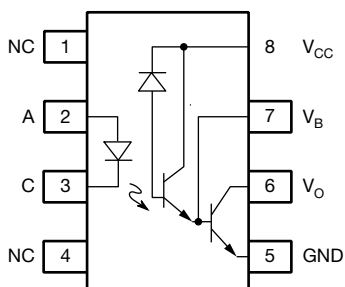


High Speed Optocoupler, 100 kBd, Low Input Current, Photodiode Darlington Output



LINKS TO ADDITIONAL RESOURCES



DESCRIPTION

High common mode transient immunity and very high current ratio are achieved by coupling and LED with an integrated high gain photo detector in an eight pin dual-in-line package. Separate pins for the photo diode and output stage enable TTL compatible saturation voltages with high speed operation.

Access to the base terminal allows adjustment to the gain bandwidth.

The 6N139 is suited for low power logic applications involving CMOS and low power TTL applications. A 400 % current transfer ratio with only 0.5 mA of LED current is guaranteed.

FEATURES

- 400 % (min) high current transfer ratio
- 0.5 mA low input drive current
- Enhanced CTI of 275
- 10 kV/μs (typ.) high common mode transient immunity
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

APPLICATIONS

- Microprocessor system interface
- PLC, ATE input / output isolation
- RS232, SPI, I2C bus systems
- TTL, CMOS voltage level translation
- Multiplexed data transmission
- Ground loop and electrical noise elimination

AGENCY APPROVALS

- [UL 1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\)](#), available with option 1

**ORDERING INFORMATION**

6 N 1 3 # PART NUMBER X 0 # # PACKAGE OPTION T TAPE AND REEL											
AGENCY CERTIFIED / PACKAGE		CTR (%)									
		1.6 mA									
UL, cUL		> 500									
DIP-8		6N139									
SMD-8, option 7		6N139-X007T									
UL, cUL, VDE (option 1)		> 500									
DIP-8		6N139-X001									
SMD-8, option 7		6N139-X017T									

ABSOLUTE MAXIMUM RATINGS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT				
Reverse voltage		V_R	5	V
Average forward input current		I_F	20	mA
Input power dissipation		P_{diss}	35	mW
OUTPUT				
Supply voltage		V_{CC}	18	V
Output voltage		V_O	18	V
Output current		I_O	50	mA
Output power dissipation		P_{diss}	100	mW
COUPLER				
Storage temperature		T_{stg}	-55 to +150	$^{\circ}\text{C}$
Operating temperature		T_{amb}	-40 to +100	$^{\circ}\text{C}$
Lead soldering temperature	$t = 10\text{ s}$	T_{sld}	260	$^{\circ}\text{C}$

Note

- 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. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

ELECTRICAL CHARACTERISTICS

($T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$, $V_{CC} = 4.5\text{ V}$ to 5.5 V , $I_F = 7.5\text{ mA}$; typical values are at $T_{amb} = 25\text{ }^{\circ}\text{C}$)

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT						
Input forward voltage	$I_F = 1.6\text{ mA}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$	V_F	-	1.1	1.7	V
Input reverse breakdown voltage	$I_R = 10\text{ }\mu\text{A}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$	B_{VR}	5	-	-	V
Input capacitance	$f = 1\text{ MHz}$, $V_F = 0$	C_{IN}	-	60	-	pF
Temperature coefficient of forward voltage	$I_F = 1.6\text{ mA}$		-	-1.9	-	mV/ $^{\circ}\text{C}$
OUTPUT						
Logic low, output voltage ⁽¹⁾	$I_F = 1.6\text{ mA}$, $I_O = 8\text{ mA}$, $V_{CC} = 4.5\text{ V}$	V_{OL}	-	0.1	0.4	V
	$I_F = 5\text{ mA}$, $I_O = 15\text{ mA}$, $V_{CC} = 4.5\text{ V}$	V_{OL}	-	0.1	0.4	V
	$I_F = 12\text{ mA}$, $I_O = 24\text{ mA}$, $V_{CC} = 4.5\text{ V}$	V_{OL}	-	0.2	0.4	V
Logic high, output current ⁽¹⁾	$I_F = 0\text{ mA}$, $V_O = 18\text{ V}$, $V_{CC} = 18\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$	I_{OH}	-	0.1	100	μA
Logic low supply current ⁽¹⁾	$I_F = 1.6\text{ mA}$, $V_O = \text{open}$, $V_{CC} = 18\text{ V}$	I_{CCL}	-	0.4	1.5	mA
Logic high supply current ⁽¹⁾	$I_F = 0\text{ mA}$, $V_O = \text{open}$, $V_{CC} = 18\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$	I_{CCH}	-	0.01	10	μA
COUPLER						
Coupling capacitance	$f = 1\text{ MHz}$	C_{IO}	-	25	-	pF

