

# SPECIFICATIONS

Customer	
Product Name	Multi-layer Chip Inductor for Choke
Sunlord Part Number	MCL1608 Series
Customer Part Number	

New Released,  Revised]

SPEC No.: **MCL0105210000**

**【This SPEC is total 10 pages including specifications and appendix.】**  
**【ROHS, Halogen-Free and SVHC Compliant Parts】**

Approved By	Checked By	Issued By

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**【For Customer approval Only】**

Date: \_\_\_\_\_

Qualification Status:  Full  Restricted  Rejected

Approved By	Verified By	Re-checked By	Checked By

Comments:  
\_\_\_\_\_

**【Version change history】**

Rev.	Effective Date	Changed Contents	Change reasons	Approved By
01	/	New release	/	Hai Guo

#### 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

1. Scope

This specification applies to MCL1608 Series of multi-layer chip inductors for choke.

2. Product Description and Identification (Part Number)

- 1) Description  
MCL1608 Series of multi-layer chip inductors for choke.

- 2) Product Identification (Part Number)

MCL 1608 S XXX □ ◎  
 ① ② ③ ④ ⑤ ⑥

①	Type
MCL	Chip Inductor for choke

②	External Dimensions (L x W) (mm)
1608 [0603]	1.6 X 0.8

③	Feature Type
S	Standard

④	Nominal Inductance
Example	Nominal Value
1R0	1.0μH
100	10μH

⑤	Inductance Tolerance
M	±20%
N	±30%

⑥	Packing
T	Tape Carrier Package

3. Electrical Characteristics

Please refer to Appendix A (Page 10).

- 1) Operating and storage temperature range (individual chip without packing): -55°C ~ +125°C ( Including Self-heating )
- 2) Storage temperature range (packaging conditions): -10°C~+40°C 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.

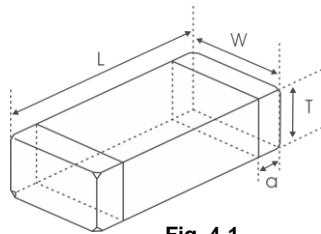


Fig. 4-1

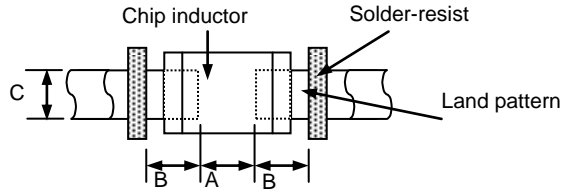


Fig. 4-2

[Table 4-1]

Unit: mm [inch]

Type	L	W	T	a	A	B	C
1608 [0603]	1.60±0.15 [0.063±0.006]	0.8±0.15 [0.031±0.006]	0.8±0.15 [0.031±0.006]	0.3±0.2 [0.012±0.008]	0.70	0.70	1.0

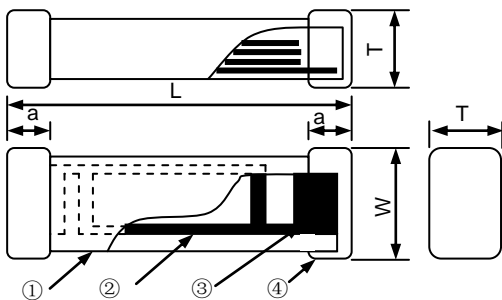


Fig. 4-3

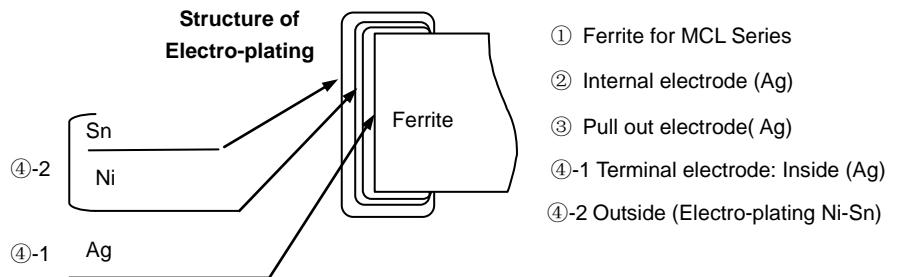


Fig. 4-4

- ① Ferrite for MCL Series
- ② Internal electrode (Ag)
- ③ Pull out electrode (Ag)
- ④-1 Terminal electrode: Inside (Ag)
- ④-2 Outside (Electro-plating Ni-Sn)

