



# 晶体管光耦 Photo Transistor

## AT816X

### Product Data Sheet

AOTE DCC  
RELEASE

台湾奥特半导体科技有限公司

TAIWAN AOTE SEMICONDUCTOR TECHNOLOGY CO.,LTD

[www.aotesemi.com](http://www.aotesemi.com)

## 概述 Description

AT816X是一款由发光二极管和光电晶体管组成的光电耦合器。四引脚封装，三种形式（DIP、DIP-M、SMD）。

The AT816X is a photoelectric coupler composed of light-emitting diode and phototransistor. It is packaged in a 4-pin package of three forms such as DIP、DIP-M、SMD.

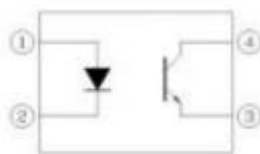
## 特性 Features

- 电流转换比(CTR)范围: CTR : 50% ( $I_F = 5\text{mA}$ ,  $V_{CE} = 5\text{V}$ )  
Current transfer ratio: CTR : 50% ( $I_F = 5\text{mA}$ ,  $V_{CE} = 5\text{V}$ )
- 高输入-输出隔离电压 ( $V_{ISO} = 5000\text{ Vrms}$ )  
High isolation voltage between input and output ( $V_{ISO} = 5000\text{ Vrms}$ )
- 工作温度:  $-55^\circ\text{C} \sim 110^\circ\text{C}$   
Operating Temperature:  $-55^\circ\text{C} \sim 110^\circ\text{C}$
- 符合安规标准: UL 1577, VDE DIN EN60747-5-5 (VDE 0884-5), CQC11-471543-2022  
Meet safety standard approval: UL 1577, VDE DIN EN60747-5-5 (VDE 0884-5), CQC11-471543-2022
- RoHs
- MLS1

## 应用 Applications

- 开关电源，智能电表  
Switching power supply, intelligent meter
- 可编程控制器  
Programmable controllers
- 家用电器，比如空调、风扇、热水器等  
Household appliances: such as air conditioners, fans, water heaters, etc.

## 封装和原理图 Package and Schematic Diagram



Pin Configuration

- 1. Anode
- 2. Cathode
- 3. Emitter
- 4. Collector

## 产品型号命名规则 Order Code

# AT 816 X- UN Y - W (V) (ZZ)

①      ②      ③      ④      ⑤      ⑥      ⑦      ⑧

- ① 公司代码 Company Code ( AT: 奥特 AOTE )
- ② 产品系列 Product Series ( 816 : 816 )
- ③ CTR档位 Classification (代码 Code: C or D)
- ④ 框架类型 Lead Frame ( Cu: 铜框架 Copper , Fe : 铁框架 Ferrum )
- ⑤ 树脂类型 Epoxy Type ( H: 无卤 Halogen-free )
- ⑥ 封装形式 Package ( D:DIP,S:SMD,M:DIP-M )
- ⑦ 细分档位 Subdivision Code ( T : D1 , Y : D2)
- ⑧ 内部补充代码 Internal Supplementary Code ( 数字或者空白 Number or None )

## 印字信息 Marking Information

- 印字中 “” 为奥特品牌 LOGO  
 “” denotes LOGO
- 印字中 “Y” 代表年份: A(2018), B(2019), C(2020).....  
 “Y” denotes YEAR : A(2018), B(2019), C(2020).....
- 印字中 “WW” 代表周号  
 “WW” denotes Week' s number
- 印字中 “N” 代表星期几  
 “N” denotes the day of the week
- 印字中的 “H” 代表无卤  
 “H” denotes Halogen-free



## 绝缘和安规信息 Insulation and Safety related specifications

| 项目<br>Item                            | 符号<br>Symbol      | 数值<br>Value | 单位<br>Unit        | 备注<br>Remark                                                                                               |
|---------------------------------------|-------------------|-------------|-------------------|------------------------------------------------------------------------------------------------------------|
| 爬电距离<br>Creepage Distance             | L                 | >7.0        | mm                | 从输入端到输出端，沿本体最短距离路径<br>Measured from input terminals to output terminals, shortest distance path along body |
| 电气间隙<br>Clearance Distance            | L                 | >7.0        | mm                | 从输入端到输出端，通过空气的最短距离<br>Measured from input terminals to output terminals, shortest distance through air     |
| 绝缘距离<br>Insulation Thickness          | DTI               | >0.4        | mm                | 发射器和探测器之间的绝缘厚度<br>Insulation thickness between emitter and detector                                        |
| 峰值隔离电压<br>Peak Isolation Voltage      | V <sub>IORM</sub> | 1500        | V <sub>peak</sub> | DIN/EN/IEC EN60747-5-5                                                                                     |
| 瞬态隔离电压<br>Transient isolation voltage | V <sub>IOTM</sub> | 7000        | V <sub>peak</sub> | DIN/EN/IEC EN60747-5-5                                                                                     |
| 隔离电压<br>Isolation Voltage             | V <sub>iso</sub>  | >5000       | V <sub>rms</sub>  | For 1 min, RH < 60%                                                                                        |

