FAIRCHILD
SEMICONDUCTOR™

# HIGH VOLTAGE PHOTOTRANSISTOR OPTOCOUPLERS

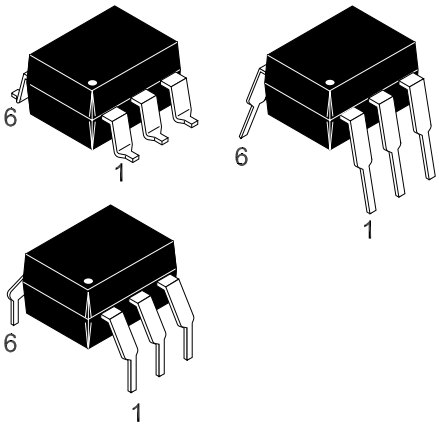
**H11D1**
**H11D2**
**H11D3**
**H11D4**
**4N38**

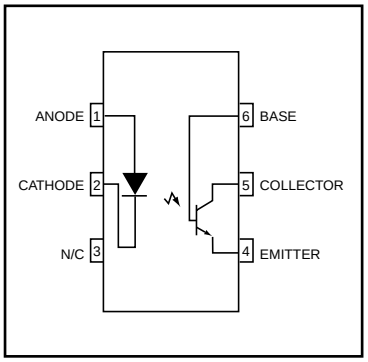
## DESCRIPTION

The H11DX and 4N38 are phototransistor-type optically coupled optoisolators. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

## FEATURES

- High Voltage
  - H11D1, H11D2, $BV_{CER}$ = 300 V
  - H11D3, H11D4, $BV_{CER}$ = 200 V
- High isolation voltage
  - 5300 VAC RMS - 1 minute
  - 7500 VAC PEAK - 1 minute
- Underwriters Laboratory (UL) recognized File# E90700




## APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| **TOTAL DEVICE** Storage Temperature | $T_{STG}$ | -55 to +150 | °C |
| Operating Temperature | $T_{OPR}$ | -55 to +100 | °C |
| Lead Solder Temperature | $T_{SOL}$ | 260 for 10 sec | °C |
| Total Device Power Dissipation @ $T_A$ = 25°C | $P_D$ | 260 | mW |
| Derate above 25°C | | 3.5 | mW/°C |
| **EMITTER** *Forward DC Current | $I_F$ | 80 | mA |
| *Reverse Input Voltage | $V_R$ | 6.0 | V |
| *Forward Current - Peak (1µs pulse, 300pps) | $I_F$(pk) | 3.0 | A |
| *LED Power Dissipation @ $T_A$ = 25°C | $P_D$ | 150 | mW |
| Derate above 25°C | | 1.41 | mW/°C |

## ABSOLUTE MAXIMUM RATINGS (Cont.)

| Parameter | | Symbol | Value | Units |
|---|---|---|---|---|
| **DETECTOR** | | | | |
| *Power Dissipation @ $T_A$ = 25°C | | $P_D$ | 300 | mW |
| Derate linearly above 25°C | | | 4.0 | mW/°C |
| *Collector to Emitter Voltage | H11D1 - H11D2 | $V_{CER}$ | 300 | V |
| | H11D3 - H11D4 | | 200 | |
| | 4N38 | | 80 | |
| *Collector Base Voltage | H11D1 - H11D2 | $V_{CBO}$ | 300 | |
| | H11D3 - H11D4 | | 200 | |
| | 4N38 | | 80 | |
| *Emitter to Collector Voltage | H11D1 - H11D2<br>H11D3 - H11D4 | $V_{ECO}$ | 7 | |
| Collector Current (Continuous) | | | 100 | mA |

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C Unless otherwise specified.)

