

# for Automotive Electronics

# SPECIFICATIONS

|                      |                               |
|----------------------|-------------------------------|
| Customer             |                               |
| Product Name         | Wire Wound SMD Power Inductor |
| Sunlord Part Number  | AMWPH6045S Series             |
| Customer Part Number |                               |
| Weight               | 635mg/pcs Typ.                |

New Released,  Revised

SPEC No.: **AMWPH0603230000**

【This SPEC is total 15 pages.】

【RoHS Compliant Parts】

| Approved By | Checked By | Issued By |
|-------------|------------|-----------|
|             |            |           |

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**【For Customer approval Only】**

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

Qualification Status:  Full  Restricted  ejected

| Approved By | Verified By | Re-checked By | Checked By |
|-------------|-------------|---------------|------------|
|             |             |               |            |

Comments:

\_\_\_\_\_

| Version Change History |      |      |                  |                |            |               |          |
|------------------------|------|------|------------------|----------------|------------|---------------|----------|
| Rev.                   | Date | Item | Changed Contents | Change Reasons | Drawing    | Check         | Approval |
| 01                     | /    | /    | New release      | /              | Jingkui Li | Pengfei Cheng | Yubo Su  |

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for Automotive Electronics

1 Scope

1.1 Scope of parts

This specification applies to the AMWPH6045S Series of wire wound SMD power inductor for automotive electronics based on AEC-Q200D.

1.2 Scope of application

Product numbers recorded in this specification are used for automotive applications.

1.3 Operating and storage temperature

The part temperature (ambient + temp. rise) should not exceed 125°C under worst case operating conditions. Circuit design, component placement, PCB trace size and thickness, airflow and other cooling provisions all affect the part temperature. Part temperature should be verified in the end application.

- 1) Operating and storage temperature range (individual chip without packing): -40°C ~ +125°C (including self-heating)..
- 2) Storage temperature range (packaging conditions): -10°C~+40°C and RH 70% (Max.)
- 3) MSL: Level 1

2 Product Description and Identification (Part Number)

1) Description:

AMWPH6045S Series of Wire wound SMD power inductor.

2) Product Identification (Part Number)

|   |      |      |   |     |   |   |     |
|---|------|------|---|-----|---|---|-----|
| A | MWPH | 6045 | S | 1R0 | M | T | Y01 |
| ① | ②    | ③    | ④ | ⑤   | ⑥ | ⑦ | ⑧   |

|                                  |                                     |
|----------------------------------|-------------------------------------|
| ①Feature Code                    | A: for Automotive                   |
| ②Product Type                    | MWPH: Wire wound SMD power inductor |
| ③External Dimensions(L×W×H) [mm] | 6045: 6.0×6.0×4.4                   |
| ④Feature type                    | S:Standard Type                     |
| ⑤Nominal Inductance              | 1R0=1.0uH,100=10uH,101=100uH        |
| ⑥Inductance Tolerance            | M: ±20%,N: ±30%                     |
| ⑦Packing Code                    | T: Tape Carrier Package             |
| ⑧Special Process code            | Standard product is blank           |

3 Shape and Dimensions

Dimensions and recommended PCB pattern for reflow soldering, please see Fig.3-1 and Table3-1.

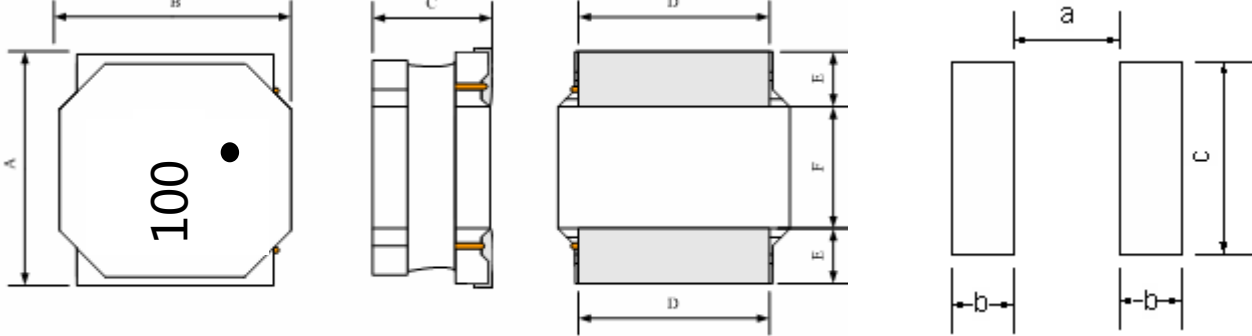


Fig.3-1

[Table 3-1] (Unit: mm)

| Series     | A       | B       | C       | D(ref.) | E        | a        | b        | c       |
|------------|---------|---------|---------|---------|----------|----------|----------|---------|
| AMWPH6045S | 6.0±0.3 | 6.0±0.3 | 4.4±0.2 | 4.9±0.3 | 1.55±0.3 | 2.5 Typ. | 2.2 Typ. | 5.7Typ. |

Note: ※ 1Ddimension: Measure the total length of both ends of the electrode.

