

规格承认书

SPECIFICATION

编号(No):

日期(Date):

客户 (Customer):

品名(Product Name): 片式NTC热敏电阻 Chip NTC thermistor

恭成料号 (QAMCN Part Number) : QN0603X103J3950HB

客户规格(Customer's Part Number):

| 客户承认 CUSTOMER CONFIRM | | | |
|-----------------------|---------------|-------------|------------------|
| 承认章 STAMP | 核准 APPROVE | 审核 CHECK | 经办人 SIGNATURE |
| | | | |

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1 外形尺寸 Shape and Dimensions

- 尺寸: 见图 1 和表 1
- PCB 焊盘: 见图 2 和表 1
- Dimensions: See Fig.1 and Table 1.
- Recommended PCB pattern for reflow soldering: See Fig.2 and Table 1

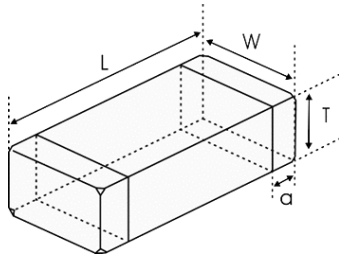


图 1 Fig.1

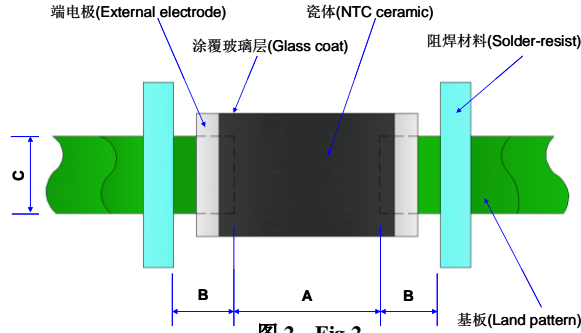


图 2 Fig.2

表 1 (Table 1)

单位 unit: inch[mm]

| 类别 Type | L | W | T | a | A | B | C |
|----------------|---------------------------|---------------------------|---------------------------|--------------------------|-----------|-----------|-----------|
| 0603 [1608] | 0.063±0.006 [1.6±0.15] | 0.031±0.006 [0.8±0.15] | 0.031±0.006 [0.8±0.15] | 0.012±0.008 [0.3±0.2] | [0.6-0.8] | [0.6-0.7] | [0.6-0.8] |

2 产品标识 (料号) Product Identification(Part Number)

QN 0603 X 103 J 3950 H B
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

| | |
|---|-------------------------------------|
| ① 类别 Type | |
| QN | 片式 NTC 热敏电阻器 Chip NTC Thermistor |
| ② 外形尺寸(mm) External Dimensions (L×W×T) | |
| 0201[0603] | 0.60×0.30×0.30 |
| 0402[1005] | 1.00×0.50×0.50 |
| 0603[1608] | 1.60×0.80×0.80 |
| 0805[2012] | 2.00×1.25×0.85 |
| 1206[3216] | 3.20×1.60×0.85 |
| ③ 分隔符 Delimiter | |
| | X |

| | |
|--|-------|
| ④ 25℃的零功率电阻 Nominal Zero-Power Resistance | |
| 472 | 4.7kΩ |
| 103 | 10kΩ |
| 154 | 150kΩ |

| | |
|------------------------------------|-----|
| ⑤ 电阻值公差 Tolerance of Resistance | |
| F | ±1% |
| G | ±2% |
| H | ±3% |
| J | ±5% |

| | |
|--------------------|-------|
| ⑥ B 值常数 B Constant | |
| 3600 | 3600K |
| 3950 | 3950K |
| 4500 | 4500K |

| | |
|------------------------------------|-----|
| ⑦ B 值公差 Tolerance of B Constant | |
| F | ±1% |
| H | ±3% |

| | |
|--|-----------|
| ⑧ B 值计算方式 B constant calculation method | |
| A | 25℃ & 85℃ |
| B | 25℃ & 50℃ |

3 电气特性 Electrical Characteristics

| 型号 Part No | 电阻值 Resistance (25℃) (kΩ) | B 常数 B Constant (25/50℃) (K) | B 常数 B Constant (25/85℃) (K) | 允许工作电流 Permissible Operating Current (25℃) (mA) | 耗散系数 Dissipation Factor (mW/℃) | 热时间常数 Thermal Time Constant (s) | 额定功率 Rated Electric Power(25℃) (mW) | 工作温度 Operating ambient temperature (℃) |
|-------------------|------------------------------------|---------------------------------------|---------------------------------------|---|---|---|--|--|
| QN0603X103J3950HB | 10±5% | 3950±3% | 3987 | 0.31 | 1.0 | <5 | 100 | -40~+125 |

4 检验和测试程序

测试条件

如无特别规定，检验和测试的标准大气环境条件如下：

- a. 环境温度：20±5℃；
- b. 相对湿度：65±20%；
- c. 气压：86 kPa~106 kPa

如果对测试结果有异议，则在下述条件下测试：

- a. 环境温度：25±2℃；
- b. 相对湿度：65±5%
- c. 气压：86kPa ~ 106kPa

检查设备

外观检查：20 倍放大镜；
阻值检查：热敏电阻测试仪

4 Test and Measurement Procedures

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: 86kPa to 106kPa

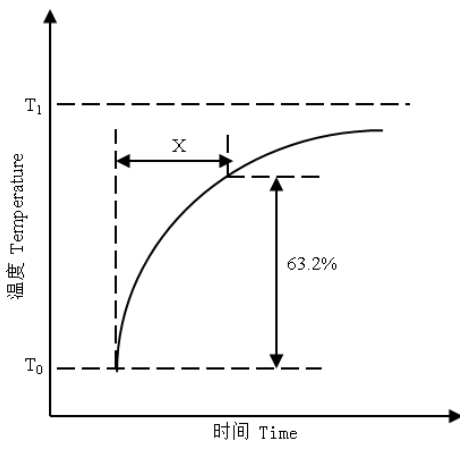
If any doubt on the results, measurements/tests should be made within the following limits:

