



Low Input Current Photodarlington Coupler

Features

- Low current – 0.5mA
- Superior CTR-2000%
- CTR guaranteed 0–70°C
- MSL class 1
- Regulatory Approvals
 - ✓ UL - UL1577 (E364000)
 - ✓ VDE - EN60747-5-5(VDE0884-5)
 - ✓ CQC – GB4943.1, GB8898(14001104999)
 - ✓ IEC62368 (FI/41119)

Applications

- Digital logic ground isolation
- Telephone ring detector
- EIA-RS-232C line receiver
- High common mode noise line receiver
- μ P bus isolation
- Current loop receiver

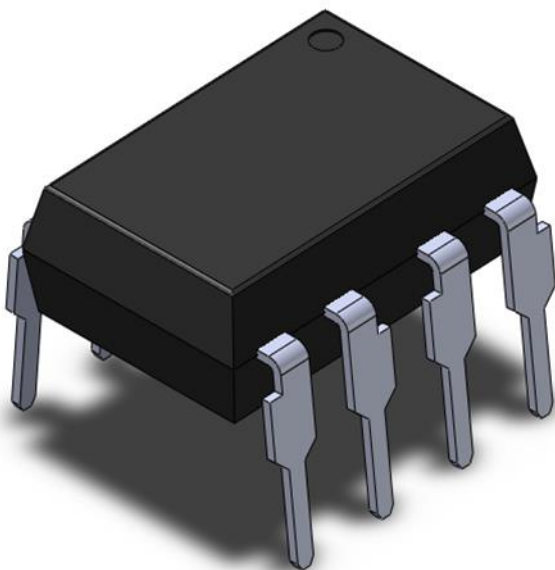
Description

The 6N138 & 6N139 optocouplers consist of an AlGaAs LED optically coupled to a high gain split darlington photodetector.

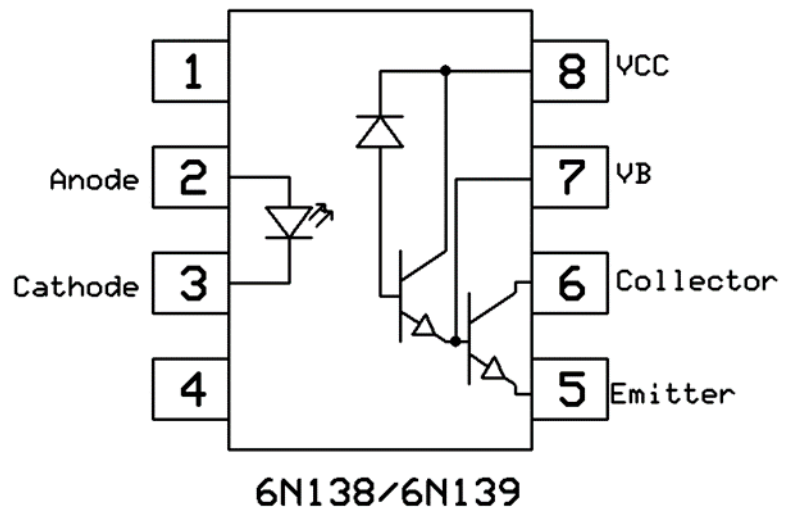
The combination of a very low input current of 0.5mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements.

The devices are packaged in an 8-pin DIP package and also available in gullwing (400mil) spacing and surface mount lead forming option.

Package Outline



Schematic



Note: Different lead forming options available. See package dimension.



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www.ct-micro.com**Absolute Maximum Ratings** $T_A = 25^\circ\text{C}$, unless otherwise specified

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameters	Ratings	Units	Notes
V _{ISO}	Isolation voltage (AC, 1 minute, 40 ~ 60% R.H.)	5000	V _{RMS}	
T _{OPR}	Operating temperature	-55 ~ +100	°C	
T _{STG}	Storage temperature	-55 ~ +125	°C	
T _{SOL}	Soldering temperature (For 10 seconds)	260	°C	
Emitter				
I _F	Forward current	25	mA	
I _{FP}	Peak forward current (50% duty, 1ms P.W)	50	mA	
I _{F(TRANS)}	Peak transient current (≤1μs P.W,300pps)	1	A	
V _R	Reverse voltage	5	V	
P _C	Power dissipation	40	mW	
Detector				
P _D	Power dissipation	100	mW	
V _{EBR}	Emitter-Base reverse voltage	0.5	V	
I _O	Output Current	60	mA	
V _O	Output voltage	6N138	-0.5 to 7	V
		6N139	-0.5 to 18	V
V _{CC}	Supply voltage	6N138	-0.5 to 7	V
		6N139	-0.5 to 18	V



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www.ct-micro.com**Electrical Characteristics** $T_A = 0 - 70^\circ\text{C}$, $V_{CC}=4.5\text{V}$ (unless otherwise specified).**Emitter Characteristics**

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
V_F	Forward voltage	$I_F = 16\text{mA}$	-	1.45	1.6	V	
I_R	Reverse Current	$V_R = 5\text{V}$	-	-	5	μA	
$\Delta V_F/\Delta T_A$	Temperature coefficient of forward voltage	$I_F = 16\text{mA}$	-	-1.8	-	$\text{mV}/^\circ\text{C}$	

Detector Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
I_{OH}	Logic High Output Current	$I_F=0\text{mA}$, $V_O=V_{CC}=18\text{V}$,	-	0.008	80	μA	
			-	-	200		
I_{CCL}	Logic Low Supply Current	$I_F=1.6\text{mA}$, $V_O=\text{Open}$, $V_{CC}=18\text{V}$	-	0.5	1.4	mA	
I_{CCH}	Logic High Supply Current	$I_F=0\text{mA}$, $V_O=\text{Open}$, $V_{CC}=18\text{V}$	-	0.04	8	μA	

Transfer Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
CTR	Current Transfer Ratio	$I_F=0.5\text{mA}$, $V_O=0.4\text{V}$,	400	2500	-	%	
		$I_F=1.6\text{mA}$, $V_O=0.5\text{V}$,	300	2000	-		
			500	2000	-		
V_{OL}	Logic Low Output Voltage	$I_F=0.5\text{mA}$, $I_O=2\text{mA}$	-	0.04	0.4	V	
		$I_F=1.6\text{mA}$, $I_O=8\text{mA}$	-	0.08	0.4		
		$I_F=5\text{mA}$, $I_O=15\text{mA}$	-	0.11	0.4		
		$I_F=12\text{mA}$, $I_O=24\text{mA}$	-	0.16	0.4		
		$I_F=1.6\text{mA}$, $I_O=4.8\text{mA}$	-	0.05	0.4		



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Electrical Characteristics $T_A = 0 - 70^\circ\text{C}$, $V_{CC} = 5\text{V}$ (unless otherwise specified).

