# 6-Pin DIP High dv/dt Random Phase Triac Drivers

# FOD420, FOD4208, FOD4216, FOD4218

### 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.

### Features

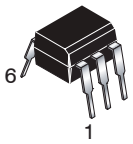
- 300 $mA_{peak}$ On−State Current
- High Blocking Voltage
  - 600 V (FOD420, FOD4216)
  - 800 V (FOD4208, FOD4218)
- High Trigger Sensitivity
  - 1.3 mA (FOD4216, FOD4218)
  - 2 mA (FOD420, FOD4208)
- High Static dv/dt (10,000 V/μs)
- Safety and Regulatory Approvals:
  - UL1577, 5,000 $VAC_{RMS}$ for 1 Minute
  - DIN−EN/IEC60747−5−5
- These Devices are Pb−Free and are RoHS Compliant

### Applications

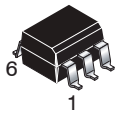
- Solid−State Relays
- Industrial Controls
- Lighting Controls
- Static Power Switches
- AC Motor Starters

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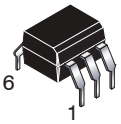
www.onsemi.com




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CASE 709AG

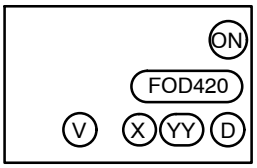



**PDIP6 7.3x6.5, 2.54P**
CASE 646CE



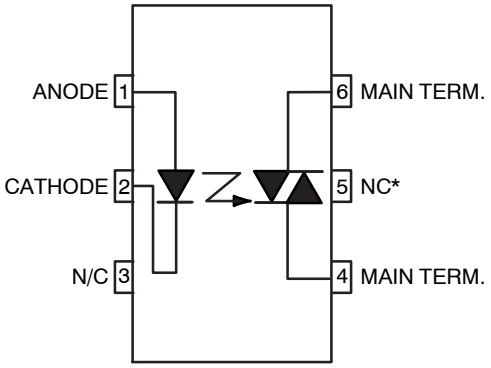

**PDIP6 7.3x6.5, 2.54P**
CASE 646CF

### MARKING DIAGRAM




| | |
|---|---|
| ON | = ON Semiconductor Logo |
| FOD420 | = Device Number |
| V | = VDE mark. DIN EN/IEC60747−5−5 Option (only appears on component ordered with this option) |
| X | = One−Digit Year Code |
| YY | = Digit Work Week |
| D | = Assembly Package Code |

### FUNCTIONAL SCHEMATIC




*DO NOT CONNECT
(TRIAC SUBSTRATE)

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

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## SAFETY AND INSULATION RATINGS

| 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 |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥0.4 | mm |
| $T_S$ | Case Temperature (Note 1) | 175 | °C |
| $I_{S,INPUT}$ | Input Current (Note 1) | 400 | mA |
| $P_{S,OUTPUT}$ | Output Power (Note 1) | 700 | mW |
| $R_{IO}$ | Insulation Resistance at $T_S$, $V_{IO}$ = 500 V (Note 1) | $>10^9$ | Ω |

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.

1. Safety limit values − maximum values allowed in the event of a failure.

**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C, unless otherwise specified)

| Symbol | Parameter | Device | Value | Unit |
|---|---|---|---|---|
| $T_{STG}$ | Storage Temperature | All | −55 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | All | −55 to +100 | °C |
| $T_J$ | Junction Temperature | All | −55 to +125 | °C |
| $T_{SOL}$ | Lead Solder Temperature | All | 260 for 10 sec | °C |
| $P_{D(TOTAL)}$ | Total Device Power Dissipation @ 25°C | All | 500 | mW |
| | Derate Above 25°C | All | 6.6 | mW/°C |
| **EMITTER** | | | | |
| $I_F$ | Continuous Forward Current | All | 30 | mA |
| $V_R$ | Reverse Voltage | All | 6 | V |
| $P_{D(EMITTER)}$ | Total Power Dissipation 25°C Ambient | All | 50 | mW |
| | Derate Above 25°C | All | 0.71 | mW/°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 | $A_{peak}$ |
| $I_{TM}$ | Peak On−State Current | All | 300 | $mA_{peak}$ |
| $P_{D(DETECTOR)}$ | Total Power Dissipation @ 25°C Ambient | All | 450 | mW |
| $P_{D(DETECTOR)}$ | Derate Above 25°C | All | 5.9 | mW/°C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise specified)