Notes

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

⁽¹⁾ Pin 7 open

CURRENT TRANSFER RATIO

($T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$, $V_{CC} = 4.5\text{ V}$ to 5.5 V , $I_F = 7.5\text{ mA}$; typical values are at $T_{amb} = 25\text{ }^{\circ}\text{C}$)

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Current transfer ratio ⁽¹⁾	$I_F = 0.5\text{ mA}$, $V_O = 0.4\text{ V}$, $V_{CC} = 4.5\text{ V}$	CTR	400	2000	5000	%
	$I_F = 1.6\text{ mA}$, $V_O = 0.4\text{ V}$, $V_{CC} = 4.5\text{ V}$	CTR	500	1600	2600	%

Notes
⁽¹⁾ Pin 7 open

SAFETY AND INSULATION RATINGS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 110 / 21	
Comparative tracking index	Insulation group IIIa	CTI	275	
Maximum rated withstanding isolation voltage	According to UL 1577, $t = 1\text{ min}$	V_{ISO}	5000	V_{RMS}
Maximum transient isolation voltage	According to DIN EN 60747-5-5	V_{IOTM}	6000	V_{peak}
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	V_{IORM}	630	V_{peak}
Isolation resistance	$T_{amb} = 25\text{ }^{\circ}\text{C}$, $V_{IO} = 500\text{ V}$	R_{IO}	$\geq 10^{12}$	Ω
	$T_{amb} = 100\text{ }^{\circ}\text{C}$, $V_{IO} = 500\text{ V}$	R_{IO}	$\geq 10^{11}$	Ω
Output safety power		P_{SO}	600	mW
Input safety current		I_{SI}	230	mA
Input safety temperature		T_S	175	$^{\circ}\text{C}$
Creepage distance	DIP-8, SMD-8, option 7		≥ 7	mm
Clearance distance			≥ 7	mm
Insulation thickness		DTI	≥ 0.4	mm

Note

- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for "safe electrical insulation" only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

SWITCHING CHARACTERISTICS

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Propagation delay time to logic low at output	$I_F = 0.5 \text{ mA}$, $R_L = 4.7 \text{ k}\Omega$	t_{PHL}	-	5	25	μs
	$I_F = 12 \text{ mA}$, $R_L = 270 \Omega$	t_{PHL}	-	0.1	1	μs
Propagation delay time to logic high at output	$I_F = 0.5 \text{ mA}$, $R_L = 4.7 \text{ k}\Omega$	t_{PLH}	-	18	60	μs
	$I_F = 12 \text{ mA}$, $R_L = 270 \Omega$	t_{PLH}	-	2	7	μs

