



April 2015

# H11AA1M, H11AA4M 6-Pin DIP AC Input Phototransistor Optocouplers

## Features

- Bi-polar Emitter Input
- Built-in Reverse Polarity Input Protection
- 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

## Applications

- AC Line Monitor
- Unknown Polarity DC Sensor
- Telephone Line Interface

## Description

The H11AA1M and H11AA4M devices consist of two gallium-arsenide infrared emitting diodes connected in inverse parallel driving a single silicon phototransistor output.

## Schematic

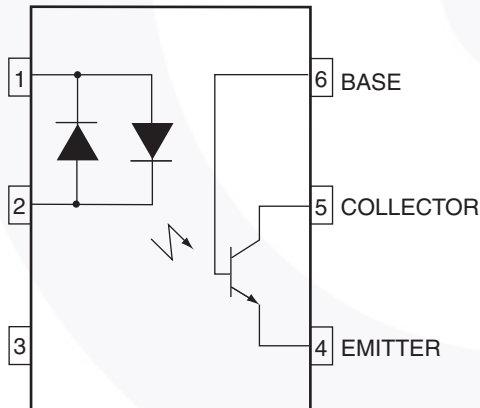


Figure 1. Schematic

## Package Outlines

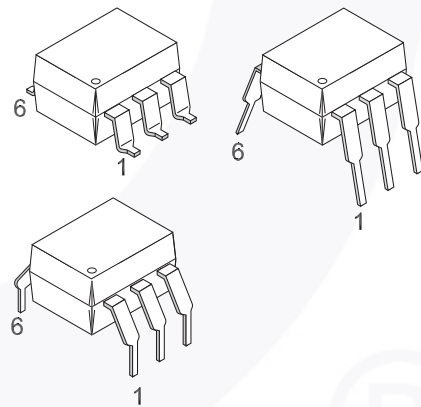


Figure 2. Package Outlines

## 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 <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.

| Symbol              | Parameter   | Value              | Unit  |
|---------------------|---|--------------------|-------|
| <b>TOTAL DEVICE</b> |   |                    |       |
| $T_{STG}$           | Storage Temperature                               | -40 to +125        | °C    |
| $T_{OPR}$           | Operating Temperature                             | -40 to +100        | °C    |
| $T_J$               | Junction Temperature                              | -40 to +125        | °C    |
| $T_{SOL}$           | Lead Solder Temperature                           | 260 for 10 seconds | °C    |
| $P_D$               | Total Device Power Dissipation @ 25°C             | 270                | mW    |
|                     | Derate Linearly From 25°C                         | 2.94               | mW/°C |
| <b>EMITTER</b>      |   |                    |       |
| $I_F$               | Continuous Forward Current                        | 60                 | mA    |
| $I_F(pk)$           | Forward Current – Peak (1 $\mu$ s pulse, 300 pps) | $\pm 1.0$          | A     |
| $P_D$               | LED Power Dissipation @ 25°C                      | 120                | mW    |
|                     | Derate Linearly From 25°C                         | 1.41               | mW/°C |
| <b>DETECTOR</b>     |   |                    |       |
| $I_C$               | Continuous Collector Current                      | 50                 | mA    |
| $P_D$               | Detector Power Dissipation @ 25°C                 | 150                | mW    |
|                     | Derate linearity from 25°C                        | 1.76               | mW/°C |

## Electrical Characteristics

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

### Individual Component Characteristics

| Symbol          | Parameter                               | Test Conditions                         | Min. | Typ. | Max. | Unit |
|-----------------|---|---|------|------|------|------|
| <b>EMITTER</b>  |   |   |      |      |      |      |
| $V_F$           | Input Forward Voltage                   | $I_F = \pm 10\text{ mA}$                |      | 1.17 | 1.50 | V    |
| $C_J$           | Capacitance                             | $V_F = 0\text{ V}, f = 1.0\text{ MHz}$  |      | 80   |      | pF   |
| <b>DETECTOR</b> |   |   |      |      |      |      |
| $BV_{CEO}$      | Breakdown Voltage, Collector-to-Emitter | $I_C = 1.0\text{ mA}, I_F = 0$          | 30   | 100  |      | V    |
| $BV_{CBO}$      | Breakdown Voltage, Collector-to-Base    | $I_C = 100\text{ }\mu\text{A}, I_F = 0$ | 70   | 120  |      | V    |
| $BV_{EBO}$      | Breakdown Voltage, Emitter-to-Base      | $I_E = 100\text{ }\mu\text{A}, I_F = 0$ | 5    | 10   |      | V    |
| $BV_{ECO}$      | Breakdown Voltage, Emitter-to-Collector | $I_E = 100\text{ }\mu\text{A}, I_F = 0$ | 7    | 10   |      | V    |
| $I_{CEO}$       | Leakage Current, Collector-to-Emitter   | $V_{CE} = 10\text{ V}, I_F = 0$         |      | 1    | 50   | nA   |
| $C_{CE}$        | Capacitance Collector to Emitter        | $V_{CE} = 0, f = 1\text{ MHz}$          |      | 10   |      | pF   |
| $C_{CB}$        | Collector to Base                       | $V_{CB} = 0, f = 1\text{ MHz}$          |      | 80   |      | pF   |
| $C_{EB}$        | Emitter to Base                         | $V_{EB} = 0, f = 1\text{ MHz}$          |      | 15   |      | pF   |

