



Is Now Part of



**ON Semiconductor®**

To learn more about ON Semiconductor, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.



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/μs)
- Safety and Regulatory Approvals:
  - UL1577, 5,000 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5

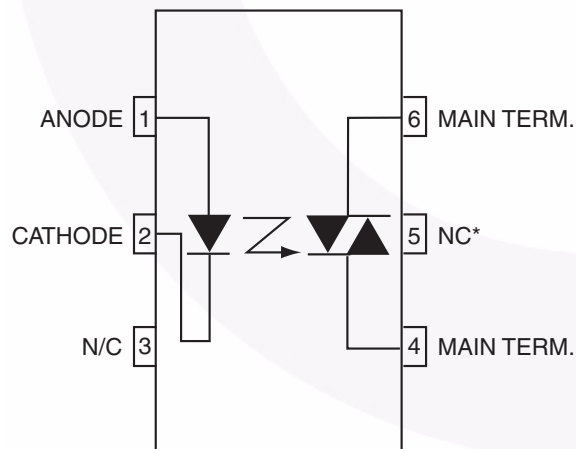
## Description

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

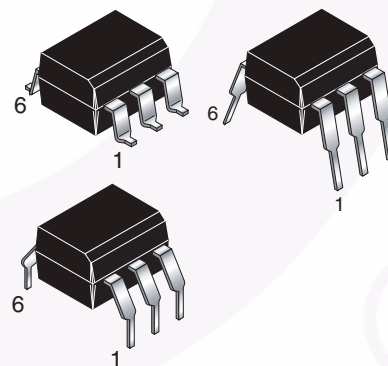


Figure 2. Package Outlines

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 <sub>RMS</sub>
	< 300 V <sub>RMS</sub>
Climatic Classification	55/100/21
Pollution Degree (DIN VDE 0110/1.89)	2
Comparative Tracking Index	175

Symbol	Parameter	Value	Unit
V <sub>PR</sub>	Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC	1360	V <sub>peak</sub>
	Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC	1594	V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	850	V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over-Voltage	6000	V <sub>peak</sub>
	External Creepage	≥ 7	mm
	External Clearance	≥ 7	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	mm
T <sub>S</sub>	Case Temperature <sup>(1)</sup>	175	°C
I <sub>S,INPUT</sub>	Input Current <sup>(1)</sup>	400	mA
P <sub>S,OUTPUT</sub>	Output Power <sup>(1)</sup>	700	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V <sup>(1)</sup>	> 10 <sup>9</sup>	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/ $^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	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/ $^\circ\text{C}$
<b>DETECTOR</b>				
$V_{DRM}$	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
<b>EMITTER</b>							
$V_F$	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	$\mu\text{A}$
<b>DETECTOR</b>							
$I_{D(RMS)}$	Peak Blocking Current, Either Direction	$I_F = 0,$ $T_A = 100^\circ\text{C}^{(2)}$	$V_D = 600\text{ V}$	FOD420, FOD4216	3	100	$\mu\text{A}$
			$V_D = 800\text{ V}$	FOD4208, FOD4218			
$I_{R(RMS)}$	Reverse Current	$T_A = 100^\circ\text{C}$	$V_D = 600\text{ V}$	FOD420, FOD4216	3	100	$\mu\text{A}$
			$V_D = 800\text{ V}$	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/ $\mu\text{s}$

#### Notes:

- Test voltage must be applied within dv/dt rating.
- 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 <sup>(4)</sup>	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	$\mu\text{A}$
$I_L$	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	$\mu\text{s}$
			$V_{RM} = V_{DM} = 565$ VAC	FOD4208			
$t_{OFF}$	Turn-Off Time		$V_{RM} = V_{DM} = 424$ VAC	FOD420, FOD4216, FOD4218		52	$\mu\text{s}$
			$V_{RM} = V_{DM} = 565$ VAC	FOD4208			
$dv/dt_C$	Critical Rate of Rise of Voltage at Current Commutation	$V_D = 230 V_{RMS}$ , $I_D = 300$ mA <sub>PK</sub>	All		10		V/ $\mu\text{s}$
$di/dt_C$	Critical Rate of Rise of On-State Current Commutation	$V_D = 230 V_{RMS}$ , $I_D = 300$ mA <sub>PK</sub>	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/ $\mu\text{s}$

