



Low Input Current Photodarlington Coupler

Features

- Low current – 0.5mA
- Superior CTR-2000%
- CTR guaranteed 0–70°C

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

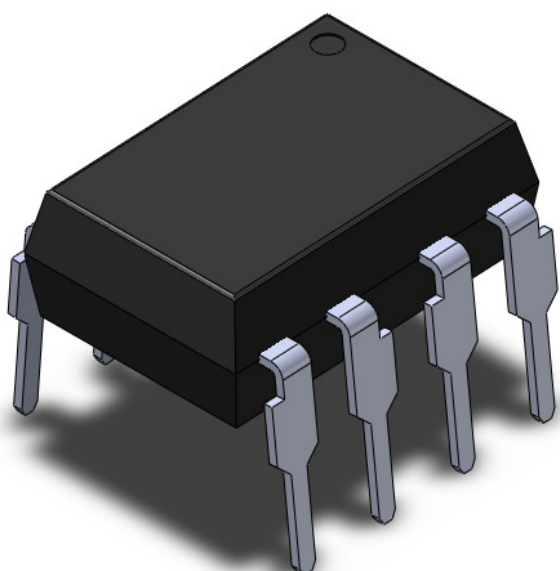
Description

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

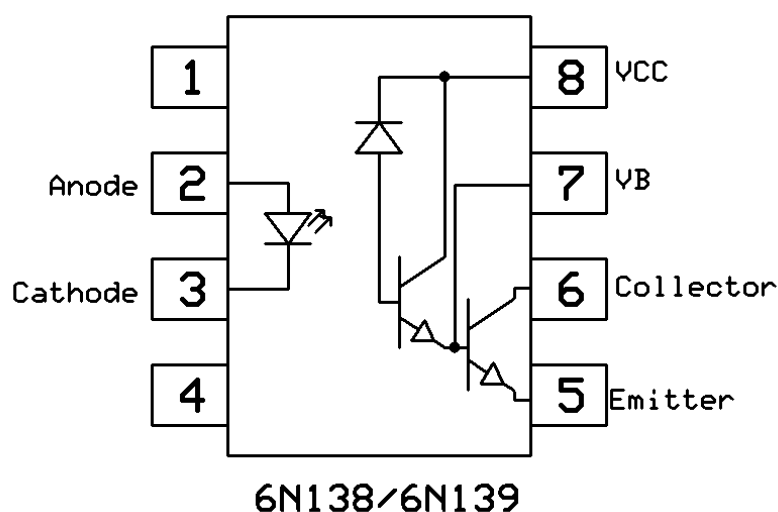
The combination of a very low input current of 0.5mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements.

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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Absolute Maximum Rating at 25°C

Symbol	Parameters	Ratings	Units	Notes	
V _{ISO}	Isolation voltage	5000	V _{RMS}		
T _{OPR}	Operating temperature	-55 ~ +100	°C		
T _{STG}	Storage temperature	-55 ~ +125	°C		
T _{SOL}	Soldering temperature	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 _D	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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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	6N139	$I_F=0\text{mA}$, $V_O=V_{CC}=18\text{V}$,	-	0.008	80	μA
		6N138		-	-	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	6N139	$I_F=0.5\text{mA}$, $V_O=0.4\text{V}$,	400	2500	-	%
		6N138		300	2000	-	
		6N139	$I_F=1.6\text{mA}$, $V_O=0.5\text{V}$,	500	2000	-	
V_{OL}	Logic Low Output Voltage	6N139	$I_F=0.5\text{mA}$, $I_O=2\text{mA}$	-	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	
		6N138	$I_F=1.6\text{mA}$, $I_O=4.8\text{mA}$	-	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	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}$	-	-	30	μs
			$T_A = 25^\circ\text{C}$	-	4.8	25	
		6N138	$I_F = 12\text{mA}$, $R_L = 250$	-	-	2	
			$T_A = 25^\circ\text{C}$	-	0.2	1	
		6N138	$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}$	-	-	15	
			$T_A = 25^\circ\text{C}$	-	1.35	10	
T_{PLH}	Low to High Propagation Delay	6N139	$I_F = 0.5\text{mA}$, $R_L = 4.7\text{k}$	-	-	90	μs
			$T_A = 25^\circ\text{C}$	-	15	60	
		6N139	$I_F = 12\text{mA}$, $R_L = 250$	-	-	10	
			$T_A = 25^\circ\text{C}$	-	1.6	7	
		6N138	$I_F = 1.6\text{mA}$, $R_L = 2.2\text{k}$	-	-	50	
			$T_A = 25^\circ\text{C}$	-	7.6	35	
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	-	-		



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Typical Characteristic Curves