### Transfer Characteristics

| Symbol        | Characteristics                              | Test Conditions   | Device  | Min. | Typ. | Max. | Unit |
|---------------|--|---|---------|------|------|------|------|
| $CTR_{CE}$    | Current Transfer Ratio, Collector-to-Emitter | $I_F = \pm 10\text{ mA}, V_{CE} = 10\text{ V}$                | H11AA1M | 20   |      |      | %    |
|               |  |   | H11AA4M | 100  |      |      | %    |
|               | Current Transfer Ratio, Symmetry             | $I_F = \pm 10\text{ mA}, V_{CE} = 10\text{ V}$<br>(Figure 13) | All     | 0.33 |      | 3.00 |      |
| $V_{CE(SAT)}$ | Saturation Voltage, Collector-to-Emitter     | $I_F = \pm 10\text{ mA}, I_{CE} = 0.5\text{ mA}$              | All     |      |      | 0.40 | V    |

### Isolation Characteristics

| Symbol    | Characteristic                 | Test Conditions  | Min.      | Typ. | Max. | Unit          |
|-----------|--------------------------------|--|-----------|------|------|---------------|
| $V_{ISO}$ | Input-Output Isolation Voltage | $t = 1\text{ Minute}$                                  | 4170      |      |      | $V_{AC(RMS)}$ |
| $C_{ISO}$ | Isolation Capacitance          | $V_{I-O} = 0\text{ V}, f = 1\text{ MHz}$               |           | 0.7  |      | pF            |
| $R_{ISO}$ | Isolation Resistance           | $V_{I-O} = \pm 500\text{ VDC}, T_A = 25^\circ\text{C}$ | $10^{11}$ |      |      | $\Omega$      |

