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.

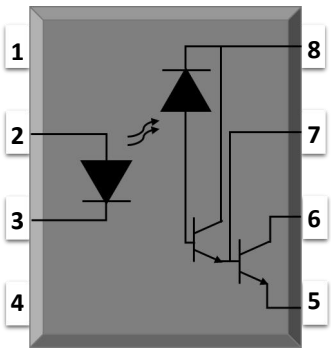
Features

- 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

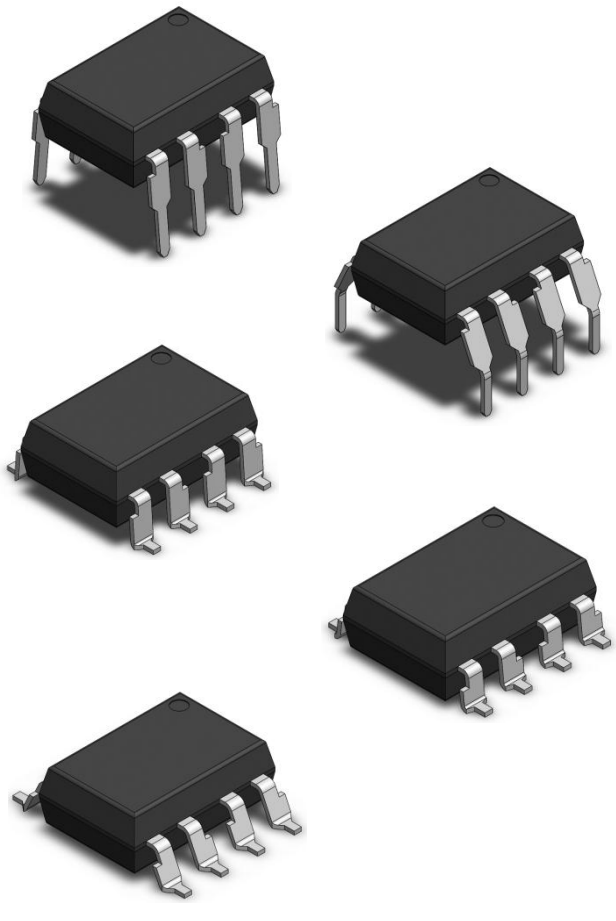
SCHEMATIC



PIN DEFINITION

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

OUTLINE



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	Ptot	200	mW	
Isolation Voltage	Viso	5000	Vrms	3
Operating Temperature	Topr	-55~100	°C	
Storage Temperature	Tstg	-55~150	°C	
Soldering Temperature	Tsol	260	°C	4

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

Note 2. ≤1μs P.W,300pps

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

Note 4. For 10 seconds

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		Cin	-	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		Riso	10^12	10^14	-	Ω	DC500V, 40 ~ 60% R.H.	
Floating Capacitance		C_{IO}	-	0.3	1	pF	V=0, f=1MHz	

ELECTRICAL OPTICAL CHARACTERISTICS								
PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION	NOTE
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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}=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		Riso	10^12	10^14	-	Ω	DC500V, 40 ~ 60% R.H.	
Floating Capacitance		C_{IO}	-	0.3	1	pF	V=0, f=1MHz	

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, RL=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, RL=2.2kΩ, T_A =25°C	Fig.15
	6N138		1000	-	-			