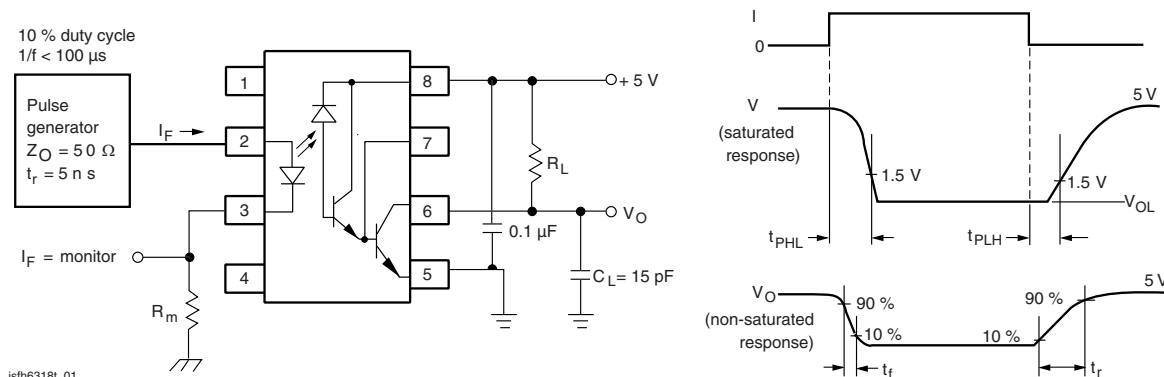


Fig. 1 - Switching Test Circuit

COMMON MODE TRANSIENT IMMUNITY

PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Common mode transient immunity, logic high level output	$I_F = 0 \text{ mA}$, $R_L = 2.2 \text{ k}\Omega$, $R_{CC} = 0$, $ V_{CM} = 10 \text{ V}_{P-P}$	$ CM_H $	1	10	-	$\text{kV}/\mu\text{s}$
Common mode transient immunity, logic low level output	$I_F = 1.6 \text{ mA}$, $R_L = 2.2 \text{ k}\Omega$, $R_{CC} = 0$, $ V_{CM} = 10 \text{ V}_{P-P}$	$ CM_L $	1	10	-	$\text{kV}/\mu\text{s}$

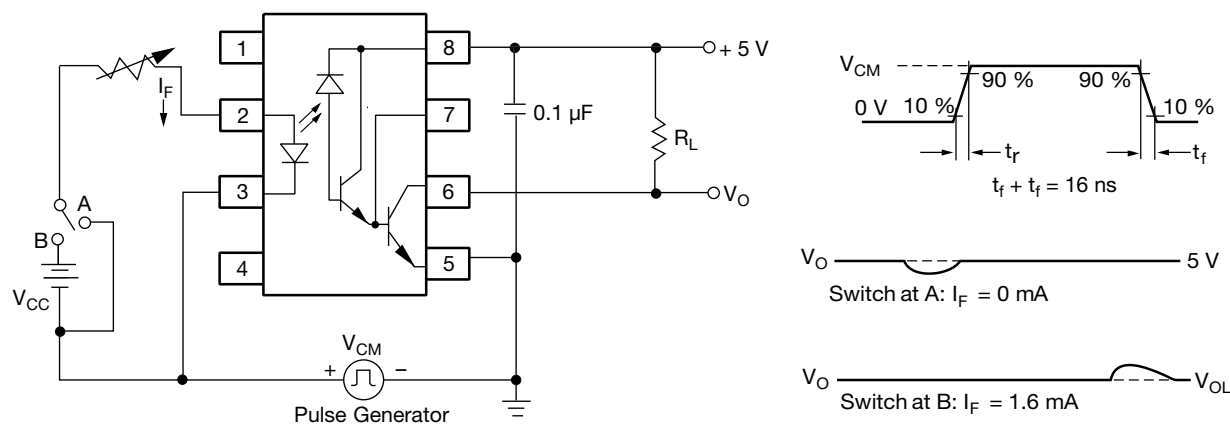


Fig. 2 - Test Circuit for Transient Immunity and Typical Waveforms

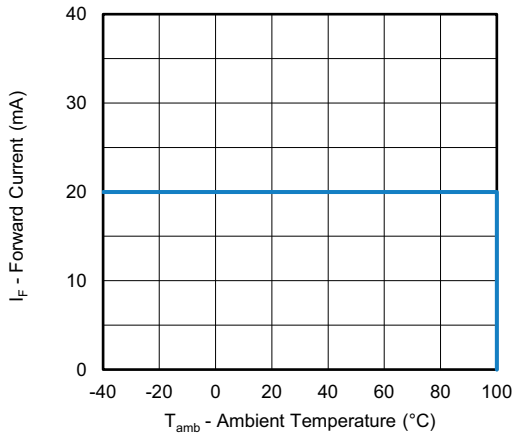
TYPICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)


