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April 2015

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M 6-Pin General Purpose Phototransistor Optocouplers

## Features

- Minimum Current Transfer Ratio at $I_F$ = 10 mA, $V_{CE}$ = 10 V:
  - 10% for 4N27M and 4N28M
  - 20% for 4N25M and 4N26M
  - 100% for 4N35M, 4N36M and 4N37M
- Safety and Regulatory Approvals:
  - UL1577, 4,170 $VAC_{RMS}$ for 1 Minute
  - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

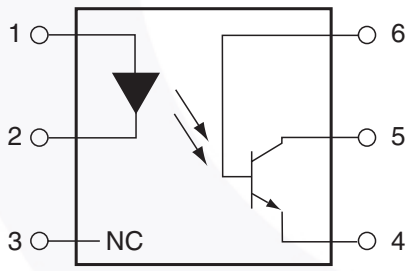
## Applications

- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs

## Description

The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a standard plastic six-pin dual-in-line package.

## Schematic




PIN 1. ANODE
2. CATHODE
3. NO CONNECTION
4. EMITTER
5. COLLECTOR
6. BASE

**Figure 1. Schematic**

## Package Outlines

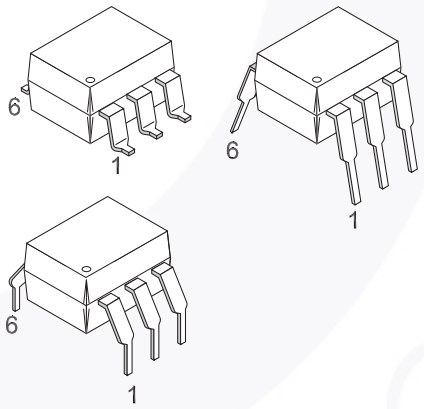



**Figure 2. Package Outlines**

## 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. $T_A$ = 25°C unless otherwise specified.

| Symbol | Parameter | 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 @ $T_A$ = 25°C | 270 | mW |
| | Derate Above 25°C | 2.94 | mW/°C |
| **EMITTER** | | | |
| $I_F$ | DC/Average Forward Input Current | 60 | mA |
| $V_R$ | Reverse Input Voltage | 6 | V |
| $I_F$(pk) | Forward Current – Peak (300 µs, 2% Duty Cycle) | 3 | A |
| $P_D$ | LED Power Dissipation @ $T_A$ = 25°C | 120 | mW |
| | Derate Above 25°C | 1.41 | mW/°C |
| **DETECTOR** | | | |
| $V_{CEO}$ | Collector-to-Emitter Voltage | 30 | V |
| $V_{CBO}$ | Collector-to-Base Voltage | 70 | V |
| $V_{ECO}$ | Emitter-to-Collector Voltage | 7 | V |
| $P_D$ | Detector Power Dissipation @ $T_A$ = 25°C | 150 | mW |
| | Derate Above 25°C | 1.76 | mW/°C |

## Electrical Characteristics

TA = 25°C unless otherwise specified.

### Individual Component Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = 10 mA | | 1.18 | 1.50 | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 6.0 V | | 0.001 | 10 | µA |
| **DETECTOR** | | | | | | |
| $BV_{CEO}$ | Collector-to-Emitter Breakdown Voltage | $I_C$ = 1.0 mA, $I_F$ = 0 | 30 | 100 | | V |
| $BV_{CBO}$ | Collector-to-Base Breakdown Voltage | $I_C$ = 100 µA, $I_F$ = 0 | 70 | 120 | | V |
| $BV_{ECO}$ | Emitter-to-Collector Breakdown Voltage | $I_E$ = 100 µA, $I_F$ = 0 | 7 | 10 | | V |
| $I_{CEO}$ | Collector-to-Emitter Dark Current | $V_{CE}$ = 10 V, $I_F$ = 0 | | 1 | 50 | nA |
| $I_{CBO}$ | Collector-to-Base Dark Current | $V_{CB}$ = 10 V | | | 20 | nA |
| $C_{CE}$ | Capacitance | $V_{CE}$ = 0 V, f = 1 MHz | | 8 | | pF |

### Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| CTR | Current Transfer Ratio, Collector-to-Emitter | $I_F$ = 10 mA, $V_{CE}$ = 10 V | 4N35M, 4N36M, 4N37M | 100 | | | % |
| | | | 4N25M, 4N26M | 20 | | | % |
| | | | 4N27M, 4N28M | 10 | | | % |
| | | $I_F$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = -55°C | 4N35M, 4N36M, 4N37M | 40 | | | % |
| | | $I_F$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = +100°C | 4N35M, 4N36M, 4N37M | 40 | | | % |
| $V_{CE\ (SAT)}$ | Collector-to-Emitter Saturation Voltage | $I_C$ = 2 mA, $I_F$ = 50 mA | 4N25M, 4N26M, 4N27M, 4N28M | | | 0.5 | V |
| | | $I_C$ = 0.5 mA, $I_F$ = 10 mA | 4N35M, 4N36M, 4N37M | | | 0.3 | V |
| **AC CHARACTERISTICS** | | | | | | | |
| $T_{ON}$ | Non-Saturated Turn-on Time | $I_F$ = 10 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω (Figure 13) | 4N25M, 4N26M, 4N27M, 4N28M | | 2 | | µs |
| | | $I_C$ = 2 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω (Figure 13) | 4N35M, 4N36M, 4N37M | | 2 | 10 | µs |
| $T_{OFF}$ | Turn-off Time | $I_F$ = 10 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω (Figure 13) | 4N25M, 4N26M, 4N27M, 4N28M | | 2 | | µs |
| | | $I_C$ = 2 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω (Figure 13) | 4N35M, 4N36M, 4N37M | | 2 | 10 | 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