- a. Ambient Temperature: 25±2℃
- b. Relative Humidity: 65±5%
- c. Air Pressure: 86kPa to 106kPa

Inspection Equipment

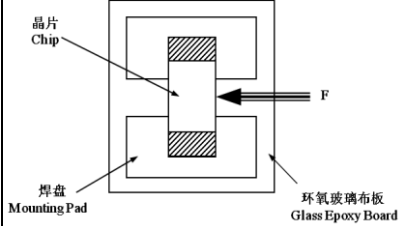
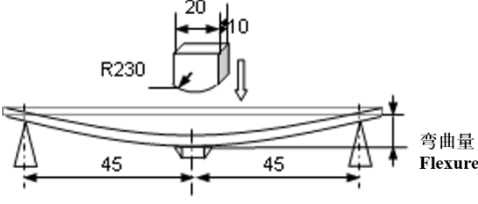
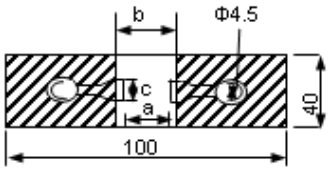
Visual Examination: 20× magnifier
Resistance value test: Thermistor resistance tester

5 电性测试 Electrical Test

| 序号 No. | 项目 Items | 测试方法及备注 Test Methods and Remarks |
|--------|--|--|
| 1 | 25℃零功率电阻值 Nominal Zero-Power Resistance at 25℃(R25) | 环境温度 Ambient temperature: 25±0.05℃ 测试功率 Measuring electric power: ≤0.1mW |
| 2 | B 值常数 Nominal B Constant | 分别在环境温度 25±0.05℃, 50±0.05℃或 85±0.05℃下测量电阻值。 Measure the resistance at the ambient temperature of 25±0.05℃, 50±0.05℃ or 85±0.05℃. $B(25-50^{\circ}\text{C}) = \frac{\ln R_{25} - \ln R_{50}}{1/T_{25} - 1/T_{50}} \quad B(25-85^{\circ}\text{C}) = \frac{\ln R_{25} - \ln R_{85}}{1/T_{25} - 1/T_{85}}$ T: 绝对温度 (K) Absolute temperature (K) |
| 3 | 热时间常数 Thermal Time Constant | 在零功率条件下，当热敏电阻的环境温度发生急剧变化时，热敏电阻元件产生最初温度 T0 与最终温度 T1 两者温度差的 63.2% 的温度变化所需要的时间，通常以秒(S)表示。 The total time for the temperature of the thermistor to change by 63.2% of the difference from ambient temperature T ₀ (°C) to T ₁ (°C) by the drastic change of the power applied to thermistor from Non-zero Power to Zero-Power state, normally expressed in second(S).  |

| | | |
|---|---|---|
| 4 | 耗散系数 Dissipation Factor | 在一定环境温度下，NTC 热敏电阻通过自身发热使其温度升高 1℃时所需要的功率，通常以 mW/℃表示。可由下面公式计算： The required power which makes the NTC thermistor body temperature raise 1℃ through self-heated, normally expressed in milliwatts per degree Celsius (mW/℃). It can be calculated by the following formula: $\delta = \frac{W}{T-T_0}$ |
| 5 | 额定功率 Rated Power | 在环境温度 25℃下因自身发热使表面温度升高 100℃所需要的功率。 The necessary electric power makes thermistor's temperature rise 100℃ by self-heating at ambient temperature 25℃. |
| 6 | 允许工作电流 Permissible operating current | 在静止空气中通过自身发热使其升温为 1℃的电流。 The current that keep body temperature of chip NTC on the PC board in still air rising 1℃ by self-heating. |