CHARACTERISTIC CURVES

Fig.1 Forward Current vs. Forward Voltage

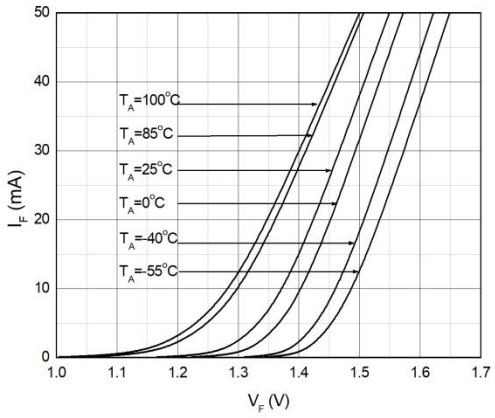


Fig.2 Current Transfer Ratio vs. Forward Current

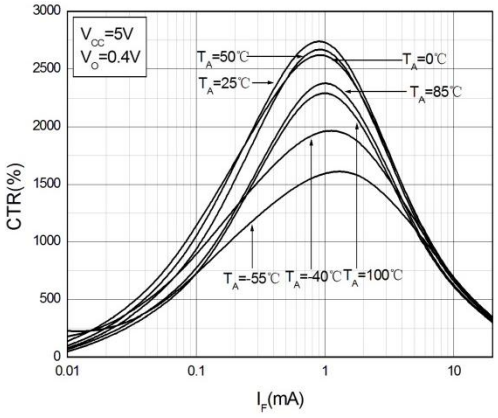


Fig.3 Normalized Current Transfer Ratio vs. Ambient Temperature

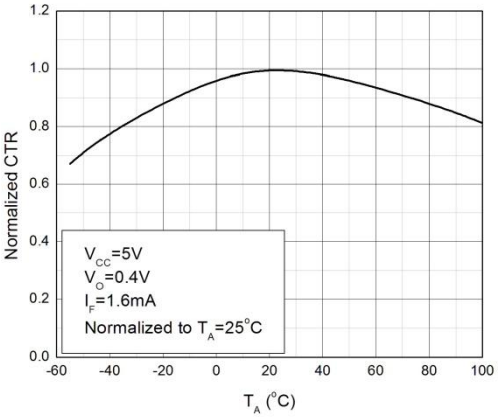


Fig.4 Current Transfer Ratio vs. Base-Emitter Resistance

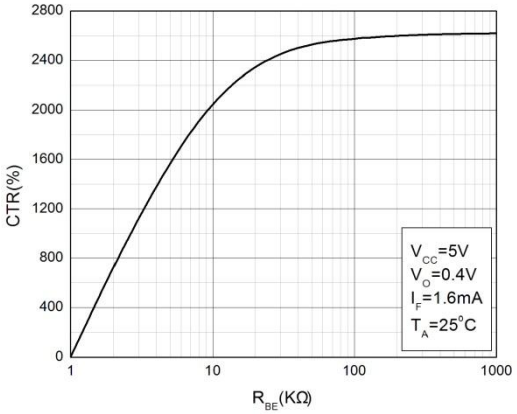


Fig.5 Low Level Output Current vs. Output Voltage

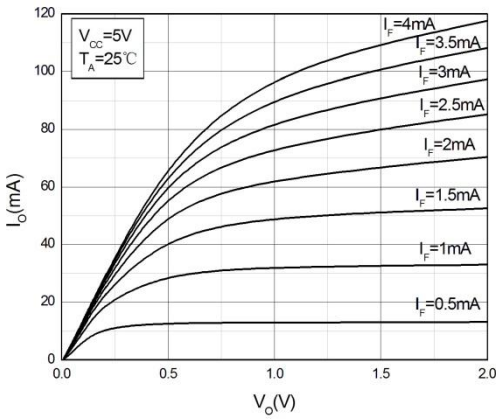
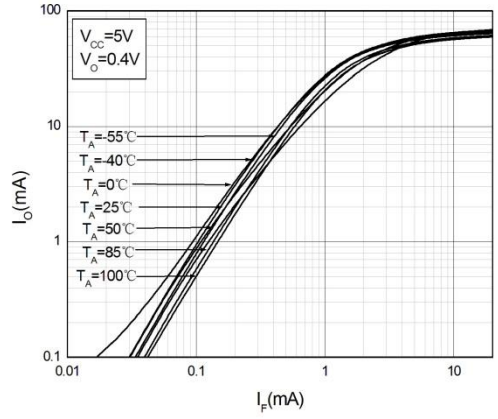


Fig.6 Low Level Output Current vs. Forward Current



CHARACTERISTIC CURVES

Fig.7 High Level Output Current vs. Ambient Temperature

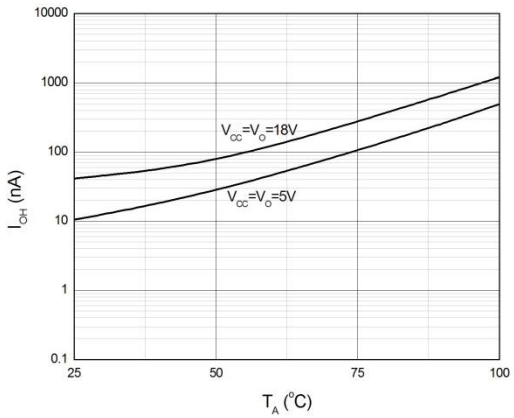


Fig.8 Propagation Delay vs. Pulse Width

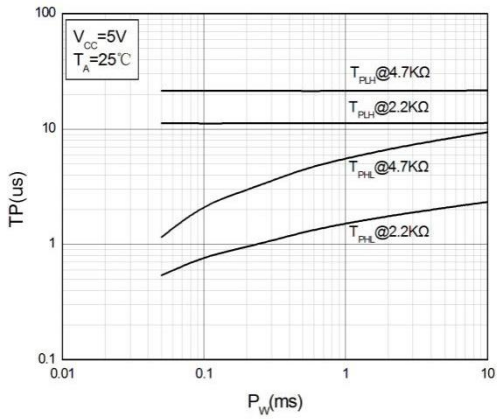


Fig.9 Rise and Fall Time vs. Load Resistance

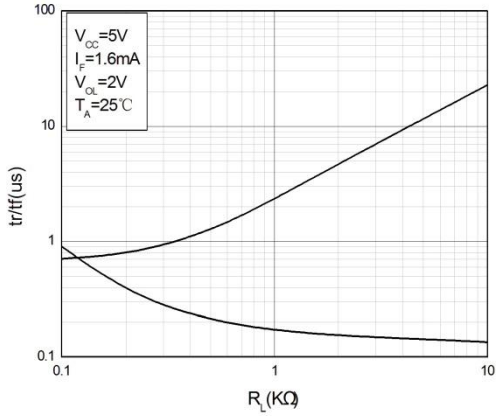


Fig.10 Propagation Delay vs. Ambient Temperature

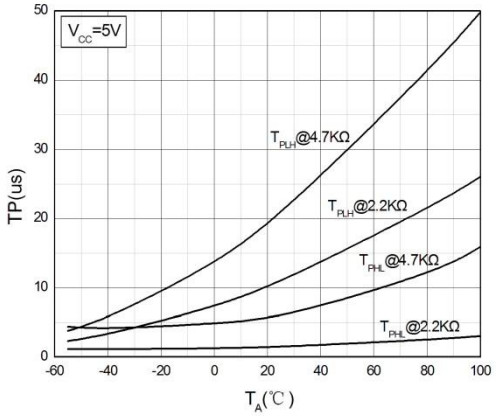


Fig.11 Propagation Delay vs. Forward Current

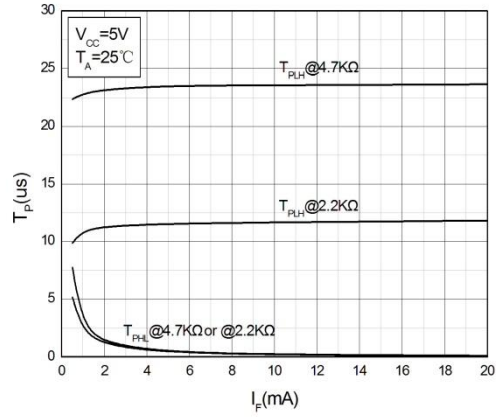
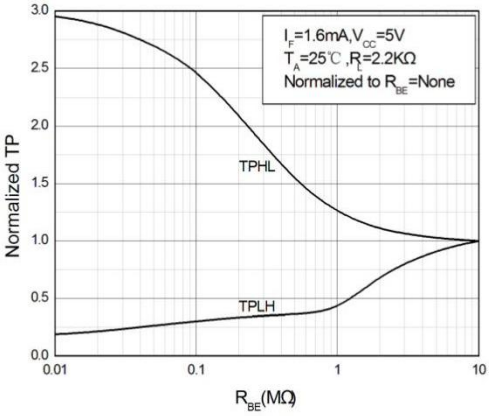