Switching Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
T_{PHL}	High to Low Propagation Delay	6N139	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	-	-	30	μs
			$T_A = 25^\circ\text{C}$	-	4.8	25	
		6N138	$I_F = 12\text{mA}$, $R_L = 250\Omega$	-	-	2	
			$T_A = 25^\circ\text{C}$	-	0.2	1	
T_{PLH}	Low to High Propagation Delay	6N139	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}\Omega$	-	-	90	μs
			$T_A = 25^\circ\text{C}$	-	15	60	
		6N138	$I_F = 12\text{mA}$, $R_L = 250\Omega$	-	-	10	
			$T_A = 25^\circ\text{C}$	-	1.6	7	
CM_H	Common Mode Transient Immunity at Logic High	$I_F = 0\text{mA}$, $ V_{CM} = 10V_{P-P}$, $T_A = 25^\circ\text{C}$, $R_L = 2.2\text{k}\Omega$	1,000	-	-	$V/\mu\text{s}$	
CM_L	Common Mode Transient Immunity at Logic Low	$I_F = 1.6\text{mA}$, $ V_{CM} = 10V_{P-P}$, $T_A = 25^\circ\text{C}$, $R_L = 2.2\text{k}\Omega$	1,000	-	-	$V/\mu\text{s}$	



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Typical Characteristic Curves $T_A = 25^\circ\text{C}$, unless otherwise specified

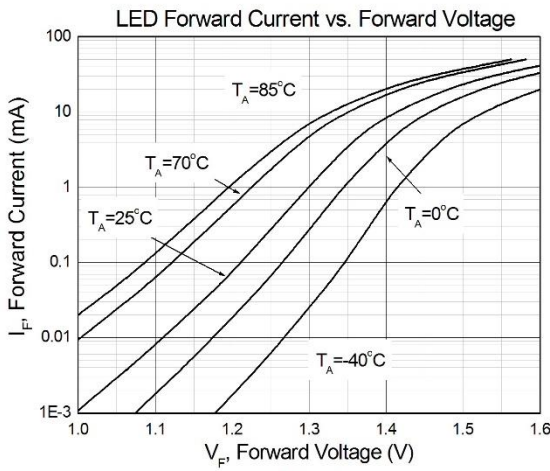


Figure 1

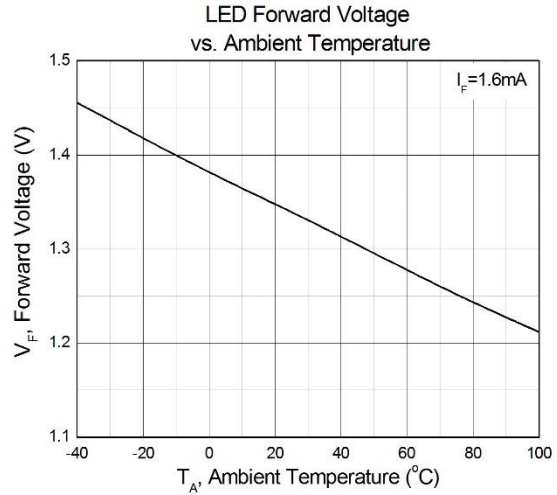


Figure 2

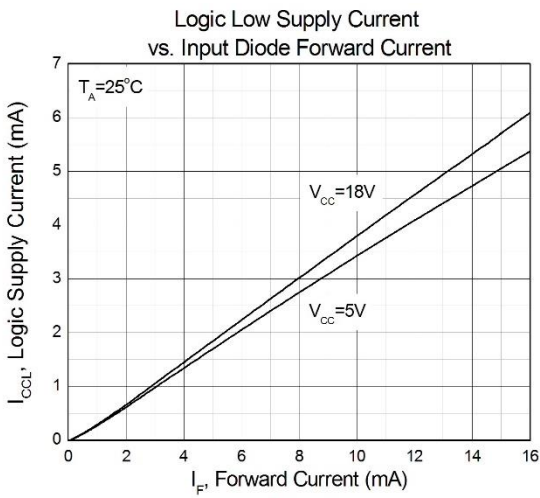


Figure 3

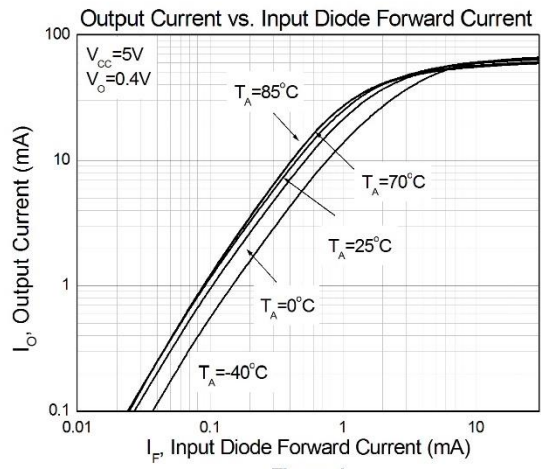


Figure 4

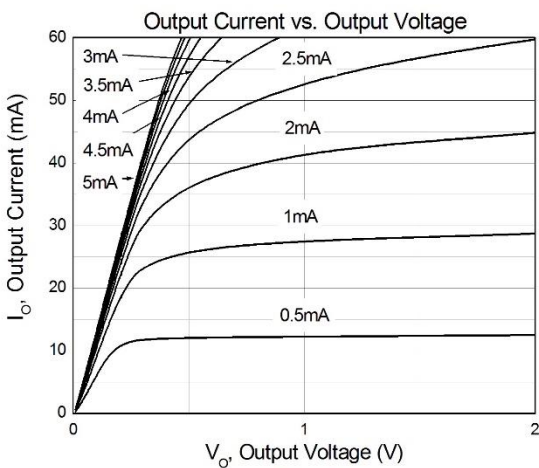


Figure 5

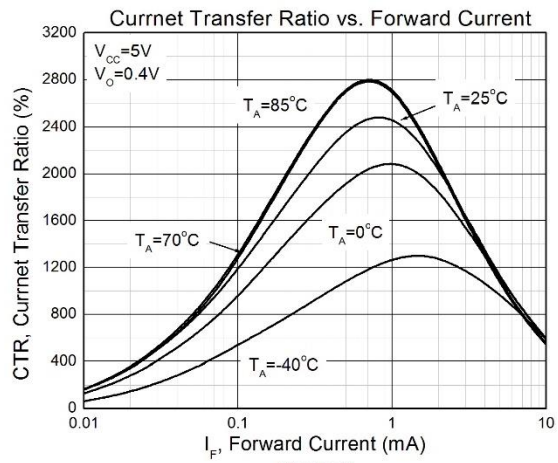


Figure 6



Low Input Current Photodarlington Coupler

Typical Characteristic Curves $T_A = 25^\circ\text{C}$, unless otherwise specified

