April 2015

# H11AG1M
# 6-Pin DIP 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 200 µA)
- Safety and Regulatory Approvals:
  - UL1577, 4,170 $VAC_{RMS}$ for 1 Minute
  - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

## 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 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

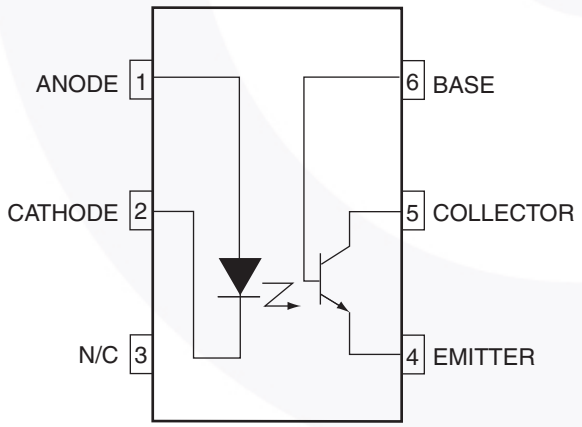



**Figure 1. Schematic**

## Package Outlines

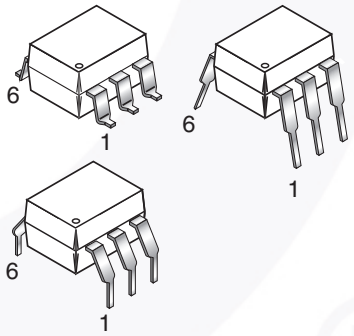



**Figure 2. Package Outlines**

## 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 $V_{RMS}$ | I–IV |
| | < 300 $V_{RMS}$ | I–IV |
| Climatic Classification | | 55/100/21 |
| Pollution Degree (DIN VDE 0110/1.89) | | 2 |
| Comparative Tracking Index | | 175 |

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{PR}$ | Input-to-Output Test Voltage, Method A, $V_{IORM}$ x 1.6 = $V_{PR}$, Type and Sample Test with $t_m$ = 10 s, Partial Discharge < 5 pC | 1360 | $V_{peak}$ |
| | Input-to-Output Test Voltage, Method B, $V_{IORM}$ x 1.875 = $V_{PR}$, 100% Production Test with $t_m$ = 1 s, Partial Discharge < 5 pC | 1594 | $V_{peak}$ |
| $V_{IORM}$ | Maximum Working Insulation Voltage | 850 | $V_{peak}$ |
| $V_{IOTM}$ | Highest Allowable Over-Voltage | 6000 | $V_{peak}$ |
| | 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 |
| $T_S$ | Case Temperature(1) | 175 | °C |
| $I_{S,INPUT}$ | Input Current(1) | 350 | mA |
| $P_{S,OUTPUT}$ | Output Power(1) | 800 | mW |
| $R_{IO}$ | Insulation Resistance at $T_S$, $V_{IO}$ = 500 V(1) | > $10^9$ | 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.

| Symbol | Parameters | Value | Unit |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| $T_{STG}$ | Storage Temperature | -40 to +125 | °C |
| $T_{OPR}$ | Operating Temperature | -40 to +100 | °C |
| $T_J$ | Junction Temperature | -40 to +125 | ºC |
| $T_{SOL}$ | Lead Solder Temperature | 260 for 10 seconds | °C |
| $P_D$ | Total Device Power Dissipation @ 25°C (LED plus detector) | 225 | 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 (1 µs pulse, 300 pps) | 3.0 | A |
| $P_D$ | LED Power Dissipation @ 25°C | 75 | mW |
| | Derate Linearly From 25°C | 1.0 | mW/°C |
| **DETECTOR** | | | |
| $I_C$ | Continuous Collector Current | 50 | mA |
| $P_D$ | Detector Power Dissipation @ 25°C | 150 | mW |
| | Derate Linearly From 25°C | 2.0 | mW/°C |

## Electrical Characteristics

$T_A$ = 25°C unless otherwise specified.