| Symbol | Parameter | Test Condition | | Device | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| **INDIVIDUAL COMPONENT CHARACTERISTICS** | | | | | | | | |
| **Emitter** | | | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = 20 mA | | All | – | 1.28 | 1.50 | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 6 V | | All | – | 0.01 | 10 | μA |
| **Detector** | | | | | | | | |
| $I_{D(RMS)}$ | Peak Blocking Current, Either Direction | $I_F$ = 0, $T_A$ = 100°C (Note 2) | $V_D$ = 600 V | FOD420, FOD4216 | – | 3 | 100 | μA |
| | | | $V_D$ = 800 V | FOD4208, FOD4218 | | | | |
| $I_{R(RMS)}$ | Reverse Current | $T_A$ = 100°C | $V_D$ = 600 V | FOD420, FOD4216 | – | 3 | 100 | μA |
| | | | $V_D$ = 800 V | FOD4208, FOD4218 | | | | |
| dv/dt | Critical Rate of Rise of Off−State Voltage | $I_F$ = 0 A (Note 3) | $V_D$ = $V_{DRM}$ | All | 10,000 | – | – | V/μs |
| **TRANSFER CHARACTERISTICS** | | | | | | | | |
| $I_{FT}$ | LED Trigger Current | Main Terminal Voltage = 5 V (Note 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, $I_F$ = 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 |
| $dv_{(IO)}/dt$ | Critical Rate of Rise of Coupled Input / Output Voltage | $I_T$ = 0 A, $V_{RM}$ = $V_{DM}$ = 424 VAC | | All | 10,000 | – | – | V/μs |
| **ISOLATION CHARACTERISTICS** | | | | | | | | |
| $V_{ISO}$ | Steady State Isolation Voltage | f = 60 Hz, t = 1 Minute (Note 5) | | All | 5,000 | – | – | $VAC_{RMS}$ |

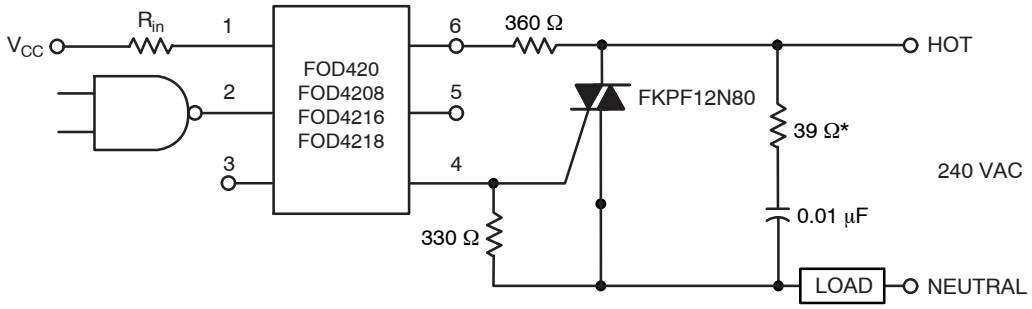
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt.. Commutating dv/dt is a function of the load−driving thyristor(s) only.
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).
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 1 shows a typical circuit for when hot line switching 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.

Rin 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 Ω.

