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September 2016

H11N1M, H11N2M — 6-Pin DIP Schmitt Trigger Output Optocoupler

# H11N1M, H11N2M 6-Pin DIP Schmitt Trigger Output Optocoupler

## Features

- High Data Rate, 5 MHz Typical (NRZ)
- Free from Latch-up and Oscillation Throughout Voltage and Temperature Ranges
- Microprocessor Compatible Drive
- Logic Compatible Output Sinks 16 mA at 0.5 V Maximum
- Guaranteed On/Off Threshold Hysteresis
- Wide Supply Voltage Capability, Compatible with All Popular Logic Systems
- Safety and Regulatory Approvals:
  - UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

## Description

The H11NXM series has a high-speed integrated circuit detector optically coupled to an aluminium gallium arsenide (AlGaAs) infrared emitting diode. The output incorporates a Schmitt trigger, which provides hysteresis for noise immunity and pulse shaping. The detector circuit is optimized for simplicity of operation and utilizes an open-collector output for maximum application flexibility.

## Applications

- Logic-to-Logic Isolator
- Programmable Current Level Sensor
- Line Receiver—Eliminate Noise and Transient Problems
- AC to TTL Conversion—Square Wave Shaping
- Interfaces Computers with Peripherals
- Isolated Power MOS Driver for Power Supplies

## Schematic

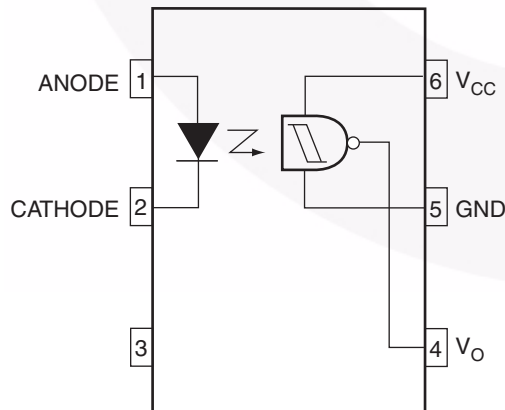


Figure 1. Schematic

## Package Outlines



Figure 2. Package Outlines

## Truth Table

| Input | Output |
|-------|--------|
| H     | L      |
| L     | H      |

## Safety and Insulation Ratings

As per DIN EN/IEC 60747-5-5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

| Parameter   |                        | Characteristics |
|---|------------------------|-----------------|
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | < 150 V <sub>RMS</sub> | I–IV            |
|   | < 300 V <sub>RMS</sub> | I–IV            |
| Climatic Classification   |                        | 55/100/21       |
| Pollution Degree (DIN VDE 0110/1.89)  |                        | 2               |
| Comparative Tracking Index  |                        | 175             |

| Symbol                | Parameter  | Value             | Unit              |
|-----------------------|--|-------------------|-------------------|
| V <sub>PR</sub>       | Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | 1360              | V <sub>peak</sub> |
|                       | Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 1594              | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage   | 850               | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage   | 6000              | V <sub>peak</sub> |
|                       | External Creepage  | ≥ 7               | mm                |
|                       | External Clearance   | ≥ 7               | mm                |
|                       | External Clearance (for Option TV, 0.4" Lead Spacing)  | ≥ 10              | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)   | ≥ 0.5             | mm                |
| T <sub>S</sub>        | Case Temperature <sup>(1)</sup>  | 175               | °C                |
| I <sub>S,INPUT</sub>  | Input Current <sup>(1)</sup>   | 350               | mA                |
| P <sub>S,OUTPUT</sub> | Output Power <sup>(1)</sup>  | 800               | mW                |
| R <sub>IO</sub>       | Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V <sup>(1)</sup>   | > 10 <sup>9</sup> | Ω                 |

### Note:

1. Safety limit values – maximum values allowed in the event of a failure.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.  $T_A = 25^\circ\text{C}$  unless otherwise specified.