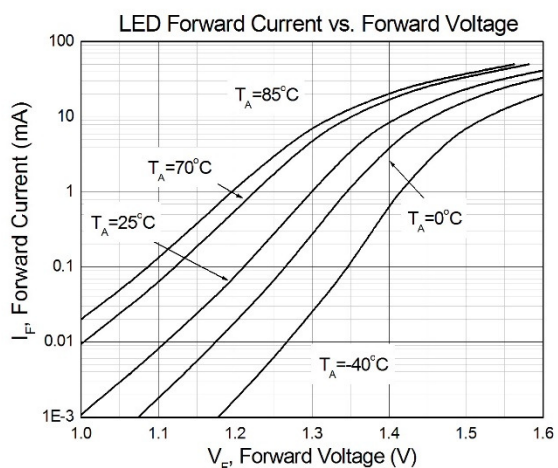


Figure 1

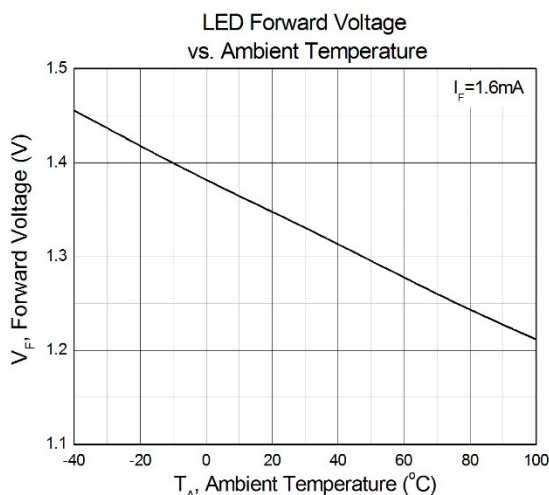


Figure 2

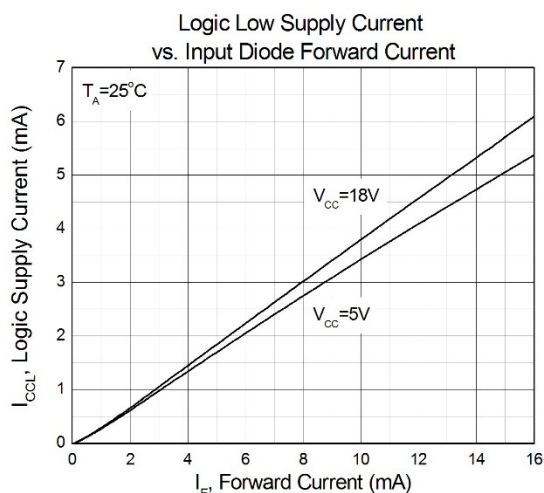


Figure 3

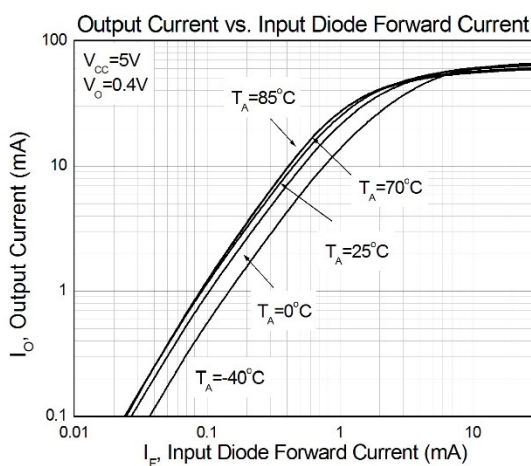


Figure 4

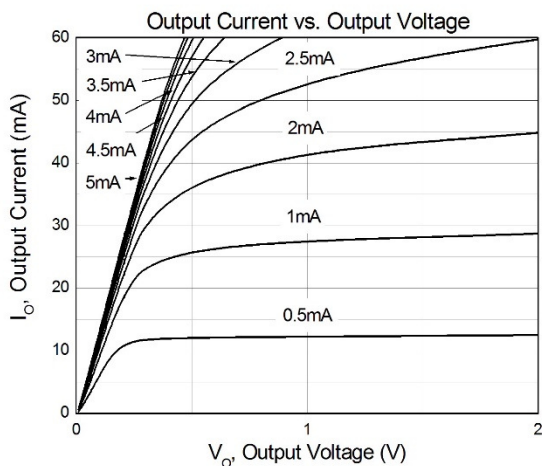


Figure 5