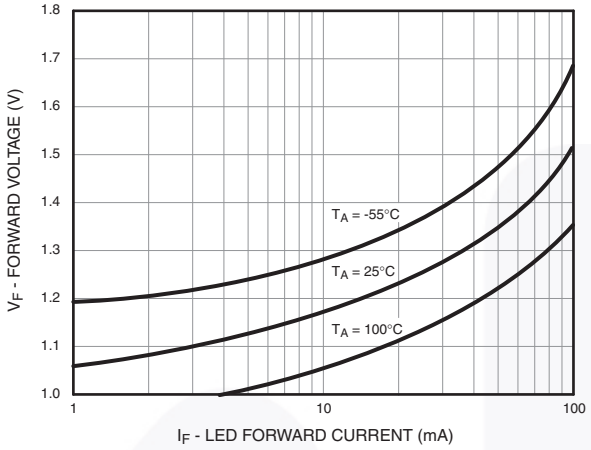



**Figure 3. LED Forward Voltage vs. Forward Current**

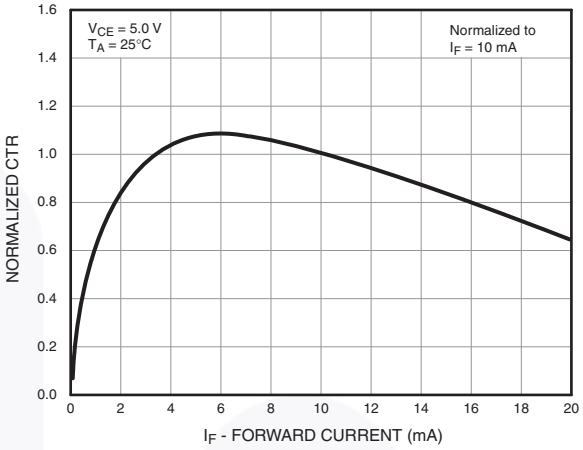



**Figure 4. Normalized CTR vs. Forward Current**

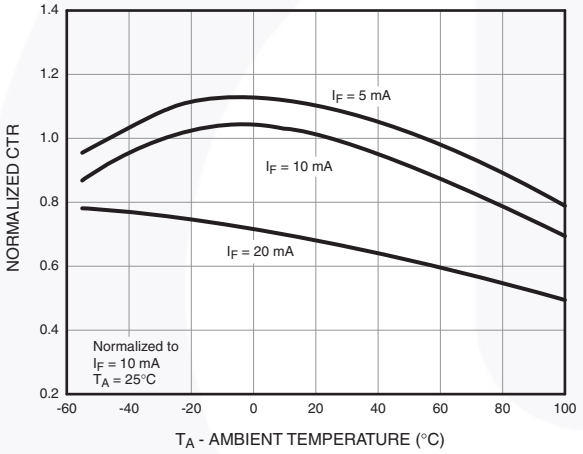



**Figure 5. Normalized CTR vs. Ambient Temperature**

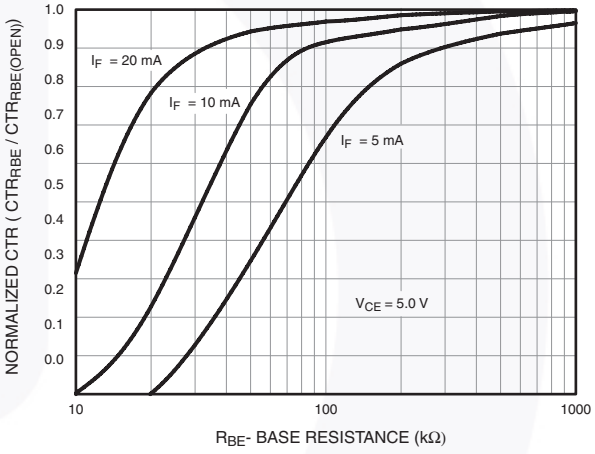



**Figure 6. CTR vs. RBE (Unsaturated)**

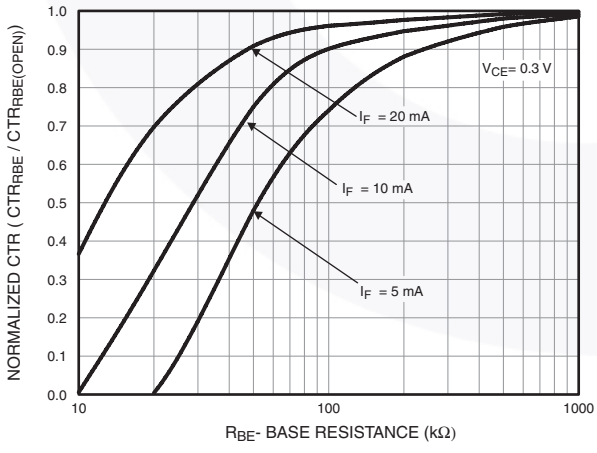



**Figure 7. CTR vs. RBE (Saturated)**

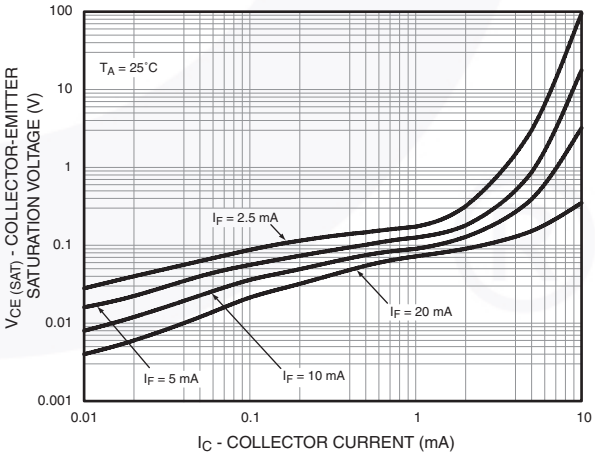



**Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current**

## Typical Performance Curves (Continued)

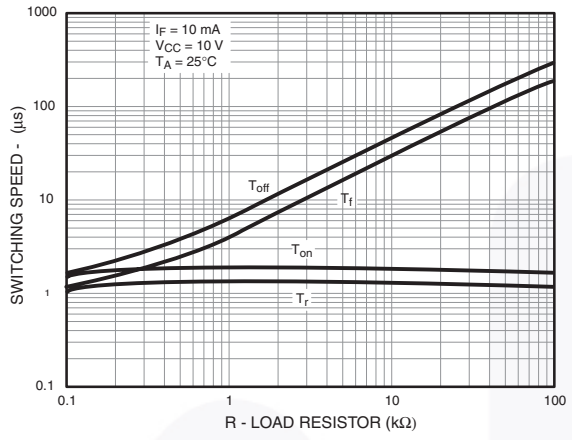



