



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.

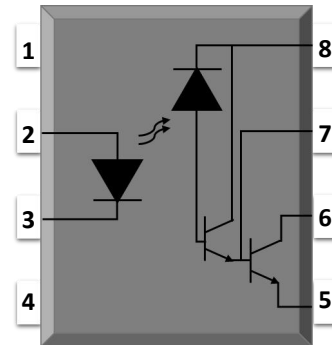
Features

- 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

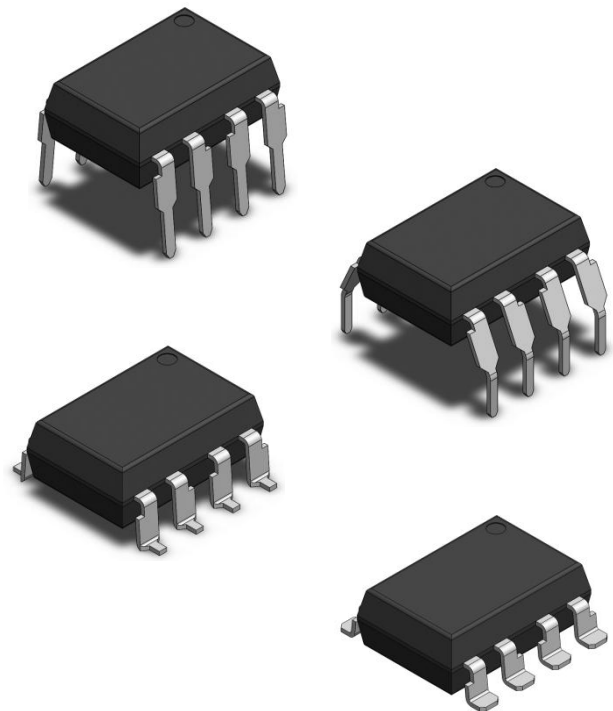
SCHEMATIC



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	Vrms	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

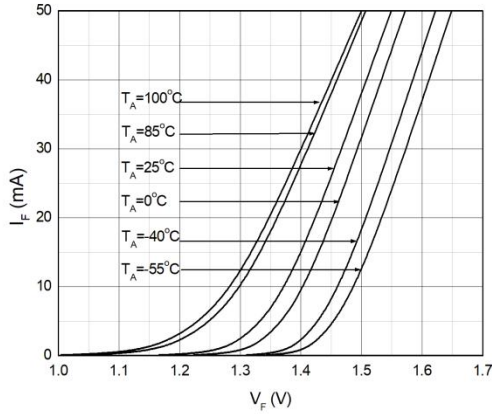


Fig.2 Current Transfer Ratio vs. Forward Current

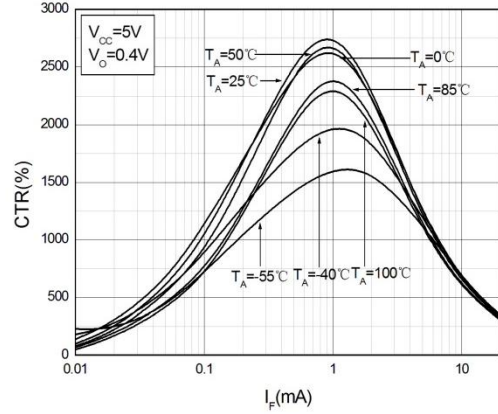


Fig.3 Normalized Current Transfer Ratio vs. Ambient Temperature

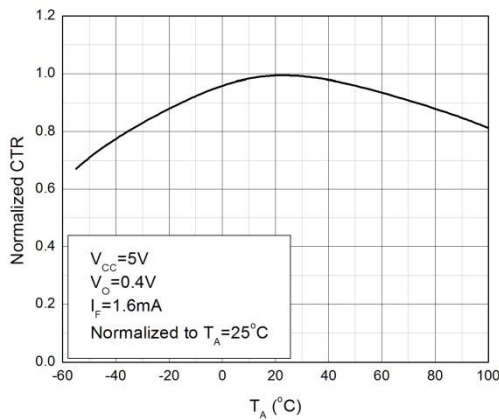


Fig.4 Current Transfer Ratio vs. Base-Emitter Resistance

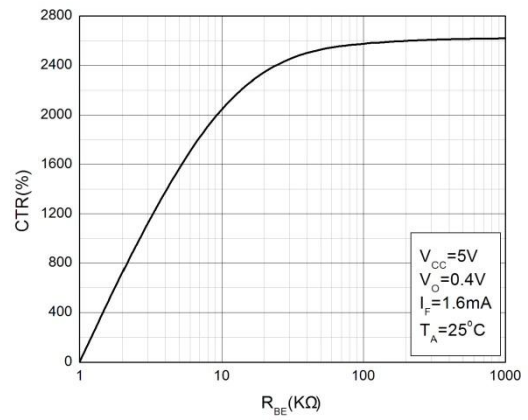


Fig.5 Low Level Output Current vs. Output Voltage

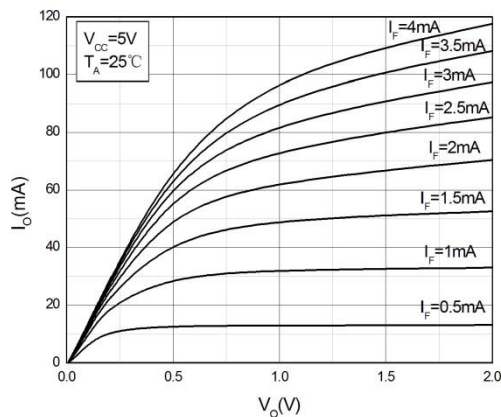
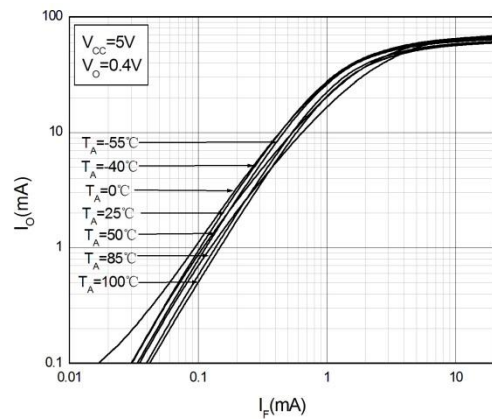


