

## 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

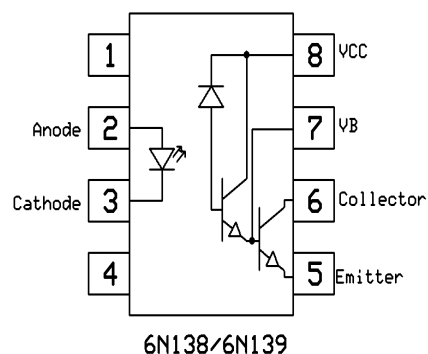
**Truth Table** (Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H	NC	L
L	NC	H

## Applications

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

## Package Outlines



<b>ABSOLUTE MAXIMUM RATINGS</b>				
PARAMETER	SYMBOL	VALUE	UNIT	Note
<b>INPUT</b>				
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	
<b>OUTPUT</b>				
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	
<b>COMMON</b>				
Total Power Dissipation	$P_{tot}$	200	mW	
Isolation Voltage	$V_{iso}$	5000	V <sub>rms</sub>	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

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

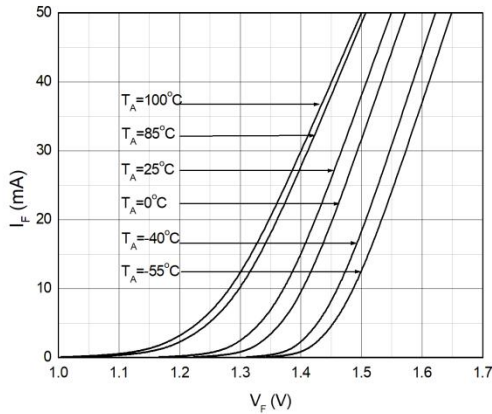
### ELECTRICAL OPTICAL CHARACTERISTICS

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	-	$I_F = 1.6\text{mA}, V_O = 0.4\text{V}, V_{CC}=4.5\text{V}$		
Logic Low Output Voltage	6N139	V <sub>OL</sub>	-	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	R <sub>iso</sub>	10 <sup>12</sup>	10 <sup>14</sup>	-	Ω	DC500V, 40 ~ 60% R.H.	
Floating Capacitance	C <sub>IO</sub>	-	0.3	1	pF	V=0, f=1MHz	

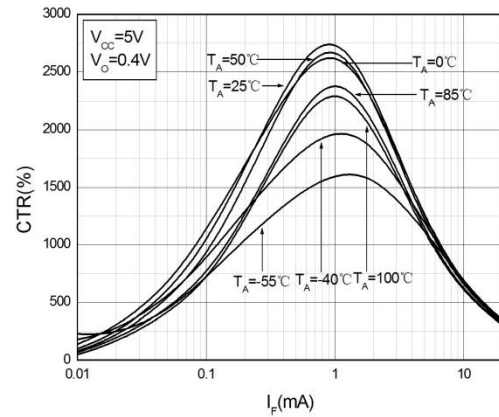
ELECTRICAL OPTICAL CHARACTERISTICS								
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION	NOTE	
SWITCHING CHARACTERISTICS(at Ta=0 to 70°C,V <sub>CC</sub> =5V, unless specified otherwise)								
Propagation Delay Time to Logic Low	6N139	TPHL	-	5	25	μs	I <sub>F</sub> = 0.5mA,R <sub>L</sub> =4.7kΩ, T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

**CHARACTERISTIC CURVES**

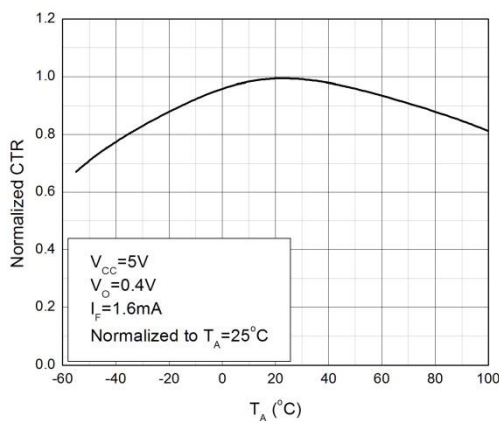
**Fig.1 Forward Current vs. Forward Voltage**