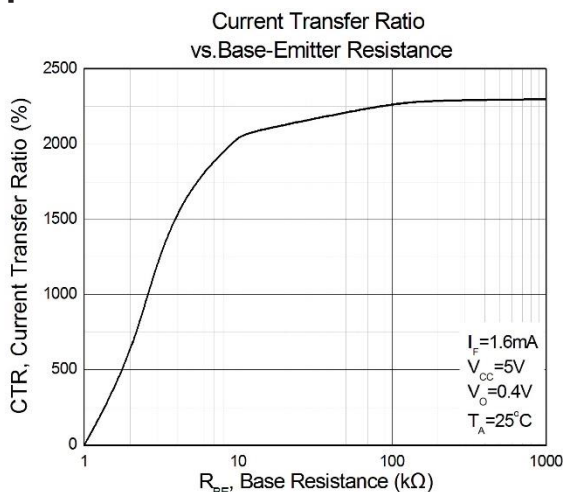


Figure 7

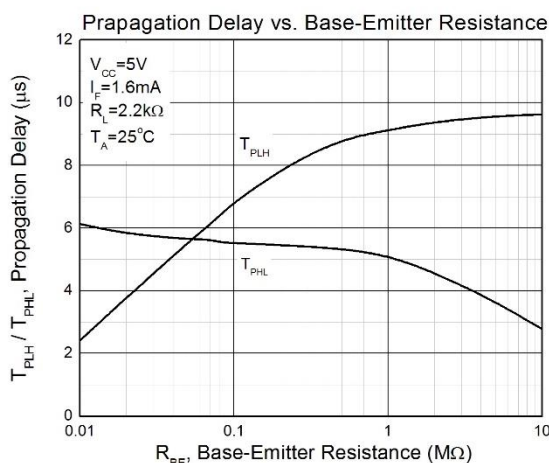


Figure 8

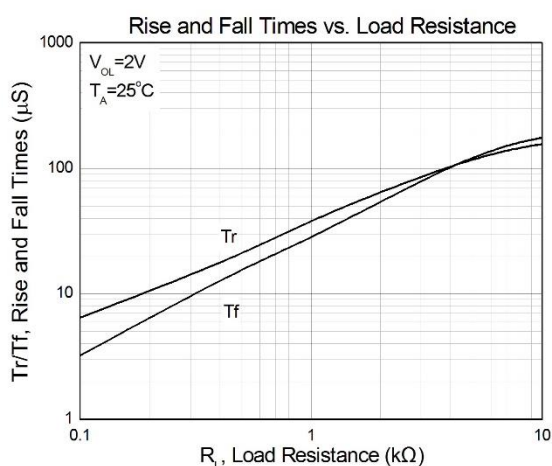


Figure 9

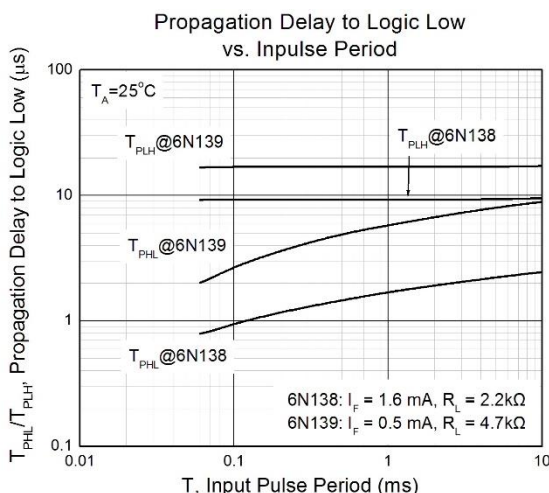


Figure 10

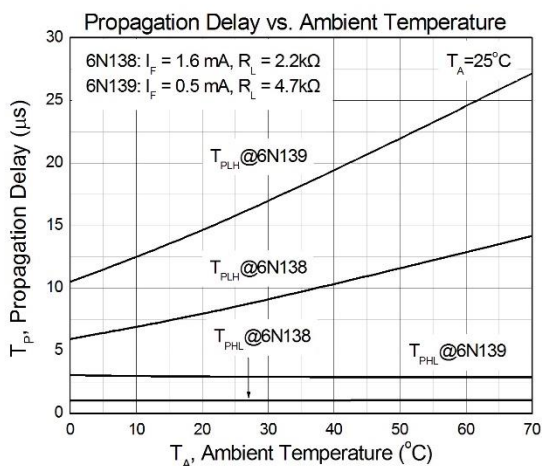


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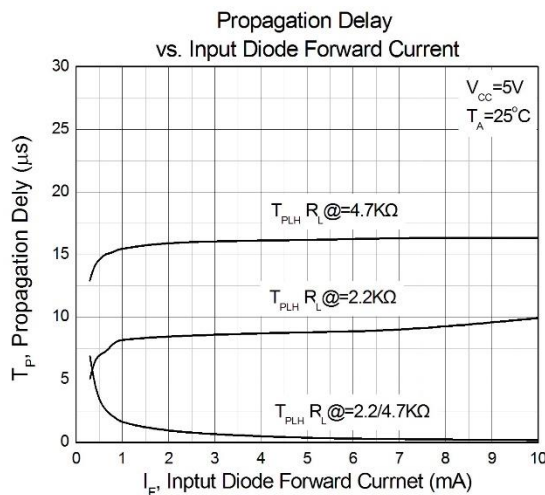