6 信赖性试验 Reliability Test

| 项目 Items | 测试标准 Standard | 测试方法及备注 Test Methods and Remarks | 要求 Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------|------------------|--|--------------------|---------------|-------------------------|------------------|-------|-------|----------|-------|---|-----|---|---------|---|---|---|------|------|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|------|
| 端头附着力 Terminal Strength | IEC 60068-2-21 | <p>将晶片焊接在测试基板上（如右图所示的环氧玻璃布板），按箭头所示方向施加作用力； Solder the chip to the testing jig (glass epoxy board shown in the right) using eutectic solder. Then apply a force in the direction of the arrow.</p> <table border="1" data-bbox="497 1075 1034 1209"> <thead> <tr> <th>尺寸 Size</th> <th>F</th> <th>保持时间 Duration</th> </tr> </thead> <tbody> <tr> <td>0201, 0402, 0603</td> <td>5N</td> <td rowspan="2">10±1s</td> </tr> <tr> <td>0805</td> <td>10N</td> </tr> </tbody> </table> | 尺寸 Size | F | 保持时间 Duration | 0201, 0402, 0603 | 5N | 10±1s | 0805 | 10N | <p>端电极无脱落且瓷体无损伤。 No removal or split of the termination or other defects shall occur.</p>  | | | | | | | | | | | | | | | | | | | | | | |
| 尺寸 Size | F | 保持时间 Duration | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0201, 0402, 0603 | 5N | 10±1s | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0805 | 10N | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 抗弯强度 Resistance to Flexure | IEC 60068-2-21 | <p>将晶片焊接在测试基板上（如右图所示的环氧玻璃布板），按下图箭头所示方向施加作用力； Solder the chip to the test jig (glass epoxy board shown in the right) using a eutectic solder. Then apply a force in the direction shown as follow;</p>  <table border="1" data-bbox="446 1758 1085 1982"> <thead> <tr> <th>尺寸 Size</th> <th>弯曲变形量 Flexure</th> <th>施压速度 Pressurizing Speed</th> <th>保持时间 Duration</th> </tr> </thead> <tbody> <tr> <td>0201,</td> <td>1mm</td> <td rowspan="2"><0.5mm/s</td> <td rowspan="2">10±1s</td> </tr> <tr> <td>0402, 0603, 0805</td> <td>2mm</td> </tr> </tbody> </table> | 尺寸 Size | 弯曲变形量 Flexure | 施压速度 Pressurizing Speed | 保持时间 Duration | 0201, | 1mm | <0.5mm/s | 10±1s | 0402, 0603, 0805 | 2mm | <p>① 无外观损伤。 No visible damage. ② ΔR25/R25 ≤5%</p> <p>单位 unit: mm</p> <table border="1" data-bbox="1157 1512 1524 1724"> <thead> <tr> <th>类型 Type</th> <th>a</th> <th>b</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>0201</td> <td>0.25</td> <td>0.3</td> <td>0.3</td> </tr> <tr> <td>0402</td> <td>0.4</td> <td>1.5</td> <td>0.5</td> </tr> <tr> <td>0603</td> <td>1.0</td> <td>3.0</td> <td>1.2</td> </tr> <tr> <td>0805</td> <td>1.2</td> <td>4.0</td> <td>1.65</td> </tr> </tbody> </table>  | 类型 Type | a | b | c | 0201 | 0.25 | 0.3 | 0.3 | 0402 | 0.4 | 1.5 | 0.5 | 0603 | 1.0 | 3.0 | 1.2 | 0805 | 1.2 | 4.0 | 1.65 |
| 尺寸 Size | 弯曲变形量 Flexure | 施压速度 Pressurizing Speed | 保持时间 Duration | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0201, | 1mm | <0.5mm/s | 10±1s | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0402, 0603, 0805 | 2mm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 类型 Type | a | b | c | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0201 | 0.25 | 0.3 | 0.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0402 | 0.4 | 1.5 | 0.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0603 | 1.0 | 3.0 | 1.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0805 | 1.2 | 4.0 | 1.65 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

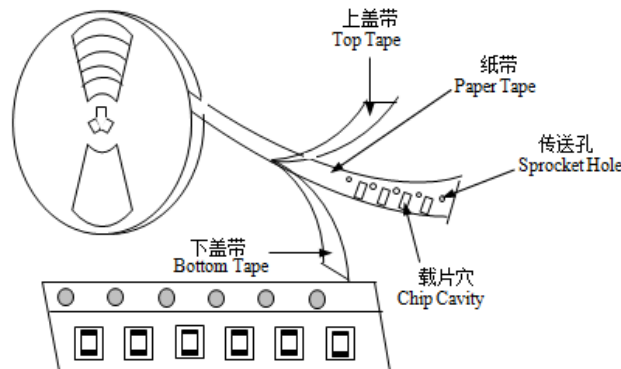
| <p>振动 Vibration</p> | <p>IEC 60068-2-80</p> | <p>① 将晶片焊接在测试基板上（如右图所示的环氧玻璃布板）； Solder the chip to the testing jig (glass epoxy board shown in the left) using eutectic solder.</p> <p>② 晶片以全振幅为 1.5mm 进行振动，频率范围为 10Hz ~ 55 Hz； The chip shall be subjected to a simple harmonic motion having total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55 Hz.</p> <p>③ 振动频率按 10Hz→55Hz→10Hz 循环，周期为 1 分钟，在空间三个互相垂直的方向上各振动 2 小时（共 6 小时）。 The frequency ranges 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).</p> | <p>无外观损伤。 No visible damage.</p>  <p>铜箔 Cu pad 阻焊膜 Solder mask 环氧玻璃布板 Glass Epoxy Board</p> | | | | | | | | | | | | | | | |
|---|-----------------------|---|---|----------------|---------|---|--------|---------|---|-------|--------|---|--------|---------|---|-------|--------|--|
| <p>坠落 Dropping</p> | <p>IEC 60068-2-32</p> | <p>从 1m 的高度让晶片自由坠落至水泥地面 10 次。 Drop a chip 10 times on a concrete floor from a height of 1 meter.</p> | <p>无外观损伤。 No visible damage.</p> | | | | | | | | | | | | | | | |
| <p>可焊性 Solderability</p> | <p>IEC 60068-2-58</p> | <p>① 焊接温度 Solder temperature: 245±5℃. ② 浸渍时间 Duration: 3±0.3s. ③ 焊锡成分 Solder: Sn/3.0Ag/0.5Cu. ④ 助焊剂 Flux: （重量比）25% 松香和 75% 酒精 25% Resin and 75% ethanol in weight.</p> | <p>① 无外观损伤； No visible damage. ② 元件端电极的焊锡覆盖率不小于 95%。 Wetting shall exceed 95% coverage.</p> | | | | | | | | | | | | | | | |
| <p>耐焊性 Resistance to Soldering Heat</p> | <p>IEC 60068-2-58</p> | <p>① 焊接温度 Solder temperature: 260±5℃. ② 浸渍时间 Duration: 10±1s. ③ 焊锡成分 Solder: Sn/3.0Ag/0.5Cu. ④ 助焊剂 Flux: （重量比）25% 松香和 75% 酒精 25% Resin and 75% ethanol in weight. ⑤ 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring.</p> | <p>① 无外观损伤； No visible damage. ② $\Delta R_{25}/R_{25} \leq 5\%$ ③ $\Delta B/B \leq 2\%$</p> | | | | | | | | | | | | | | | |
| <p>温度周期 Temperature cycling</p> | <p>IEC 60068-2-14</p> | <p>① 无负载于下表所示的环境条件下重复 5 次。 5 cycles of following sequence without loading.</p> <table border="1" data-bbox="491 1429 1040 1624"> <thead> <tr> <th>步骤 Step</th> <th>温度 Temperature</th> <th>时间 Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40±5℃</td> <td>30±3min</td> </tr> <tr> <td>2</td> <td>25±2℃</td> <td>5±3min</td> </tr> <tr> <td>3</td> <td>125±2℃</td> <td>30±3min</td> </tr> <tr> <td>4</td> <td>25±2℃</td> <td>5±3min</td> </tr> </tbody> </table> <p>② 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring.</p> | 步骤 Step | 温度 Temperature | 时间 Time | 1 | -40±5℃ | 30±3min | 2 | 25±2℃ | 5±3min | 3 | 125±2℃ | 30±3min | 4 | 25±2℃ | 5±3min | <p>① 无外观损伤； No visible damage. ② $\Delta R_{25}/R_{25} \leq 3\%$ ③ $\Delta B/B \leq 2\%$</p> |
| 步骤 Step | 温度 Temperature | 时间 Time | | | | | | | | | | | | | | | | |
| 1 | -40±5℃ | 30±3min | | | | | | | | | | | | | | | | |
| 2 | 25±2℃ | 5±3min | | | | | | | | | | | | | | | | |
| 3 | 125±2℃ | 30±3min | | | | | | | | | | | | | | | | |
| 4 | 25±2℃ | 5±3min | | | | | | | | | | | | | | | | |
| <p>高温存放 Resistance to dry heat</p> | <p>IEC 60068-2-2</p> | <p>① 在 125±5℃ 空气中，无负载放置 1000±24 小时。 125±5℃ in air, for 1000±24 hours without loading. ② 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring.</p> | <p>① 无外观损伤； No visible damage. ② $\Delta R_{25}/R_{25} \leq 5\%$ ③ $\Delta B/B \leq 2\%$</p> | | | | | | | | | | | | | | | |