### Typical Performance Characteristics

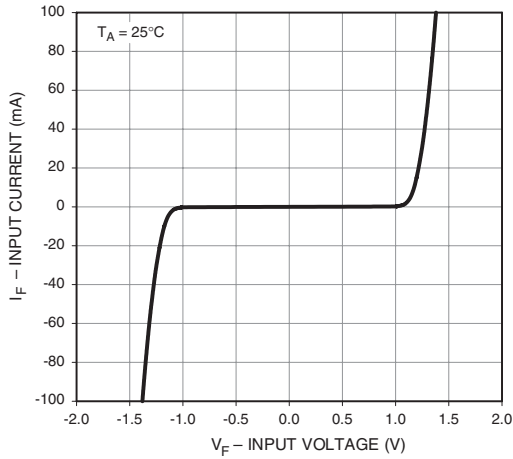


Figure 3. Input Voltage vs. Input Current

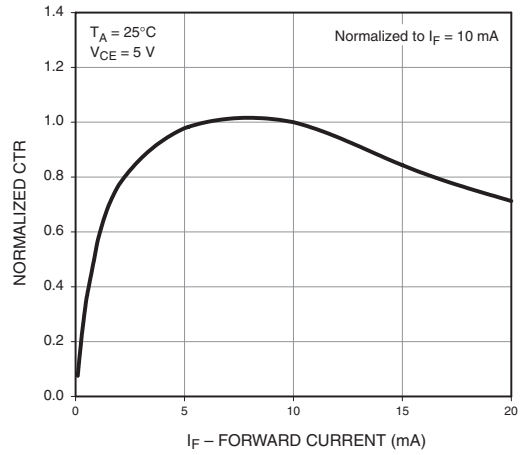


Figure 4. Normalized CTR vs. Forward Current

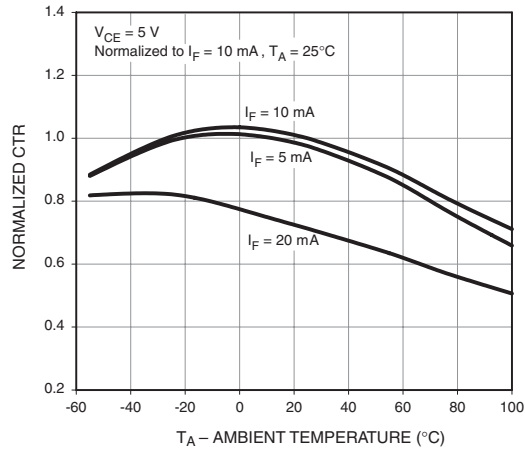


Figure 5. Normalized CTR vs. Ambient Temperature

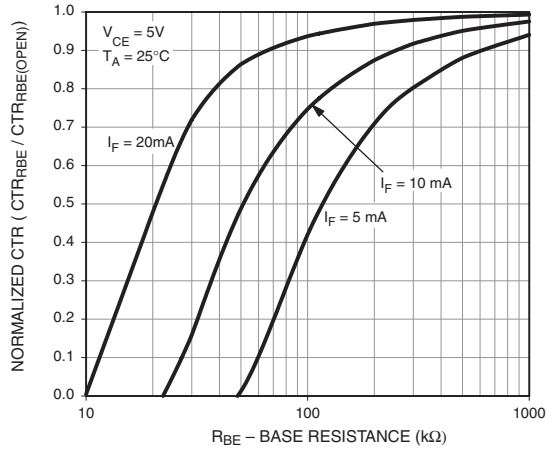


Figure 6. CTR vs. RBE (Unsaturated)

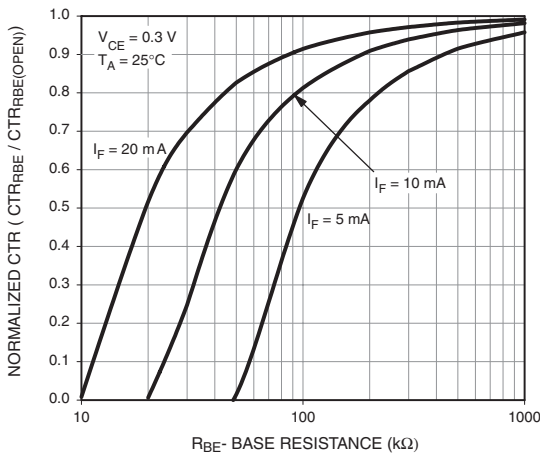


Figure 7. CTR vs. RBE (Saturated)

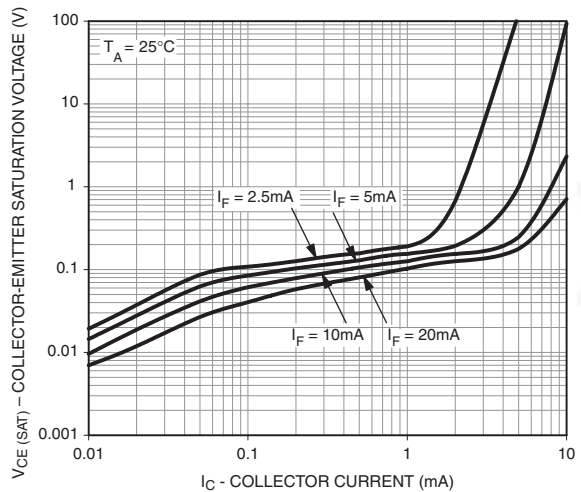


Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current

Typical Performance Characteristics (Continued)