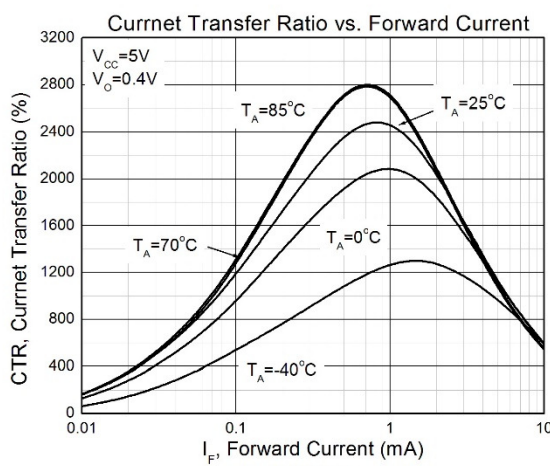
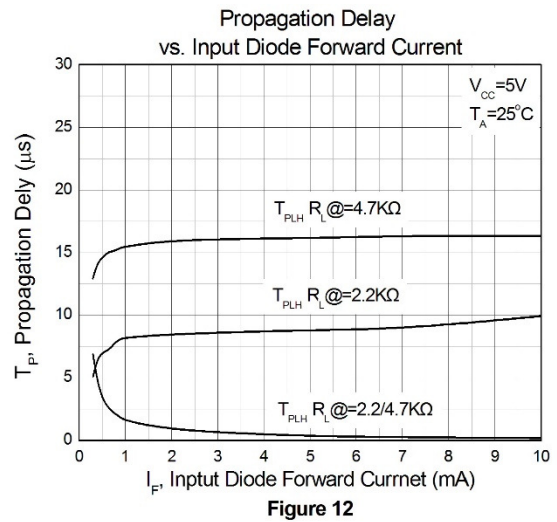
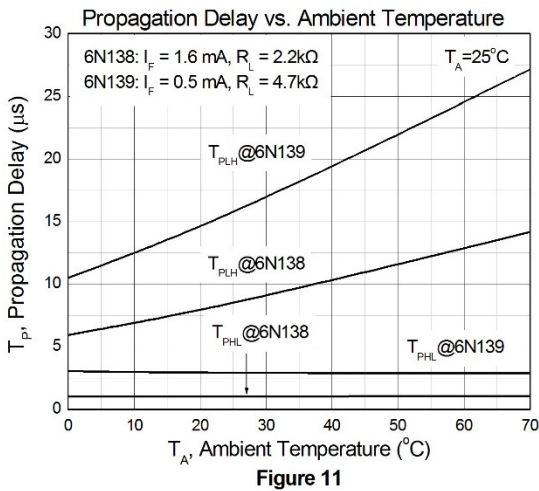
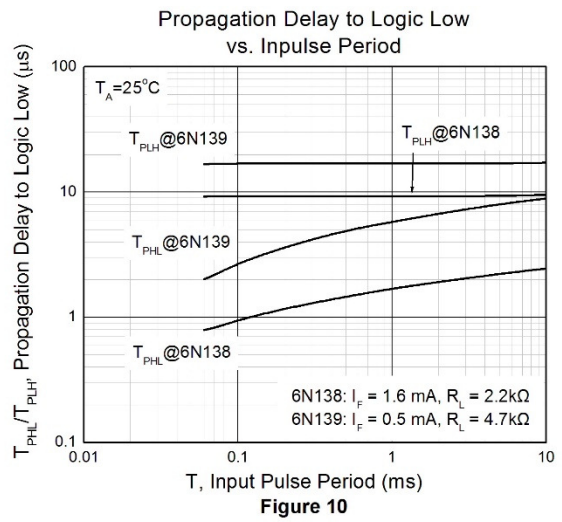
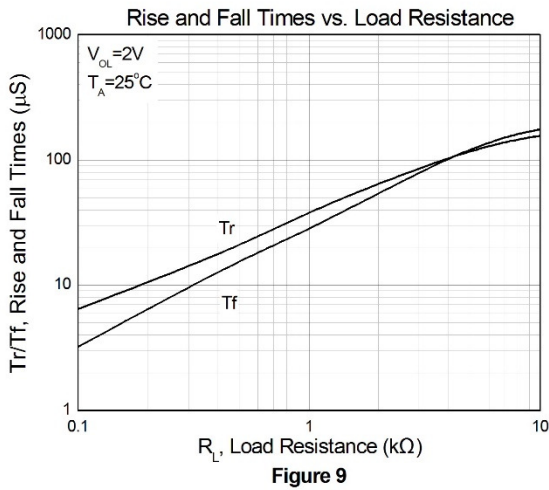
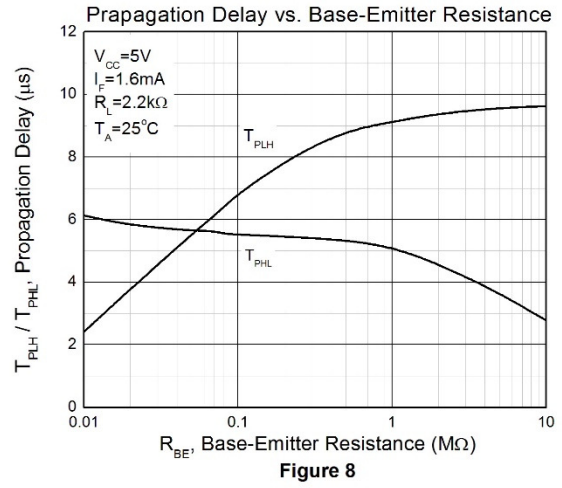
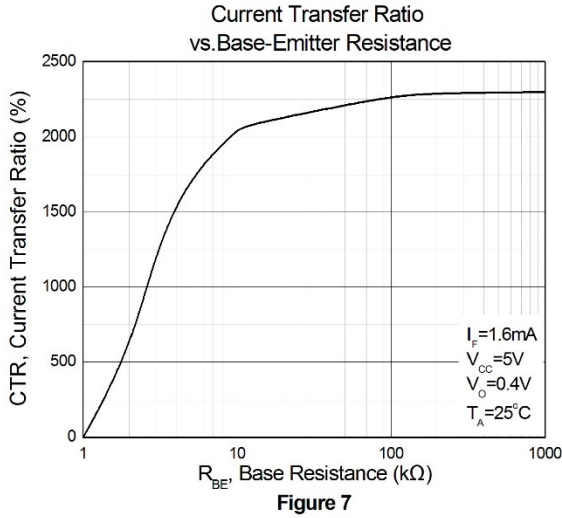


