note: The reflow profile in the above table is only for qualification and is not meant to specify board assembly profiles. Actual board assembly profiles must be based on the customer's specific board design, solder paste and process, and should not exceed the parameters as the Reflow profile shows.]



7.2 Iron Soldering Profile

△ Iron soldering power: Max. 30W
△ Pre-heating: 150℃/60sec.
△ Soldering Tip temperature: 350℃ Max.
△ Soldering time: 3sec. Max.
△ Solder paste: Sn/3.0Ag/0.5Cu
△ Max.1 times for iron soldering

[Note: Take care not to apply the tip of the soldering iron to the terminal electrodes.]



Appendix A: Electrical Characteristics (HQ0603H_T01 Series of Inductors)

HQ0603H_T01 **Series of Inductor**

Part Number 型号	Inductance 电感量	Min. Quality Factor 品质因子	L, Q Test Freq. L/Q 测试频率	Typical Q @ Freq. (GHz)					Min. Self-resonant Frequency 自谐频率	Max. DC Resistance 直流电阻	Max. Rated Current 额定电流	Thickness 厚度
				0.5	0.8	1.8	2.0	2.4				
Units	nH	-	MHz	-					MHz	Ω	mA	mm [inch]
Symbol	L	Q	Freq	Q					S.R.F	DCR	Ir	T
HQ0603H0N6□T01	0.6	17	500	96	135	254	291	300	20000	0.05	1000	
HQ0603H0N7□T01	0.7	17	500	85	127	259	332	304	20000	0.05	1000	
HQ0603H0N8□T01	0.8	17	500	65	78	152	170	178	18000	0.05	1000	
HQ0603H0N9□T01	0.9	17	500	40	52	94	103	107	18000	0.08	800	
HQ0603H1N0□T01	1.0	17	500	47	63	94	107	118	17000	0.08	800	
HQ0603H1N1□T01	1.1	17	500	38	52	86	93	103	17000	0.08	800	
HQ0603H1N2□T01	1.2	17	500	36	46	78	84	93	17000	0.08	800	
HQ0603H1N3□T01	1.3	17	500	36	48	80	85	97	17000	0.1	700	
HQ0603H1N4□T01	1.4	17	500	32	42	69	73	80	16000	0.1	700	
HQ0603H1N5□T01	1.5	17	500	35	44	71	76	82	15000	0.1	650	
HQ0603H1N6□T01	1.6	17	500	34	44	69	75	80	15000	0.1	650	
HQ0603H1N7□T01	1.7	17	500	35	44	68	72	77	15000	0.1	650	
HQ0603H1N8□T01	1.8	17	500	33	41	64	68	74	15000	0.1	650	
HQ0603H1N9□T01	1.9	17	500	34	41	65	68	73	12500	0.1	650	
HQ0603H2N0□T01	2.0	17	500	32	40	59	62	68	12500	0.1	650	
HQ0603H2N1□T01	2.1	17	500	33	41	59	61	67	11000	0.12	650	
HQ0603H2N2□T01	2.2	17	500	32	39	55	57	62	11000	0.12	650	
HQ0603H2N3□T01	2.3	17	500	32	40	57	58	64	11000	0.15	550	
HQ0603H2N4□T01	2.4	17	500	30	37	53	55	60	11000	0.15	550	
HQ0603H2N5□T01	2.5	17	500	31	38	55	57	62	10000	0.15	550	0.3±0.02
HQ0603H2N6□T01	2.6	17	500	31	38	55	57	62	10000	0.15	550	[.012±.0008]
HQ0603H2N7□T01	2.7	17	500	28	35	51	52	57	10000	0.15	550	
HQ0603H2N8□T01	2.8	17	500	29	36	51	53	58	10000	0.2	500	
HQ0603H2N9□T01	2.9	17	500	29	36	51	53	57	10000	0.2	500	
HQ0603H3N0□T01	3.0	17	500	28	35	50	52	56	9500	0.2	500	
HQ0603H3N1□T01	3.1	17	500	29	36	52	54	58	9500	0.24	450	
HQ0603H3N2□T01	3.2	17	500	27	35	51	53	57	9500	0.24	450	
HQ0603H3N3□T01	3.3	17	500	28	35	50	52	56	9500	0.24	450	
HQ0603H3N4□T01	3.4	17	500	28	35	50	52	55	8000	0.25	450	
HQ0603H3N5□T01	3.5	17	500	27	34	49	50	53	8000	0.25	450	
HQ0603H3N6□T01	3.6	17	500	28	35	49	51	55	8000	0.25	400	
HQ0603H3N7□T01	3.7	17	500	28	34	49	51	53	6500	0.25	400	
HQ0603H3N8□T01	3.8	17	500	27	33	48	50	52	6500	0.25	400	
HQ0603H3N9□T01	3.9	17	500	25	31	44	45	48	6500	0.25	400	
HQ0603H4N0□T01	4.0	17	500	24	30	44	46	50	6500	0.35	360	
HQ0603H4N1□T01	4.1	17	500	25	31	45	46	49	6500	0.35	360	
HQ0603H4N2□T01	4.2	17	500	25	31	46	47	50	6500	0.35	360	
HQ0603H4N3□T01	4.3	17	500	23	29	43	44	48	6500	0.35	360	
HQ0603H4N7□T01	4.7	17	500	23	28	41	43	45	6500	0.35	350	
HQ0603H5N1□T01	5.1	17	500	25	33	45	47	51	6500	0.39	350	

