

## FOD410, FOD4108, FOD4116, FOD4118 6-Pin DIP Zero-Cross Triac Drivers

### Features

- 300mA on-state current
- Zero-voltage crossing
- High blocking voltage
  - 800V (FOD4108, FOD4118)
  - 600V (FOD410, FOD4116)
- High trigger sensitivity
  - 1.3mA (FOD4116, FOD4118)
  - 2mA (FOD410, FOD4108)
- High static dv/dt (10,000V/μs)
- UL, VDE, CSA approved
- Lead free assembly

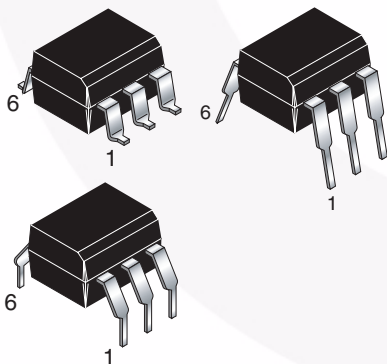
### Applications

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

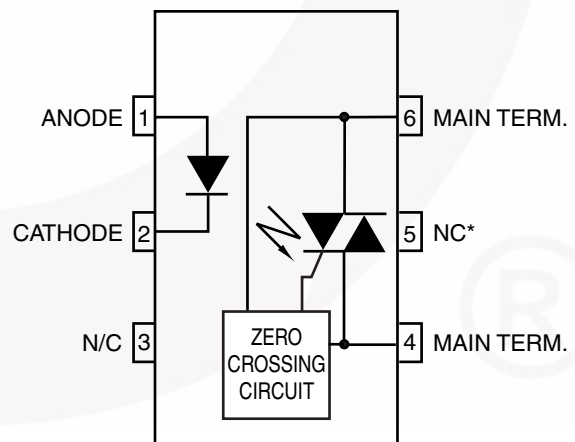
### Description

The FOD410, FOD4108, FOD4116 and FOD4118 devices consist of an infrared emitting diode coupled to a hybrid triac formed with two inverse parallel SCRs which form the triac function capable of driving discrete triacs. The FOD4116 and FOD4118 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



\*DO NOT CONNECT  
(TRIAC SUBSTRATE)

**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> (rms AC voltage, 60Hz, 1 min. duration)	All	5000	Vac(rms)
$P_{DTOTAL}$	Total Device Power Dissipation @ 25 $^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	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 Derate above 25 $^\circ\text{C}$	All	50	mW
			0.71	mW/ $^\circ\text{C}$
<b>DETECTOR</b>				
$V_{DRM}$	Off-State Output Terminal Voltage	FOD410, FOD4116	600	V
		FOD4108, FOD4118	800	
$I_{TSM}$	Peak Non-Repetitive Surge Current (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 Derate above 25 $^\circ\text{C}$	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<sub>A</sub> = 25°C Unless otherwise specified)

### Individual Component Characteristics

Symbol	Parameters	Test Conditions	Device	Min.	Typ.*	Max	Units
<b>EMITTER</b>							
V <sub>F</sub>	Input Forward Voltage	I <sub>F</sub> = 20mA	All		1.25	1.5	V
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> = 6V	All		0.0001	10	μA
<b>DETECTOR</b>							
I <sub>D(RMS)</sub>	Peak Blocking Current, Either Direction	I <sub>F</sub> = 0, T <sub>A</sub> = 100°C <sup>(2)</sup>	V <sub>D</sub> = 800V	FOD4108, FOD4118	3	100	μA
			V <sub>D</sub> = 600V	FOD410, FOD4116			
I <sub>R(RMS)</sub>	Reverse Current	T <sub>A</sub> = 100°C	V <sub>D</sub> = 800V	FOD4108, FOD4118	3	100	μA
			V <sub>D</sub> = 600V	FOD410, FOD4116			
dv/dt	Critical Rate of Rise of Off-State Voltage	I <sub>F</sub> = 0 <sup>(4)</sup> (Fig. 11)		10,000			V/μs