Fig. 3 - Forward Current vs. Ambient Temperature

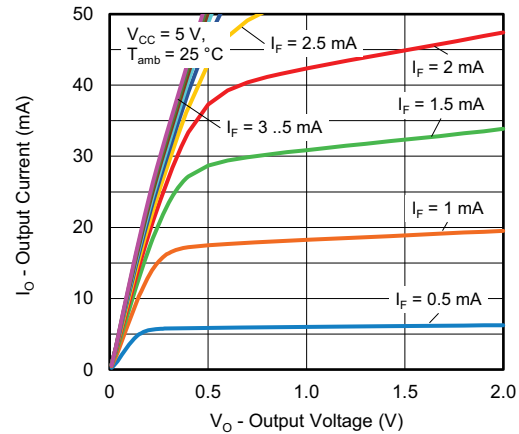


Fig. 6 - Output Current vs. Output Voltage

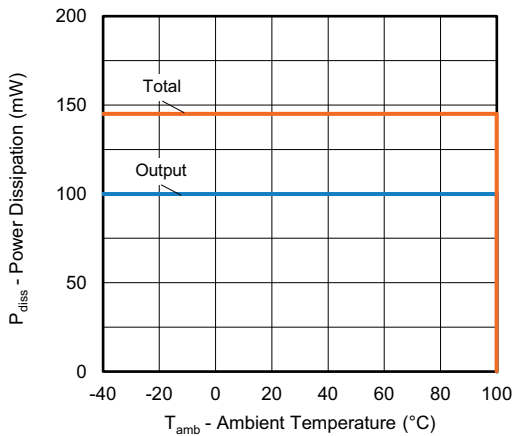


Fig. 4 - Power Dissipation vs. Ambient Temperature

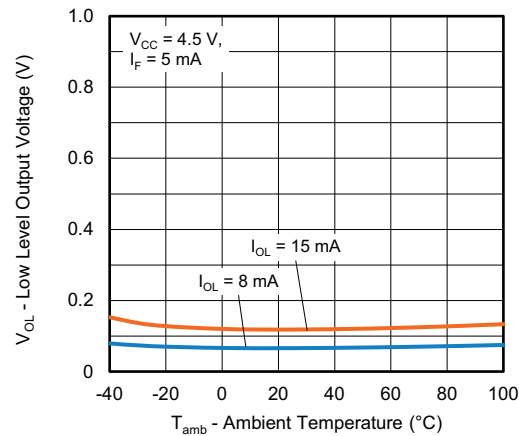


Fig. 7 - Low Level Output Voltage vs. Ambient Temperature

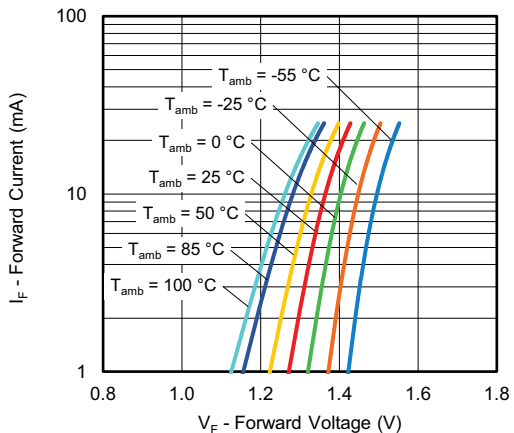


Fig. 5 - Forward Current vs. Forward Voltage

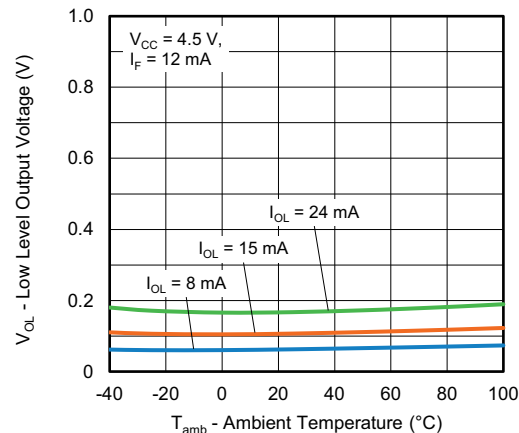


Fig. 8 - Low Level Output Voltage vs. Ambient Temperature