## INDIVIDUAL COMPONENT CHARACTERISTICS

| Characteristic | Test Conditions | Symbol | Device | Min | Typ** | Max | Unit |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| *Forward Voltage | ($I_F$ = 10 mA) | $V_F$ | ALL | | 1.15 | 1.5 | V |
| Forward Voltage Temp. Coefficient | | $\frac{\Delta V_F}{\Delta T_A}$ | ALL | | -1.8 | | mV/°C |
| Reverse Breakdown Voltage | ($I_R$ = 10 µA) | $BV_R$ | ALL | 6 | 25 | | V |
| Junction Capacitance | ($V_F$ = 0 V, f = 1 MHz) | $C_J$ | ALL | | 50 | | pF |
| | ($V_F$ = 1 V, f = 1 MHz) | | ALL | | 65 | | pF |
| *Reverse Leakage Current | ($V_R$ = 6 V) | $I_R$ | ALL | | 0.05 | 10 | µA |
| **DETECTOR** | ($R_{BE}$ = 1 MΩ) | $BV_{CER}$ | H11D1/2 | 300 | | | V |
| *Breakdown Voltage | ($I_C$ = 1.0 mA, $I_F$ = 0) | | H11D3/4 | 200 | | | |
| Collector to Emitter | (No $R_{BE}$) ($I_C$ = 1.0 mA) | $BV_{CEO}$ | 4N38 | 80 | | | |
| *Collector to Base | ($I_C$ = 100 µA, $I_F$ = 0) | $BV_{CBO}$ | H11D1/2 | 300 | | | |
| | | | H11D3/4 | 200 | | | |
| | | | 4N38 | 80 | | | |
| Emitter to Base | ($I_E$ = 100 µA , $I_F$ = 0) | $BV_{EBO}$ | 4N38 | 7 | | | |
| Emitter to Collector | | $BV_{ECO}$ | ALL | 7 | 10 | | |
| *Leakage Current Collector to Emitter ($R_{BE}$ = 1 MΩ) | ($V_{CE}$ = 200 V, $I_F$ = 0, $T_A$ = 25°C) | $I_{CER}$ | H11D1/2 | | | 100 | nA |
| | ($V_{CE}$ = 200 V, $I_F$ = 0, $T_A$ = 100°C) | | | | | 250 | µA |
| | ($V_{CE}$ = 100 V, $I_F$ = 0, $T_A$ = 25°C) | | H11D3/4 | | | 100 | nA |
| | ($V_{CE}$ = 100 V, $I_F$ = 0, $T_A$ = 100°C) | | | | | 250 | µA |
| | (No $R_{BE}$) ($V_{CE}$ = 60 V, $I_F$ = 0, $T_A$ = 25°C) | $I_{CEO}$ | 4N38 | | | 50 | nA |

Notes

* Parameters meet or exceed JEDEC registered data (for 4N38 only)

** All typical values at $T_A$ = 25°C

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**H11D1, H11D2, H11D3, H11D4, 4N38**

## TRANSFER CHARACTERISTICS

| DC Characteristic | Test Conditions | Symbol | Device | Min | Typ** | Max | Unit |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| Current Transfer Ratio Collector to Emitter | ($I_F$ = 10 mA, $V_{CE}$ = 10 V) ($R_{BE}$ = 1 MΩ) | CTR | H11D1 | | | | mA (%) |
| | | | H11D2 | 2 (20) | | | |
| | | | H11D3 | | | | |
| | | | H11D4 | 1 (10) | | | |
| | ($I_F$ = 10 mA, $V_{CE}$ = 10 V) | | 4N38 | 2 (20) | | | |
| *Saturation Voltage | ($I_F$ = 10 mA, $I_C$ = 0.5 mA) ($R_{BE}$ = 1 MΩ) | $V_{CE\ (SAT)}$ | H11D1/2/3/4 | | 0.1 | 0.40 | V |
| | ($I_F$ = 20 mA, $I_C$ = 4 mA) | | 4N38 | | | 1.0 | |

## TRANSFER CHARACTERISTICS

| Characteristic | Test Conditions | Symbol | Device | Min | Typ** | Max | Unit |
|---|---|---|---|---|---|---|---|
| **SWITCHING TIMES** Non-Saturated Turn-on Time | ($V_{CE}$ =10 V, $I_{CE}$ = 2 mA) | $t_{on}$ | ALL | | 5 | | µs |
| Turn-off Time | ($R_L$ = 100 Ω) | $t_{off}$ | ALL | | 5 | | |

## ISOLATION CHARACTERISTICS

| Characteristic | Test Conditions | Symbol | Device | Min | Typ** | Max | Unit |
|---|---|---|---|---|---|---|---|
| Isolation Voltage | ($I_{I-O}$ ≤ 1 µA, 1 min.) | $V_{ISO}$ | ALL | 5300 | | | ($V_{AC}$RMS) |
| | | | | 7500 | | | ($V_{AC}$PEAK) |
| Isolation Resistance | ($V_{I-O}$ = 500 VDC) | $R_{ISO}$ | ALL | $10^{11}$ | | | Ω |
| Isolation Capacitance | (f = 1 MHz) | $C_{ISO}$ | ALL | | 0.5 | | pF |