Figure 6



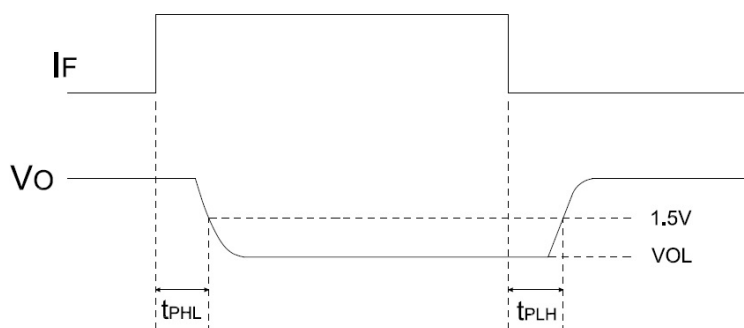
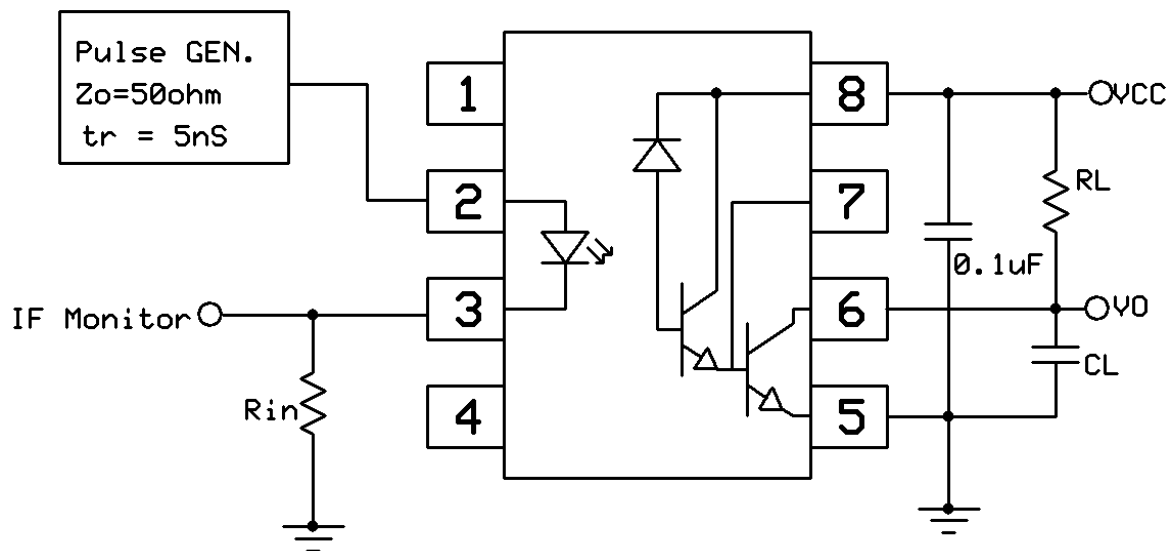
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Test Circuits

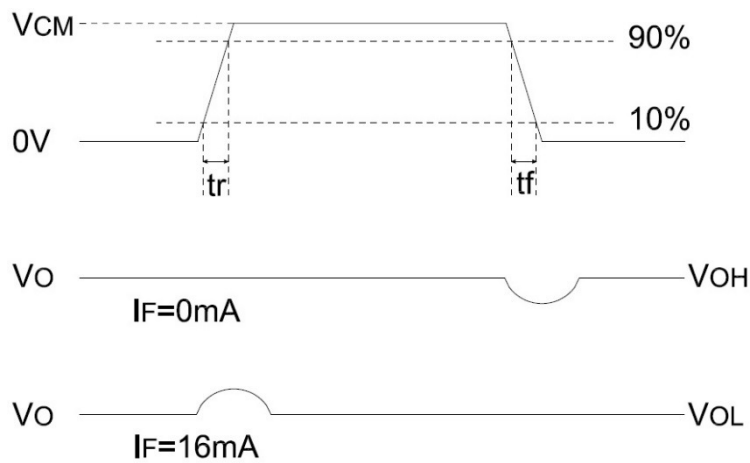
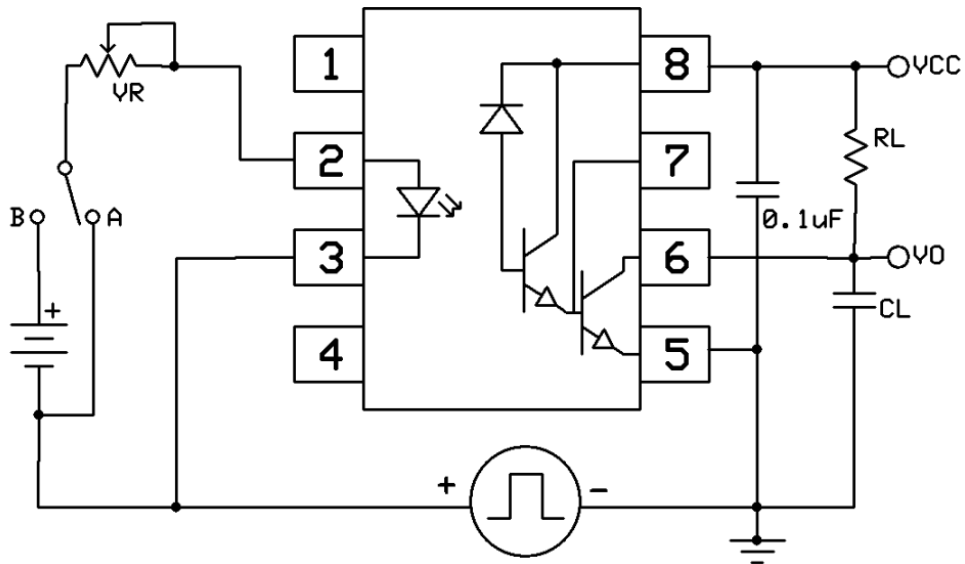