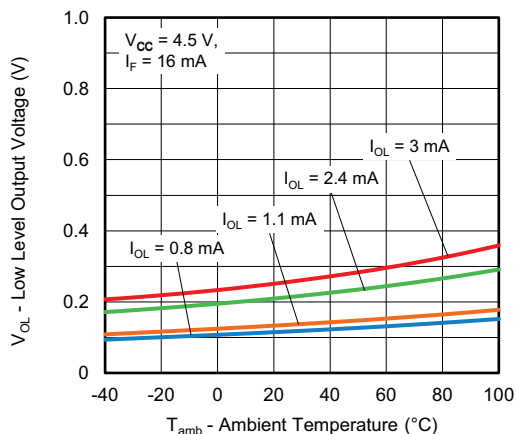


Fig. 9 - Low Level Output Voltage vs. Ambient Temperature

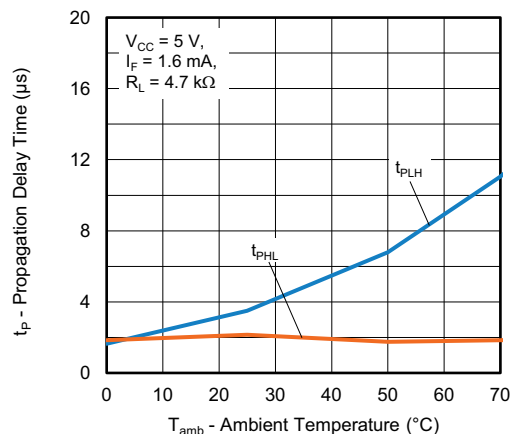


Fig. 12 - Propagation Delay Time vs. Ambient Temperature

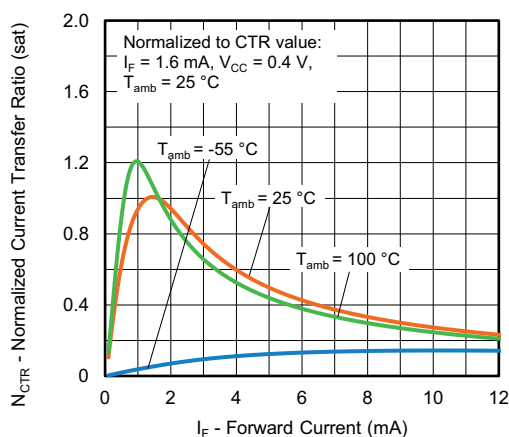


Fig. 10 - Normalized Current Transfer Ratio (saturated) vs. Forward Current

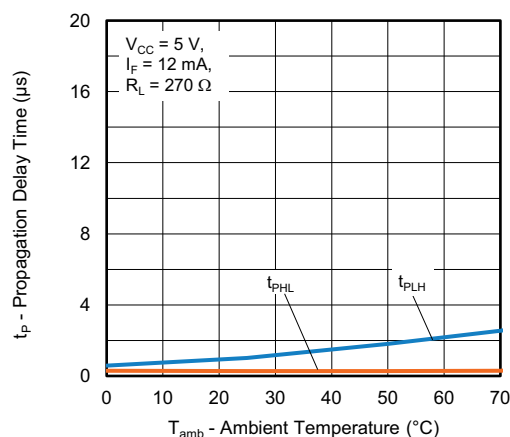


Fig. 13 - Propagation Delay Time vs. Ambient Temperature

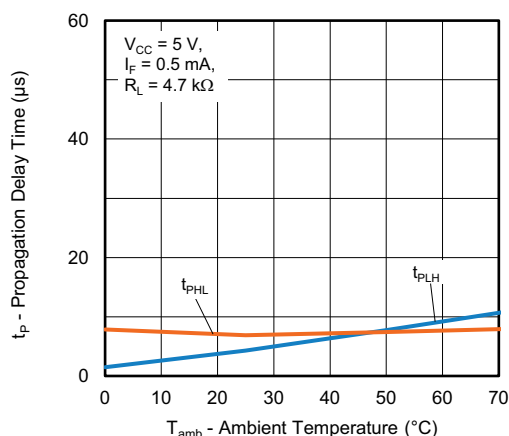


Fig. 11 - Propagation Delay Time vs. Ambient Temperature

PACKAGE DIMENSIONS (in millimeters)