Fig.6 Low Level Output Current vs. Forward Current





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CHARACTERISTIC CURVES

Fig.7 High Level Output Current vs. Ambient Temperature

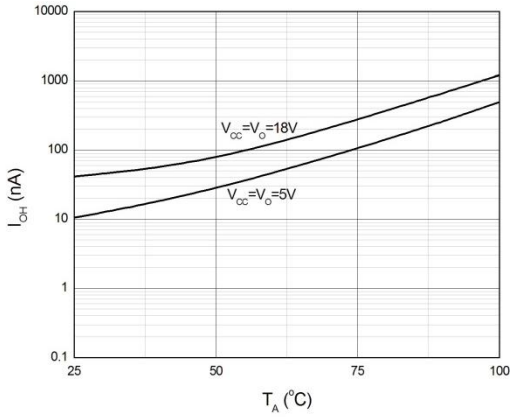


Fig.8 Propagation Delay vs. Pulse Width

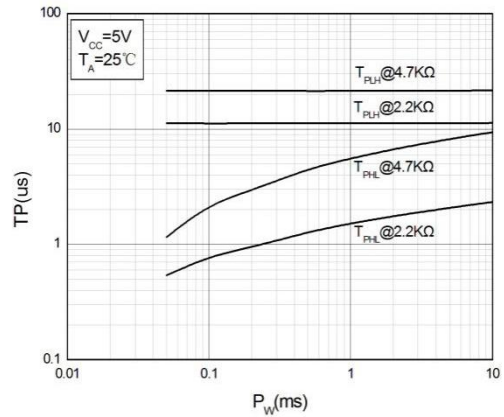


Fig.9 Rise and Fall Time vs. Load Resistance

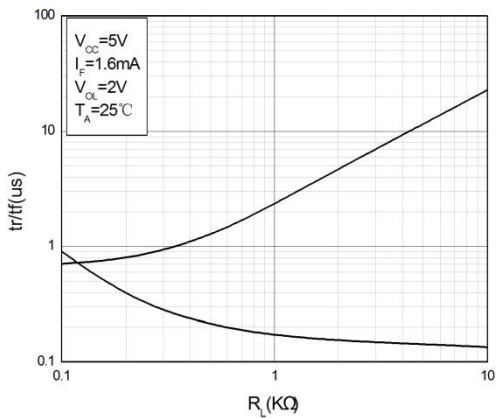


Fig.10 Propagation Delay vs. Ambient Temperature

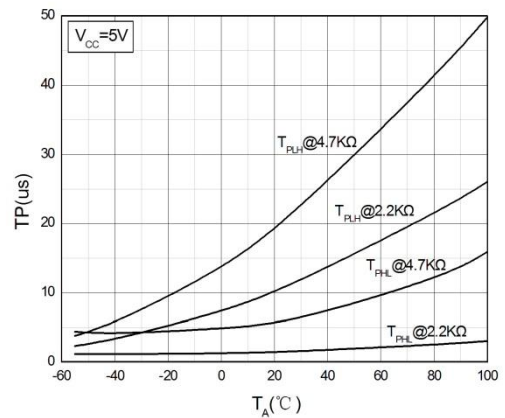


Fig.11 Propagation Delay vs. Forward Current

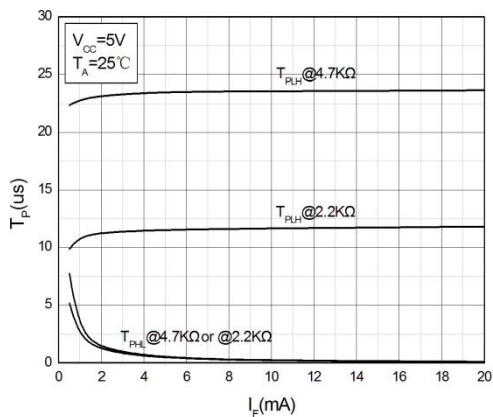
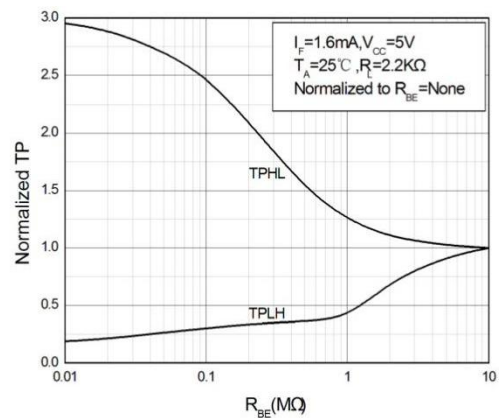


Fig.12 Propagation Delay vs. Base-Emitter Resistance



TEST CIRCUITS

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

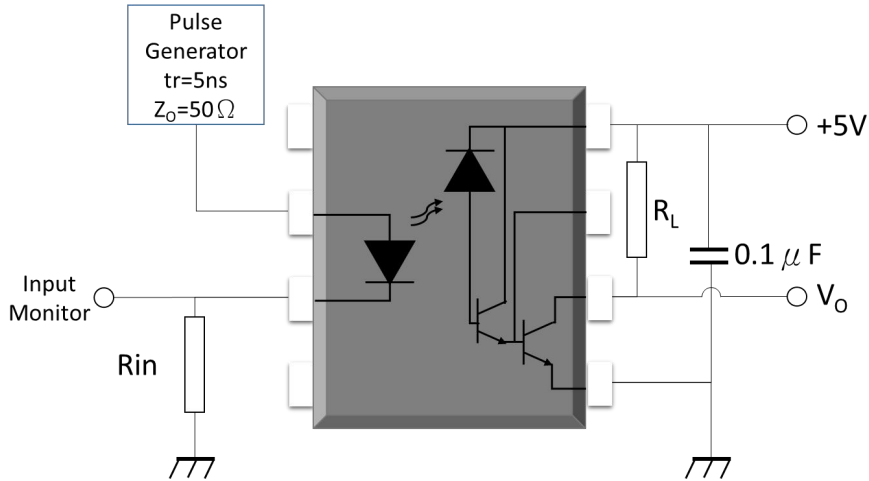
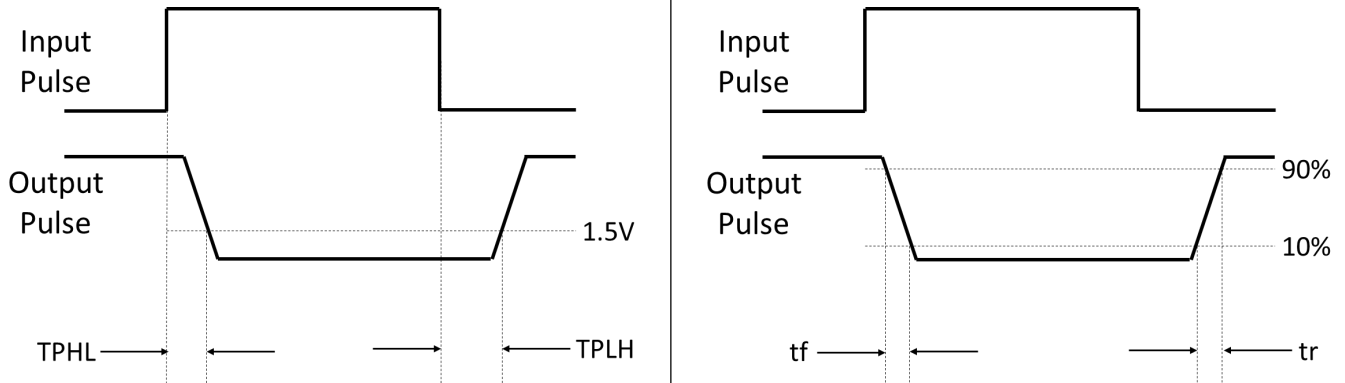