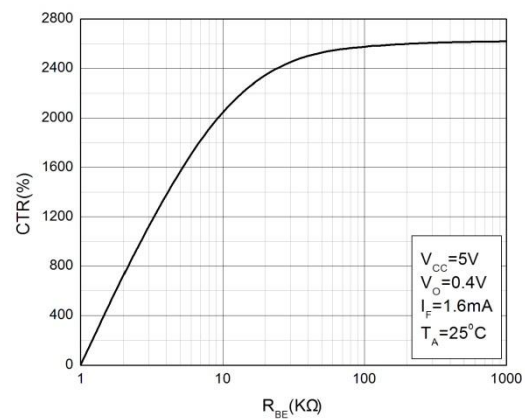
**Fig.2 Current Transfer Ratio vs. Forward Current**



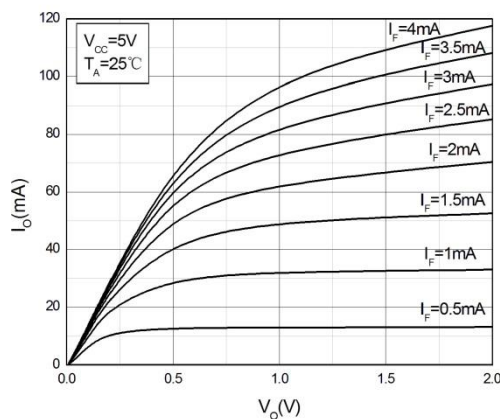
**Fig.3 Normalized Current Transfer Ratio vs. Ambient Temperature**



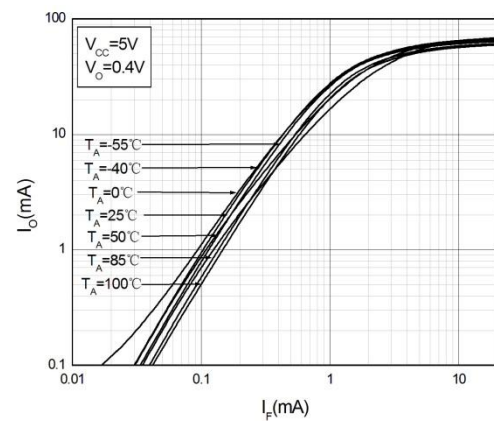
**Fig.4 Current Transfer Ratio vs. Base-Emitter Resistance**