DIP-8

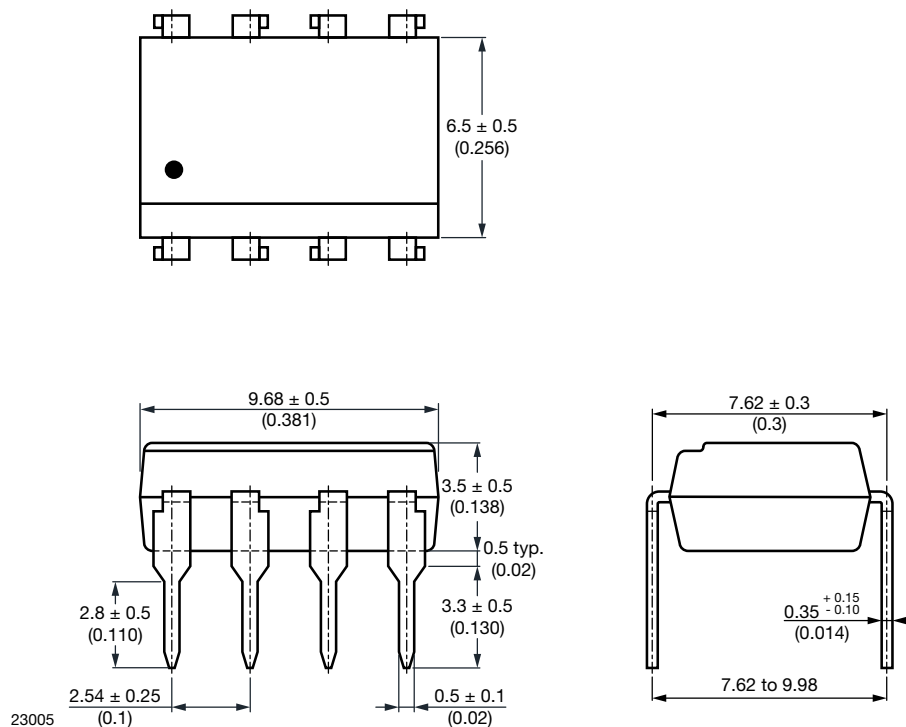


Fig. 14

SMD-8, Option 7

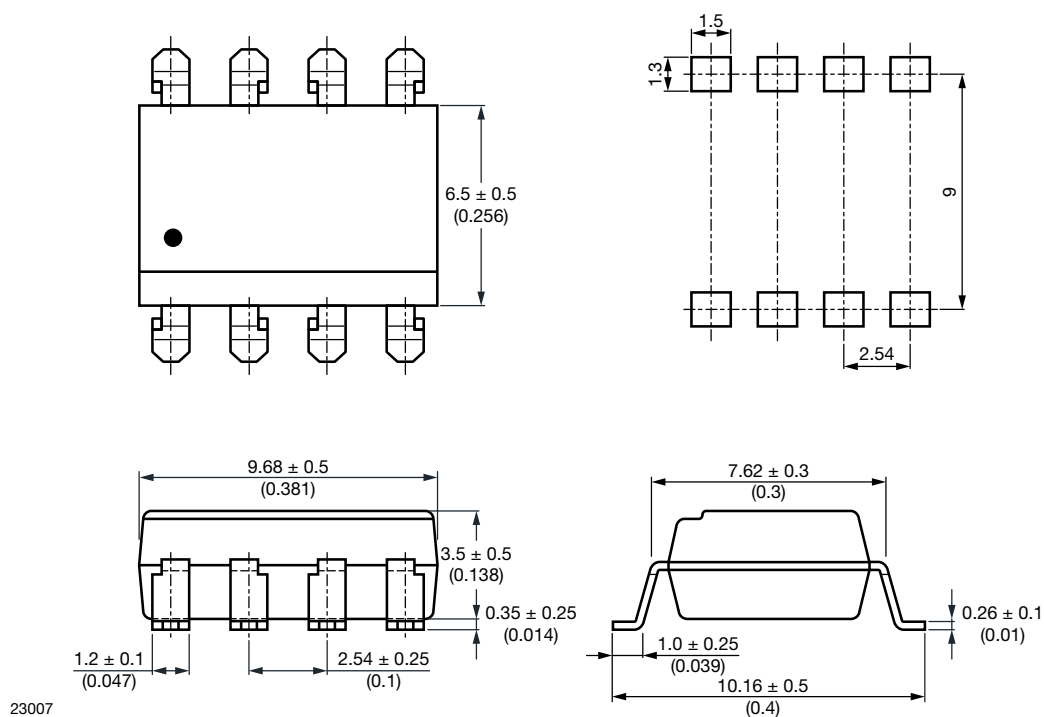


Fig. 15

PACKAGE MARKING

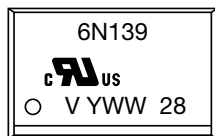


Fig. 16 - Example of 6N139

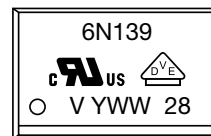


Fig. 17 - Example of 6N139-X017T

Notes

- “YWW” is the date code marking (Y = year code, WW = week code)
- VDE logo is only marked on VDE option parts
- Tape and reel suffix (T) is not part of the package marking