## 4 Electrical Characteristics

| Customer P/N | Part Number     | Inductance    | Min. Self-resonant frequency | DC Resistance |          | Saturation Current |       | Heat Rating Current |      | Marking |
|--------------|-----------------|---------------|------------------------------|---------------|----------|--------------------|-------|---------------------|------|---------|
|              |                 | 0.1MHz/1V     | frequency                    | Max.          | Typ.     | Max.               | Typ.  | Max.                | Typ. |         |
|              | Units           | $\mu\text{H}$ | MHz                          | $\Omega$      | $\Omega$ | A                  | A     | A                   | A    |         |
|              | Symbol          | L             | SRF                          | DCR           |          | Isat               |       | Irms                |      | -       |
|              | AMWPH6045SR55MT | 0.55±20%      | 137                          | 0.009         | 0.007    | 13.50              | 15.50 | 5.90                | 6.50 | R55     |
|              | AMWPH6045S1R0MT | 1.0±20%       | 90                           | 0.013         | 0.010    | 9.30               | 10.50 | 5.40                | 5.90 | 1R0     |
|              | AMWPH6045S1R5MT | 1.5±20%       | 63                           | 0.016         | 0.012    | 7.80               | 8.70  | 4.95                | 5.40 | 1R5     |
|              | AMWPH6045S2R2MT | 2.2±20%       | 47                           | 0.020         | 0.016    | 6.30               | 6.90  | 4.30                | 4.70 | 2R2     |
|              | AMWPH6045S4R7MT | 4.7±20%       | 27                           | 0.040         | 0.030    | 4.60               | 5.15  | 3.10                | 3.40 | 4R7     |
|              | AMWPH6045S6R3MT | 6.3±20%       | 20                           | 0.045         | 0.036    | 3.40               | 3.80  | 2.60                | 3.05 | 6R3     |
|              | AMWPH6045S100MT | 10±20%        | 16                           | 0.060         | 0.049    | 3.00               | 3.45  | 2.45                | 2.70 | 100     |
|              | AMWPH6045S150MT | 15±20%        | 12                           | 0.085         | 0.071    | 2.40               | 2.70  | 1.90                | 2.05 | 150     |
|              | AMWPH6045S220MT | 22±20%        | 11                           | 0.140         | 0.116    | 2.00               | 2.25  | 1.55                | 1.75 | 220     |
|              | AMWPH6045S330MT | 33±20%        | 10                           | 0.174         | 0.145    | 1.50               | 1.70  | 1.45                | 1.55 | 330     |
|              | AMWPH6045S470MT | 47±20%        | 7.5                          | 0.300         | 0.225    | 1.35               | 1.50  | 1.10                | 1.20 | 470     |
|              | AMWPH6045S680MT | 68±20%        | 6.0                          | 0.395         | 0.328    | 1.15               | 1.30  | 0.90                | 1.00 | 680     |
|              | AMWPH6045S101MT | 100±20%       | 5.0                          | 0.560         | 0.460    | 0.90               | 1.05  | 0.75                | 0.85 | 101     |
|              | AMWPH6045S121MT | 120±20%       | 4.6                          | 0.593         | 0.494    | 0.85               | 0.95  | 0.70                | 0.85 | 121     |

