

## FOD420, FOD4208, FOD4216, FOD4218 6-Pin DIP Triac Drivers

### Features

- 300mA on-state current
- High blocking voltage
  - 800V (FOD4208, FOD4218)
  - 600V (FOD420, FOD4216)
- High trigger sensitivity
  - 1.3mA (FOD4216, FOD4218)
  - 2mA (FOD420, FOD4208)
- High static dv/dt (10,000V/μs)
- 6 pin DIP dual in-line package
  - available with surface mount leadform.
- Lead free assembly
- UL, VDE, FIMKO and C-UL approved

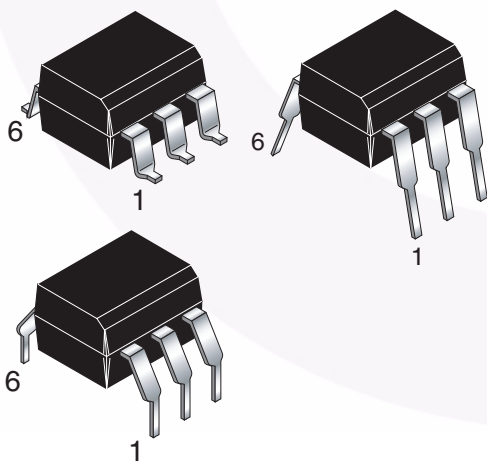
### Applications

- Solid-state relays
- Industrial controls
- Lighting controls
- Static power switches
- AC motor starters

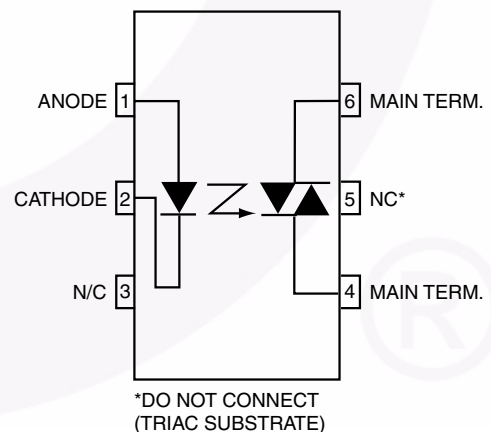
### Description

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.

### Package



### Schematic



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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  | Device           | Value          | Units                |
|---------------------|---|------------------|----------------|----------------------|
| <b>TOTAL DEVICE</b> |   |                  |                |                      |
| $T_{STG}$           | Storage Temperature   | All              | -55 to +150    | $^\circ\text{C}$     |
| $T_{OPR}$           | Operating Temperature   | All              | -55 to +100    | $^\circ\text{C}$     |
| $T_{SOL}$           | Lead Solder Temperature (Wave)  | All              | 260 for 10 sec | $^\circ\text{C}$     |
| $T_J$               | Junction Temperature Range  | All              | 125            | $^\circ\text{C}$     |
| $V_{ISO}$           | Isolation Test Voltage <sup>(1)</sup><br>(rms AC voltage, 60Hz, 1 min. duration)          | All              | 5000           | Vac(rms)             |
| $P_{DTOTAL}$        | Total Device Power Dissipation @ 25 $^\circ\text{C}$<br>Derate above 40 $^\circ\text{C}$  | All              | 500            | mW                   |
|                     |   |                  | 6.6            | mW/ $^\circ\text{C}$ |
| <b>EMITTER</b>      |   |                  |                |                      |
| $I_F$               | Continuous Forward Current  | All              | 30             | mA                   |
| $V_R$               | Reverse Voltage   | All              | 6              | V                    |
| $P_{DE}$            | Total Power Dissipation 25 $^\circ\text{C}$ Ambient<br>Derate above 40 $^\circ\text{C}$   | All              | 50             | mW                   |
|                     |   |                  | 0.71           | mW/ $^\circ\text{C}$ |
| <b>DETECTOR</b>     |   |                  |                |                      |
| $V_{DRM}$           | Off-State Output Terminal Voltage   | FOD420, FOD4216  | 600            | V                    |
|                     |   | FOD4208, FOD4218 | 800            |                      |
| $I_{TSM}$           | Peak Non-Repetitive Surge Current<br>(single cycle 60Hz sine wave)                        | All              | 3              | A                    |
| $I_{TM}$            | Peak On-State Current   | All              | 300            | mA                   |
| $P_{DDET}$          | Total Power Dissipation @ 25 $^\circ\text{C}$ Ambient<br>Derate above 40 $^\circ\text{C}$ | All              | 450            | mW                   |
|                     |   |                  | 5.9            | mW/ $^\circ\text{C}$ |

**Note:**

1. 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 VRMS for 1 minute duration is equivalent to 6,000 VRMS for 1 second duration.

