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October 2016

FOD420, FOD4208, FOD4216, FOD4218 6-Pin DIP High dv/dt Random Phase Triac Drivers

Features

- 300 mA On-State Current
- High Blocking Voltage
 - 600 V (FOD420, FOD4216)
 - 800 V (FOD4208, FOD4218)
- High Trigger Sensitivity
 - 1.3 mA (FOD4216, FOD4218)
 - 2 mA (FOD420, FOD4208)
- High Static dv/dt (10,000 V/ μ s)
- Safety and Regulatory Approvals:
 - UL1577, 5,000 VAC_{RMS} for 1 Minute
 - DIN-EN/IEC60747-5-5

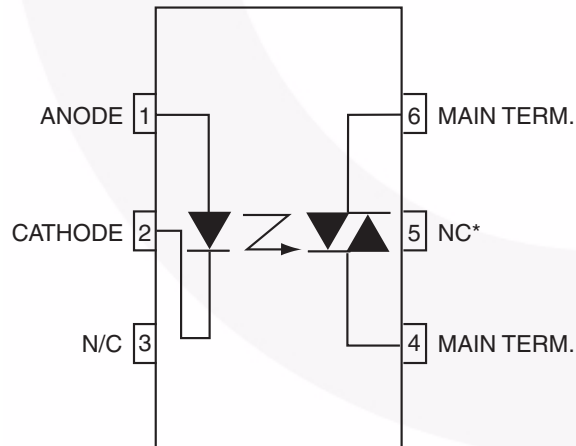
Description

The FOD420, FOD4208, FOD4216 and FOD4218 devices consist of an infrared emitting diode coupled to a hybrid random phase triac formed with two inverse parallel SCRs which form the triac function capable of driving discrete triacs. The FOD4216 and FOD4218 utilize a high efficiency infrared emitting diode which offers an improved trigger sensitivity. These devices are housed in a standard 6-pin dual in-line (DIP) package.

Applications

- Solid-State Relays
- Industrial Controls
- Lighting Controls
- Static Power Switches
- AC Motor Starters

Functional Schematic



*DO NOT CONNECT
(TRIAC SUBSTRATE)

Figure 1. Schematic

Package Outlines

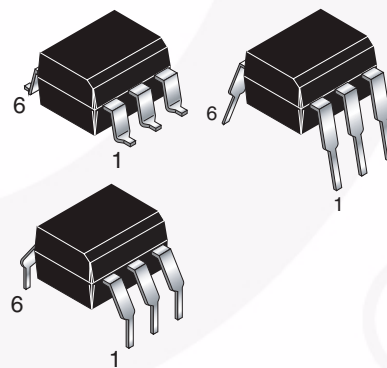


Figure 2. Package Outlines

FOD420, FOD4208, FOD4216, FOD4218 — 6-Pin DIP High dv/dt Random Phase Triac Drivers

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} |
| | < 300 V _{RMS} |
| 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} × 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} × 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 |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥ 0.4 | mm |
| T _S | Case Temperature ⁽¹⁾ | 175 | °C |
| I _{S,INPUT} | Input Current ⁽¹⁾ | 400 | mA |
| P _{S,OUTPUT} | Output Power ⁽¹⁾ | 700 | 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. $T_A = 25^\circ\text{C}$ unless otherwise specified.

