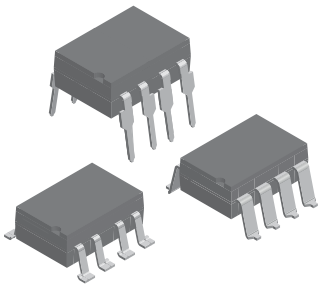
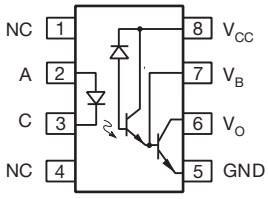
High Speed Optocoupler, 100 kBd, Low Input Current, Photodiode Darlington Output





DESIGN SUPPORT TOOLS

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DESCRIPTION

High common mode transient immunity and very high current ratio together with 5300 V_{RMS} insulation 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.

Caution: Due to the small geometries of this device, it should be handled with Electrostatic Discharge (ESD) precautions. Proper grounding would prevent damage further and/or degradation which may be induced by ESD.

FEATURES

- High current transfer ratio, 500 %
- Low input current, 1.6 mA
- High common mode rejection, 500 V/µs
- Adjustable bandwidth-access to base
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

APPLICATIONS

- Microprocessor system interface
- PLC, ATE input / output isolation
- EIA RS232 line receiver
- TTL, CMOS voltage level translation
- Multiplexed data transmission
- Digital control power supply
- Ground loop and electrical noise elimination

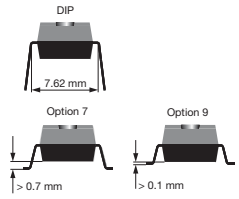
AGENCY APPROVALS

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

ORDERING INFORMATION

6	N	1	3	#	-	X	0	#	#	T

PART NUMBER | PACKAGE OPTION | TAPE AND REEL



AGENCY CERTIFIED/PACKAGE	CTR (%)
	1.6 mA
UL, cUL	**> 500**
DIP-8	6N139
SMD-8, option 7	6N139-X007, 6N139-X007T
SMD-8, option 9	6N139-X009, 6N139-X009T
UL, cUL, VDE (option 1)	**> 500**
DIP-8	6N139-X001
SMD-8, option 7	6N139-X017T
SMD-8, option 9	6N139-X019T

Note

- For additional information on the available options refer to option information

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ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
INPUT				
Reverse voltage		V_R	5	V
Forward current		I_F	25	mA
Average input current		$I_{f(avg)}$	20	mA
Input power dissipation		P_{diss}	35	mW
OUTPUT				
Supply and output voltage	Pin 8 to 5, pin 6 to 5	V_{CC}, V_O	-0.5 to 18	V
Emitter base reverse voltage	Pin 5 to 7		0.5	V
Peak input current	50 % duty cycle - 1 ms pulse width		40	mA
Peak transient input current	$t_p \leq 1$ µs, 300 pps		1	A
Output current	Pin 6	I_O	60	mA
Output power dissipation		P_{diss}	100	mW
COUPLER				
Storage temperature		T_{stg}	-55 to +150	°C
Operating temperature		T_{amb}	-55 to +100	°C
Lead soldering temperature	t = 10 s	T_{sld}	260	°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} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
INPUT						
Input forward voltage	I_F = 1.6 mA	V_F	-	1.4	1.7	V
Input reverse breakdown voltage	I_R = 10 µA	B_{VR}	5	-	-	V
Input capacitance	f = 1 MHz, V_F = 0	C_{IN}	-	25	-	pF
Temperature coefficient of forward voltage	I_F = 1.6 mA		-	-1.8	-	mV/°C
OUTPUT						
Logic low, output voltage (1)	I_F = 1.6 mA, I_O = 8 mA, V_{CC} = 4.5 V	V_{OL}	-	0.1	0.4	V
	I_F = 5 mA, I_O = 15 mA, V_{CC} = 4.5 V	V_{OL}	-	0.15	0.4	V
	I_F = 12 mA, I_O = 24 mA, V_{CC} = 4.5 V	V_{OL}	-	0.25	0.4	V
Logic high, output current (1)	I_F = 0 mA, V_{CC} = 18 V	I_{OH}	-	0.05	100	µA
Logic low supply current (1)	I_F = 1.6 mA, V_O = OPEN, V_{CC} = 18 V	I_{CCL}	-	0.2	1.5	mA
Logic high supply current (1)	I_F = 0 mA, V_O = OPEN, V_{CC} = 18 V	I_{CCH}	-	0.001	10	µA
COUPLER						
Input output insulation leakage current	45 % relative humidity, T_{amb} = 25 °C, t = 5 s, V_{IO} = 3000 V_{DC}		-	-	1	µA
Coupling capacitance	f = 1 MHz	C_{IO}	-	0.6	-	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