**Figure 1. Hot−Line Switching Application Circuit**

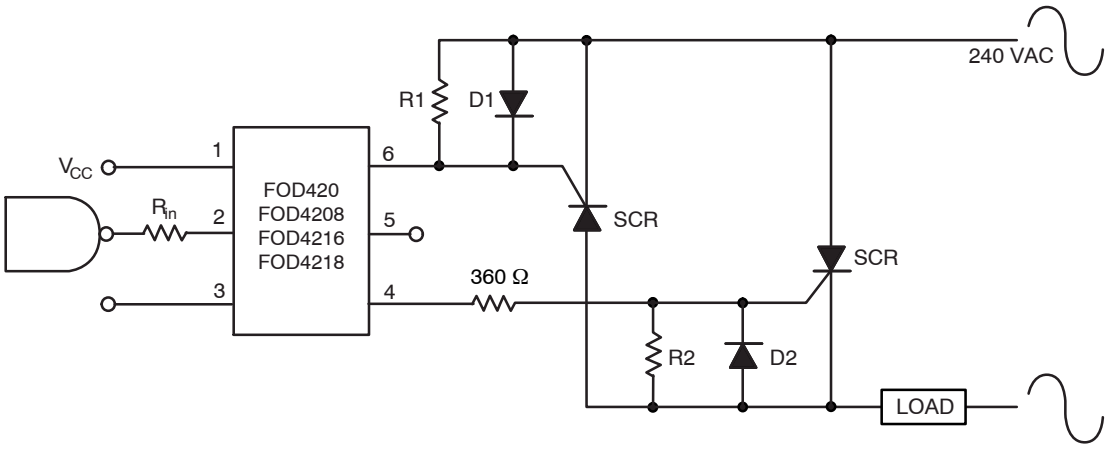



**Figure 2. Inverse−Parallel SCR Driver Circuit**

Suggested method of firing two, back−to−back SCR’s with On Semiconductor 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 CHARACTERISTICS