Switching Time Test Circuit



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Test Circuits



CMR Test Circuit

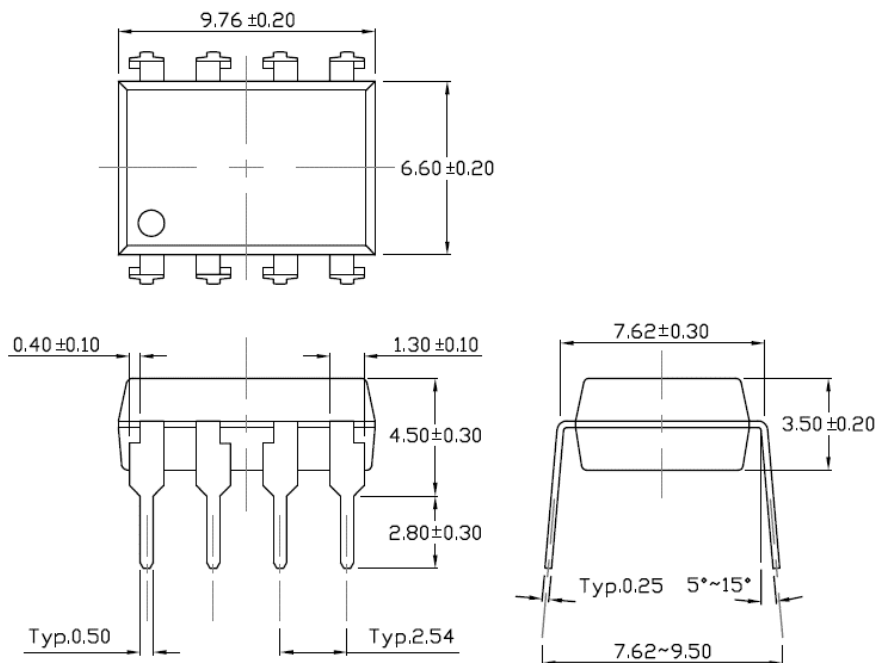


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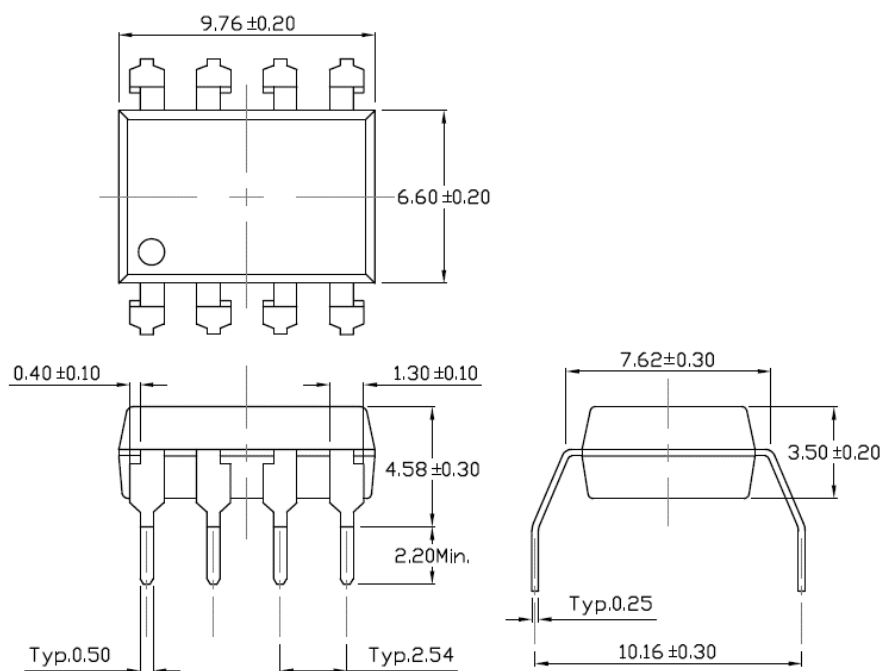
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Package Dimension *Dimensions in mm unless otherwise stated*