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CURRENT TRANSFER RATIO						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Current transfer ratio (1)	I_F = 0.5 mA, V_O = 0.4 V, V_{CC} = 4.5 V	CTR	400	1600	-	%
	I_F = 1.6 mA, V_O = 0.4 V, V_{CC} = 4.5 V	CTR	500	2000	-	%

Notes

(1) Pin 7 open

SAFETY AND INSULATION RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
Climatic classification	According to IEC 68 part 1		55 / 100 / 21	
Comparative tracking index	Insulation group IIIa	CTI	175	
Maximum rated withstanding isolation voltage	According to UL 1577, t = 1 min	V_{ISO}	5300	V_{RMS}
Maximum transient isolation voltage	According to DIN EN 60747-5-5	V_{IOTM}	8000	V_{peak}
Maximum repetitive peak isolation voltage	According to DIN EN 60747-5-5	V_{IORM}	890	V_{peak}
Isolation resistance	T_{amb} = 25 °C, V_{IO} = 500 V	R_{IO}	≥ 10^{12}	Ω
	T_{amb} = 100 °C, V_{IO} = 500 V	R_{IO}	≥ 10^{11}	Ω
Output safety power		P_{SO}	500	mW
Input safety current		I_{SI}	300	mA
Input safety temperature		T_S	175	°C
Creepage distance	DIP-8		≥ 7	mm
Clearance distance			≥ 7	mm
Creepage distance	SMD-8, option 7, SMD-8, option 9		≥ 8	mm
Clearance distance			≥ 8	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 mA, R_L = 4.7 kΩ	t_{PHL}	-	6	25	µs
	I_F = 12 mA, R_L = 270 Ω	t_{PHL}	-	0.6	1	µs
Propagation delay time to logic high at output	I_F = 0.5 mA, R_L = 4.7 kΩ	t_{PLH}	-	4	60	µs
Propagation delay time to logic high at output	I_F = 12 mA, R_L = 270 Ω	t_{PLH}	-	1.5	7	µs

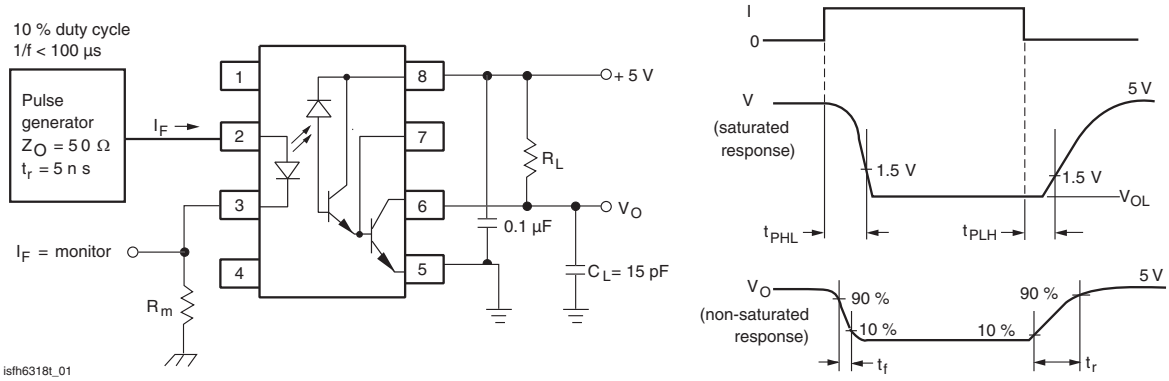

Fig. 1 - Switching Test Circuit

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COMMON MODE TRANSIENT IMMUNITY						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Common mode transient immunity, logic high level output (1)	I_F = 0 mA, R_L = 2.2 kΩ, R_{CC} = 0, $\|V_{CM}\|$ = 10 V_{P-P}	$\|CM_H\|$	-	500	-	V/µs
Common mode transient immunity, logic low level output (1)	I_F = 16 mA, R_L = 2.2 kΩ, R_{CC} = 0, $\|V_{CM}\|$ = 10 V_{P-P}	$\|CM_L\|$	-	- 500	-	V/µs