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

[Table 4-2]

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

**5. Test and Measurement Procedures**

**5.1 Test Conditions**

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

- a. Ambient Temperature: 20±15°C
- b. Relative Humidity: 65±20%
- c. Air Pressure: 86kPa to 106kPa

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

- a. Ambient Temperature: 20±2°C
- b. Relative Humidity: 65±5%
- c. Air Pressure: 86kPa to 106kPa

**5.2 Visual Examination**

- a. Inspection Equipment: 20x 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 +HP16192A or equivalent.
- c. Test signal: -20dBm or 50mV.
- d. Test frequency refers to **Appendix A**.

5.3.3 Self-Resonant Frequency (SRF)

- a. Refer to **Appendix A**.
- b. Test equipment: High Accuracy RF Impedance/Material Analyzer-E4991A +HP16192A or equivalent.
- c. Test signal: -20dBm or 50 mV.

5.3.4 Rated Current

- a. Refer to **Appendix A**.
- b. Test equipment: HP6632B system DC power supply, -E4991A +HP16192A+HP16200A or equivalent.
- c. Measurement method:

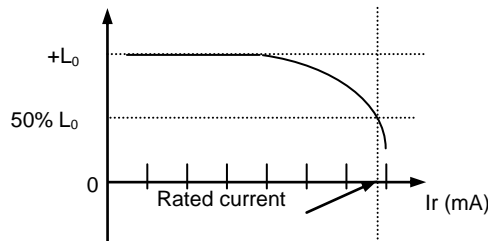
1. Measurement conditions of initial inductance L: Measuring Frequency: 1MHz.  
Test Current: 1.0µH~4.7µH, 1mA; 10µH, 0.1mA.

2. Raising the voltage of the DC power supply, measure the inductance at the various current.

The rated current is the value of DC current at which the inductance will be 50% down compared with the initial inductance value.

Note: In the period of raising voltage, voltage cannot be reduced.

- d. Definition of Rated Current (Ir): Ir is the value of DC current as inductance L (µH) decreased just 50% against initial value (see **Fig. 5.3.4-1**).



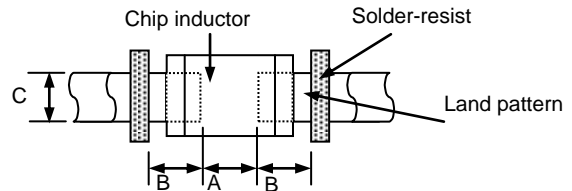
**Fig. 5.3.4-1**

**5.4 Reliability Test**

※ The land dimensions for reliability test is :