#### 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 <sup>(5)</sup>	All	5,000			VAC <sub>RMS</sub>

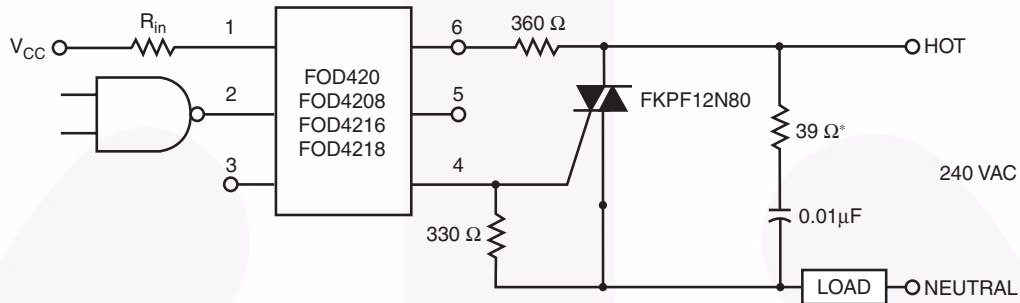
#### Note:

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<sub>RMS</sub> for 1 minute duration is equivalent to 6,000 VAC<sub>RMS</sub> for 1 second duration.

## Typical Application

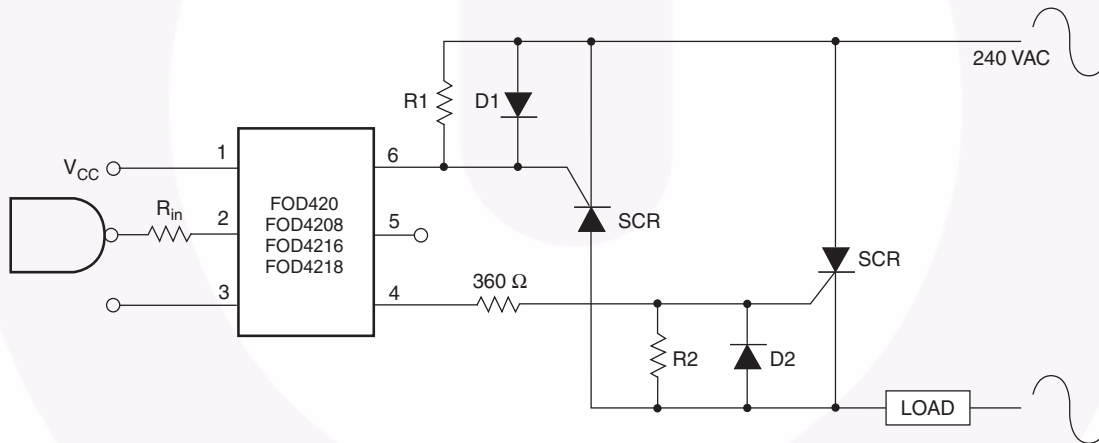
Figure 3 shows a typical circuit for when hot line switch-ing is required. In this circuit the “hot” side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

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 ohms.

**Figure 3. Hot-Line Switching Application Circuit**

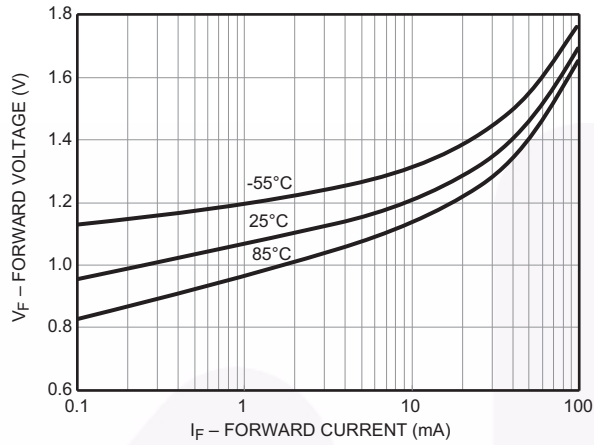


**Figure 4. Inverse-Parallel SCR Driver Circuit**

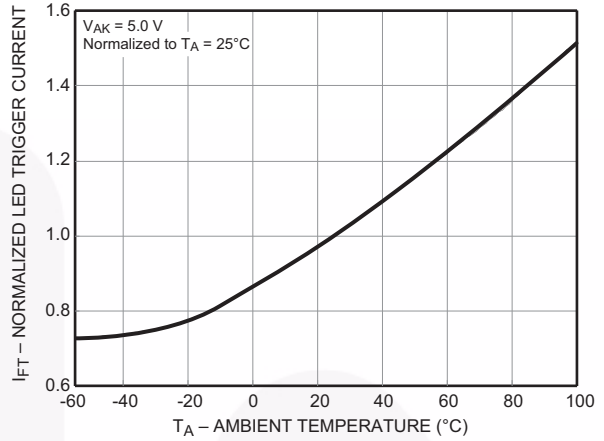
Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330 Ω.