Note

(1) In applications where dV/dt may exceed 50 000 V/µs (such as state discharge) a series resistor, R_{CC} should be included to protect I_C from destructively high surge currents. The recommend value is $R_{CC} \cong [(1\ V)/(0.15\ I_F\ (mA)]\ k\Omega$

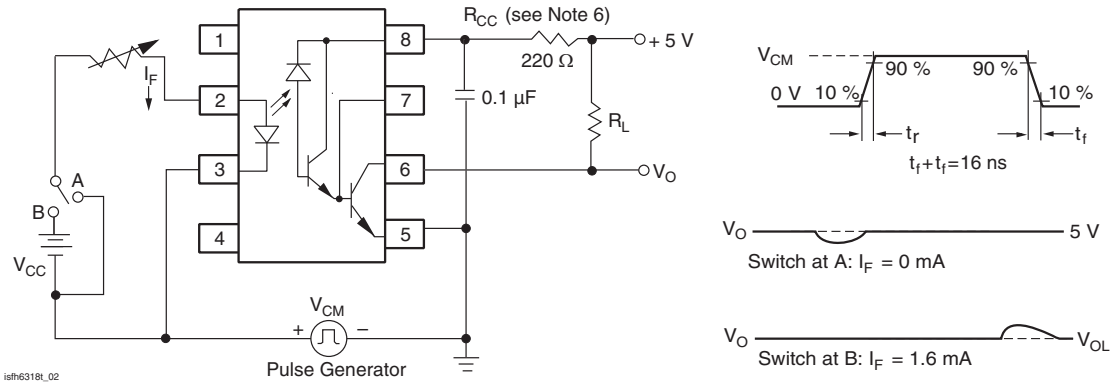

Fig. 2 - Test Circuit for Transient Immunity and Typical Waveforms

TYPICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

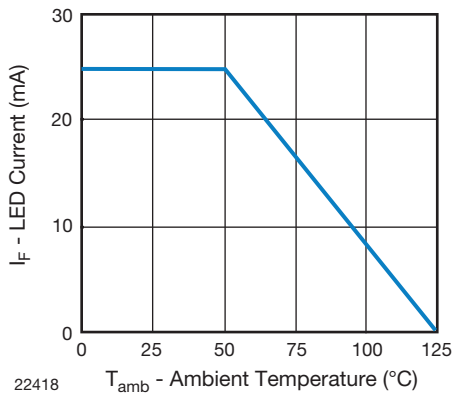

Fig. 2 - Permissible Forward LED Current vs. Temperature

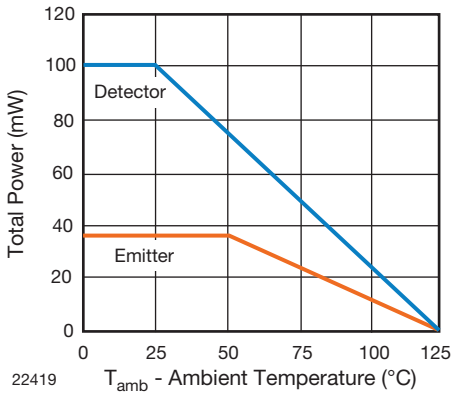

Fig. 3 - Permissible Power Dissipation vs. Temperature

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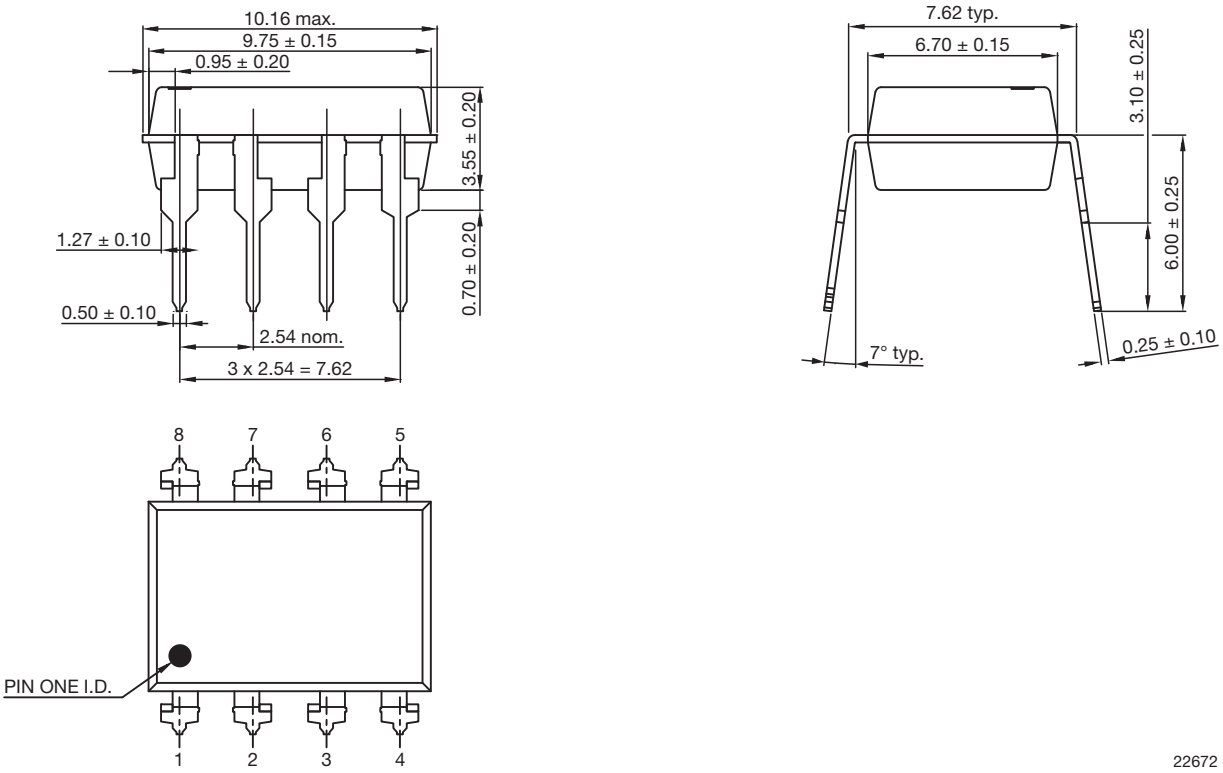
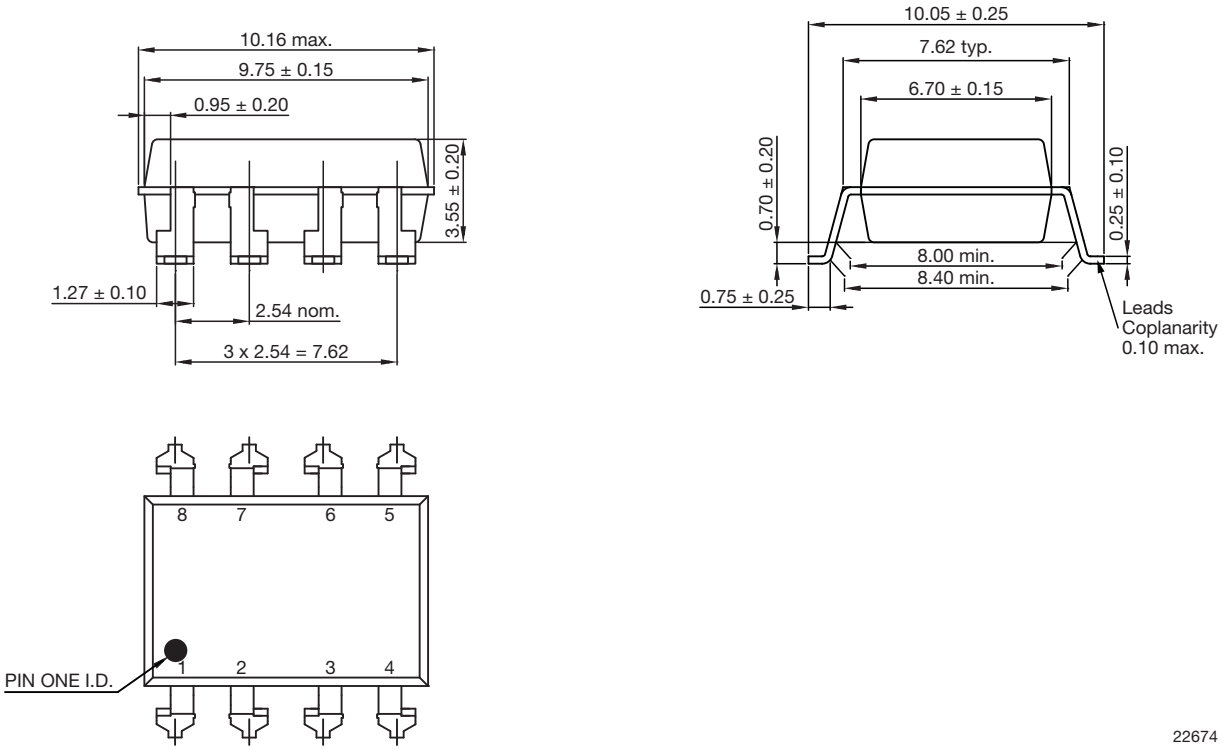
PACKAGE DIMENSIONS (in millimeters)

