FAIRCHILD SEMICONDUCTOR®

September 2007

# H11D1M, H11D2M, H11D3M, 4N38M, MOC8204M
# High Voltage Phototransistor Optocouplers

## Features

- High voltage:
  - MOC8204M, $BV_{CER}$ = 400V
  - H11D1M, H11D2M, $BV_{CER}$ = 300V
  - H11D3M, $BV_{CER}$ = 200V
- High isolation voltage:
  - 7500 $V_{AC}$ peak, 1 second
- Underwriters Laboratory (UL) recognized
  File # E90700, Volume 2

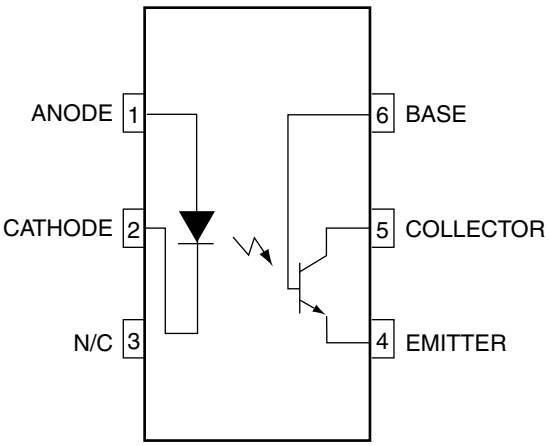
## Applications

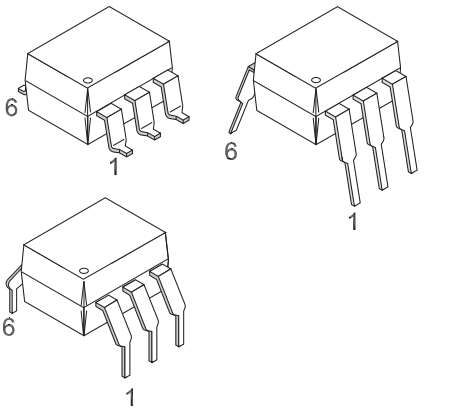
- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

## General Description

The H11DXM, 4N38M and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

## Schematic



## 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.

| Symbol | Parameter | Device | Value | Units |
|---|---|---|---|---|
| **TOTAL DEVICE** | | | | |
| $T_{STG}$ | Storage Temperature | All | -55 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | All | -40 to +100 | °C |
| $T_{SOL}$ | Lead Solder Temperature (Wave Solder) | All | 260 for 10 sec | °C |
| $P_D$ | Total Device Power Dissipation @ $T_A$ = 25°C | All | 260 | mW |
| | Derate Above 25°C | | 3.5 | mW/°C |
| **EMITTER** | | | | |
| $I_F$ | Forward DC Current(1) | All | 80 | mA |
| $V_R$ | Reverse Input Voltage(1) | All | 6.0 | V |
| $I_F$(pk) | Forward Current – Peak (1µs pulse, 300pps)(1) | All | 3.0 | A |
| $P_D$ | LED Power Dissipation @ $T_A$ = 25°C(1) | All | 150 | mW |
| | Derate Above 25°C | | 1.41 | mW/°C |
| **DETECTOR** | | | | |
| $P_D$ | Power Dissipation @ $T_A$ = 25°C | All | 300 | mW |
| | Derate linearly above 25°C | | 4.0 | mW/°C |
| $V_{CER}$ | Collector to Emitter Voltage(1) | MOC8204M | 400 | V |
| | | H11D1M, H11D2M | 300 | |
| | | H11D3M | 200 | |
| | | 4N38M | 80 | |
| $V_{CBO}$ | Collector Base Voltage(1) | MOC8204M | 400 | V |
| | | H11D1M, H11D2M | 300 | |
| | | H11D3M | 200 | |
| | | 4N38M | 80 | |
| $V_{ECO}$ | Emitter to Collector Voltage(1) | H11D1M, H11D2M, H11D3M, MOC8204M | 7 | V |
| $I_C$ | Collector Current (Continuous) | All | 100 | mA |