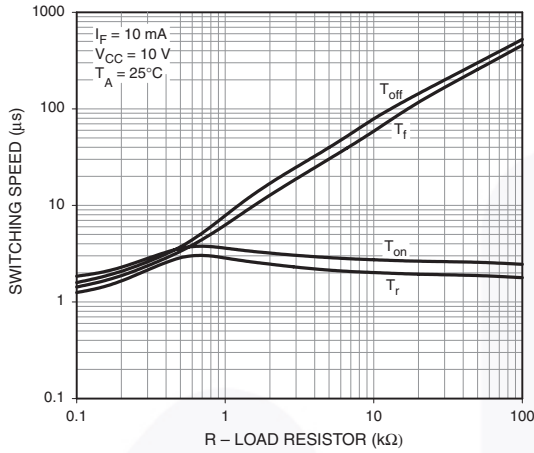


Figure 9. Switching Speed vs. Load Resistor

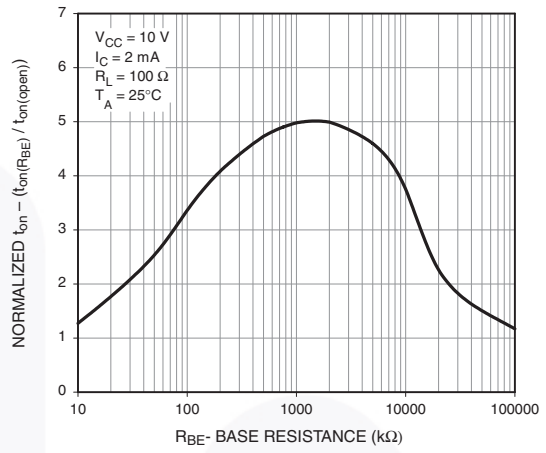


Figure 10. Normalized  $t_{on}$  vs.  $R_{BE}$

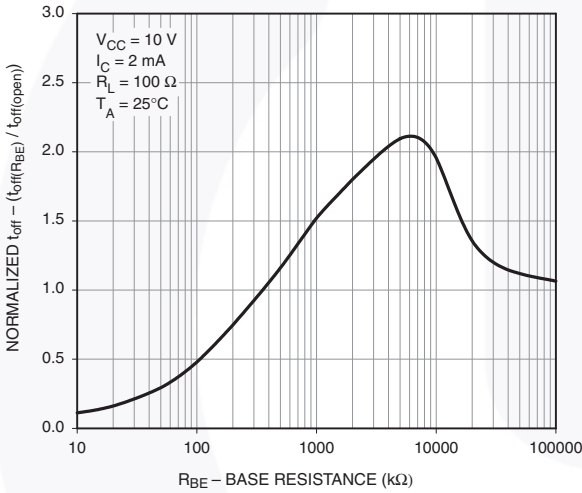


Figure 11. Normalized  $t_{off}$  vs.  $R_{BE}$

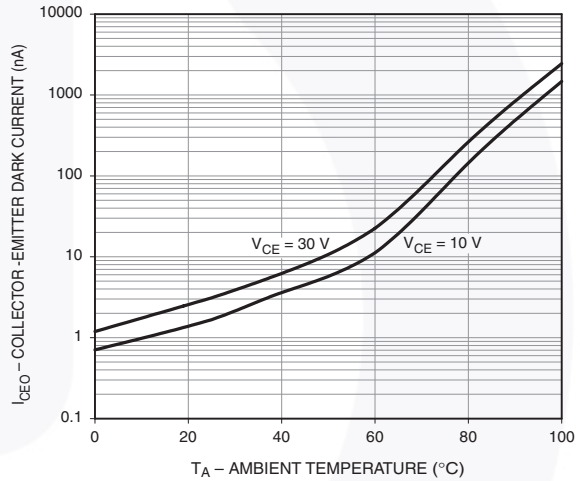


Figure 12. Dark Current vs. Ambient Temperature

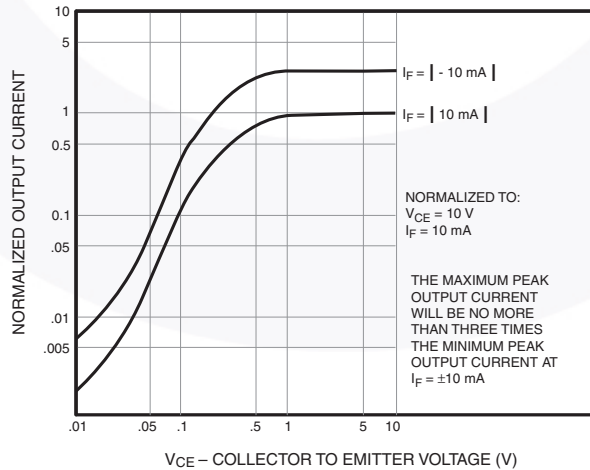


Figure 13. Output Symmetry Characteristics

### Reflow Profile

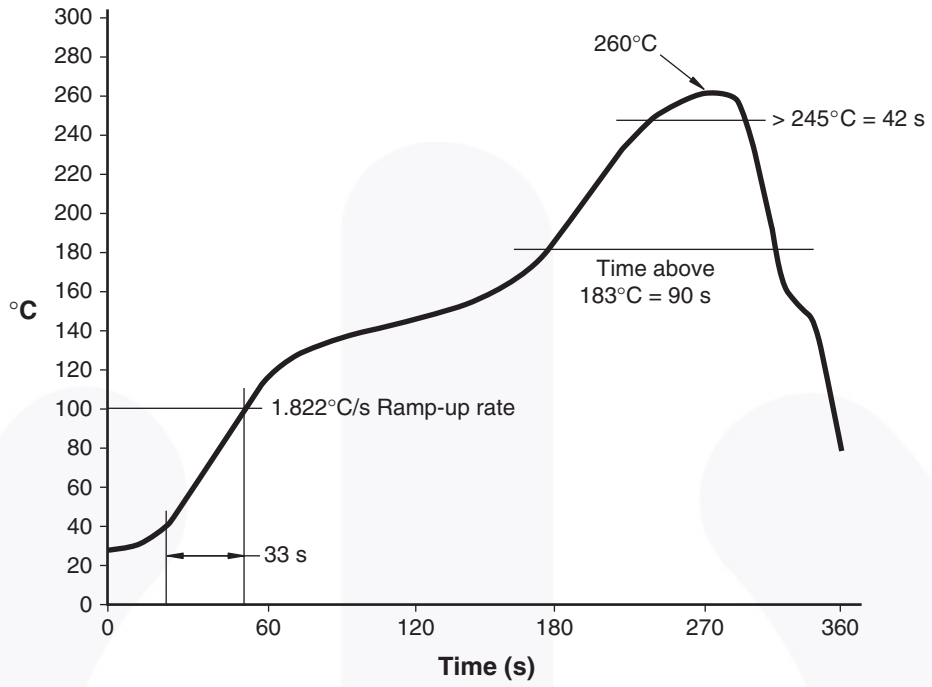


Figure 14. Reflow Profile



## Ordering Information

| Part Number | Package  | Packing Method             |
|-------------|--|----------------------------|
| H11AA1M     | DIP 6-Pin  | Tube (50 Units)            |
| H11AA1SM    | SMT 6-Pin (Lead Bend)                                    | Tube (50 Units)            |