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

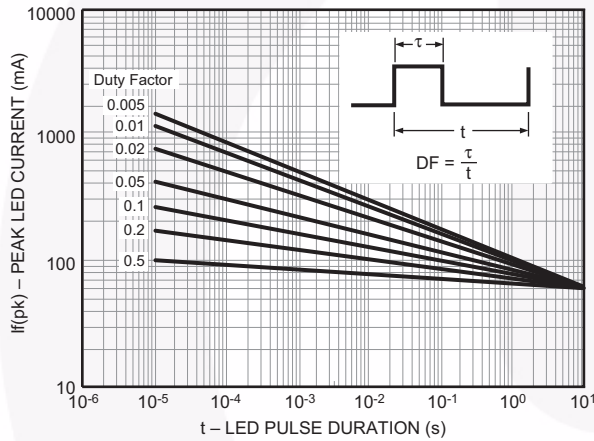
## Typical Performance Characteristics



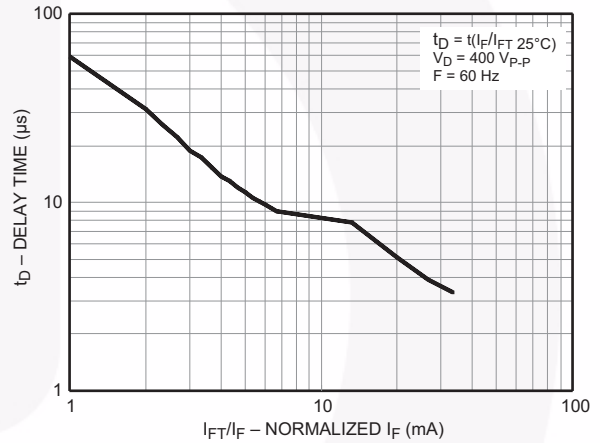
**Figure 5. Forward Voltage ( $V_F$ ) vs. Forward Current ( $I_F$ )**



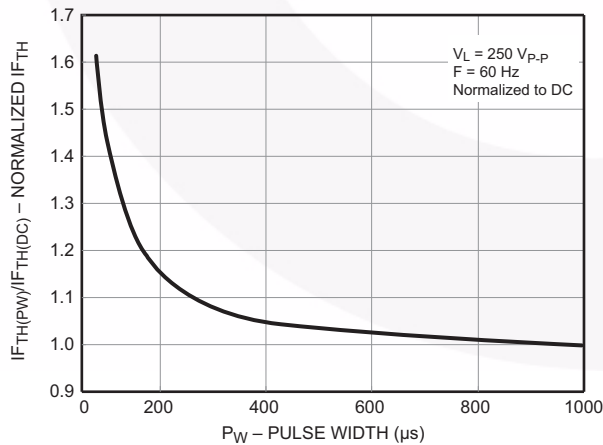
**Figure 6. Normalized LED Trigger Current ( $I_{FT}$ ) vs. Ambient Temperature ( $T_A$ )**



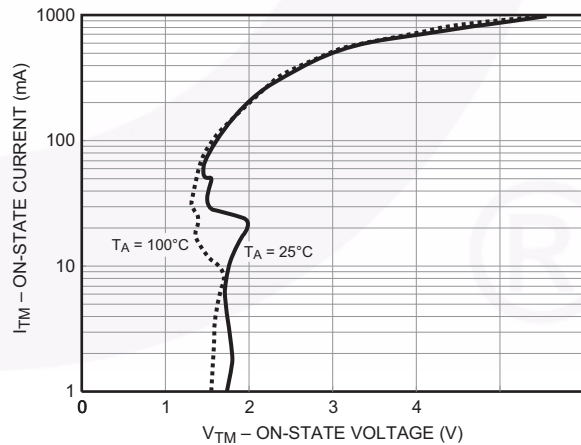
**Figure 7. Peak LED Current vs. Duty Factor, Tau**