Figure 12



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Test Circuits

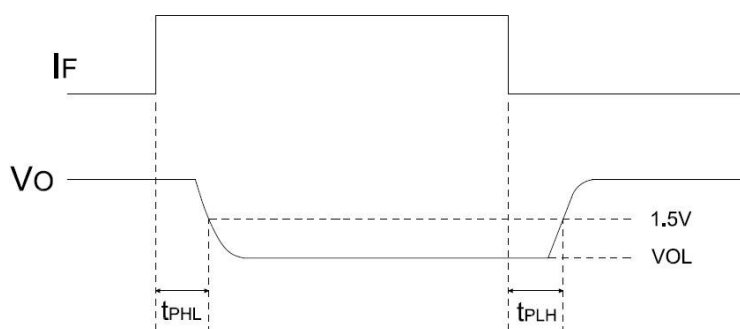
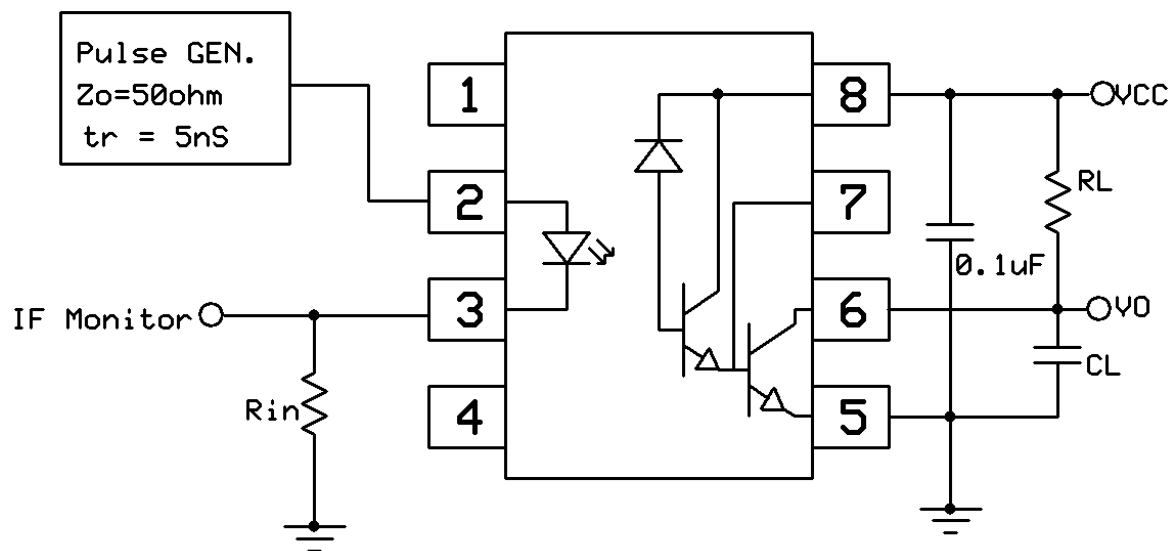


Figure 13: Switching Time Test Circuits



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Test Circuits

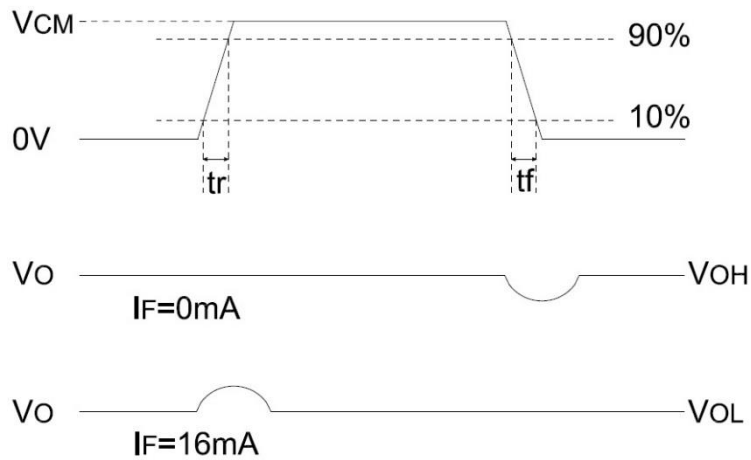
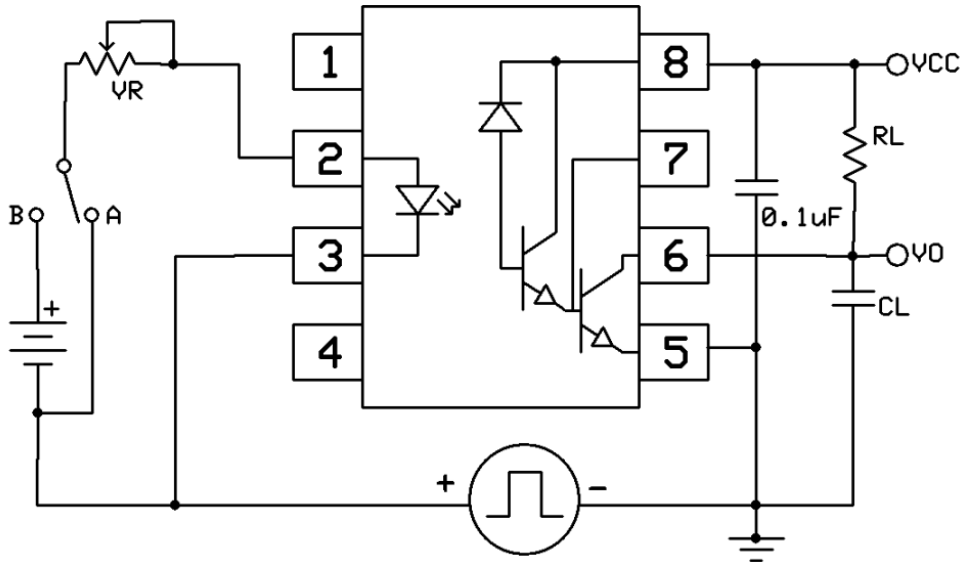