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified)

**Individual Component Characteristics**

| Symbol          | Parameters                                 | Test Conditions                               | Device              | Min.                | Typ.* | Max | Units            |
|-----------------|--|---|---------------------|---------------------|-------|-----|------------------|
| <b>EMITTER</b>  |  |   |                     |                     |       |     |                  |
| $V_F$           | Input Forward Voltage                      | $I_F = 20\text{mA}$                           | All                 |                     | 1.28  | 1.5 | V                |
| $I_R$           | Reverse Leakage Current                    | $V_R = 6\text{V}$                             | All                 |                     | 0.01  | 10  | $\mu\text{A}$    |
| <b>DETECTOR</b> |  |   |                     |                     |       |     |                  |
| $I_{DRM}$       | Peak Blocking Current, Either Direction    | $I_F = 0,$<br>$T_A = 100^\circ\text{C}^{(2)}$ | $V_D = 800\text{V}$ | FOD4208,<br>FOD4218 | 3     | 100 | $\mu\text{A}$    |
|                 |  |   | $V_D = 600\text{V}$ | FOD420,<br>FOD4216  |       |     |                  |
| $I_{R(RMS)}$    | Reverse Current                            | $T_A = 100^\circ\text{C}$                     | $V_D = 800\text{V}$ | FOD4208,<br>FOD4218 | 3     | 100 | $\mu\text{A}$    |
|                 |  |   | $V_D = 600\text{V}$ | FOD420,<br>FOD4216  |       |     |                  |
| dv/dt           | Critical Rate of Rise of Off-State Voltage | $I_F = 0^{(4)}$ (Fig. 11)                     |                     | 10,000              |       |     | V/ $\mu\text{s}$ |

**Transfer Characteristics**

| Symbol               | DC Characteristics                                      | Test Conditions  | Device                             | Min.                           | Typ.*  | Max. | Units            |
|----------------------|---|--|------------------------------------|--------------------------------|--------|------|------------------|
| $I_{FT}$             | LED Trigger Current                                     | Main Terminal Voltage = $5\text{V}^{(3)}$                  | FOD420,<br>FOD4208                 |                                | 0.75   | 2.0  | mA               |
|                      |   |  | FOD4216,<br>FOD4218                |                                | 0.75   | 1.3  |                  |
| $V_{TM}$             | Peak On-State Voltage, Either Direction                 | $I_{TM} = 300\text{ mA peak}, I_F = \text{rated } I_{FT}$  | All                                |                                | 2.2    | 3    | V                |
| $I_H$                | Holding Current, Either Direction                       | $V_T = 3\text{V}$  | All                                |                                | 200    | 500  | $\mu\text{A}$    |
| $I_L$                | Latching Current  | $V_T = 2.2\text{V}$  | All                                |                                | 5      |      | mA               |
| $t_{ON}$             | Turn-On Time  | PF = 1.0,<br>$I_T = 300\text{mA}$                          | $V_{RM} = V_{DM} = 565\text{ VAC}$ | FOD4208                        |        | 60   | $\mu\text{s}$    |
|                      |   |  | $V_{RM} = V_{DM} = 424\text{ VAC}$ | FOD420,<br>FOD4216,<br>FOD4218 |        |      |                  |
| $t_{OFF}$            | Turn-Off Time   |  | $V_{RM} = V_{DM} = 565\text{ VAC}$ | FOD4208                        |        | 52   | $\mu\text{s}$    |
|                      |   |  | $V_{RM} = V_{DM} = 424\text{ VAC}$ | FOD420,<br>FOD4216,<br>FOD4218 |        |      |                  |
| dv/dt <sub>crq</sub> | Critical Rate of Rise of Voltage at Current Commutation | $V_D = 0.67 V_{DRM},$<br>$di/dt_{crq} \leq 15\text{ A/ms}$ | $T_j = 25^\circ\text{C}$           | All                            | 10,000 |      | V/ $\mu\text{s}$ |
|                      |   |  | $T_j = 80^\circ\text{C}$           |                                | 5,000  |      |                  |
| di/dt <sub>cr</sub>  | Critical Rate of Rise of On-State Current               |  | All                                |                                |        | 8    | A/ $\mu\text{s}$ |
| dV(IO)/dt            | Critical Rate of Rise of Coupled Input/Output Voltage   | $I_T = 0\text{A},$<br>$V_{RM} = V_{DM} = 424\text{VAC}$    | All                                |                                | 10,000 |      | V/ $\mu\text{s}$ |