（Continued）

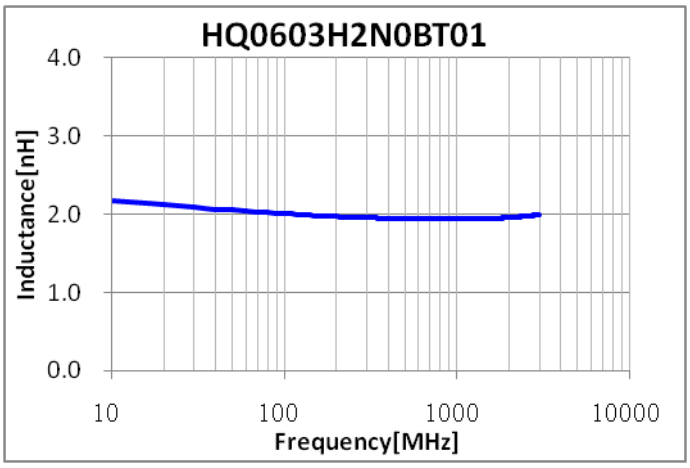
Part Number 型号	Inductance 电感量	Min. Quality Factor 品质因子	L, Q Test Freq. L/Q 测试频率	Typical Q @ Freq. (GHz)					Min. Self-resonant Frequency 自谐频率	Max. DC Resistance 直流电阻	Max. Rated Current 额定电流	Thickness 厚度
				0.5	0.8	1.8	2.0	2.4				
Units	nH	-	MHz	-					MHz	Ω	mA	mm [inch]
Symbol	L	Q	Freq	Q					SRF	DCR	Ir	T
HQ0603H5N6□T01	5.6	17	500	24	31	44	47	52	6000	0.39	350	
HQ0603H6N2□T01	6.2	17	500	24	30	43	45	47	6000	0.55	300	
HQ0603H6N8□T01	6.8	17	500	23	31	42	43	44	5400	0.55	300	
HQ0603H7N5□T01	7.5	17	500	23	29	39	40	42	4800	0.55	300	
HQ0603H8N2□T01	8.2	17	500	23	28	37	39	40	4800	0.65	250	
HQ0603H9N1□T01	9.1	17	500	23	28	38	39	39	4500	0.65	250	
HQ0603H10N□T01	10	17	500	22	27	38	38	37	4500	0.69	250	
HQ0603H11N□T01	11	17	500	22	28	36	37	36	3700	0.69	250	
HQ0603H12N□T01	12	17	500	22	27	34	33	32	3700	0.69	250	
HQ0603H13N□T01	13	17	500	22	27	34	33	32	3700	0.69	250	
HQ0603H15N□T01	15	14	500	22	27	33	32	30	3500	0.8	250	0.3±0.02
HQ0603H18N□T01	18	14	500	22	26	32	30	26	3500	1.1	200	[.012±.0008]
HQ0603H20N□T01	20	14	500	21	26	30	28	24	3000	1.2	200	
HQ0603H22N□T01	22	14	500	21	26	26	24	20	3000	1.2	200	
HQ0603H24N□T01	24	14	500	21	26	26	23	16	2000	1.6	150	
HQ0603H27N□T01	27	14	500	21	25	25	22	14	2000	1.6	150	
HQ0603H30N□T01	30	11	500	21	25	24	20	12	1700	2	150	
HQ0603H33N□T01	33	11	300	21	25	22	19	10	1700	2	150	
HQ0603H36N□T01	36	11	300	22	26	20	16	6	1500	2.5	130	
HQ0603H39N□T01	39	11	300	22	26	20	16	6	1500	2.5	130	
HQ0603H43N□T01	43	11	300	22	24	10	5	6	1300	3.5	130	
HQ0603H47N□T01	47	11	300	22	24	10	5	6	1300	3.5	130	