**Figure 9. Switching Speed vs. Load Resistor**

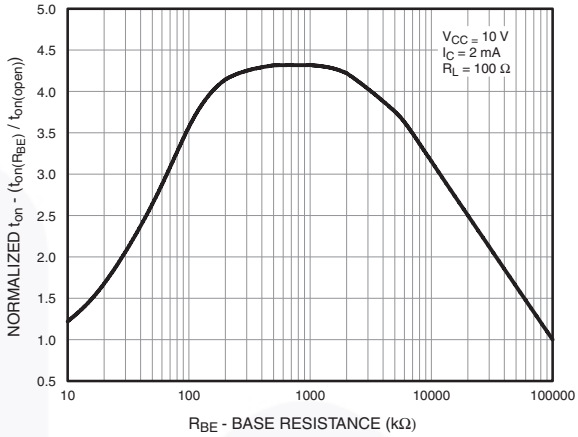



**Figure 10. Normalized $t_{on}$ vs. $R_{BE}$**

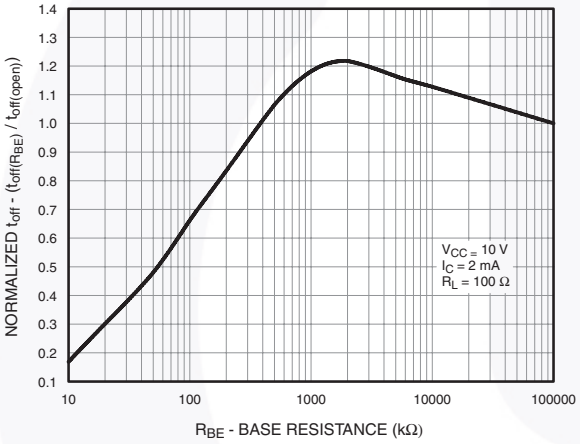



**Figure 11. Normalized $t_{off}$ vs. $R_{BE}$**

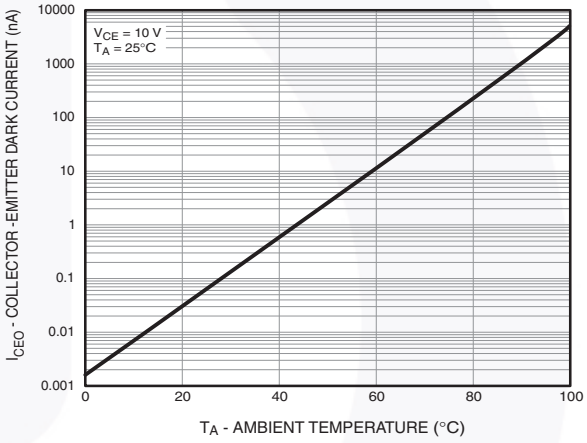



**Figure 12. Dark Current vs. Ambient Temperature**

## Switching Time Test Circuit and Waveforms

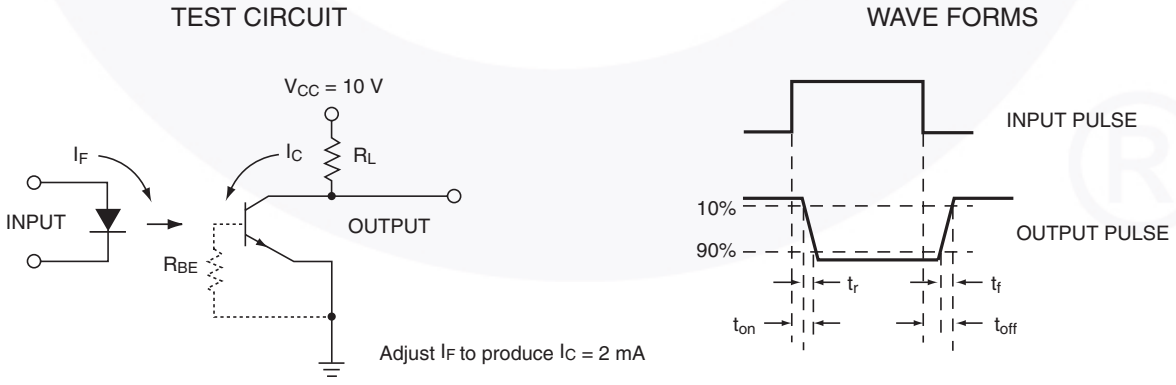



**Figure 13. Switching Time Test Circuit and Waveforms**

## Reflow Profile

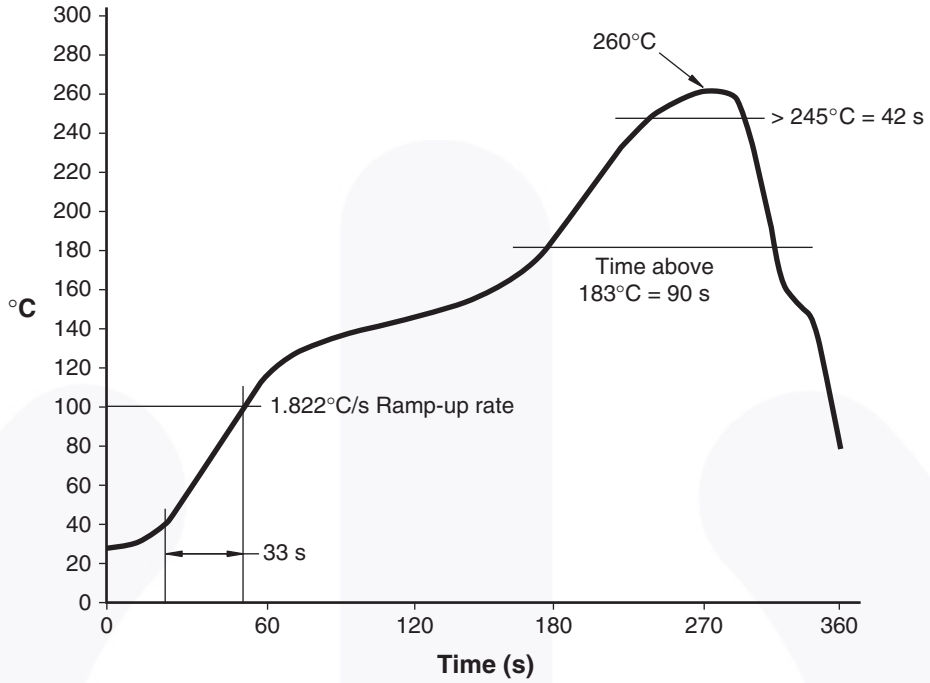



**Figure 14. Reflow Profile**

## Ordering Information

| Part Number | Package | Packing Method |
|---|---|---|
| 4N25M | DIP 6-Pin | Tube (50 Units) |
| 4N25SM | SMT 6-Pin (Lead Bend) | Tube (50 Units) |
| 4N25SR2M | SMT 6-Pin (Lead Bend) | Tape and Reel (1000 Units) |
| 4N25VM | DIP 6-Pin, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| 4N25SVM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| 4N25SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tape and Reel (1000 Units) |
| 4N25TVM | 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 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, and 4N37M devices.