Fig.12 Propagation Delay vs. Base-Emitter Resistance



TEST CIRCUITS

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

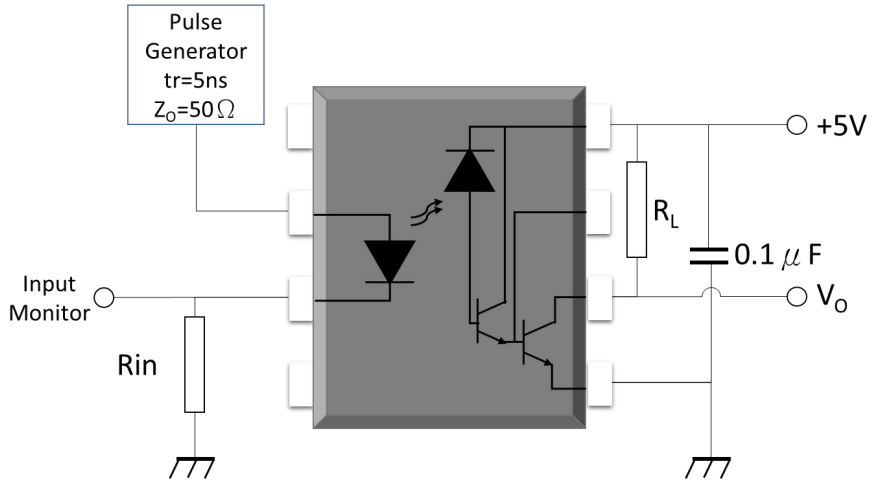
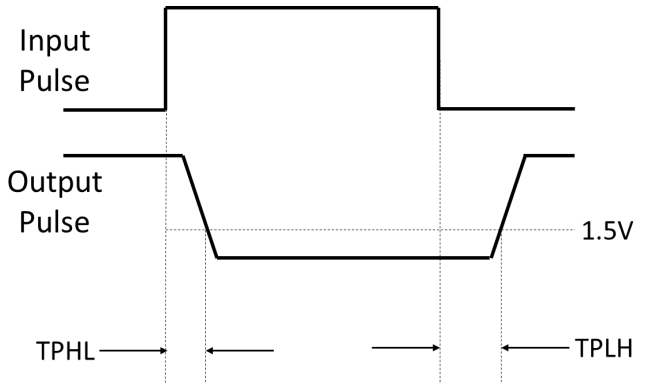
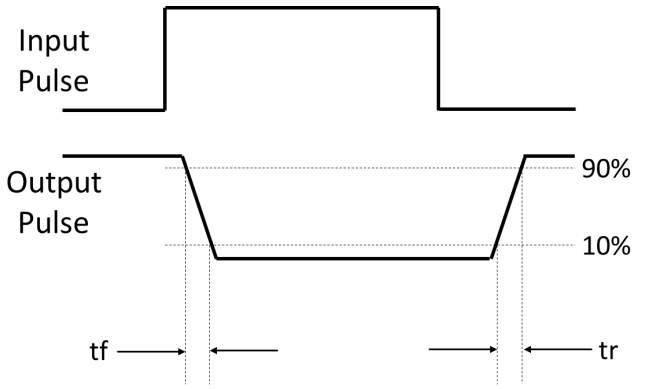


Fig.14 Waveforms of TPHL, TPLH, tr, tf





TEST CIRCUITS

Fig.15 Test Circuits for Common Mode Transient Immunity

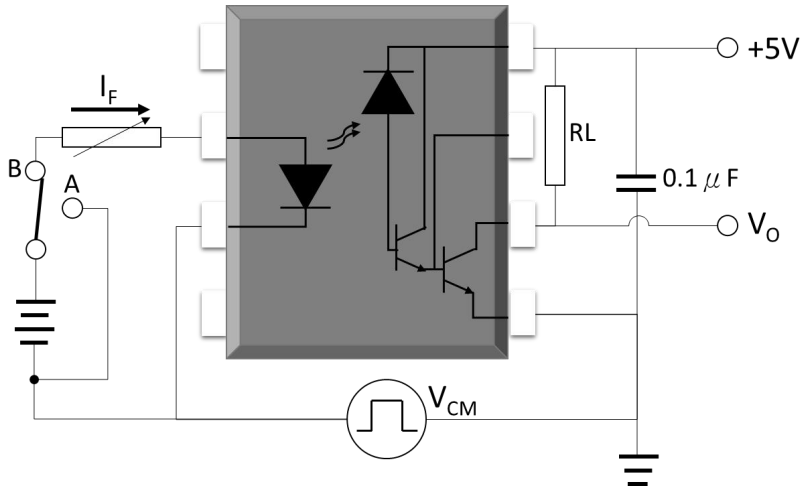
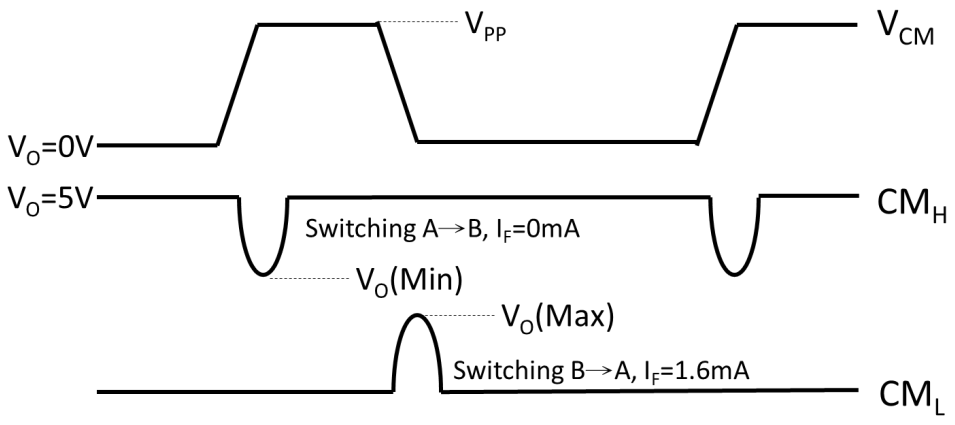
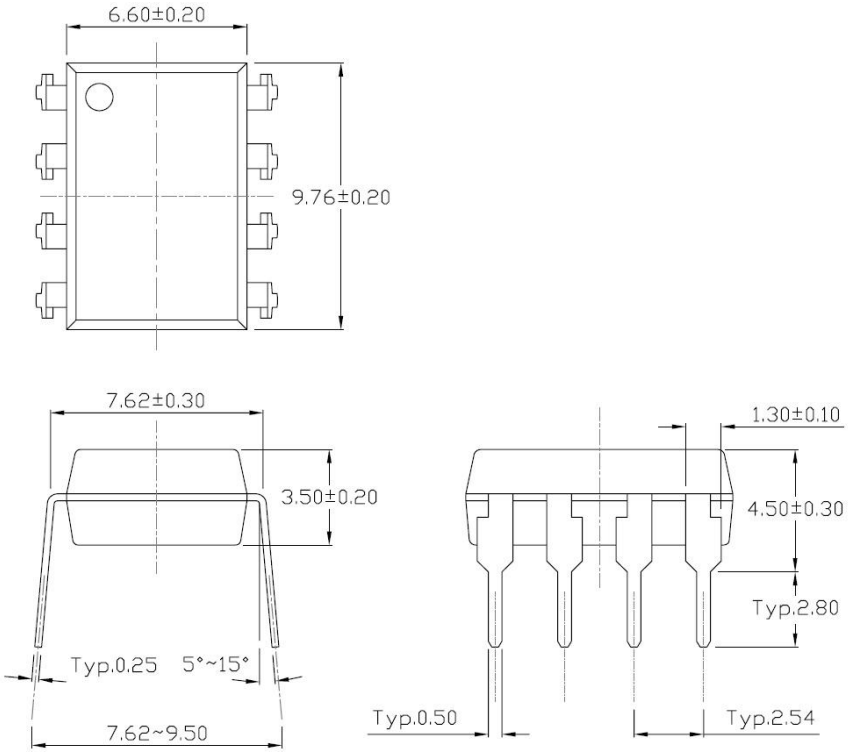