### Individual Component Characteristics

| Symbol | Parameters | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = 1 mA | | 1.25 | 1.50 | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 5 V, $T_A$ = 25°C | | | 10 | µA |
| $C_J$ | Capacitance | V = 0, f = 1.0 MHz | | | 100 | pF |
| **DETECTOR** | | | | | | |
| $BV_{CEO}$ | Breakdown Voltage, Collector-to-Emitter | $I_C$ = 1.0 mA, $I_F$ = 0 | 30 | | | V |
| $BV_{CBO}$ | Breakdown Voltage, Collector-to-Base | $I_C$ = 100 µA, $I_F$ = 0 | 70 | | | V |
| $BV_{ECO}$ | Breakdown Voltage, Emitter-to-Collector | $I_C$ = 100 µA, $I_F$ = 0 | 7 | | | V |
| $I_{CEO}$ | Leakage Current, Collector-to-Emitter | $V_{CE}$ = 10 V, $I_F$ = 0 | | 5 | 10 | µA |
| $C_{CE}$ | Capacitance | $V_{CE}$ = 10 V, f = 1 MHz | | 10 | | pF |

### Transfer Characteristics

| Symbol | Characteristics | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| CTR | Current Transfer Ratio | $I_F$ = 1 mA, $V_{CE}$ = 5 V | 300 | | | % |
| | | $I_F$ = 1 mA, $V_{CE}$ = 0.6 V | 100 | | | % |
| | | $I_F$ = 0.2 mA, $V_{CE}$ = 1.5 V | 100 | | | % |
| $V_{CE(SAT)}$ | Saturation Voltage | $I_F$ = 2.0 mA, $I_C$ = 0.5 mA | | | 0.40 | V |
| **AC CHARACTERISTICS** (Non-Saturated Switching Times) | | | | | | |
| $t_{on}$ | Turn-On Time | $R_L$ = 100 Ω, $I_F$ = 1 mA, $V_{CC}$ = 5 V | | 5 | | µs |
| $t_{off}$ | Turn-Off Time | $R_L$ = 100 Ω, $I_F$ = 1 mA, $V_{CC}$ = 5 V | | 5 | | µs |

### Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{ISO}$ | Input-Output Isolation Voltage | t = 1 Minute | 4170 | | | $VAC_{RMS}$ |
| $C_{ISO}$ | Isolation Capacitance | $V_{I-O}$ = 0 V, f = 1 MHz | | 0.2 | | pF |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = ±500 VDC, $T_A$ = 25°C | $10^{11}$ | | | Ω |