## Marking Information

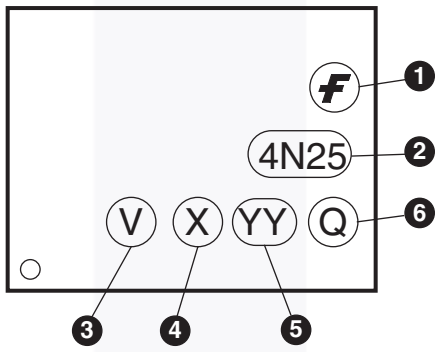
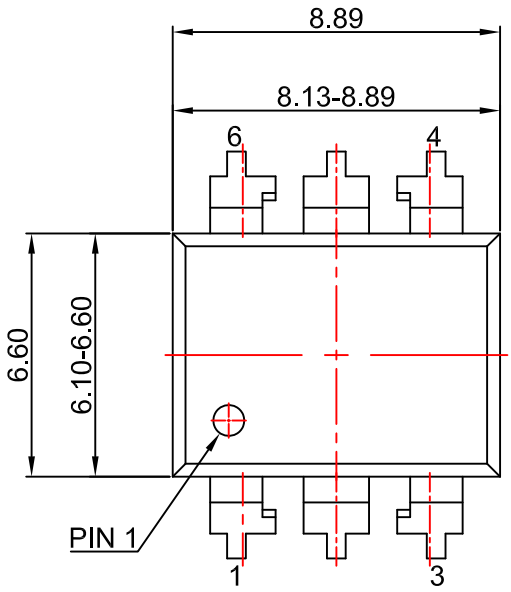
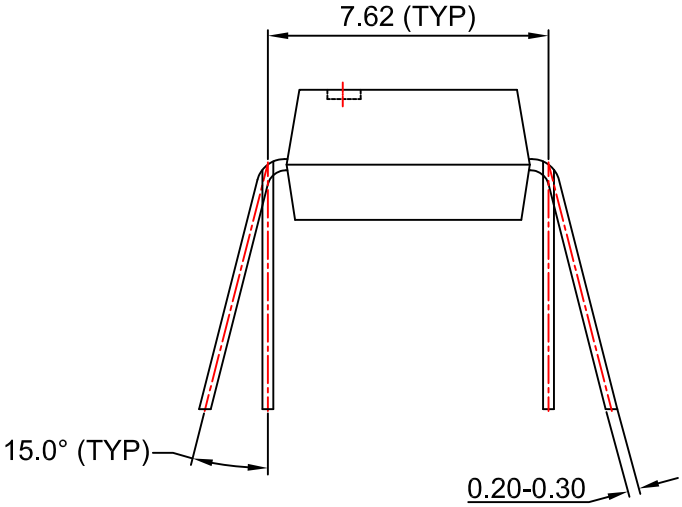