### Transfer Characteristics

Symbol	DC Characteristics	Test Conditions	Device	Min.	Typ.*	Max.	Units
I <sub>FT</sub>	LED Trigger Current	Main Terminal Voltage = 5V <sup>(3)</sup>	FOD410, FOD4108		0.65	2.0	mA
			FOD4116, FOD4118		0.65	1.3	
V <sub>TM</sub>	Peak On-State Voltage, Either Direction	I <sub>TM</sub> = 300 mA peak, I <sub>F</sub> = rated I <sub>FT</sub>	All		2.2	3	V
I <sub>H</sub>	Holding Current, Either Direction	V <sub>T</sub> = 3V	All		200	500	μA
I <sub>L</sub>	Latching Current	V <sub>T</sub> = 2.2V	All		5		mA
t <sub>ON</sub>	Turn-On Time	PF = 1.0, I <sub>T</sub> = 300mA	V <sub>RM</sub> = V <sub>DM</sub> = 565 VAC	FOD4108		60	μs
			V <sub>RM</sub> = V <sub>DM</sub> = 424 VAC	FOD410, FOD4116, FOD4118			
t <sub>OFF</sub>	Turn-Off Time		V <sub>RM</sub> = V <sub>DM</sub> = 565 VAC	FOD4108		52	μs
			V <sub>RM</sub> = V <sub>DM</sub> = 424 VAC	FOD410, FOD4116, FOD4118			
dv/dt <sub>crq</sub>	Critical Rate of Rise of Voltage at Current Commutation	V <sub>D</sub> = 0.67 V <sub>DRM</sub> , di/dt <sub>crq</sub> ≤ 15 A/ms	T <sub>j</sub> = 25°C	All	10,000		V/μs
			T <sub>j</sub> = 80°C		5,000		
di/dt <sub>cr</sub>	Critical Rate of Rise of On-State Current		All			8	A/μs
dV(IO)/dt	Critical Rate of Rise of Coupled Input/Output Voltage	I <sub>T</sub> = 0A, V <sub>RM</sub> = V <sub>DM</sub> = 424VAC	All		10,000		V/μs

\*Typical values at T<sub>A</sub> = 25°C

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

**Zero Crossing Characteristics**

Symbol	DC Characteristics	Test Conditions	Min.	Typ.*	Max.	Units
$V_{INH}$	Inhibit Voltage (MT1-MT2 voltage above which device will not trigger)	$I_F = \text{Rated } I_{FT}$		8	25	V
$I_{DRM2}$	Leakage in Inhibited State	$I_F = \text{Rated } I_{FT}$ , Rated $V_{DRM}$ , off state		20	200	$\mu\text{A}$

**Isolation Characteristics**

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

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

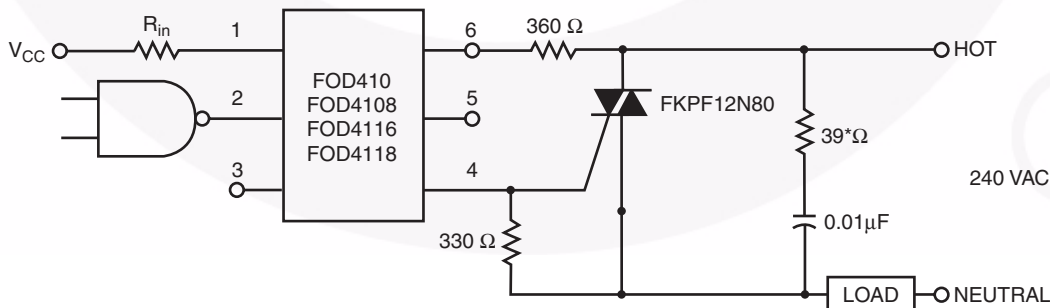
**Notes:**

- Test voltage must be applied within  $dv/dt$  rating.
- 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 FOD410 and FOD4108 and 1.3mA for FOD4116 and FOD4118 and the absolute max  $I_F$  (60mA).
- This is static  $dv/dt$ . See Figure 11 for test circuit. Commutating  $dv/dt$  is a function of the load-driving thyristor(s) only.
- 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 FOD410 and FOD4108, 1.3mA for FOD4116 and FOD4118. The 39 $\Omega$  resistor and 0.01 $\mu\text{F}$  capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load use.