Notes

* Parameters meet or exceed JEDEC registered data (for 4N38 only)

** All typical values at $T_A$ = 25°C

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

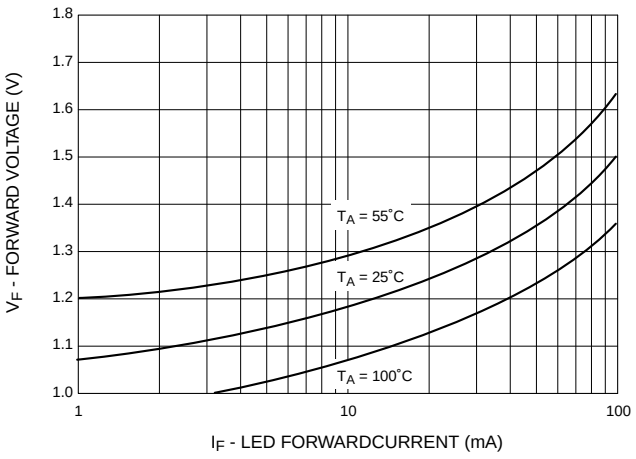



**Fig.2 Normalized Output Characteristics**

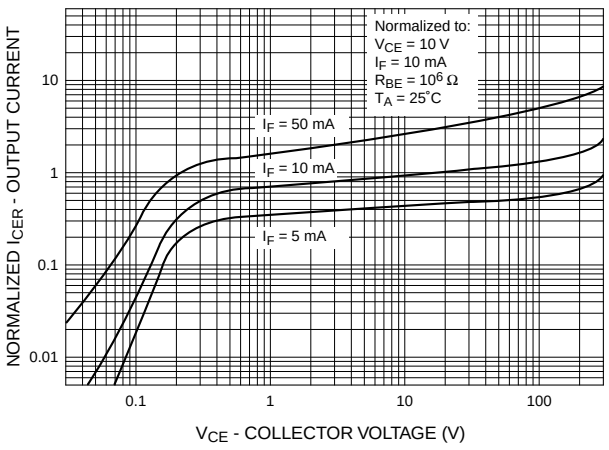


**Fig.3 Normalized Output Current vs. LED Input Current**

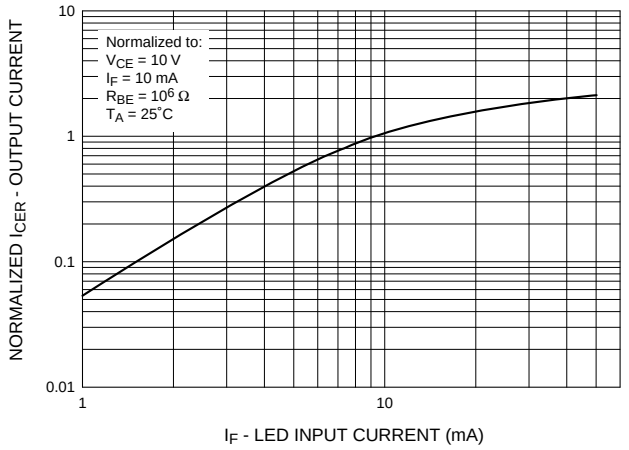