**Fig.5 Low Level Output Current vs. Output Voltage**

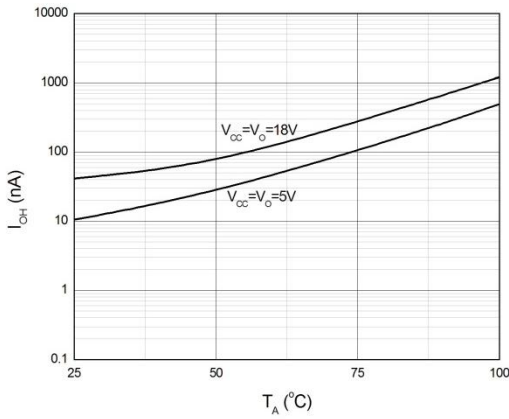


**Fig.6 Low Level Output Current vs. Forward Current**

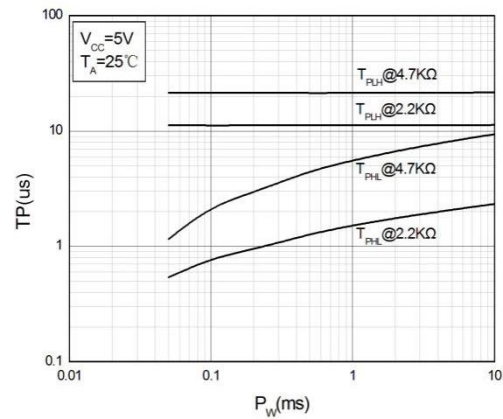


**CHARACTERISTIC CURVES**

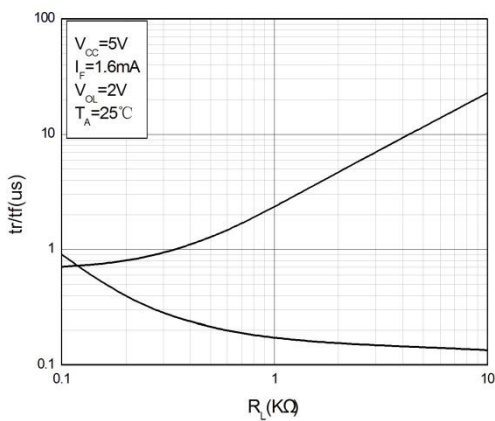
**Fig.7 High Level Output Current vs. Ambient Temperature**



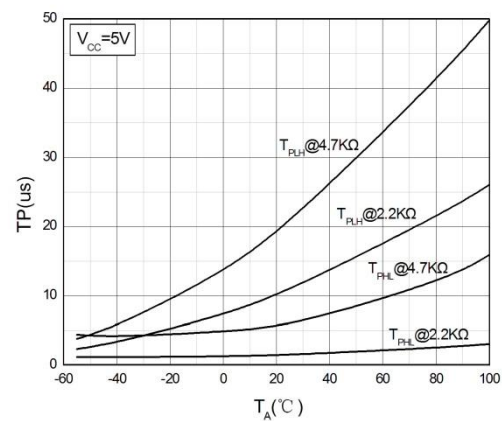
**Fig.8 Propagation Delay vs. Pulse Width**



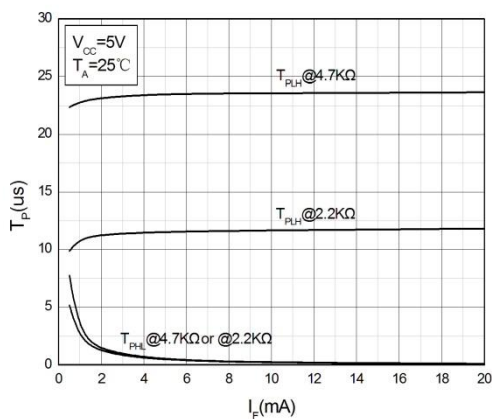
**Fig.9 Rise and Fall Time vs. Load Resistance**



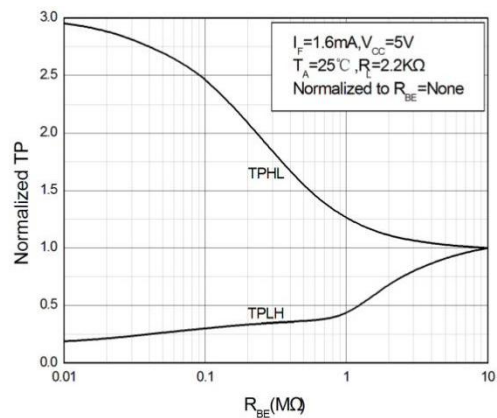
**Fig.10 Propagation Delay vs. Ambient Temperature**