Figure 14: CMR Test Circuit

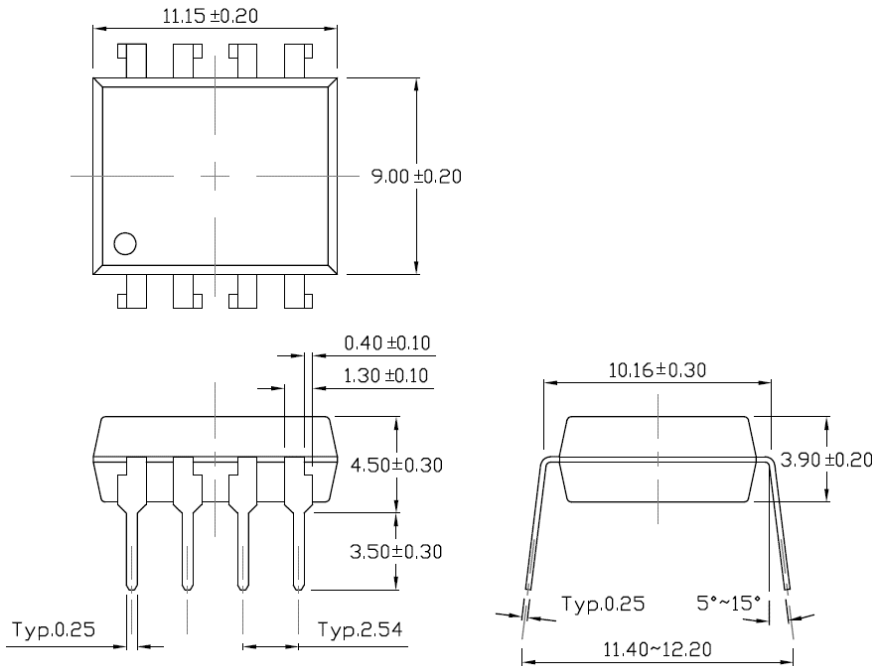


6N138, 6N139

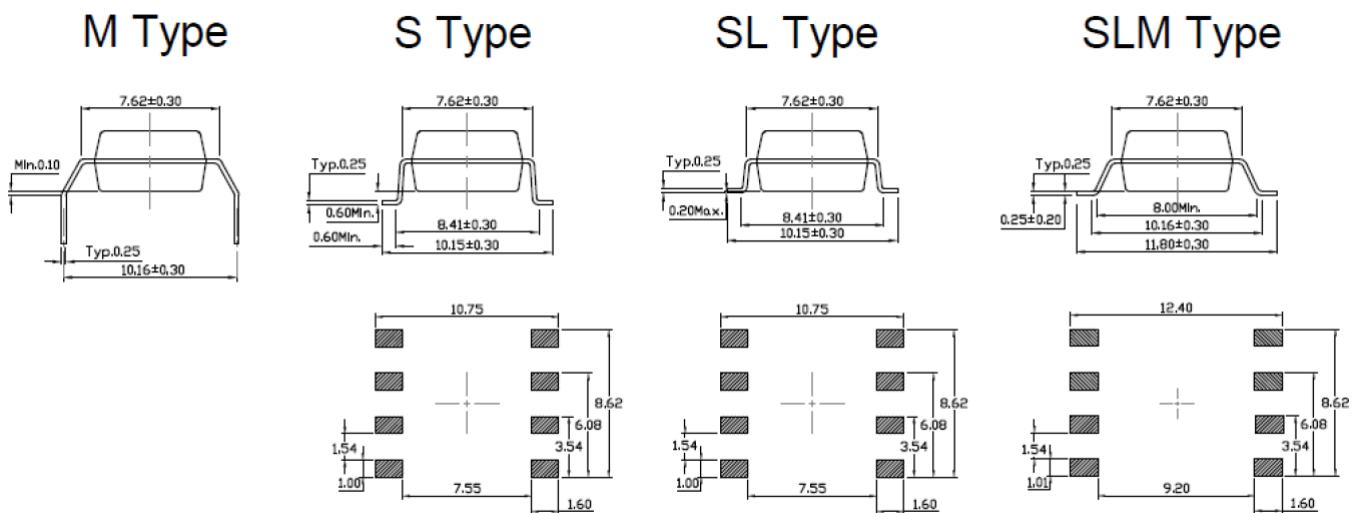
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Package Dimension *Dimensions in mm unless otherwise stated*



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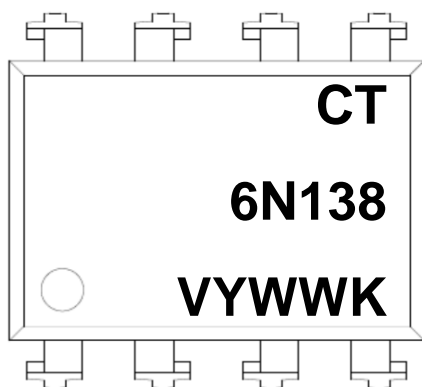


6N138, 6N139

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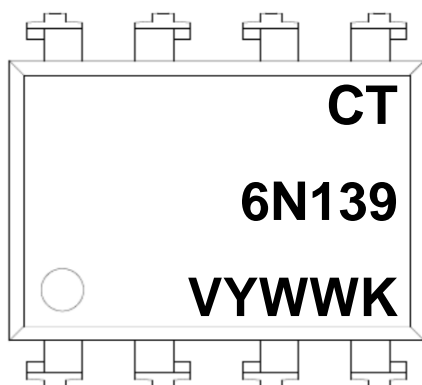
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Marking Information



Note:

CT : Denotes "CT Micro"
6N138: Part Number
V : VDE Safety Mark Option (Blank or V)
Y : One Digit Year Code
WW : Two Digit Work Week
K : Manufacturing Code



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Ordering Information

6N138(V)(Y)(Z)

- 6N138 = Part Number
- V = VDE Safety Mark Option (Blank or V)
- Y = Lead Form Option (S, SL, M, SLM or none)
- Z = Tape and Reel Option (Blank, T1 or T2)

6N139(V)(Y)(Z)

- 6N139 = Part Number
- V = VDE Safety Mark Option (Blank or V)
- Y = Lead Form Option (S, SL, M, SLM or none)
- Z = Tape and Reel Option (Blank, T1 or T2)

Option	Description	Quantity
None	Standard 8 Pin Dip	40 Units/Tube
M	Gullwing (400mil) Lead Forming	40 Units/Tube
S(T1)	Surface Mount (Low Profile) Lead Forming– With Option 2 Taping	750 Units/Reel
S(T2)	Surface Mount (Low Profile) Lead Forming– With Option 2 Taping	750 Units/Reel
SL(T1)	Surface Mount (Low Profile) Lead Forming– With Option 1 Taping	750 Units/Reel
SL(T2)	Surface Mount (Low Profile) Lead Forming– With Option 2 Taping	750 Units/Reel
SLM(T1)	Surface Mount (Gullwing) Lead Forming– With Option 1 Taping	1000 Units/Reel
SLM(T2)	Surface Mount (Gullwing) Lead Forming – With Option 2 Taping	1000 Units/Reel



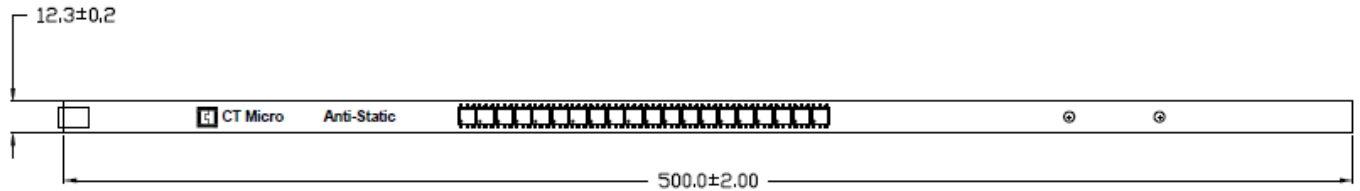
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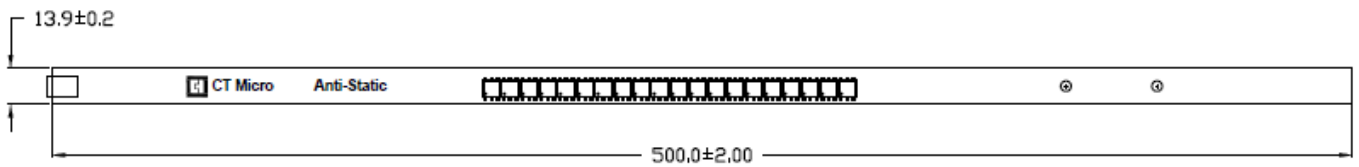
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Carrier Specifications *Dimensions in mm unless otherwise stated*