## 极限参数 Absolute Maximum Ratings (TA = 25°C)

| 参数<br>Parameter                |                                                      | 符号<br>Symbol     | 额定值<br>Rating | 单位<br>Unit       |
|--------------------------------|------------------------------------------------------|------------------|---------------|------------------|
| 发射端<br>Input                   | 正向电流<br>Forward Current                              | I <sub>F</sub>   | 50            | mA               |
|                                | 反向电压<br>Reverse Voltage                              | V <sub>R</sub>   | 6             | V                |
|                                | 峰值正向电流(1us, 脉冲)<br>Peak forward current (1us, pulse) | I <sub>FP</sub>  | 1000          | mA               |
|                                | 功耗<br>Power Dissipation                              | P <sub>D</sub>   | 70            | mW               |
| 接收端<br>output                  | 集电极功耗<br>Collector Power Dissipation                 | P <sub>C</sub>   | 50            | mW               |
|                                | 集电极电流<br>Collector Current                           | I <sub>C</sub>   | 150           | mA               |
|                                | 集电极-发射极电压<br>Collector-Emitter Voltage               | V <sub>CEO</sub> | 80            | V                |
|                                | 发射极-集电极电压<br>Emitter-Collector Voltage               | V <sub>ECO</sub> | 7             | V                |
| 总功耗<br>Total Power Dissipation |                                                      | P <sub>tot</sub> | 200           | mW               |
| 隔离电压<br>Isolation Voltage      |                                                      | V <sub>iso</sub> | 5000          | V <sub>rms</sub> |
| 工作温度<br>Operating Temperature  |                                                      | T <sub>opr</sub> | -55~+110      | °C               |
| 存储温度<br>Storage Temperature    |                                                      | T <sub>stg</sub> | -55~+125      | °C               |
| 焊接温度<br>Soldering Temperature  |                                                      | T <sub>sol</sub> | 260           | °C               |

**产品特性参数 Electro-optical Characteristics ( $T_A = 25^{\circ}\text{C}$ )**

|                                     | 参数<br>Parameter                                     | 符号<br>Symbol  | 条件<br>Condition                                                      | 最小<br>Min.         | 典型<br>Typ. | 最大<br>Max. | 单位<br>Unit    |
|-------------------------------------|-----------------------------------------------------|---------------|----------------------------------------------------------------------|--------------------|------------|------------|---------------|
| 发射端<br>Input                        | 正向电压<br>Forward Voltage                             | $V_F$         | $I_F = 20\text{mA}$                                                  | 1.2                | -          | 1.4        | V             |
|                                     | 反向电流<br>Reverse Current                             | $I_R$         | $V_R = 4\text{V}$                                                    | -                  | -          | 10         | $\mu\text{A}$ |
|                                     | 终端电容<br>Terminal Capacitance                        | $C_t$         | $V=0, F=1\text{kHz}$                                                 | -                  | 30         | 250        | pF            |
| 接收端<br>Output                       | 集电极暗电流<br>Collector Dark Current                    | $I_{CEO}$     | $V_{CE} = 20\text{V}$                                                | -                  | -          | 100        | nA            |
|                                     | 集电极-发射极击穿电压<br>Collector-Emitter Breakdown Voltage  | $BV_{CEO}$    | $I_C = 0.1\text{mA}, I_F = 0$                                        | 80                 | -          | -          | V             |
|                                     | 发射极-集电极击穿电压<br>Emitter-Collector Breakdown Voltage  | $BV_{ECO}$    | $I_E = 10\mu\text{A}, I_F = 0$                                       | 7                  | -          | -          | V             |
| 传输特性<br>Transfer<br>Characteristics | 电流传输比<br>Current Transfer Ratio                     | CTR*          | $I_F = 5\text{mA}, V_{CE} = 5\text{V}$                               | 200                | -          | 600        | %             |
|                                     | 集电极-发射极饱和压降<br>Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_F = 1\text{mA}, I_C = 1\text{mA}$                                 | -                  | -          | 0.4        | V             |
|                                     | 隔离电阻<br>Isolation Resistance                        | $R_{SO}$      | DC500V, 40 ~ 60% R.H.                                                | $1 \times 10^{12}$ | -          | -          | $\Omega$      |
|                                     | 隔离电容<br>Isolation capacitance                       | $C_{ISO}$     | $V=0, F=1\text{MHz}$                                                 | -                  | 0.6        | 1.0        | pF            |
|                                     | 截至频率<br>Cut-off Frequency                           | $F_c$         | $V_{CE} = 5\text{V}, I_C = 2\text{mA}, R_L = 100\Omega, -3\text{dB}$ | -                  | 80         | -          | KHz           |
|                                     | 上升时间<br>Rise Time                                   | $T_r$         | $V_{CE} = 10\text{V}, I_C = 2\text{mA}, R_L = 100\Omega$             | 4                  | -          | 18         | $\mu\text{s}$ |
|                                     | 下降时间<br>Fall Time                                   | $T_f$         | $V_{CE} = 10\text{V}, I_C = 2\text{mA}, R_L = 100\Omega$             | 3                  | -          | 18         | $\mu\text{s}$ |
|                                     | 导通时间<br>Turn on time                                | $T_{on}$      | $V_{CE} = 10\text{V}, I_C = 2\text{mA}, R_L = 100\Omega$             | -                  | -          | 12         | $\mu\text{s}$ |
|                                     | 关断时间<br>Turn off time                               | $T_{off}$     | $V_{CE} = 10\text{V}, I_C = 2\text{mA}, R_L = 100\Omega$             | -                  | -          | 12         | $\mu\text{s}$ |