**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)

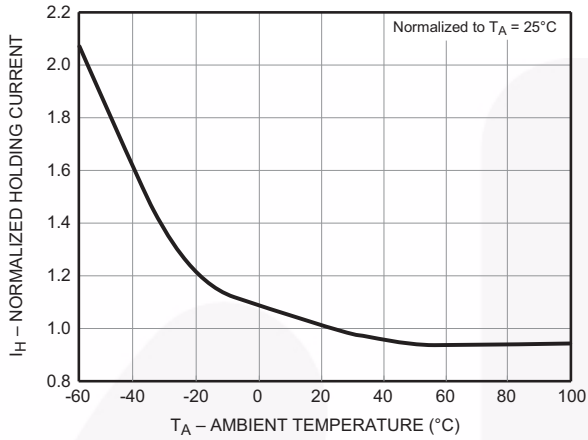


Figure 11. Normalized Holding Current (I<sub>H</sub>) vs. Ambient Temperature (T<sub>A</sub>)

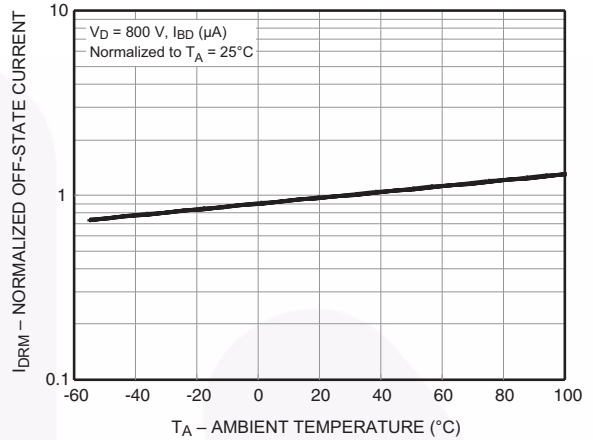


Figure 12. Normalized Off-State Current (I<sub>DRM</sub>) vs. Ambient Temperature (T<sub>A</sub>)