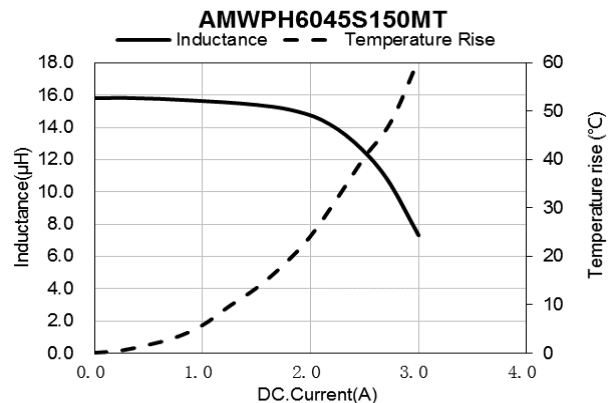
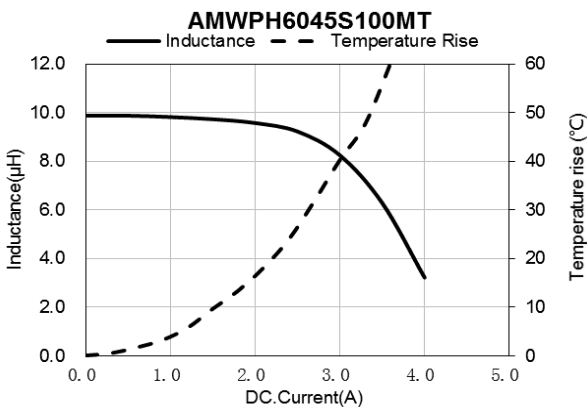
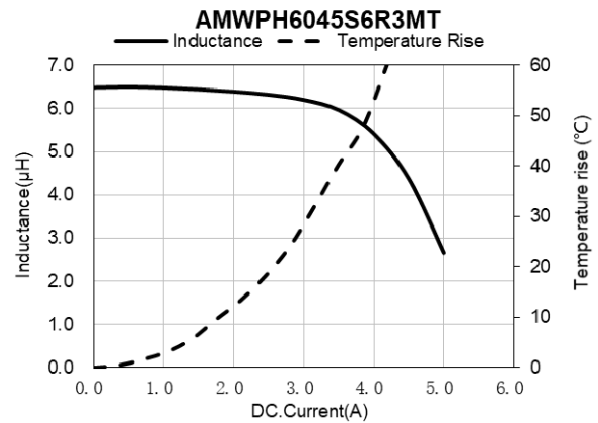
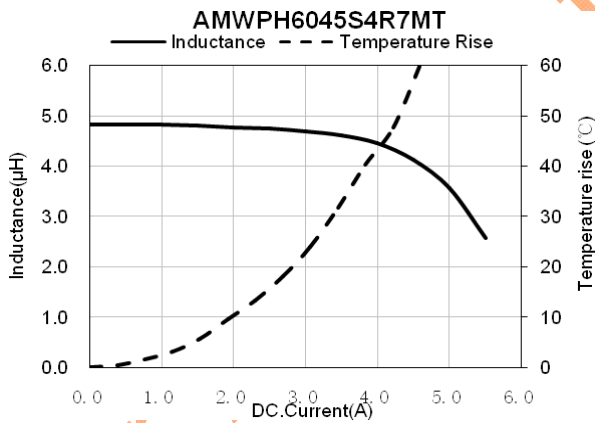
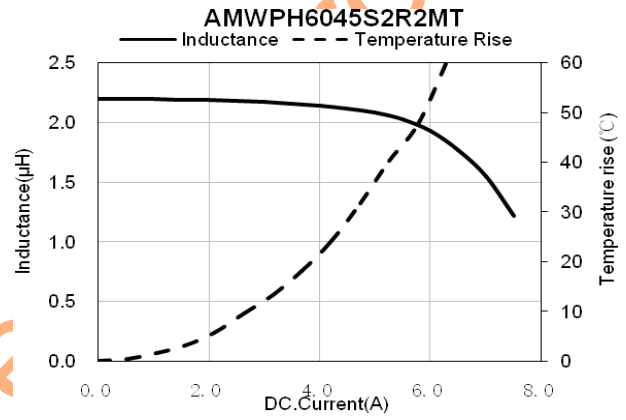
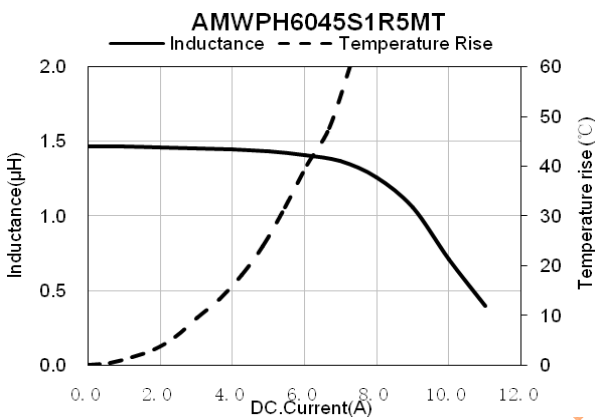
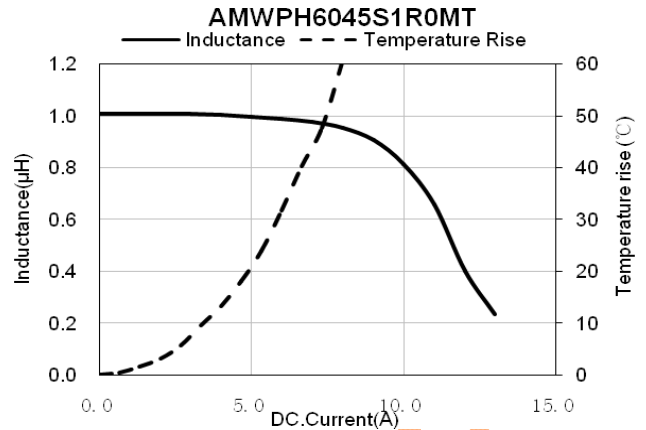
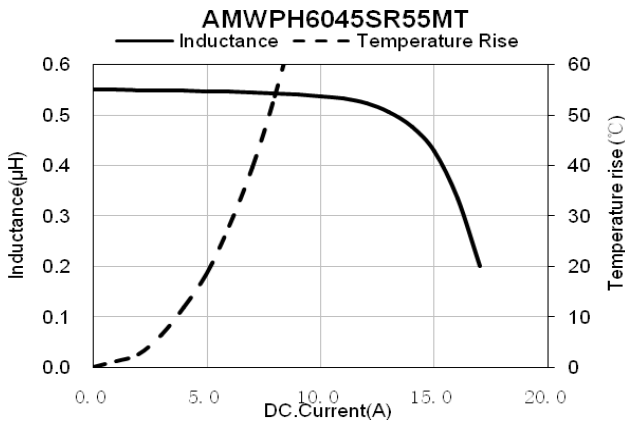
Note: ※ 1: Rated current: Isat (max.) or Irms (max.), whichever is smaller;