Fig.14 Waveforms of TPHL, TPLH, tr, tf



TEST CIRCUITS

Fig.15 Test Circuits for Common Mode Transient Immunity

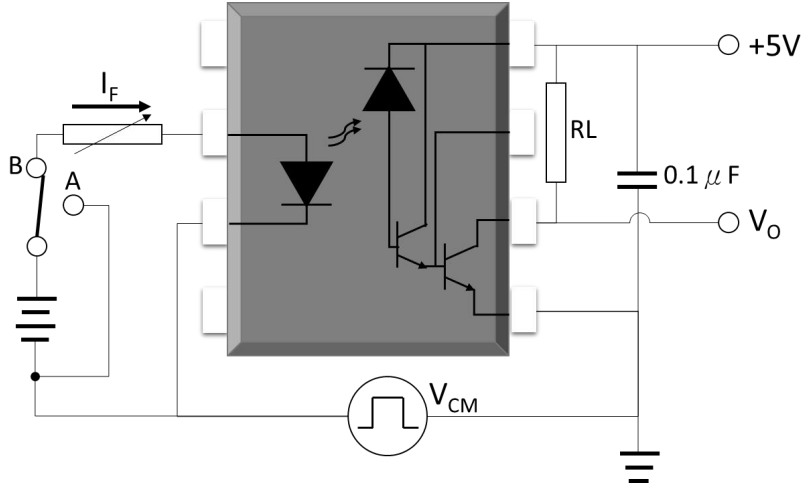
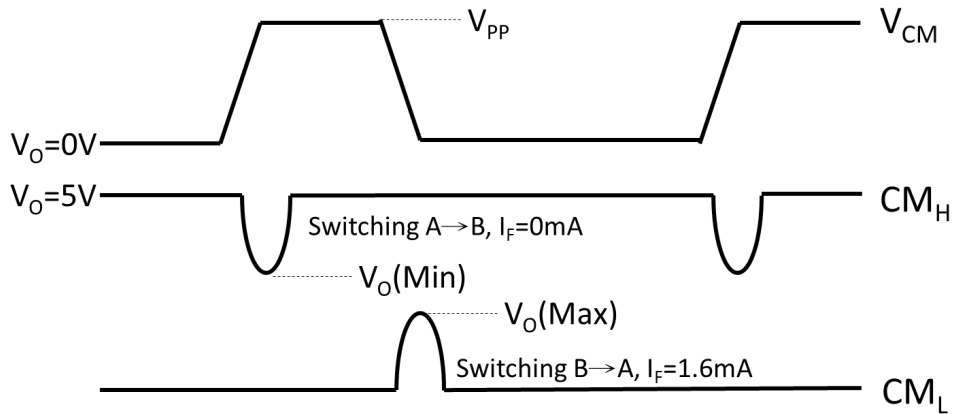


Fig.16 Waveforms of Common Mode Transient Immunity



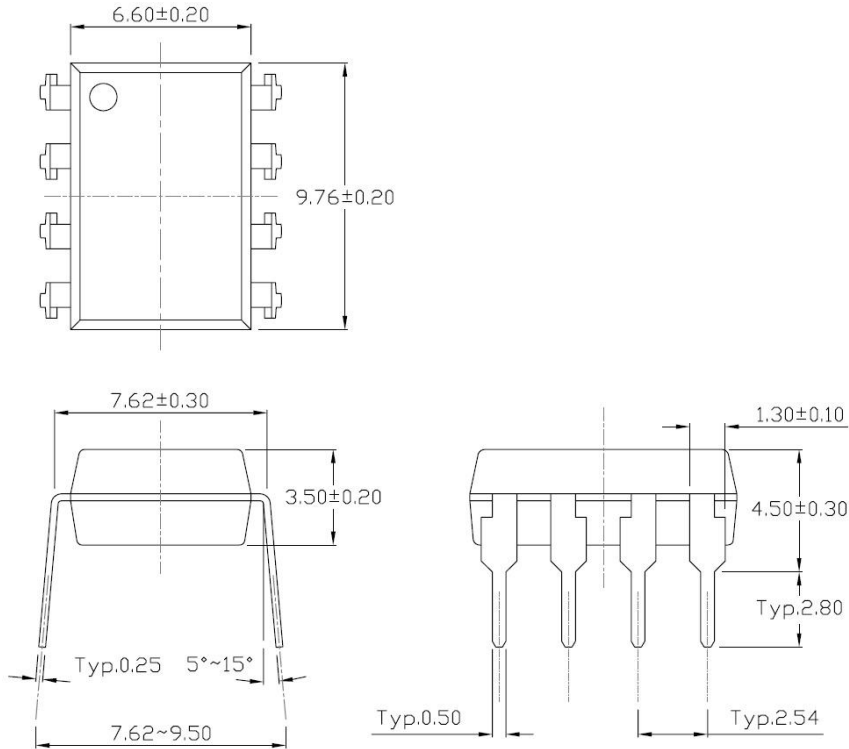


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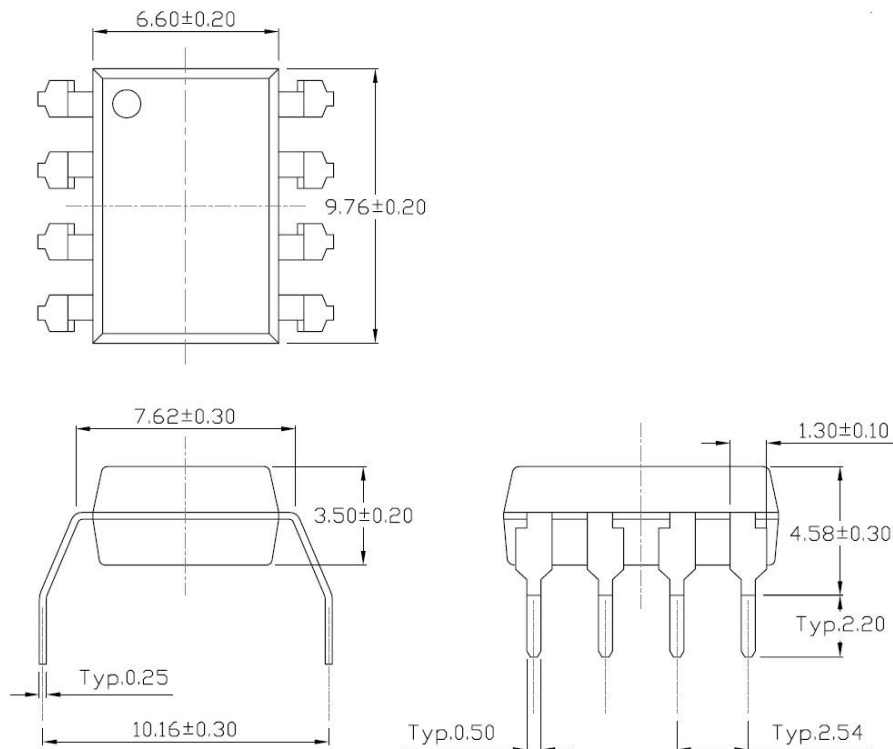
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PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Standard DIP – Through Hole (DIP Type)