**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

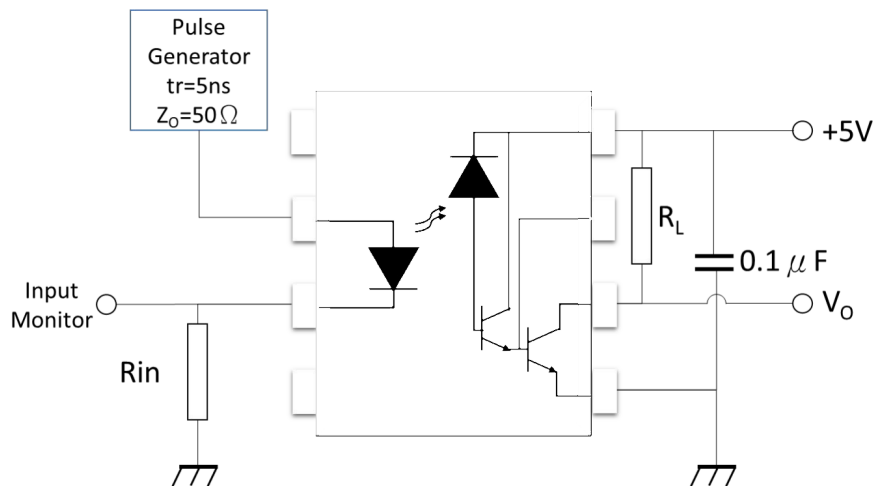
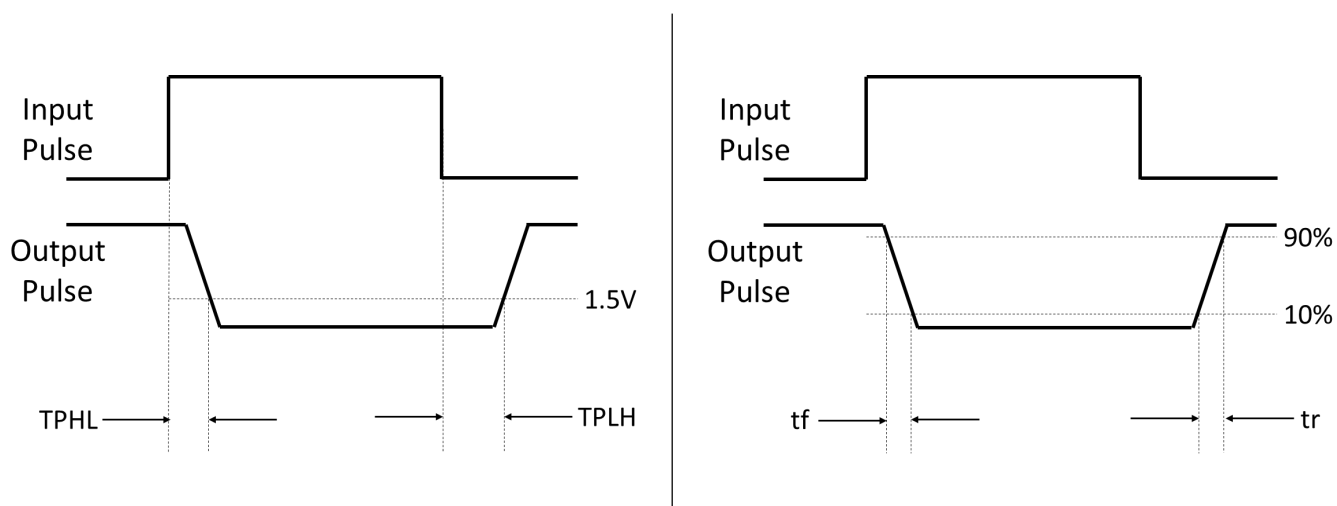