## Typical Performance Curves

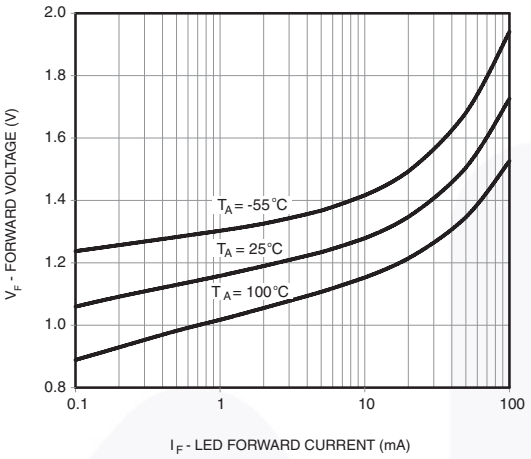



**Figure 3. LED Forward Voltage vs. Forward Current**

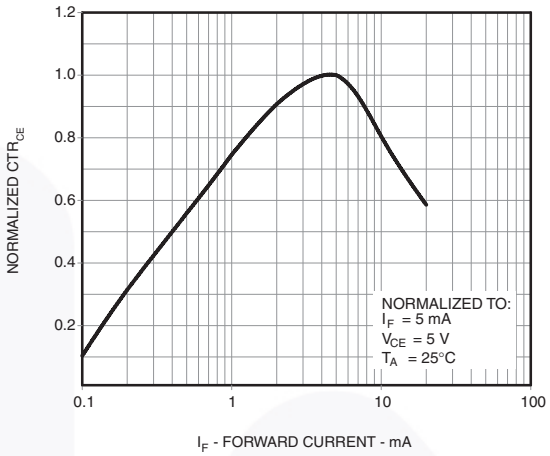



**Figure 4. Normalized Current Transfer Ratio vs. Forward Current**

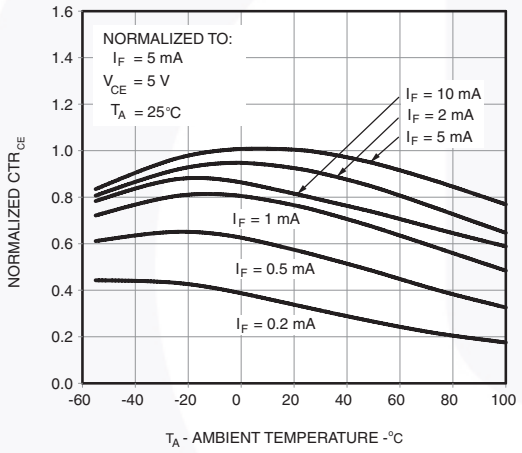



**Figure 5. Normalized CTR vs. Temperature**

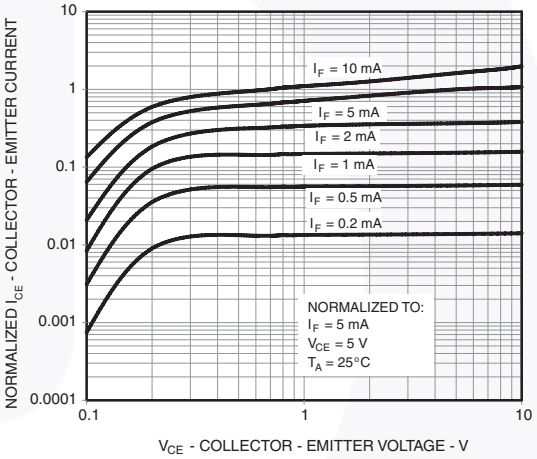



**Figure 6. Normalized Collector vs. Collector-Emitter Voltage**

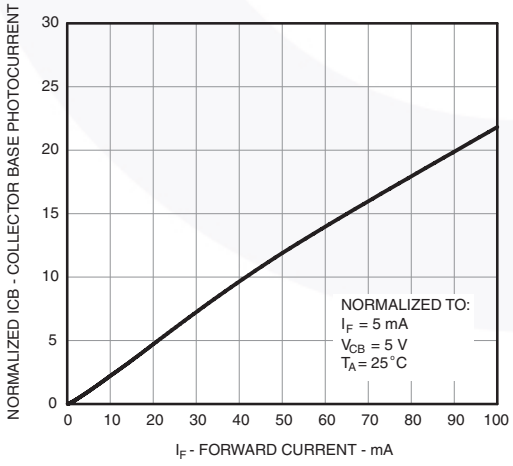



**Figure 7. Normalized Collector-Base Photocurrent Ratio vs. Forward Current**

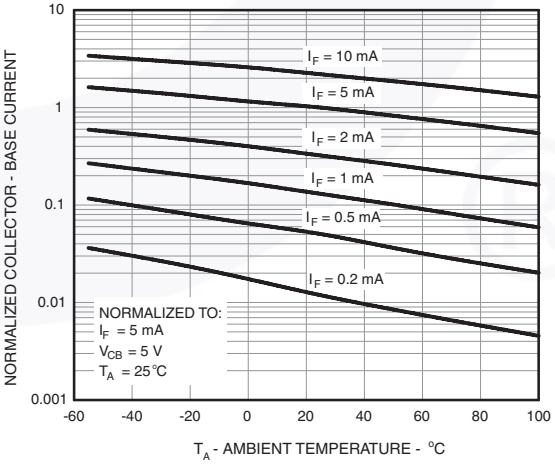