Fig.16 Waveforms of Common Mode Transient Immunity

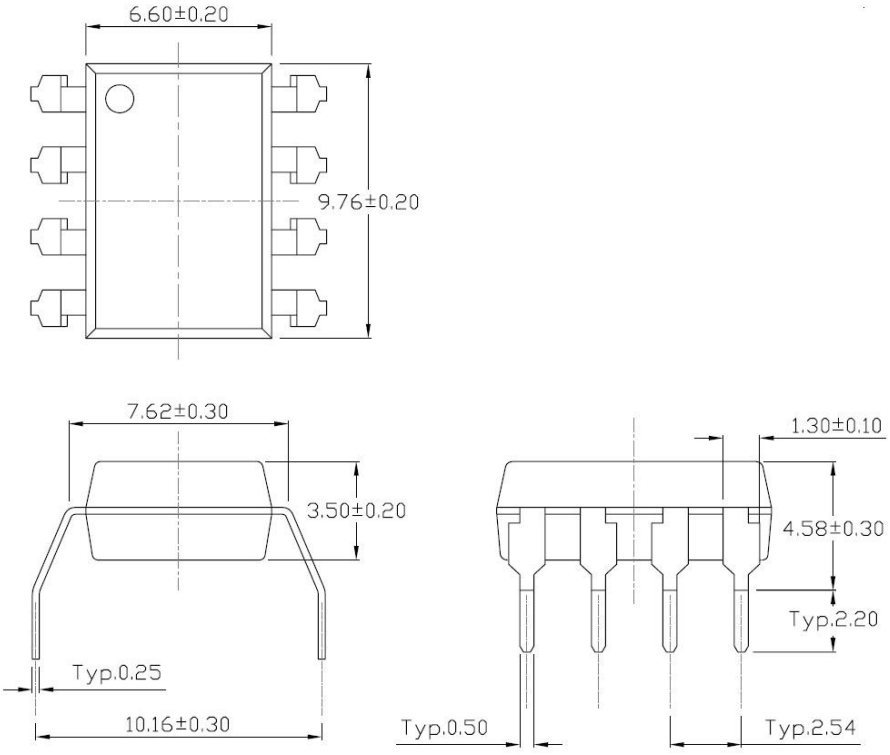


PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Standard DIP – Through Hole (DIP Type)