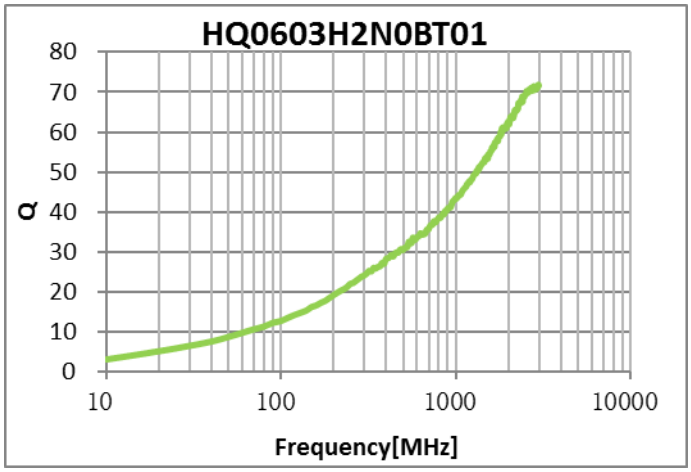
Note: □: Please specify the inductance tolerance. For L≤4.2nH, choose B=±0.1nH, C=±0.2nH or S=±0.3nH; For L ＞4.2nH,choose, H=±3%, J=±5%.

TYPICAL ELECTRICAL CHARACTERISTICS

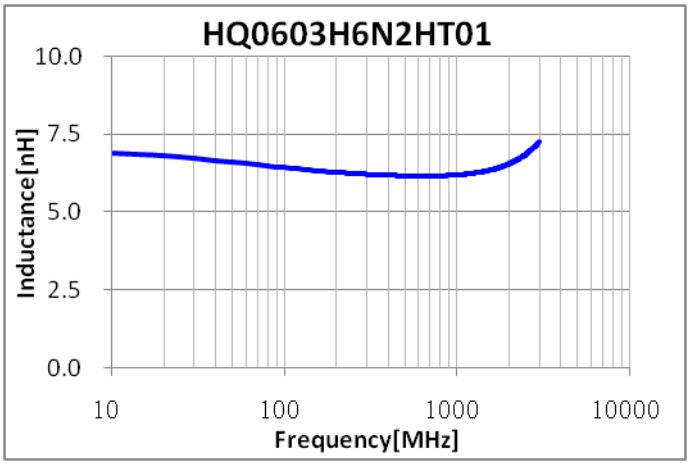
Inductance-Frequency Characteristics(Typ.) Q-Frequency Characteristics(Typ.)