**Figure 8. Normalized Collector-Base Current vs. Temperature**

## Typical Performance Curves (Continued)

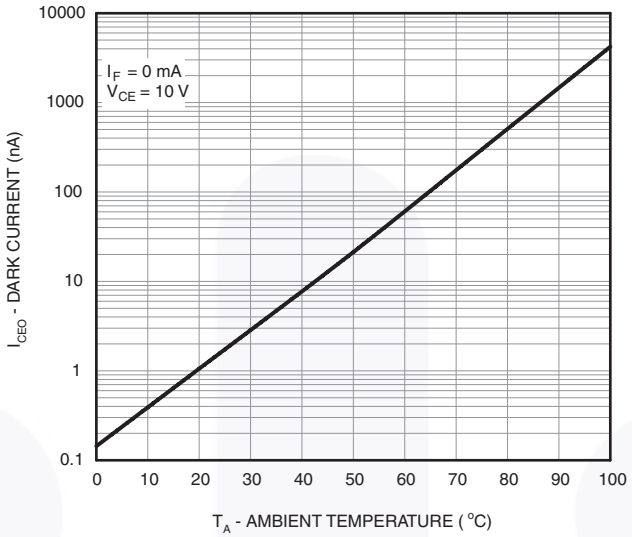
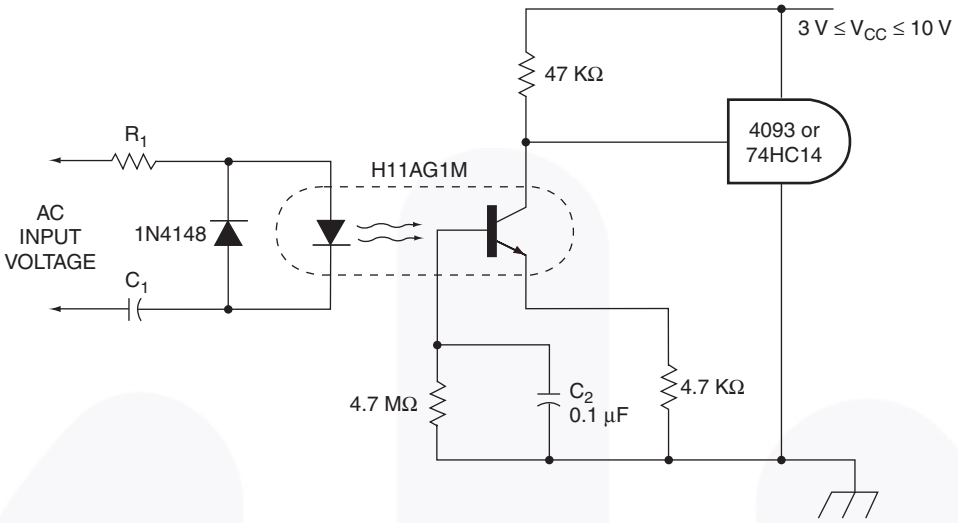



**Figure 9. Collector-Emitter Dark Current vs. Ambient Temperature**

## Typical Application




| Input | R1 | C1 | Z |
|---|---|---|---|
| 40-90 $VAC_{RMS}$<br>20 Hz | 75 KΩ<br>1/10 W | 0.1 µF<br>100 V | 109 KΩ |
| 95-135 $VAC_{RMS}$<br>60 Hz | 180 KΩ<br>1/10 W | 12 nF<br>200 V | 285 KΩ |
| 200-280 $VAC_{RMS}$<br>50/60 Hz | 390 KΩ<br>1/4 W | 6.80 nF<br>400 V | 550 KΩ |

DC component of input voltage is ignored due to C1

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.