PACKAGING INFORMATION (in millimeters)

DEVICES PER TUBES			
TYPE	UNITS/TUBE	TUBES/BOX	UNITS/BOX
DIP-8	50	40	2000

SMD-8 Tape

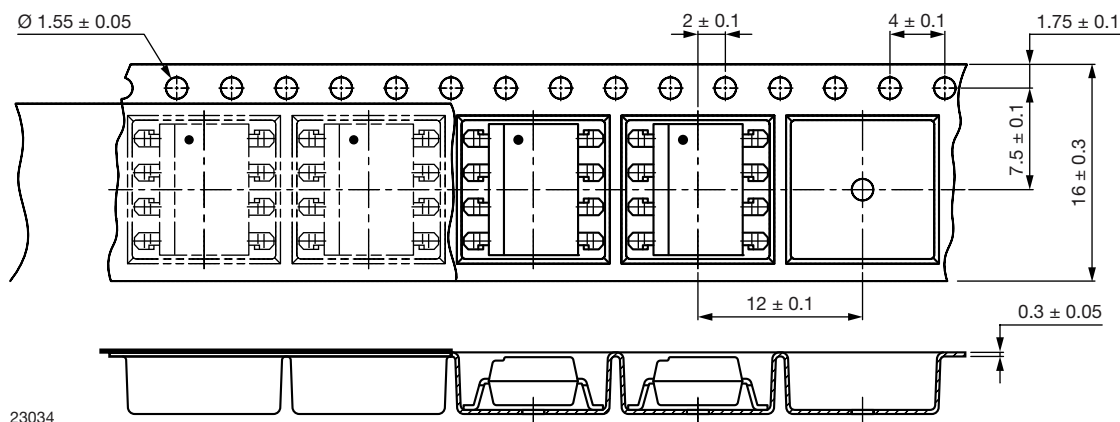


Fig. 18 - Tape and Reel Packaging (1000 pieces on reel)