**Isolation Characteristics**

| Symbol    | Characteristics                | Test Conditions                     | Min. | Typ.* | Max. | Units    |
|-----------|--------------------------------|-------------------------------------|------|-------|------|----------|
| $V_{ISO}$ | Input-Output Isolation Voltage | f = 60Hz, t = 1 min. <sup>(5)</sup> | 5000 |       |      | Vac(rms) |

\*Typical values at  $T_A = 25^\circ\text{C}$

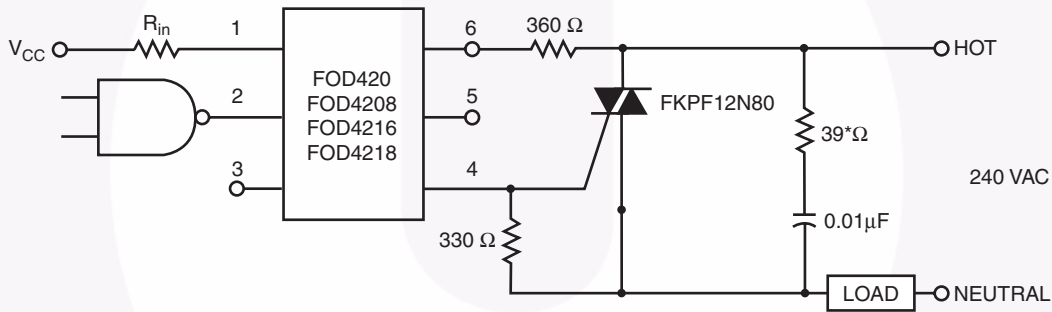
**Notes:**

2. Test voltage must be applied within dv/dt rating.
3. 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  $I_{FT}$  (2mA for FOD420 and FOD4208 and 1.3mA for FOD4216 and FOD4218 and the absolute max  $I_F$  (30mA).
4. This is static dv/dt. See Figure 11 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.
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.

**Typical Application**

Typical circuit for use 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.

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

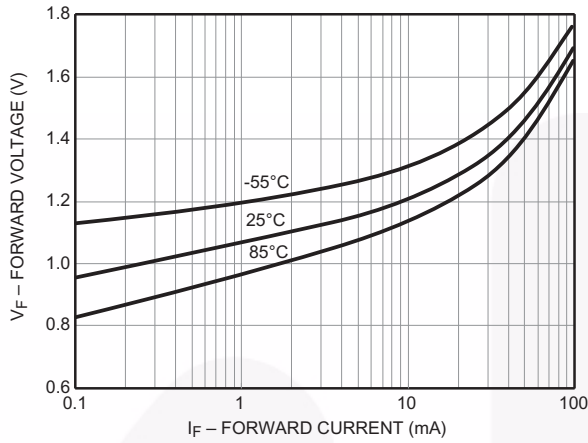


\* For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

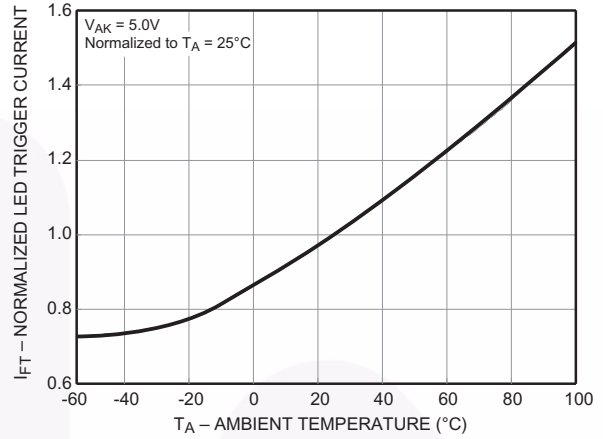
**Figure 1. Hot-Line Switching Application Circuit**