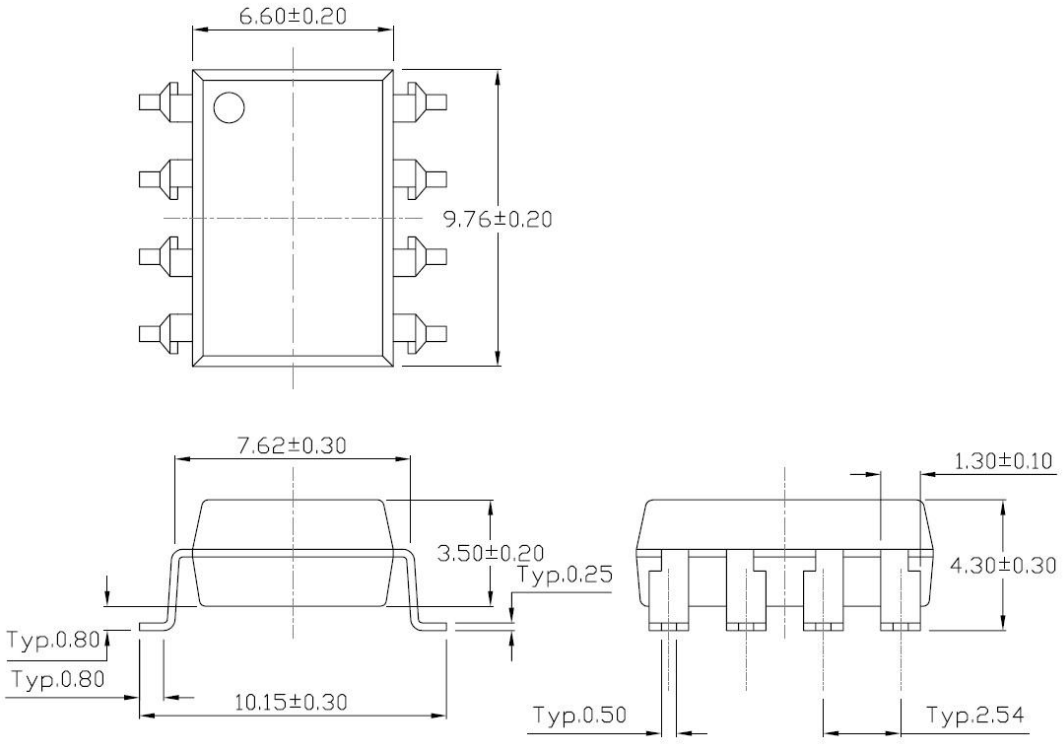


Gullwing (400mil) Lead Forming – Through Hole (M Type)

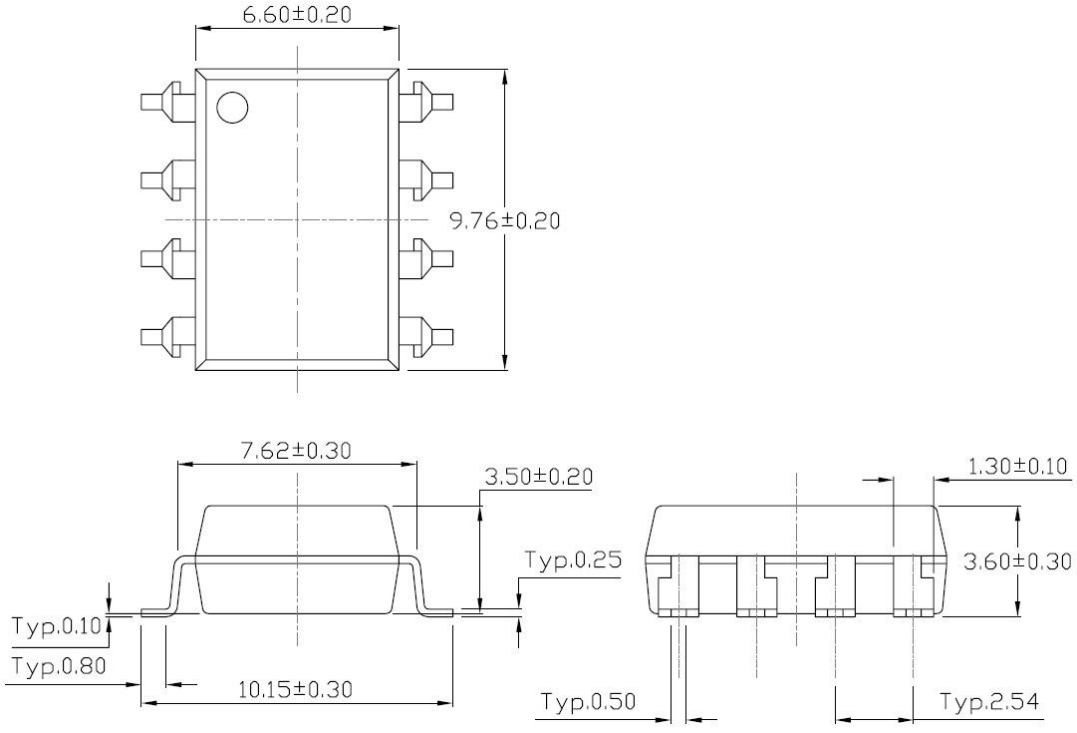


PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Surface Mount Lead Forming (S Type)

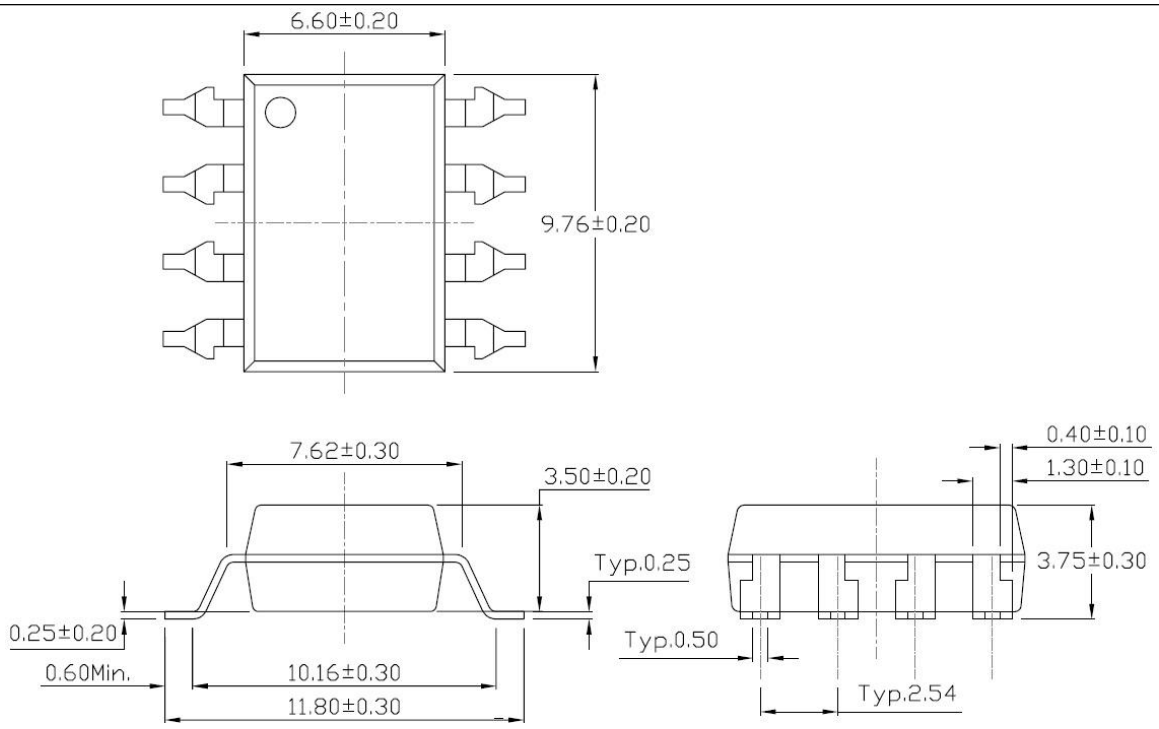


Surface Mount (Low Profile) Lead Forming (SL Type)



