

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 an 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/ μ s
- Adjustable bandwidth-access to base
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



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



| 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



| 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 |
| 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 | $t_p \leq 1\text{ }\mu\text{s}$, 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 | $^{\circ}\text{C}$ |
| Operating temperature | | T_{amb} | -55 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 ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------|------|-------|------|------------------------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| INPUT | | | | | | |
| Input forward voltage | $I_F = 1.6\text{ mA}$ | V_F | - | 1.4 | 1.7 | V |
| Input reverse breakdown voltage | $I_R = 10\text{ }\mu\text{A}$ | B_{VR} | 5 | - | - | V |
| Input capacitance | $f = 1\text{ MHz}$, $V_F = 0$ | C_{IN} | - | 25 | - | pF |
| Temperature coefficient of forward voltage | $I_F = 1.6\text{ mA}$ | | - | -1.8 | - | 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} | - | 0.15 | 0.4 | V |
| | $I_F = 12\text{ mA}$, $I_O = 24\text{ mA}$, $V_{CC} = 4.5\text{ V}$ | V_{OL} | - | 0.25 | 0.4 | V |
| Logic high, output current ⁽¹⁾ | $I_F = 0\text{ mA}$, $V_{CC} = 18\text{ V}$ | I_{OH} | - | 0.05 | 100 | μA |
| Logic low supply current ⁽¹⁾ | $I_F = 1.6\text{ mA}$, $V_O = \text{OPEN}$, $V_{CC} = 18\text{ V}$ | I_{CCL} | - | 0.2 | 1.5 | mA |
| Logic high supply current ⁽¹⁾ | $I_F = 0\text{ mA}$, $V_O = \text{OPEN}$, $V_{CC} = 18\text{ V}$ | I_{CCH} | - | 0.001 | 10 | μA |
| COUPLER | | | | | | |
| Input output insulation leakage current | 45 % relative humidity, $T_{amb} = 25\text{ }^{\circ}\text{C}$, $t = 5\text{ s}$, $V_{IO} = 3000\text{ V}_{DC}$ | | - | - | 1 | μA |
| Coupling capacitance | $f = 1\text{ MHz}$ | 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

CURRENT TRANSFER RATIO

| 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 | 1600 | - | % |
| | $I_F = 1.6 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$ | CTR | 500 | 2000 | - | % |

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 / 100 / 21 | |
| Comparative tracking index | Insulation group IIIa | CTI | 175 | |
| Maximum rated withstanding isolation voltage | According to UL 1577, $t = 1 \text{ min}$ | 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 | $T_{amb} = 25 \text{ }^\circ\text{C}, V_{IO} = 500 \text{ V}$ | 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} | 500 | mW |
| Input safety current | | I_{SI} | 300 | mA |
| Input safety temperature | | T_S | 175 | $^\circ\text{C}$ |
| 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 | $I_F = 0.5 \text{ mA}, R_L = 4.7 \text{ k}\Omega$ | t_{PHL} | - | 6 | 25 | μs |
| | $I_F = 12 \text{ mA}, R_L = 270 \Omega$ | t_{PHL} | - | 0.6 | 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} | - | 4 | 60 | μs |
| Propagation delay time to logic high at output | $I_F = 12 \text{ mA}, R_L = 270 \Omega$ | t_{PLH} | - | 1.5 | 7 | μs |

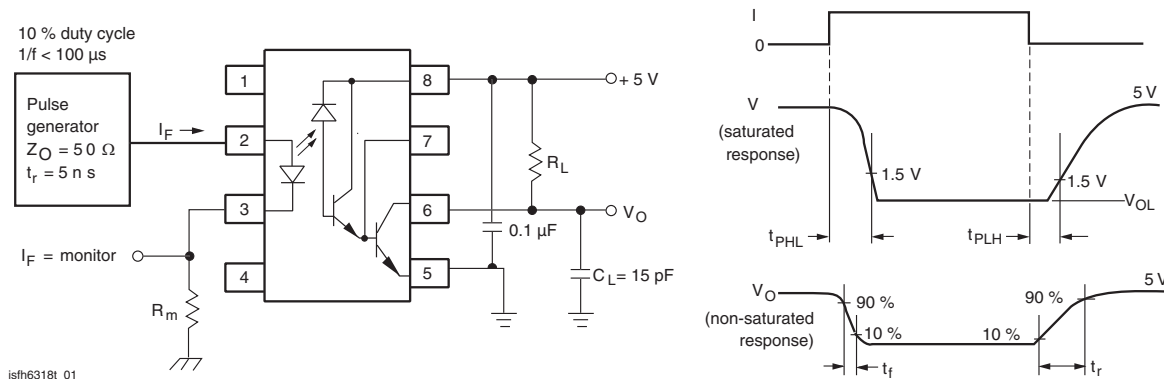


Fig. 1 - Switching Test Circuit

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

Note

⁽¹⁾ In applications where dV/dt may exceed 50 000 V/ μ s (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 $R_{CC} \equiv [(1 \text{ V})/(0.15 I_F \text{ (mA)})] \text{ k}\Omega$