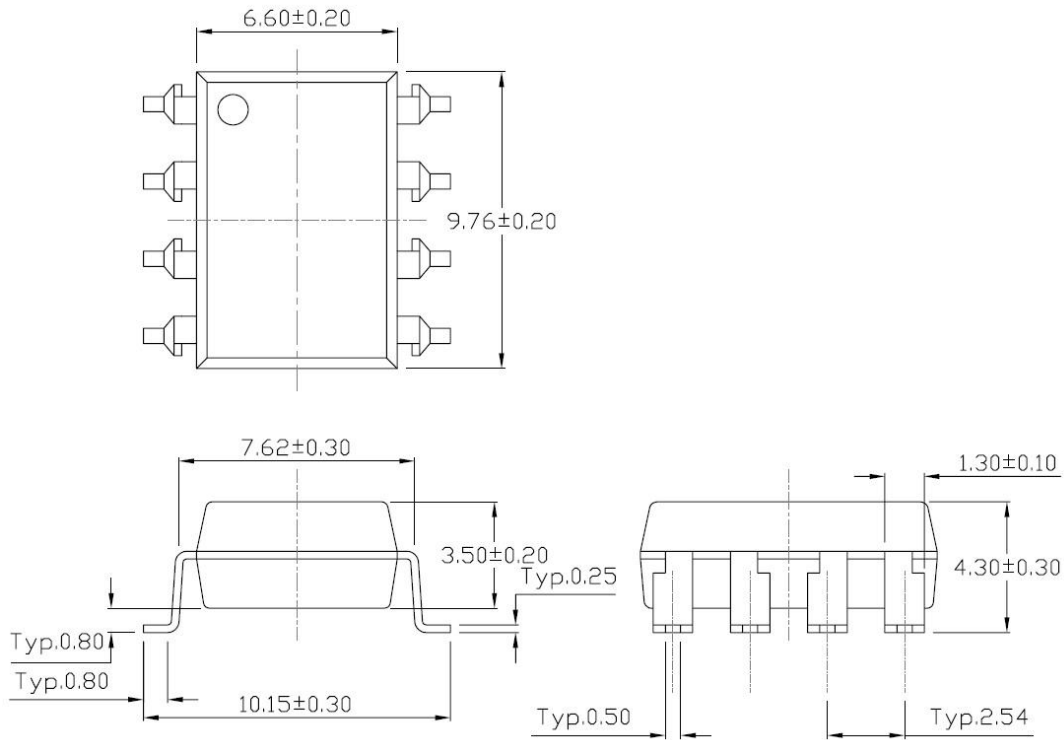


Gullwing (400mil) Lead Forming – Through Hole (M Type)

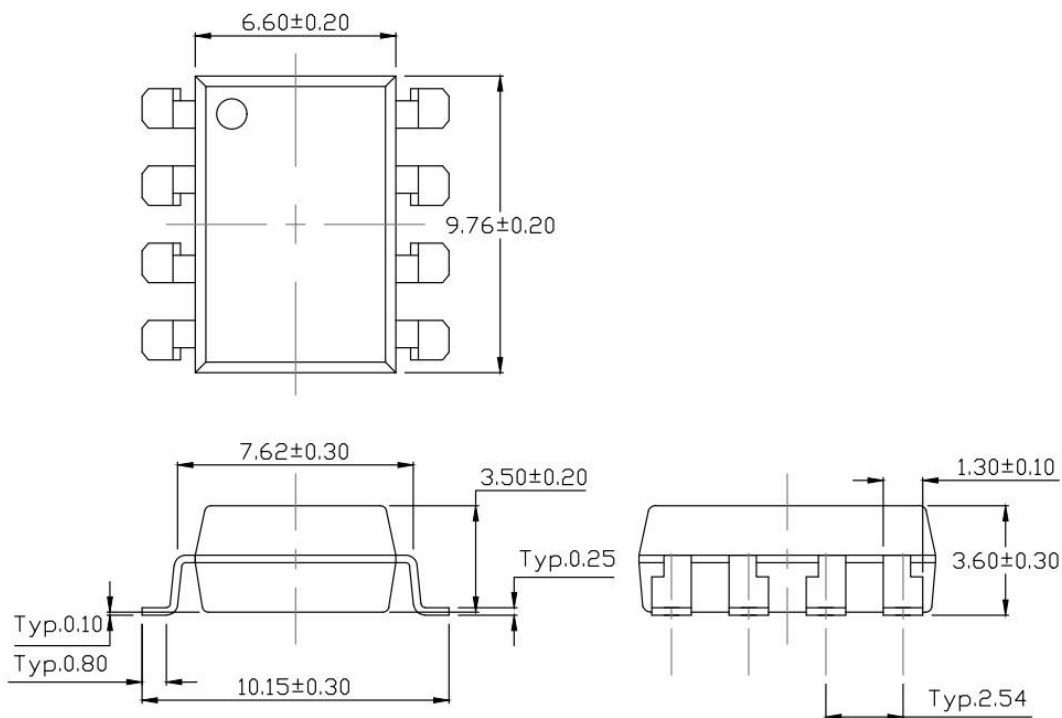


PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Surface Mount Lead Forming (S Type)



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



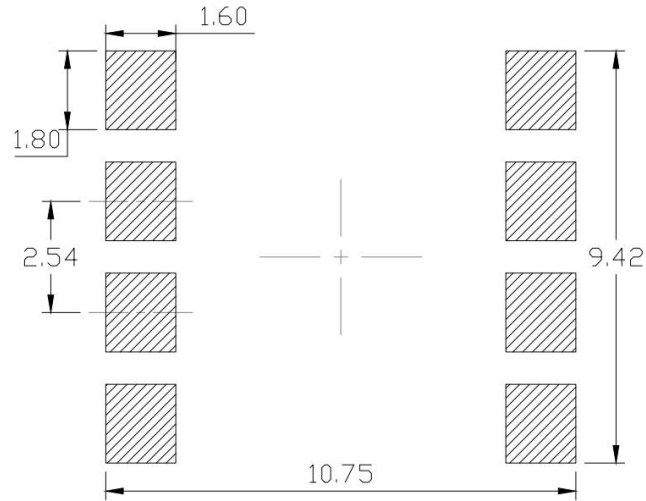


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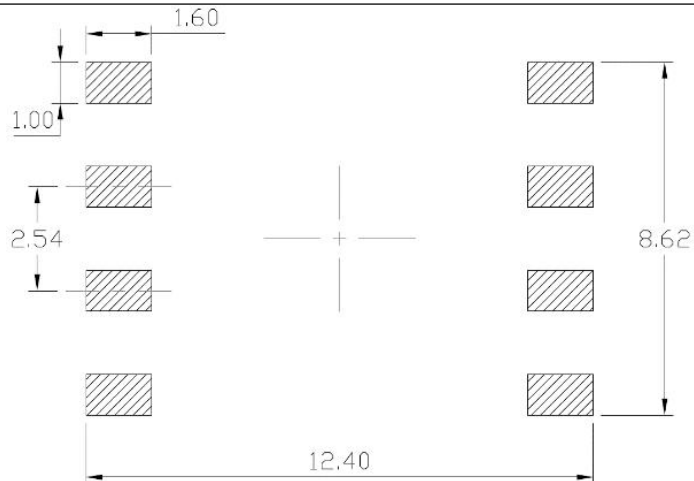
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Recommended Solder Mask (Dimensions in mm unless otherwise stated)