| Symbol | Parameter | Device | Value | Unit |
|-------------------|--|------------------|----------------|----------------------|
| T_{STG} | Storage Temperature | All | -55 to +150 | $^\circ\text{C}$ |
| T_{OPR} | Operating Temperature | All | -55 to +100 | $^\circ\text{C}$ |
| T_J | Junction Temperature | All | -55 to +125 | $^\circ\text{C}$ |
| T_{SOL} | Lead Solder Temperature | All | 260 for 10 sec | $^\circ\text{C}$ |
| $P_{D(TOTAL)}$ | Total Device Power Dissipation @ 25 $^\circ\text{C}$ | All | 500 | mW |
| | Derate Above 25 $^\circ\text{C}$ | All | 6.6 | mW/ $^\circ\text{C}$ |
| EMITTER | | | | |
| I_F | Continuous Forward Current | All | 30 | mA |
| V_R | Reverse Voltage | All | 6 | V |
| $P_{D(EMITTER)}$ | Total Power Dissipation 25 $^\circ\text{C}$ Ambient | All | 50 | mW |
| | Derate Above 25 $^\circ\text{C}$ | All | 0.71 | mW/ $^\circ\text{C}$ |
| DETECTOR | | | | |
| V_{DRM} | Off-State Output Terminal Voltage | FOD420, FOD4216 | 600 | V |
| | | FOD4208, FOD4218 | 800 | |
| I_{TSM} | Peak Non-Repetitive Surge Current (single cycle 60 Hz sine wave) | All | 3 | A |
| I_{TM} | Peak On-State Current | All | 300 | mA |
| $P_{D(DETECTOR)}$ | Total Power Dissipation @ 25 $^\circ\text{C}$ Ambient | All | 450 | mW |
| | Derate Above 25 $^\circ\text{C}$ | All | 5.9 | mW/ $^\circ\text{C}$ |

Electrical Characteristics

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

Individual Component Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|-----------------|--|---|----------------------|---------------------|--------|------|------------------|
| EMITTER | | | | | | | |
| V_F | Input Forward Voltage | $I_F = 20\text{ mA}$ | All | | 1.28 | 1.50 | V |
| I_R | Reverse Leakage Current | $V_R = 6\text{ V}$ | All | | 0.01 | 10 | μA |
| DETECTOR | | | | | | | |
| $I_{D(RMS)}$ | Peak Blocking Current, Either Direction | $I_F = 0,$ $T_A = 100^\circ\text{C}^{(2)}$ | $V_D = 600\text{ V}$ | FOD420, FOD4216 | 3 | 100 | μA |
| | | | $V_D = 800\text{ V}$ | FOD4208, FOD4218 | | | |
| $I_{R(RMS)}$ | Reverse Current | $T_A = 100^\circ\text{C}$ | $V_D = 600\text{ V}$ | FOD420, FOD4216 | 3 | 100 | μA |
| | | | $V_D = 800\text{ V}$ | FOD4208, FOD4218 | | | |
| dv/dt | Critical Rate of Rise of Off-State Voltage | $I_F = 0\text{ A}^{(3)}$ (Figure 14) | $V_D = V_{DRM}$ | All | 10,000 | | V/ μs |

Notes:

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt. See Figure 14 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.

Electrical Characteristics (Continued)

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

Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|--------------|---|---|-----------------------------|--------------------------|------|------|------------------|
| I_{FT} | LED Trigger Current | Main Terminal Voltage = 5 V ⁽⁴⁾ | FOD420, FOD4208 | | 0.75 | 2.0 | mA |
| | | | FOD4216, FOD4218 | | 0.75 | 1.3 | |
| V_{TM} | Peak On-State Voltage, Either Direction | $I_{TM} = 300$ mA peak, $I_F = \text{Rated } I_{FT}$ | All | | 2.2 | 3 | V |
| I_H | Holding Current, Either Direction | $V_T = 3$ V | All | | 200 | 500 | μA |
| I_L | Latching Current | $V_T = 2.2$ V | All | | 5 | | mA |
| t_{ON} | Turn-On Time | PF = 1.0, $I_T = 300$ mA | $V_{RM} = V_{DM} = 424$ VAC | FOD420, FOD4216, FOD4218 | | 60 | μs |
| | | | $V_{RM} = V_{DM} = 565$ VAC | FOD4208 | | | |
| t_{OFF} | Turn-Off Time | | $V_{RM} = V_{DM} = 424$ VAC | FOD420, FOD4216, FOD4218 | | 52 | μs |
| | | | $V_{RM} = V_{DM} = 565$ VAC | FOD4208 | | | |
| dv/dt_C | Critical Rate of Rise of Voltage at Current Commutation | $V_D = 230 V_{RMS}$, $I_D = 300$ mA _{PK} | All | | 10 | | V/ μs |
| di/dt_C | Critical Rate of Rise of On-State Current Commutation | $V_D = 230 V_{RMS}$, $I_D = 300$ mA _{PK} | All | | 9 | | A/ms |
| $dv(i_O)/dt$ | Critical Rate of Rise of Coupled Input/Output Voltage | $I_T = 0$ A, $V_{RM} = V_{DM} = 424$ VAC | All | 10,000 | | | V/ μs |