A	B	C
0.70	0.70	1.0

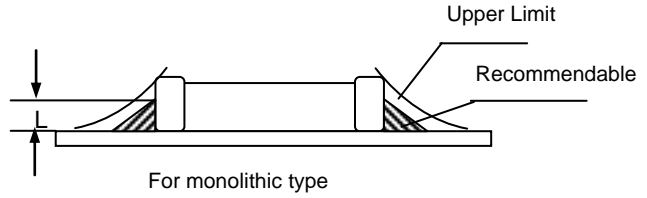
Unit: mm

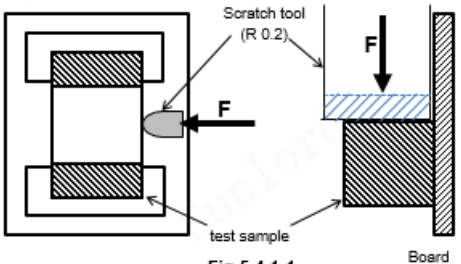
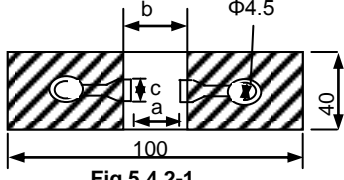
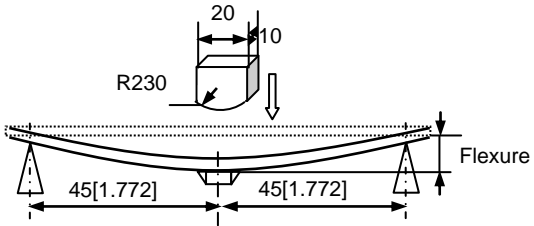
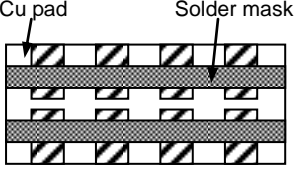
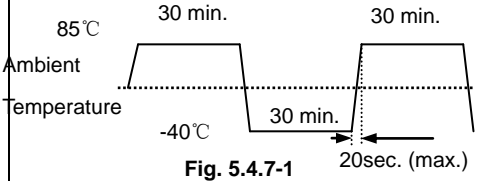


- ※ The thickness of Stencil is 0.08mm~0.1mm,add the standard thickness of solder paste:0.10mm~0.15mm .
- ※ Solder shall be used as shown below.

$$1/3T \leq L \leq T$$

(T: height of electrode)



Items	Requirements	Test Methods and Remarks								
5.4.1 Terminal Strength	No removal or split of the termination or other defects shall occur.  <p style="text-align: center;">Fig.5.4.1-1</p>	<ol style="list-style-type: none"> <li>① Solder the inductor to the testing jig (glass epoxy board shown in <b>Fig.5.4.1-1</b>) using leadfree solder. Then apply a 5N force in the direction of the arrow.</li> <li>② Keep time: 10±1s.</li> <li>③ Speed: 1.0mm/s.</li> <li>④ The Scratch tool shall be keep a distance of 0.1mm from the Board.</li> </ol>								
5.4.2 Resistance to Flexure	No visible mechanical damage. <table border="1" data-bbox="327 622 766 694"> <thead> <tr> <th>Type</th> <th>a</th> <th>b</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>1608[0603]</td> <td>1.0</td> <td>3.0</td> <td>1.2</td> </tr> </tbody> </table> Unit: mm [inch]  <p style="text-align: center;">Fig.5.4.2-1</p>	Type	a	b	c	1608[0603]	1.0	3.0	1.2	<ol style="list-style-type: none"> <li>① Solder the inductor to the test jig (glass epoxy board shown in <b>Fig.5.4.2-1</b>) Using a leadfree solder. Then apply a force in the direction shown <b>Fig. 5.4.2-2</b>.</li> <li>② Flexure: 2mm.</li> <li>③ Pressurizing Speed: 0.5mm/sec.</li> <li>④ Keep time: 30 sec.</li> </ol>  <p style="text-align: center;">Fig.5.4.2-2</p>
Type	a	b	c							
1608[0603]	1.0	3.0	1.2							
5.4.3 Vibration	No visible mechanical damage.  <p style="text-align: center;">Glass Epoxy Board Fig. 5.4.3-1</p>	<ol style="list-style-type: none"> <li>① Solder the inductor to the testing jig (glass epoxy board shown in <b>Fig.5.4.3-1</b>) using leadfree solder.</li> <li>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.</li> <li>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 3 mutually perpendicular directions (total of 6 hours).</li> </ol>								
5.4.4 Temperature	Inductance change should be within ±20% of initial value measuring at 20°C.	Temperature range: -40°C~ +85°C Reference temperature: +20°C								
5.4.5 Solderability	<ol style="list-style-type: none"> <li>① No visible mechanical damage.</li> <li>② Wetting shall exceed 95% coverage.</li> </ol>	<ol style="list-style-type: none"> <li>① Solder temperature: 240±2°C</li> <li>② Duration: 3sec.</li> <li>③ Solder: Sn/3.0Ag/0.5Cu.</li> <li>④ Flux: 25% Resin and 75% ethanol in weight.</li> </ol>								
5.4.6 Resistance to Soldering Heat	<ol style="list-style-type: none"> <li>① No visible mechanical damage.</li> <li>② Wetting shall exceed 95% coverage.</li> <li>③ Inductance change: Within ±20%.</li> </ol>	<ol style="list-style-type: none"> <li>① Solder temperature: 260±3°C.</li> <li>② Duration: 5sec.</li> <li>③ Solder: Sn/3.0Ag/0.5Cu.</li> <li>④ Flux: 25% Resin and 75% ethanol in weight.</li> <li>⑤ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</li> </ol>								
5.4.7 Thermal Shock	<ol style="list-style-type: none"> <li>① No mechanical damage.</li> <li>② Inductance change: Within ±20%.</li> </ol>  <p style="text-align: center;">Fig. 5.4.7-1</p>	<ol style="list-style-type: none"> <li>① Temperature, Time: (See <b>Fig.5.4.7-1</b>) -40°C for 30±3 min→ 85°C for 30±3min.</li> <li>② Transforming interval: 20sec.(max.).</li> <li>③ Tested cycle: 100 cycles.</li> <li>④ The chip shall be stabilized at normal condition for 1~2 hours before measuring.</li> </ol>								