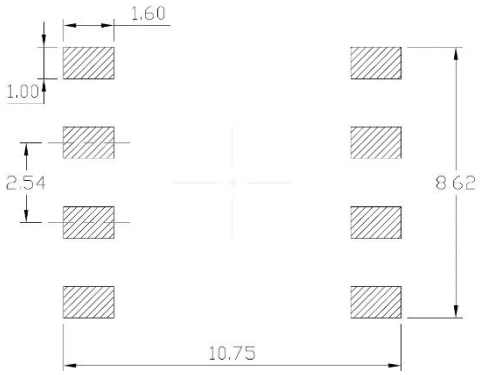
PACKAGE DIMENSIONS (Dimensions in mm unless otherwise stated)

Surface Mount (Gullwing) Lead Forming (SLM Type)

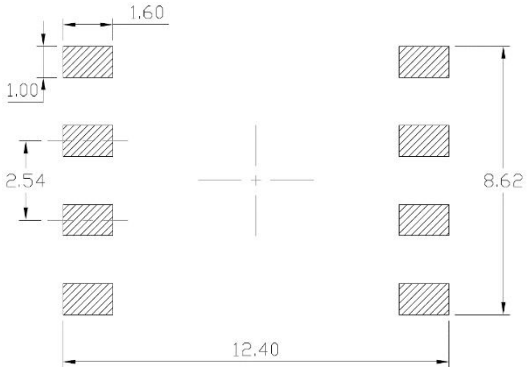


Recommended Solder Mask (Dimensions in mm unless otherwise stated)