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

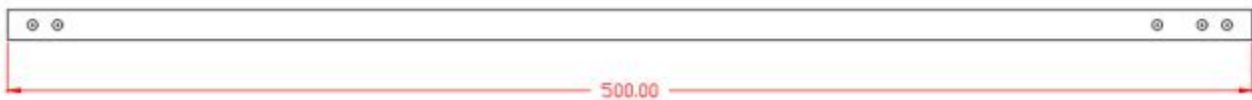
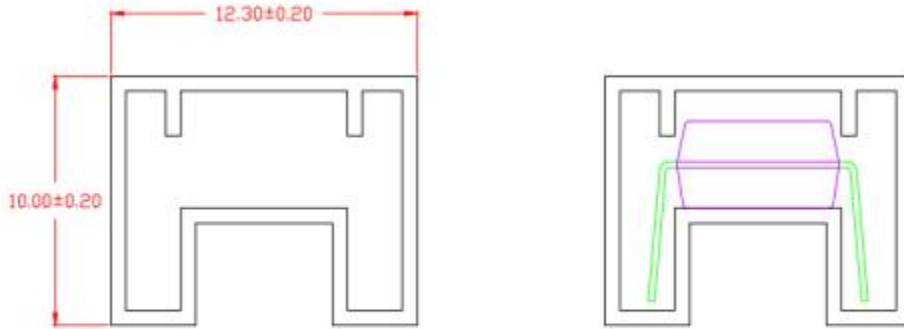


Surface Mount (Gullwing) Lead Forming

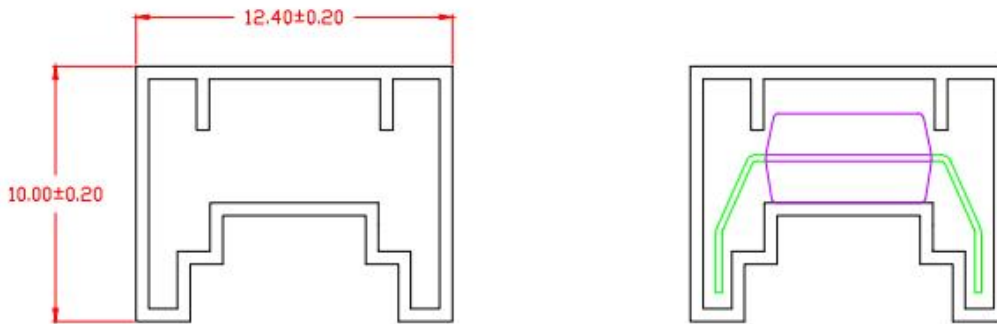


TUBE SPECIFICATIONS (Dimensions in mm unless otherwise stated)

Standard DIP



Option M



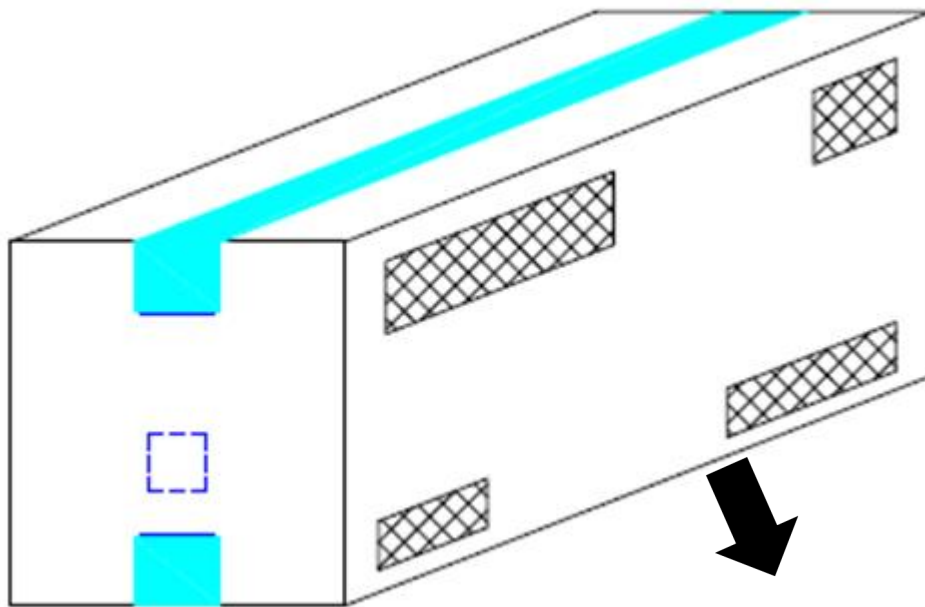
BOX SPECIFICATIONS (Tube Type)