Note:

4. All devices are guaranteed to trigger at an I_F value less than or equal to max I_{FT} . Therefore, recommended operating I_F lies between max I_{FT} (2 mA for FOD420 and FOD4208 and 1.3 mA for FOD4216 and FOD4218) and the absolute max I_F (30 mA).

Isolation Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|-----------|--------------------------------|--|--------|-------|------|------|--------------------|
| V_{ISO} | Steady State Isolation Voltage | $f = 60$ Hz, $t = 1$ Minute ⁽⁵⁾ | All | 5,000 | | | VAC _{RMS} |

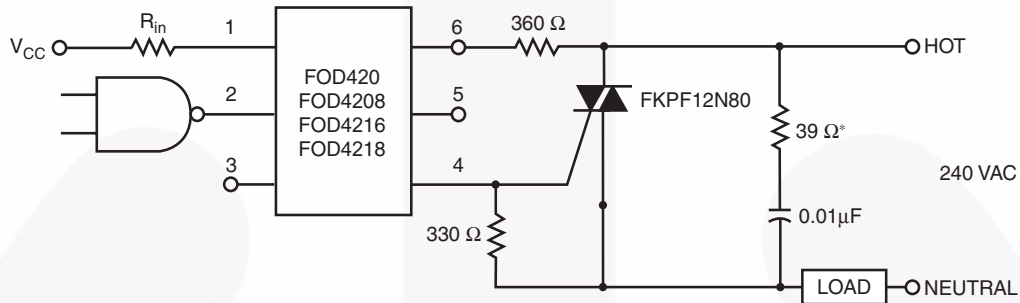
Note:

5. Isolation voltage, V_{ISO} , is an internal device dielectric breakdown rating. For this test, pins 1, 2 and 3 are common, and pins 4, 5 and 6 are common. 5,000 VAC_{RMS} for 1 minute duration is equivalent to 6,000 VAC_{RMS} for 1 second duration.

Typical Application

Figure 3 shows a typical circuit for when hot line switch-ing is required. In this circuit the “hot” side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

R_{in} is calculated so that IF is equal to the rated IFT of the part, 2 mA for FOD420 and FOD4208, 1.3 mA for FOD4216 and FOD4218. The 39 Ω resistor and 0.01 μF capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load use.