| | | | |
|---|--------------------|--|--|
| 低温存放 Resistance to cold | IEC 60068-2-1 | ① 在-40±3℃空气中，无负载放置 1000±24 小时。 -40±3℃ in air, for 1000±24 hours without loading. ② 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring. | ① 无外观损伤； No visible damage. ② $ \Delta R25/R25 \leq 5\%$ ③ $ \Delta B/B \leq 2\%$ |
| 湿热存放 Resistance to damp heat | IEC 60068-2-78 | ① 在 40±2℃，相对湿度 90~95% 空气中，无负载放置 1000±24 小时。 40±2℃, 90~95%RH in air, for 1000±24 hours without loading. ② 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring. | ① 无外观损伤； No visible damage. ② $ \Delta R25/R25 \leq 3\%$ ③ $ \Delta B/B \leq 2\%$ |
| 高温负荷 Resistance to high temperature load | IEC 60539-1 5.25.4 | ① 在 85±2℃空气中，施加允许工作电流 1000±48 小时。 85±2℃ in air with permissive operating current for 1000±48 hours ② 试验后标准条件下放置 1~2 小时后测量。 The chip shall be stabilized at normal condition for 1~2 hours before measuring. | ① 无外观损伤； No visible damage. ② $ \Delta R25/R25 \leq 5\%$ ③ $ \Delta B/B \leq 2\%$ |

7 编带 Taping

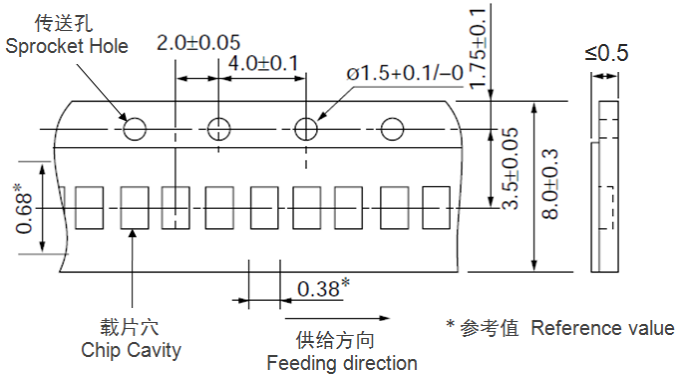
| 类型 Type | 0201 | 0402 | 0603 | 0805 |
|----------------------------|---------------|----------|----------|----------|
| 编带厚度 Tape thickness(mm) | 0.5±0.15 | 0.5±0.15 | 0.8±0.15 | 0.85±0.2 |
| 编带材质 Tape material | 纸带 Paper Tape | | | |
| 每盘数量 Quantity per Reel | 15K | 10K | 4K | 4K |

(1) 编带图 Taping Drawings

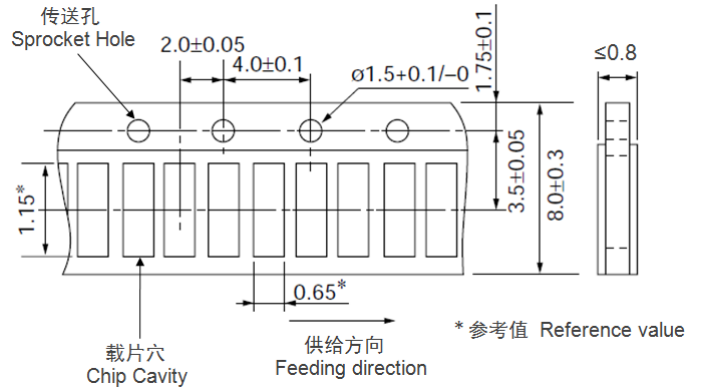


(2) 纸带尺寸 Paper Tape Dimensions (单位 Unit: mm)