DIP-8



SMD-8, Option 7



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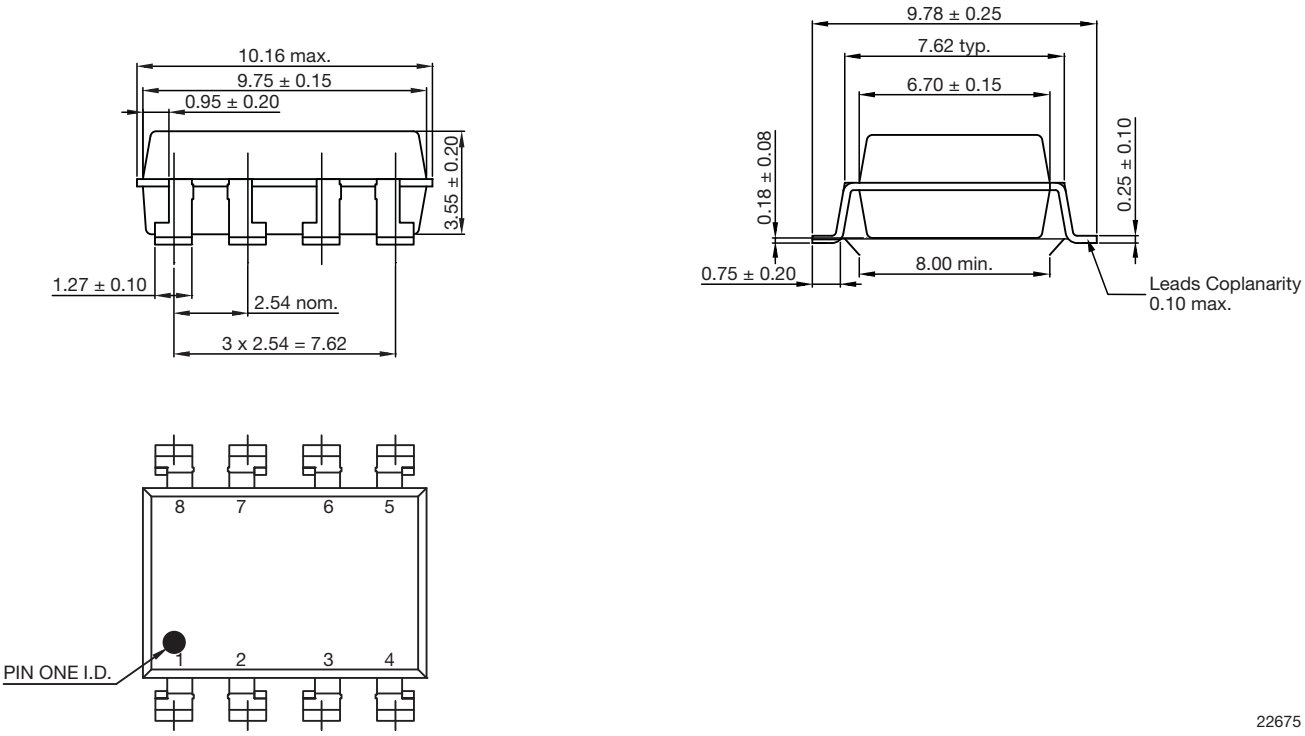
SMD-8, Option 9