Tube Option Standard DIP

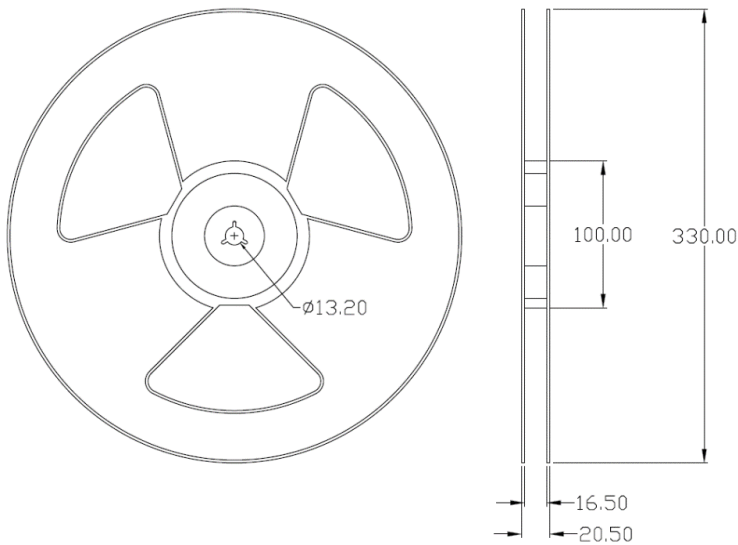


Tube Option M Type

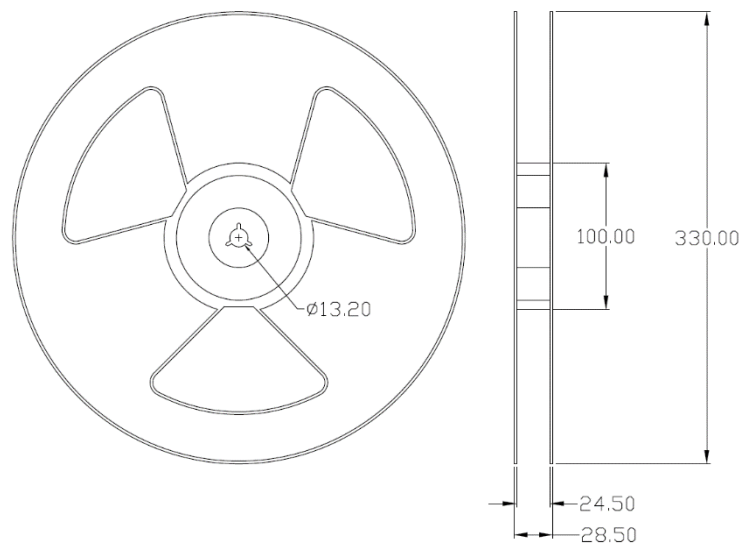


Reel Dimension *All dimensions are in mm, unless otherwise stated*

Option S(T1/T2) & SL(T1/T2)



Option SLM(T1/T2)





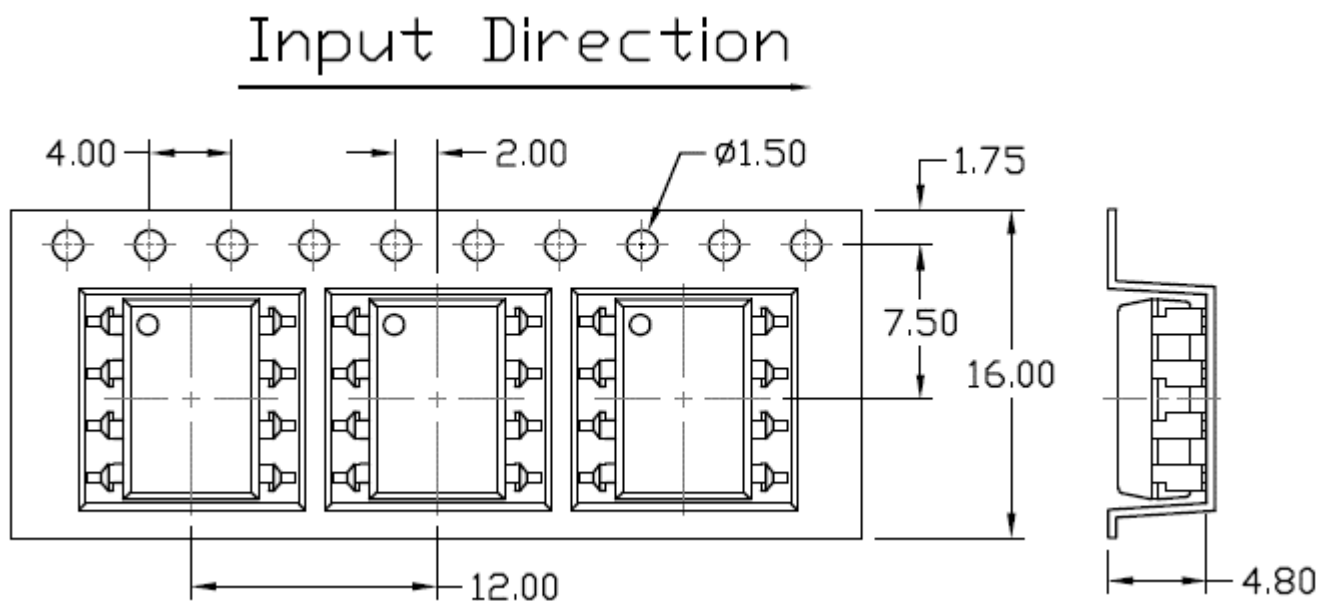
6N138, 6N139

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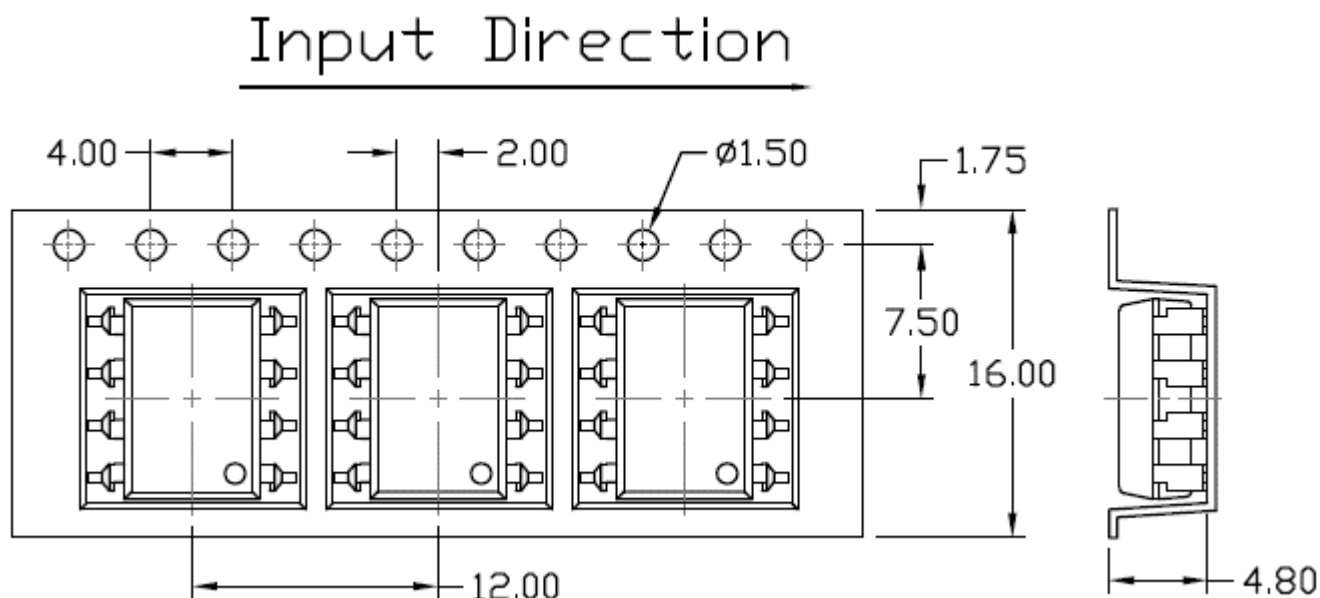
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Carrier Tape Specifications *Dimensions in mm unless otherwise stated*