Inner Box

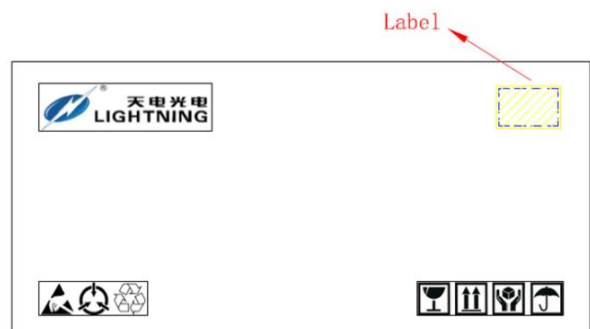


L x W x H = 52.5cm x 10.7cm x 4.7cm

Outer Box

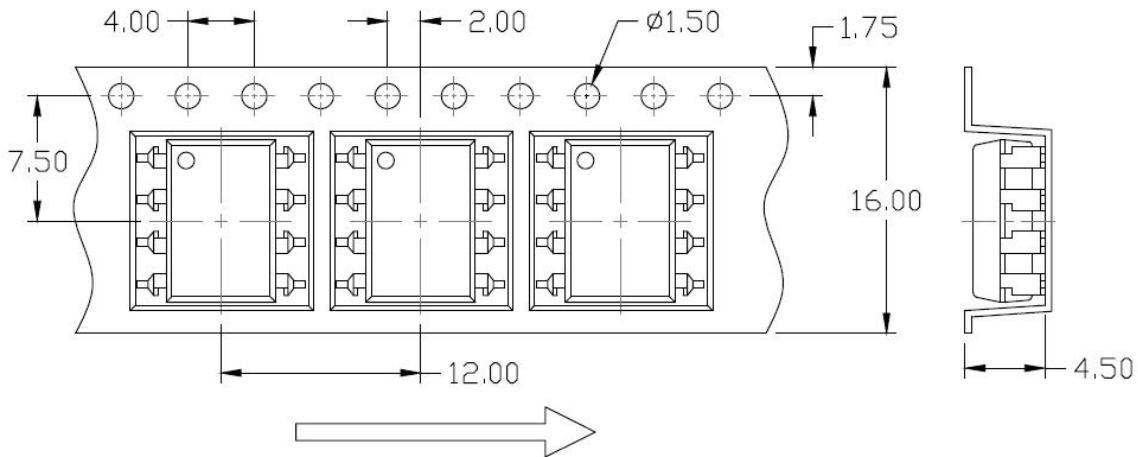


L x W x H = 53.5cm x 23.5cm x 25.5cm

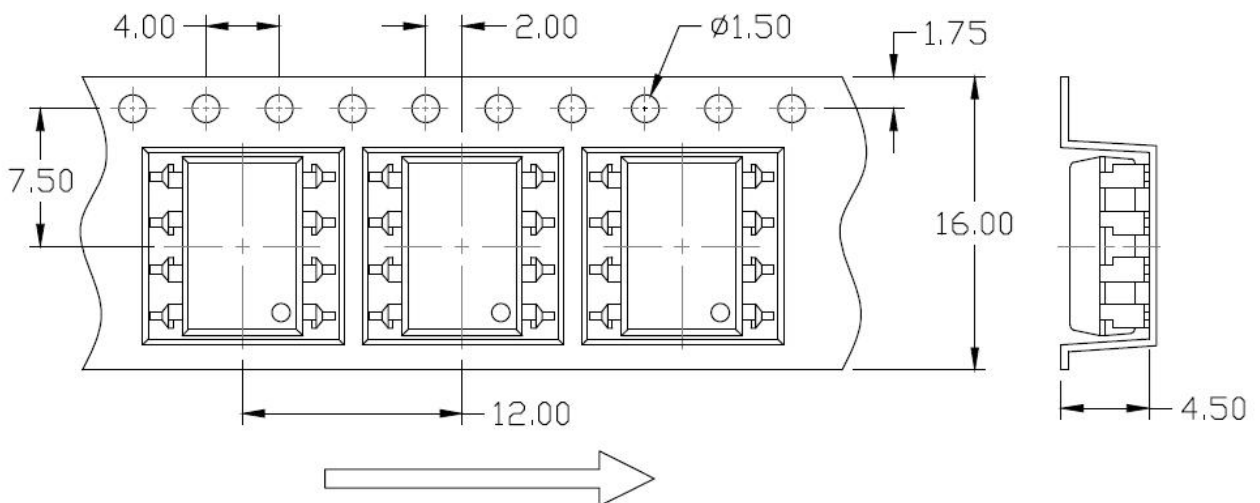


Carrier Tape Specifications (Dimensions in mm unless otherwise stated)

Option S(T1)

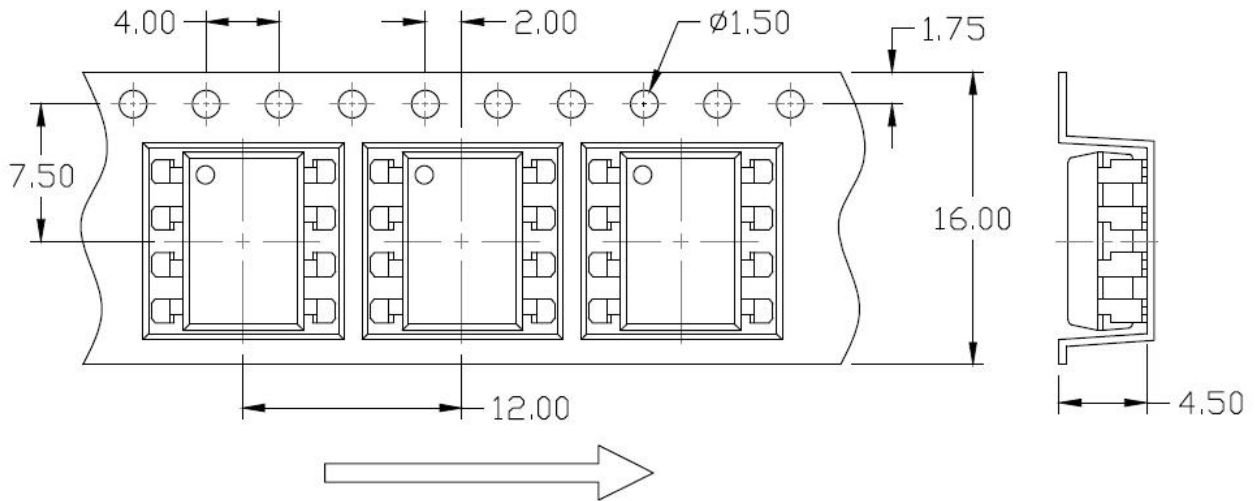


Option S(T2)

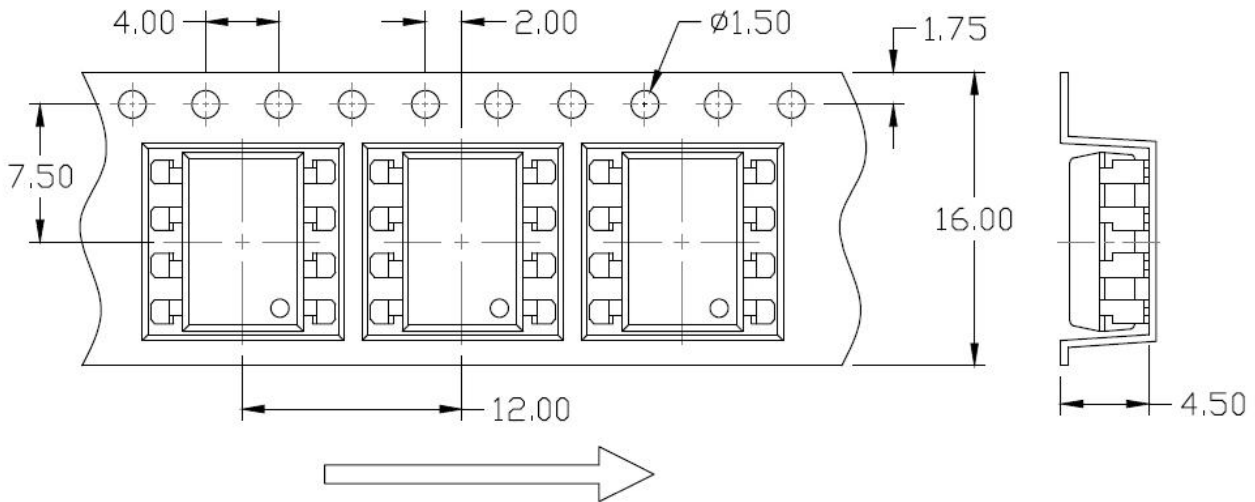


Carrier Tape Specifications (Dimensions in mm unless otherwise stated)

Option SL(T1)