## Typical Performance Curves

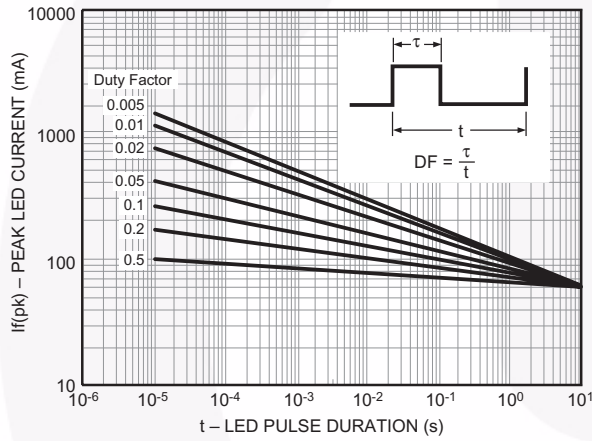
**Figure 2. Forward Voltage ( $V_F$ ) vs. Forward Current ( $I_F$ )**



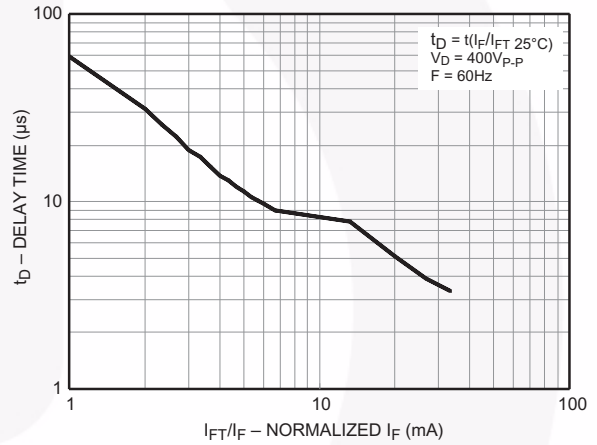
**Figure 3. Normalized LED Trigger Current ( $I_{FT}$ ) vs. Ambient Temperature ( $T_A$ )**



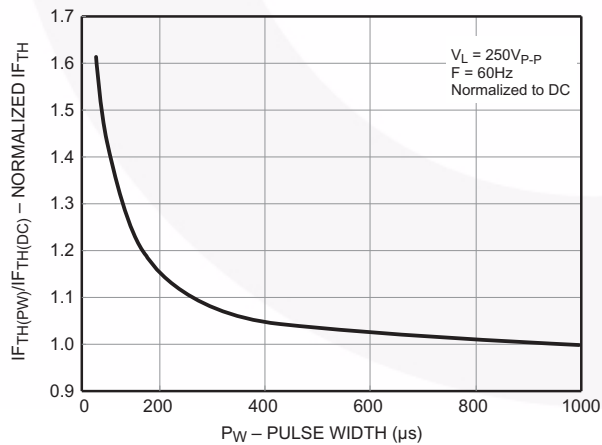
**Figure 4. Peak LED Current vs. Duty Factor, Tau**



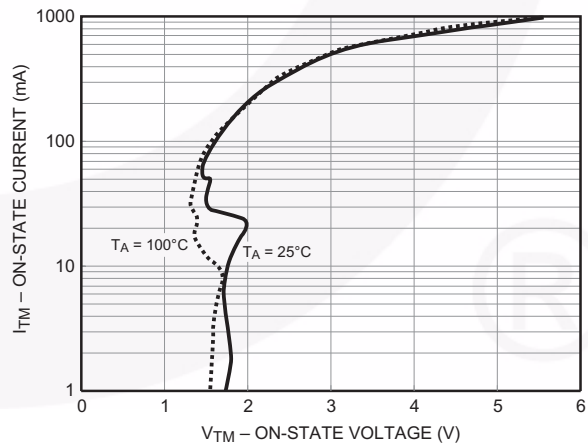
**Figure 5. Trigger Delay Time**



**Figure 6. Pulse Trigger Current**



**Figure 7. On-State Voltage ( $V_{TM}$ ) vs. On-State Current ( $I_{TM}$ )**



Typical Performance Curves (Continued)

Figure 8. Normalized Holding Current ( $I_H$ ) vs. Ambient Temperature ( $T_A$ )