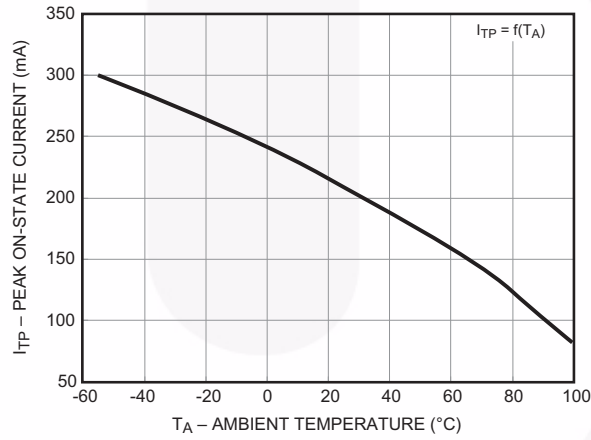


Figure 13. Current Reduction

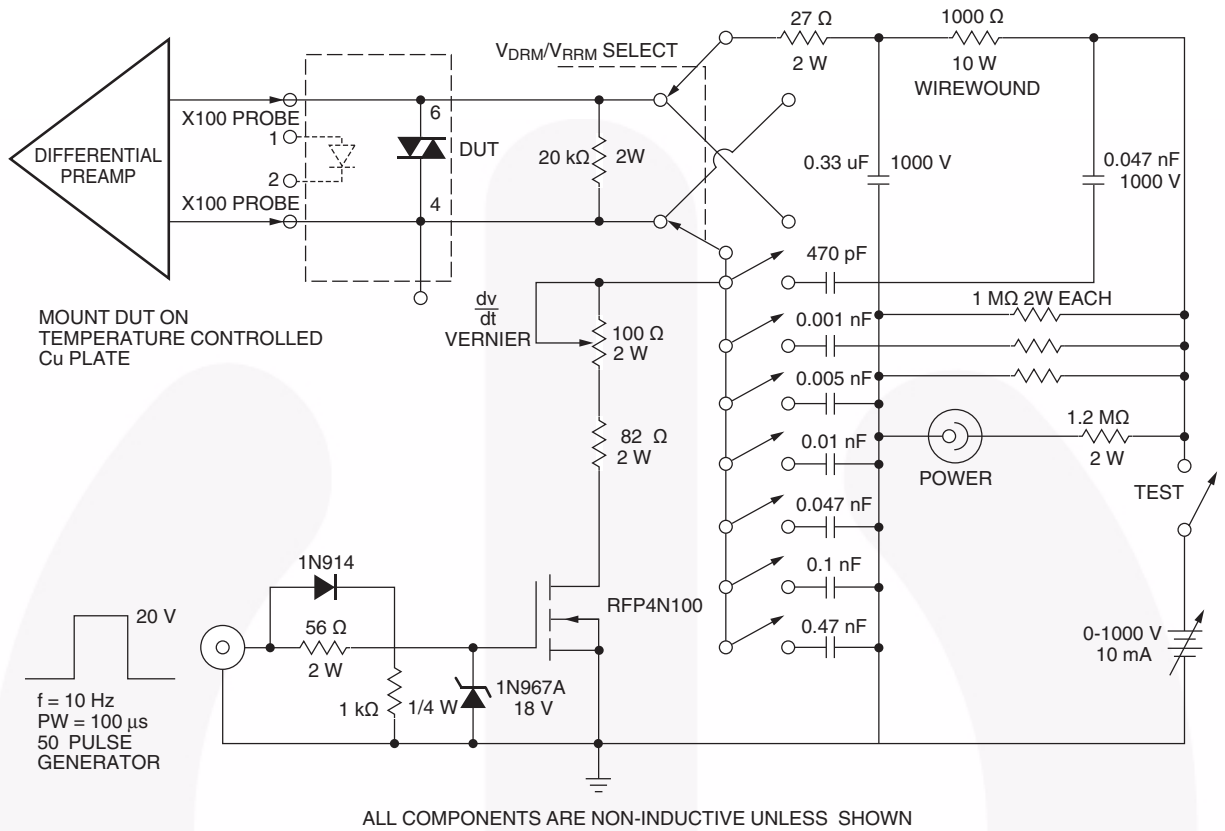
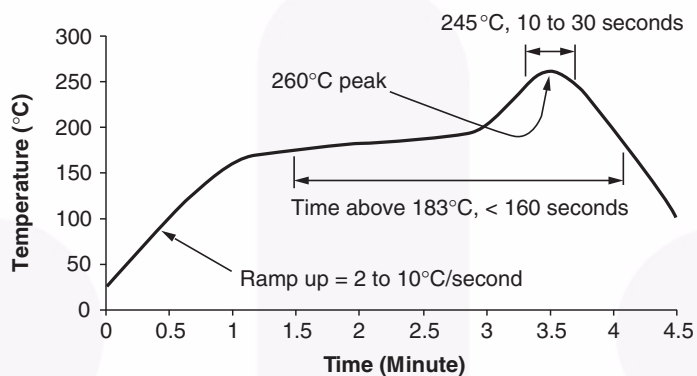