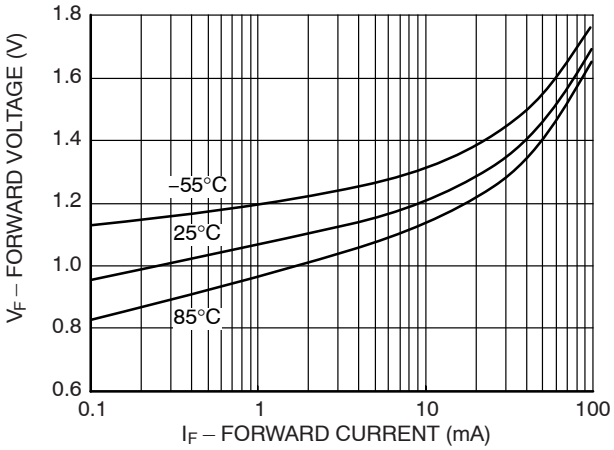



**Figure 3. Forward Voltage ($V_F$) vs. Forward Current ($I_F$)**

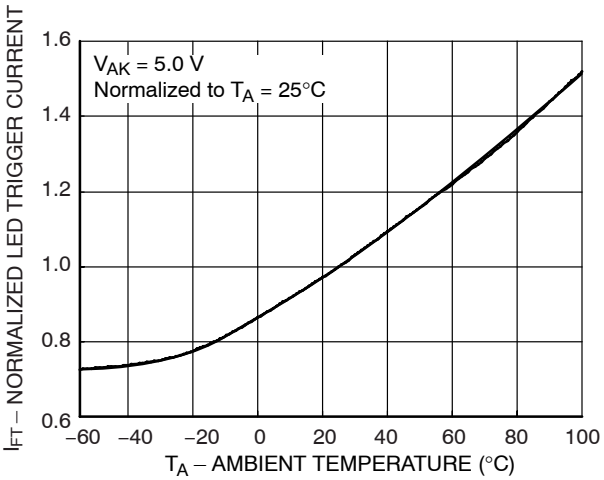



**Figure 4. Normalized LED Trigger Current ($I_{FT}$) vs. Ambient Temperature ($T_A$)**

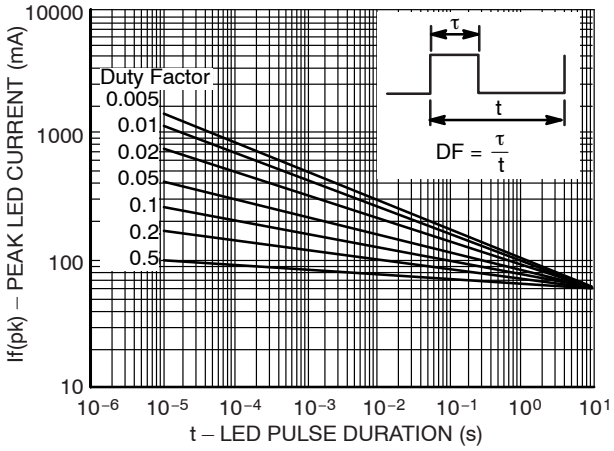



**Figure 5. Peak LED Current vs. Duty Factor, Tau**

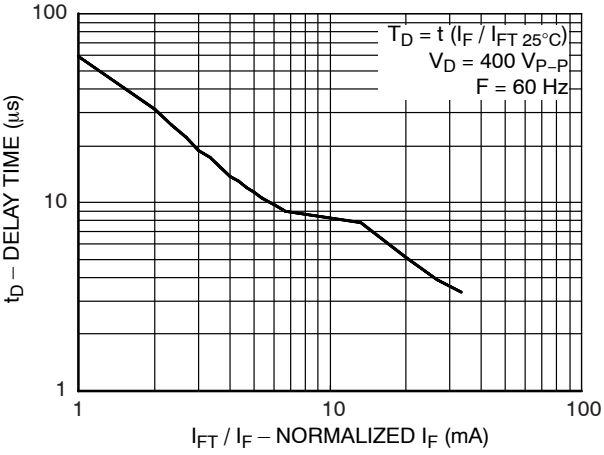



**Figure 6. Trigger Delay Time**

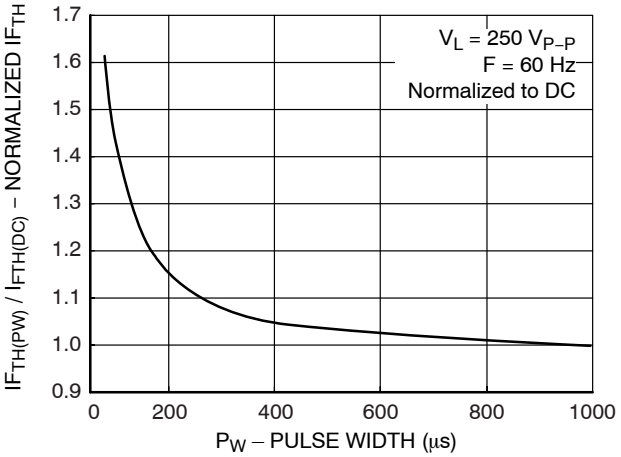



**Figure 7. Pulse Trigger Current**

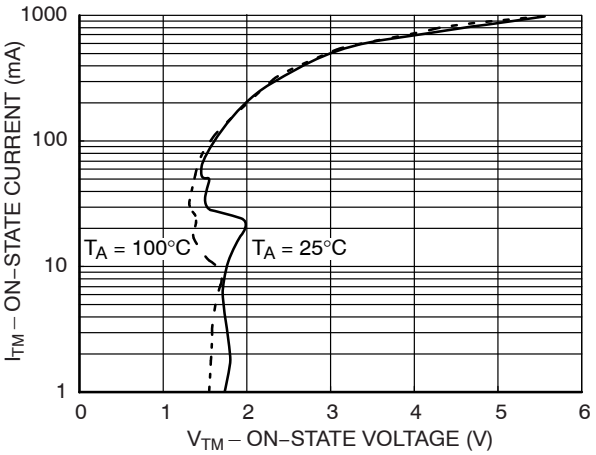