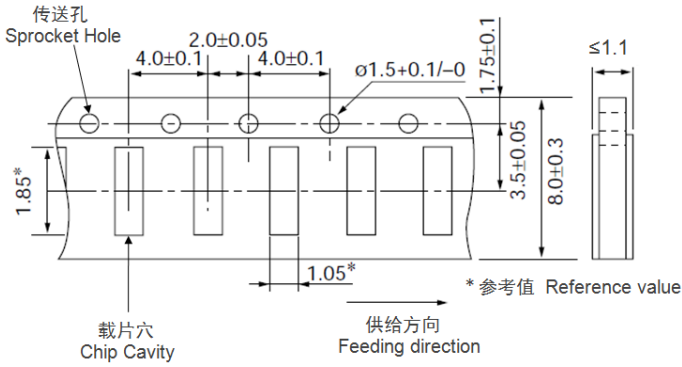
QN0201 系列 QN0201 series



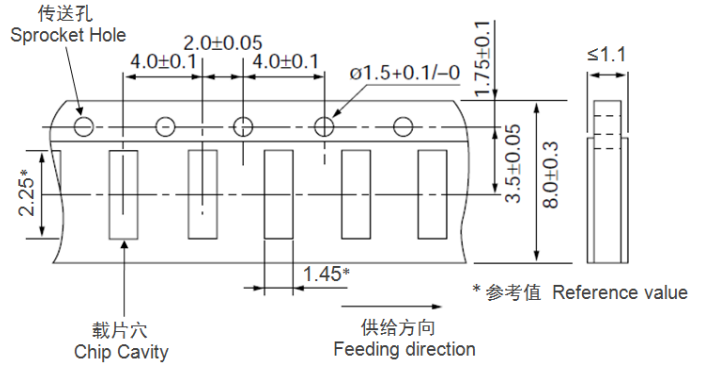
QN0402 系列 QN0402 series



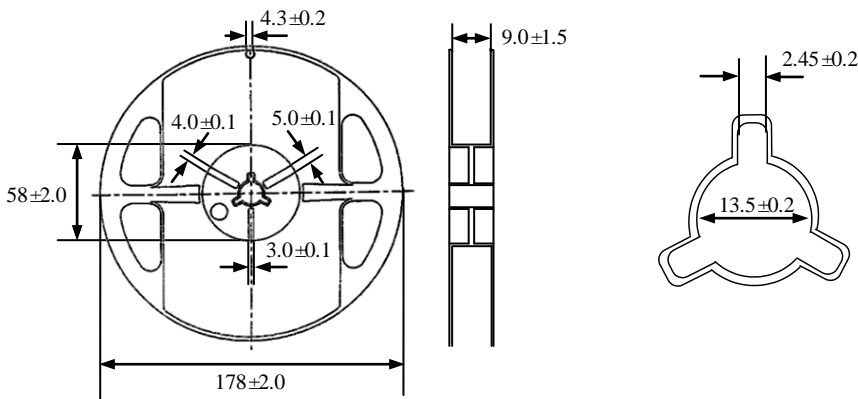
QN0603 系列 QN0603 series



QN0805 系列 QN0805 series



(3) 卷盘尺寸 Reel Dimensions (单位 Unit: mm)



8 储存

- 储存条件
 - a. 储存温度: $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$
 - b. 相对湿度: $\leq 75\% \text{RH}$
 - c. 避免接触粉尘、腐蚀性气氛和阳光
- 储存期限: 产品交付后 6 个月

9 注意事项

- QN 系列热敏电阻不可在以下条件下工作或储存:
 - (1) 腐蚀性气体或还原性气体
(氯气、硫化氢气体、氨气、硫酸气体、一氧化氮等)。
 - (2) 挥发性或易燃性气体
 - (3) 多尘条件
 - (4) 高压或低压条件
 - (5) 潮湿场所
 - (6) 存在盐水、油、化学液体或有机溶剂的场所
 - (7) 强烈振动
 - (8) 存在类似有害条件的其他场所
- QN 系列热敏电阻的陶瓷属于易碎材料, 使用时不可施加过大压力或冲击。
- QN 系列热敏电阻不可在超过目录规定的温度范围情况下工作。

8 Storage

- **Storage Conditions**
 - a. Storage Temperature: $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$
 - b. Relative Humidity: $\cong 75\% \text{RH}$
 - c. Keep away from corrosive atmosphere and sunlight.
- **Period of Storage: 6 Months after delivery**

9 Notes & Warnings

- The QN series thermistors shall not be operated and stored under the following environmental condition:
 - (1) Corrosive or deoxidized atmospheres
(such as chlorine, sulfurated hydrogen, ammonia, sulfuric acid, nitric oxide and so on)
 - (2) Volatile or inflammable atmospheres
 - (3) Dusty condition
 - (4) Excessively high or low pressure condition
 - (5) Humid site
 - (6) Places with brine, oil, chemical liquid or organic solvent
 - (7) Intense vibration
 - (8) Places with analogously deleterious conditions
- The ceramic body of the QN series thermistors is fragile, no excessive pressure or impact shall be exerted on it.
- The QN series thermistors shall not be operated beyond the specified "Operating Temperature Range" in the catalog.

10 建议焊接条件

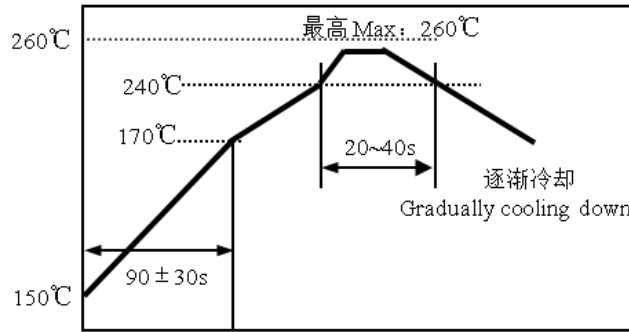
• 回流焊

- 温升 1~2°C/sec.
- 预热: 150~170°C/90±30 sec.
- 大于 240°C 时间: 20~40sec
- 峰值温度: 最高 260°C/10 sec.
- 焊锡: Sn/3.0Ag/0.5Cu
- 回流焊: 最多 2 次