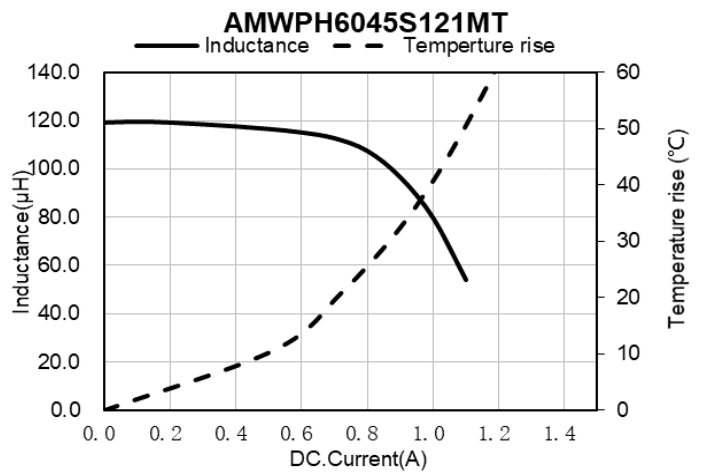
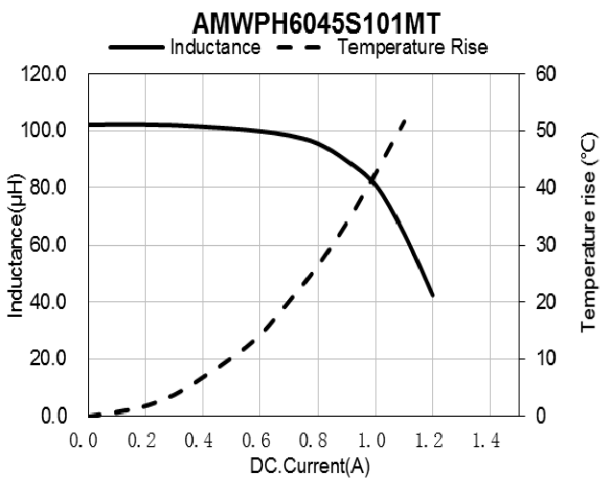
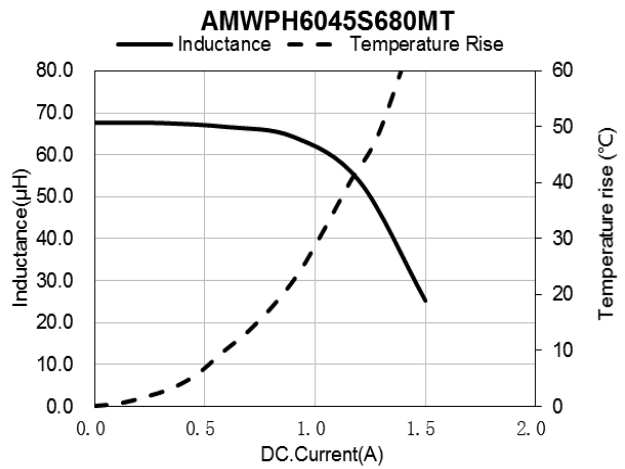
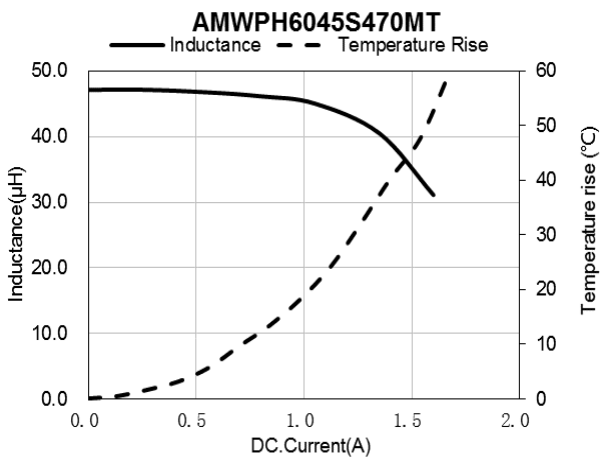
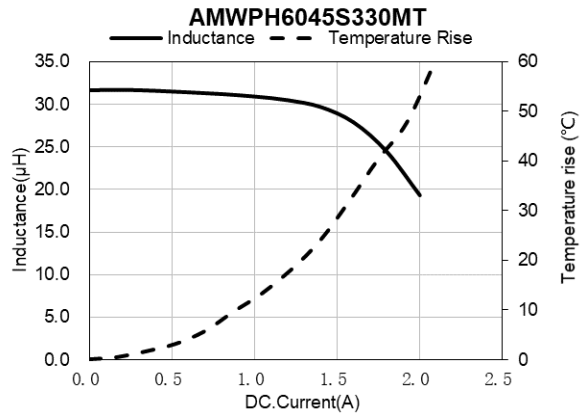
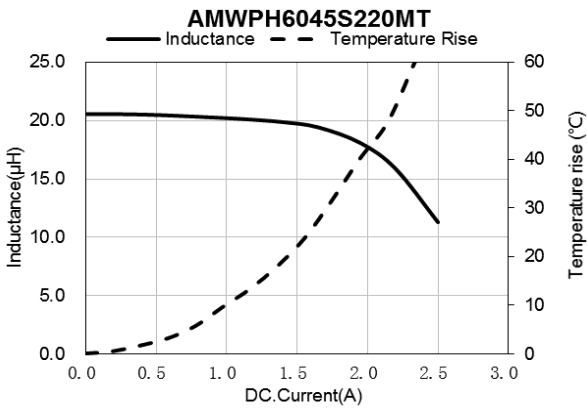
※ 2: Saturation Current: Max. Value, DC current at which the inductance drops less than 30% from its value without current;  
Typ. Value, DC current at which the inductance drops approximate 30% from its value without current;

※ 3: Irms: DC current that causes the temperature rise ( $\Delta T$ ) from 20°C ambient.

For Max. Value,  $\Delta T < 40^\circ\text{C}$ ; For Typ. Value,  $\Delta T$  is approximate 40°C.

Appendix :Typical Electrical Characteristics





## 5 Test and Measurement Procedures

### 5.1 Test Conditions

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

- Ambient Temperature:  $20 \pm 15^\circ\text{C}$
- Relative Humidity:  $65 \pm 20\%$
- Air Pressure: 86kPa to 106kPa

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

- Ambient Temperature:  $20 \pm 2^\circ\text{C}$
- Relative Humidity:  $65 \pm 5\%$
- Air Pressure: 86kPa to 106kPa

### 5.2 Visual Examination

Inspection Equipment: Visual.

### 5.3 Electrical Test

5.3.1 Inductance (L)

- Refer to **Item 4**. Test equipment: WK3260B LCR meter or equivalent.
- Test Frequency and Voltage: refers to **Item 4**.

5.3.2 Direct Current Resistance (DCR)

- Refer to **Item 4**.
- Test equipment: HIOKI 3540 or equivalent.

5.3.3 Saturation Current ( $I_{\text{sat}}$ )

- Refer to **Item 4**.
- Test equipment: WK3260B LCR meter or equivalent.

5.3.4 Temperature rise current ( $I_{\text{rms}}$ )

- Refer to **Item 4**.
- Test equipment (**see Fig. 5.3.4-1, Fig. 5.3.4-2**): Electric Power, Electric current meter, Thermometer.
- Measurement method
  - Set test current to be 0 mA.
  - Measure initial temperature of choke surface.
  - Gradually increase current and measure choke temperature for corresponding current.
  - Definition of Temperature rise current: DC current that causes the temperature rise ( $\Delta T$ ) from ambient temperature.