| Symbol              | Parameters  | Value              | Units                |
|---------------------|---|--------------------|----------------------|
| <b>Total Device</b> |   |                    |                      |
| $T_{\text{STG}}$    | Storage Temperature   | -40 to +125        | $^\circ\text{C}$     |
| $T_{\text{OPR}}$    | Operating Temperature   | -40 to +85         | $^\circ\text{C}$     |
| $T_J$               | Junction Temperature  | -40 to +125        | $^\circ\text{C}$     |
| $T_{\text{SOL}}$    | Lead Solder Temperature   | 260 for 10 seconds | $^\circ\text{C}$     |
| $P_D$               | Total Device Power Dissipation at $25^\circ\text{C}$<br>Derate Above $25^\circ\text{C}$ | 210                | mW                   |
|                     |   | 2.94               | mW/ $^\circ\text{C}$ |
| <b>Emitter</b>      |   |                    |                      |
| $I_F$               | Continuous Forward Current  | 30                 | mA                   |
| $V_R$               | Reverse Voltage   | 6                  | V                    |
| $I_F(\text{pk})$    | Forward Current – Peak (1 $\mu\text{s}$ pulse, 300 pps)                                 | 100                | mA                   |
| $P_D$               | LED Power Dissipation   | 60                 | mW                   |
| <b>Detector</b>     |   |                    |                      |
| $P_D$               | Detector Power Dissipation  | 150                | mW                   |
| $V_O$               | $V_{45}$ Allowed Range  | 0 to 16            | V                    |
| $V_{\text{CC}}$     | $V_{65}$ Allowed Range  | 3 to 16            | V                    |
| $I_O$               | $I_4$ Output Current  | 50                 | mA                   |

## Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise specified.

### Individual Component Characteristics

| Symbol               | Parameters              | Test Conditions                               | Min. | Typ. | Max. | Units         |
|----------------------|-------------------------|---|------|------|------|---------------|
| <b>Emitter</b>       |                         |   |      |      |      |               |
| $V_F$                | Input Forward Voltage   | $I_F = 10 \text{ mA}$                         |      | 1.4  | 2.0  | V             |
|                      |                         | $I_F = 0.3 \text{ mA}$                        | 0.75 | 1.25 |      |               |
| $I_R$                | Reverse Current         | $V_R = 5 \text{ V}$                           |      |      | 10   | $\mu\text{A}$ |
| $C_J$                | Capacitance             | $V = 0, f = 1.0 \text{ MHz}$                  |      |      | 100  | pF            |
| <b>Detector</b>      |                         |   |      |      |      |               |
| $V_{\text{CC}}$      | Operating Voltage Range |   | 4    |      | 15   | V             |
| $I_{\text{CC(off)}}$ | Supply Current          | $I_F = 0, V_{\text{CC}} = 5 \text{ V}$        |      | 6    | 10   | mA            |
| $I_{\text{OH}}$      | Output Current, High    | $I_F = 0, V_{\text{CC}} = V_O = 15 \text{ V}$ |      |      | 100  | $\mu\text{A}$ |

**Electrical Characteristics** (Continued) $T_A = 25^\circ\text{C}$  unless otherwise specified.**Transfer Characteristics**

| Symbol                   | DC Characteristics         | Test Conditions  | Device | Min. | Typ. | Max. | Units |
|--------------------------|----------------------------|--|--------|------|------|------|-------|
| $I_{CC(on)}$             | Supply Current             | $I_F = 10\text{ mA}$ , $V_{CC} = 5\text{ V}$                               | All    |      | 6.5  | 10.0 | mA    |
| $V_{OL}$                 | Output Voltage, Low        | $R_L = 270\ \Omega$ , $V_{CC} = 5\text{ V}$ ,<br>$I_F = I_{F(on)}$ Maximum | All    |      |      | 0.5  | V     |
| $I_{F(on)}$              | Turn-On Threshold Current  | $R_L = 270\ \Omega$ , $V_{CC} = 5\text{ V}^{(2)}$                          | H11N1M | 0.8  |      | 3.2  | mA    |
|                          |                            |  | H11N2M | 2.3  |      | 5.0  |       |
| $I_{F(off)}$             | Turn-Off Threshold Current | $R_L = 270\ \Omega$ , $V_{CC} = 5\text{ V}$                                | All    | 0.3  |      |      | mA    |
| $I_{F(off)} / I_{F(on)}$ | Hysteresis Ratio           | $R_L = 270\ \Omega$ , $V_{CC} = 5\text{ V}$                                | All    | 0.65 |      | 0.95 |       |