**Note:**

1. Parameters meet or exceed JEDEC registered data (for 4N38M only).

## Electrical Characteristics ($T_A$ = 25°C unless otherwise specified.)

### Individual Component Characteristics

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| $V_F$ | Forward Voltage(2) | $I_F$ = 10mA | All | | 1.15 | 1.5 | V |
| $\frac{\Delta V_F}{\Delta T_A}$ | Forward Voltage Temp. Coefficient | | All | | -1.8 | | mV/°C |
| $BV_R$ | Reverse Breakdown Voltage | $I_R$ = 10µA | All | 6 | 25 | | V |
| $C_J$ | Junction Capacitance | $V_F$ = 0V, f = 1MHz | All | | 50 | | pF |
| | | $V_F$ = 1V, f = 1MHz | | | 65 | | pF |
| $I_R$ | Reverse Leakage Current(2) | $V_R$ = 6V | All | | 0.05 | 10 | µA |
| **DETECTOR** | | | | | | | |
| $BV_{CER}$ | Breakdown Voltage Collector to Emitter(2) | $R_{BE}$ = 1MΩ, $I_C$ = 1.0mA, $I_F$ = 0 | MOC8204M | 400 | | | V |
| | | | H11D1M/2M | 300 | | | |
| | | | H11D3M | 200 | | | |
| $BV_{CEO}$ | | No RBE, $I_C$ = 1.0mA | 4N38M | 80 | | | |
| $BV_{CBO}$ | Collector to Base(2) | $I_C$ = 100µA, $I_F$ = 0 | MOC8204M | 400 | | | V |
| | | | H11D1M/2M | 300 | | | |
| | | | H11D3M | 200 | | | |
| | | | 4N38M | 80 | | | |
| $BV_{EBO}$ | Emitter to Base | $I_E$ = 100µA, $I_F$ = 0 | 4N38M | 7 | | | V |
| $BV_{ECO}$ | Emitter to Collector | $I_E$ = 100µA, $I_F$ = 0 | All | 7 | 10 | | V |
| $I_{CER}$ | Leakage Current Collector to Emitter(2) ($R_{BE}$ = 1MΩ) | $V_{CE}$ = 300V, $I_F$ = 0, $T_A$ = 25°C | MOC8204M | | | 100 | nA |
| | | $V_{CE}$ = 300V, $I_F$ = 0, $T_A$ = 100°C | | | | 250 | µA |
| | | $V_{CE}$ = 200V, $I_F$ = 0, $T_A$ = 25°C | H11D1M/2M | | | 100 | nA |
| | | $V_{CE}$ = 200V, $I_F$ = 0, $T_A$ = 100°C | | | | 250 | µA |
| | | $V_{CE}$ = 100V, $I_F$ = 0, $T_A$ = 25°C | H11D3M | | | 100 | nA |
| | | $V_{CE}$ = 100V, $I_F$ = 0, $T_A$ = 100°C | | | | 250 | µA |
| $I_{CEO}$ | | No $R_{BE}$, $V_{CE}$ = 60V, $I_F$ = 0, $T_A$ = 25°C | 4N38M | | | 50 | nA |

### Transfer Characteristics ($T_A$ = 25°C Unless otherwise specified.)

| Symbol | Characteristics | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| CTR | Current Transfer Ratio, Collector to Emitter | $I_F$ = 10mA, $V_{CE}$ = 10V, $R_{BE}$ = 1MΩ | H11D1M/2M/3M, MOC8204M | 2 (20) | | | mA (%) |
| | | $I_F$ = 10mA, $V_{CE}$ = 10V | 4N38M | 2 (20) | | | |
| $V_{CE(SAT)}$ | Saturation Voltage(2) | $I_F$ = 10mA, $I_C$ = 0.5mA, $R_{BE}$ = 1MΩ | H11D1M/2M/3M, MOC8204M | | 0.1 | 0.40 | V |
| | | $I_F$ = 20mA, $I_C$ = 4mA | 4N38M | | | 1.0 | |
| **SWITCHING TIMES** | | | | | | | |
| $t_{ON}$ | Non-Saturated Turn-on Time | $V_{CE}$ = 10V, $I_{CE}$ = 2mA, $R_L$ = 100Ω | All | | 5 | | µs |
| $t_{OFF}$ | Turn-off Time | | All | | 5 | | µs |