| H11AA1SR2M  | SMT 6-Pin (Lead Bend)                                    | Tape and Reel (1000 Units) |
| H11AA1VM    | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                    | Tube (50 Units)            |
| H11AA1SVM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tube (50 Units)            |
| H11AA1SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | Tape and Reel (1000 Units) |
| H11AA1TVM   | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units)            |

**Note:**

2. The product orderable part number system listed in this table also applies to the H11AA4M device.

## Marking Information

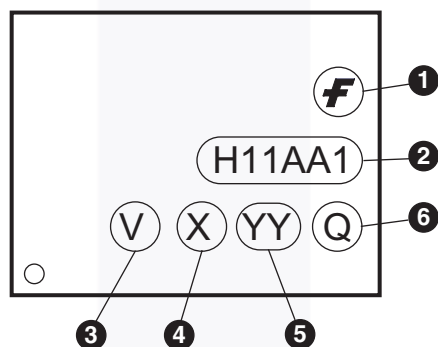
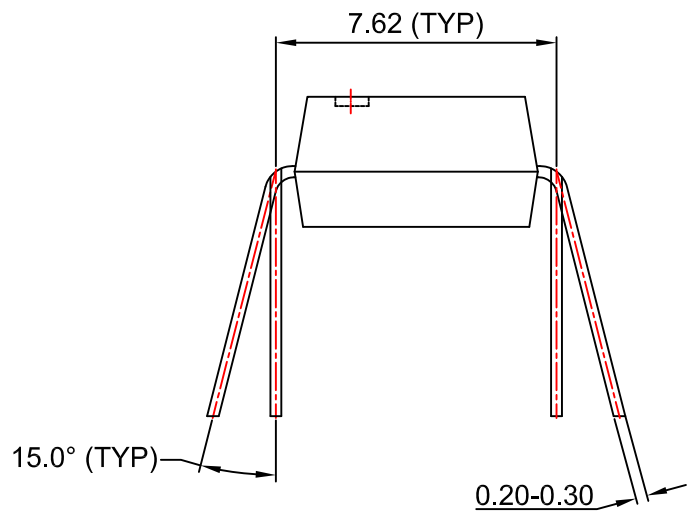


Figure 15. Top Mark

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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