Fig.14 Waveforms of TPHL, TPLH, tr, tf





TEST CIRCUITS

Fig.15 Test Circuits for Common Mode Transient Immunity

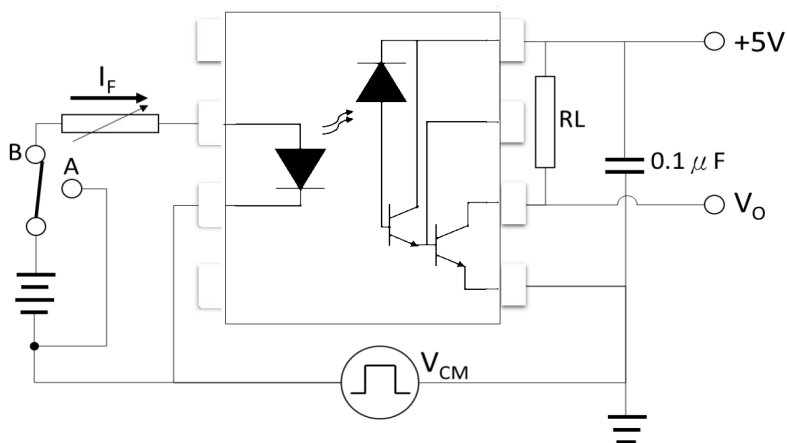
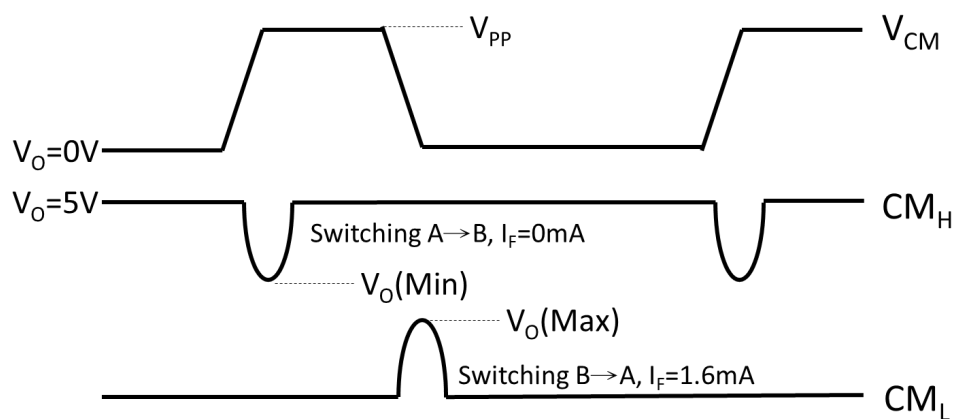
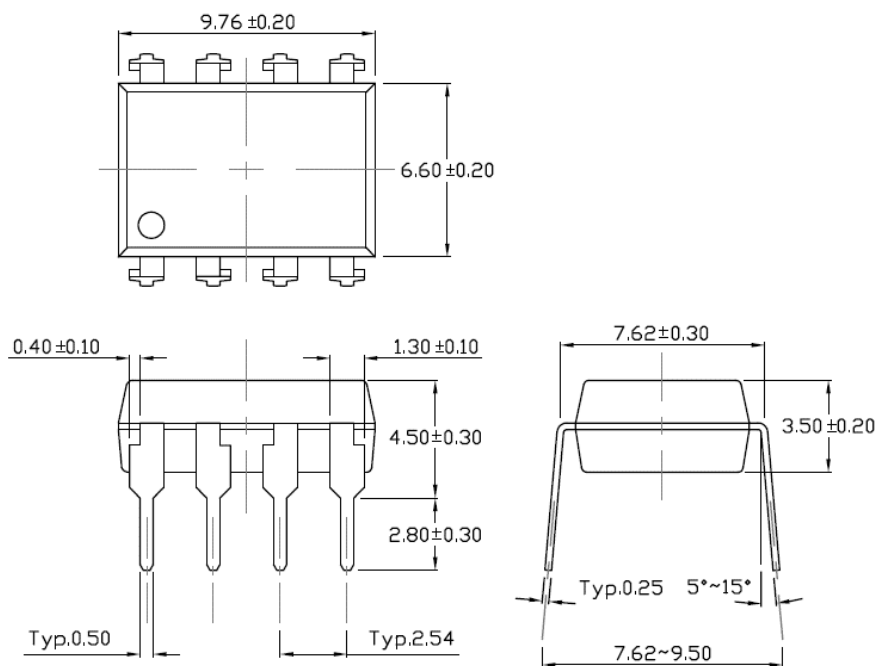