*All Typical values at $T_A$ = 25°C

**Note:**

2. Parameters meet or exceed JEDEC registered data (for 4N38M only).

## DC Electrical Characteristics ($T_A$ = 25°C unless otherwise specified.) (Continued)

### Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{ISO}$ | Isolation Voltage | f = 60Hz, t = 1 sec. | All | 7500 | | | $V_{AC}$PEAK |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = 500 VDC | All | $10^{11}$ | | | Ω |
| $C_{ISO}$ | Isolation Capacitance | f = 1MHz | All | | 0.2 | | pF |

*All Typical values at $T_A$ = 25°C

## Typical Performance Curves

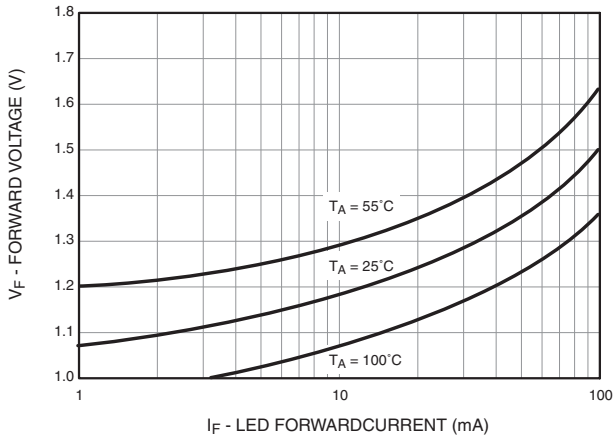



**Fig. 1 LED Forward Voltage vs. Forward Current**

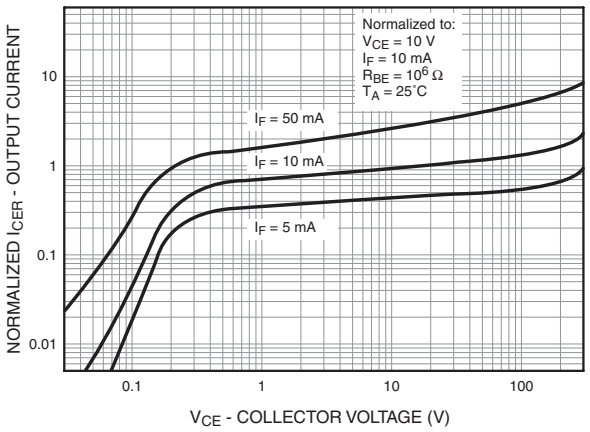



**Fig. 2 Normalized Output Characteristics**

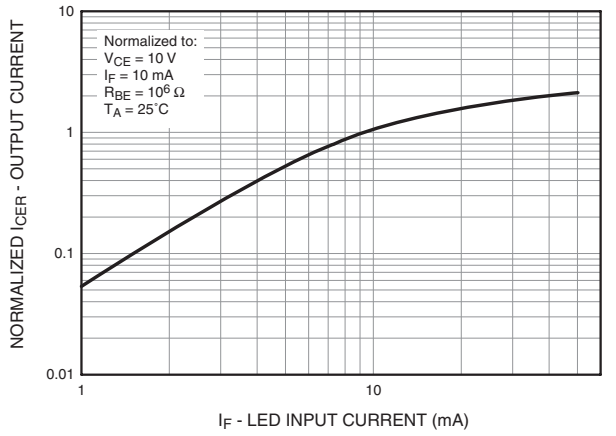



**Fig. 3 Normalized Output Current vs. LED Input Current**

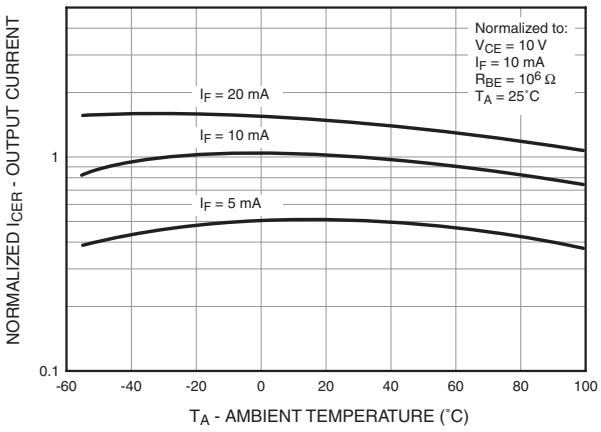



**Fig. 4 Normalized Output Current vs. Temperature**

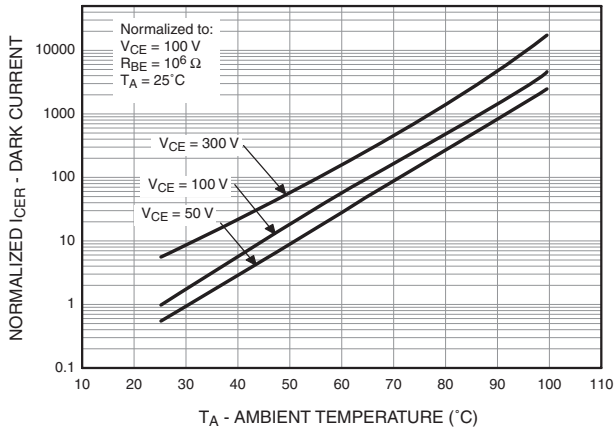



**Fig. 5 Normalized Dark Current vs. Ambient Temperature**

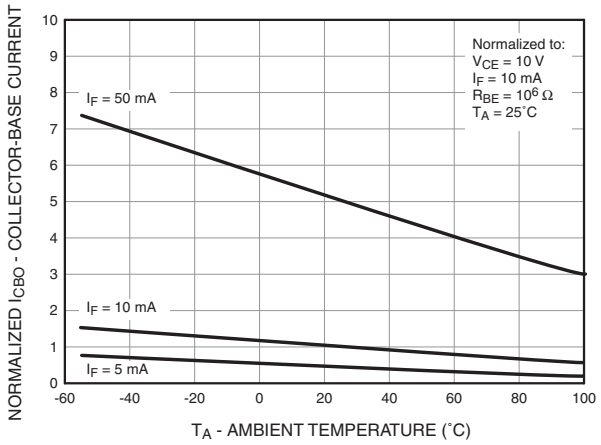
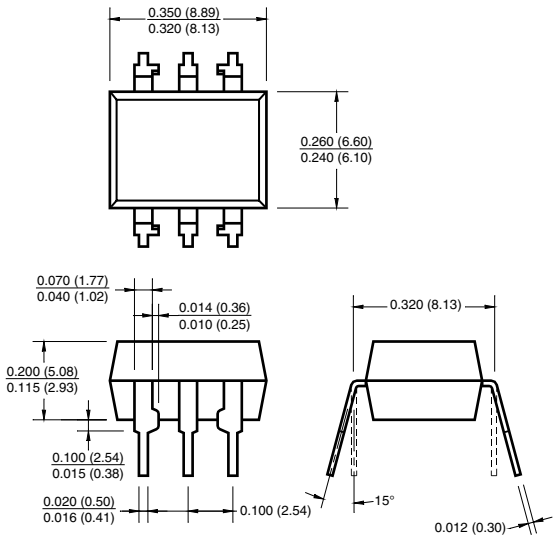