10 Recommended Soldering Technologies

• **Re-flowing Profile**

- 1~2°C/sec. Ramp
- Pre-heating: 150~170°C/90±30 sec.
- Time above 240°C: 20~40 sec.
- Peak temperature: 260°C Max./10 sec.
- Solder paste: Sn/3.0Ag/0.5Cu
- Max.2 times for re-flowing



• 手工焊

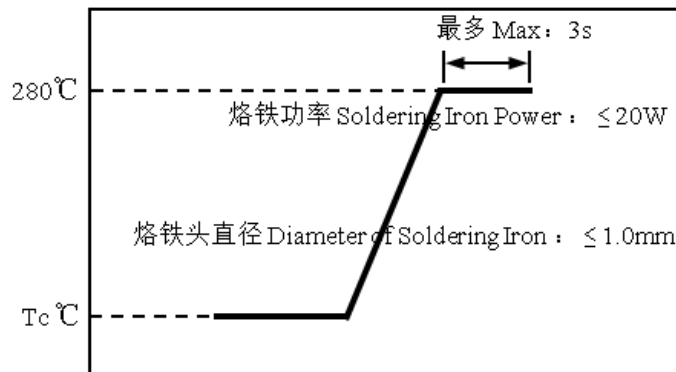
- 烙铁功率: 最大 20W
- 预热: 150°C/60sec.
- 烙铁头温度: 最高 280°C
- 焊接时间: 最多 3sec.
- 焊锡: Sn/3.0Ag/0.5Cu
- 手工焊: 最多 1 次

• **Iron Soldering Profile**

- Iron soldering power: Max.20W
- Pre-heating: 150°C/60sec.
- Soldering Tip temperature: 280°C Max.
- Soldering time: 3 sec Max.
- Solder paste: Sn/3.0Ag/0.5Cu
- Max.1 times for iron soldering

[注: 不要使烙铁头接触到端头]

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



11 R-T 表 R-T table

QN0603X103J3950HB

| 温度 Temp. (°C) | R 最小值 R_Min (Kohm) | R 中心值 R_Cent (Kohm) | R 最大值 R_Max (Kohm) | 阻值公差 Res TOL. | 温度公差 Temp. TOL.(°C) |
|------------------|-----------------------|------------------------|-----------------------|------------------|------------------------|
| -40 | 294.947 | 345.275 | 403.180 | 16.77% | 2.41 |
| -39 | 276.298 | 322.791 | 376.165 | 16.54% | 2.39 |
| -38 | 258.956 | 301.925 | 351.144 | 16.30% | 2.38 |
| -37 | 242.820 | 282.549 | 327.957 | 16.07% | 2.36 |
| -36 | 227.800 | 264.549 | 306.457 | 15.84% | 2.35 |
| -35 | 213.811 | 247.816 | 286.512 | 15.61% | 2.33 |
| -34 | 200.774 | 232.254 | 267.998 | 15.39% | 2.32 |
| -33 | 188.620 | 217.774 | 250.804 | 15.17% | 2.30 |
| -32 | 177.283 | 204.292 | 234.827 | 14.95% | 2.28 |
| -31 | 166.703 | 191.735 | 219.974 | 14.73% | 2.27 |
| -30 | 156.824 | 180.032 | 206.158 | 14.51% | 2.25 |
| -29 | 147.596 | 169.120 | 193.300 | 14.30% | 2.24 |
| -28 | 138.971 | 158.941 | 181.327 | 14.08% | 2.22 |
| -27 | 130.906 | 149.441 | 170.174 | 13.87% | 2.20 |
| -26 | 123.362 | 140.571 | 159.779 | 13.66% | 2.19 |
| -25 | 116.302 | 132.284 | 150.086 | 13.46% | 2.17 |
| -24 | 109.676 | 124.522 | 141.024 | 13.25% | 2.15 |
| -23 | 103.472 | 117.266 | 132.568 | 13.05% | 2.13 |
| -22 | 97.658 | 110.480 | 124.673 | 12.85% | 2.12 |
| -21 | 92.209 | 104.130 | 117.298 | 12.65% | 2.10 |
| -20 | 87.098 | 98.185 | 110.407 | 12.45% | 2.08 |
| -19 | 82.304 | 92.618 | 103.965 | 12.25% | 2.06 |
| -18 | 77.804 | 87.402 | 97.939 | 12.06% | 2.05 |
| -17 | 73.578 | 82.513 | 92.301 | 11.86% | 2.03 |
| -16 | 69.609 | 77.927 | 87.022 | 11.67% | 2.01 |
| -15 | 65.878 | 73.626 | 82.079 | 11.48% | 1.99 |
| -14 | 62.371 | 69.588 | 77.446 | 11.29% | 1.97 |
| -13 | 59.073 | 65.797 | 73.105 | 11.11% | 1.95 |
| -12 | 55.969 | 62.237 | 69.033 | 10.92% | 1.94 |
| -11 | 53.048 | 58.890 | 65.213 | 10.74% | 1.92 |
| -10 | 50.297 | 55.744 | 61.628 | 10.55% | 1.90 |
| -9 | 47.705 | 52.786 | 58.262 | 10.37% | 1.88 |
| -8 | 45.263 | 50.002 | 55.100 | 10.19% | 1.86 |
| -7 | 42.961 | 47.382 | 52.128 | 10.02% | 1.84 |
| -6 | 40.790 | 44.916 | 49.335 | 9.84% | 1.82 |
| -5 | 38.741 | 42.592 | 46.709 | 9.67% | 1.80 |
| -4 | 36.805 | 40.400 | 44.234 | 9.49% | 1.78 |
| -3 | 34.978 | 38.333 | 41.906 | 9.32% | 1.76 |
| -2 | 33.252 | 36.385 | 39.714 | 9.15% | 1.74 |
| -1 | 31.622 | 34.548 | 37.649 | 8.98% | 1.72 |
| 0 | 30.081 | 32.814 | 35.705 | 8.81% | 1.70 |
| 1 | 28.627 | 31.179 | 33.874 | 8.64% | 1.68 |