**Fig.4 Normalized Output Current vs. Temperature**

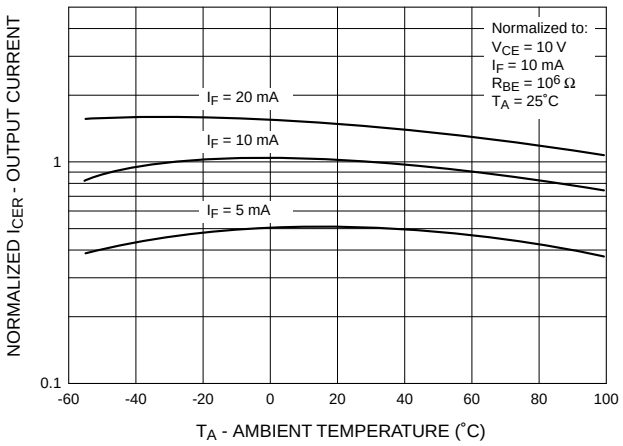
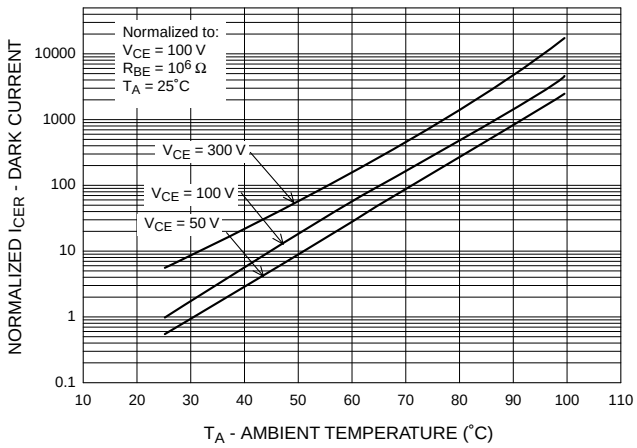
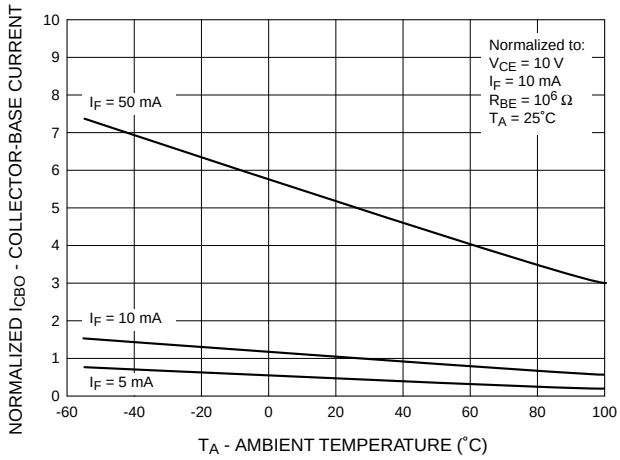



**Fig.5 Normalized Dark Current vs. Ambient Temperature**




**Normalized Collector-Base Current vs. Temperature**



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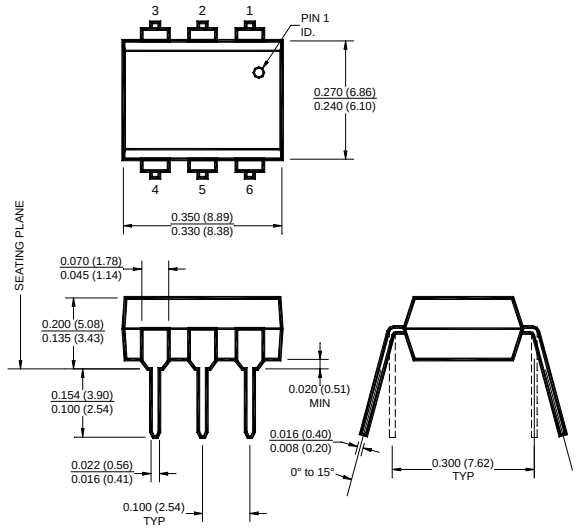
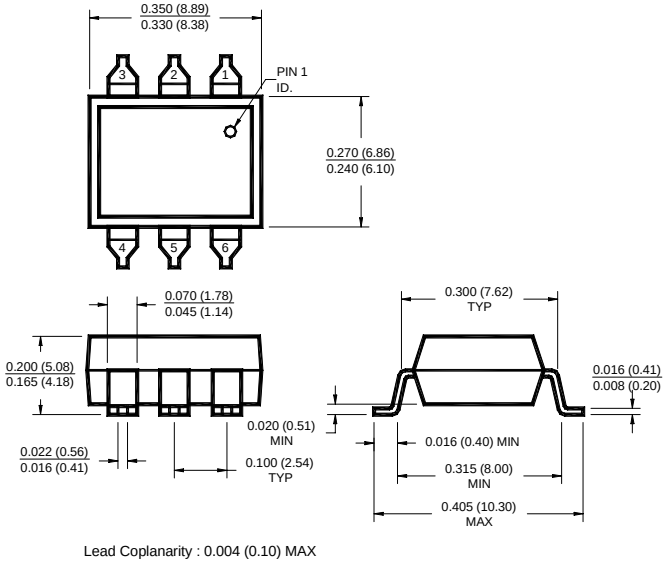
**H11D1, H11D2, H11D3, H11D4, 4N38**