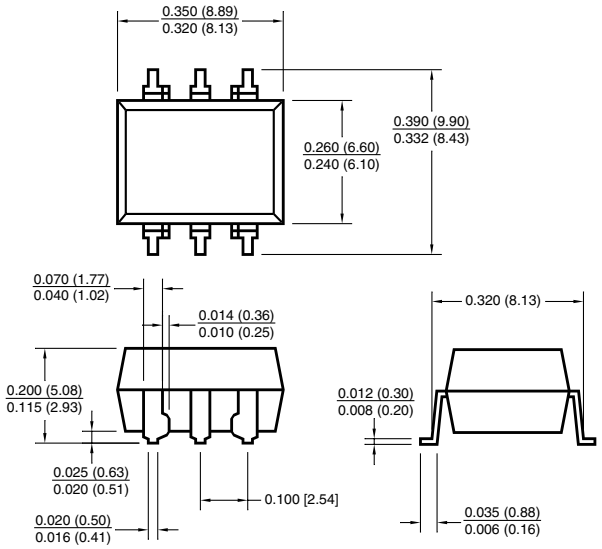

**Fig. 6 Normalized Collector-Base Current vs. Temperature**

## Package Dimensions

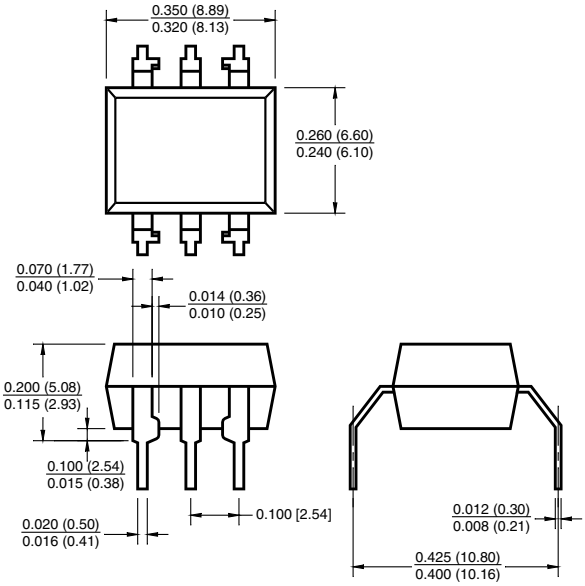
### Through Hole



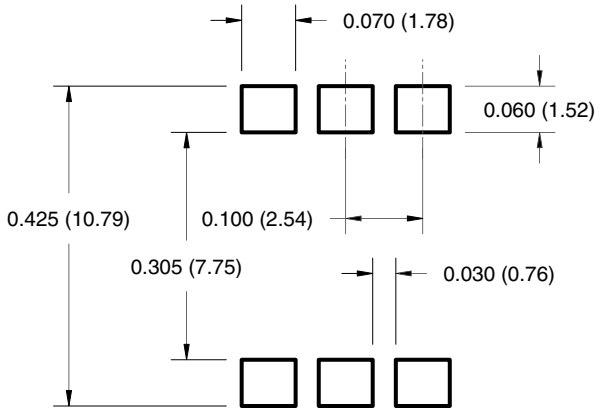

### Surface Mount




### 0.4" Lead Spacing




### Recommended Pad Layout for Surface Mount Leadform

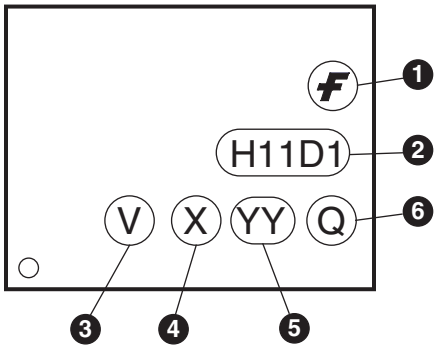



**Note:**
All dimensions are in inches (millimeters).

## Ordering Information

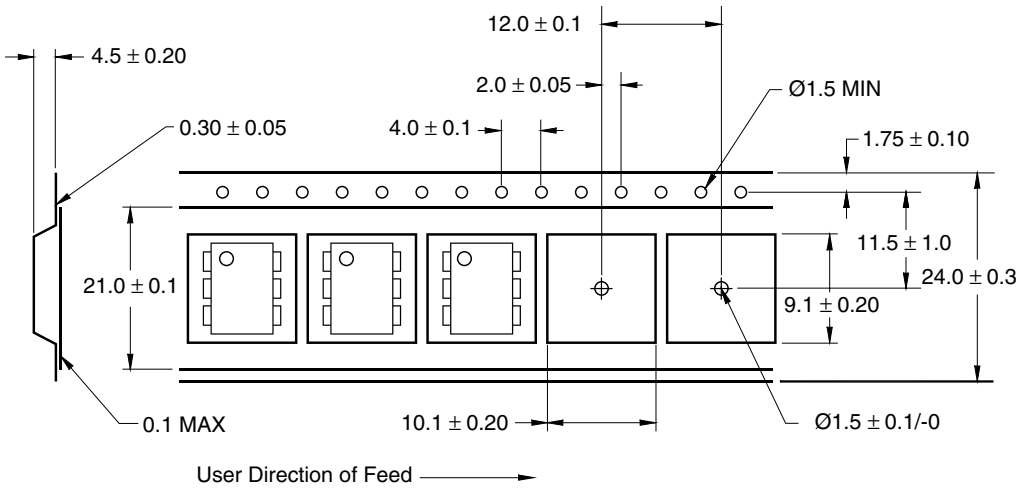
| Option | Order Entry Identifier (Example) | Description |
|---|---|---|
| No option | H11D1M | Standard Through Hole Device |
| S | H11D1SM | Surface Mount Lead Bend |