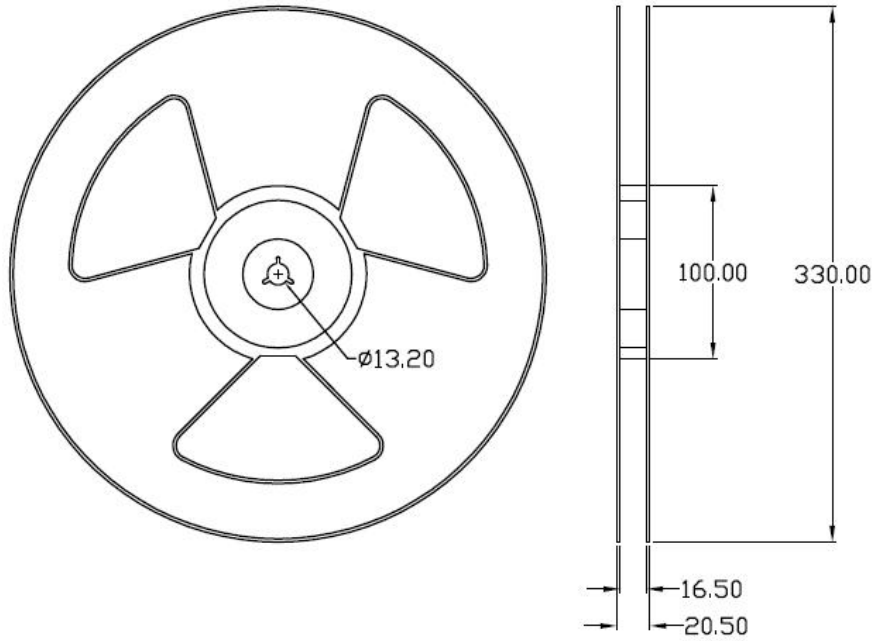


Option SL(T2)



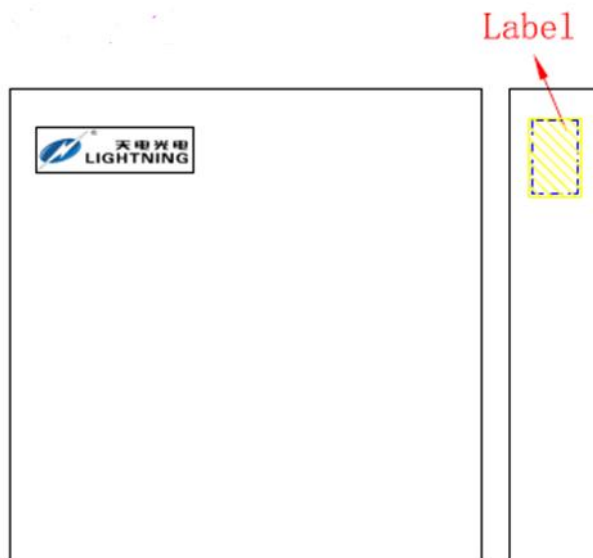
REEL SPECIFICATIONS (Dimensions in mm unless otherwise stated)

Option S & Option SL



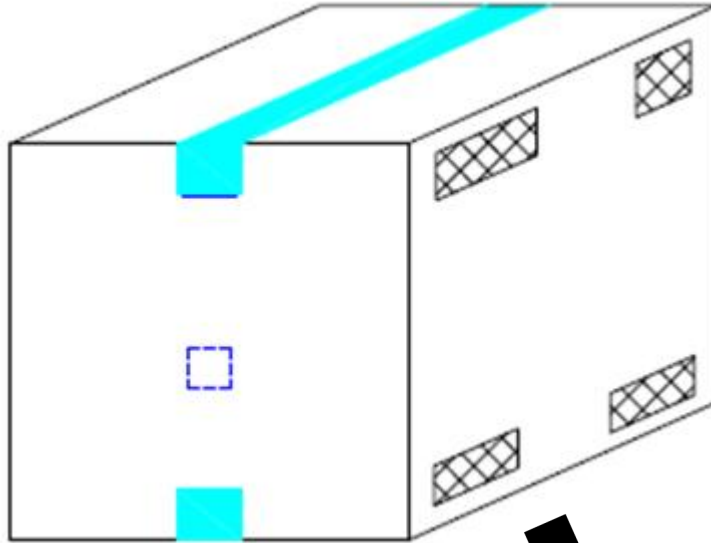
BOX SPECIFICATIONS (Reel Type)

Inner Box

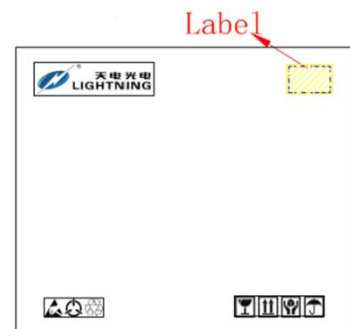


- L x W x H = 36cm x 36cm x 6.9cm

Outer Box



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



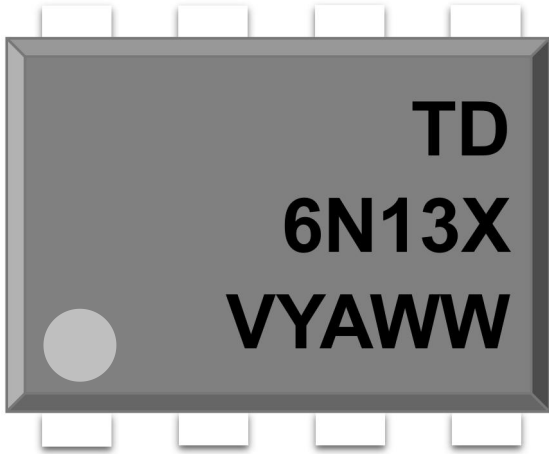


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ORDERING AND MARKING INFORMATION