PACKAGE MARKING

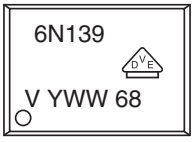


Fig. 3 - Example of 6N139-X017T

Note

- VDE logo is only marked on option 1 parts
- Tape and reel suffix (T) is not part of the package marking

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PACKING INFORMATION (in millimeters)

Tube

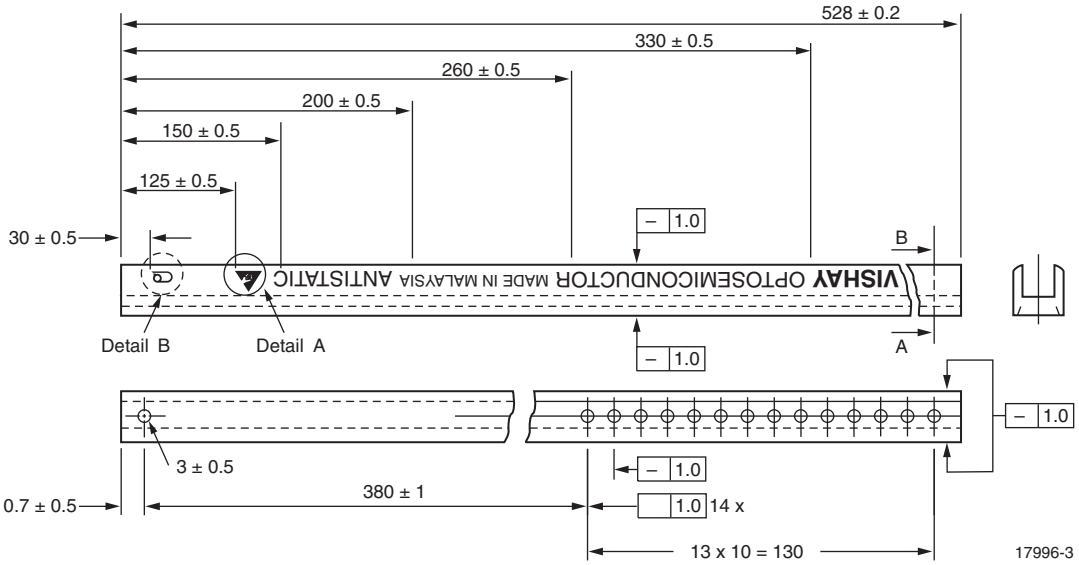

Fig. 4 - Shipping Tube Specifications for DIP-8 Packages

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