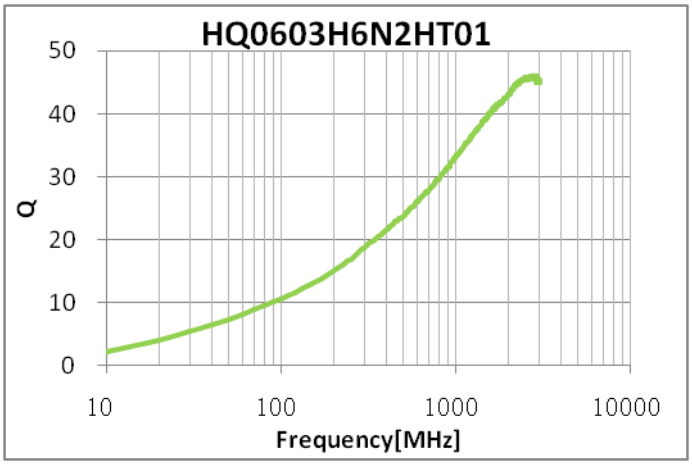
HQ0603H2N0BT01





HQ0603H6N2HT01





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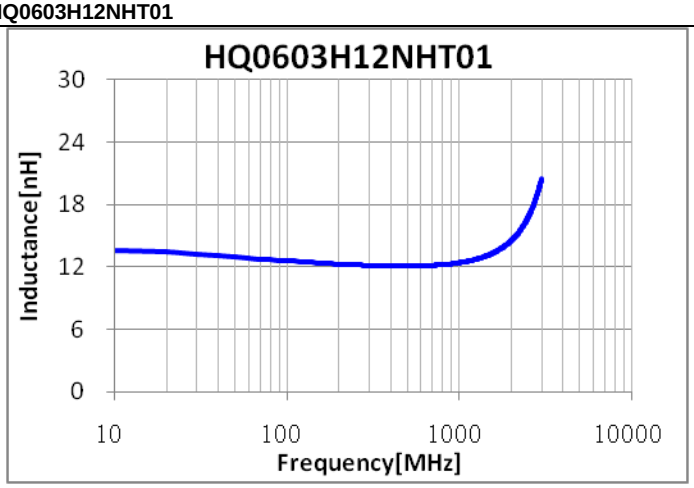