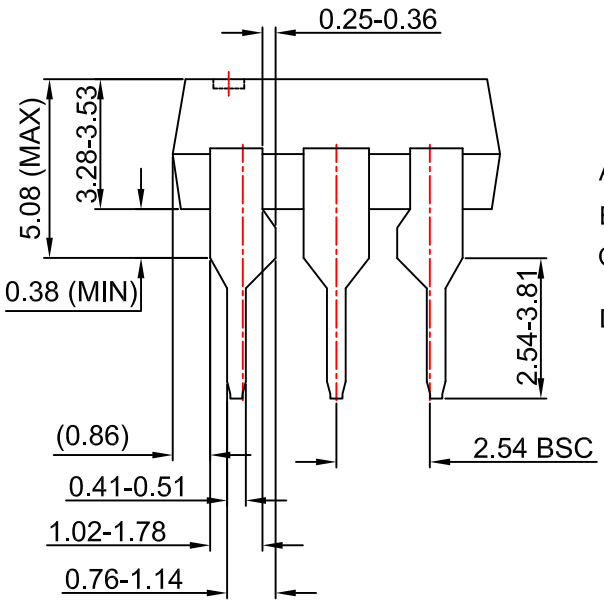

**Figure 15. Top Mark**

**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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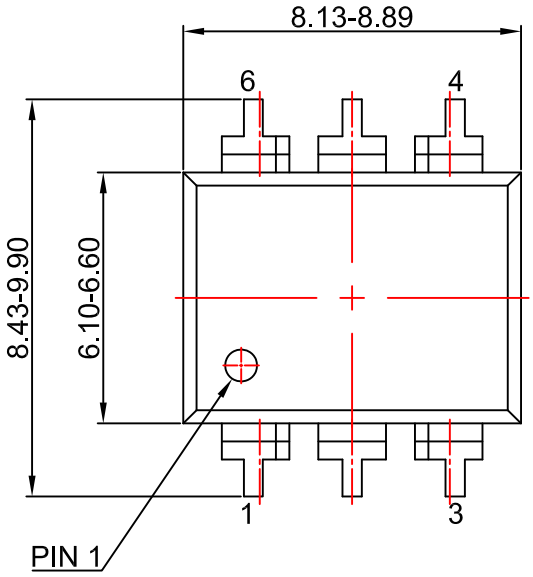
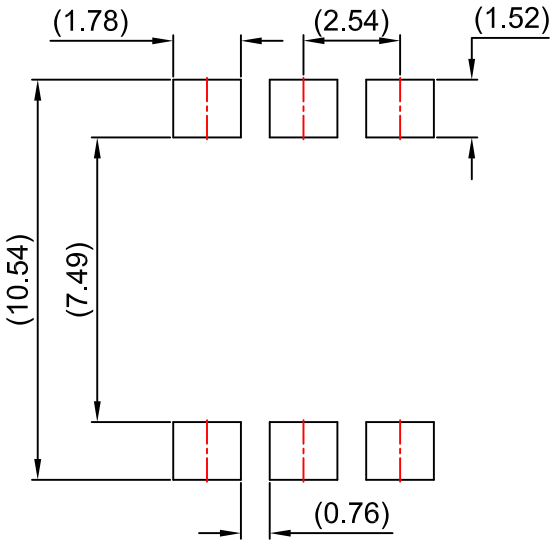
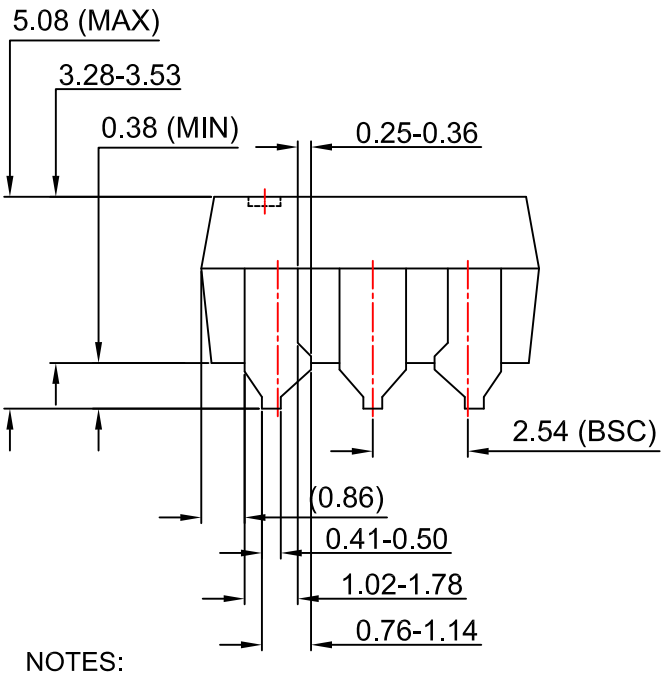
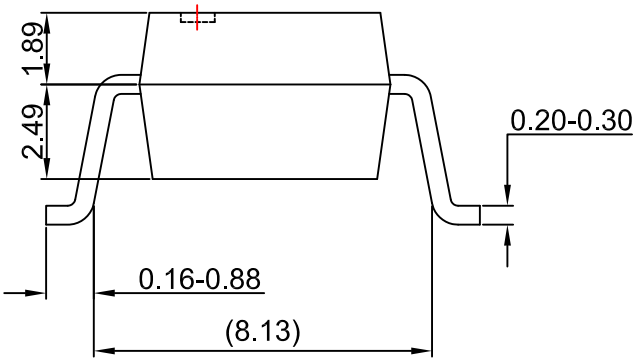