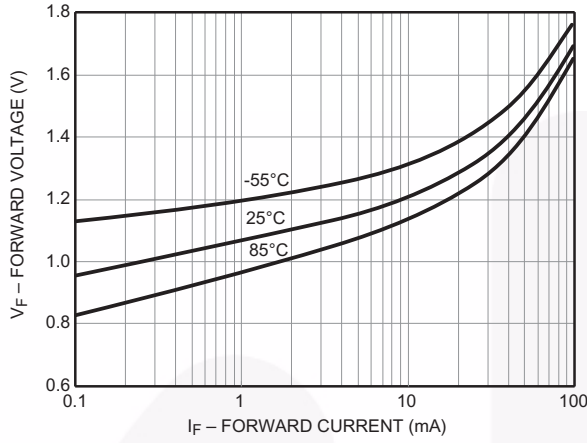


\* For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

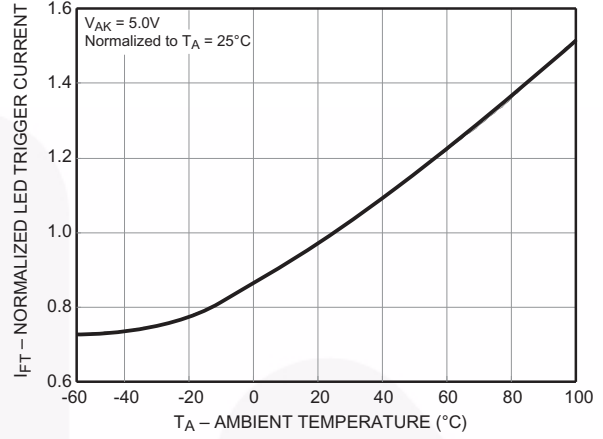
**Figure 1. Hot-Line Switching Application Circuit**

## Typical Performance Curves

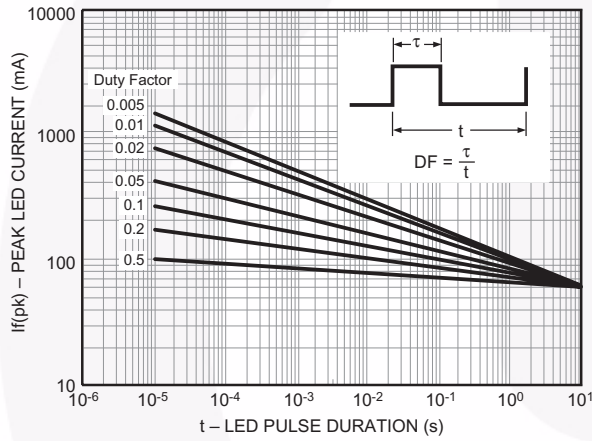
**Figure 2. Forward Voltage ( $V_F$ ) vs. Forward Current ( $I_F$ )**



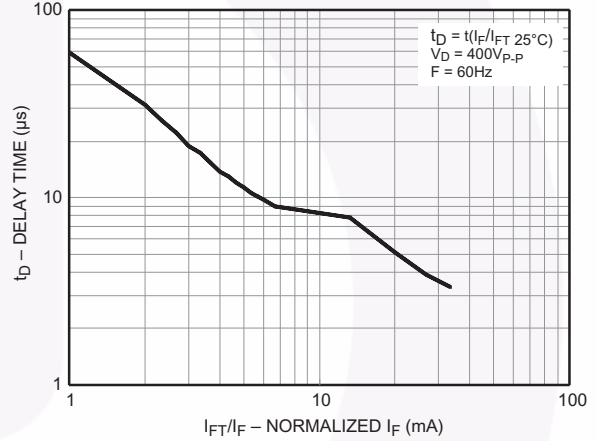
**Figure 3. Normalized LED Trigger Current ( $I_{FT}$ ) vs. Ambient Temperature ( $T_A$ )**



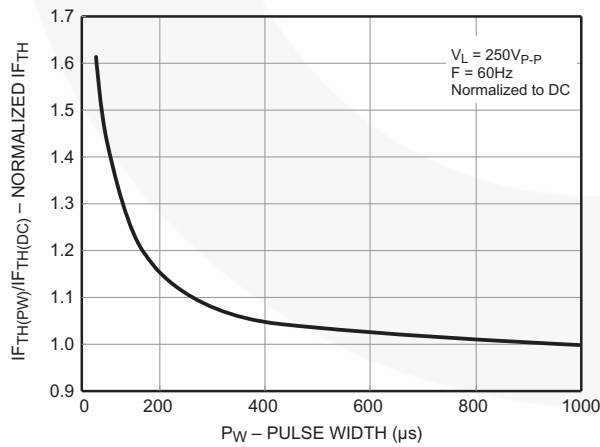
**Figure 4. Peak LED Current vs. Duty Factor, Tau**



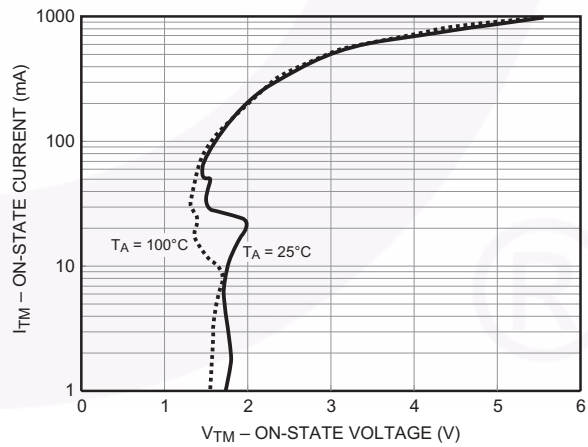
**Figure 5. Trigger Delay Time**



**Figure 6. Pulse Trigger Current**

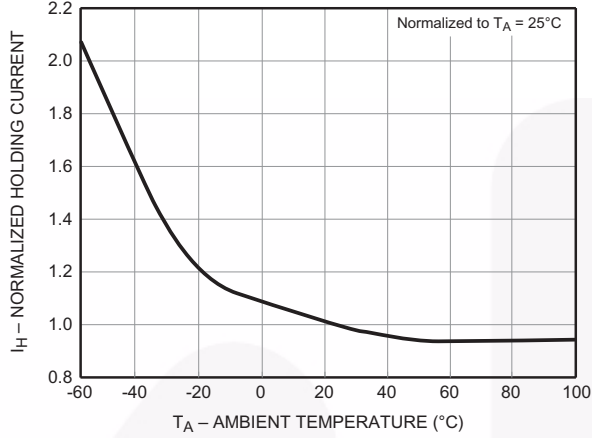


**Figure 7. On-State Voltage ( $V_{TM}$ ) vs. On-State Current ( $I_{TM}$ )**

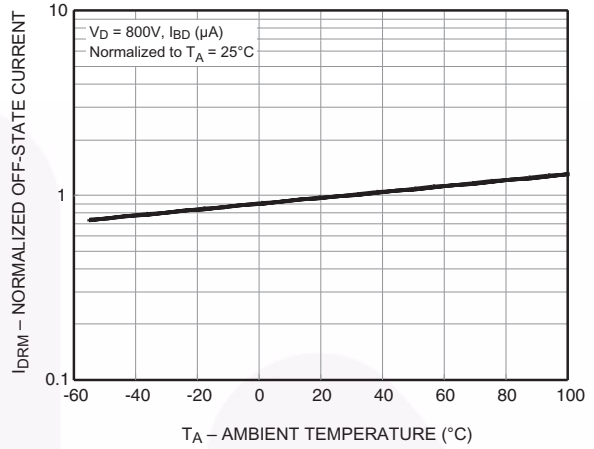


**Typical Performance Curves (Continued)**

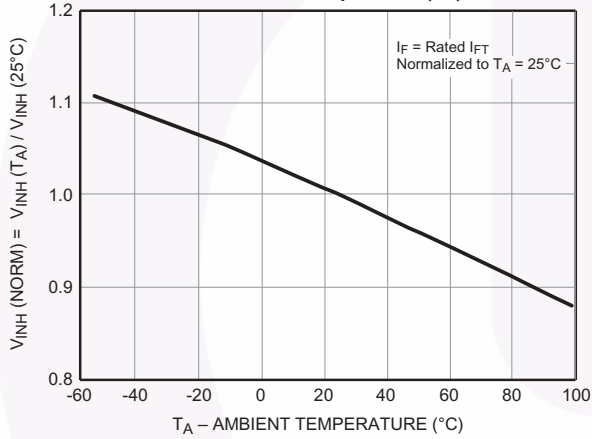
**Figure 8. Normalized Holding Current ( $I_H$ ) vs. Ambient Temperature ( $T_A$ )**



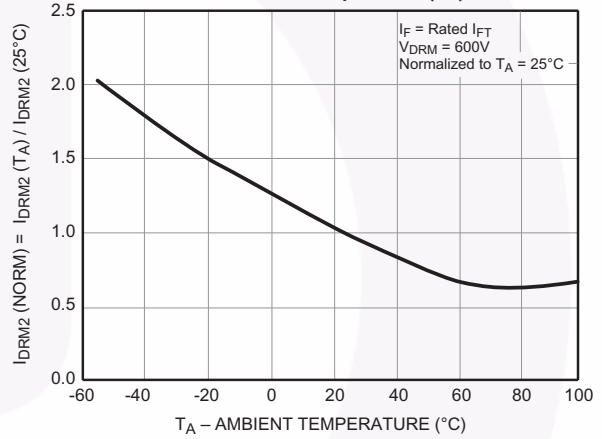
**Figure 9. Normalized Off-State Current ( $I_{DRM}$ ) vs. Ambient Temperature ( $T_A$ )**



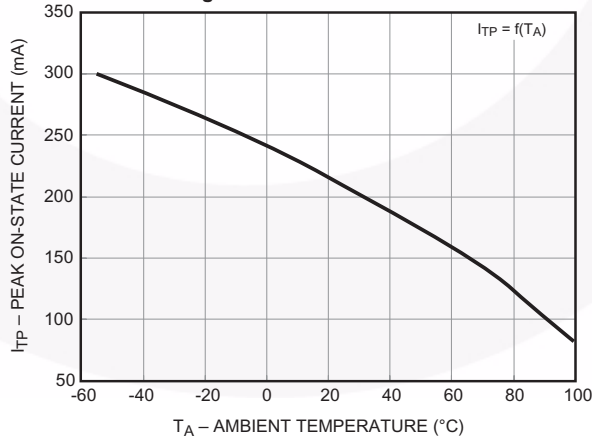
**Figure 10. Normalized Inhibit Voltage ( $V_{INH}$ ) vs. Ambient Temperature ( $T_A$ )**

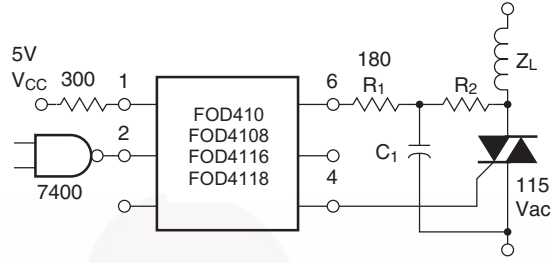


**Figure 11. Normalized Leakage in Inhibit State ( $I_{DRM2}$ ) vs. Ambient Temperature ( $T_A$ )**



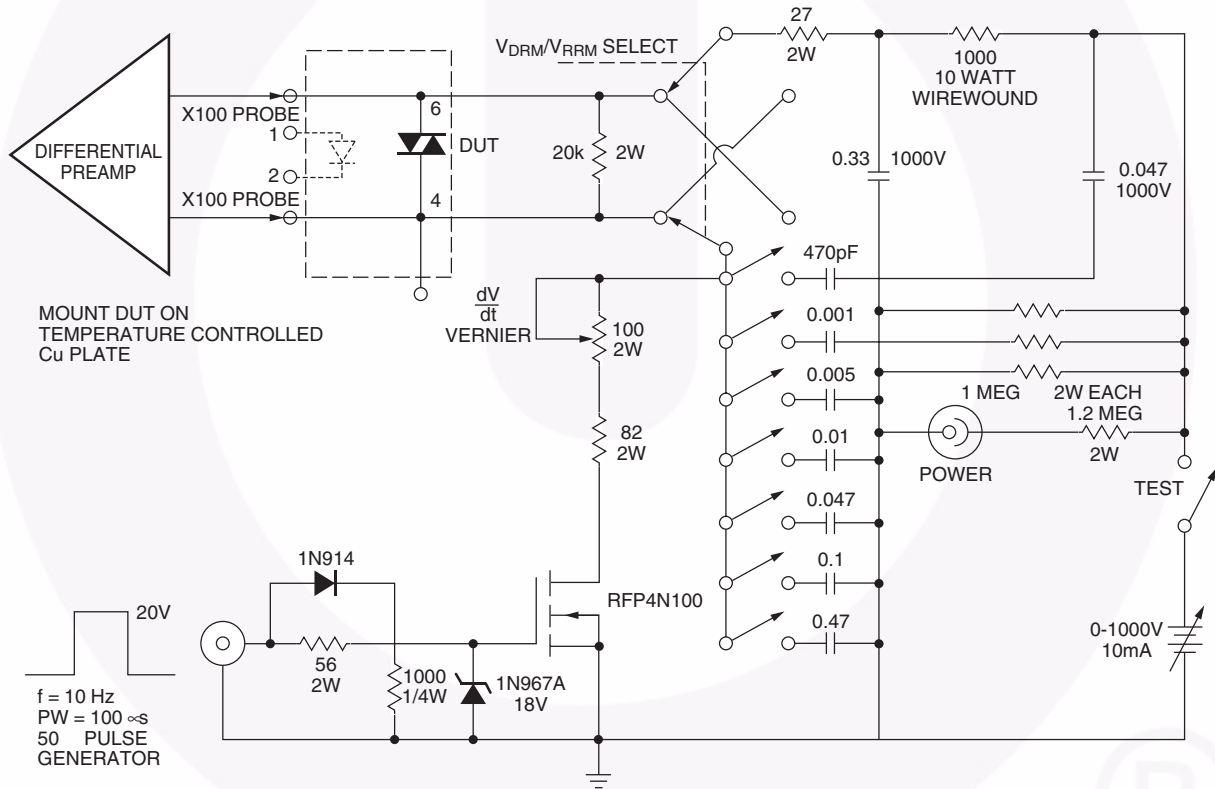
**Figure 12. Current Reduction**





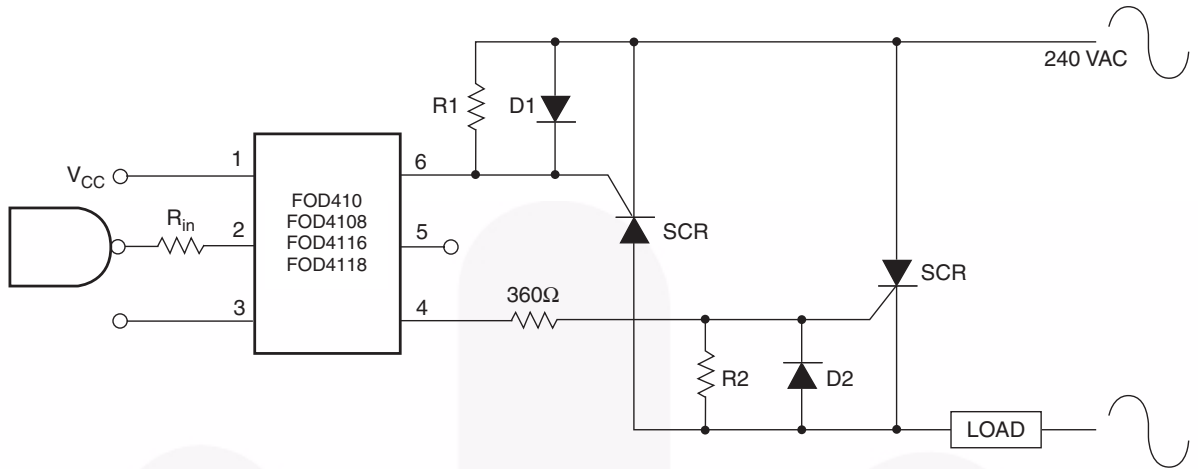
NOTE: Circuit supplies 25mA drive to gate of triac at  $V_{in} = 25V$  and  $T_A < 70^\circ C$

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**

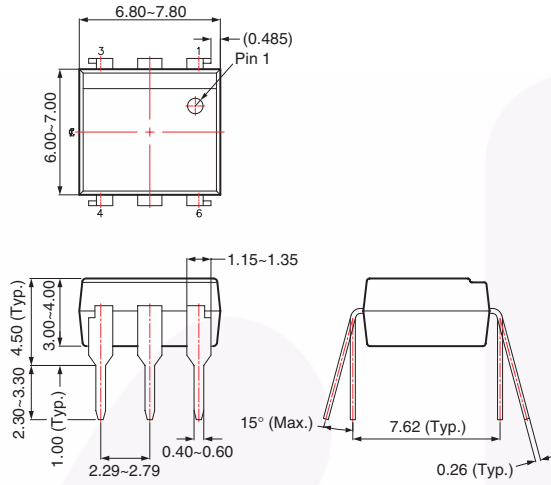
Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330Ω.

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

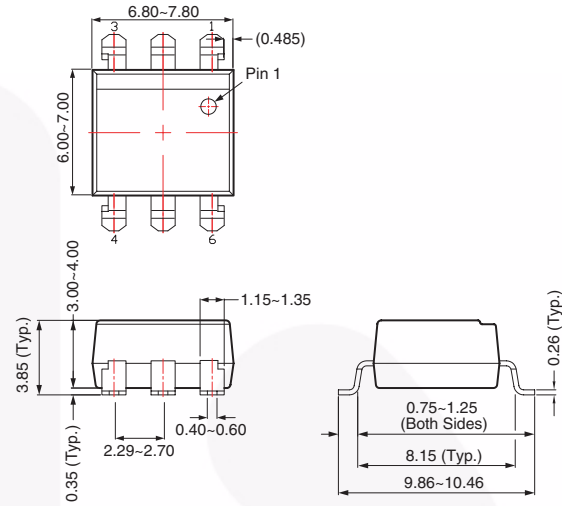


## Package Dimensions

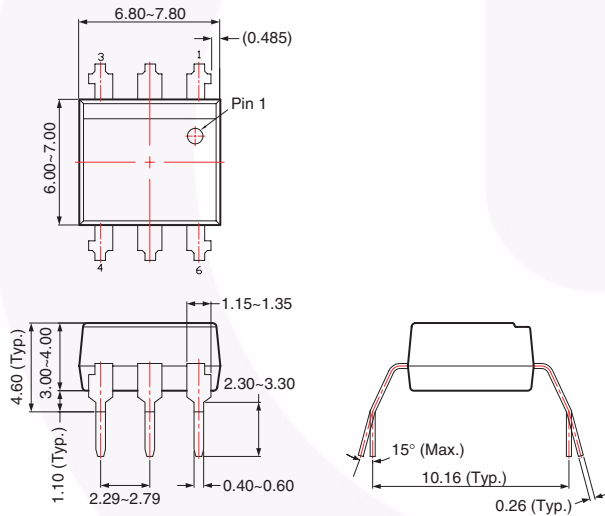
### Through Hole



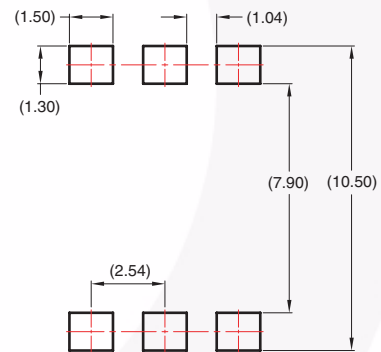
### Surface Mount



### 0.4" Lead Spacing



### Recommended Pad Layout for Surface Mount Leadforms



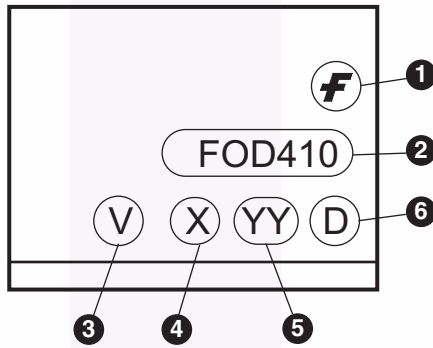
**Note:**

All dimensions are in millimeters.

### Ordering Information

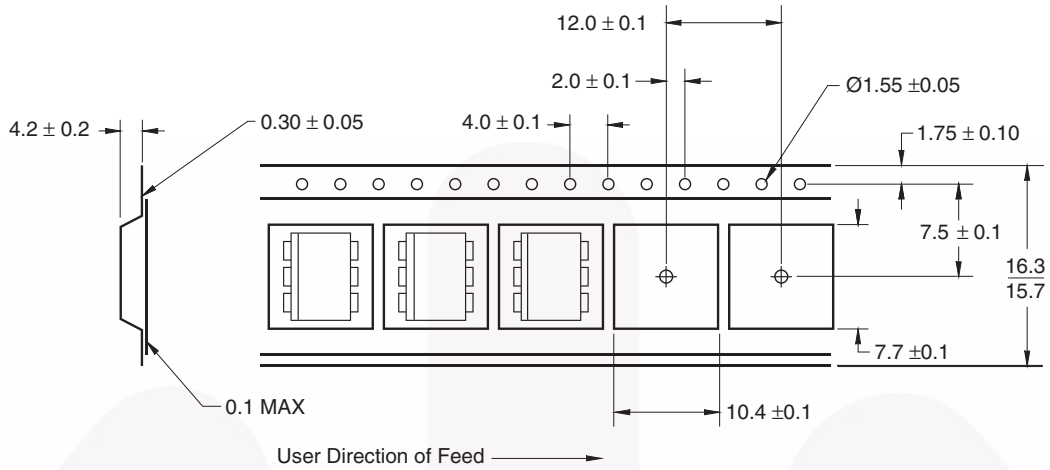
Option	Order Entry Identifier (example)	Description
None	FOD410	Standard Through Hole Device
S	FOD410S	Surface Mount Lead Bend
SD	FOD410SD	Surface Mount; Tape and reel
T	FOD410T	0.4" Lead Spacing
V	FOD410V	IEC60747-5-2 certification
TV	FOD410TV	IEC60747-5-2 certification, 0.4" Lead Spacing
SV	FOD410SV	IEC60747-5-2 certification, Surface Mount
SDV	FOD410SDV	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

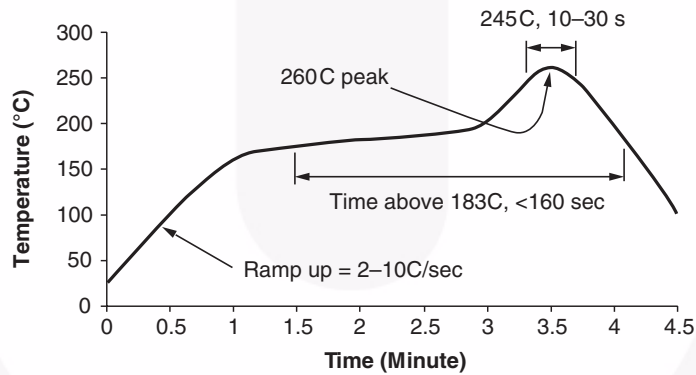
## Carrier Tape Specifications



### Note:

All dimensions are in inches (millimeters).

## Reflow Profile






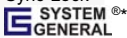


- Peak reflow temperature:  $260\text{C}$  (package surface temperature)
- Time of temperature higher than  $183\text{C}$  for 160 seconds or less
- One time soldering reflow is recommended



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**PRODUCT STATUS DEFINITIONS**

**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.
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Rev. 140



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