Option S(T1) & SL(T1)



Option S(T2) & SL(T2)





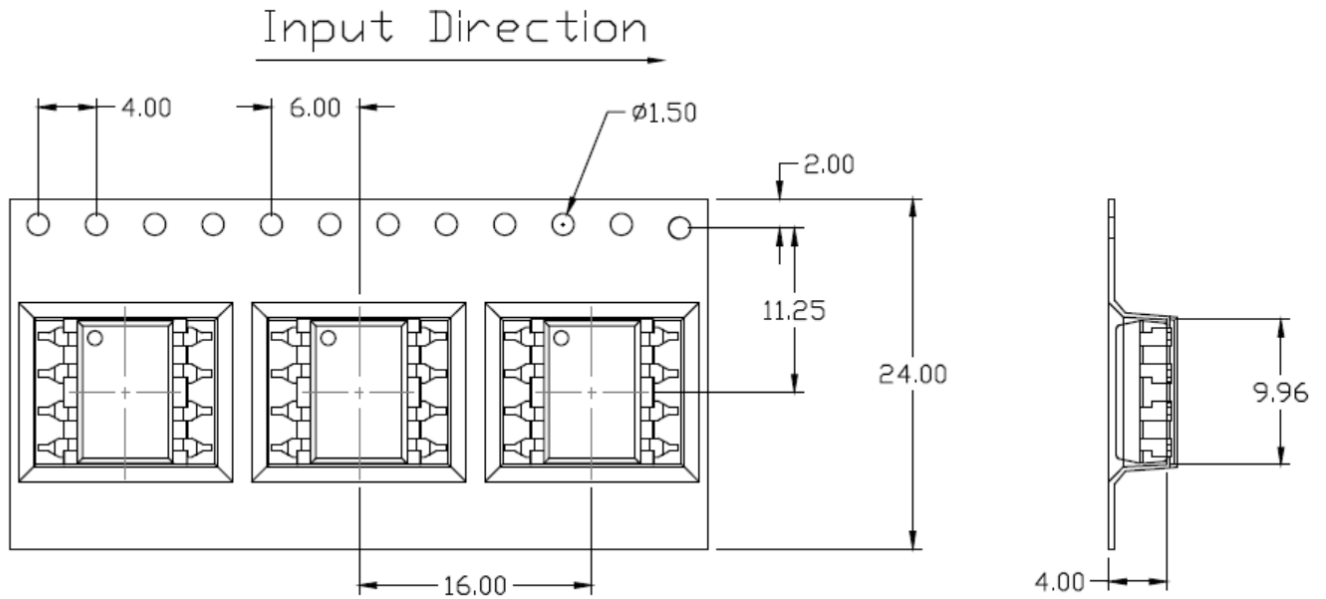
6N138, 6N139

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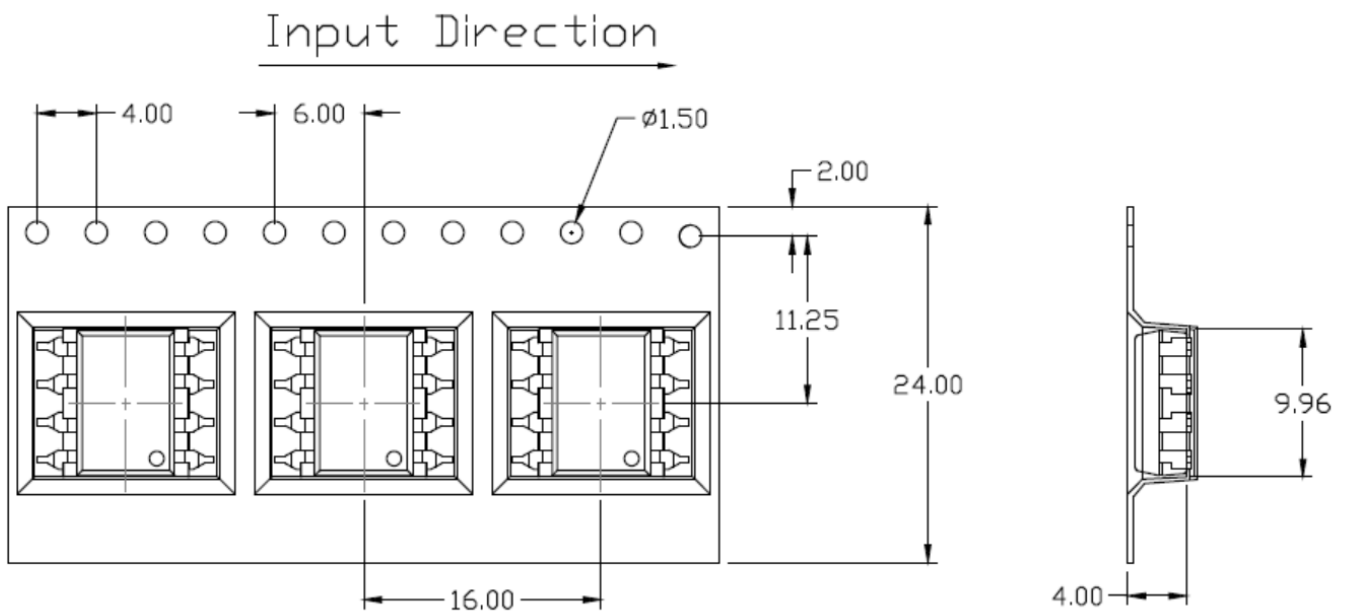
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Carrier Tape Specifications *Dimensions in mm unless otherwise stated*

Option SLM(T1)



Option SLM(T2)





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Solderability spec (Follow the JEDEC standard JESD22-B102)

Reflow Soldering: Immersed surface, other than the end of pin as cut-surface, must be covered by solder.