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

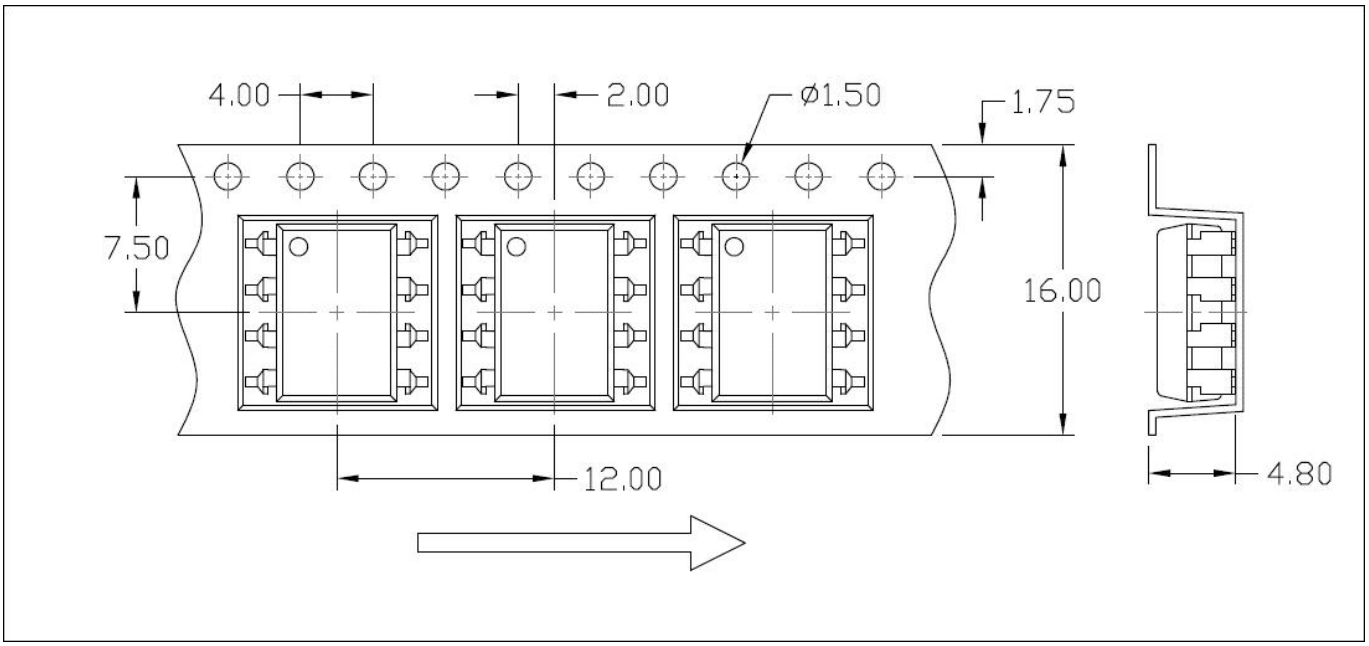


Surface Mount (Gullwing) Lead Forming

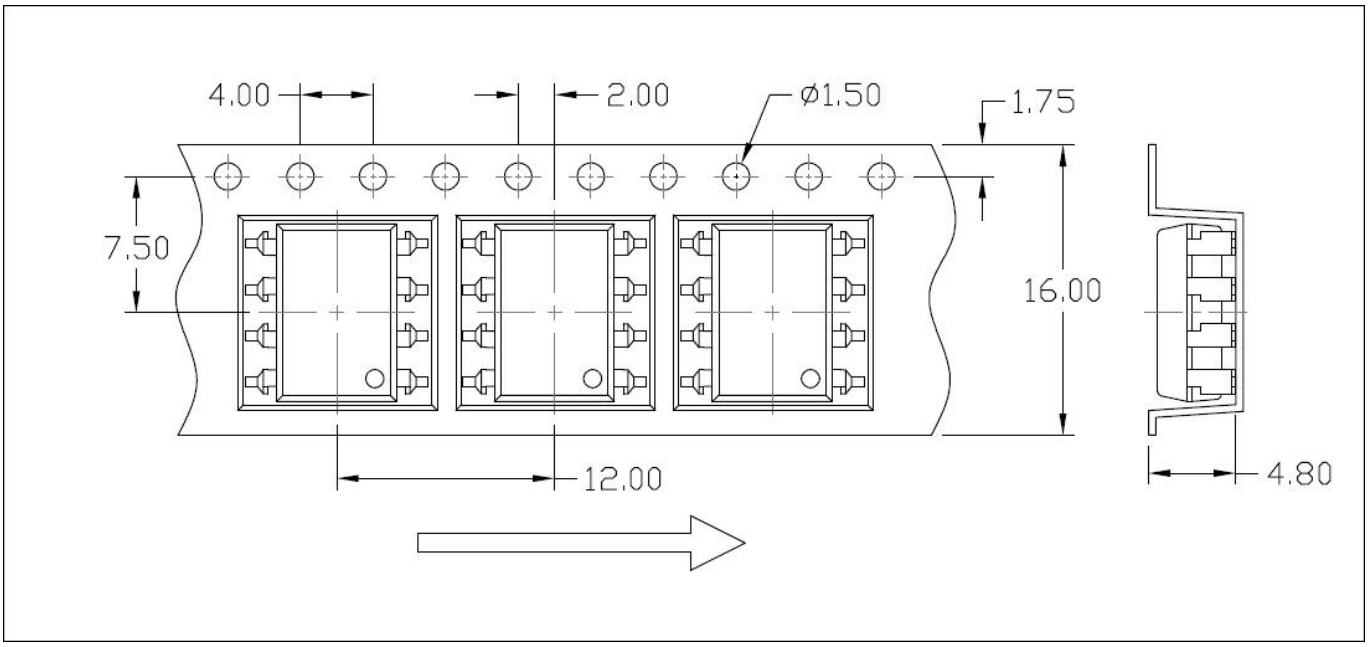


Carrier Tape Specifications (Dimensions in mm unless otherwise stated)

Option S(T1) & SL(T1)

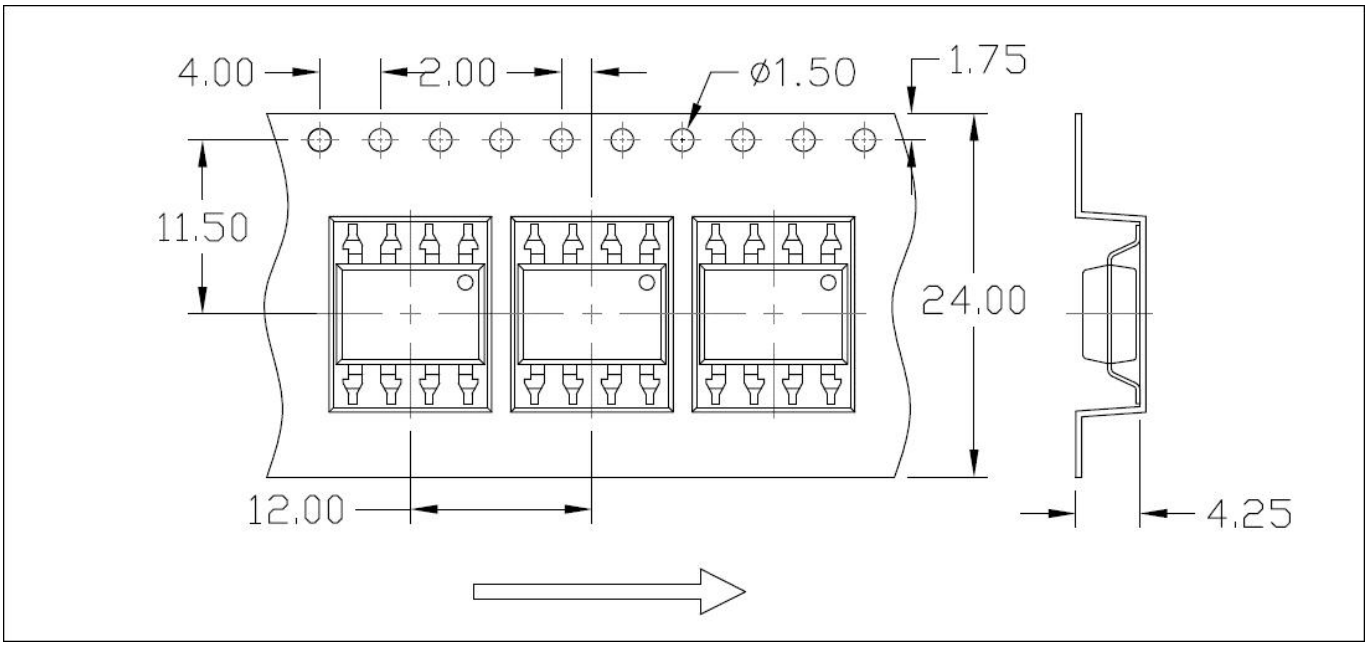


Option S(T2) & SL(T2)

