FAIRCHILD SEMICONDUCTOR®

October 2007

# H11AG1M
# Phototransistor Optocoupler

## Features

- High efficiency low degradation liquid epitaxial IRED
- Logic level compatible, input and output currents, with CMOS and LS/TTL
- High DC current transfer ratio at low input currents (as low as 200μA)
- Underwriters Laboratory (UL) recognized File #E90700, Volume 2
- IEC 60747-5-2 approved (ordering option V)

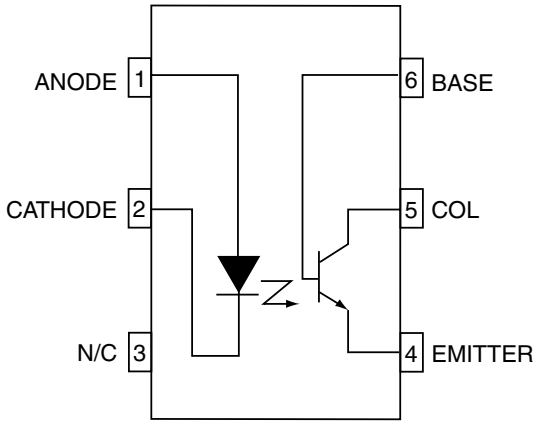
## Applications

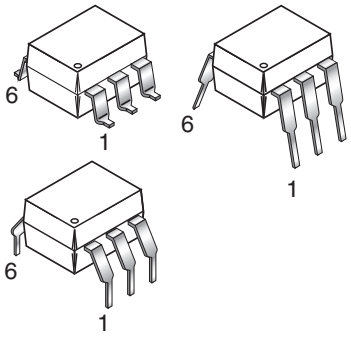
- CMOS driven solid state reliability
- Telephone ring detector
- Digital logic isolation

## Description

The H11AG1M device consists of a Gallium-Aluminum-Arsenide IRED emitting diode coupled with a silicon phototransistor in a dual in-line package. This device provides the unique feature of the high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low power logic circuits, telecommunications equipment and portable electronics isolation applications.

## 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 | Parameters | Value | Units |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| $T_{STG}$ | Storage Temperature | -55 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | -40 to +100 | °C |
| $T_{SOL}$ | Lead Solder Temperature (Wave Solder) | 260 for 10 sec | °C |
| $P_D$ | Total Device Power Dissipation @ 25°C (LED plus detector) | 260 | mW |
| | Derate Linearly From 25°C | 3.5 | mW/°C |
| **EMITTER** | | | |
| $I_F$ | Continuous Forward Current | 50 | mA |
| $V_R$ | Reverse Voltage | 6 | V |
| $I_F$(pk) | Forward Current – Peak (1µs pulse, 300pps) | 3.0 | A |
| $P_D$ | LED Power Dissipation 25°C Ambient | 75 | mW |
| | Derate Linearly From 25°C | 1.0 | mW/°C |
| **DETECTOR** | | | |
| $P_D$ | Detector Power Dissipation @ 25°C | 150 | mW |
| | Derate Linearly from 25°C | 2.0 | mW/°C |
| $I_C$ | Continuous Collector Current | 50 | mA |

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

### Individual Component Characteristics

| Symbol | Parameters | Test Conditions | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = 1mA | | 1.25 | 1.5 | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 5V, $T_A$ = 25°C | | | 10 | µA |
| $C_J$ | Capacitance | V = 0, f = 1.0MHz | | | 100 | pF |
| **DETECTOR** | | | | | | |
| $BV_{CEO}$ | Breakdown Voltage, Collector to Emitter | $I_C$ = 1.0mA, $I_F$ = 0 | 30 | | | V |
| $BV_{CBO}$ | Collector to Base | $I_C$ = 100µA, $I_F$ = 0 | 70 | | | V |
| $BV_{ECO}$ | Emitter to Collector | $I_C$ = 100µA, $I_F$ = 0 | 7 | | | V |
| $I_{CEO}$ | Leakage Current, Collector to Emitter | $V_{CE}$ = 10V, $I_F$ = 0 | | 5 | 10 | µA |
| $C_{CE}$ | Capacitance | $V_{CE}$ = 10V, f = 1MHz | | 10 | | pF |

*Typical values at $T_A$ = 25°C.