**Switching Speed**

| Symbol    | AC Characteristics | Test Conditions   | Min. | Typ. | Max. | Units |
|-----------|--------------------|---|------|------|------|-------|
| $t_{on}$  | Turn-On Time       | $C = 120\text{ pF}$ , $t_p = 1\ \mu\text{s}$ ,<br>$R_E = ^{(3)}$ , Figure 9 |      | 100  | 330  | ns    |
| $t_r$     | Rise Time          | $C = 120\text{ pF}$ , $t_p = 1\ \mu\text{s}$ ,<br>$R_E = ^{(3)}$ , Figure 9 |      | 7.5  |      | ns    |
| $t_{off}$ | Turn-Off Time      | $C = 120\text{ pF}$ , $t_p = 1\ \mu\text{s}$ ,<br>$R_E = ^{(3)}$ , Figure 9 |      | 150  | 330  | ns    |
| $t_f$     | Fall Time          | $C = 120\text{ pF}$ , $t_p = 1\ \mu\text{s}$ ,<br>$R_E = ^{(3)}$ , Figure 9 |      | 12   |      | ns    |
|           | Data Rate          |   |      | 5    |      | MHz   |

**Isolation Characteristics**

| Symbol    | Parameters                     | Test Conditions   | Min.      | Typ. | Max. | Units         |
|-----------|--------------------------------|---|-----------|------|------|---------------|
| $V_{ISO}$ | Input-Output Isolation Voltage | $t = 1\text{ Minute}$                                     | 4170      |      |      | $V_{AC(RMS)}$ |
| $C_{ISO}$ | Isolation Capacitance          | $V_{I-O} = 0\text{ V}$ , $f = 1\text{ MHz}$               |           | 0.4  | 0.6  | pF            |
| $R_{ISO}$ | Isolation Resistance           | $V_{I-O} = \pm 500\text{ VDC}$ , $T_A = 25^\circ\text{C}$ | $10^{11}$ |      |      | $\Omega$      |

**Notes:**

- Maximum  $I_{F(on)}$  is the maximum current required to trigger the output. For example, a 3.2 mA maximum trigger current would require the LED to be driven at a current greater than 3.2 mA to guarantee the device will turn on. A 10% guard band is recommended to account for degradation of the LED over its lifetime. The maximum allowable LED drive current is 30 mA.
- H11N1:  $R_E = 910\ \Omega$ , H11N2:  $R_E = 560\ \Omega$