**Figure 8. On−State Voltage ($V_{TM}$) vs. On−State Current ($I_{TM}$)**

## TYPICAL CHARACTERISTICS (continued)

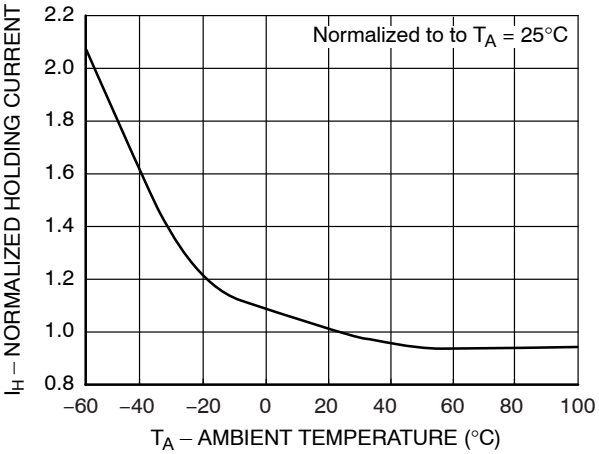



**Figure 9. Normalized Holding Current ($I_H$) vs. Ambient Temperature ($T_A$)**

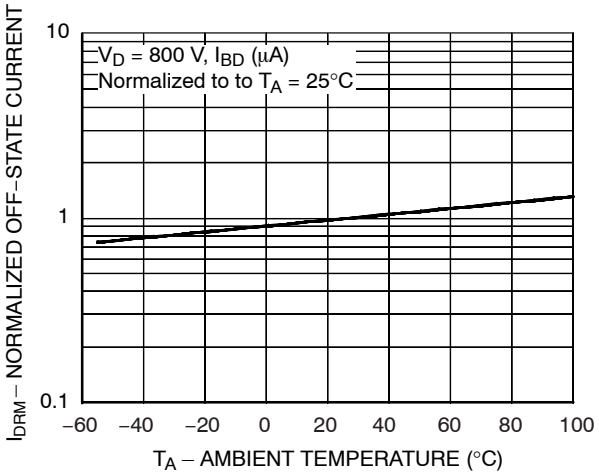



**Figure 10. Normalized Off−State Current (IDRM) vs. Ambient Temperature ($T_A$)**

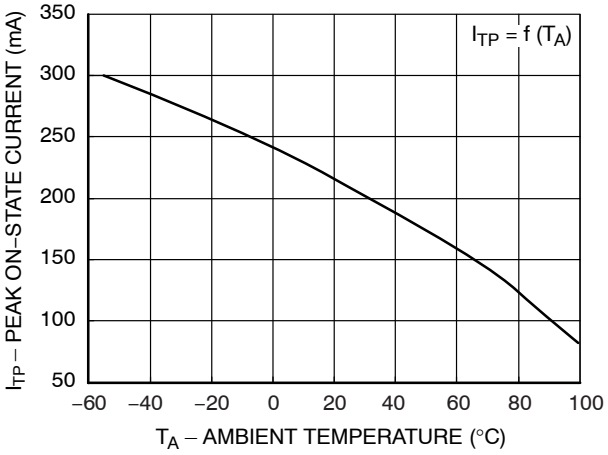
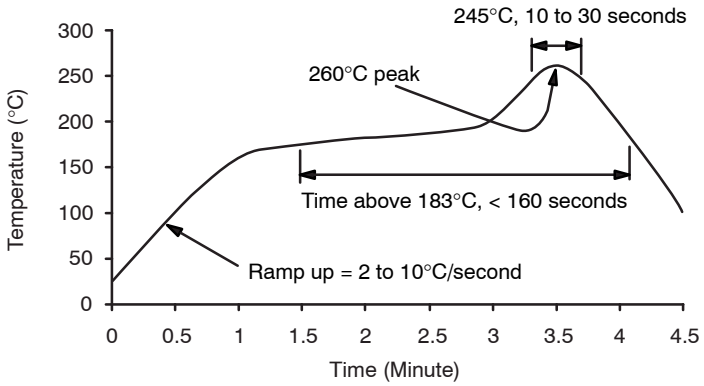



**Figure 11. Current Reduction**

## REFLOW PROFILE




- Peak reflow temperature: 262°C (package surface temperature)
- Time of temperature higher than 183°C for 160 seconds or less
- One time soldering reflow is recommended