Solder-Bath: More than 95% of the electrode must be covered with solder.

Wave soldering (Follow the JEDEC standard JESD22-A111)

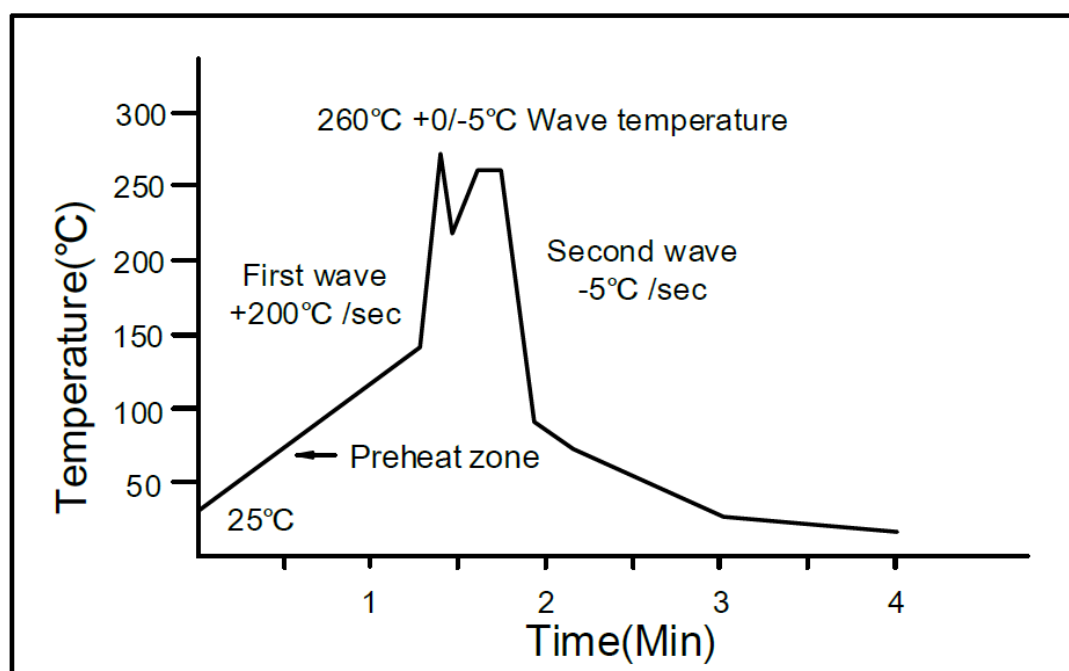
One time soldering is recommended within the condition of temperature.

Temperature: $260 \pm 0/-5^\circ\text{C}$.

Time: 10 sec.

Preheat temperature: 25 to 140°C .

Preheat time: 30 to 80 sec.



Iron soldering (Follow the standard MIL-STD 202G, Method 210F)

Allow single lead soldering in every single process.

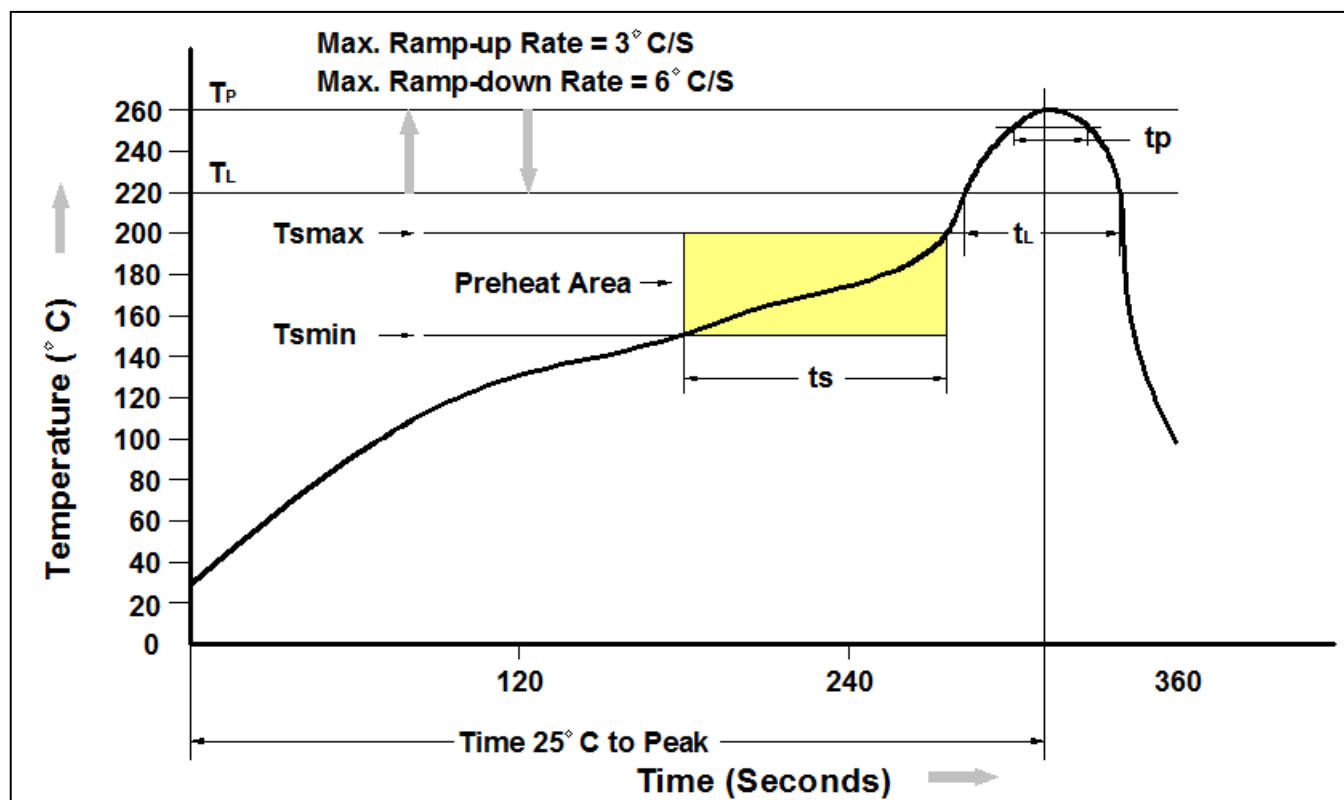
One time soldering is recommended. Temperature: $350 \pm 10^\circ\text{C}$

Time: 5 sec max.



Low Input Current Photodarlington Coupler

Reflow Profile (Follow the JEDEC standard J-STD-020)



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



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- 2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.*