### Isolation Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{ISO}$ | Input-Output Isolation Voltage | f = 60Hz, t = 1 sec. | 7500 | | | $V_{AC}$PEAK |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = 500VDC, $T_A$ = 25°C | $10^{11}$ | | | Ω |

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

| Symbol | Characteristics | Test Conditions | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| CTR | Current Transfer Ratio | $I_F$ = 1mA, $V_{CE}$ = 5V | 300 | | | % |
| | | $I_F$ = 1mA, $V_{CE}$ = 0.6V | 100 | | | |
| | | $I_F$ = 0.2mA, $V_{CE}$ = 1.5V | 100 | | | |
| $V_{CE(SAT)}$ | Saturation Voltage | $I_F$ = 2.0mA, $I_C$ = 0.5mA | | | .40 | V |
| **AC CHARACTERISTICS** | | | | | | |
| Non-Saturated Switching Times | | | | | | |
| $t_{on}$ | Turn-On Time | $R_L$ = 100Ω, $I_F$ = 1mA, $V_{CC}$ = 5V | | 5 | | µs |
| $t_{off}$ | Turn-Off Time | $R_L$ = 100Ω, $I_F$ = 1mA, $V_{CC}$ = 5V | | 5 | | µs |

*Typical values at $T_A$ = 25°C

## Typical Performance Curves

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

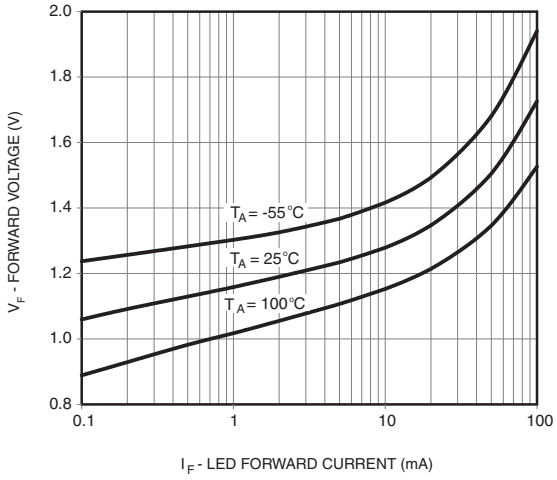



**Figure 2. Normalized Current Transfer Ratio vs. Forward Current**

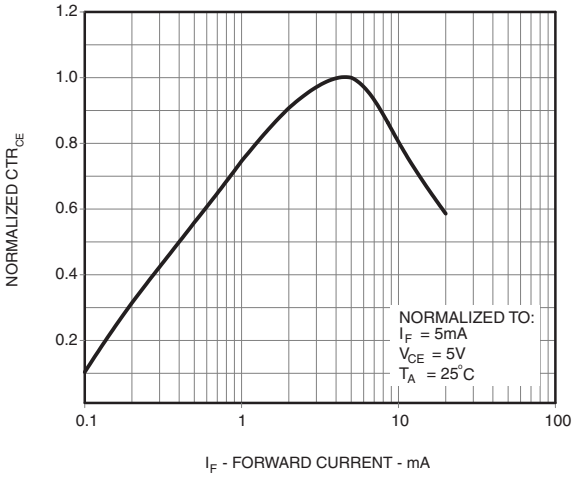



**Figure 3. Normalized CTR vs. Temperature**

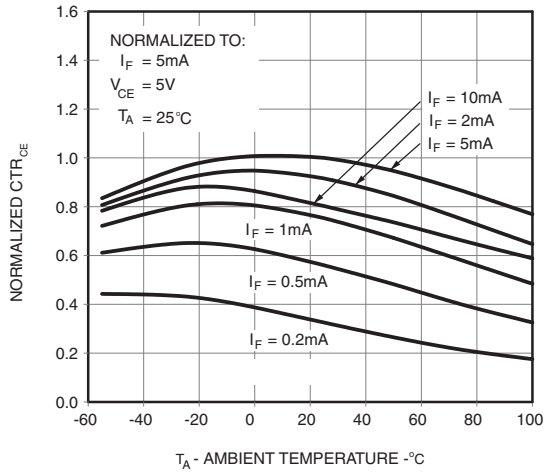



**Figure 4. Normalized Collector vs. Collector - Emitter Voltage**

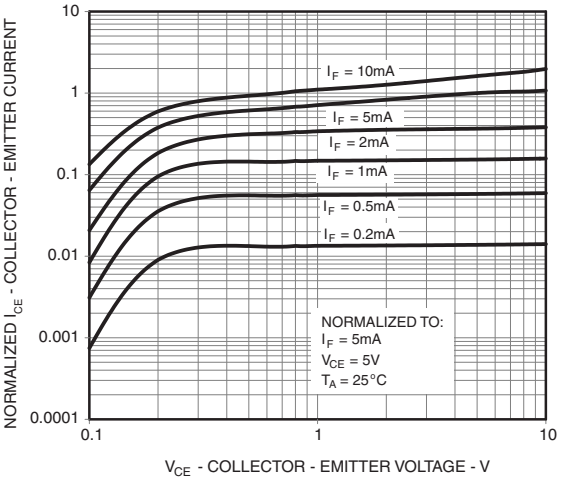



**Figure 5. Normalized Collector Base Photocurrent Ratio vs. Forward Current**

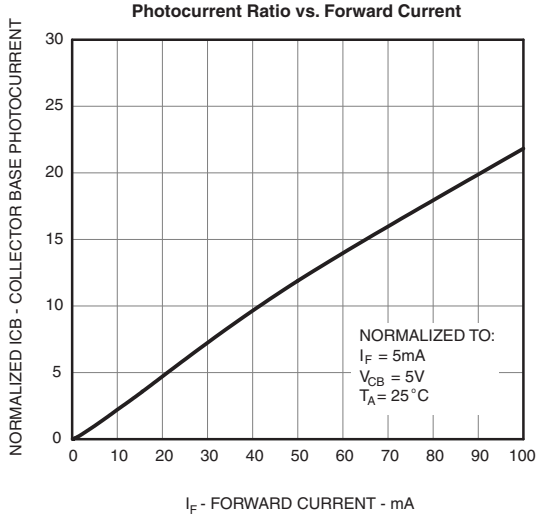
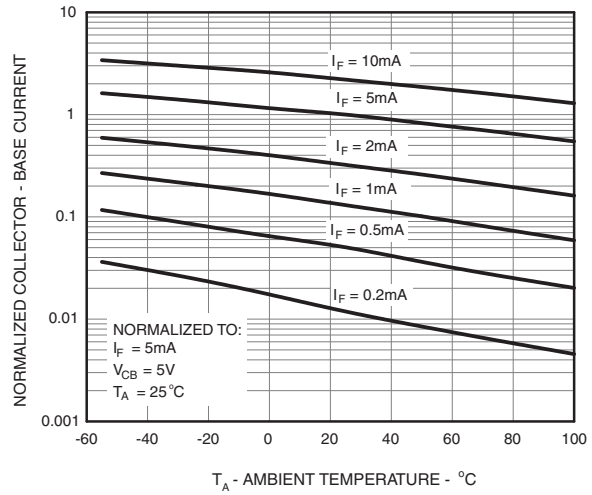
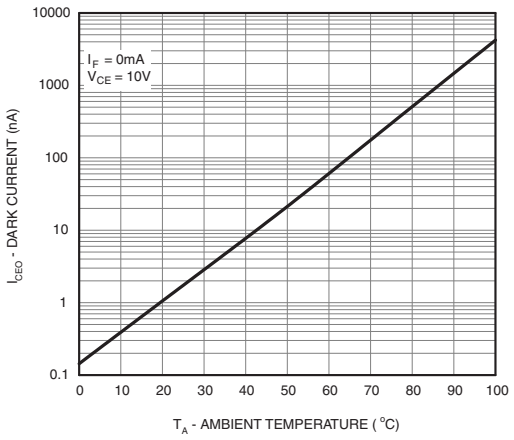