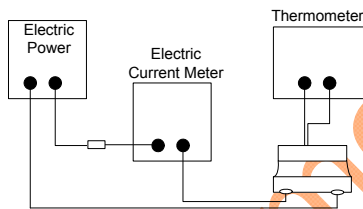


Fig. 5.3.4-1

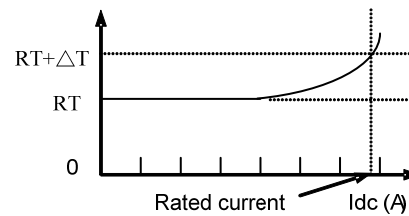


Fig. 5.3.4-2

5.3.5 Self-resonant frequency (SRF)

- Refer to **Item 4**.
- Test equipment: Agilent E4991A+16197 or equivalent

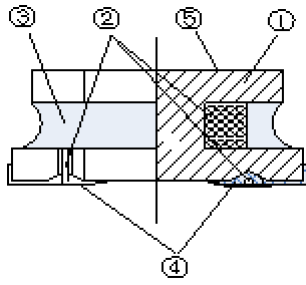
### 5.4 Schematic Diagram





6 Structure

1) The structure of AMWPH6045S product, please refer to Fig.6-1 and Table 6-1.



[Table 6-1]

| No. | Components    | Material                                 |
|-----|---------------|--|
| ①   | Ferrite Core  | NiZn Ferrite                             |
| ②   | Wire          | Polyurethane system enameled copper wire |
| ③   | Magnetic Glue | Epoxy resin and magnetic powder          |
| ④   | Electrodes    | Ag/Ni/Sn+ Cu +Sn Alloy                   |
| ⑤   | Marking       | Laser Marking                            |

7 Product Marking

Please refer to Fig. 7-1.

Marking method: laser

○: polarity pointd

100: Inductance, refer to specifications

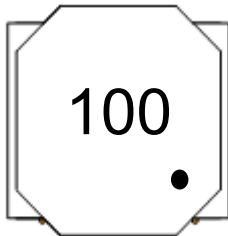


Fig. 7-1

for Automotive Electronics

## 8 Reliability Test

| No. | Test Items                           | Test Methods  | Requirements   |
|-----|--------------------------------------|---|--|
| 1   | Pre-and Post -Stress Electrical Test | Inductance of the components<br>DC resistance of the components   | (1)The electrical values before the test meet the specifications<br>(2)The electrical values after the test meet the rate of change requirements;<br>Inductance change: Within $\pm 10\%$  |
| 2   | External Visual                      | Appearance of the components  | (1)No visible mechanical damage  |
| 3   | Physical Dimension                   | Dimensions of the components  | (1) meet the specifications  |
| 4   | Electrical Characterization          | Ambient temperature 25°C(15+3min) → ambient temperature -40°C(15+3min) → ambient temperature +125°C(15+3min).   | (1)Inductance change should be within $\pm 10\%$ of reference value measuring at 25°C  |
| 5   | Flammability                         | Refer to MIL-STD-202 Method 111、UL-94   | ① t1 or t2: $\leq 10s$ ;<br>② t1 plus t2 for the 5 specimens: $\leq 50s$ ;<br>③ t2+t3 for each specimen: $\leq 30s$ ;<br>④ No after-flame or after-glow of any specimen up to the holding clamp;<br>⑤ No cotton indicator ignited by flaming particles or drops. |
| 6   | Terminal Strength                    | 1.Precondition: 3 reflow cycles;<br>2.Test condition: 17.7N,X,Ydirect, 60(+5)s, Speed: 1.0mm/s.   | (1)No visible mechanical damage  |
| 7   | Board Flex                           | 1.Precondition: 3 reflow cycles;<br>2.Test condition: 2mm,60(+5)s.  | (1)No visible mechanical damage  |
| 8   | Solder ability                       | Method 1:<br>①pretreatment;155°C, 4h<br>②235°C,5(-0.5,+0)s, 25 $\pm$ 6 mm/s;<br>③Solder: Sn/3.0Ag/0.5Cu<br>Method 2:<br>①Steam aging:8h $\pm$ 15min;<br>②235°C,5(-0.5,+0)s, 25 $\pm$ 6 mm/s;<br>③Solder: Sn/3.0Ag/0.5Cu<br>Method 3:<br>①Steam aging:8h $\pm$ 15min;<br>②260°C,7(-0.5,+0.5)s, 25 $\pm$ 6 mm/s;<br>③Solder: Sn/3.0Ag/0.5Cu | (1)Wetting shall be exceeded 95% coverage  |
| 9   | Resistance to Soldering Heat         | Method 1:<br>Max 260°C/10s, 3 times. Solder: Sn/3.0Ag/0.5Cu.  | (1) No visible mechanical damage   |
| 10  | High Frequency Vibration             | Reflow 3 times,10~2000Hz,5g,20min/Cycle,4 hours in each 3 mutually perpendicular directions (total of 12 hours) .   | (2) Inductance change: Within $\pm 10\%$<br>(3) DCR: Satisfy electrical characteristic.  |

