

## **ZERO-CROSS TRIAC DRIVER PHOTOCOUPLER**

### **1. Product features**

- Peak breakdown voltage 400V
- High isolation voltage between inputs and output (Viso=5000 V rms)
- Zero voltage crossing
- Compliance with EU REACH
- Pb free and RoHS compliant
- Safety approval  
CQC approved (No. CQC23001407999)  
UL approved (No. UL-CA-2340753-0)

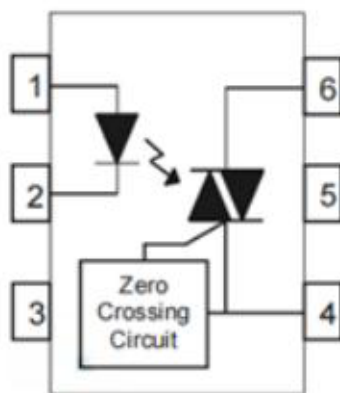
### **2. Product Description**

- The KL304X of devices each consist of a GaAs infrared emitting diode optically coupled to a monolithic silicon zero voltage crossing photo triac.
- It is designed for use with a discrete power triac in the interface of logic systems to equipment powered from 110 to 380 VAC lines, such as solid-state relays, industrial controls, motors, solenoids and consumer appliances.

### **3. Product Applications**

- Light controls, Solenoid/valve controls
- Static power switch, E.M. contactors
- AC motor drivers, AC Motor starters
- Temperature controls

### **4. Functional Diagram**



#### **Pin Configuration**

1. Anode
2. Cathode
3. No Connection
4. Terminal
5. Substrate (do not connect)
6. Terminal

## 5. Electrical-Optical characteristics

- Absolute Maximum Ratings( $T_a=25^{\circ}\text{C}$ )

| Parameter                    |                                                     | Symbol              | Rated Value | Unit                    |
|------------------------------|-----------------------------------------------------|---------------------|-------------|-------------------------|
| Input                        | Forward current                                     | $I_F$               | 60          | mA                      |
|                              | Reverse voltage                                     | $V_R$               | 6           | V                       |
|                              | Power dissipation                                   | $P_D$               | 100         | mW                      |
|                              | Derating factor (above $T_a = 85^{\circ}\text{C}$ ) |                     | 3.8         | mW / $^{\circ}\text{C}$ |
| Output                       | Off-state Output Terminal Voltage                   | $V_{\text{DRM}}$    | 400         | V                       |
|                              | Peak Repetitive Surge Current (pw=1ms,120pps)       | $I_{\text{TSM}}$    | 1           | A                       |
|                              | On-State RMS Current                                | $I_{\text{T(RMS)}}$ | 100         | mA                      |
|                              | Output Power dissipation                            | $P_C$               | 300         | mW                      |
|                              | Derating factor (above $T_a = 85^{\circ}\text{C}$ ) |                     | 7.6         | mW/ $^{\circ}\text{C}$  |
| Total Consume Power          |                                                     | $P_{\text{TOT}}$    | 330         | mW                      |
| Isolation Voltage ( 1* )     |                                                     | $V_{\text{iso}}$    | 5000        | Vrms                    |
| Operating temperature        |                                                     | $T_{\text{OPR}}$    | -55 to +100 | $^{\circ}\text{C}$      |
| Storage temperature          |                                                     | $T_{\text{STG}}$    | -55 to +125 | $^{\circ}\text{C}$      |
| Soldering temperature ( 2* ) |                                                     | $T_{\text{SOL}}$    | 260         | $^{\circ}\text{C}$      |

(Notes):

1\* AC for 1 minute, R.H.= 40 ~ 60% R.H. In this test, pins 1, 2&3 are shorted together, and pins 4, 5 & 6 are shorted together.

2\* Soldering time is 10 seconds

## 6. Electrical Characteristics(Ta=25°C unless specified otherwise)

| Parameter |                                                                       | Symbol            | Min. | Typ. | Max. | Unit             | Condition                                                                                          |
|-----------|-----------------------------------------------------------------------|-------------------|------|------|------|------------------|----------------------------------------------------------------------------------------------------|
| In put    | Forward voltage                                                       | $V_F$             | -    | -    | 1.5  | V                | $I_F=30\text{mA}$                                                                                  |
|           | Reverse current                                                       | $I_R$             | -    | -    | 10   | $\mu\text{A}$    | $V_R=6\text{V}$                                                                                    |
| Out put   | Peak Blocking Current                                                 | $I_{\text{DRM1}}$ | -    | -    | 100  | nA               | $V_{\text{DRM}} = \text{Rated } V_{\text{DRM}}$<br>$I_F = 0 \text{ mA } 2^*$                       |
|           | Peak On-state Voltage                                                 | $V_{\text{TM}}$   | -    | -    | 3    | V                | $I_{\text{TM}}=100 \text{ mA}$<br>peak,<br>$I_F=\text{Rated } I_{\text{FT}}$                       |
|           | Critical Rate of Rise off-state Voltage                               | $dv/dt$           | 1000 | -    | -    | V/ $\mu\text{s}$ | $V_{\text{PEAK}} = \text{Rated } V_{\text{DRM}}$ , $I_F=0\text{mA}$<br>(Fig. 10) 3*                |
|           | Inhibit Voltage (MT1-MT2 voltage above which device will not trigger) | $V_{\text{INH}}$  | -    | -    | 20   | V                | $I_F = \text{Rated } I_{\text{FT}}$                                                                |
|           | Leakage in Inhibited State                                            | $I_{\text{DRM2}}$ | -    | -    | 500  | $\mu\text{A}$    | $I_F = \text{Rated } I_{\text{FT}}$<br>$V_{\text{DRM}} = \text{Rated } V_{\text{DRM}}$ , off state |

• (Notes):

1\*. Typical values at Ta = 25°C

2\*. Test voltage must be applied within dv/dt rating

3\*. This is static dv/dt, Commutating dv/dt is a function of the load-driving thyristor(s) only

- Transfer Characteristics (Ta=25°C unless specified otherwise)

| Parameter           |        | Symbol   | Min. | Typ. | Max. | Unit | Condition                   |
|---------------------|--------|----------|------|------|------|------|-----------------------------|
| LED Trigger Current | KL3041 | $I_{FT}$ | -    | -    | 15   | mA   | Main terminal Voltage=3V 4* |
|                     | KL3042 |          | -    | -    | 10   |      |                             |
|                     | KL3043 |          | -    | -    | 5    |      |                             |
| Holding Current     |        | $I_H$    | -    | 280  | -    | uA   |                             |

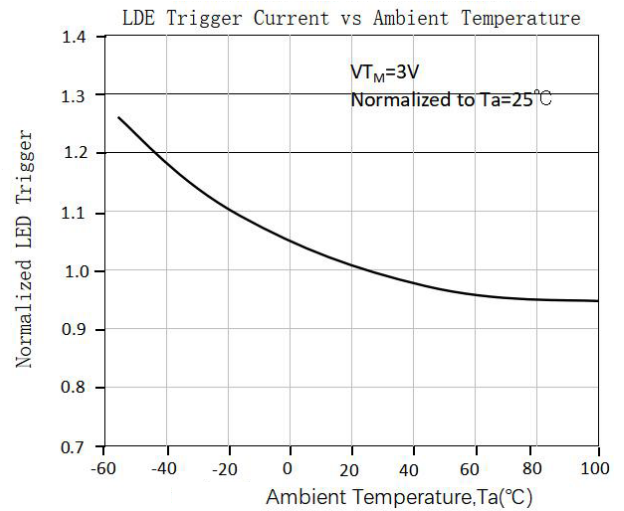
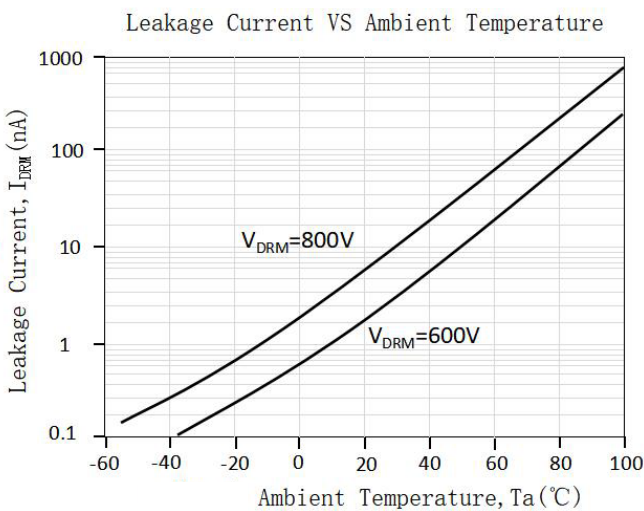
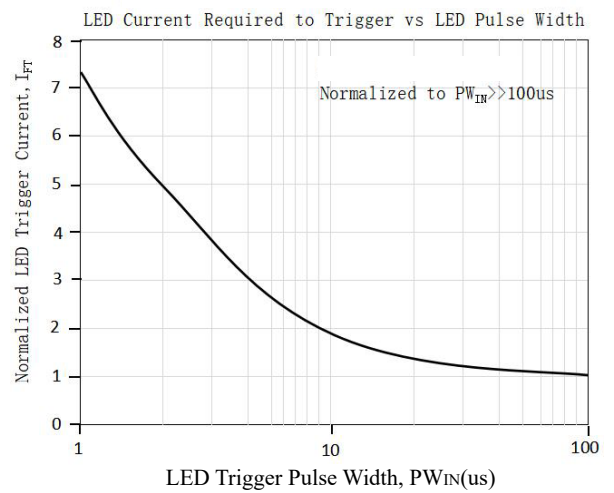
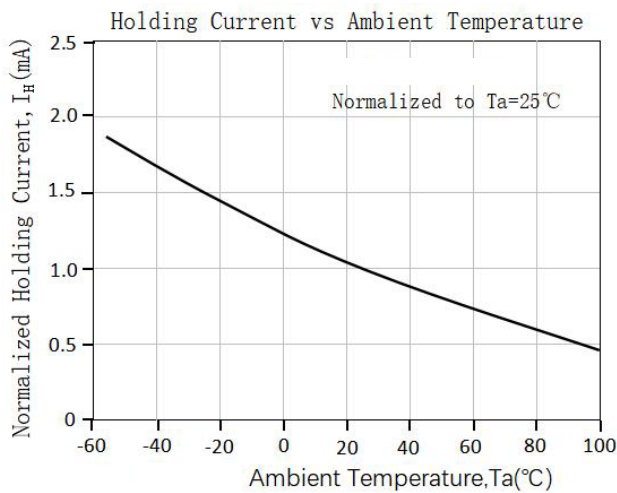
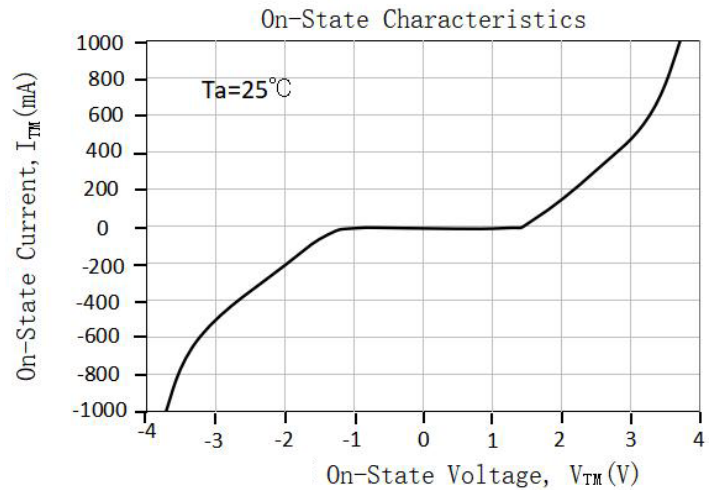
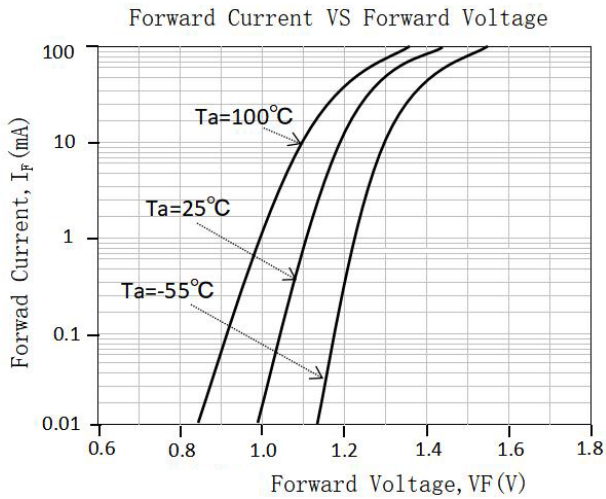
(Notes):

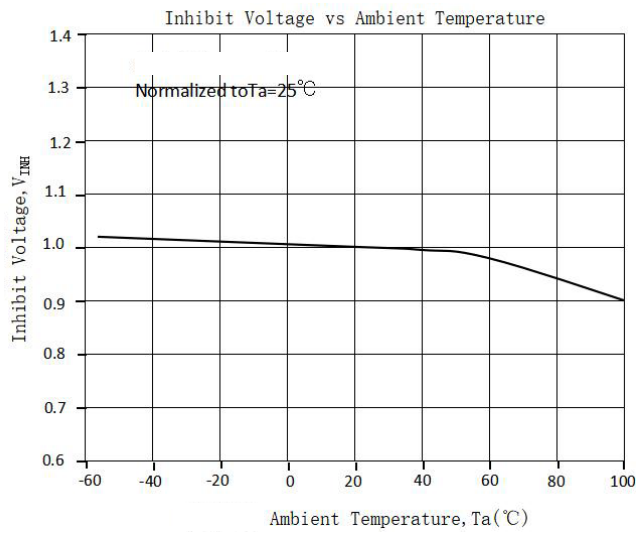
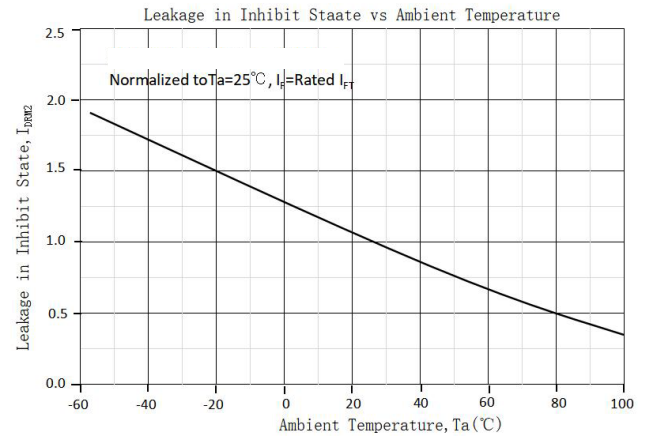
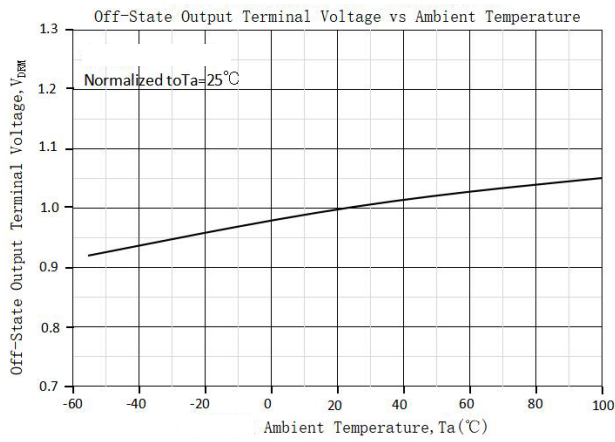
- 4\*. All devices are guaranteed to trigger at an IF value less than or equal to max IFT. Therefore, recommended operating IF lies between max IFT (15 mA for KL3041, 10 mA for KL3042, 5 mA for KL3043) and absolute maximum IF (60 mA)

## 7. Reliability Test

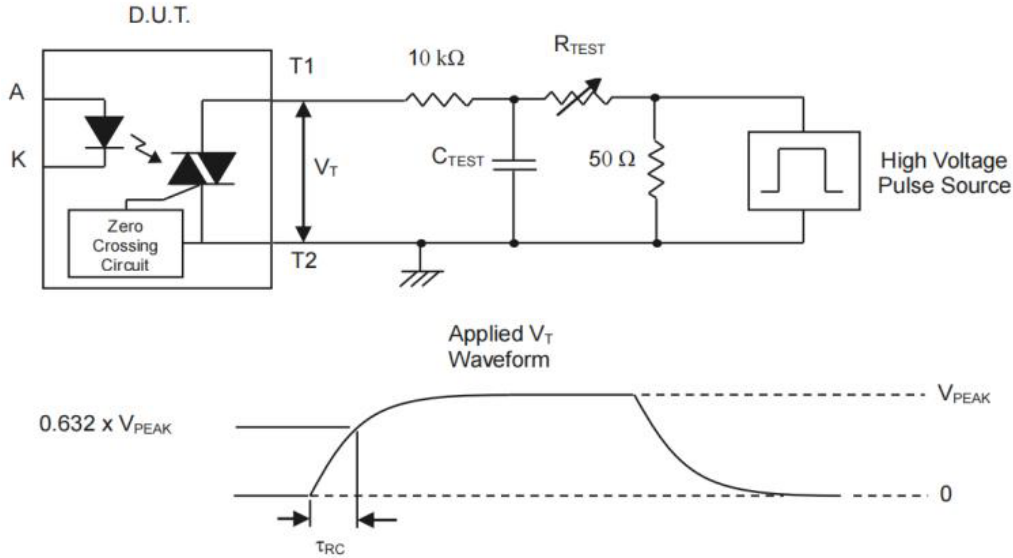
| NO.         | Test Items                                                                                                                                                                                                                                                                                           | Reference     | Test conditions                                                 | Test process         | Qty.(pcs) | LTPD |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------|----------------------|-----------|------|
| 1           | TC                                                                                                                                                                                                                                                                                                   | JESD22-A104C  | H:125±5°C 15min<br>J 5min<br>L:-55±5°C 15min                    | 300cycle             | 45        | 0/45 |
| 2           | HTOL                                                                                                                                                                                                                                                                                                 | JESD22-A108C  | HTOL@110±5°C<br>I <sub>F</sub> =15mA<br>I <sub>C</sub> =AC 20mA | 168、 500、<br>1000hrs | 45        | 0/45 |
| 3           | HTRB                                                                                                                                                                                                                                                                                                 | JESD22-A108C  | HTRB@100±5°C<br>V <sub>ce</sub> =640V                           | 168、 500、<br>1000hrs | 45        | 0/45 |
| 4           | H3TRB                                                                                                                                                                                                                                                                                                | JESD22-A101-B | H3TRB@ 85±5°C、<br>85±5%RH<br>V <sub>ce</sub> =100V              | 168、 500、<br>1000hrs | 45        | 0/45 |
| 5           | Autoclave                                                                                                                                                                                                                                                                                            | JESD22-A102-C | T <sub>a</sub> =121±5°C,<br>100%RH, 2atm                        | 96hrs                | 45        | 0/45 |
| 6           | HTS                                                                                                                                                                                                                                                                                                  | JESD22-A103C  | HTS@125±5°C                                                     | 168、 500、<br>1000hrs | 45        | 0/45 |
| 7           | LTS                                                                                                                                                                                                                                                                                                  | JESD22-A119   | LTS@-55±5°C                                                     | 168、 500、<br>1000hrs | 45        | 0/45 |
| 8           | RSH                                                                                                                                                                                                                                                                                                  | JESD22-B106C  | RSH@260±5°C                                                     | 10sec*3times         | 45        | 0/45 |
| 9           | SD                                                                                                                                                                                                                                                                                                   | JESD22-B102D  | Pb-free@<br>245±5°C                                             | 3sec*1times          | 22        | 0/22 |
| Rem<br>arks | All the tests should be performed according to customers' actual requirements, while difference of test standard or special requirements exist. Otherwise, all the tests are performed according to the standard listed above. Different current is applied to the tests of different product models |               |                                                                 |                      |           |      |

## 8. Characteristic Curves





Static dv/dt Test Circuit & Waveform



## Measurement Method

The high voltage pulse is set to the required  $V_{PEAK}$  value and applied to the D.U.T. output side through the RC circuit above. LED current is not applied. The waveform  $V_T$  is monitored using a x100 scope probe. By varying  $R_{TEST}$ , the dv/dt (slope) is increased, until the D.U.T. is observed to trigger (waveform collapses). The dv/dt is then decreased until the D.U.T. stops triggering. At this point,  $\tau_{RC}$  is recorded and the dv/dt calculated.  $dv/dt = 0.632 \times V_{PEAK} / \tau_{RC}$

For example,  $V_{PEAK} = 400V$  for KL304X series. The dv/dt value is calculated as follows:

$$dv/dt = 0.632 \times 400 / \tau_{RC}$$



## 9. Order Information

- Part Number

**KL304XY(Z)-V**  
**( PN:KL304XY-Z-V)**

**(Notes):**

X = Part No. (1, 2 or 3)

Y = Lead form option (S, S1, M or none)

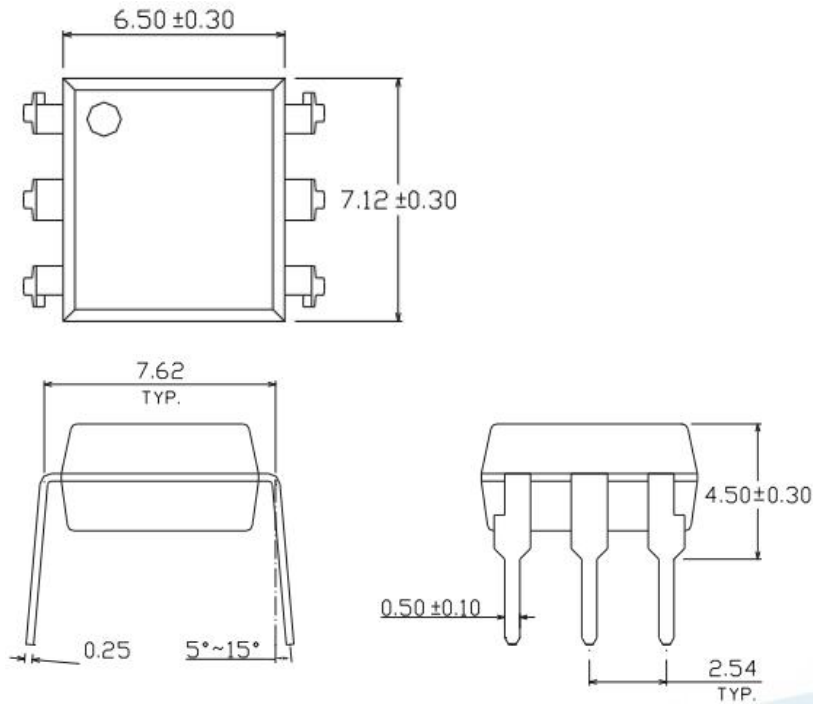
Z = Tape and reel option (TA, TB or none)

V = VDE (Only add "V" to laser characters specified by the customer)

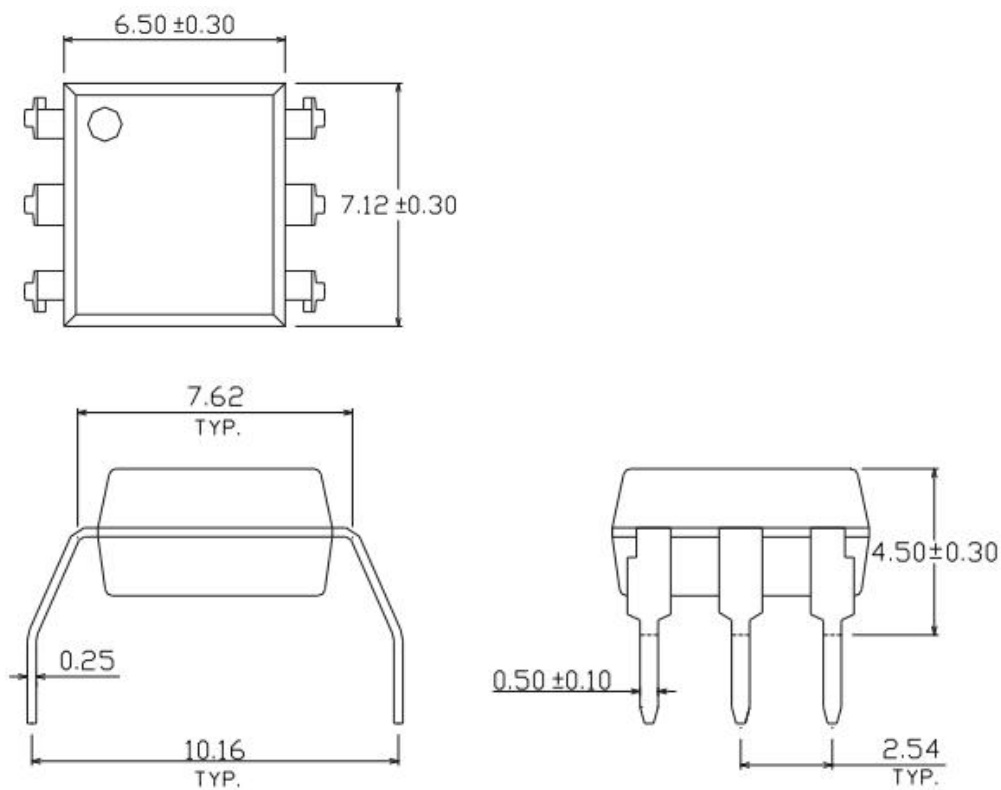
| Option  | Description                                                   | Packing quantity    |
|---------|---------------------------------------------------------------|---------------------|
| None    | Standard DIP-6                                                | 65 units per tube   |
| M       | Wide lead bend (0.4 inch spacing)                             | 65 units per tube   |
| S (TA)  | Surface mount lead form + TA tape & reel option               | 1000 units per tube |
| S (TB)  | Surface mount lead form + TB tape & reel option               | 1000 units per tube |
| S1 (TA) | Surface mount lead form (low profile) + TA tape & reel option | 1000 units per reel |
| S1 (TB) | Surface mount lead form (low profile) + TB tape & reel option | 1000 units per reel |

## 10. Package Drawing(Unit:mm)

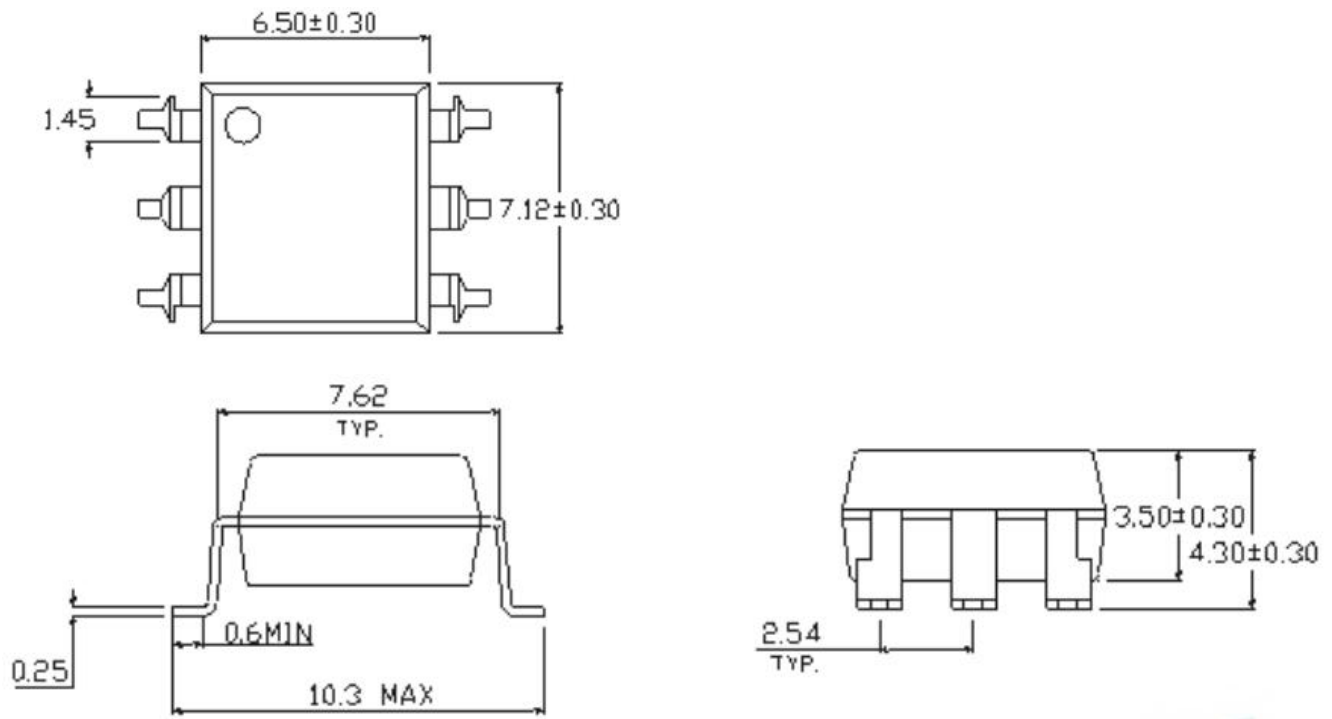
- Standard DIP Type



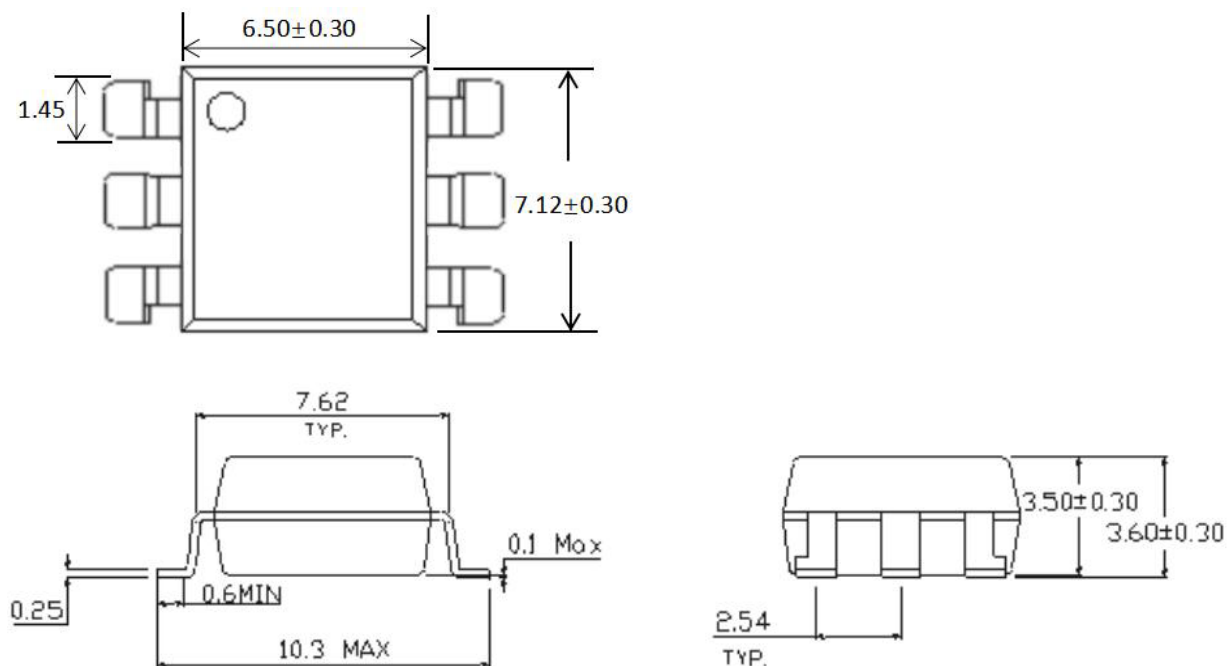
- Option M Type



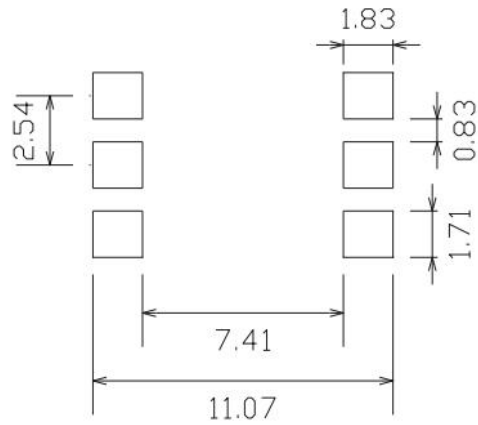
- Option S Type



- Option S1 Type



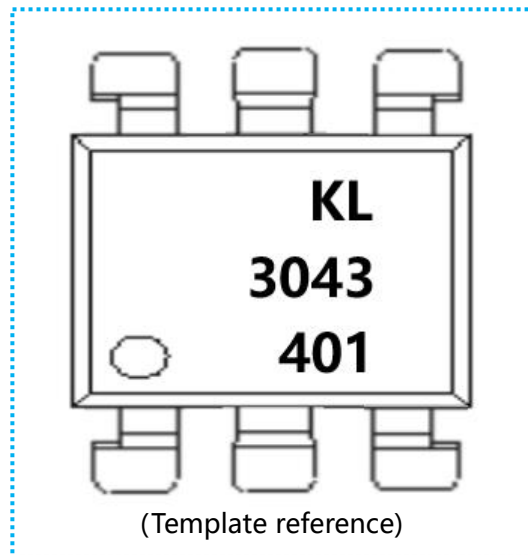
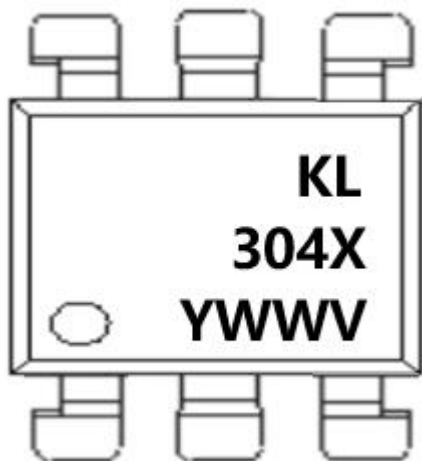
- Surface patch type PIN foot pad layout



(Notes):

- a. Suggested pad dimension is just for reference only
- b. Please modify the pad dimension based on individual need

## 11. Device marking

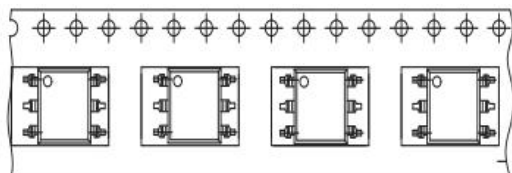


**(Notes):**

- KL = Denotes KingLight
- 304X = Denotes Device Part Number  
Part No. (1, 2 or 3)
- Y = Denotes 1 digit Year code
- WW = Denotes 2 digit Week code
- V = VDE (Only add "V" to laser characters specified by the customer)

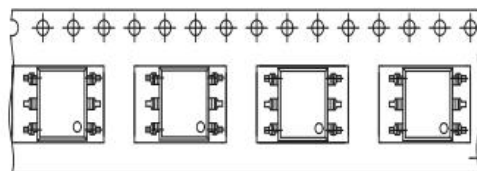
## 12. Tape & Reel Packing Specifications

- Option TA



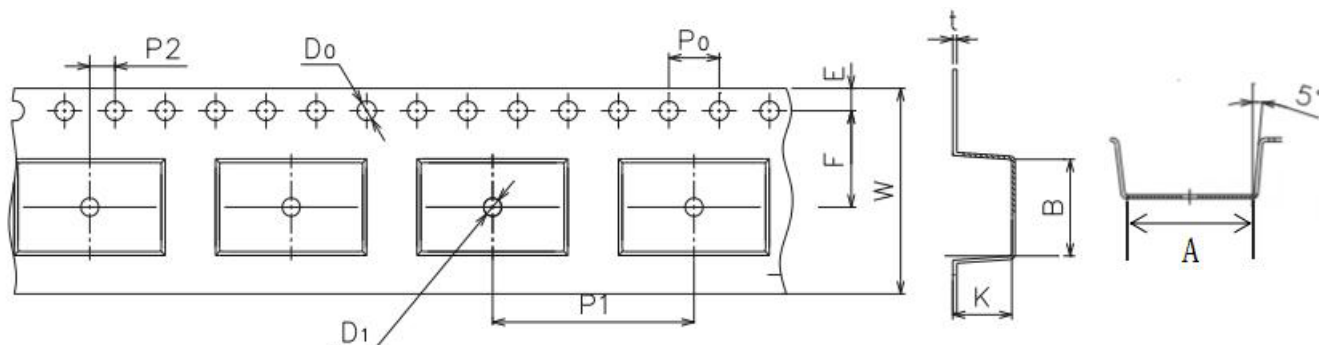
Direction of feed from reel

- Option TB



Direction of feed from reel

### Material belt size

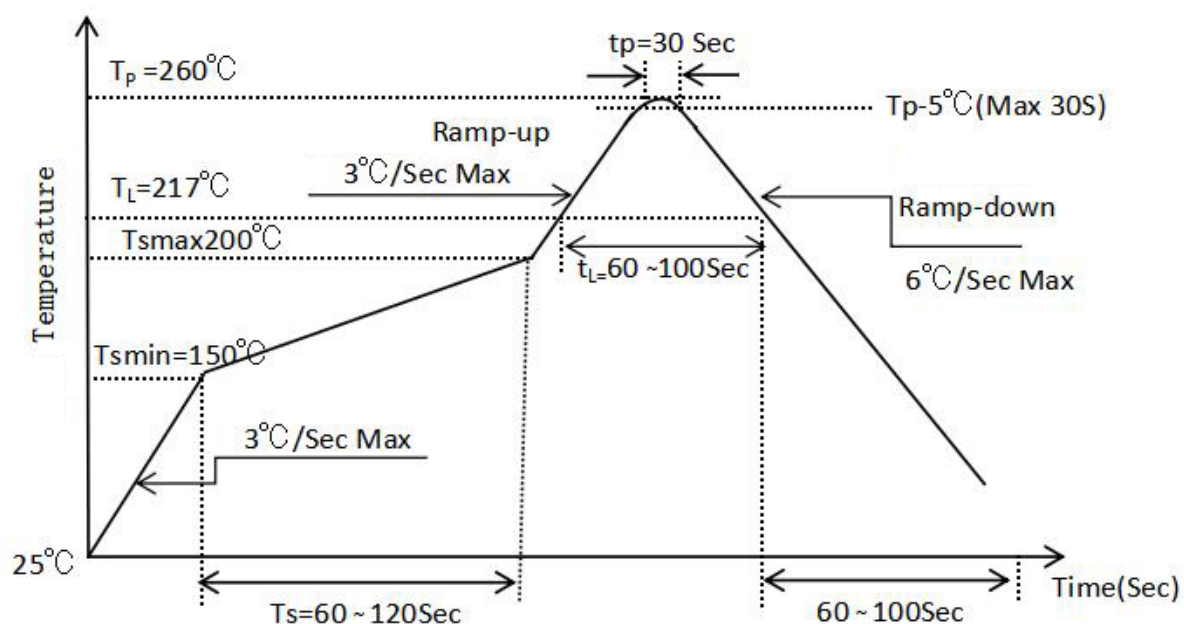


| Dimension No. | A        | B        | D0      | D1        | E        | F       |
|---------------|----------|----------|---------|-----------|----------|---------|
| Dimension(mm) | 10.8±0.1 | 7.55±0.1 | 1.5±0.1 | 1.5±0.1   | 1.75±0.1 | 7.5±0.1 |
| Dimension No. | P0       | P1       | P2      | t         | W        | K       |
| Dimension(mm) | 4.0±0.15 | 16.0±0.1 | 2.0±0.1 | 0.35±0.03 | 16.0±0.2 | 4.5±0.1 |

### 13. Temperature Profile Of Soldering

- Reflow soldering Soldering Condition**

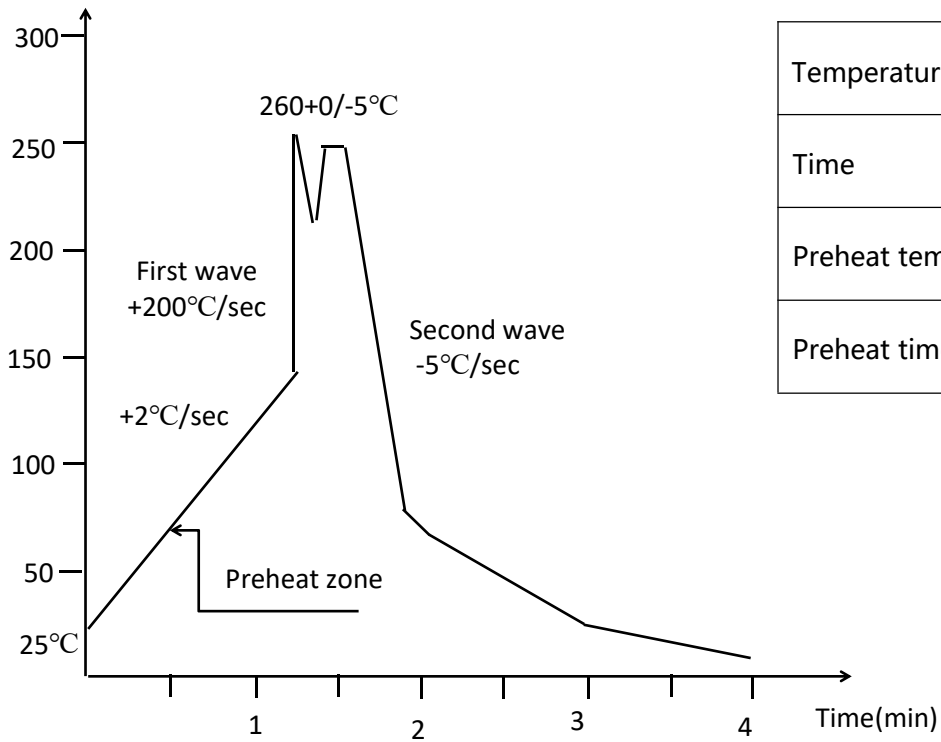
One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.



| Item                                                     | Symbol | Min. | Max. | Unit |
|----------------------------------------------------------|--------|------|------|------|
| Preheat Temperature                                      | $T_s$  | 150  | 200  | °C   |
| Preheat Time                                             | $t_s$  | 60   | 120  | s    |
| Ramp-Up Rate ( $T_L$ to $T_p$ )                          | -      | -    | 3    | °C/s |
| Liquidus Temperature                                     | $T_L$  | 217  |      | °C   |
| Time above Liquidus Temperature $T_L$                    | $t_L$  | 60   | 100  | s    |
| Peak Temperature                                         | $T_p$  | -    | 260  | °C   |
| Time During Which $T_c$ Is Between ( $T_p-5$ ) and $T_p$ | $t_p$  | -    | 30   | s    |
| Ramp-down Rate( $T_p$ to $T_L$ )                         | -      | -    | 6    | °C/s |

## • Wave Soldering

One time soldering is recommended within the condition of temperature



|                     |              |
|---------------------|--------------|
| Temperature         | 260°C+0/-5°C |
| Time                | 10S          |
| Preheat temperature | 25 to 140°C  |
| Preheat time        | 30 to 80 S   |