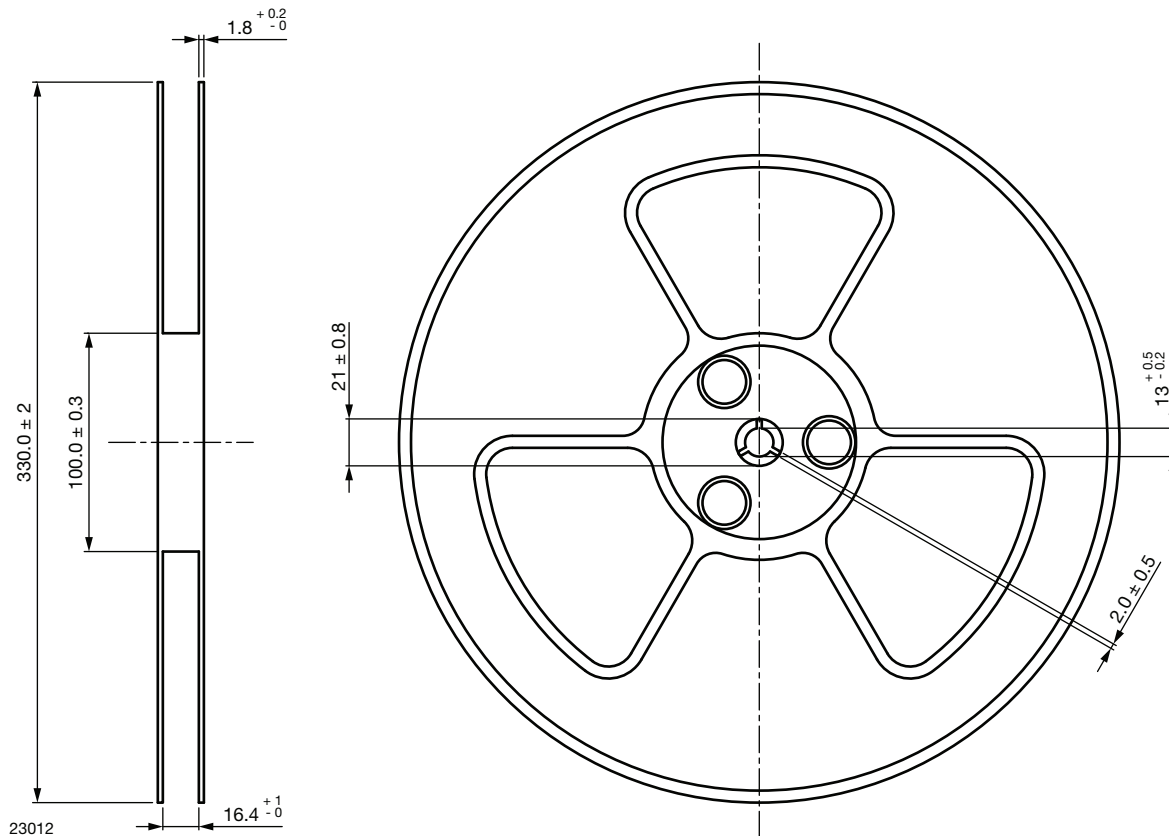
Reel


Fig. 19 - Tape and Reel Shipping Medium

SOLDER PROFILES
IR Reflow Soldering (JEDEC® J-STD-020C compliant)

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

PROFILE ITEM	CONDITIONS
Preheat	
- Temperature minimum ($T_{S \text{ min.}}$)	150 °C
- Temperature maximum ($T_{S \text{ max.}}$)	200 °C
- Time (min. to max.) (t_S)	90 s ± 30 s
Soldering zone	
- Temperature (T_L)	217 °C
- Time (t_L)	60 s
Peak temperature (T_p)	260 °C
Ramp-up rate	3 °C/s max.
Ramp-down rate	3 °C/s to 6 °C/s

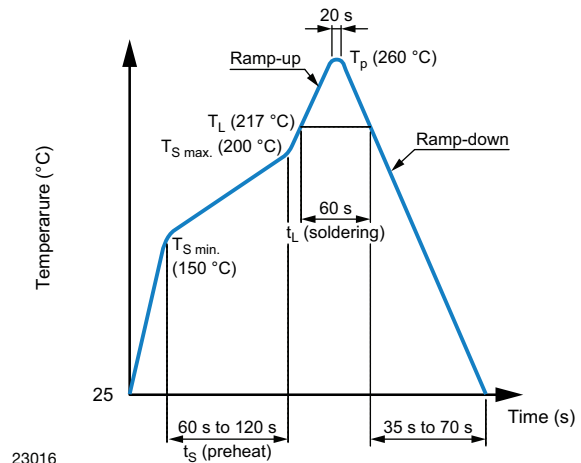


Fig. 20

Wave Soldering (JEDEC JESD22-A111 compliant)

One time soldering is recommended within the condition of temperature.

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

Time: 10 s

Preheat temperature: $25\text{ }^{\circ}\text{C}$ to $140\text{ }^{\circ}\text{C}$

Preheat time: 30 s to 80 s

HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions: $T_{\text{amb}} < 30\text{ }^{\circ}\text{C}$, RH < 85 %

Moisture sensitivity level 1, according to J-STD-020

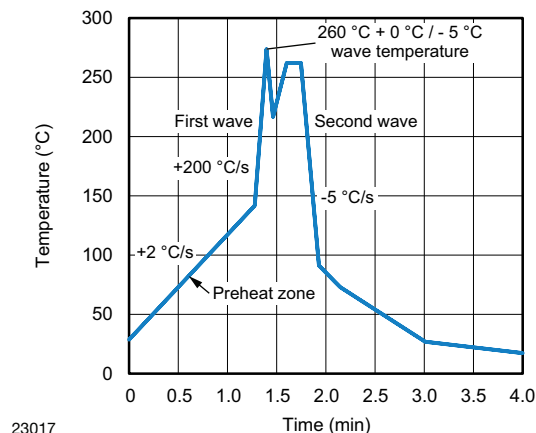


Fig. 21

Hand Soldering by Soldering Iron

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature: $380\text{ }^{\circ}\text{C} + 0\text{ }^{\circ}\text{C} / - 5\text{ }^{\circ}\text{C}$

Time: 3 s max.



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