**Figure 10. Telephone Ring Detector / A.C. Line CMOS Input Isolator**

## Reflow Profile

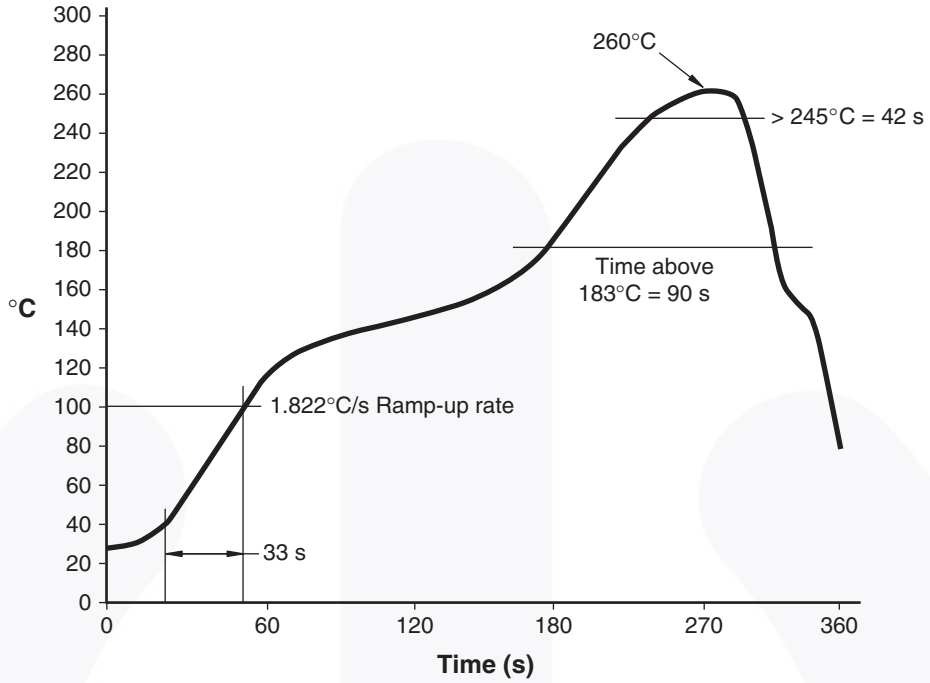



**Figure 11. Reflow Profile**

## Ordering Information

| Part Number | Package | Packing Method |
|---|---|---|
| H11AG1M | DIP 6-Pin | Tube (50 Units) |
| H11AG1SM | SMT 6-Pin (Lead Bend) | Tube (50 Units) |
| H11AG1SR2M | SMT 6-Pin (Lead Bend) | Tape and Reel (1000 Units) |
| H11AG1VM | DIP 6-Pin, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| H11AG1SVM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| H11AG1SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tape and Reel (1000 Units) |
| H11AG1TVM | DIP 6-Pin, 0.4” Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |

## Marking Information

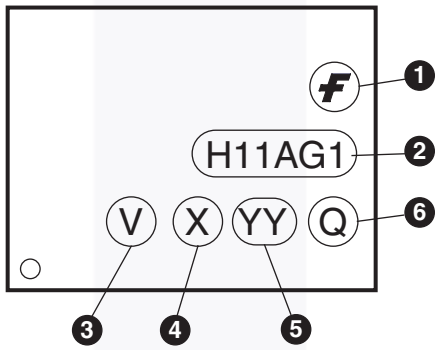
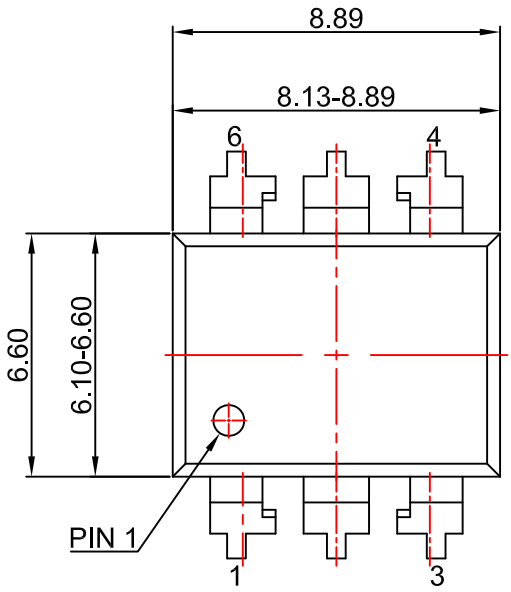
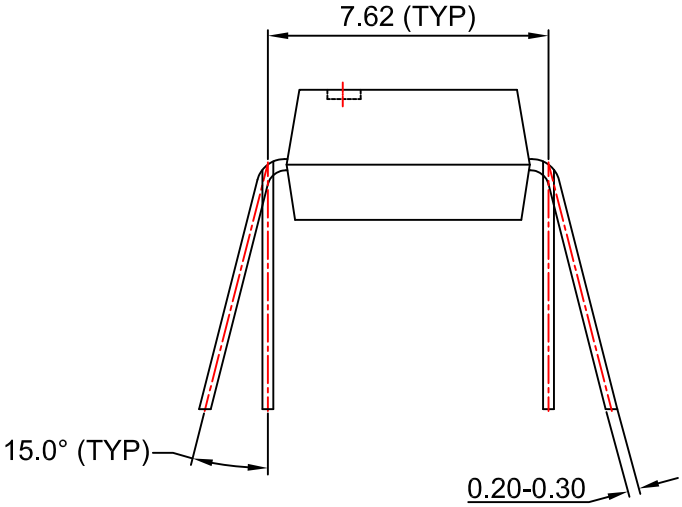