5.4.8 Resistance to Low Temperature	① No mechanical damage. ② Inductance change: Within $\pm 20\%$ .	① Temperature: $-40\pm 2^{\circ}\text{C}$ ② Duration: $1000^{+24}$ hours. ③ The chip shall be stabilized at normal condition for 1~2 hours before measuring.
5.4.9 Loading Under Damp Heat	① No visible mechanical damage. ② Inductance change: within $\pm 20\%$ .	① Temperature: $60\pm 2^{\circ}\text{C}$ 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.
5.4.10 Loading at High Temperature (Life Test)	① No visible mechanical damage. ② Inductance change: within $\pm 20\%$ .	① Temperature: $85\pm 2^{\circ}\text{C}$ 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, Storage

6.1 Packaging

Tape Carrier Packaging:

Packaging code: T

- a. Tape carrier packaging are specified in attached figure Fig.6.1-1~4
- b. Tape carrier packaging quantity please see the following table:

Type	1608[0603]
T(mm)	$0.8\pm 0.15$
Tape	Paper Tape
Quantity	4K

(1) Taping Drawings (Unit: mm)

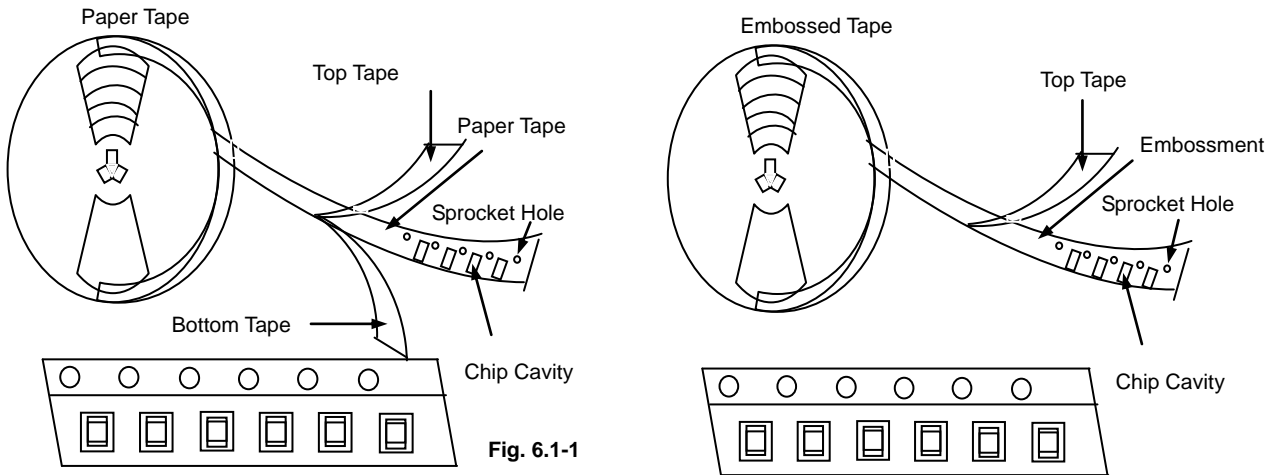


Fig. 6.1-1

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

(2) Taping Dimensions (Unit: mm)

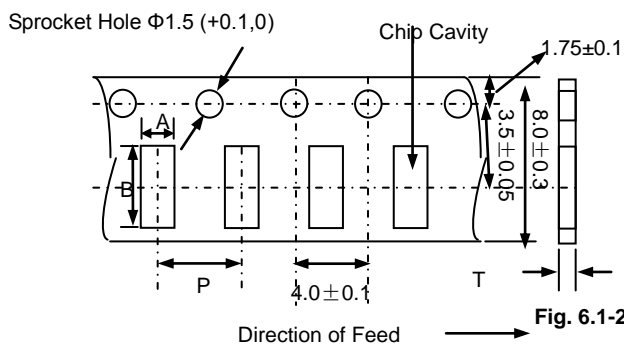


Fig. 6.1-2

Paper Tape

Type	A	B	P	T max
1608[0603]	$1.0\pm 0.2$	$1.8\pm 0.2$	$4.0\pm 0.1$	1.1



(3) Reel Dimensions (Unit: mm)

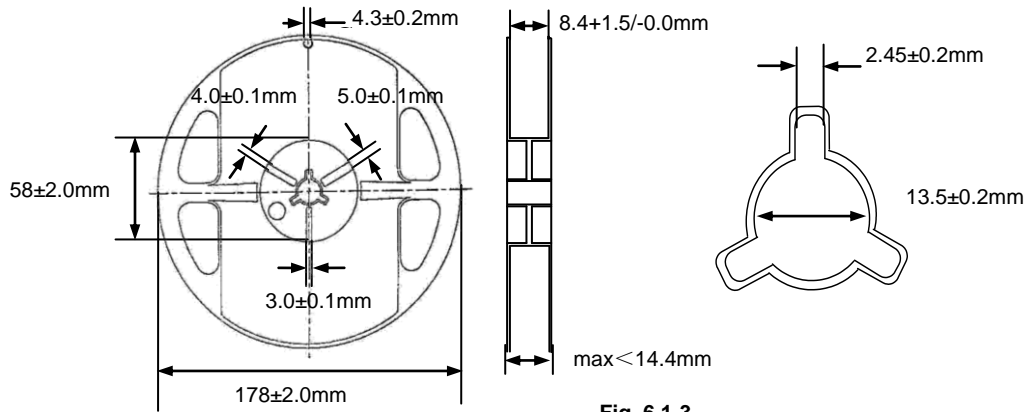


Fig. 6.1-3

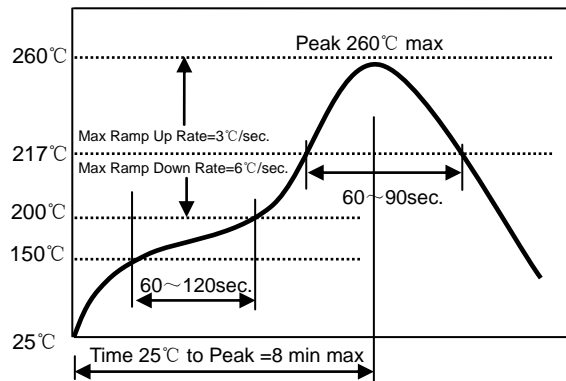
6.2 Storage

- 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°C 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 or harmful gas (e.g. HCl, sulfurous gas of H<sub>2</sub>S).
- 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 Re-flowing Profile:

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

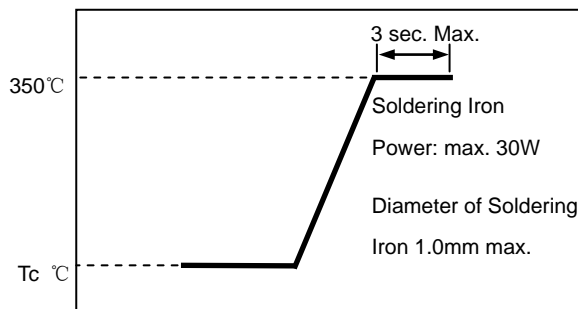


[ Note: The reflow profile in the above table is only for qualification and is not meant to specify board assembly profiles. Actual board assembly profiles must be based on the customer's specific board design, solder paste and process, and should not exceed the parameters as the Reflow profile shows.]

7.2 Iron Soldering Profile.

- △ Iron soldering power: Max.30W.
- △ Pre-heating: 150 °C / 60 sec.
- △ Soldering Tip temperature: 350°C 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

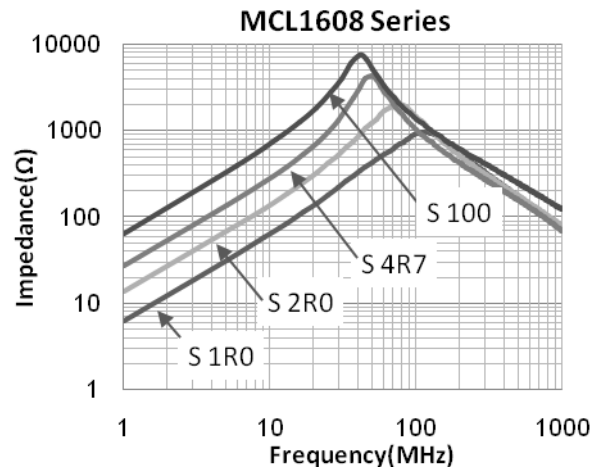
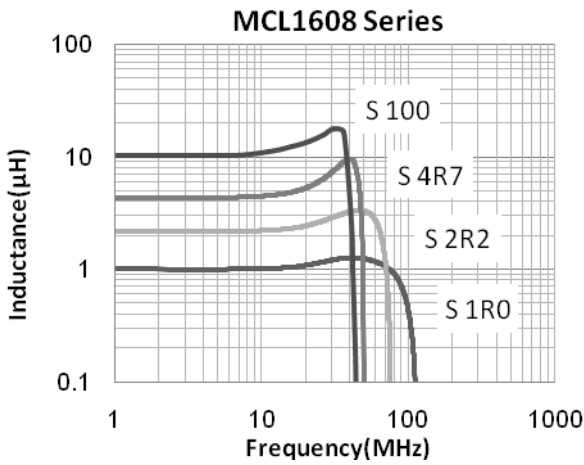
Part Number	L (μH)	L Test Freq. (MHz)	S.R.F Min. (MHz)	DCR (Ω)		I <sub>r</sub> Max. (mA)	Thickness (mm) [inch]
				(Typ.)	(Max.)		
MCL1608SR10□T	0.1	1	240	0.140	0.182	700	0.8±0.15 [.031±.006]
MCL1608SR22□T	0.22	1	150	0.270	0.351	550	
MCL1608SR47□T	0.47	1	105	0.420	0.546	400	
MCL1608S1R0□T	1.0	1	75	0.200	0.260	190	
MCL1608S2R2□T	2.2	1	50	0.400	0.520	140	
MCL1608S4R7□T	4.7	1	35	0.600	0.780	100	
MCL1608S100□T	10	1	20	0.900	1.170	50	

※□: Please specify the inductance tolerance code (M=±20%, N=±30%).

Typical Electrical Characteristics

Inductance vs. Frequency Characteristics

Impedance vs. Frequency Characteristics



Inductance vs. DC Current Characteristics