| | | | | | |
|----|--------|--------|--------|-------|------|
| 2 | 27.251 | 29.636 | 32.148 | 8.48% | 1.66 |
| 3 | 25.950 | 28.178 | 30.520 | 8.31% | 1.64 |
| 4 | 24.718 | 26.800 | 28.984 | 8.15% | 1.61 |
| 5 | 23.551 | 25.497 | 27.534 | 7.99% | 1.59 |
| 6 | 22.445 | 24.263 | 26.162 | 7.83% | 1.57 |
| 7 | 21.397 | 23.096 | 24.867 | 7.67% | 1.55 |
| 8 | 20.404 | 21.992 | 23.644 | 7.51% | 1.53 |
| 9 | 19.463 | 20.947 | 22.487 | 7.36% | 1.51 |
| 10 | 18.571 | 19.958 | 21.394 | 7.20% | 1.48 |
| 11 | 17.725 | 19.022 | 20.362 | 7.05% | 1.46 |
| 12 | 16.923 | 18.135 | 19.385 | 6.89% | 1.44 |
| 13 | 16.162 | 17.294 | 18.460 | 6.74% | 1.42 |
| 14 | 15.439 | 16.498 | 17.585 | 6.59% | 1.39 |
| 15 | 14.753 | 15.742 | 16.756 | 6.44% | 1.37 |
| 16 | 14.101 | 15.025 | 15.970 | 6.29% | 1.35 |
| 17 | 13.481 | 14.345 | 15.226 | 6.14% | 1.33 |
| 18 | 12.892 | 13.699 | 14.521 | 6.00% | 1.30 |
| 19 | 12.332 | 13.086 | 13.852 | 5.85% | 1.28 |
| 20 | 11.800 | 12.504 | 13.218 | 5.71% | 1.26 |
| 21 | 11.293 | 11.951 | 12.616 | 5.56% | 1.23 |
| 22 | 10.811 | 11.426 | 12.045 | 5.42% | 1.21 |
| 23 | 10.352 | 10.926 | 11.503 | 5.28% | 1.18 |
| 24 | 9.916 | 10.452 | 10.989 | 5.14% | 1.16 |
| 25 | 9.500 | 10.000 | 10.500 | 5.00% | 1.14 |
| 26 | 9.080 | 9.570 | 10.062 | 5.14% | 1.17 |
| 27 | 8.681 | 9.162 | 9.645 | 5.28% | 1.21 |
| 28 | 8.301 | 8.773 | 9.247 | 5.41% | 1.25 |
| 29 | 7.940 | 8.402 | 8.868 | 5.55% | 1.29 |
| 30 | 7.597 | 8.049 | 8.507 | 5.69% | 1.33 |
| 31 | 7.271 | 7.713 | 8.162 | 5.82% | 1.37 |
| 32 | 6.960 | 7.393 | 7.834 | 5.96% | 1.41 |
| 33 | 6.665 | 7.088 | 7.520 | 6.09% | 1.45 |
| 34 | 6.383 | 6.797 | 7.220 | 6.22% | 1.49 |
| 35 | 6.115 | 6.520 | 6.934 | 6.36% | 1.54 |
| 36 | 5.860 | 6.255 | 6.661 | 6.49% | 1.58 |
| 37 | 5.616 | 6.003 | 6.400 | 6.62% | 1.62 |
| 38 | 5.384 | 5.762 | 6.151 | 6.75% | 1.66 |
| 39 | 5.163 | 5.532 | 5.913 | 6.88% | 1.70 |
| 40 | 4.952 | 5.313 | 5.685 | 7.01% | 1.75 |
| 41 | 4.751 | 5.103 | 5.467 | 7.14% | 1.79 |
| 42 | 4.559 | 4.903 | 5.259 | 7.27% | 1.83 |
| 43 | 4.376 | 4.711 | 5.060 | 7.40% | 1.88 |
| 44 | 4.201 | 4.529 | 4.869 | 7.53% | 1.92 |
| 45 | 4.034 | 4.354 | 4.687 | 7.65% | 1.96 |
| 46 | 3.875 | 4.187 | 4.512 | 7.78% | 2.01 |
| 47 | 3.723 | 4.027 | 4.345 | 7.90% | 2.05 |