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

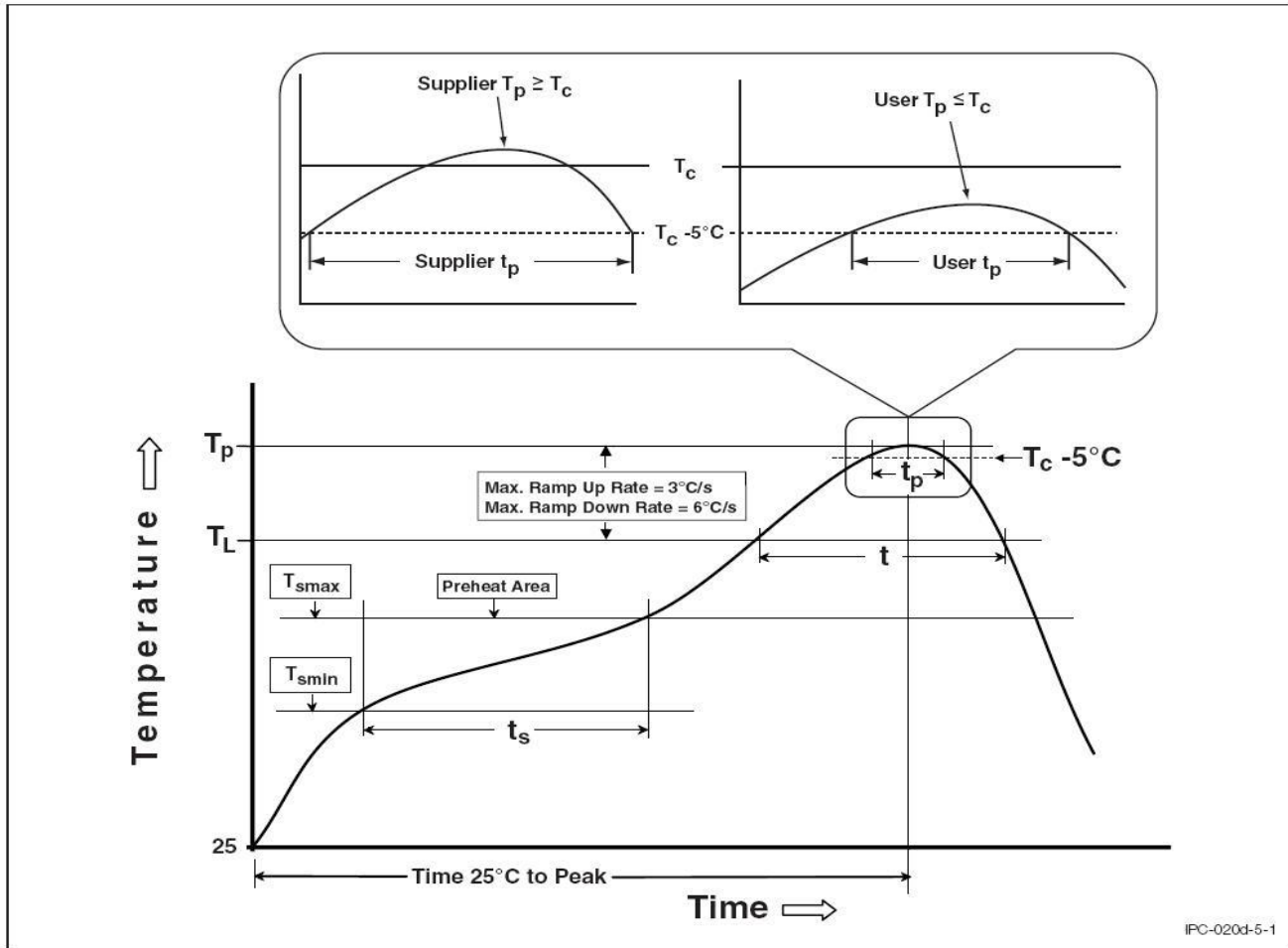


PACKING QUANTITY

Option	Quantity	Quantity – Inner box	Quantity – Outer box
None	45 Units/Tube	32 Tubes/Inner box	10 Inner box/Outer box = 14.4k Units
M	45 Units/Tube	32 Tubes/Inner box	10 Inner box/Outer box = 14.4k 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



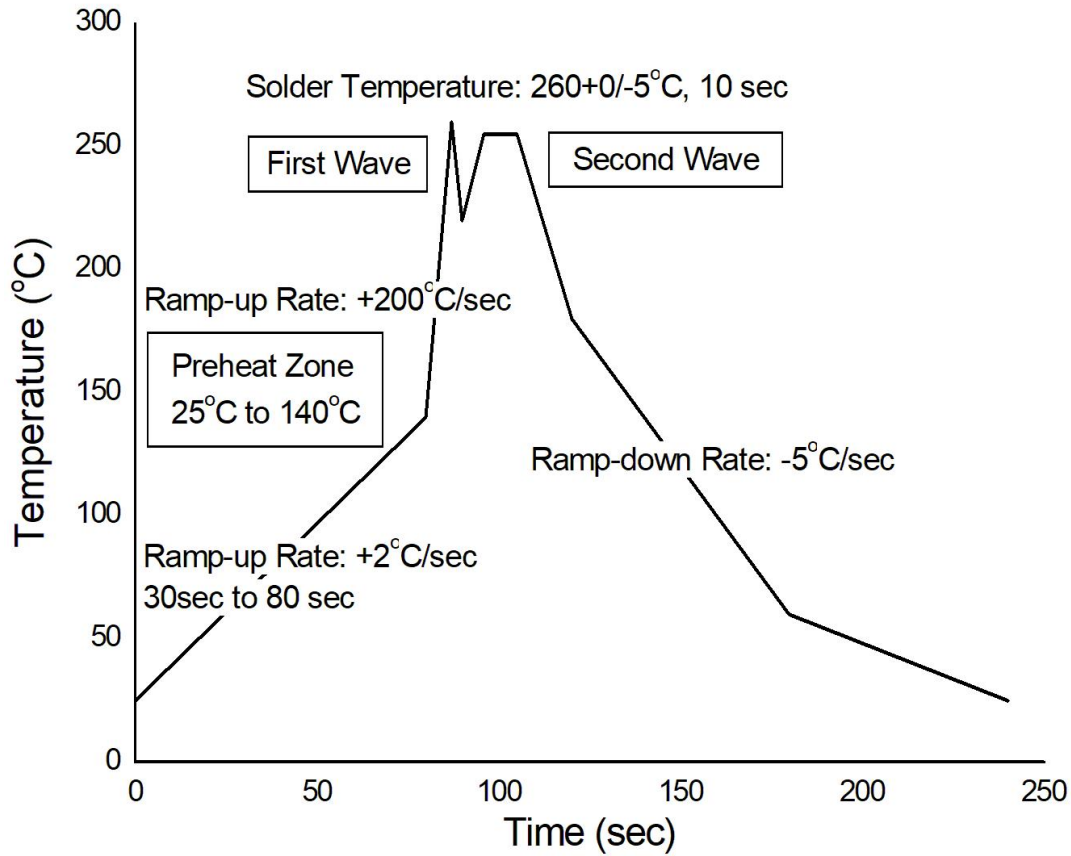
Profile Feature	Sn-Pb Assembly Profile	Pb-Free Assembly Profile
Temperature Min. (Tsmmin)	100	150°C
Temperature Max. (Tsmmax)	150	200°C
Time (ts) from (Tsmmin to Tsmmax)	60-120 seconds	60-120 seconds
Ramp-up Rate (tL to tP)	3°C/second max.	3°C/second max.
Liquidous Temperature (TL)	183°C	217°C
Time (tL) Maintained Above (TL)	60 – 150 seconds	60 – 150 seconds
Peak Body Package Temperature	235°C +0°C / -5°C	260°C +0°C / -5°C
Time (tP) within 5°C of 260°C	20 seconds	30 seconds
Ramp-down Rate (TP to TL)	6°C/second max	6°C/second max
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.



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TEMPERATURE PROFILE OF SOLDERING

WAVE SOLDERING (JESD22-A111 COMPLIANT)



HAND SOLDERING BY SOLDERING IRON

Soldering Temperature	380+0/-5°C
Soldering Time	3 sec max.

- One time soldering is recommended for all soldering method.
- Do not solder more than three times for IR reflow soldering.



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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.