Standard DIP – Through Hole



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

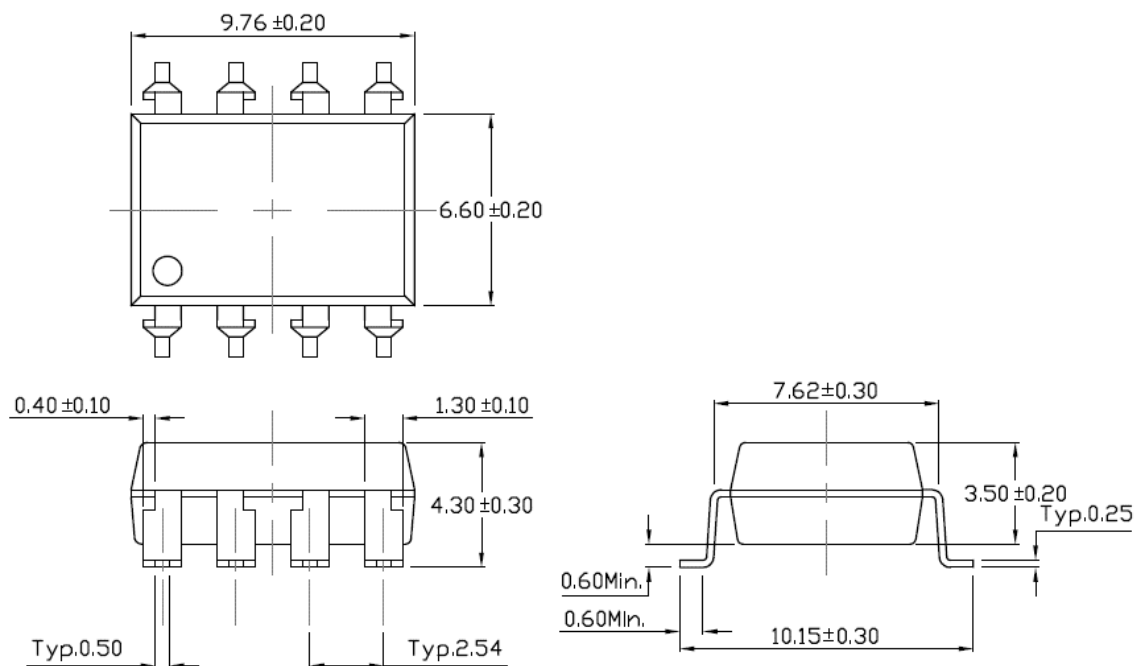




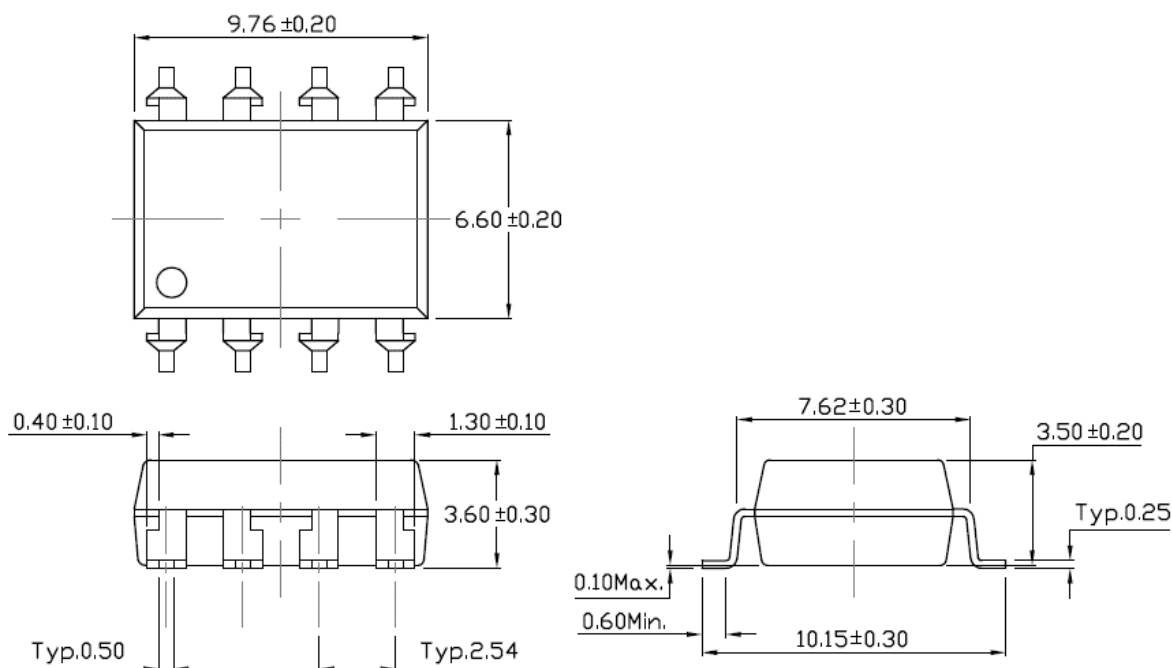
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Surface Mount Lead Forming (S Type)