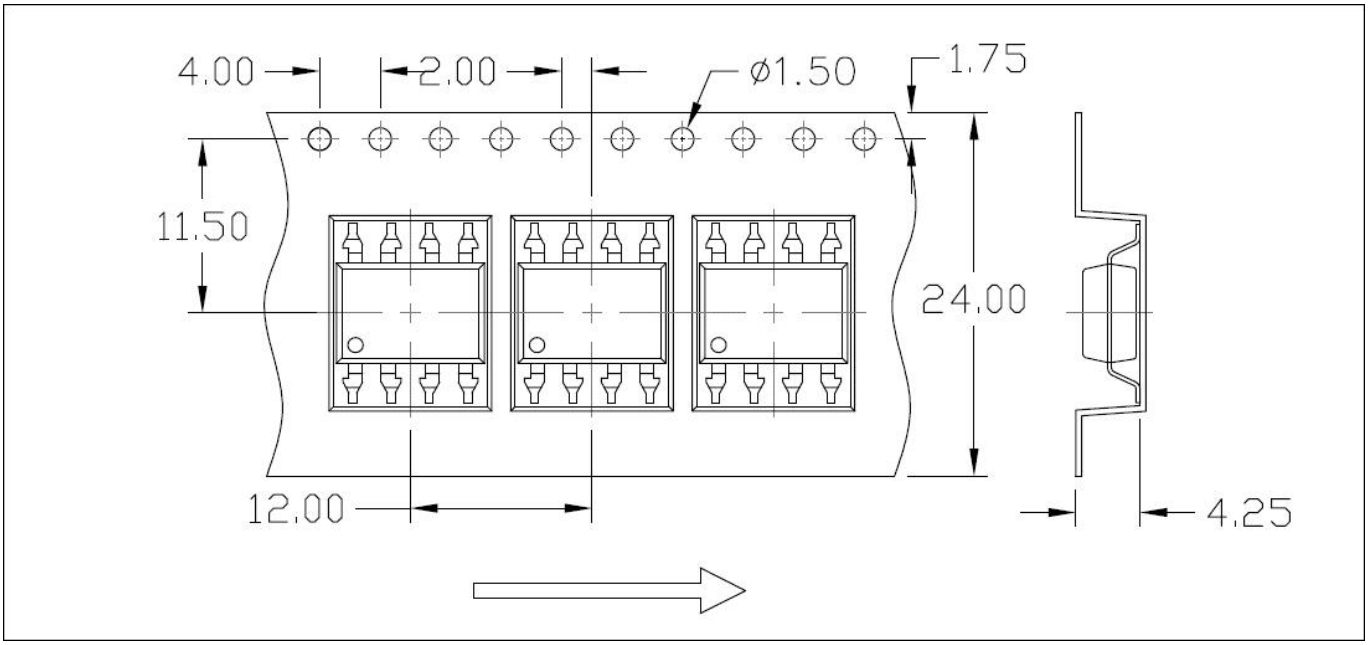


Carrier Tape Specifications (Dimensions in mm unless otherwise stated)

Option SLM(T1)

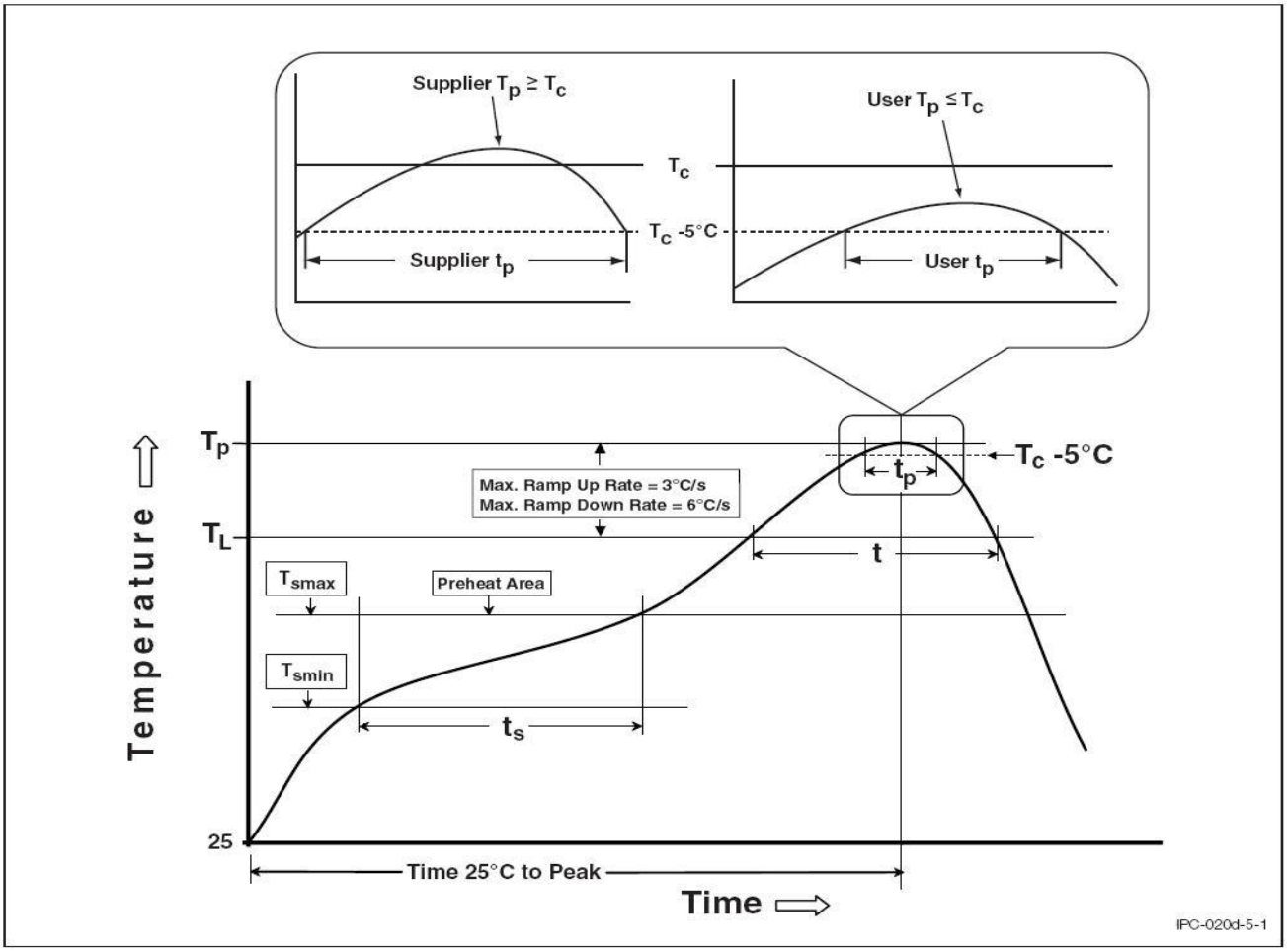


Option SLM(T2)



REFLOW INFORMATION

REFLOW PROFILE



Profile Feature	Sn-Pb Assembly Profile	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	100	150°C
Temperature Max. (Tsmax)	150	200°C
Time (ts) from (Tsmin to Tsmax)	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.