* For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

Figure 3. Hot-Line Switching Application Circuit

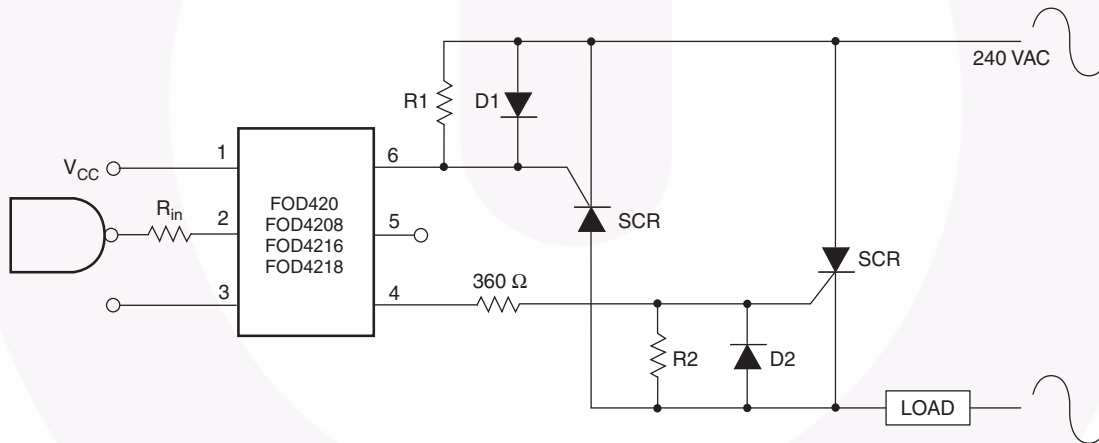


Figure 4. Inverse-Parallel SCR Driver Circuit

Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330 Ω.

Note: This optoisolator should not be used to drive a load directly. It is intended to be a discrete triac driver device only.

Typical Performance Characteristics



Figure 5. Forward Voltage (V_F) vs. Forward Current (I_F)



Figure 6. Normalized LED Trigger Current (I_{FT}) vs. Ambient Temperature (T_A)

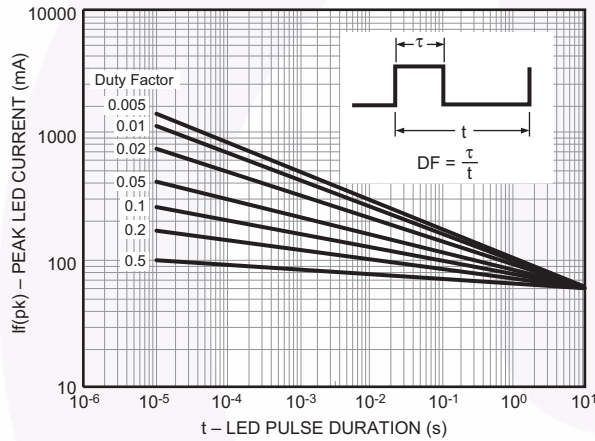


Figure 7. Peak LED Current vs. Duty Factor, Tau



Figure 8. Trigger Delay Time



Figure 9. Pulse Trigger Current



Figure 10. On-State Voltage (V_{TM}) vs. On-State Current (I_{TM})

Typical Performance Characteristics (Continued)



Figure 11. Normalized Holding Current (I_H) vs. Ambient Temperature (T_A)



Figure 12. Normalized Off-State Current (I_{DRM}) vs. Ambient Temperature (T_A)

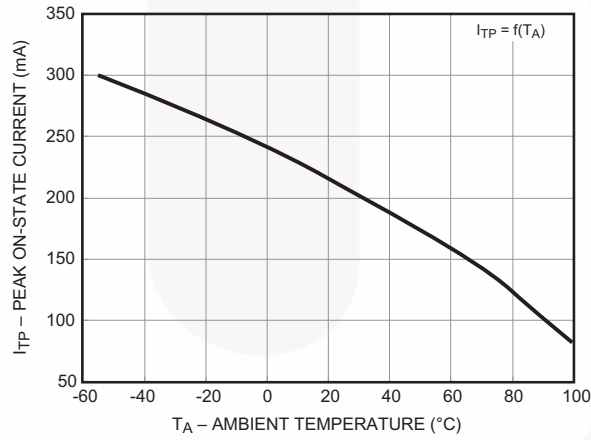


Figure 13. Current Reduction



Figure 14. Circuit for Static $\frac{dv}{dt}$ Measurement of Power Thyristors

Reflow Profile



- Peak reflow temperature: 260°C (package surface temperature)
- Time of temperature higher than 183°C for 160 seconds or less
- One time soldering reflow is recommended

Figure 15. Reflow Profile

Ordering Information

| Part Number | Package | Packing Method |
|-------------|--|----------------------------|
| FOD420 | DIP 6-Pin | Tube (50 Units) |
| FOD420S | SMT 6-Pin (Lead Bend) | Tube (50 Units) |
| FOD420SD | SMT 6-Pin (Lead Bend) | Tape and Reel (1000 Units) |
| FOD420V | DIP 6-Pin, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| FOD420SV | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tube (50 Units) |
| FOD420SDV | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option | Tape and Reel (1000 Units) |
| FOD420TV | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | Tube (50 Units) |

Note:

6. The product orderable part number system listed in this table also applies to the FOD4208, FOD4216, and FOD4218 product families.