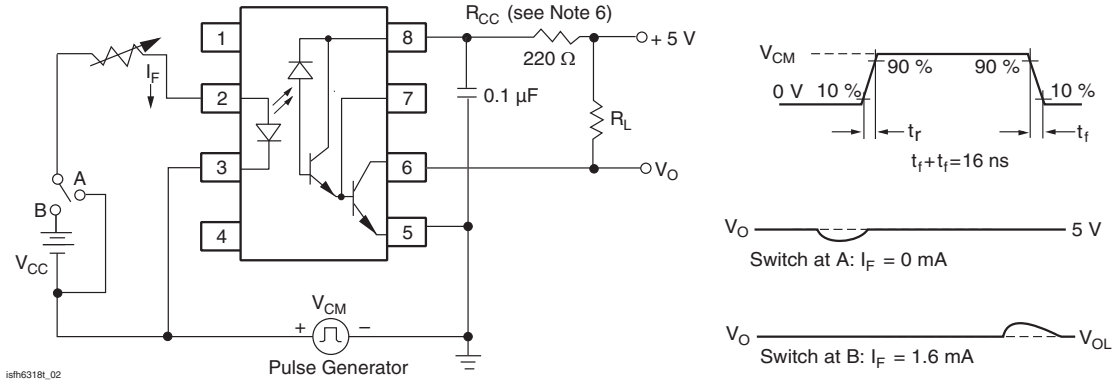


Fig. 2 - Test Circuit for Transient Immunity and Typical Waveforms

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

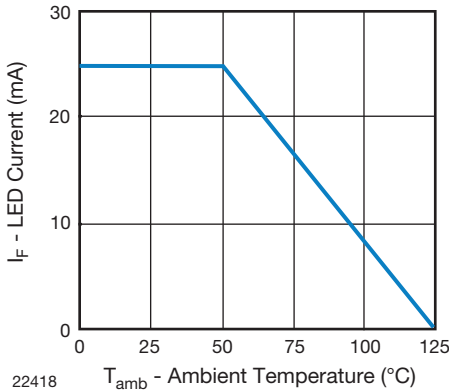


Fig. 2 - Permissible Forward LED Current vs. Temperature

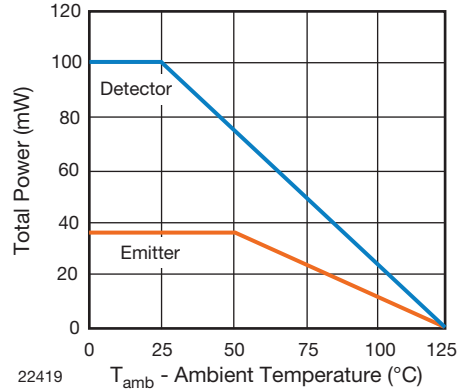


Fig. 3 - Permissible Power Dissipation vs. Temperature



PACKAGE DIMENSIONS (in millimeters)

DIP-8



22672

SMD-8, Option 7



22674

SMD-8, Option 9



22675

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

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

Tape and Reel

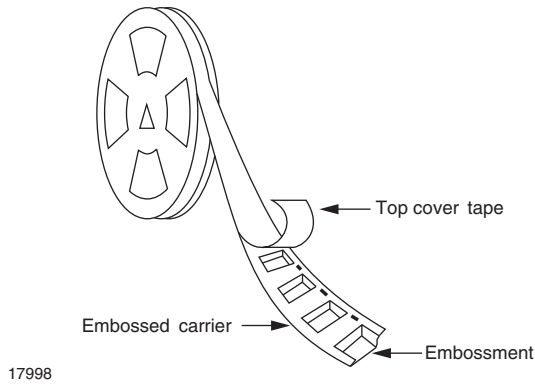


Fig. 6 - Tape and Reel Shipping Medium



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)

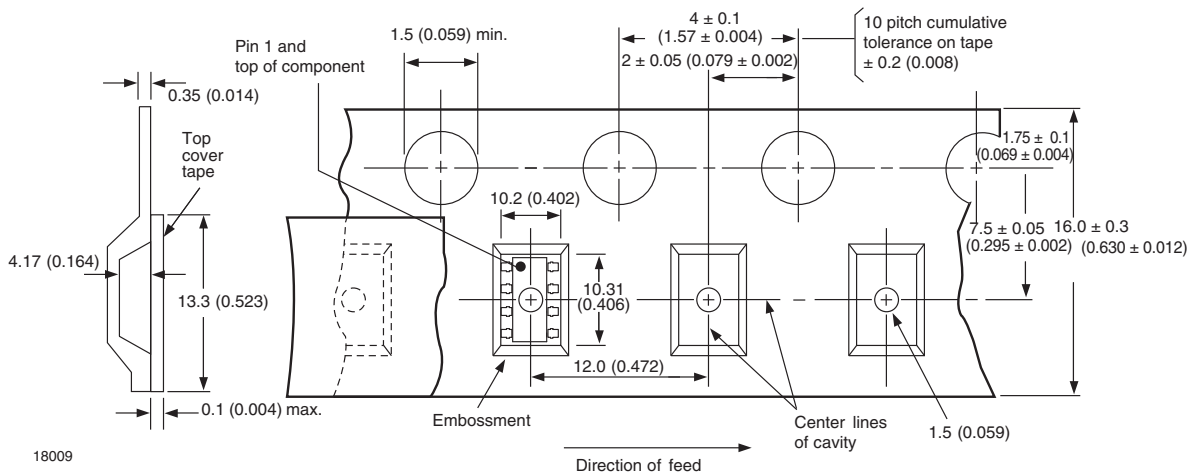


Fig. 9 - Tape and Reel Shipping Medium

SOLDER PROFILES



948626

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



19841

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: $T_{amb} < 30\text{ °C}$, RH < 85 %

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



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