DIP-8

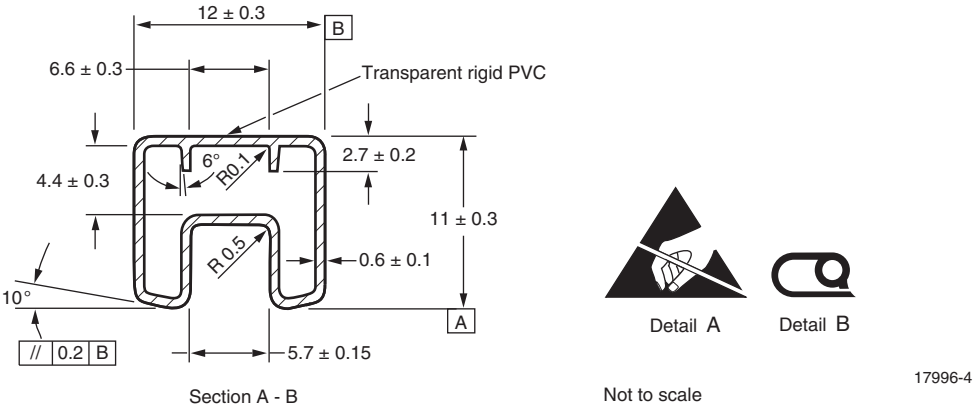

Fig. 5 - Tube Shipping Medium

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Tape and Reel

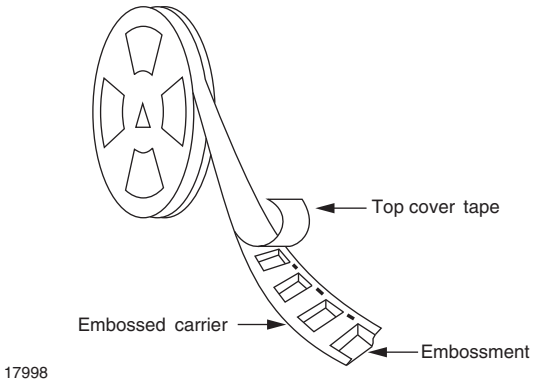

Fig. 6 - Tape and Reel Shipping Medium

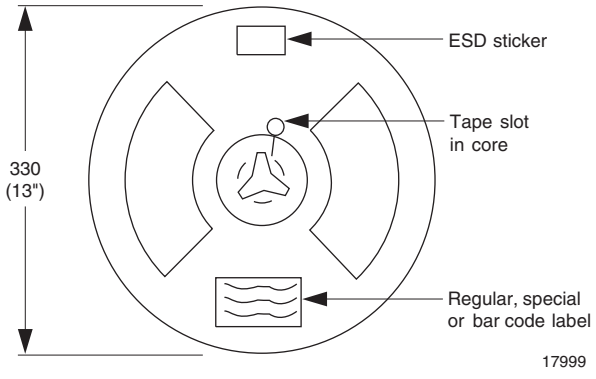

Fig. 7 - Tape and Reel Shipping Medium

SMD-8 (option 7)

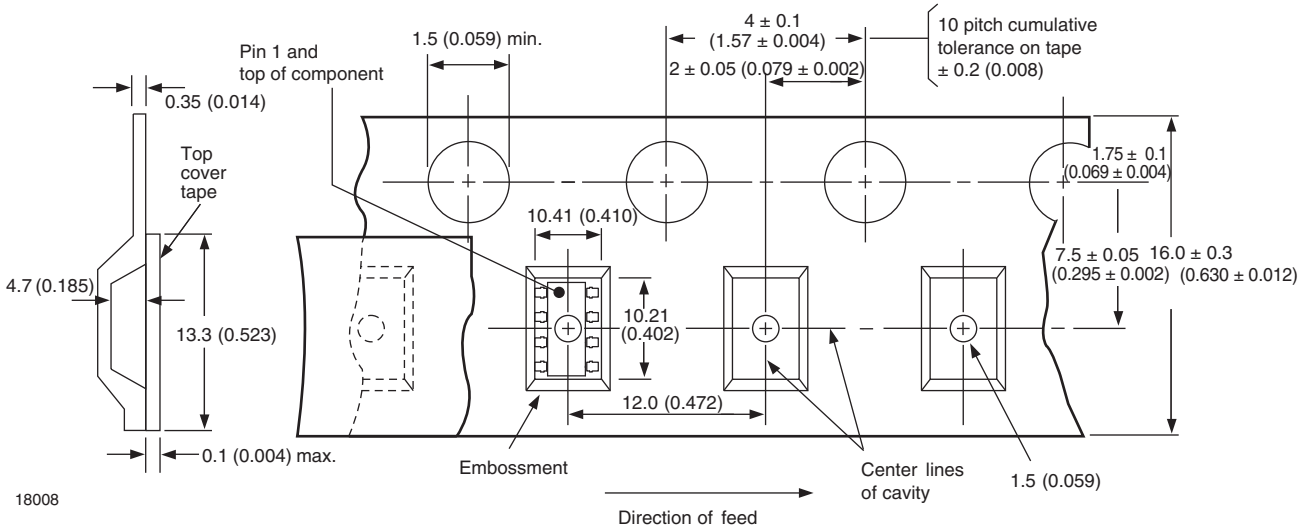

Fig. 8 - Tape and Reel Packing (1000 pieces on Reel)