LAND PATTERN RECOMMENDATION

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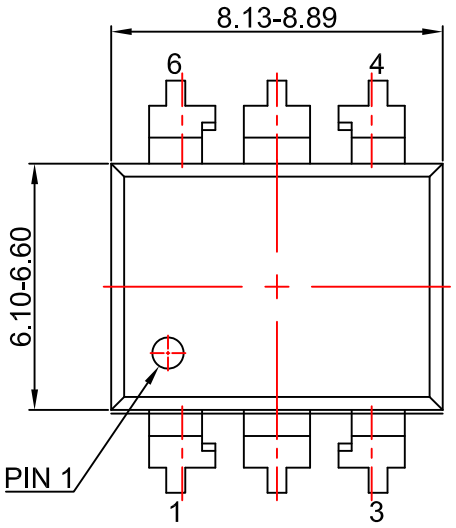


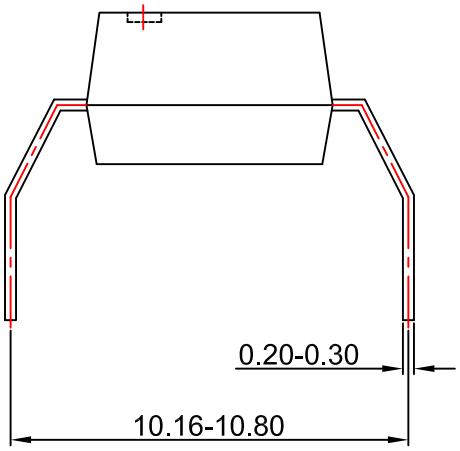


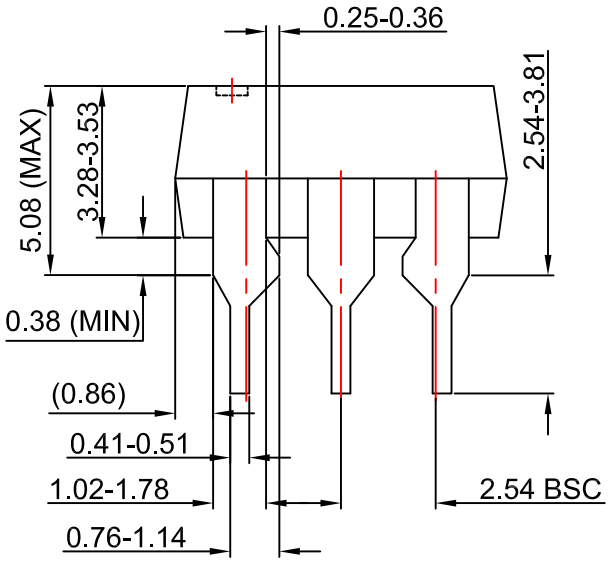


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