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

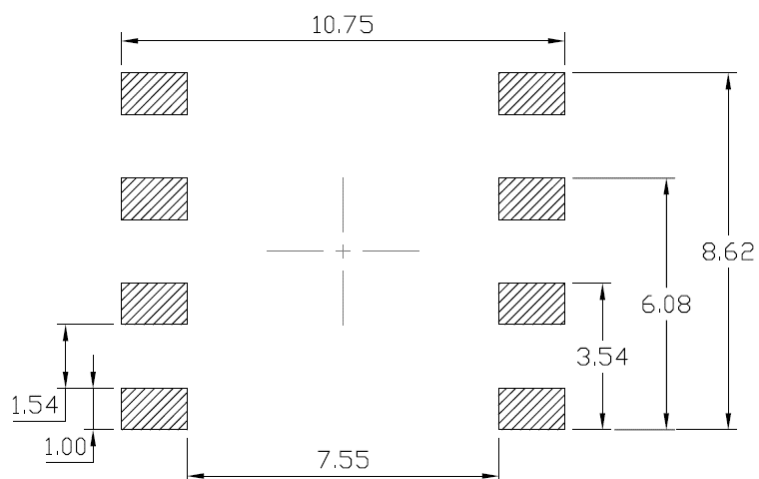




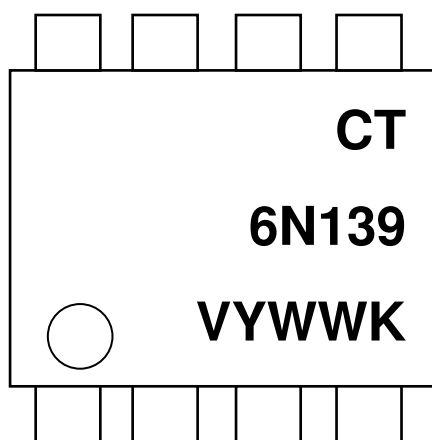
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Recommended Solder Mask *Dimensions in mm unless otherwise stated*



Device Marking



- CT : Denotes "CT Micro"
- 6N139 : Product Number
- V : VDE Option
- Y : Fiscal Year
- WW : Work Week
- K : Production Code



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Ordering Information

6N13X(V)(Y)(Z)

X = Part No. (8 or 9)

V = VDE Option (V or None)

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

Z = Tape and reel option (T1, T2 or none)