Fig.16 Waveforms of Common Mode Transient Immunity

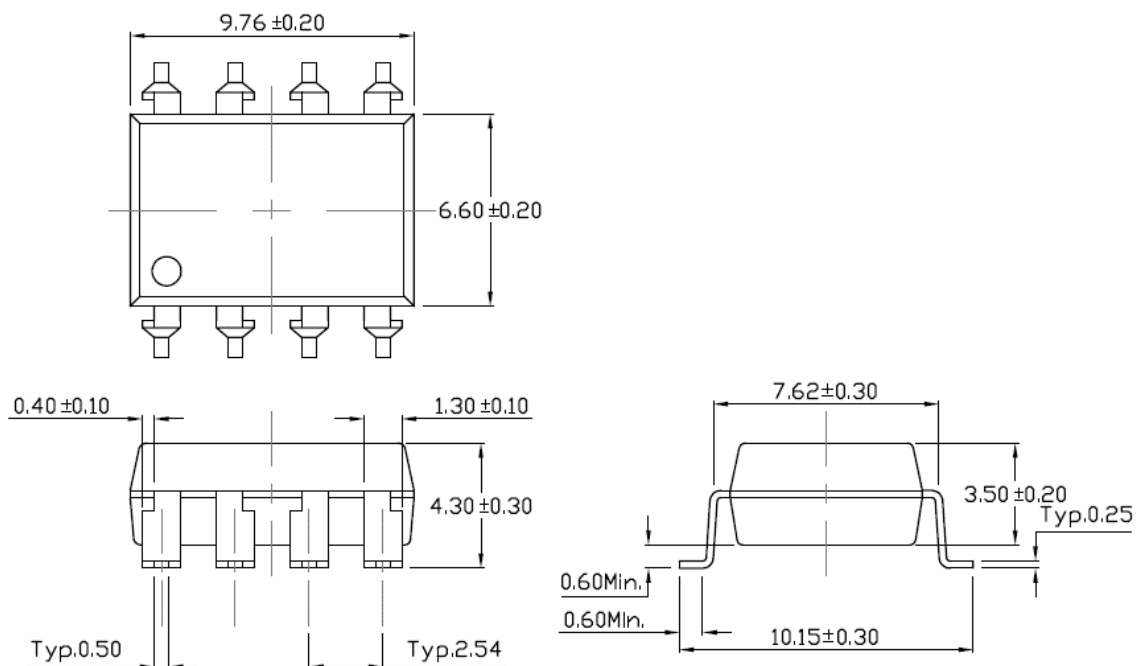


**Package Dimensions** *Dimensions in mm unless otherwise stated*

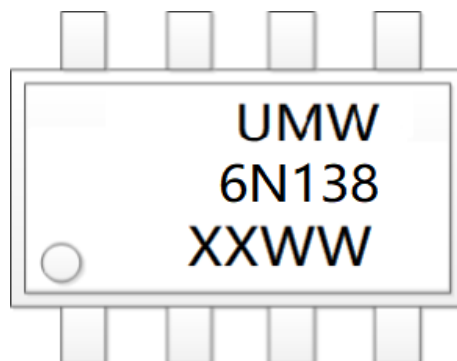
**DIP-8**



**SOP-8**



**Marking**



- “XX” denotes YEAR;
- “WW” denotes WEEK

**ORDERING INFORMATION**

Order Code	Description	Base qty
UMW 6N138M	Iron frame, DIP-8, Halogen/lead -free	1280/BOX
UMW 6N138S	Copper frame,SOP-8,Halogen-free	1000/REEL
UMW 6N139M	Iron frame, DIP-8, Halogen/lead -free	1280/BOX
UMW 6N139S	Copper frame,SOP-8,Halogen-free	1000/REEL