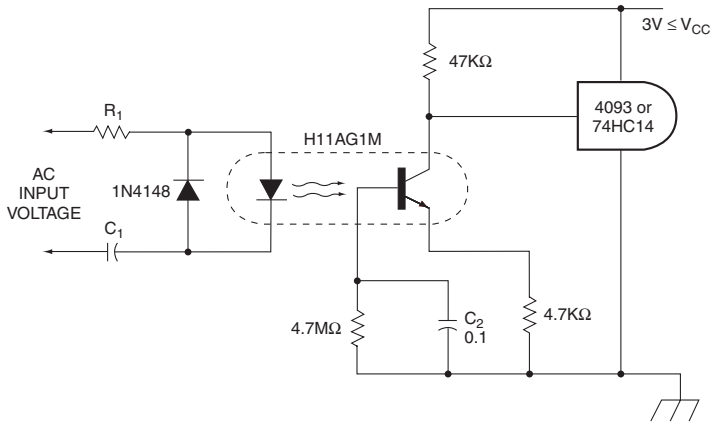

**Figure 6. Normalized Collector - Base Current vs. Temperature**



## Typical Performance Curves (Continued)

**Figure 7. Collector-Emitter Dark Current vs. Ambient Temperature**




| Input | R1 | C1 | Z |
|---|---|---|---|
| 40-90 VRMS 20Hz | 75K 1/10W | 0.1µF 100V | 109K |
| 95-135 VRMS 60Hz | 180K 1/10W | 12 ηF 200 V | 285K |
| 200-280 VRMS 50/60Hz | 390K 1/4W | 6.80 ηF 400 V | 550K |

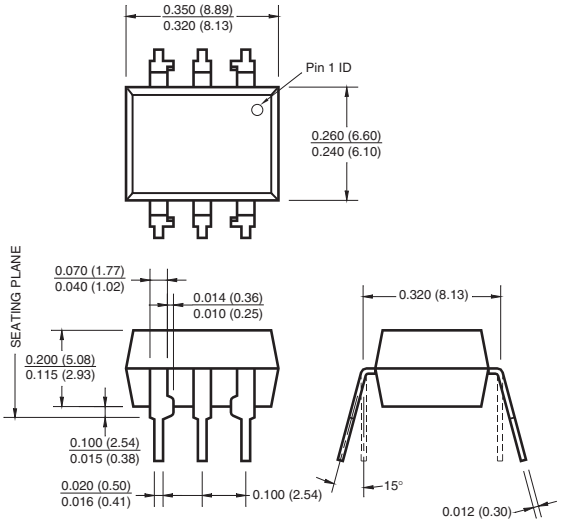
DC component of input voltage is ignored due to C1