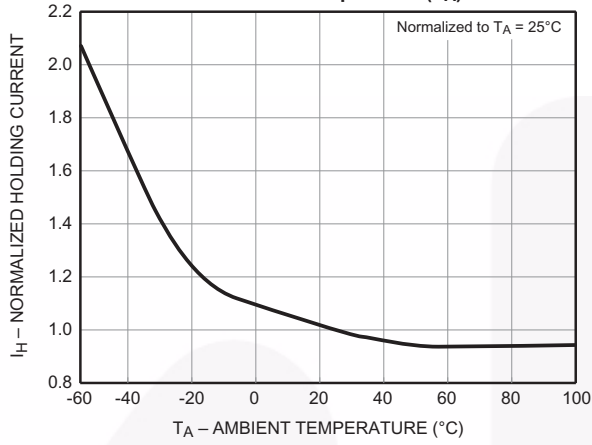


Figure 9. Normalized Off-State Current ( $I_{DRM}$ ) vs. Ambient Temperature ( $T_A$ )

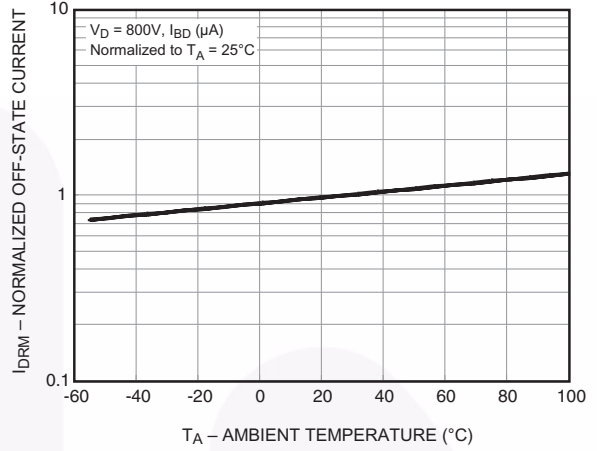
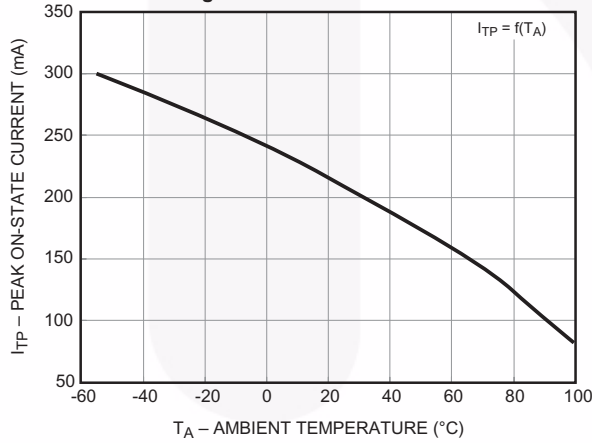
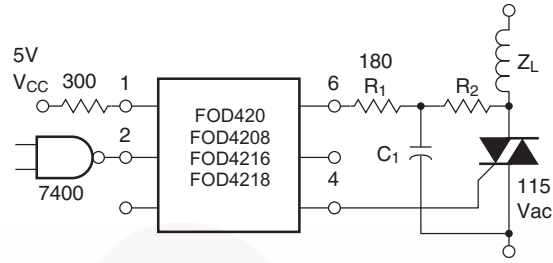