|    |   |  |  |
|----|---|--|--|
| 11 | Mechanical Shock                                | Reflow 3 times, Half sine shock pulse, 100g, 6ms, 6 shocks in each 3 mutually perpendicular directions (total of 18 shocks).   |  |
| 12 | ESD test  | HBM ESD discharge waveform, 8KV, each 1 time of +/- polarity.  |  |
| 13 | Temperature cycling Test                        | Reflow 3 times, ambient temperature -40°C/(30min), ambient temperature+125°C/(30min), transforming interval:20s,1000 cycles.<br>① Read-outs at 500,1000cycles            |  |
| 14 | low temperature Storage test                    | Reflow 3 times, ambient temperature -40°C,1000 (+24) hours.<br>① Read-outs at 500h.  |  |
| 15 | High temperature Storage test                   | Reflow 3 times, ambient temperature +125°C,1000 hours.<br>① Read-outs at 500h.   | (1) No visible mechanical damage<br>(2) Inductance change: Within ±10%<br>(3) DCR: Satisfy electrical characteristic.  |
| 16 | High Temperature And High Humidity Storage Test | (unpowered)<br>Reflow 3 times, ambient temperature 85°C,85%RH,1000 hours.<br>① Read-outs at 500h.  |  |
| 17 | High temperature over lifetime                  | Reflow 3 times, ambient temperature85±2°C,1000(+24)hours, rated current.<br>Note: .<br>① Inspect the product temperature at once a week<br>Note:Read-outs at 500h,1000h, |  |
| 18 | solvent resistance test                         | Add Aqueous wash chemical. OKEM Clean or equivalent.<br>Do not use banned solvents.  | ① No specified markings which are missing in whole or in part, faded, smeared, blurred, or shifted (dislodged) to the extent ;<br>② No specimen shall have cracks, separations, crazing, swelling, softening, and degradation of body material, end caps and seals if present. |

9 Packaging, Storage and Transportation

9.1 Tape and Reel Packaging Dimensions

9.1.1 Taping Dimensions (Unit: mm)

Please refer to Fig. 9.1.1 and Table 9.1.1.

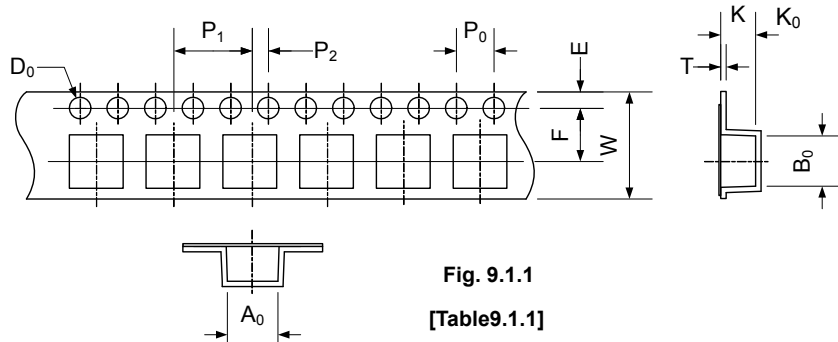


Fig. 9.1.1  
[Table 9.1.1]

| Series     | A <sub>0</sub> | B <sub>0</sub> | W        | E        | F       | P <sub>0</sub> | P <sub>1</sub> | P <sub>2</sub> | D <sub>0</sub> | T         | K <sub>0</sub> |
|------------|----------------|----------------|----------|----------|---------|----------------|----------------|----------------|----------------|-----------|----------------|
| AMWPH6045S | 6.4±0.1        | 6.4±0.1        | 16.0±0.3 | 1.75±0.1 | 7.5±0.1 | 4.0±0.1        | 8.0±0.1        | 2.0±0.1        | 1.5+0.1/-0.0   | 0.40±0.05 | 4.7±0.1        |

9.1.2 Direction of rolling

Please refer to Fig. 9.1.2

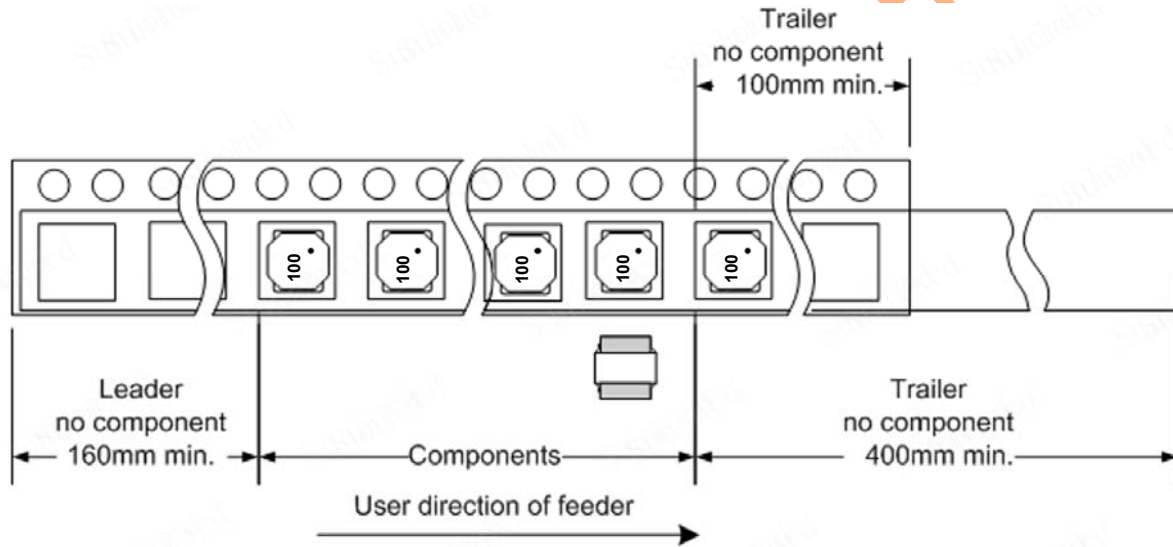


Fig. 9.1.2

9.1.3 Reel Dimensions (Unit: mm)

Please refer to Fig. 9.1.3.