注\* : 电流传输比  $= I_C / I_F \times 100\%$ .

Note\* :  $CTR = I_C / I_F \times 100\%$ .

**电流传输比分档表 CTR classification Table ( $V_{CE} = 5\text{V}, T_A = 25^{\circ}\text{C}$ )**

| 代码 code                            | 分档 classification | 符号 Symbol | 条件 condition                           | 最小值 Min | 最大值 Max |
|------------------------------------|-------------------|-----------|----------------------------------------|---------|---------|
| 电流传输比<br>Current Transfer<br>Ratio | 无                 | CTR       | $I_F = 5\text{mA}, V_{CE} = 5\text{V}$ | 50      | 600     |
|                                    | A                 |           |                                        | 80      | 160     |
|                                    | B                 |           |                                        | 130     | 260     |
|                                    | C                 |           |                                        | 200     | 400     |
|                                    | D                 |           |                                        | 300     | 600     |

## 典型光电特性曲线 Typical Electro-Optical Characteristics Curves

Fig.1 Relative Current Transfer Ratio vs. Forward Current

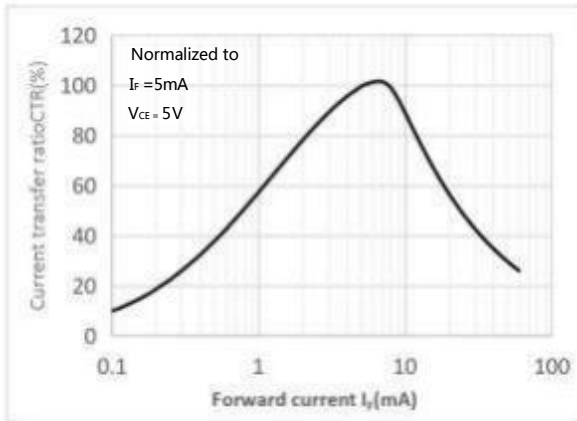


Fig.2 Forward Current vs. Forward Voltage

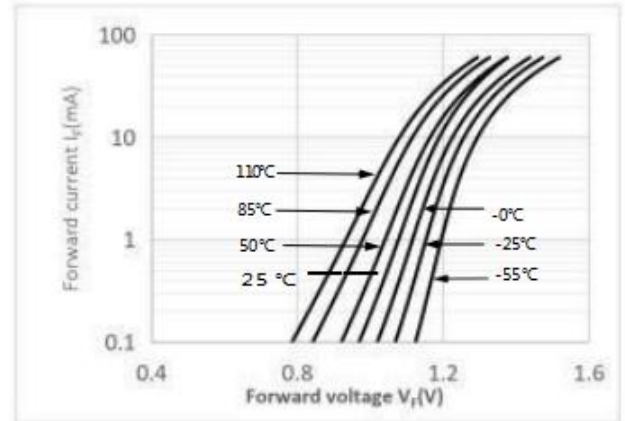


Fig.3 Collector Current vs. Collector-emitter Voltage