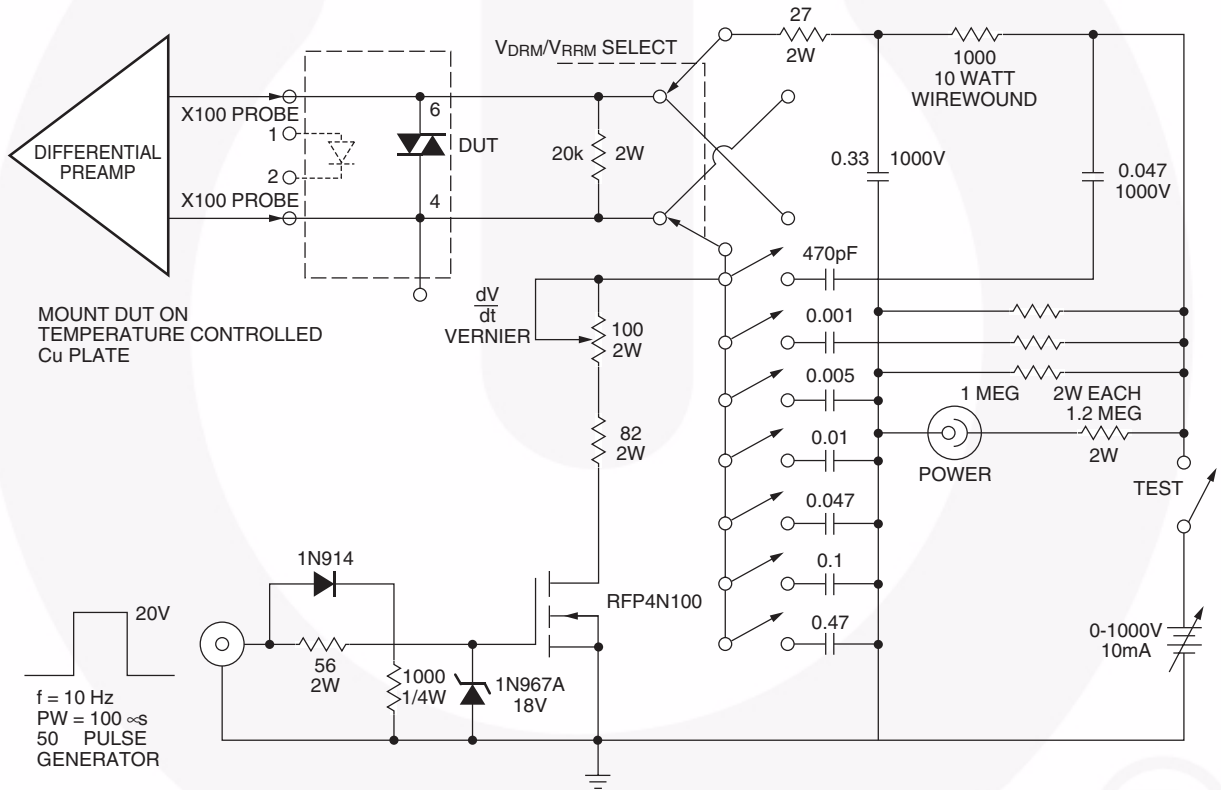
Figure 10. Current Reduction





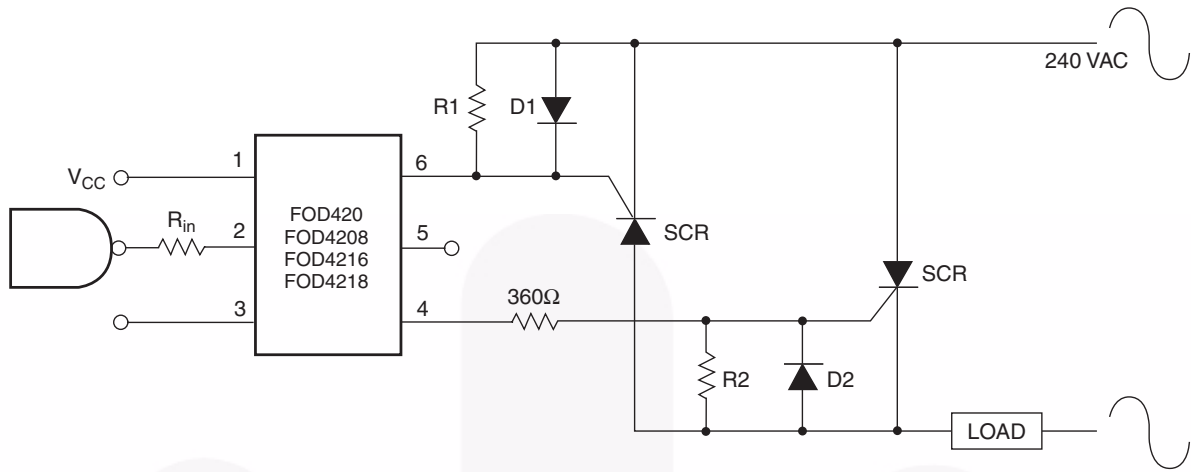
NOTE: Circuit supplies 25mA drive to gate of triac at  $V_{in} = 25V$  and  $T_A < 70^\circ C$

| TRIAC    |       |     |
|----------|-------|-----|
| $I_{GT}$ | $R_2$ | C   |
| 15 mA    | 2400  | 0.1 |
| 30 mA    | 1200  | 0.2 |
| 50 mA    | 800   | 0.3 |