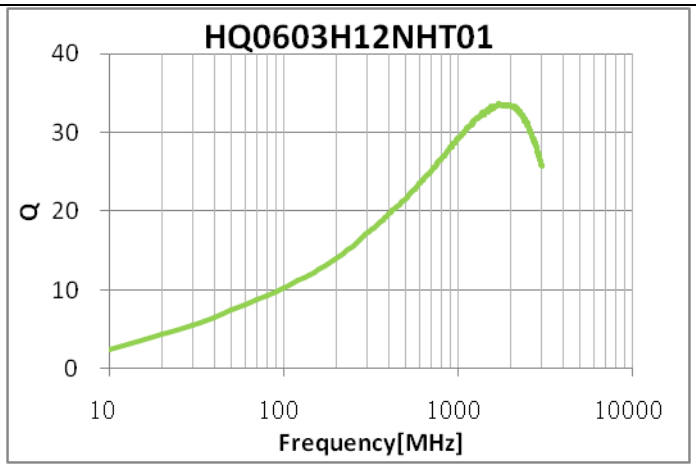

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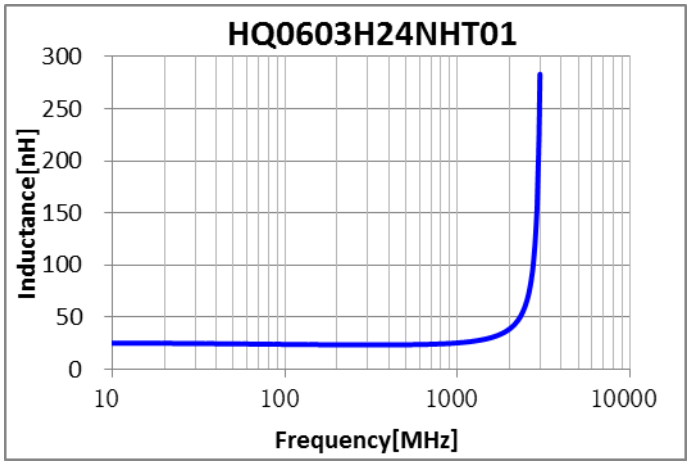
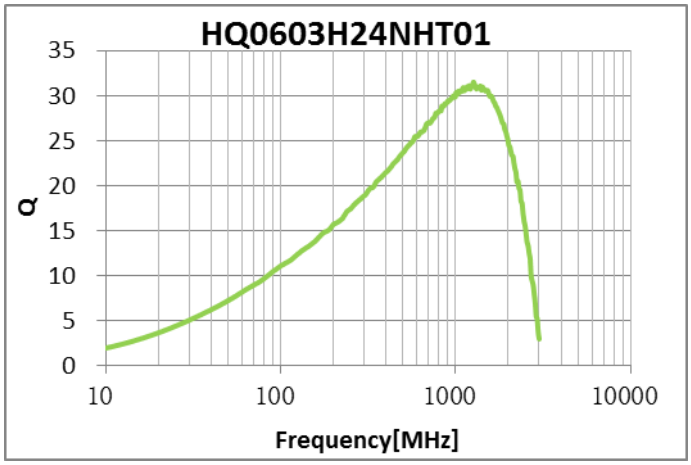
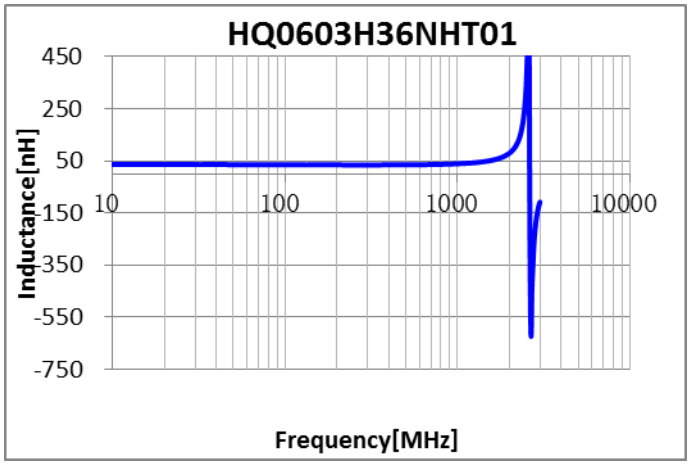
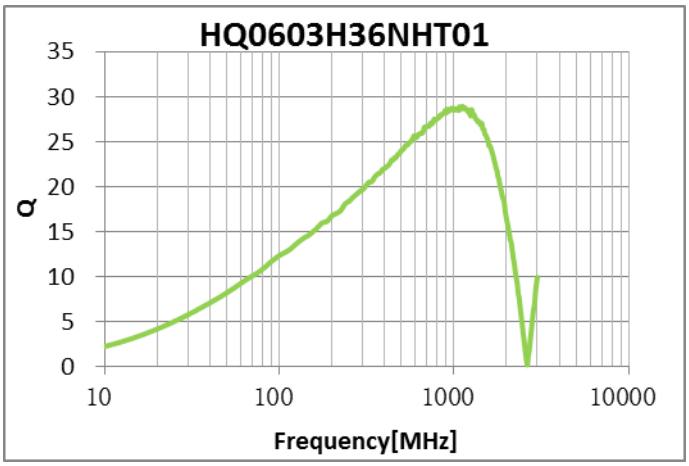




HQ0603H36NHT01





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