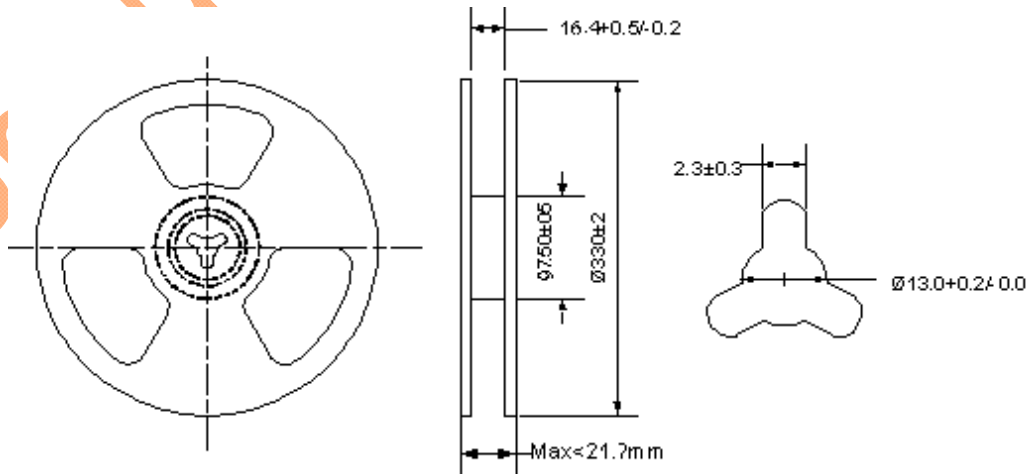
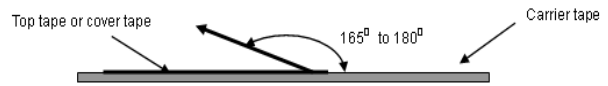


Fig. 9.1.3

- 9.1.4 Top tape strength  
 Peel-off strength: 10~150gf.  
 Peel-off angle: 165°~180°, refers to **Fig. 9.1.4**.  
 Peel-off speed: 300mm/min.

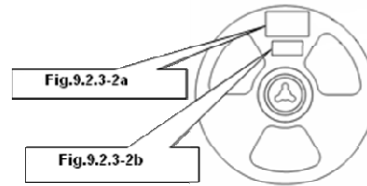


**Fig. 9.1.4**

- 9.1.5 The number of components  
 A tape & reel package contains 1500 inductors.
- 9.1.6 The allowable number of empty chip cavities: 0 chip.

**9.2 Packing Documents and Marking**

- 9.2.1 Packing Documents  
 Packing documents include the following:
  - 1) Packaging list;
  - 2) Certificate of compliance (COC).



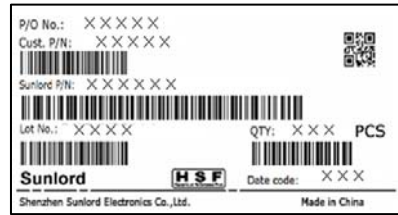
**Fig.9.2.3-1**

- 9.2.2 Packing QTY.  
 4 or 6 reels in each outer case.

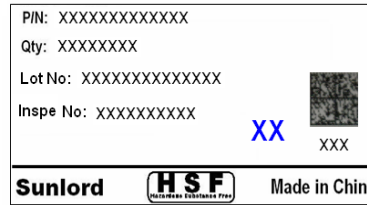
- 9.2.3 Marking  
 1) Marking label information on reels includes  
 (see **Fig. 9.2.3-1**, **Fig. 9.2.3-2a/2b**):

Fig.9.2.3-2a: Shipping labels

- a). P/O No.
- b). Customer Part No.
- c). Sunlord Part No.
- d). Quantity.
- e). Lot No.
- f). Date code.
- g). Inspection stamp.
- h). MFG address as 'Made In China'.



**Fig.9.2.3-2a**



**Fig.9.2.3-2b**

Fig.9.2.3-2b: Production labels

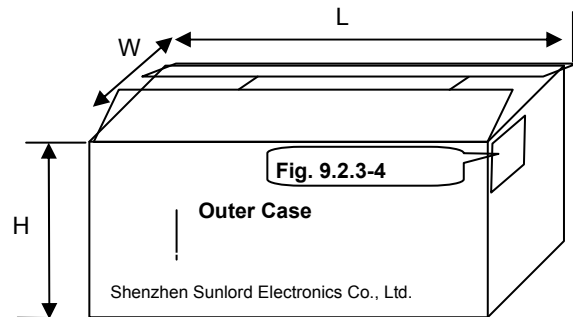
- a). P/N.
- b). Quantity.
- c). Lot No.
- d). Inspect No.
- e). Inspection stamp.
- f). MFG address as 'Made In China'.
- g). Sequence number.

- 2) Marking on outer case (see **Fig.9.2.3-3-4**):  
 Out case size please refers to **Table 9.2.3-1**.

- a). Manufacturer: Sunlord ID:  
 "Shenzhen Sunlord Electronics Co., Ltd."
- b). Packing label include the following:
  - i) BoxID.
  - ii) S/PN.
  - iii) P/N.
  - iv) D/C.
  - v) Count.
  - vi) QTY.
  - vii) QR code.

**[ Tab. 9.2.3-1 ]**

| Packaging type | L(mm) | W(mm) | H(mm) |
|----------------|-------|-------|-------|
| TPY1           | 380   | 380   | 190   |
| TPY2           | 380   | 380   | 250   |

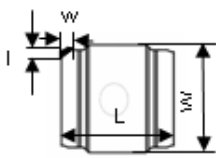
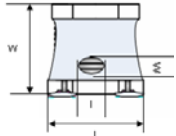
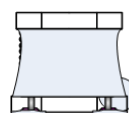
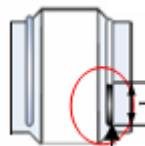
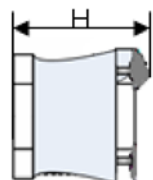
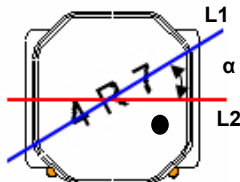