**Figure 12. Reflow Profile**

## ORDERING INFORMATION

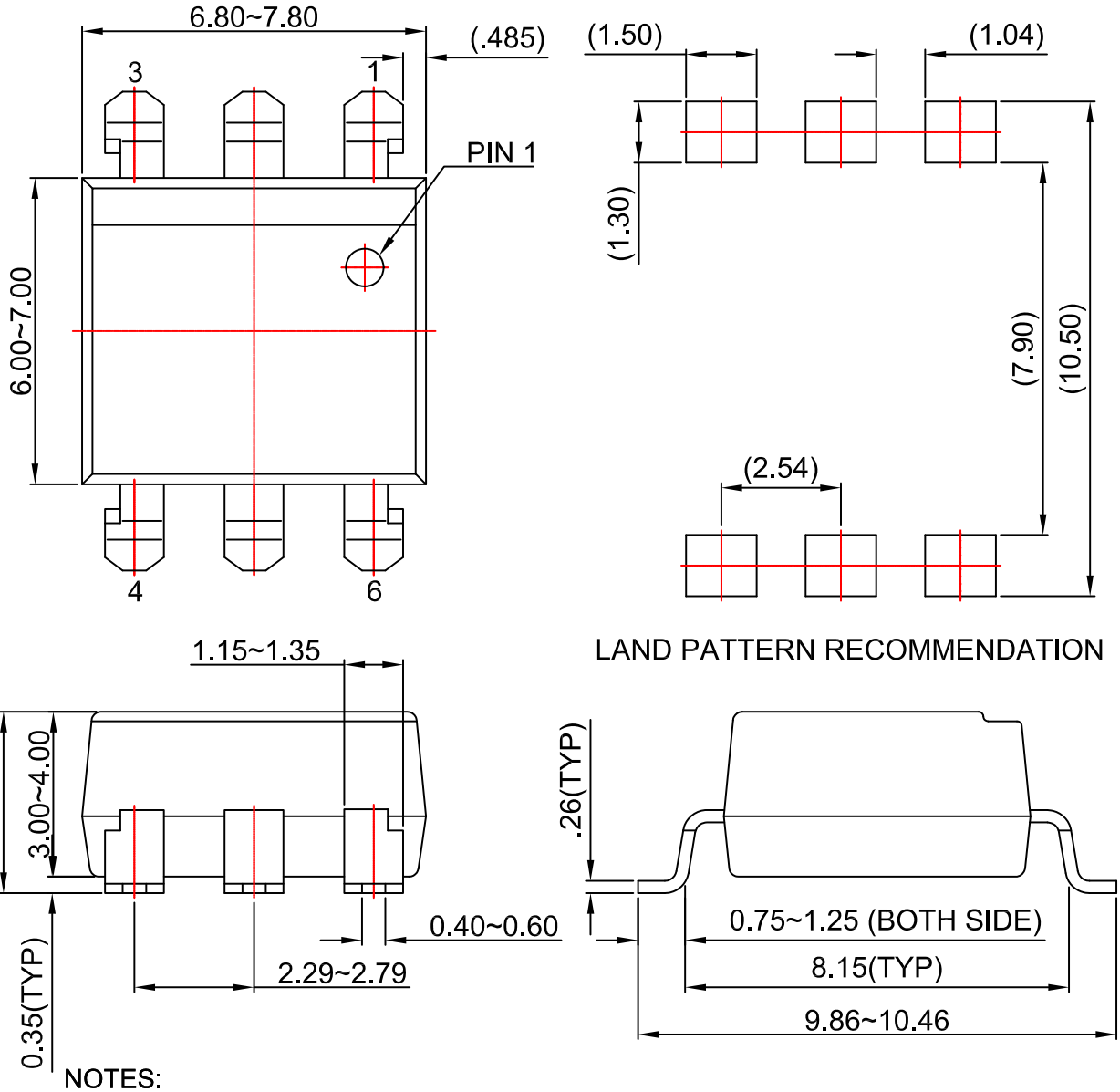
| Part Number | Package | Shipping† |
|---|---|---|
| FOD420 | DIP 6−Pin | 50 Units / Tube |
| FOD420S | SMT 6−Pin (Lead Bend) | 50 Units / Tube |
| FOD420SD | SMT 6−Pin (Lead Bend) | 1000 / Tape & Reel |
| FOD420V | DIP 6−Pin, DIN EN/IEC60747−5−5 Option | 50 Units / Tube |
| FOD420SV | SMT 6−Pin (Lead Bend), DIN EN/IEC60747−5−5 Option | 50 Units / Tube |
| FOD420SDV | SMT 6−Pin (Lead Bend), DIN EN/IEC60747−5−5 Option | 1000 / Tape & Reel |
| FOD420TV | DIP 6−Pin, 0.4” Lead Spacing, DIN EN/IEC60747−5−5 Option | 50 Units / Tube |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

6. The product orderable part number system listed in this table also applies to the FOD4208, FOD4216, and FOD4218product families.