### Typical Performance Curves

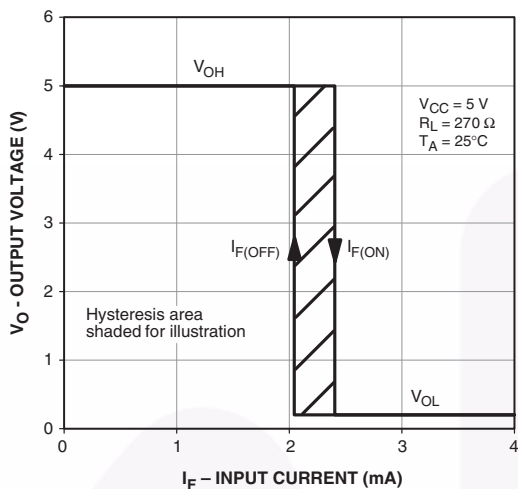


Figure 3. Transfer Characteristics

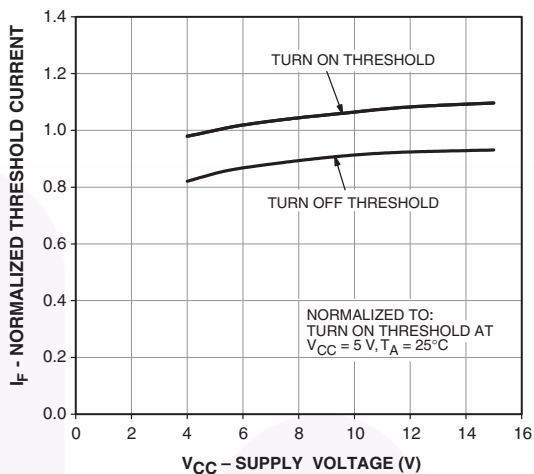


Figure 4. Threshold Current vs. Supply Voltage

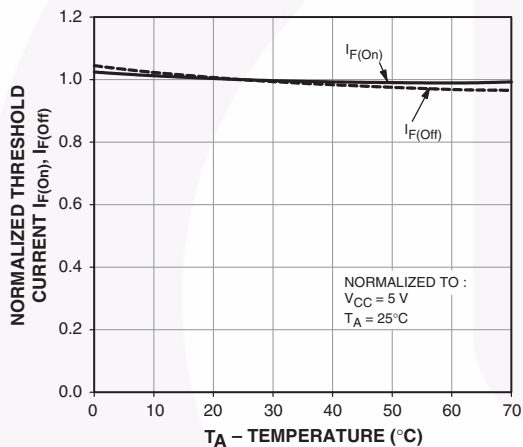


Figure 5. Threshold Current vs. Temperature

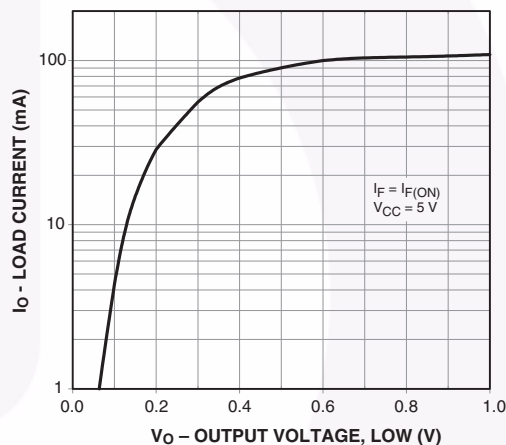


Figure 6. Load Current vs. Output Voltage

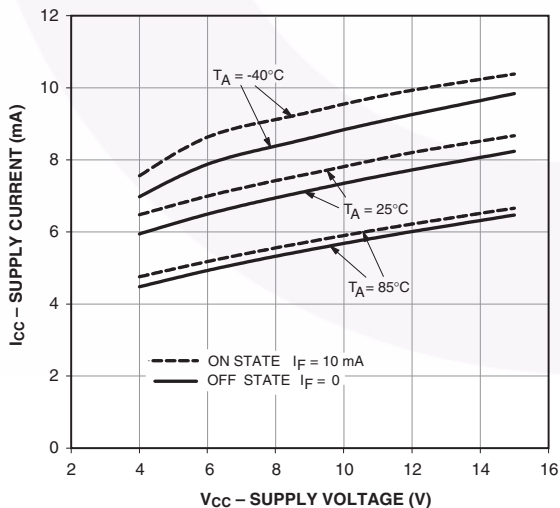


Figure 7. Supply Current vs. Supply Voltage

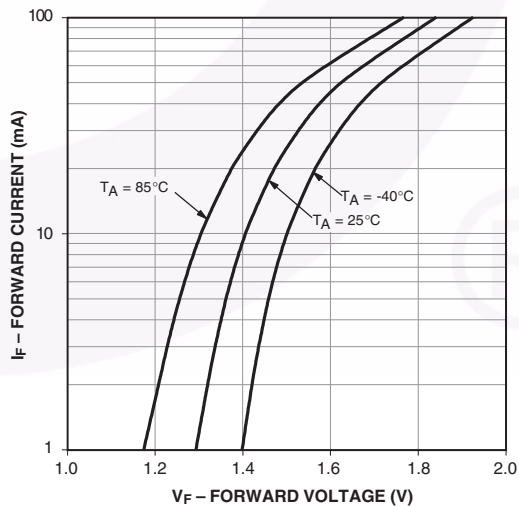


Figure 8. LED Forward Current vs. Forward Voltage

### Switching Test Circuit and Waveforms



Figure 9. Switching Test Circuit and Waveforms

### Reflow Profile



Figure 10. Reflow Profile

## Ordering Information

| Part Number | Package  | Packing Method             |
|-------------|--|----------------------------|
| H11N1M      | DIP 6-Pin  | Tube (50 Units)            |
| H11N1SM     | SMT 6-Pin (Lead Bend)                                    | Tube (50 Units)            |
| H11N1SR2M   | SMT 6-Pin (Lead Bend)                                    | Tape and Reel (1000 Units) |
| H11N1VM     | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                    | Tube (50 Units)            |
| H11N1SVM    | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tube (50 Units)            |
| H11N1SR2VM  | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tape and Reel (1000 Units) |
| H11N1TVM    | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units)            |

**Note:**

4. The product orderable part number system listed in this table also applies to the H11N2M product families.

## Marking Information



Figure 11. Top Mark

Table 1. Top Mark Definitions

|   |   |
|---|---|
| 1 | Fairchild Logo  |
| 2 | Device Number   |
| 3 | DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| 4 | One-Digit Year Code, e.g., "6"  |
| 5 | Digit Work Week, Ranging from "01" to "53"                                      |
| 6 | Assembly Package Code   |





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