SMD-8 (option 9)

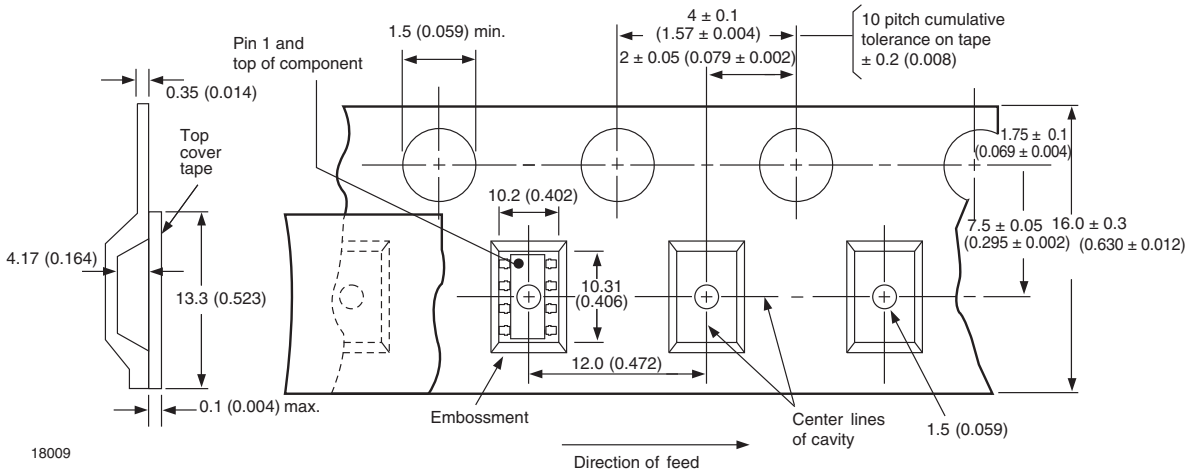

Fig. 9 - Tape and Reel Shipping Medium

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SOLDER PROFILES

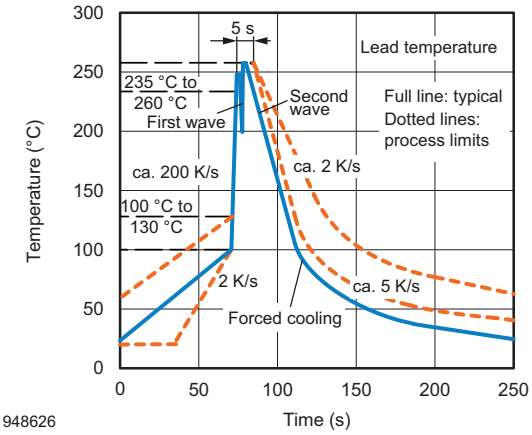

Fig. 10 - Wave Soldering Double Wave Profile According to J.STD-020 for DIP-8 Devices

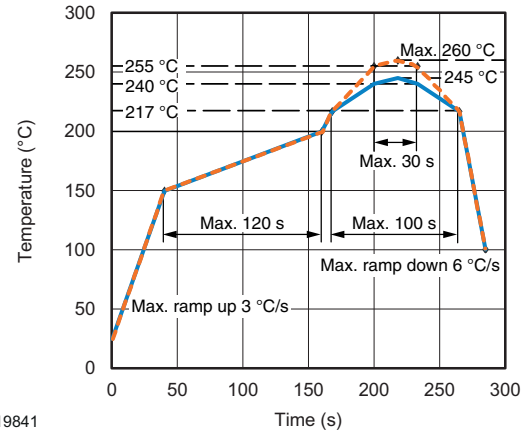

Fig. 11 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices

HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions: T_{amb} < 30 °C, RH < 85 %

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

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