| | | | | | |
|----|-------|-------|-------|--------|------|
| 48 | 3.577 | 3.874 | 4.185 | 8.03% | 2.10 |
| 49 | 3.438 | 3.728 | 4.032 | 8.15% | 2.14 |
| 50 | 3.306 | 3.588 | 3.885 | 8.28% | 2.19 |
| 51 | 3.179 | 3.454 | 3.745 | 8.40% | 2.23 |
| 52 | 3.057 | 3.326 | 3.610 | 8.53% | 2.28 |
| 53 | 2.941 | 3.203 | 3.480 | 8.65% | 2.33 |
| 54 | 2.830 | 3.086 | 3.356 | 8.77% | 2.37 |
| 55 | 2.723 | 2.973 | 3.237 | 8.89% | 2.42 |
| 56 | 2.621 | 2.865 | 3.123 | 9.01% | 2.47 |
| 57 | 2.524 | 2.761 | 3.014 | 9.13% | 2.51 |
| 58 | 2.430 | 2.662 | 2.908 | 9.25% | 2.56 |
| 59 | 2.341 | 2.567 | 2.807 | 9.37% | 2.61 |
| 60 | 2.255 | 2.476 | 2.711 | 9.49% | 2.66 |
| 61 | 2.173 | 2.388 | 2.618 | 9.61% | 2.71 |
| 62 | 2.095 | 2.304 | 2.528 | 9.73% | 2.76 |
| 63 | 2.019 | 2.224 | 2.443 | 9.84% | 2.81 |
| 64 | 1.947 | 2.146 | 2.360 | 9.96% | 2.85 |
| 65 | 1.878 | 2.072 | 2.281 | 10.08% | 2.90 |
| 66 | 1.811 | 2.001 | 2.205 | 10.19% | 2.95 |
| 67 | 1.747 | 1.932 | 2.131 | 10.31% | 3.00 |
| 68 | 1.686 | 1.866 | 2.061 | 10.42% | 3.05 |
| 69 | 1.627 | 1.803 | 1.993 | 10.54% | 3.11 |
| 70 | 1.570 | 1.742 | 1.927 | 10.65% | 3.16 |
| 71 | 1.516 | 1.684 | 1.865 | 10.76% | 3.21 |
| 72 | 1.464 | 1.628 | 1.805 | 10.88% | 3.26 |
| 73 | 1.414 | 1.574 | 1.747 | 10.99% | 3.31 |
| 74 | 1.366 | 1.522 | 1.691 | 11.10% | 3.36 |
| 75 | 1.320 | 1.472 | 1.637 | 11.21% | 3.42 |
| 76 | 1.276 | 1.424 | 1.585 | 11.32% | 3.47 |
| 77 | 1.233 | 1.378 | 1.535 | 11.43% | 3.52 |
| 78 | 1.192 | 1.333 | 1.487 | 11.54% | 3.58 |
| 79 | 1.153 | 1.290 | 1.441 | 11.65% | 3.63 |
| 80 | 1.115 | 1.249 | 1.396 | 11.76% | 3.68 |
| 81 | 1.078 | 1.209 | 1.353 | 11.87% | 3.74 |
| 82 | 1.043 | 1.171 | 1.311 | 11.98% | 3.79 |
| 83 | 1.009 | 1.134 | 1.271 | 12.09% | 3.85 |
| 84 | 0.977 | 1.099 | 1.233 | 12.19% | 3.90 |
| 85 | 0.946 | 1.065 | 1.196 | 12.30% | 3.96 |
| 86 | 0.915 | 1.032 | 1.160 | 12.40% | 4.01 |
| 87 | 0.886 | 1.000 | 1.125 | 12.51% | 4.07 |
| 88 | 0.858 | 0.969 | 1.091 | 12.62% | 4.12 |
| 89 | 0.832 | 0.940 | 1.059 | 12.72% | 4.18 |
| 90 | 0.806 | 0.911 | 1.028 | 12.82% | 4.24 |
| 91 | 0.780 | 0.884 | 0.998 | 12.93% | 4.30 |
| 92 | 0.756 | 0.857 | 0.969 | 13.03% | 4.35 |
| 93 | 0.733 | 0.831 | 0.941 | 13.13% | 4.41 |

| | | | | | |
|-----|-------|-------|-------|--------|------|
| 94 | 0.711 | 0.807 | 0.913 | 13.24% | 4.47 |
| 95 | 0.689 | 0.783 | 0.887 | 13.34% | 4.53 |
| 96 | 0.668 | 0.760 | 0.862 | 13.44% | 4.58 |
| 97 | 0.648 | 0.738 | 0.837 | 13.54% | 4.64 |
| 98 | 0.629 | 0.716 | 0.814 | 13.64% | 4.70 |
| 99 | 0.610 | 0.695 | 0.791 | 13.74% | 4.76 |
| 100 | 0.592 | 0.675 | 0.769 | 13.84% | 4.82 |
| 101 | 0.574 | 0.656 | 0.748 | 13.94% | 4.88 |
| 102 | 0.558 | 0.637 | 0.727 | 14.04% | 4.94 |
| 103 | 0.541 | 0.619 | 0.707 | 14.14% | 5.00 |
| 104 | 0.526 | 0.602 | 0.688 | 14.24% | 5.06 |
| 105 | 0.510 | 0.585 | 0.669 | 14.33% | 5.12 |
| 106 | 0.496 | 0.569 | 0.651 | 14.43% | 5.18 |
| 107 | 0.481 | 0.553 | 0.633 | 14.53% | 5.25 |
| 108 | 0.468 | 0.538 | 0.616 | 14.62% | 5.31 |
| 109 | 0.455 | 0.523 | 0.600 | 14.72% | 5.37 |
| 110 | 0.442 | 0.508 | 0.584 | 14.82% | 5.43 |
| 111 | 0.429 | 0.495 | 0.568 | 14.91% | 5.50 |
| 112 | 0.417 | 0.481 | 0.553 | 15.01% | 5.56 |
| 113 | 0.406 | 0.468 | 0.539 | 15.10% | 5.62 |
| 114 | 0.394 | 0.456 | 0.525 | 15.20% | 5.69 |
| 115 | 0.384 | 0.443 | 0.511 | 15.29% | 5.75 |
| 116 | 0.373 | 0.432 | 0.498 | 15.38% | 5.81 |
| 117 | 0.363 | 0.420 | 0.485 | 15.47% | 5.88 |
| 118 | 0.353 | 0.409 | 0.473 | 15.57% | 5.94 |
| 119 | 0.344 | 0.399 | 0.461 | 15.66% | 6.01 |
| 120 | 0.334 | 0.388 | 0.449 | 15.75% | 6.07 |
| 121 | 0.326 | 0.378 | 0.438 | 15.84% | 6.14 |
| 122 | 0.317 | 0.368 | 0.427 | 15.93% | 6.20 |
| 123 | 0.309 | 0.359 | 0.416 | 16.02% | 6.27 |
| 124 | 0.300 | 0.350 | 0.406 | 16.11% | 6.34 |
| 125 | 0.293 | 0.341 | 0.396 | 16.20% | 6.40 |