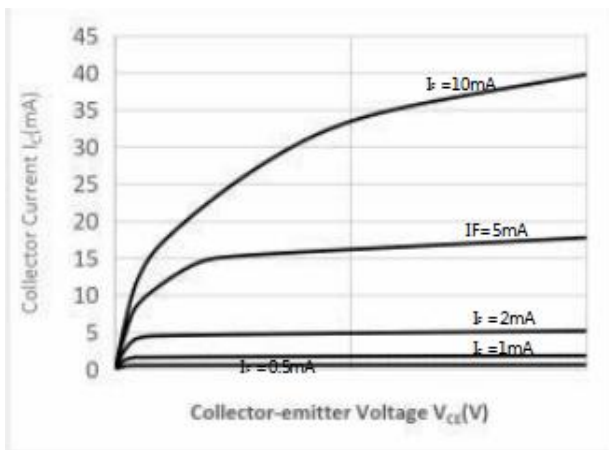


Fig.4 Relative Current Transfer Ratio vs. Ambient Temperature

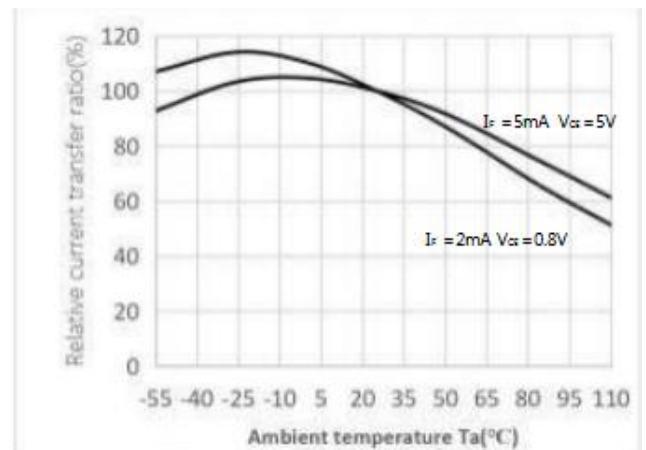


Fig.5 Collector-emitter Saturation Voltage vs. Ambient Temperature

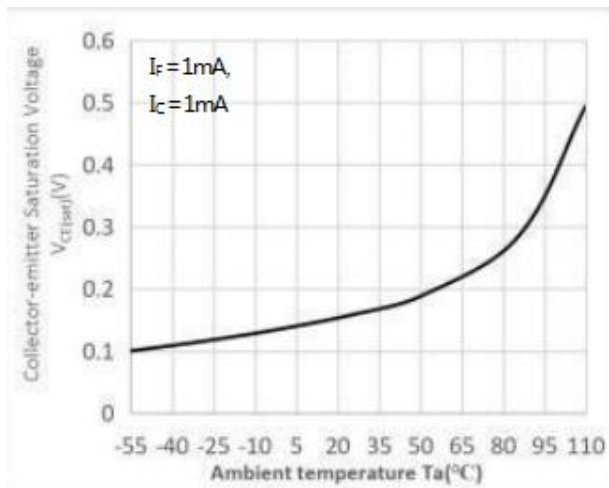


Fig.6 Collector Dark Current vs Ambient Temperature

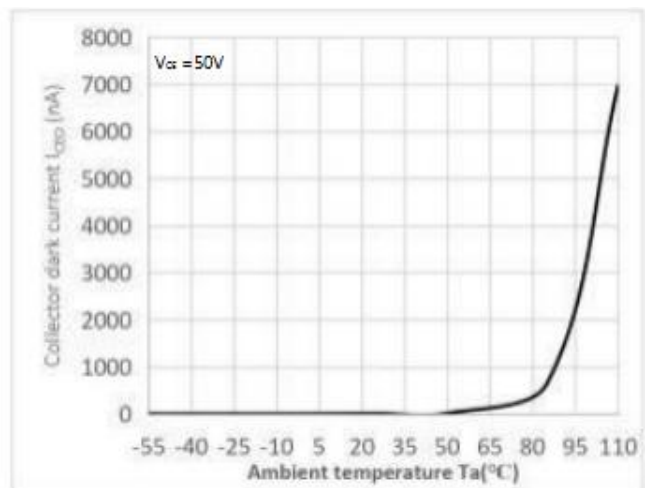


Fig.7 Response Time vs. Load Resistance

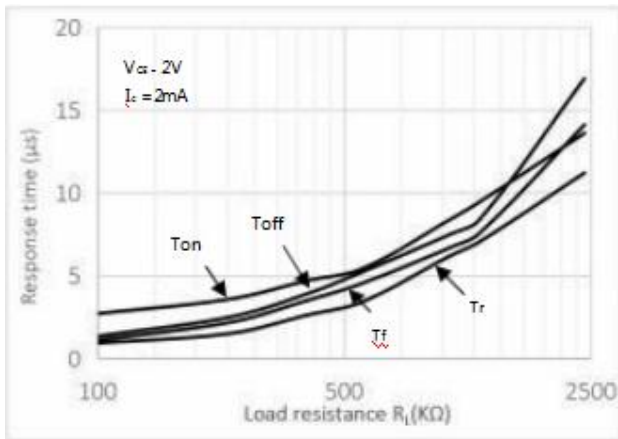


Fig.8 Frequency Response

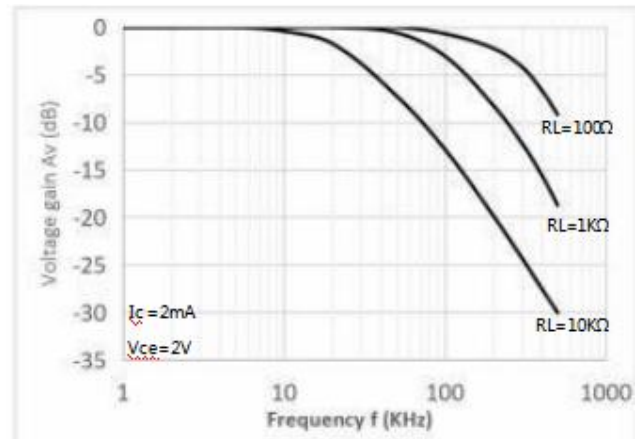


Fig.9 Collector-emitter Saturation Voltage vs Forward Current

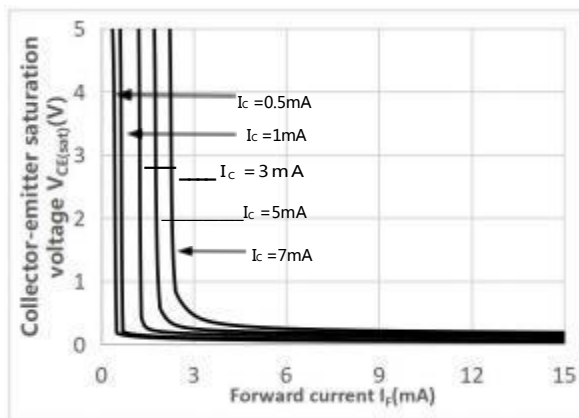
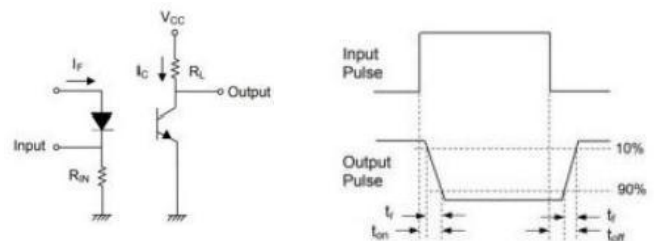
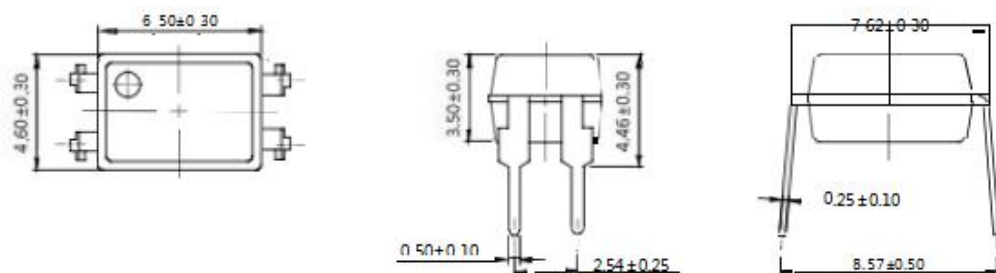


Fig.10 Switching Time Test Circuit & Waveforms

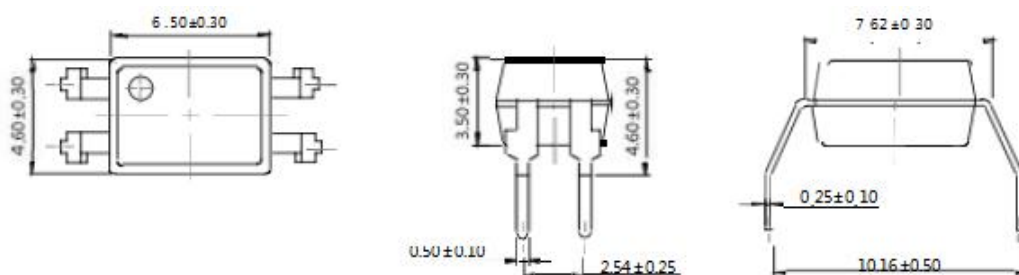


## 外形尺寸 Outline Dimensions

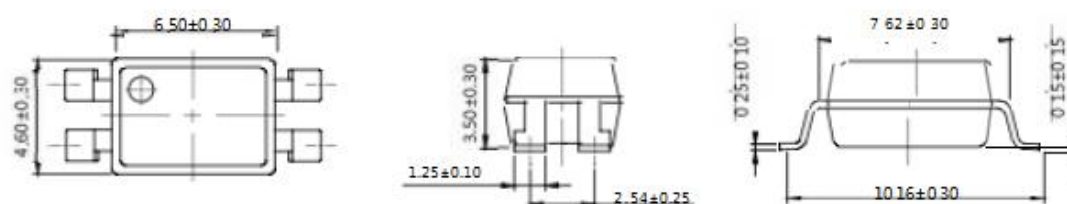
**DIP4**



**DIP4-M**

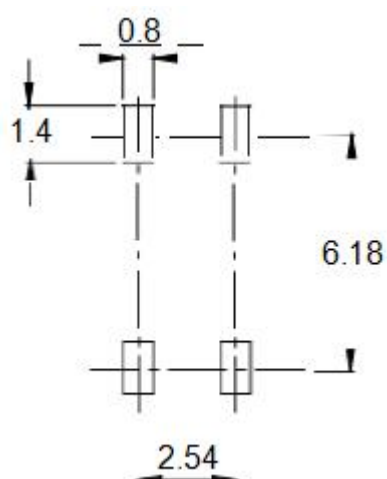


**SMD4**



单位 Unit: mm

## 建议焊盘布局 Recommended Pad Layout

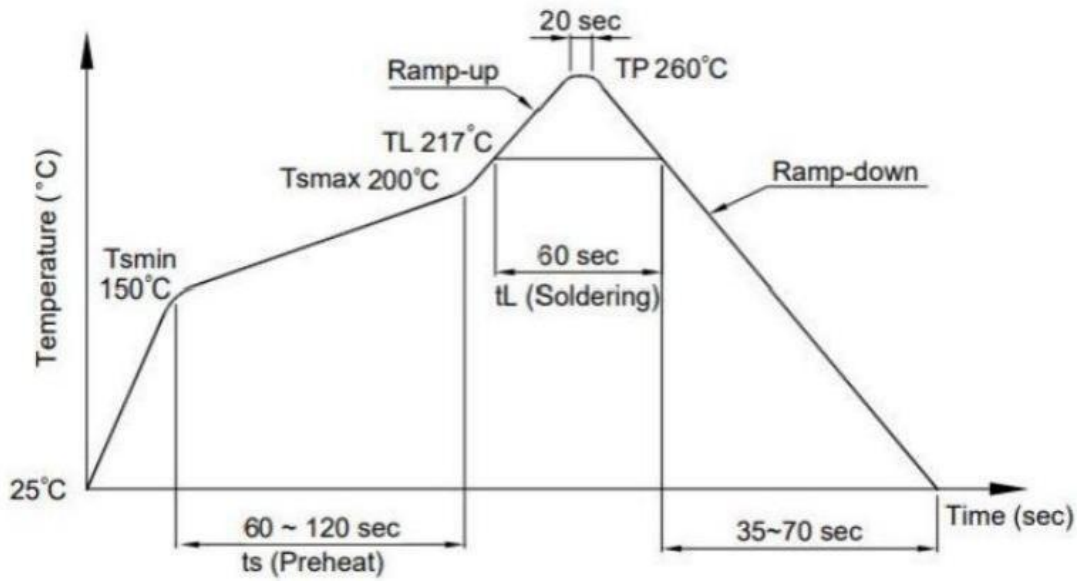


单位 Unit: mm

注：上图为产品正视图。

Note: The picture above is the front view of the product

## 回流焊温度曲线图 Solder Reflow Profile

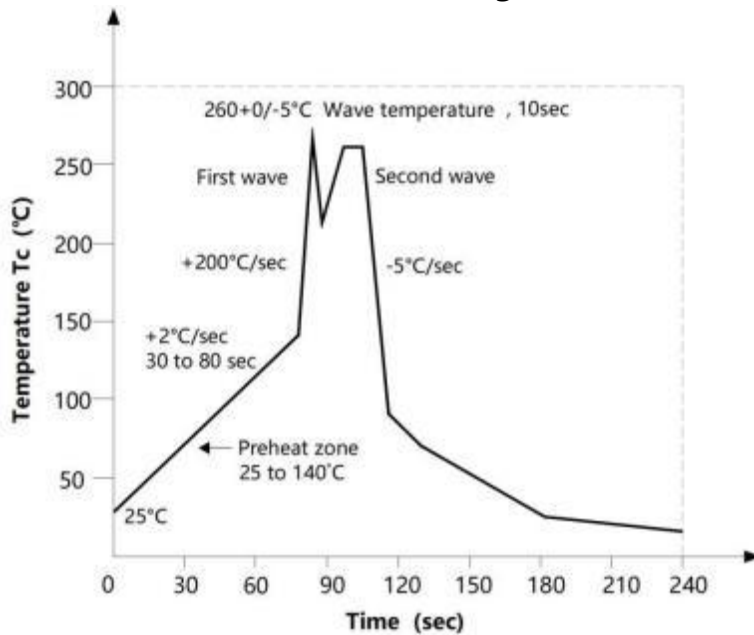


| 项目<br>Item                                                                                  | 符号<br>Symbol | 最小值<br>Min. | 最大值<br>Max. | 单位<br>Unit |
|---------------------------------------------------------------------------------------------|--------------|-------------|-------------|------------|
| 预热温度<br>Preheat Temperature                                                                 | $T_s$        | 150         | 200         | °C         |
| 预热时间<br>Preheat Time                                                                        | $t_s$        | 60          | 120         | s          |
| 升温速率<br>Ramp-Up Rate ( $T_L$ to $T_P$ )                                                     | -            | -           | 3           | °C/s       |
| 液相线温度<br>Liquidus Temperature                                                               | $T_L$        | 217         |             | °C         |
| 时间高于 $T_L$<br>Time Above $T_L$                                                              | $t_L$        | 60          | 150         | s          |
| 峰值温度<br>Peak Temperature                                                                    | $T_P$        | -           | 260         | °C         |
| $T_C$ 在( $T_P-5$ )和 $T_P$ 之间的时间<br>Time During Which $T_C$ Is Between ( $T_P-5$ ) and $T_P$ | $t_p$        | -           | 30          | s          |
| 降温速率<br>Ramp-down Rate( $T_P$ to $T_L$ )                                                    | -            | 3           | 6           | °C/s       |

注：建议在所示的温度和时间条件下进行回流焊，最多不能超过三次。

Note: Reflow soldering is recommended at the temperatures and times shown, no more than three times.

## 波峰焊温度曲线图 Wave Soldering Profile



## 手工烙铁焊接 Soldering with hand soldering iron

- A. 手工烙铁焊仅用于产品返修或样品测试；  
Hand soldering iron is only used for product rework or sample testing;
- B. 手工烙铁焊要求：温度  $360^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ，时间  $\leq 3\text{s}$ 。  
Manual soldering method Temperature:  $360^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , within 3s.

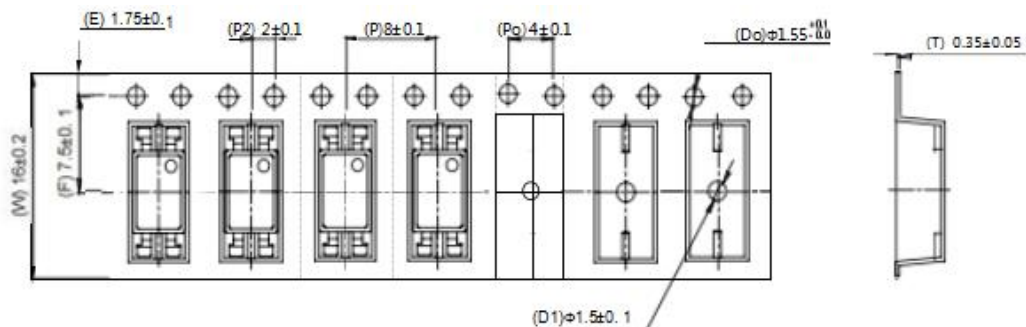
## 包装 Packing

### ■ 汇总表 Summary table

| 封装式          | 包装方式                                | 盘数量               | 盒数量              | 箱数量                 | 静电袋规格                      | 盒规格              | 箱(双瓦楞)规格             | 备注                                                                  |
|--------------|-------------------------------------|-------------------|------------------|---------------------|----------------------------|------------------|----------------------|---------------------------------------------------------------------|
| SMD4         | 卷盘<br>( $\phi 330\text{mm}$ 蓝盘)     | 1500 只/盘          | 2 盘/盒            | 10 盒/箱              | 450*390*0.1mm              | 340*60*340mm     | 620*360*365mm        | 首尾端空至少 200mm                                                        |
| DIP4         | 管装<br>(500*12*11mm)                 | 100 只/管           | 50 管/盒           | 10 盒/箱              | 不适用                        | 525*128*56mm     | 535*275*300mm        | 每管使用蓝白胶塞，<br>方向须一致                                                  |
| DIP4-M       | 管装<br>(500*13*11mm)                 | 100 只/管           | 50 管/盒           | 10 盒/箱              | 不适用                        | 525*136*58mm     | 535*295*310mm        |                                                                     |
| Package Type | packing Form                        | Quantity per Reel | Quantity per BOX | Quantity per carton | Atistatic Bag specifcation | Bbxspecification | carton specification | NIote                                                               |
| SMD4         | Reel<br>( $\phi 330\text{mm}$ Blue) | 1500 pcs/reel     | 2 reels/box      | 10 boxes/ctn        | 450*390*0.1mm              | 340*60*340mm     | 620*360*365mm        | Leave at least 200mm of blank space at both ends                    |
| DIP4         | Tube<br>(500*12*11mm)               | 100 pcs/tube      | 50 tubes/box     | 10 boxes/ctn        | NA                         | 525*128*56mm     | 535*275*300mm        | Use blue and white rubber plugs for each tube in the same direction |
| DIP4-M       | Tube<br>(500*13*11mm)               | 100 pcs/tube      | 50 tubes/box     | 10 boxes/ctn        | NA                         | 525*136*58mm     | 535*295*310mm        |                                                                     |

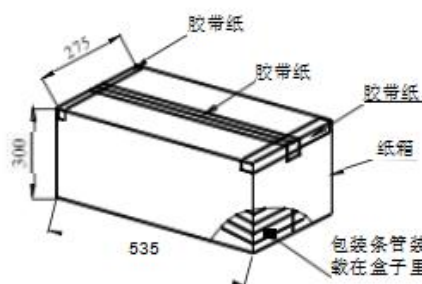
### ■ 编带包装 Tape & Reel

- 1) 每卷数量：1500 只。  
Qty/reel：2000 pcs.
- 2) 每箱数量：30000 只。  
Qty/ctn：30000 pcs.
- 3) 内包装：每盒 2 盘。  
Inner packing：2 reels/box.
- 4) 示意图 Schematic：



### ■ 管条包装 Tape & Tubel

- 1) 每管数量：100 只。  
Qty/Tube：100 pcs.
- 2) 每箱数量：50000 只。  
Qty/ctn：50000 pcs.
- 3) 内包装：每盒 50 管。  
Inner packing：50 Tube/box.
- 4) 示意图 Schematic：



单位 Unit：mm

单位 Unit：mm

## 注意 Attention

- 奥特持续不断改进质量、可靠性、功能或设计，保留此文件更改的权利恕不另行通知。  
AOTE continuously improve quality, reliability, function or design. We reserve the right to change this document without notice.
- 请遵守产品规格书使用，奥特不对使用时不符合产品规格书条件而导致的质量问题负责。  
Please use in accordance with the product specification. AOTE is not responsible for the quality problems caused by non-compliance with the product specifications.
- 对于需要高可靠性或安全性的设备/装置需求，请联系我们的销售人员。  
For equipment/devices where high reliability or safety is required, please contact our sales representatives.
- 当需要用于任何“特定”应用时，请咨询我们的销售人员。  
When requiring a device for any “specific” application, please contact our sales in advice.
- 如对文件中表述的内容有疑问，欢迎联系我们。  
If you have any questions about the contents of the document, please contact us.