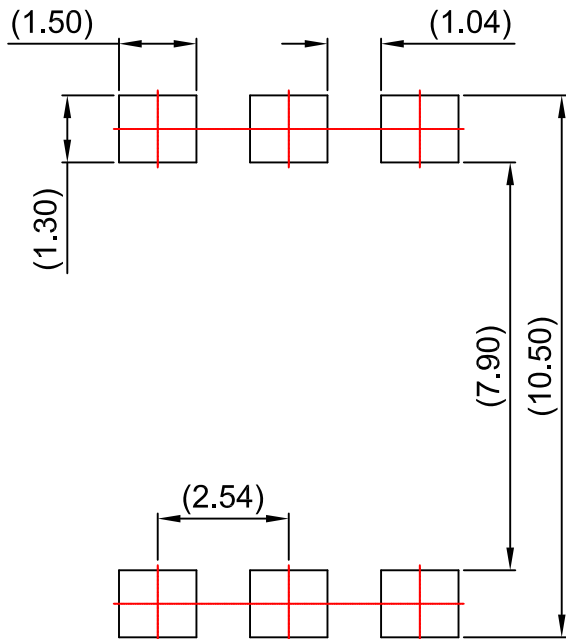
Marking Information



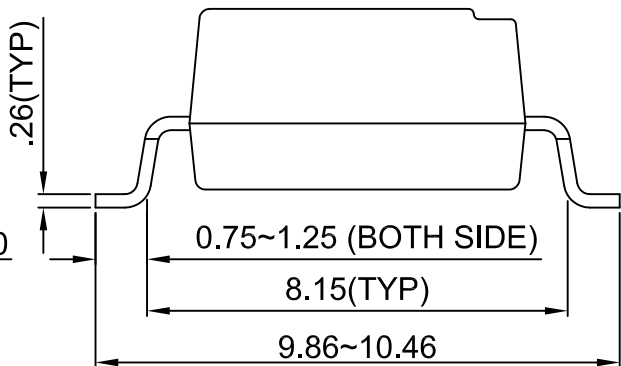
Figure 16. Top Mark

Table 1. Top Mark Definitions

| | |
|---|---|
| 1 | Fairchild Logo |
| 2 | Device Number |
| 3 | VDE mark. DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| 4 | One-Digit Year Code, e.g., "6" |
| 5 | Digit Work Week, Ranging from "01" to "53" |
| 6 | Assembly Package Code |



LAND PATTERN RECOMMENDATION



NOTES:

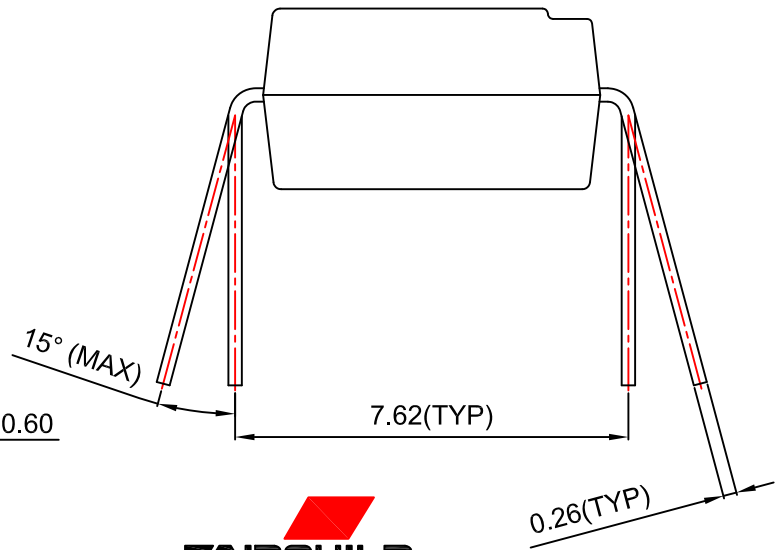
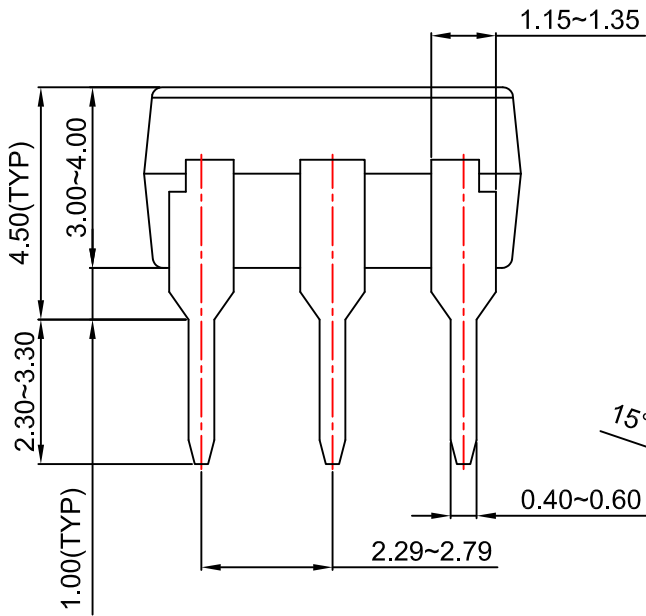
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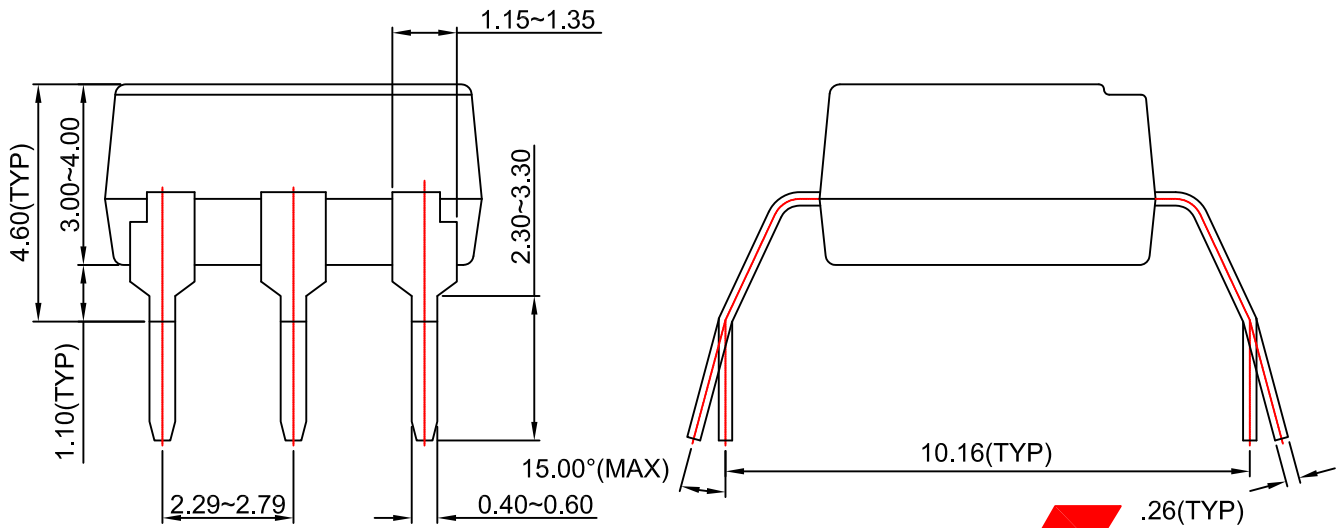
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