ALL COMPONENTS ARE NON-INDUCTIVE UNLESS SHOWN

Figure 11. Circuit for Static  $\frac{dv}{dt}$  Measurement of Power Thyristors



**Figure 12. Inverse-Parallel SCR Driver Circuit**

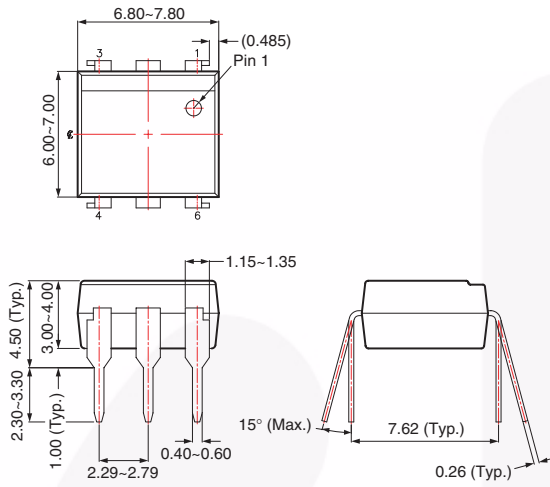
Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330Ω.

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

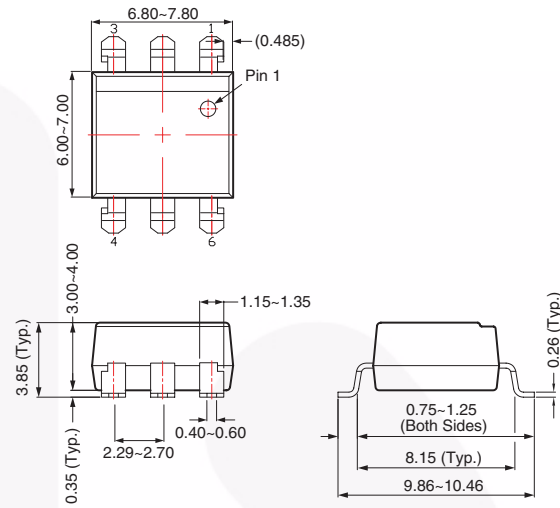


## Package Dimensions

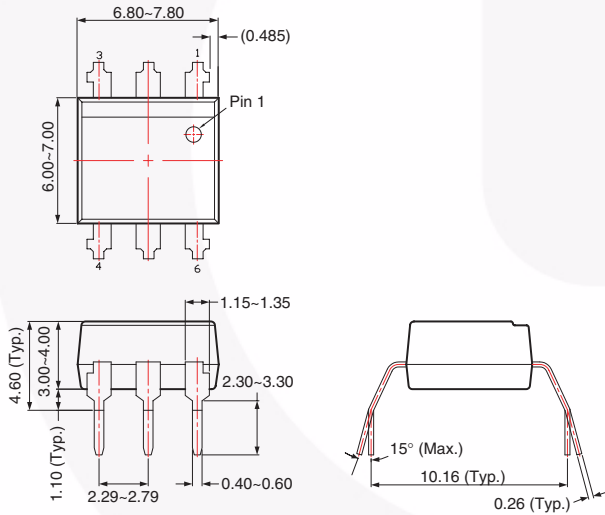
### Through Hole



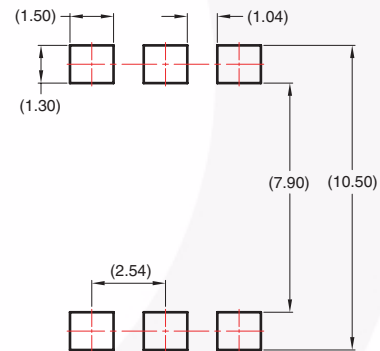
### Surface Mount



### 0.4" Lead Spacing



### Recommended Pad Layout for Surface Mount Leadforms



**Note:**

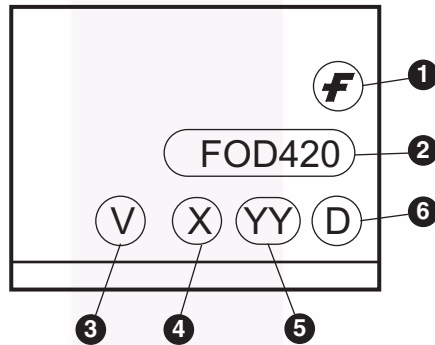
All dimensions are in millimeters.