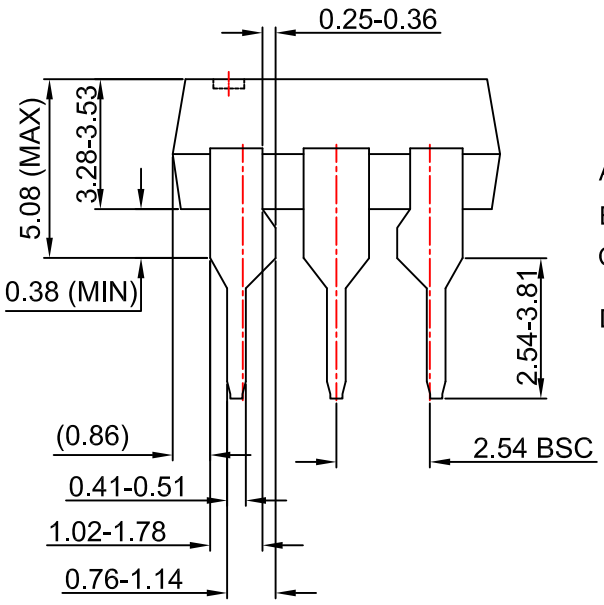

**Figure 12. Top Mark**

**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., “5” |
| 5 | Digit Work Week, Ranging from “01” to “53” |
| 6 | Assembly Package Code |

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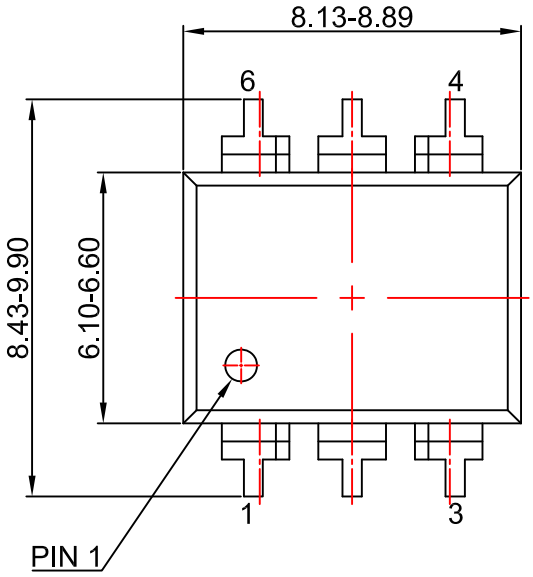
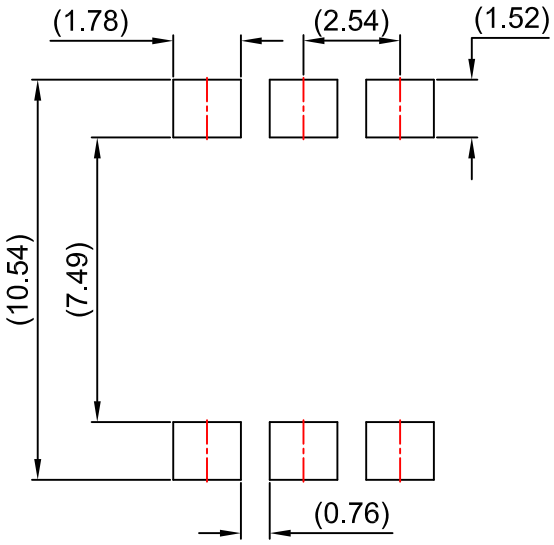
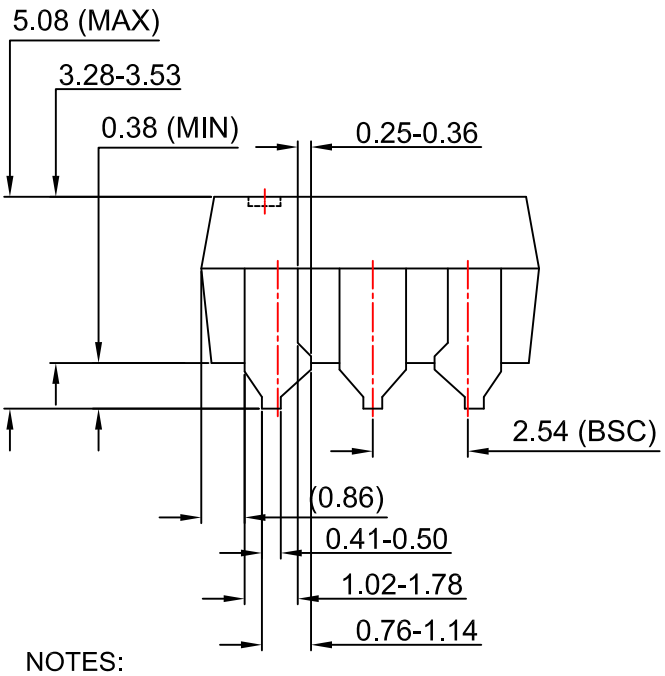
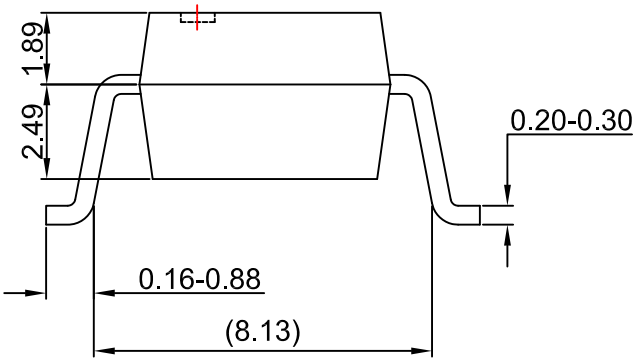