| SR2 | H11D1SR2M | Surface Mount; Tape and Reel |
| T | H11D1TM | 0.4" Lead Spacing |
| V | H11D1VM | VDE 0884 |
| TV | H11D1TVM | VDE 0884, 0.4" Lead Spacing |
| SV | H11D1SVM | VDE 0884, Surface Mount |
| SR2V | H11D1SR2VM | VDE 0884, Surface Mount, Tape and Reel |

## Marking Information

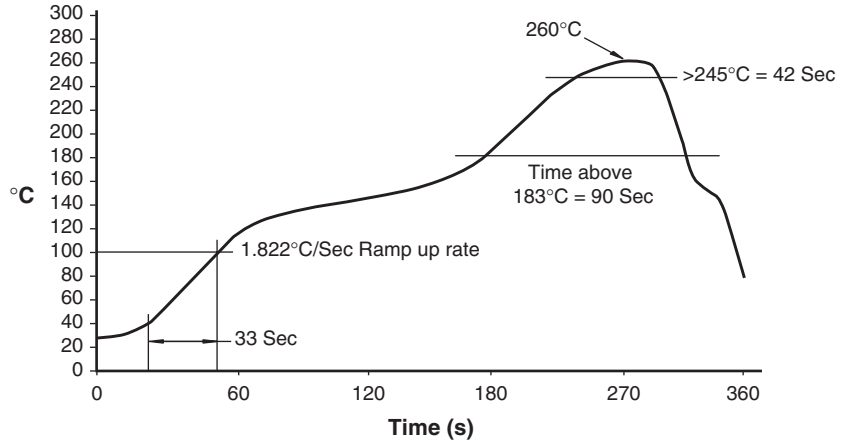



| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., ‘7’ |
| 5 | Two digit work week ranging from ‘01’ to ‘53’ |
| 6 | Assembly package code |

## Carrier Tape Specifications




## Reflow Profile



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|---|---|---|
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