## Package Dimensions (Through Hole)

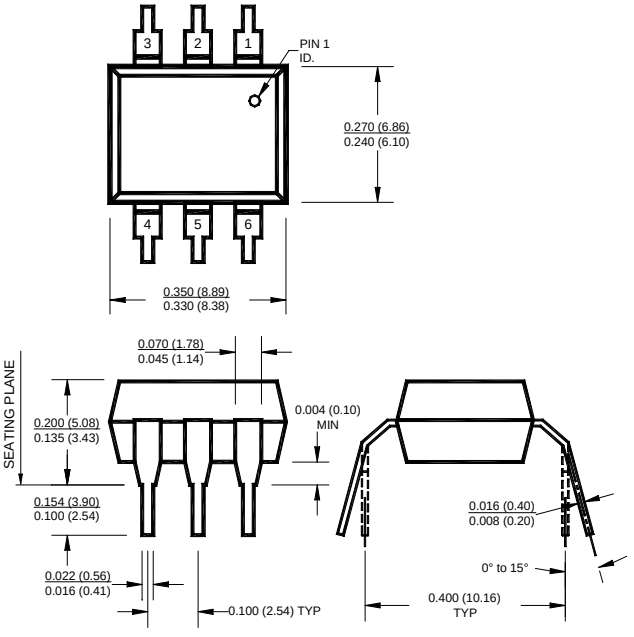



## Package Dimensions (Surface Mount)

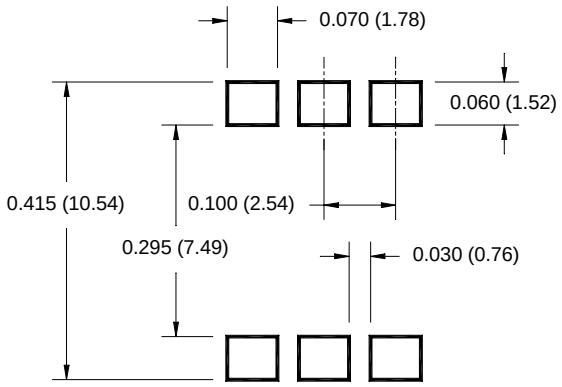



Lead Coplanarity : 0.004 (0.10) MAX

## Package Dimensions (0.4”Lead Spacing)




## Recommended Pad Layout for Surface Mount Leadform



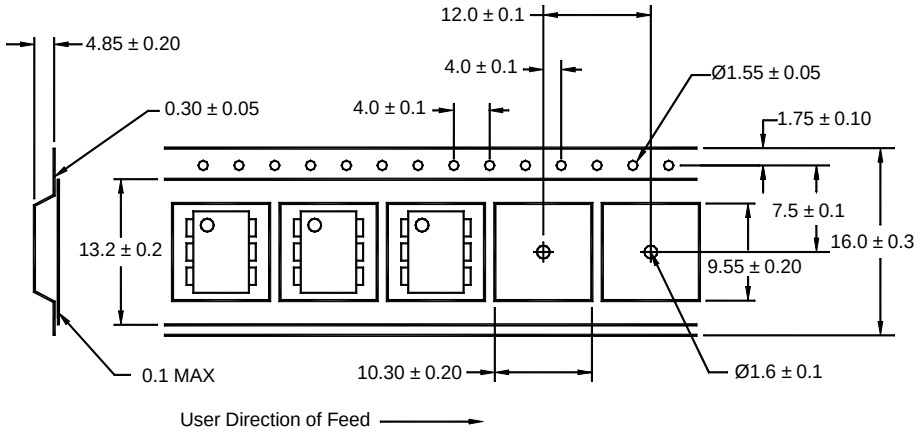

**NOTE**

All dimensions are in inches (millimeters)

## ORDERING INFORMATION

| Option | Order Entry Identifier | Description |
|---|---|---|
| S | .S | Surface Mount Lead Bend |
| SD | .SD | Surface Mount; Tape and reel |
| W | .W | 0.4” Lead Spacing |
| 300 | .300 | VDE 0884 |
| 300W | .300W | VDE 0884, 0.4” Lead Spacing |
| 3S | .3S | VDE 0884, Surface Mount |
| 3SD | .3SD | VDE 0884, Surface Mount, Tape & Reel |

## QT Carrier Tape Specifications (“D” Taping Orientation)




**NOTE**

All dimensions are in millimeters

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