LAND PATTERN RECOMMENDATION

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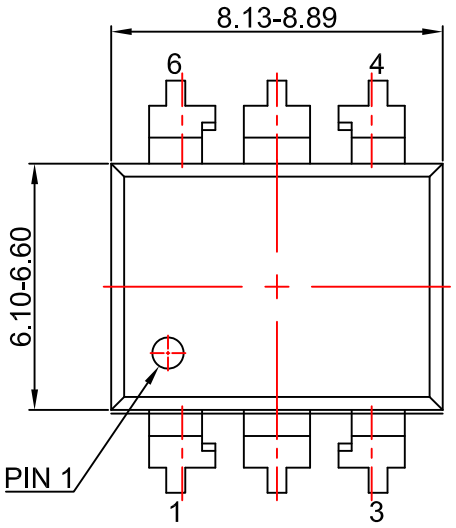


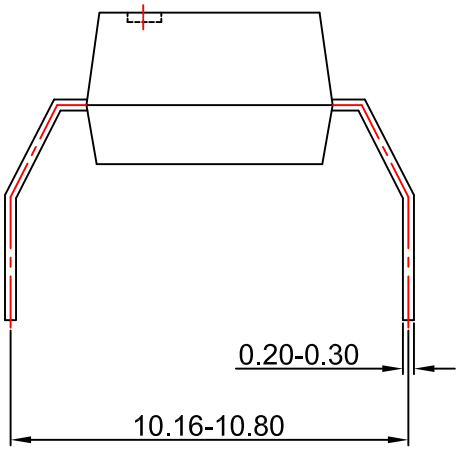


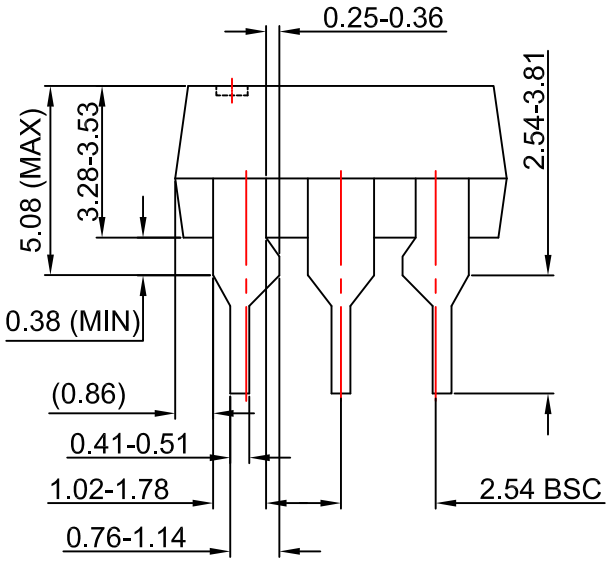


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