Figure 14. Circuit for Static  $\frac{dv}{dt}$  Measurement of Power Thyristors

## 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

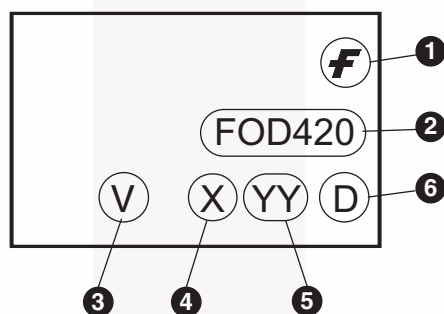
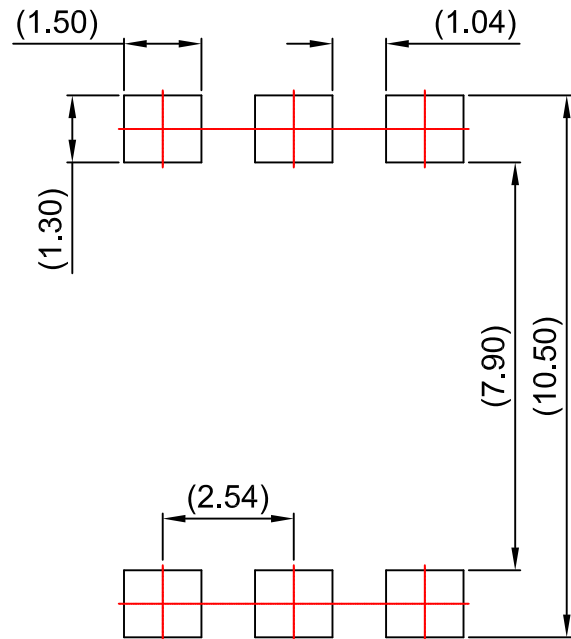
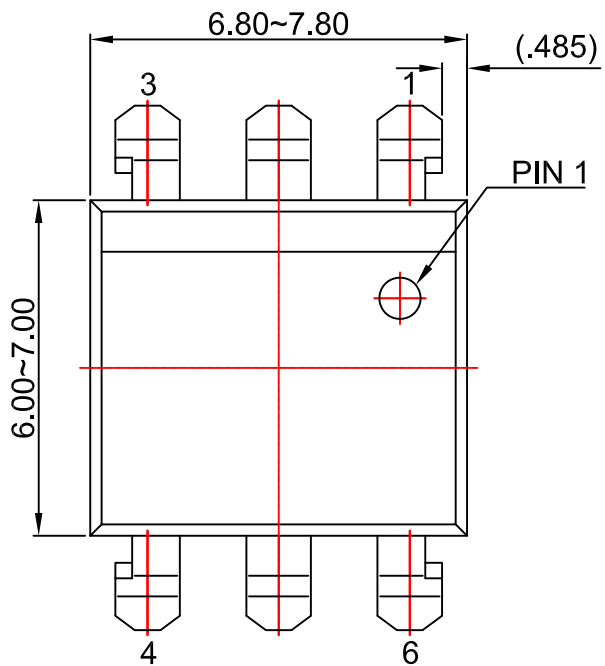


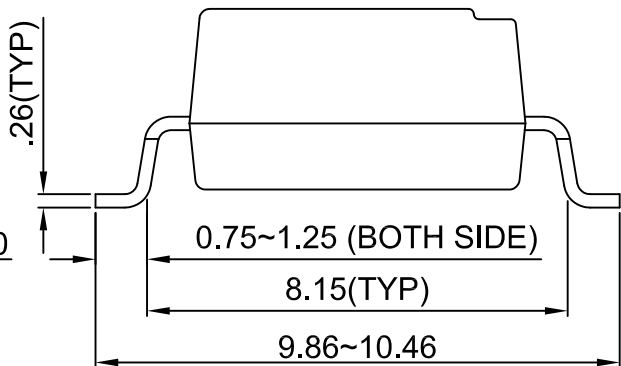
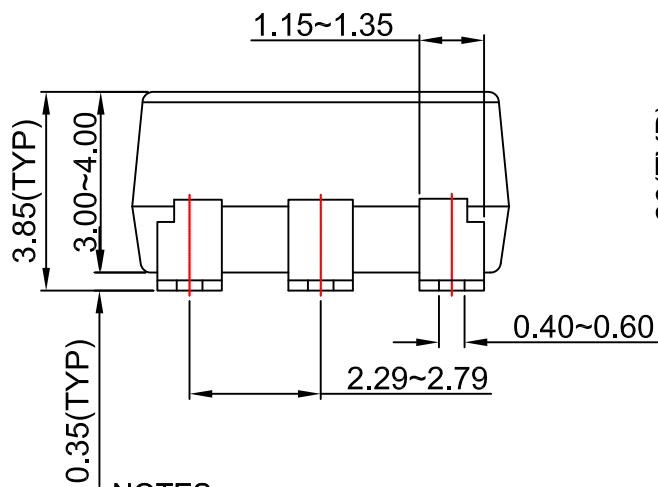
Figure 16. Top Mark

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:

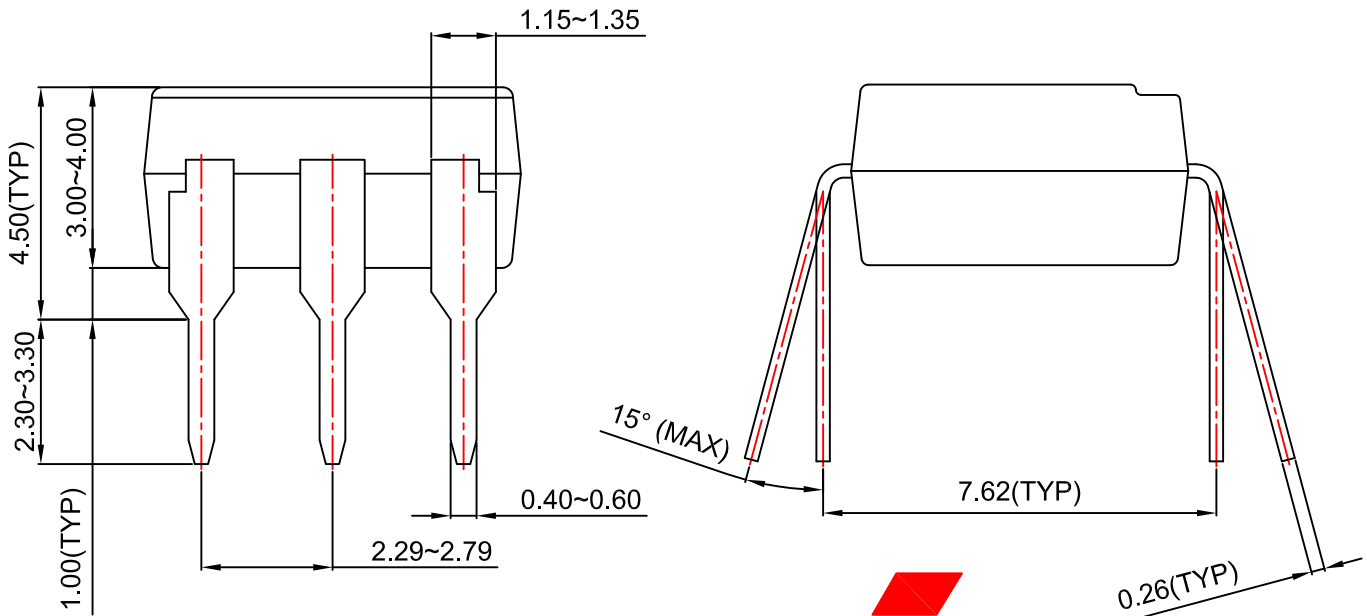
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06rev2.





NOTES:

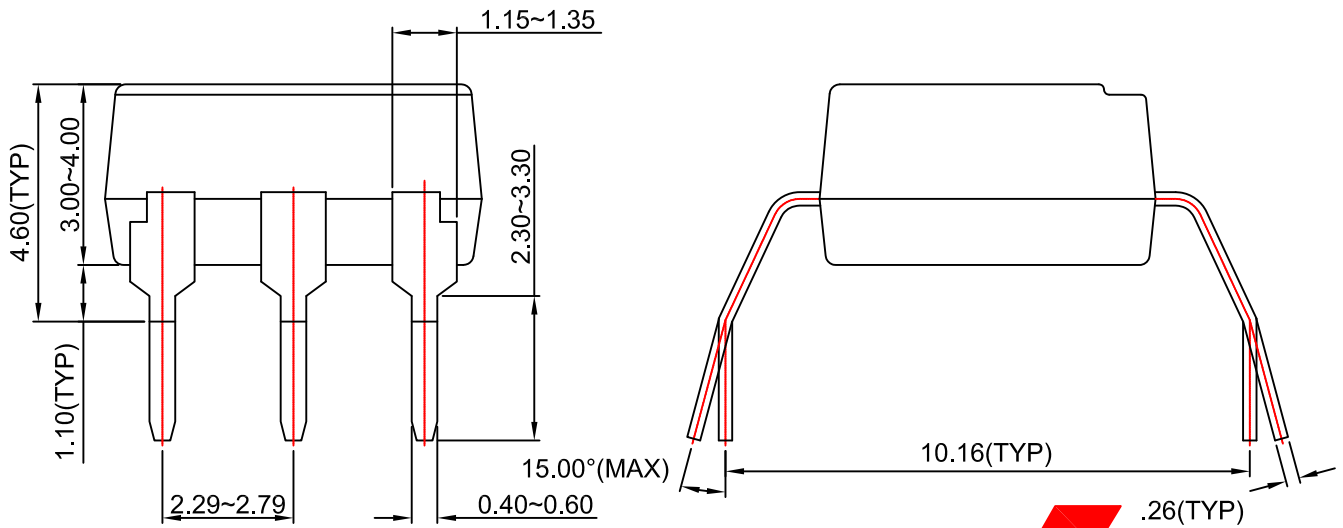
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06Erev2.





NOTES:

- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06Grev2.



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative