



6N138,6N139 Series

DIP8, Darlington High Speed Transistor Photo Coupler

Description

The 6N138 and 6N139 series combine an AlGaAs infrared emitting diode as the emitter which is optically coupled to a silicon high speed photo darlington transistor in a plastic DIP8 package with different lead forming options. A separate design between photodiode and darlington transistor reduces the base-collector capacitance of the input transistor which improves the speed by several orders of magnitude over conventional phototransistor optocouplers.

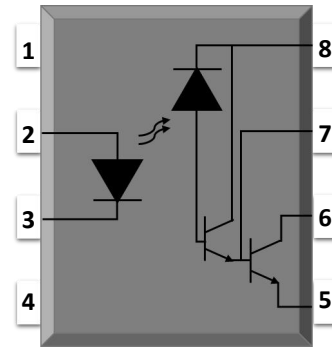
Features

- High isolation 5000 VRMS
- DC input with transistor output
- Operating temperature range - 55 °C to 100 °C
- REACH compliance
- Halogen free (Optional)
- MSL class 1
- Regulatory Approvals
 - UL - UL1577
 - VDE - EN60747-5-5(VDE0884-5)
 - CQC - GB4943.1, GB8898
 - cUL- CSA Component Acceptance Service Notice No. 5A

Applications

- Low current line receivers
- Current loop receivers
- Out interface to CMOS-LSTTL-TTL
- Pulse transformer replacement
- Computer-peripheral interface

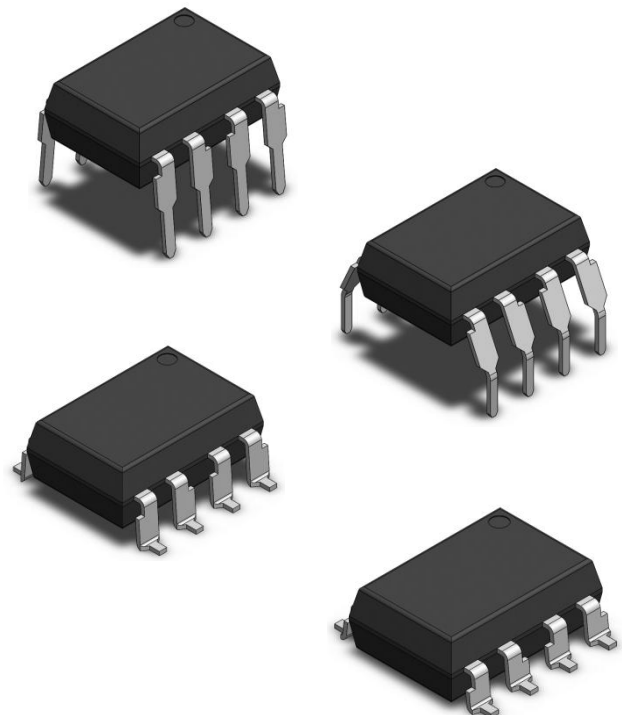
SCHEMATIC



PIN DEFINITION

| | |
|-----------|-------|
| 1.NC | 8.VCC |
| 2.Anode | 7.VB |
| 3.Cathode | 6.VO |
| 4.NC | 5.GND |

OUTLINE





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| ABSOLUTE MAXIMUM RATINGS | | | | |
|------------------------------|----------------|---------|------------------|------|
| PARAMETER | SYMBOL | VALUE | UNIT | Note |
| INPUT | | | | |
| Forward Current | I_F | 25 | mA | |
| Peak Forward Current | I_{FP} | 50 | mA | 1 |
| Peak Transient Current | $I_{F(trans)}$ | 1 | A | 2 |
| Reverse Voltage | V_R | 5 | V | |
| Input Power Dissipation | P_I | 100 | mW | |
| OUTPUT | | | | |
| Supply Voltage | V_{CC} | -0.5~18 | V | |
| Output Voltage | V_O | -0.5~18 | V | |
| Output Current | I_O | 60 | mA | |
| Emitter-Base Reverse Voltage | V_{EBR} | 0.5 | V | |
| Output Power Dissipation | P_O | 100 | mW | |
| COMMON | | | | |
| Total Power Dissipation | P_{tot} | 200 | mW | |
| Isolation Voltage | V_{iso} | 5000 | V _{rms} | 3 |
| Operating Temperature | T_{opr} | -55~100 | °C | |
| Storage Temperature | T_{stg} | -55~150 | °C | |
| Soldering Temperature | T_{sol} | 260 | °C | 4 |

Note 1. 50% duty, 1ms P.W

Note 2. $\leq 1\mu s$ P.W,300pps

Note 3. AC For 1 Minute, R.H. = 40 ~ 60%

Note 4. For 10 seconds



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ELECTRICAL OPTICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT | TEST CONDITION | NOTE | |
|--|------------------|------------------|------------------|------|------|---|--|--|
| INPUT(at Ta=0 to 70°C , unless specified otherwise) | | | | | | | | |
| Forward Voltage | V _F | - | 1.28 | 1.7 | V | I _F =1.6mA | | |
| Reverse Current | I _R | - | - | 10 | μA | V _R =5V | | |
| Input Capacitance | C _{in} | - | 60 | - | pF | V=0, f=1MHz | | |
| OUTPUT(at Ta=0 to 70°C , unless specified otherwise) | | | | | | | | |
| High Level Supply Current | I _{CCH} | - | 0.05 | 10 | μA | I _F =0mA, V _O =Open, V _{CC} =18V | | |
| Low Level Supply Current | I _{CCL} | - | 0.6 | 1.5 | mA | I _F =1.6mA, V _O =Open, V _{CC} =18V | | |
| Logic High Output Current | 6N138 | I _{OH} | - | 0.01 | 100 | μA | I _F =0mA, V _O =V _{CC} =18V, | |
| | 6N139 | | - | - | 250 | μA | | |
| TRANSFER CHARACTERISTICS(at Ta=0 to 70°C , unless specified otherwise) | | | | | | | | |
| Current Transfer Ratio | 6N139 | CTR | 400 | 2500 | - | % | I _F = 0.5mA , V _O = 0.4V, V _{CC} =4.5V | |
| | | | 500 | 2600 | - | | I _F = 1.6mA , V _O = 0.4V, V _{CC} =4.5V | |
| | 6N138 | | 300 | 2600 | - | | | |
| Logic Low Output Voltage | 6N139 | V _{OL} | - | 0.04 | 0.4 | V | I _F = 0.5mA , I _O = 2mA, V _{CC} =4.5V | |
| | | | - | 0.07 | 0.4 | | I _F = 1.6mA , I _O = 8mA, V _{CC} =4.5V | |
| | | | - | 0.11 | 0.4 | | I _F = 5mA , I _O = 15mA, V _{CC} =4.5V | |
| | | | - | 0.15 | 0.4 | | I _F = 12mA , I _O = 24mA, V _{CC} =4.5V | |
| | 6N138 | | - | 0.05 | 0.4 | | I _F = 1.6mA , I _O = 4.8mA, V _{CC} =4.5V | |
| Isolation Resistance | R _{iso} | 10 ¹² | 10 ¹⁴ | - | Ω | DC500V, 40 ~ 60% R.H. | | |
| Floating Capacitance | C _{IO} | - | 0.3 | 1 | pF | V=0, f=1MHz | | |



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ELECTRICAL OPTICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT | TEST CONDITION | NOTE |
|--|----------|-----------|-----------|------|--|-----------------------|---|
| TRANSFER CHARACTERISTICS(at Ta=0 to 70°C , unless specified otherwise) | | | | | | | |
| Current Transfer Ratio | 6N139 | CTR | 400 | 2500 | - | % | $I_F = 0.5\text{mA}, V_O = 0.4\text{V}, V_{CC}=4.5\text{V}$ |
| | | | 500 | 2600 | - | | $I_F = 1.6\text{mA}, V_O = 0.4\text{V}, V_{CC}=4.5\text{V}$ |
| | 6N138 | 300 | 2600 | - | | | |
| Logic Low Output Voltage | 6N139 | V_{OL} | - | 0.04 | 0.4 | V | $I_F = 0.5\text{mA}, I_O = 2\text{mA}, V_{CC}=5\text{V}$ |
| | | | - | 0.07 | 0.4 | | $I_F = 1.6\text{mA}, I_O = 8\text{mA}, V_{CC}=4.5\text{V}$ |
| | | | - | 0.11 | 0.4 | | $I_F = 5\text{mA}, I_O = 15\text{mA}, V_{CC}=4.5\text{V}$ |
| | | | - | 0.15 | 0.4 | | $I_F = 12\text{mA}, I_O = 24\text{mA}, V_{CC}=4.5\text{V}$ |
| | 6N138 | - | 0.05 | 0.4 | $I_F = 1.6\text{mA}, I_O = 4.8\text{mA}, V_{CC}=4.5\text{V}$ | | |
| Isolation Resistance | Riso | 10^{12} | 10^{14} | - | Ω | DC500V, 40 ~ 60% R.H. | |
| Floating Capacitance | C_{IO} | - | 0.3 | 1 | pF | V=0, f=1MHz | |



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ELECTRICAL OPTICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT | TEST CONDITION | NOTE | |
|--|--------|-----------------|------|------|------|----------------|---|--------|
| SWITCHING CHARACTERISTICS(at Ta=0 to 70°C,V _{CC} =5V, unless specified otherwise) | | | | | | | | |
| Propagation Delay Time to Logic Low | 6N139 | TPHL | - | 5 | 25 | μs | I _F = 0.5mA,R _L =4.7kΩ, T _A =25°C | Fig.13 |
| | | | - | - | 30 | | I _F = 0.5mA,R _L =4.7kΩ | |
| | | | - | 0.2 | 1 | | I _F = 12mA,R _L =270Ω, T _A =25°C | |
| | | | - | - | 2 | | I _F = 12mA,R _L =270Ω | |
| | 6N138 | | - | 1.4 | 10 | | I _F = 1.6mA,R _L =2.2kΩ, T _A =25°C | |
| | | | - | - | 15 | | I _F = 1.6mA,R _L =2.2kΩ | |
| Propagation Delay Time to Logic High | 6N139 | TPLH | - | 22 | 60 | μs | I _F = 0.5mA,R _L =4.7kΩ, T _A =25°C | Fig.13 |
| | | | - | - | 90 | | I _F = 0.5mA,R _L =4.7kΩ | |
| | | | - | 2.1 | 7 | | I _F = 12mA,R _L =270Ω, T _A =25°C | |
| | | | - | - | 10 | | I _F = 12mA,R _L =270Ω | |
| | 6N138 | | - | 10.7 | 35 | | I _F = 1.6mA,R _L =2.2kΩ, T _A =25°C | |
| | | | - | - | 50 | | I _F = 1.6mA,R _L =2.2kΩ | |
| Common Mode Transient Immunity at Logic High | 6N139 | CM _H | 1000 | - | - | V/μs | I _F = 0mA , V _{CM} =10Vpp, R _L =2.2kΩ, T _A =25°C | Fig.15 |
| | 6N138 | | 1000 | - | - | | | |
| Common Mode Transient Immunity at Logic Low | 6N139 | CM _L | 1000 | - | - | V/μs | I _F = 1.6mA , V _{CM} =10Vpp, R _L =2.2kΩ, T _A =25°C | Fig.15 |
| | 6N138 | | 1000 | - | - | | | |



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CHARACTERISTIC CURVES

Fig.1 Forward Current vs. Forward Voltage

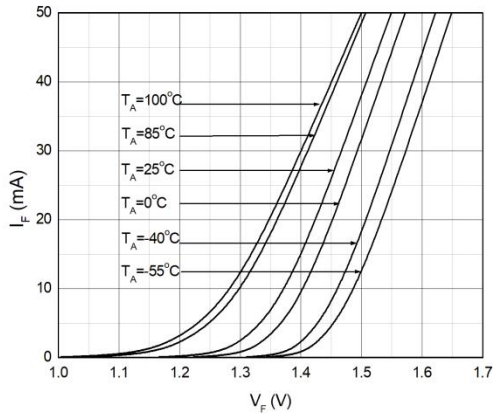


Fig.2 Current Transfer Ratio vs. Forward Current

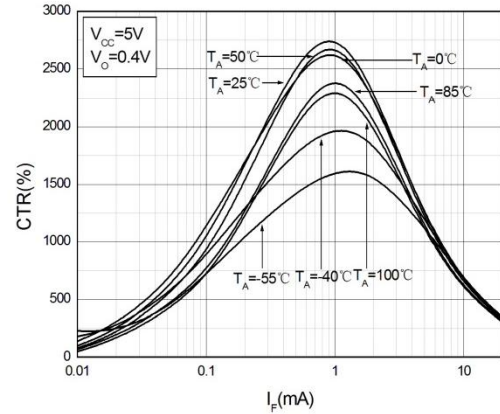


Fig.3 Normalized Current Transfer Ratio vs. Ambient Temperature

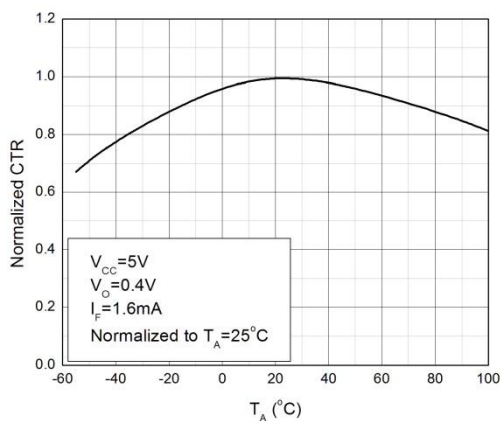


Fig.4 Current Transfer Ratio vs. Base-Emitter Resistance

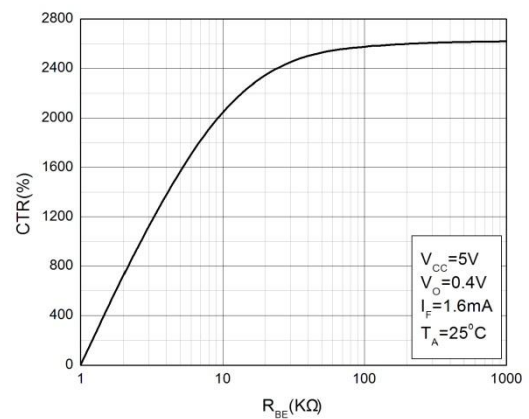


Fig.5 Low Level Output Current vs. Output Voltage

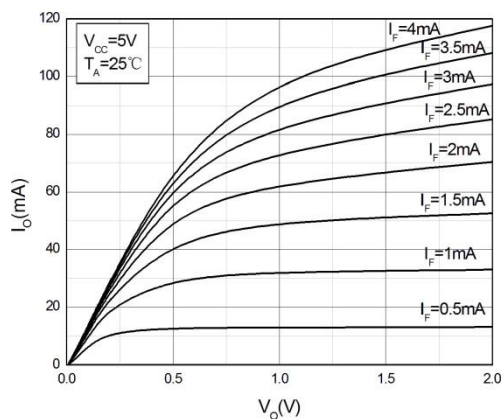
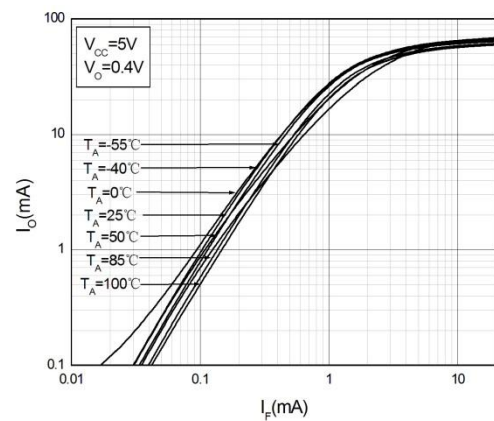


Fig.6 Low Level Output Current vs. Forward Current





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CHARACTERISTIC CURVES

Fig.7 High Level Output Current vs. Ambient Temperature

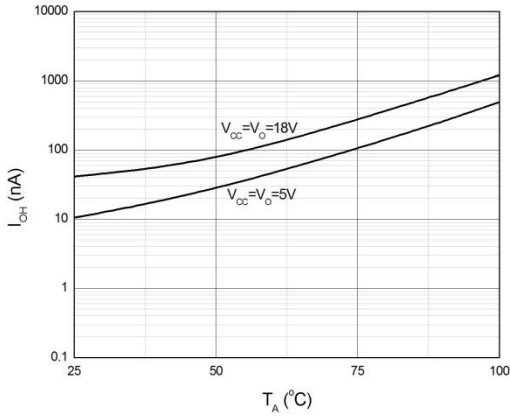


Fig.8 Propagation Delay vs. Pulse Width

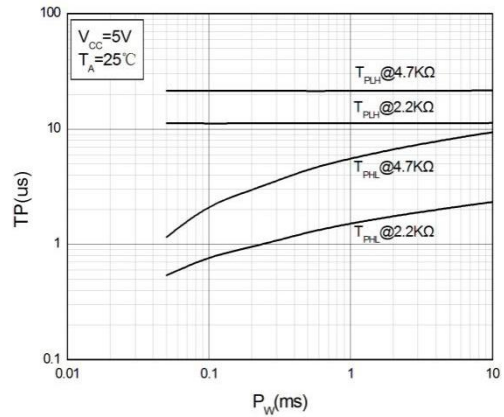


Fig.9 Rise and Fall Time vs. Load Resistance

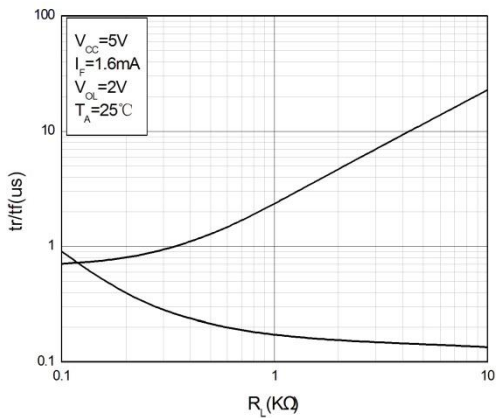


Fig.10 Propagation Delay vs. Ambient Temperature

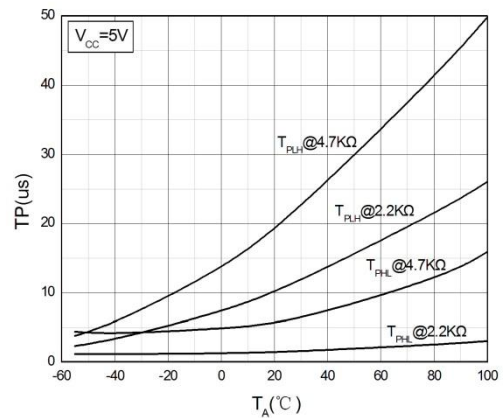


Fig.11 Propagation Delay vs. Forward Current

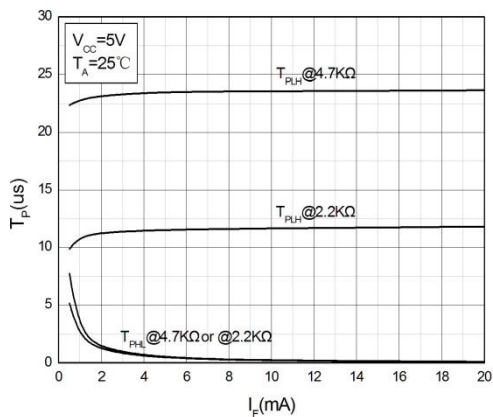
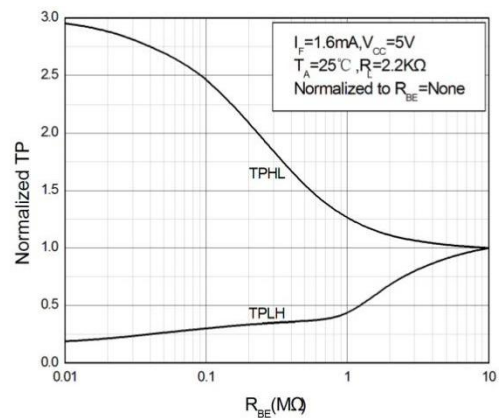


Fig.12 Propagation Delay vs. Base-Emitter Resistance



TEST CIRCUITS

Fig.13 Test Circuits for TPHL, TPLH, tr, tf

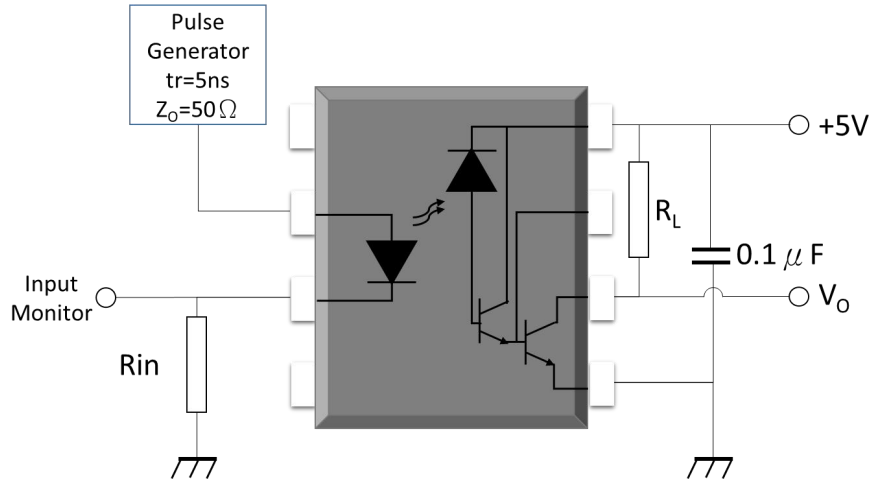
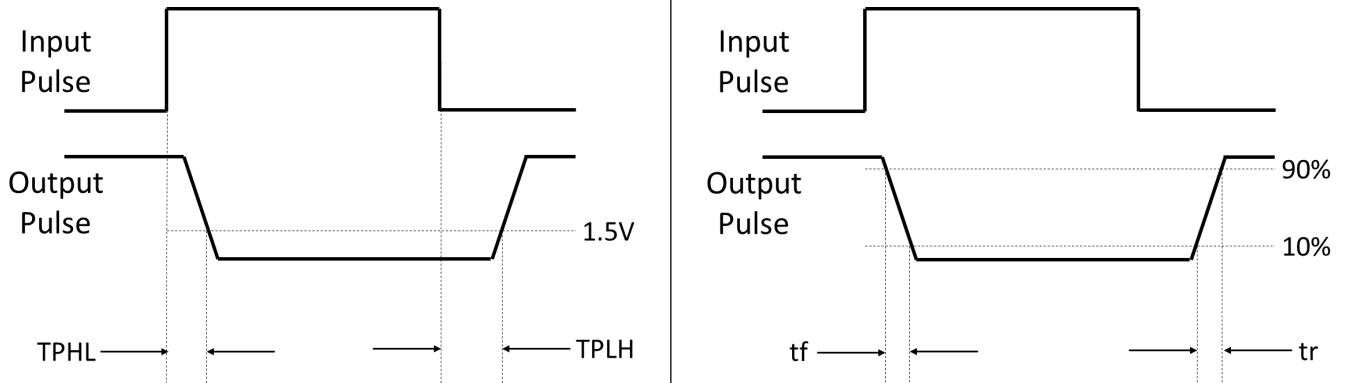


Fig.14 Waveforms of TPHL, TPLH, tr, tf



TEST CIRCUITS

Fig.15 Test Circuits for Common Mode Transient Immunity

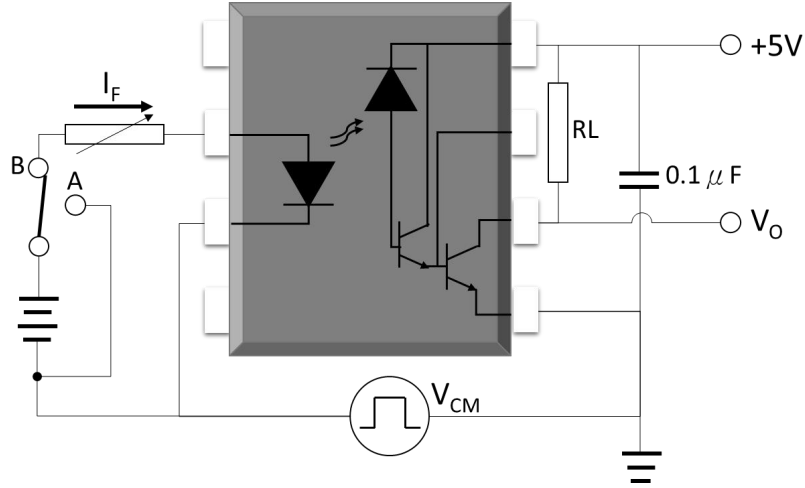
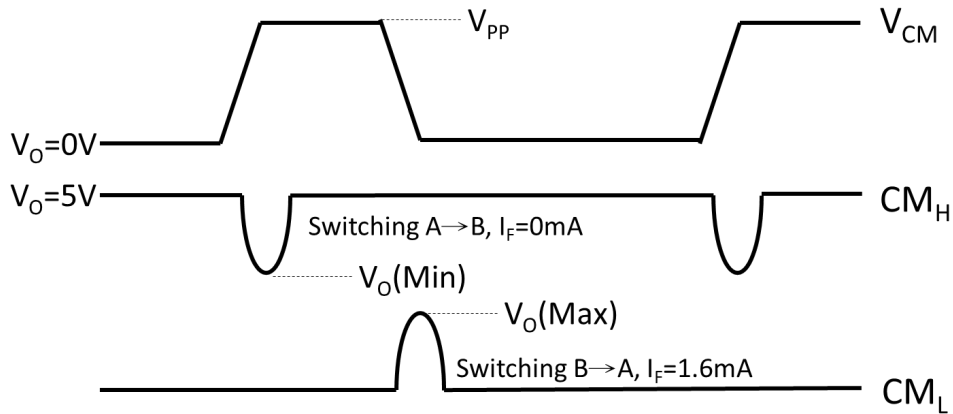


Fig.16 Waveforms of Common Mode Transient Immunity



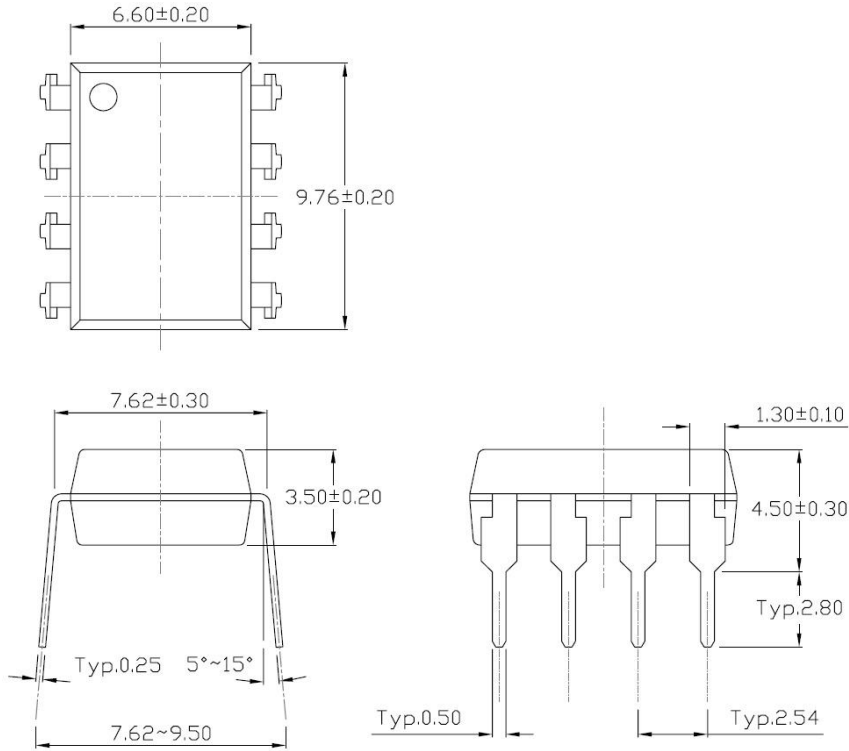


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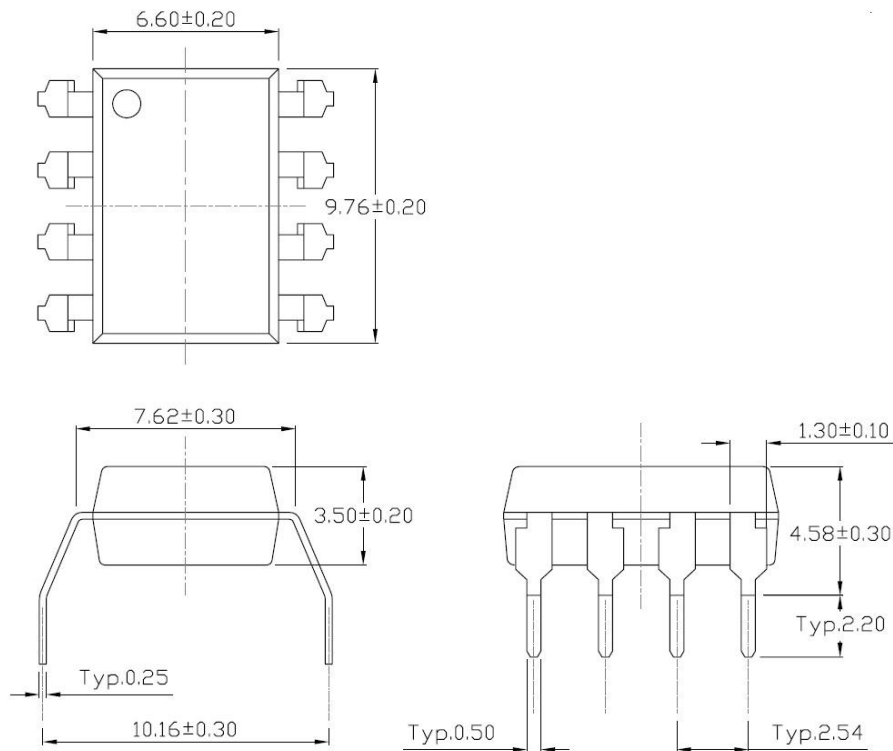
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PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Standard DIP – Through Hole (DIP Type)

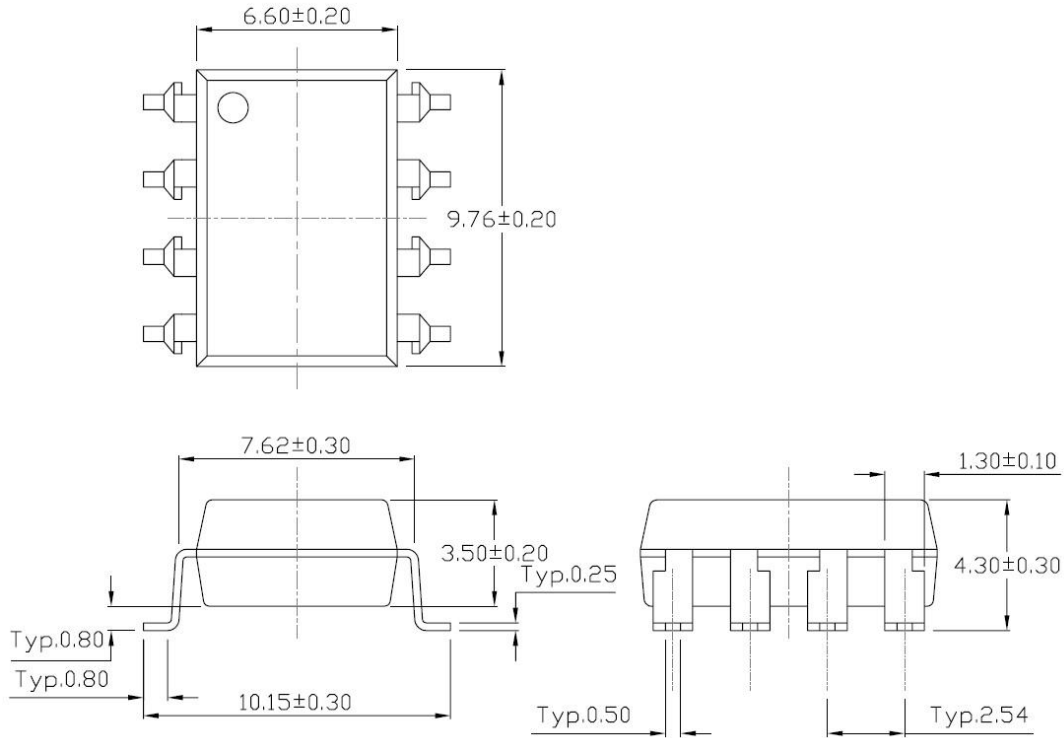


Gullwing (400mil) Lead Forming – Through Hole (M Type)

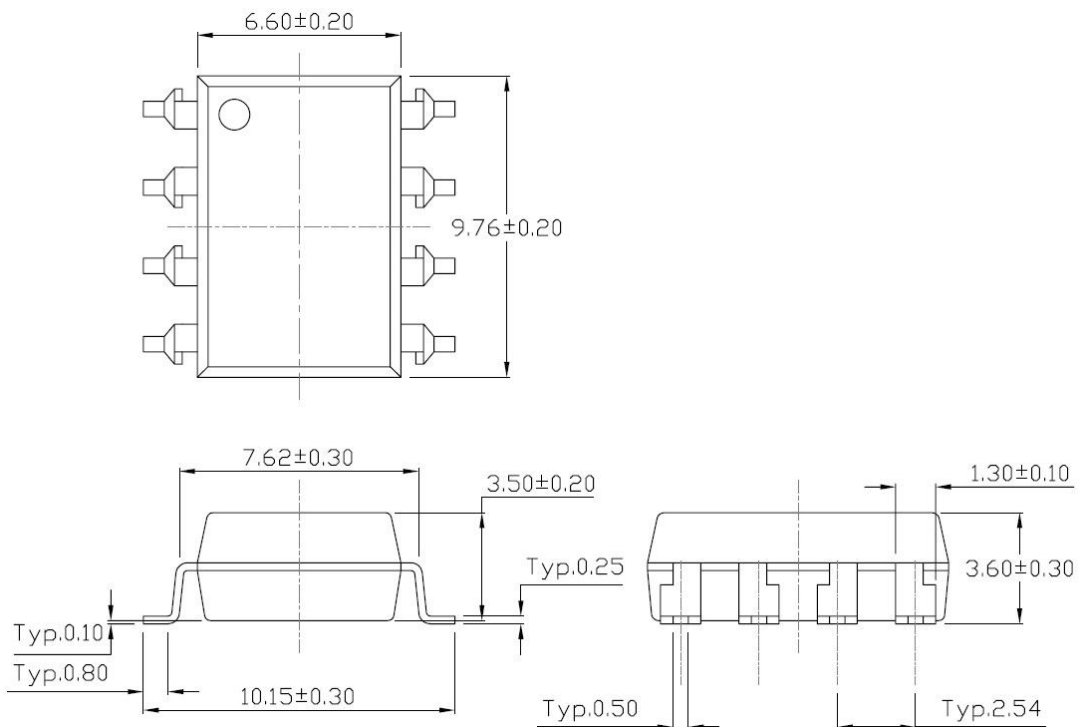


PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Surface Mount Lead Forming (S Type)



Surface Mount (Low Profile) Lead Forming (SL Type)

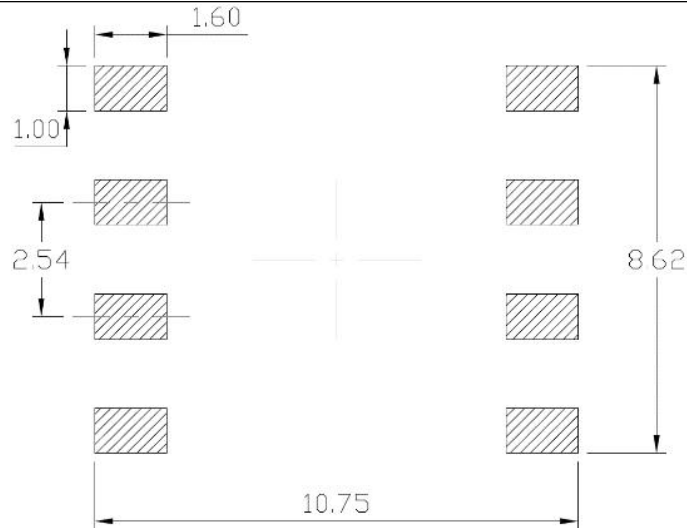




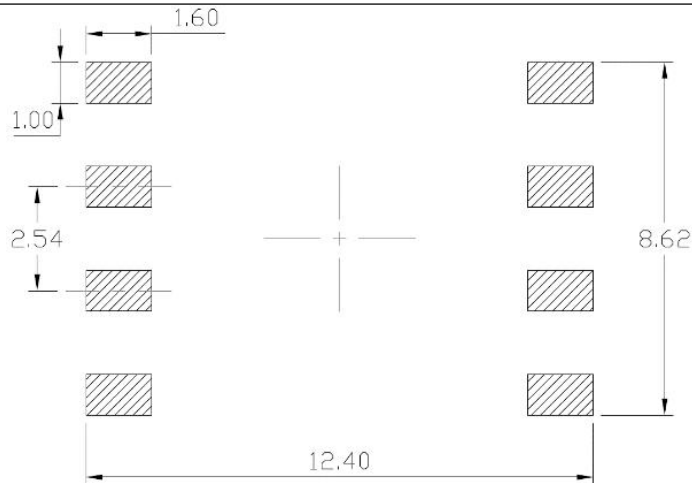
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Recommended Solder Mask (Dimensions in mm unless otherwise stated)

Surface Mount Lead Forming & Surface Mount (Low Profile) Lead Forming



Surface Mount (Gullwing) Lead Forming

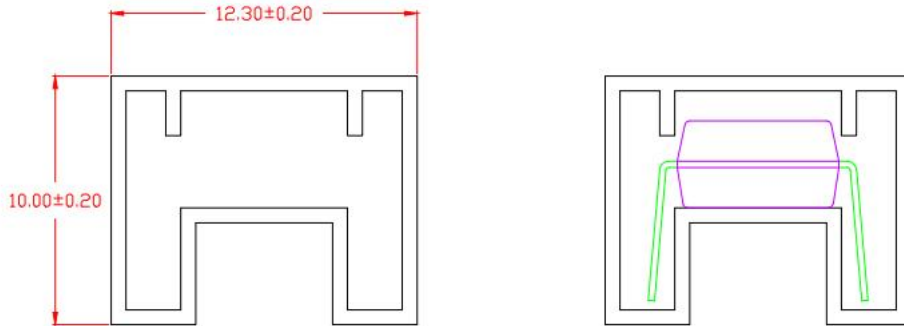




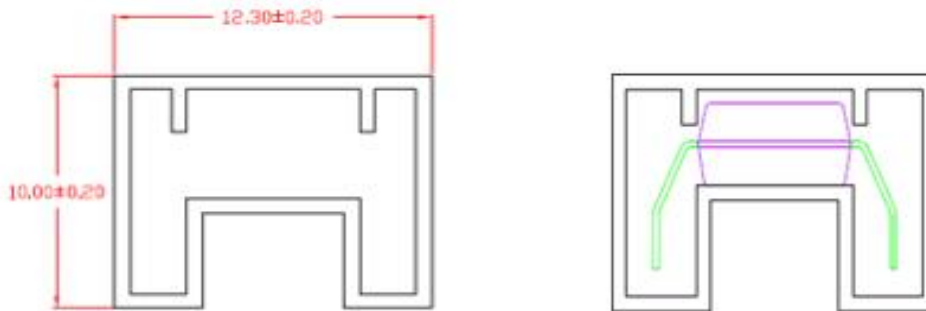
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TUBE SPECIFICATIONS (Dimensions in mm unless otherwise stated)

Standard DIP



Option M



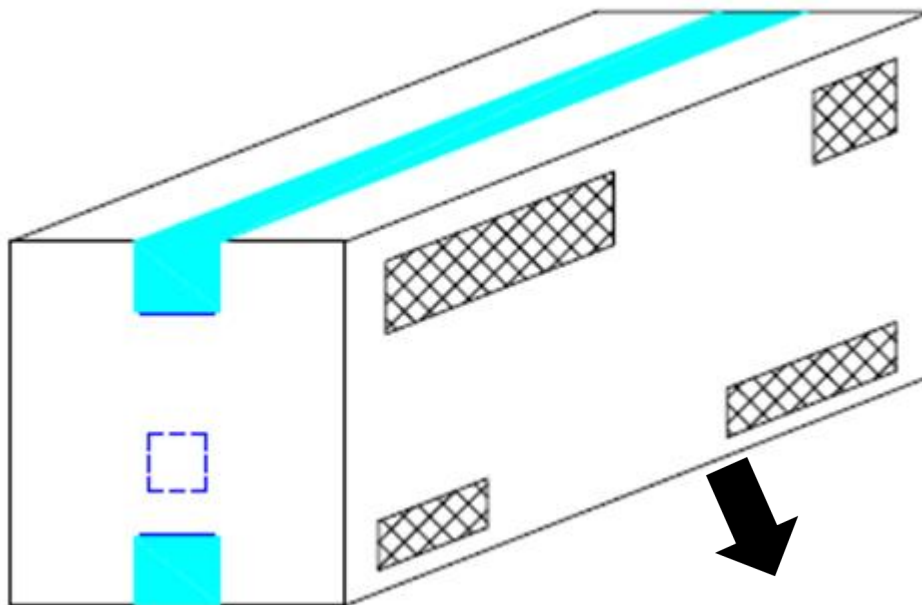
BOX SPECIFICATIONS (Tube Type)

Inner Box

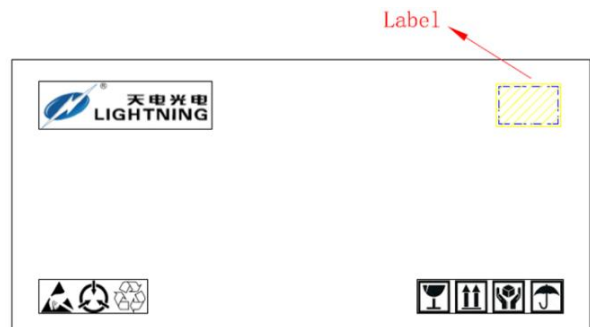


L x W x H = 52.5cm x 10.7cm x 4.7cm

Outer Box

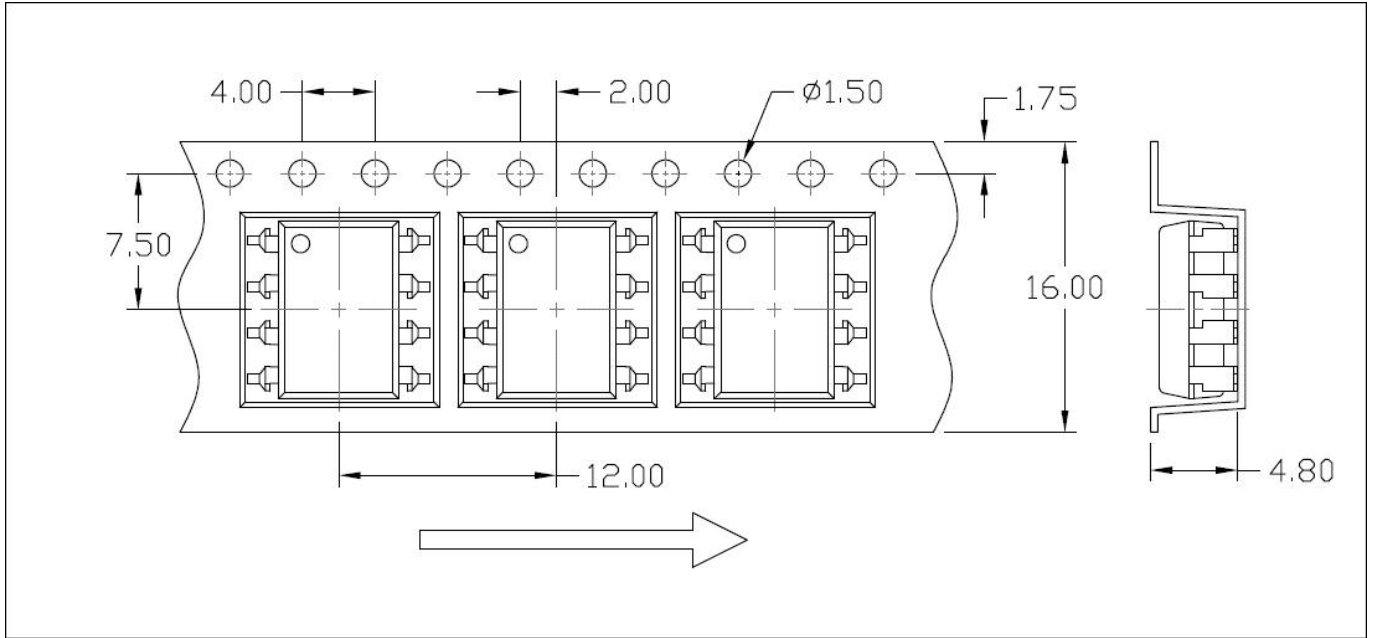


L x W x H = 53.5cm x 23.5cm x 25.5cm

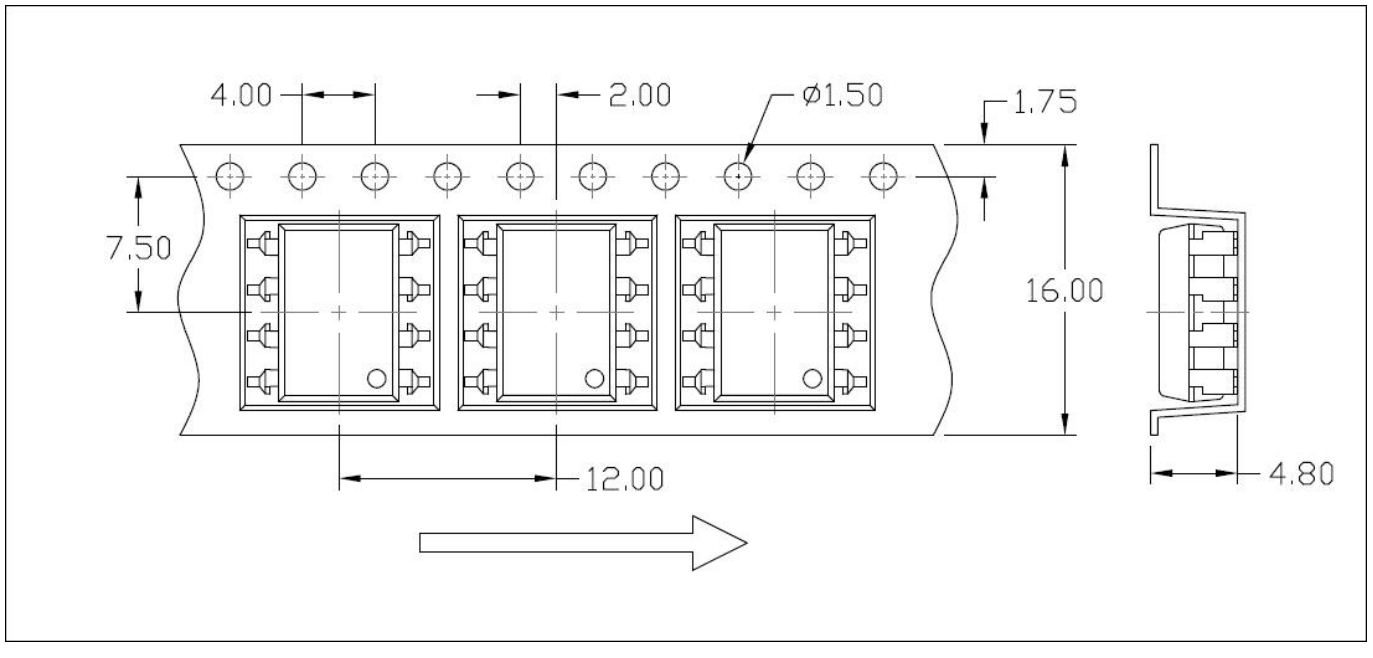


Carrier Tape Specifications (Dimensions in mm unless otherwise stated)

Option S(T1) & SL(T1)

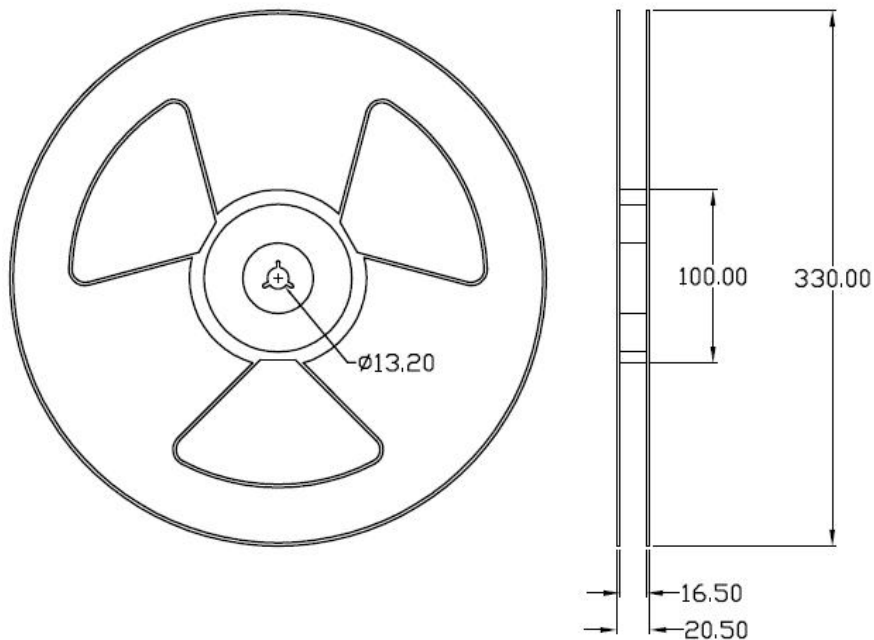


Option S(T2) & SL(T2)



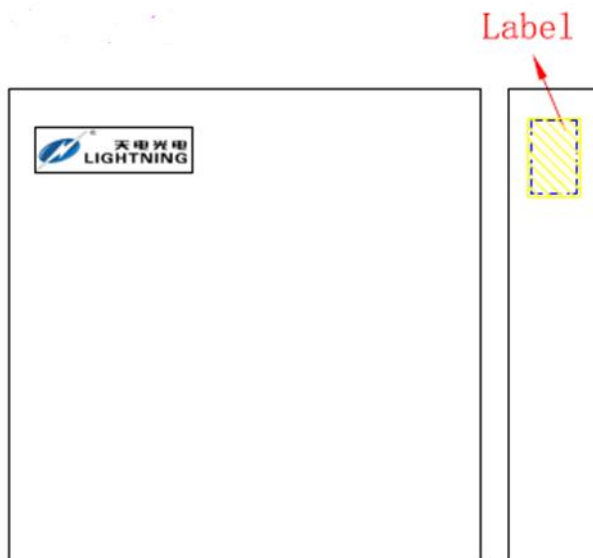
REEL SPECIFICATIONS (Dimensions in mm unless otherwise stated)

Option S & Option SL



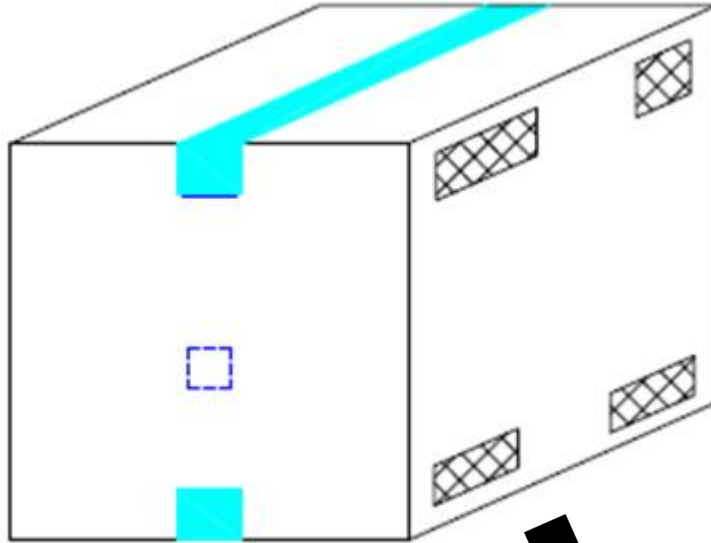
BOX SPECIFICATIONS (Reel Type)

Inner Box

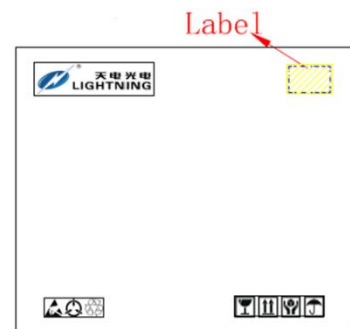


- L x W x H = 36cm x 36cm x 6.9cm

Outer Box



- L x W x H = 45cm x 38cm x 38cm



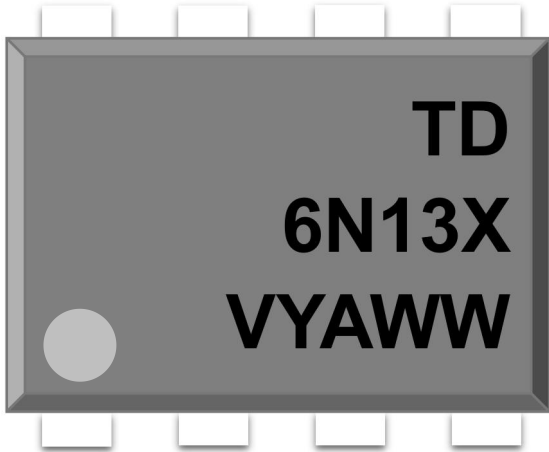


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ORDERING AND MARKING INFORMATION

MARKING INFORMATION



TD : Company Abbr.
6N13X : Part Number
V : VDE Option
Y : Fiscal Year
A : Manufacturing Code
WW : Work Week

ORDERING INFORMATION

6N13X(Y)(Z)-GV

6N13X – Part Number (X=8 or 9)
 Y – Lead Form Option (M/S/SL/None)
 Z – Tape and Reel Option (T1/T2)
 G – Material Option
 (G: Green, None: Non-Green)
 V – VDE Option (V or None)

LABEL INFORMATION

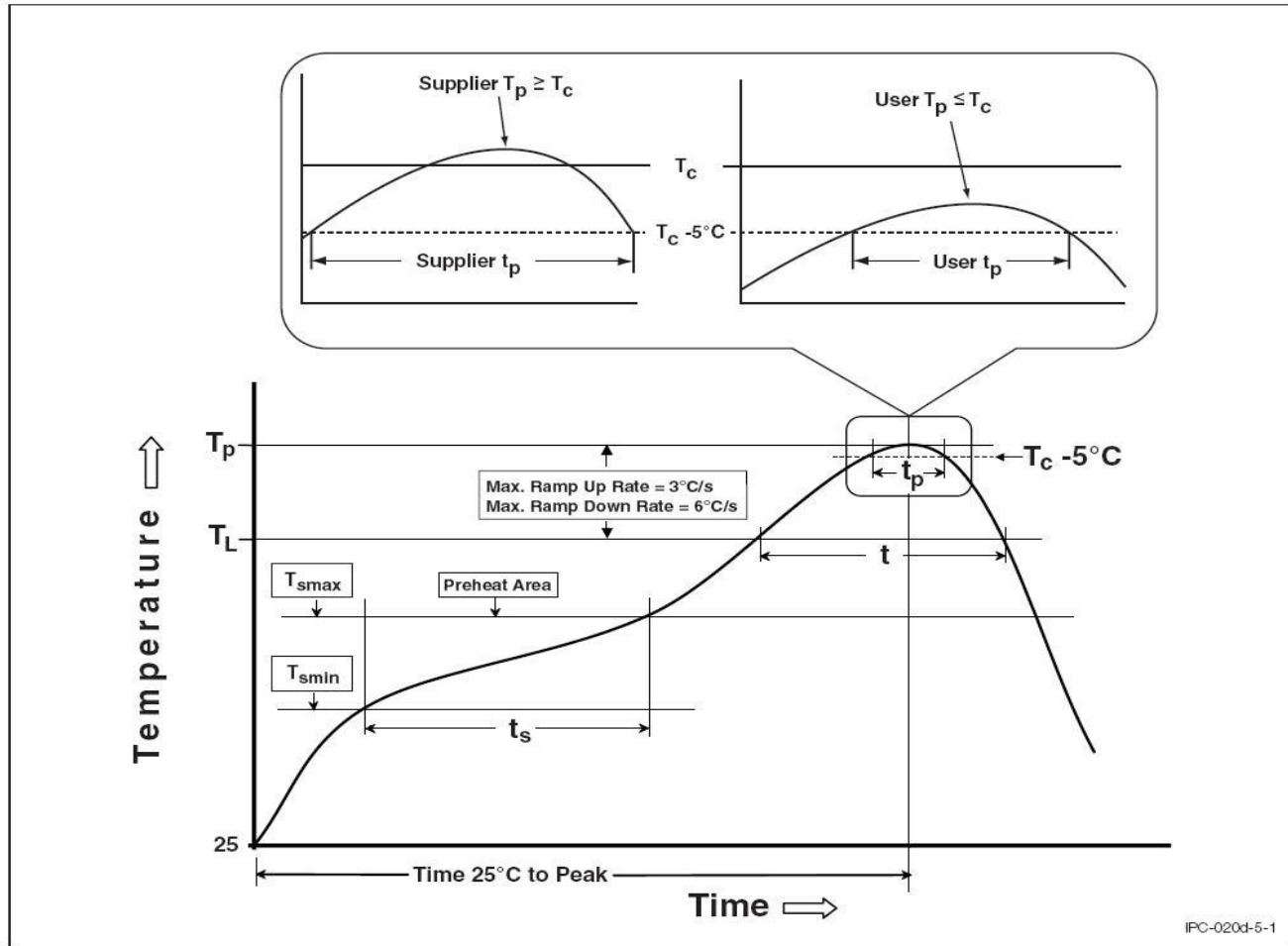


PACKING QUANTITY

| Option | Quantity | Quantity – Inner box | Quantity – Outer box |
|--------|-----------------|----------------------|------------------------------------|
| None | 40 Units/Tube | 30 Tubes/Inner box | 10 Inner box/Outer box = 12k Units |
| M | 40 Units/Tube | 30 Tubes/Inner box | 10 Inner box/Outer box = 12k Units |
| S(T1) | 1000 Units/Reel | 3 Reels/Inner box | 5 Inner box/Outer box = 15k Units |
| S(T2) | 1000 Units/Reel | 3 Reels/Inner box | 5 Inner box/Outer box = 15k Units |
| SL(T1) | 1000 Units/Reel | 3 Reels/Inner box | 5 Inner box/Outer box = 15k Units |
| SL(T2) | 1000 Units/Reel | 3 Reels/Inner box | 5 Inner box/Outer box = 15k Units |

REFLOW INFORMATION

REFLOW PROFILE



IPC-020d-5-1

| Profile Feature | Sn-Pb Assembly Profile | Pb-Free Assembly Profile |
|---|------------------------|--------------------------|
| Temperature Min. (T _{smin}) | 100 | 150°C |
| Temperature Max. (T _{smax}) | 150 | 200°C |
| Time (t _s) from (T _{smin} to T _{smax}) | 60-120 seconds | 60-120 seconds |
| Ramp-up Rate (t _L to t _P) | 3°C/second max. | 3°C/second max. |
| Liquidous Temperature (T _L) | 183°C | 217°C |
| Time (t _L) Maintained Above (T _L) | 60 – 150 seconds | 60 – 150 seconds |
| Peak Body Package Temperature | 235°C +0°C / -5°C | 260°C +0°C / -5°C |
| Time (t _P) within 5°C of 260°C | 20 seconds | 30 seconds |
| Ramp-down Rate (T _P to T _L) | 6°C/second max | 6°C/second max |
| Time 25°C to Peak Temperature | 6 minutes max. | 8 minutes max. |



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DISCLAIMER

- LIGHTNING is continually improving the quality, reliability, function and design. LIGHTNING reserves the right to make changes without further notices.
- The characteristic curves shown in this datasheet are representing typical performance which are not guaranteed.
- LIGHTNING makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, LIGHTNING disclaims (a) any and all liability arising out of the application or use of any product, (b) any and all liability, including without limitation special, consequential or incidental damages, and (c) any and all implied warranties, including warranties of fitness for particular
- The products shown in this publication are designed for the general use in electronic applications such as office automation, equipment, communications devices, audio/visual equipment, electrical application and instrumentation purpose, non-infringement and merchantability.
- This product is not intended to be used for military, aircraft, automotive, medical, life sustaining or lifesaving applications or any other application which can result in human injury or death.
- Please contact LIGHTNING sales agent for special application request.
- Immerge unit's body in solder paste is not recommended.
- Parameters provided in datasheets may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated in each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify LIGHTNING's terms and conditions of purchase, including but not limited to the warranty expressed therein.
- Discoloration might be occurred on the package surface after soldering, reflow or long-time use. It neither impacts the performance nor reliability.