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

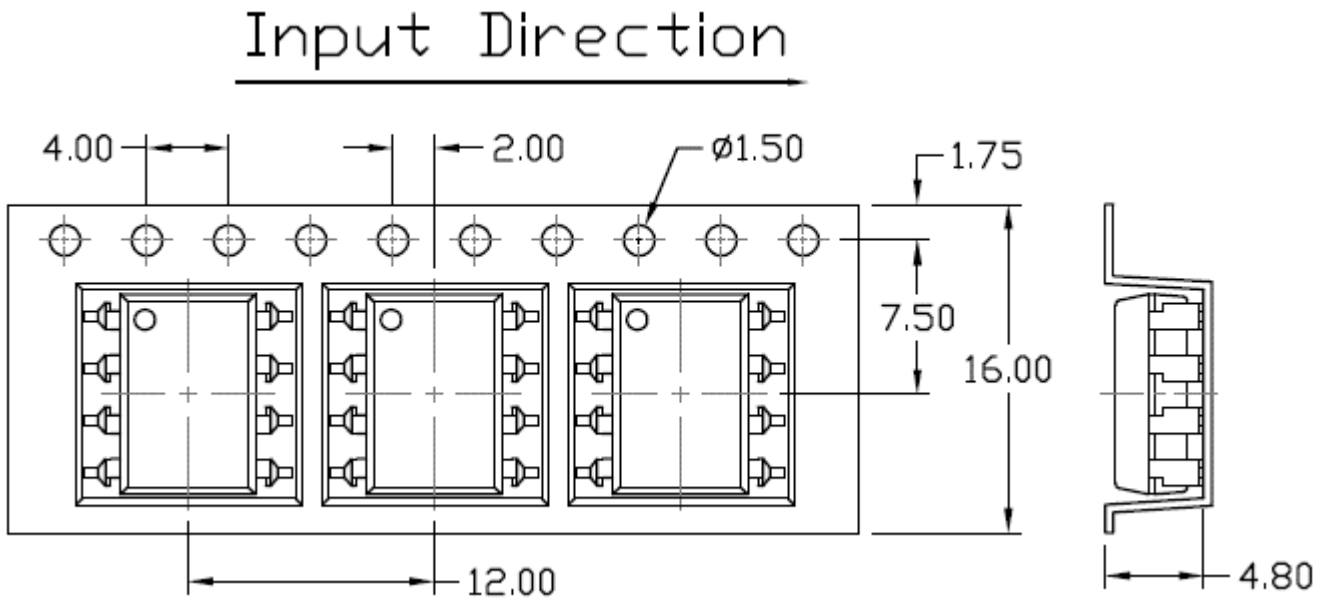


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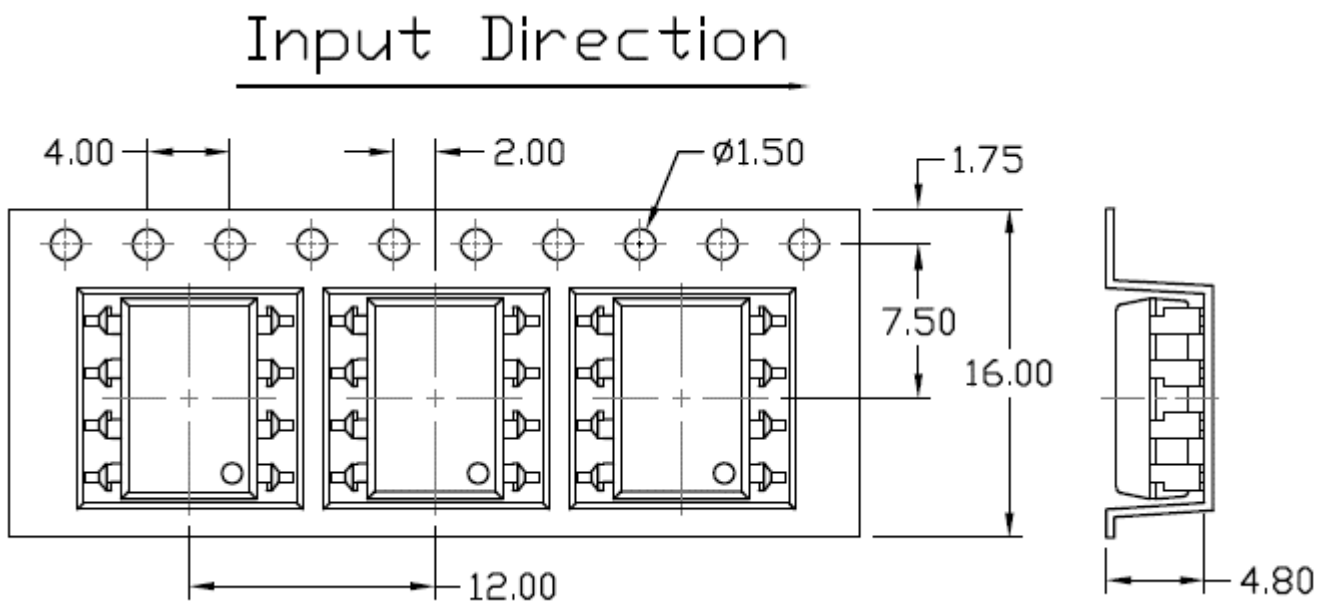
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Carrier Tape Specifications *Dimensions in mm unless otherwise stated*

Option S(T1) & SL(T1)



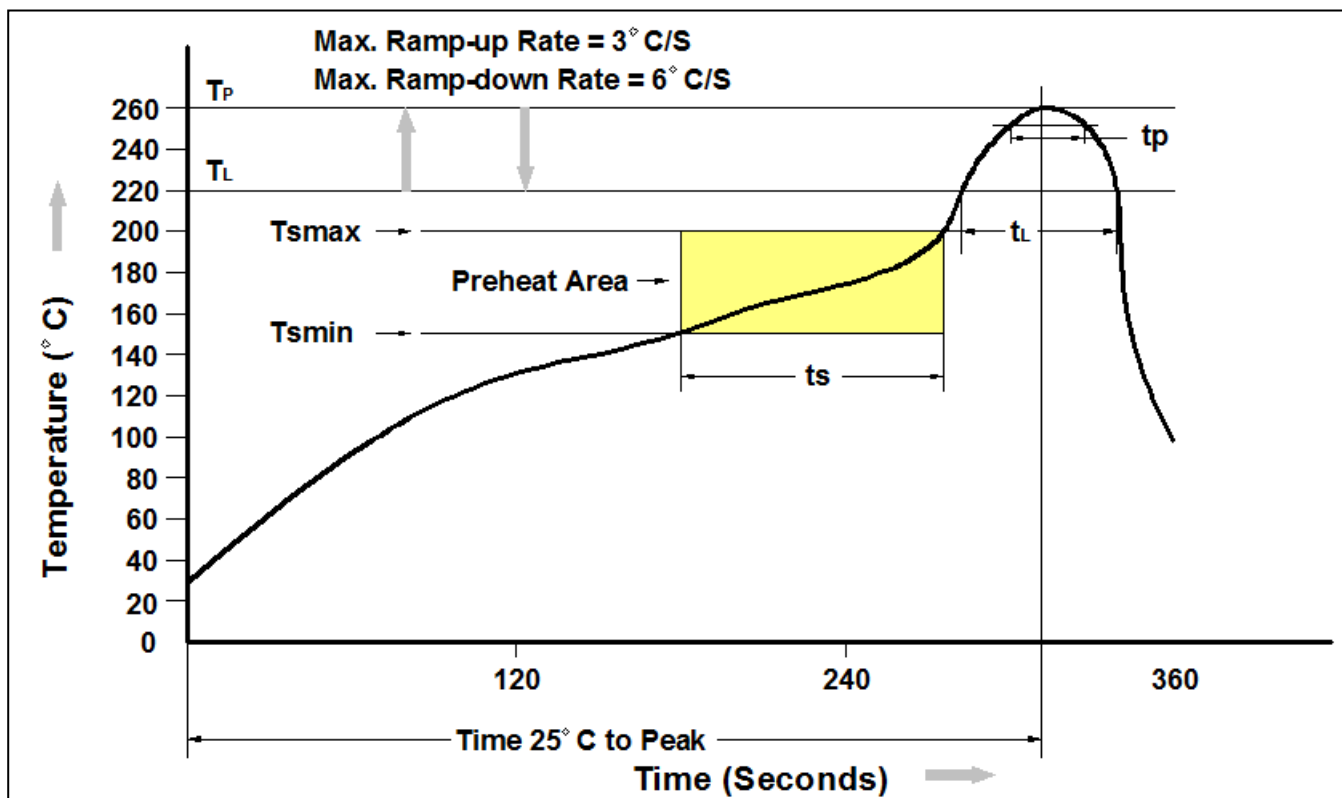
Option S(T2) & SL(T2)





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Reflow Profile



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



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