**Figure 8. Telephone Ring Detector/A.C. Line CMOS Input Isolator**

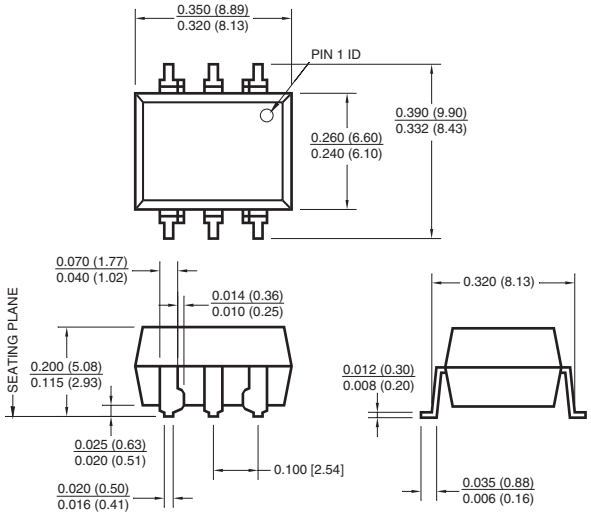
The H11AG1M uses less input power than the neon bulb traditionally used to monitor telephone and line voltages. Additionally. response time can be tailored to ignore telephone dial tap, switching transients and other undesired signals by modifying the value of C2. The high impedance to line voltage also can simply board layout spacing requirements.