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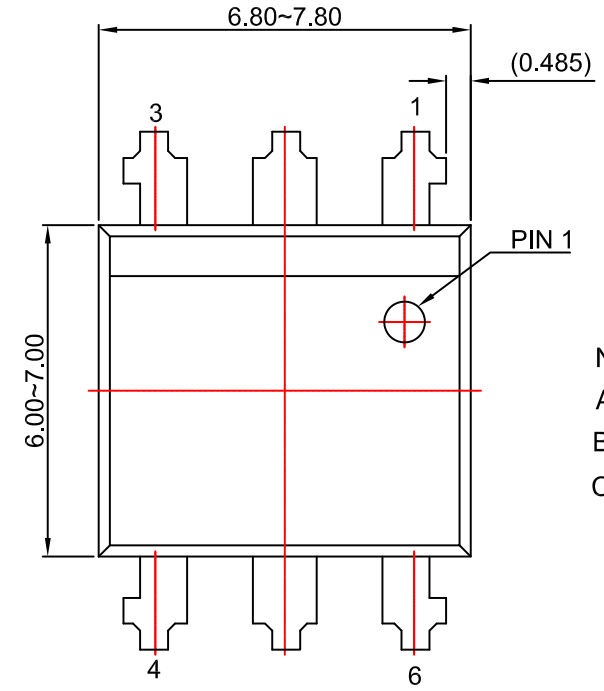
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# MECHANICAL CASE OUTLINE
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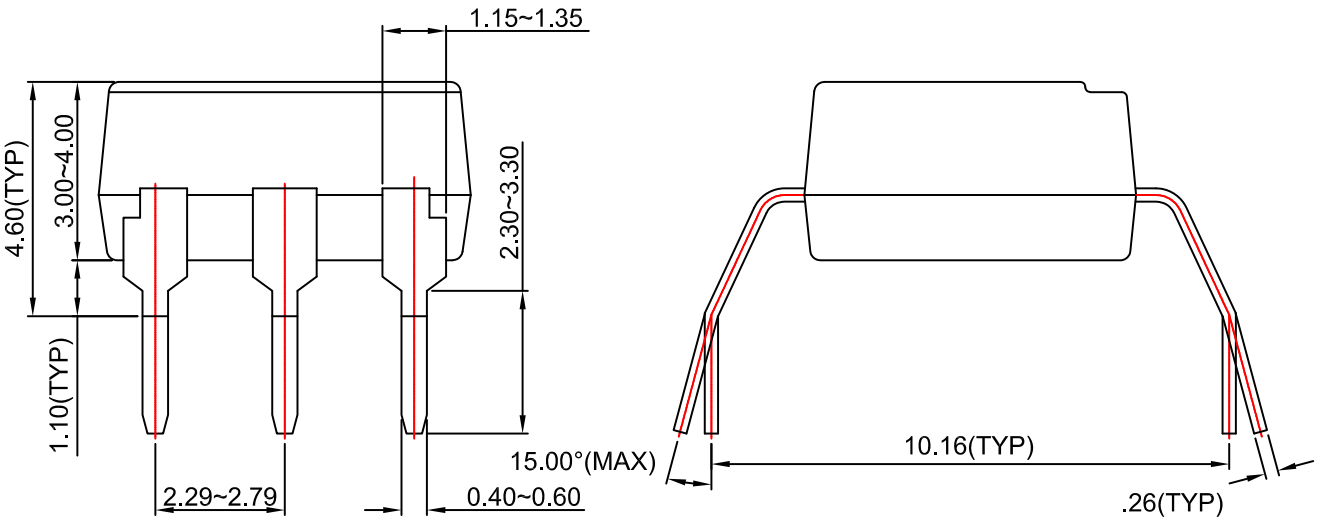