**Fig. 9.2.3-3**

|        |            |  |
|--------|------------|--|
| BoxID: |            |  |
| S/PN:  | SINVCODE   |  |
| P/N:   | 4116620100 |  |
| D/C:   | 1627       |  |
| Count: | 3          |  |
| QTY:   | 6000       |  |

**Fig. 9.2.3-4**

10 Visual inspection standard of product

| File No:        |                | Applied to Wire Wound SMD Power Inductor Series                                     |   | REV:01     |
|-----------------|----------------|---|---|------------|
| Effective date: |                |   |   |            |
| No.             | Defect Item    | Graphic   | Rejection identification  | Acceptance |
| 1               | Core defect    |    | The defect length and width (L and W) more than L/6 and W/6, NG.  | AQL=0.065  |
| 2               | Starvation     |    | Resin starved length, I, more than L/2, NG.<br>① IF W > 2mm, resin starved width, w, more than W/2, NG.<br>② IF W ≤ 2mm, resin starved width, w, don't control. | AQL=0.065  |
| 3               | Excessive glue |    | The length, width or height of product beyond specified value, NG.  | AQL=0.065  |
| 4               | Cold solder    |   | Cold solders I more than 1mm, NG.   | AQL=0.065  |
| 5               | Solder icicle  |  | The height H of product beyond specified value, NG;   | AQL=0.065  |
| 6               | Marking defect |  | ① The content of marking 1) is indistinct, 2) disagrees with current product P/N requirements, NG;<br>② Intersection angle by L1 and L2 more than 45°, NG.      | AQL=0.065  |

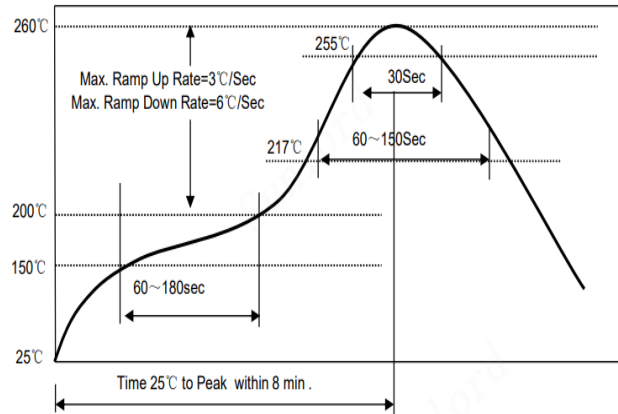
## 11 Recommended Soldering Technologies

### 11.1 Re-flowing Profile:

- △ Preheat condition: 150 ~200°C/60~180sec.
- △ Allowed time above 217°C: 60~150sec.
- △ Allowed time above 255°C: 30sec. ref.
- △ Max temp: 260°C
- △ Max time at max temp: 5sec.
- △ Solder paste: Sn/3.0Ag/0.5Cu
- △ Allowed Reflow time: 3x max

Please refer to Fig. 11.1-1.

[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.]

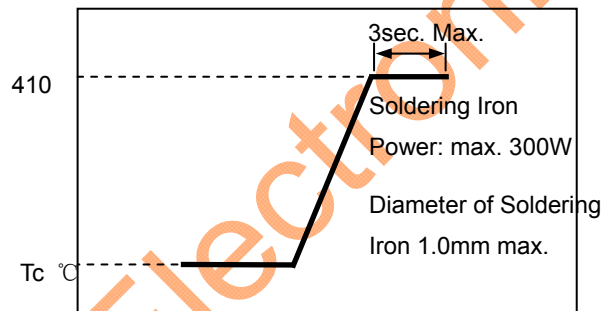


### 11.2 Iron Soldering Profile:

- △ Iron soldering power: Max. 300W
- △ Pre-heating: 150°C/60sec.
- △ Soldering Tip temperature: 390°C ~410°C
- △ Soldering time: 3sec. Max.
- △ Solder paste: Sn/3.0Ag/0.5Cu
- △ Max.1 times for iron soldering

Please refer to Fig. 11.2-1.

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



## 12 Precautions

### 12.1 Surface mounting

- Mounting and soldering condition should be checked beforehand.
- Applicable soldering process to this product is reflow soldering only.
- Recommended conditions for repair by soldering iron:
  - Preheat the circuit board with product to repair at 150°C for about 1 minute.
  - Put soldering iron on the land-pattern.
  - Soldering iron's temperature: 350°C maximum/Duration: 3 seconds maximum/1 time for each terminal.
  - The soldering iron should not directly touch the inductor.
  - Product once removes from the circuit board may not be used again.

### 12.2 Handling

- Keep the products away from all magnets and magnetic objects.
- Be careful not to subject the products to excessive mechanical shocks.
- Please avoid applying impact to the products after mounted on pc board.
- Avoid ultrasonic cleaning.

### 12.3 Storage

- To maintain the solderability of terminal electrodes and to keep the packing material in good condition, temperature and humidity in the storage area should be controlled.
- Recommended conditions: -10°C~40°C, 70%RH (Max.)
- Even under ideal storage conditions, solderability of products electrodes may decrease as time passes. For this reason, product should be used with one year from the time of delivery.
- In case of storage over 6 months, solderability shall be checked before actual usage.

### 12.4 Regarding Regulations

- Any Class- I or Class- II ozone-depleting substance (ODS) listed in the Clean Air Act in US for regulation is not included in the products or applied to the products at any stage of whose manufacturing processes.
- Certain brominated flame retardants (PBBs, PBDEs) are not used at all.
- The products of this specification are not subject to the Export Trade Control Order in China or the Export Administration Regulations in US.

### 12.5 Guarantee

- The guaranteed operating conditions of the products are in accordance with the conditions specified in this specification.
- Please note that Sunlord takes no responsibility for any failure and/or abnormality which is caused by use under other than the aforesaid operating conditions.

12.6 Please make sure to record the lot number on the label when using Sunlord's products in order for good traceability.