## Package Dimensions

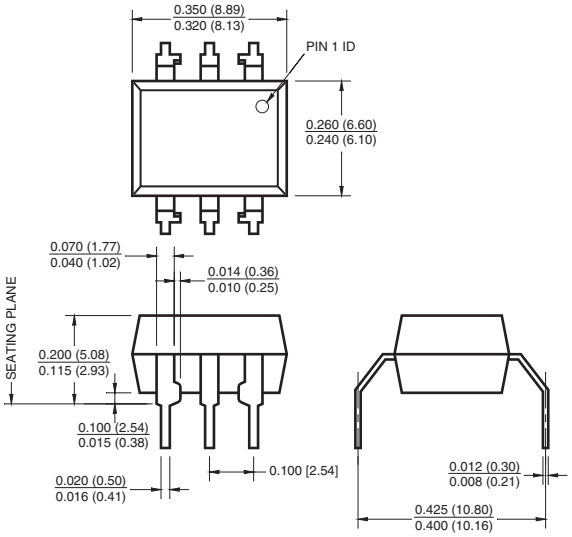
### Through Hole



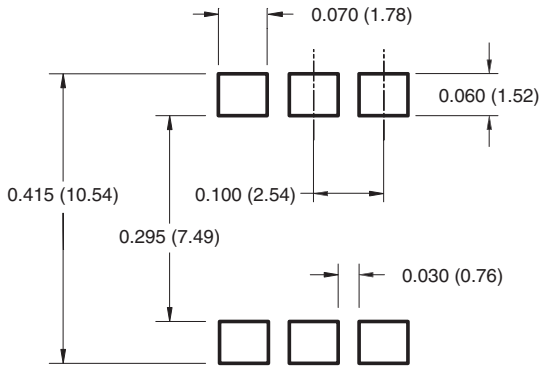

### Surface Mount




### 0.4" Lead Spacing




### Recommended Pay Layout for Surface Mount Leadform

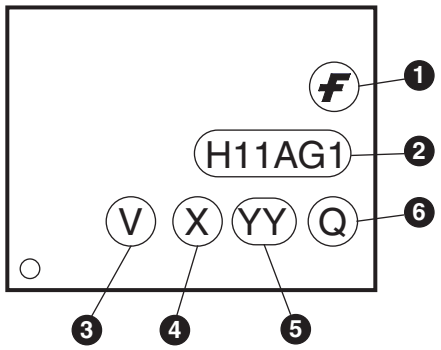



**Note:**
All dimensions are in inches (millimeters)

## Ordering Information

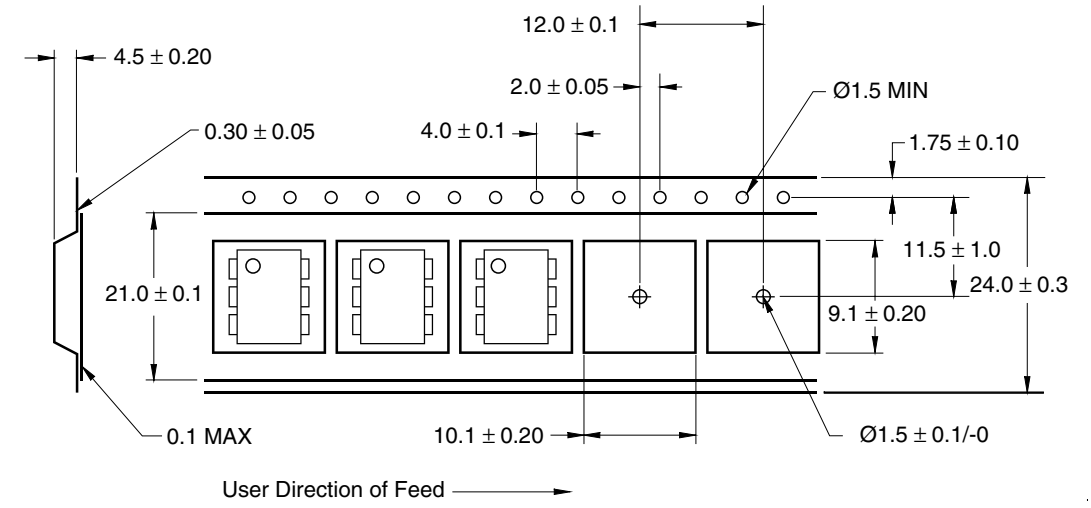
| Suffix | Example | Option |
|---|---|---|
| No Suffix | H11AG1M | Standard Through Hole Device (50 units per tube) |
| S | H11AG1SM | Surface Mount Lead Bend |
| SR2 | H11AG1SR2M | Surface Mount; Tape and Reel (1,000 units per reel) |
| T | H11AG1TM | 0.4" Lead Spacing |
| V | H11AG1VM | VDE 0884 |
| TV | H11AG1TVM | VDE 0884, 0.4" Lead Spacing |
| SV | H11AG1SVM | VDE 0884, Surface Mount |
| SR2V | H11AG1SR2VM | VDE 0884, Surface Mount, Tape & Reel (1,000 units per reel) |

## Marking Information



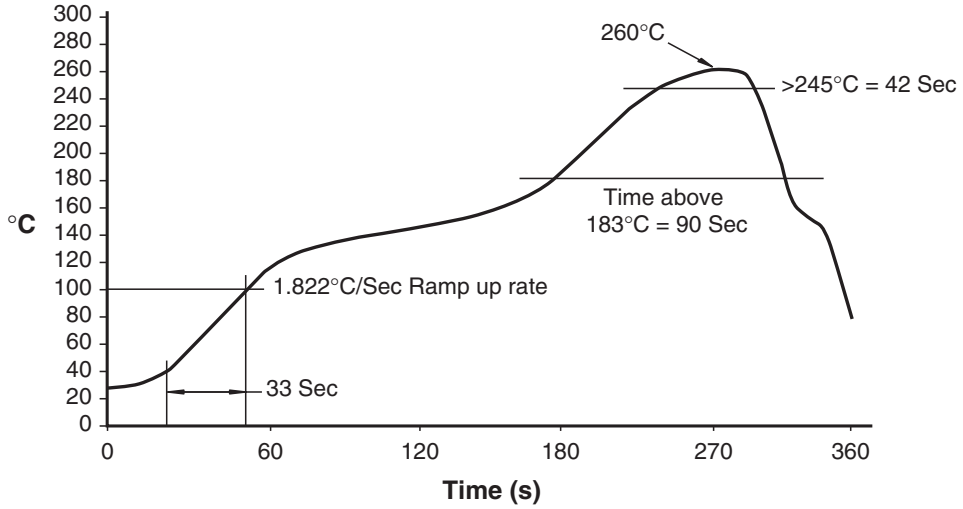

| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., ‘7’ |
| 5 | Two digit work week ranging from ‘01’ to ‘53’ |
| 6 | Assembly package code |

## Tape Dimensions




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

## Reflow Soldering Profile



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