### Ordering Information

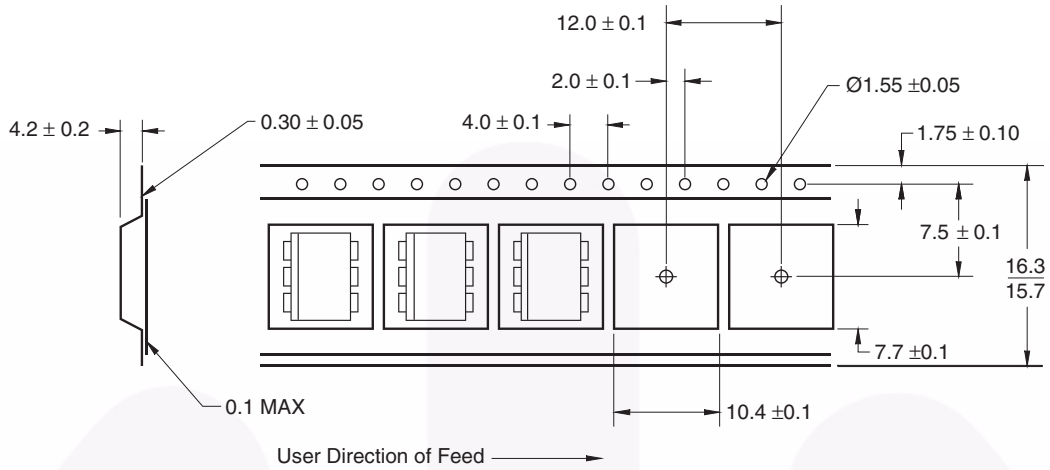
| Option | Order Entry Identifier (example) | Description  |
|--------|----------------------------------|--|
| None   | FOD420                           | Standard Through Hole Device                           |
| S      | FOD420S                          | Surface Mount Lead Bend                                |
| SD     | FOD420SD                         | Surface Mount; Tape and reel                           |
| T      | FOD420T                          | 0.4" Lead Spacing                                      |
| V      | FOD420V                          | IEC60747-5-2 certification                             |
| TV     | FOD420TV                         | IEC60747-5-2 certification, 0.4" Lead Spacing          |
| SV     | FOD420SV                         | IEC60747-5-2 certification, Surface Mount              |
| SDV    | FOD420SDV                        | IEC60747-5-2 certification, Surface Mount, Tape & Reel |

### Marking Information



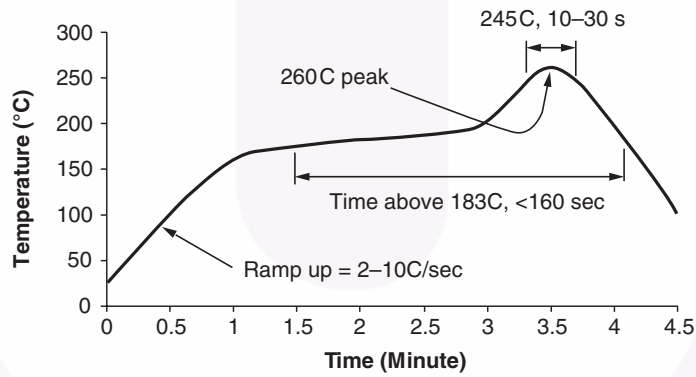
| Definitions |   |
|-------------|---|
| 1           | Fairchild logo  |
| 2           | Device number   |
| 3           | VDE mark indicates IEC60747-5-2 certified (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | One digit year code, e.g., '7'  |
| 5           | Two digit work week ranging from '01' to '53'   |
| 6           | Assembly package code   |

### Carrier Tape Specifications



**Note:**  
All dimensions are in inches (millimeters).

### Reflow Profile






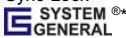


- Peak reflow temperature:  $260\text{C}$  (package surface temperature)
- Time of temperature higher than  $183\text{C}$  for 160 seconds or less
- One time soldering reflow is recommended



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**Definition of Terms**

| Datasheet Identification | Product Status        | Definition  |
|--------------------------|-----------------------|---|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.   |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.   |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.  |

Rev. 140



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