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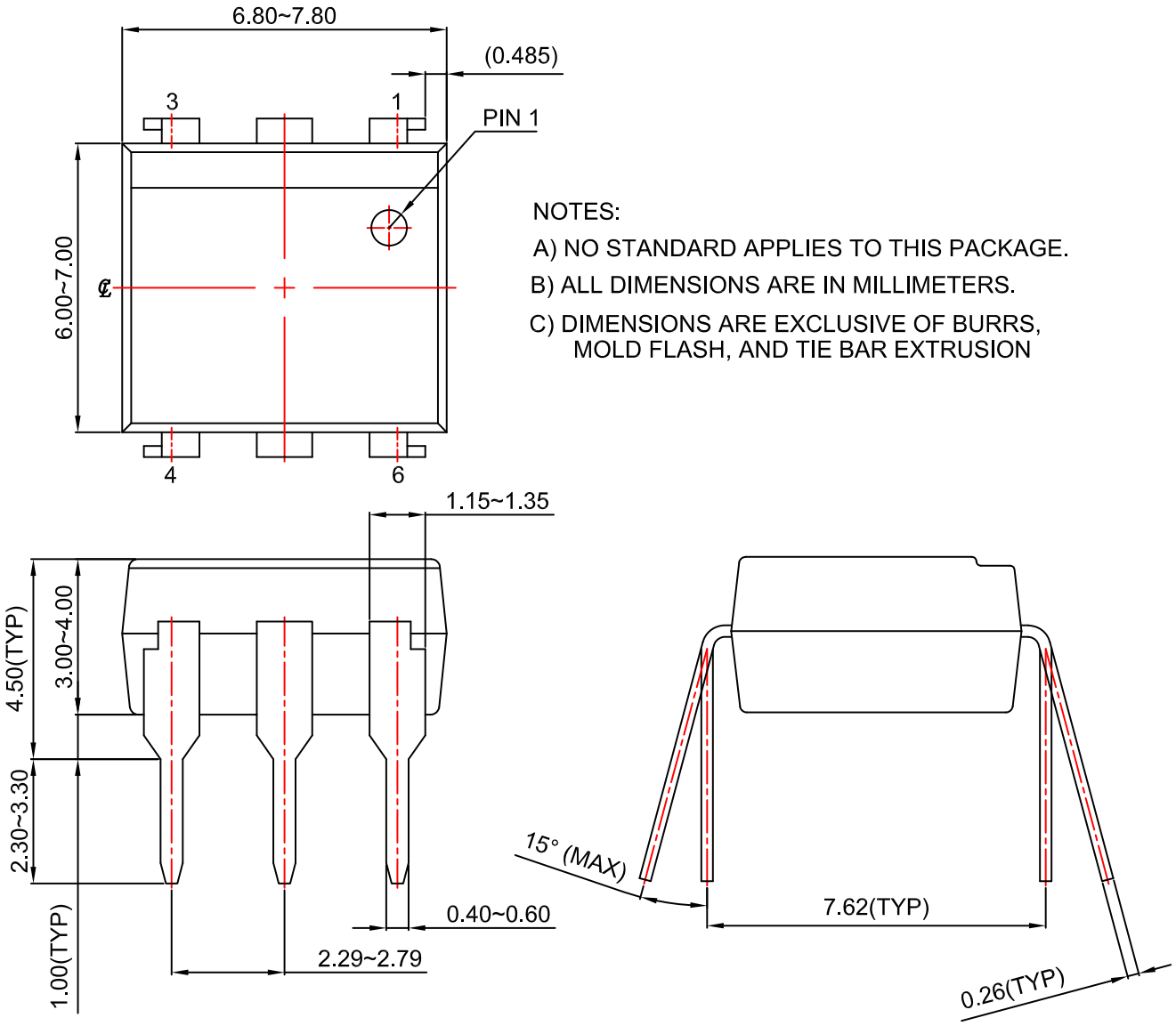
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