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June 2016

FOD420, FOD4208, FOD4216, FOD4218 6-Pin DIP Snubberless 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_{RMS} for 1 Minute
 - DIN-EN/IEC60747-5-5

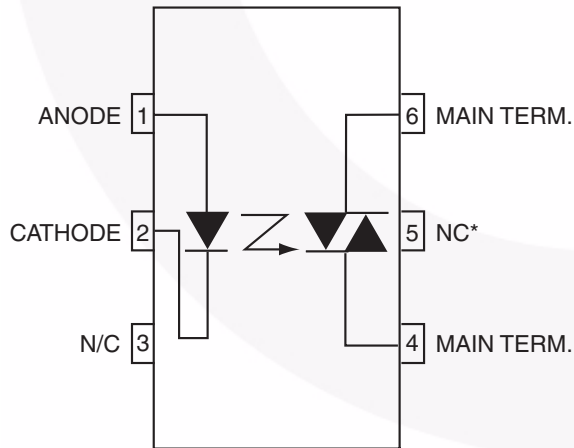
Description

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

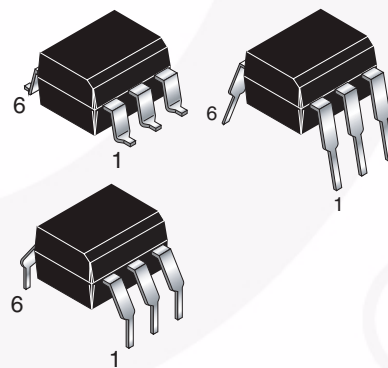


Figure 2. Package Outlines

FOD420, FOD4208, FOD4216, FOD4218 — 6-Pin DIP Snubberless Zero-Cross 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}	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} × 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	A
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	$I_F = 0^{(3)}$ (Figure 13)	All	10,000			V/ μs

Notes:

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt. See Figure 13 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	PF = 1.0, $I_T = 300$ mA	$V_{RM} = V_{DM} = 424$ VAC	FOD420, FOD4216, FOD4218	52		μs
			$V_{RM} = V_{DM} = 565$ VAC	FOD4208			
dv/dt_{crq}	Critical Rate of Rise of Voltage at Current Commutation	$V_D = 0.67 V_{DRM}$, $di/dt_{crq} \leq 15$ A/ms	$T_J = 25^\circ\text{C}$	All	10,000		V/ μs
			$T_J = 80^\circ\text{C}$		5,000		V/ μs
di/dt_{cr}	Critical Rate of Rise of On-State Current		All			8	A/ μs
$dv(1O)/dt$	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 (60 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}

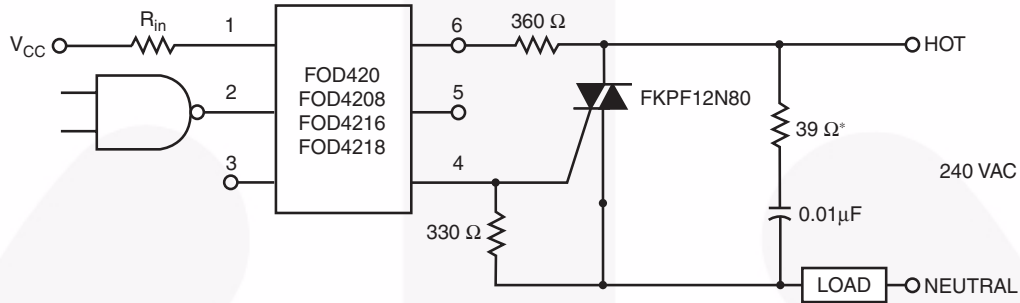
Note:

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 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, 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

Typical Performance Characteristics

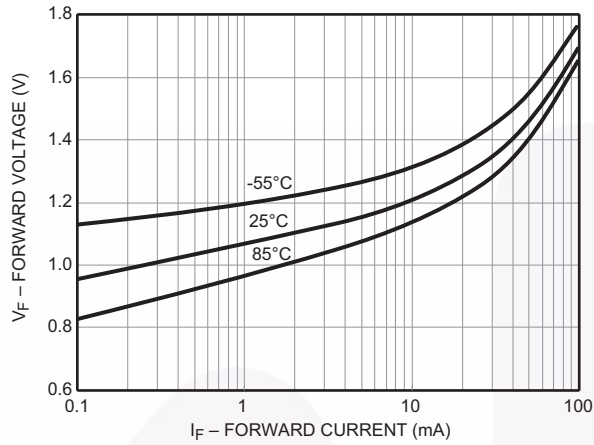


Figure 4. Forward Voltage (V_F) vs. Forward Current (I_F)

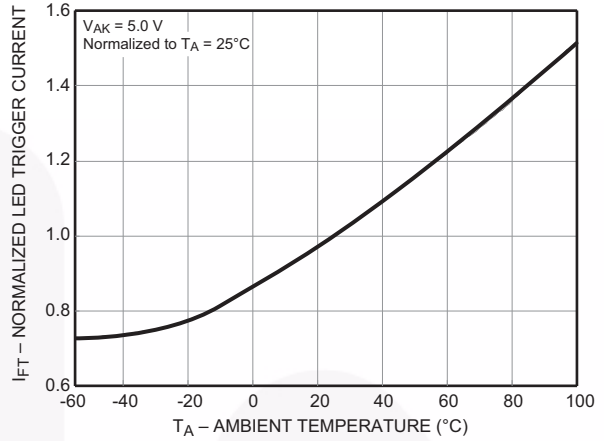


Figure 5. Normalized LED Trigger Current (I_{FT}) vs. Ambient Temperature (T_A)

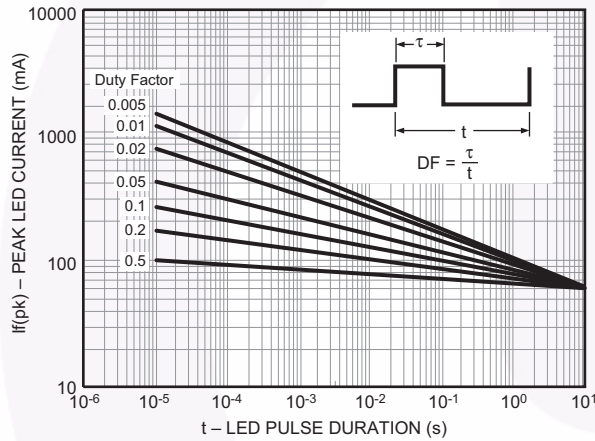


Figure 6. Peak LED Current vs. Duty Factor, Tau

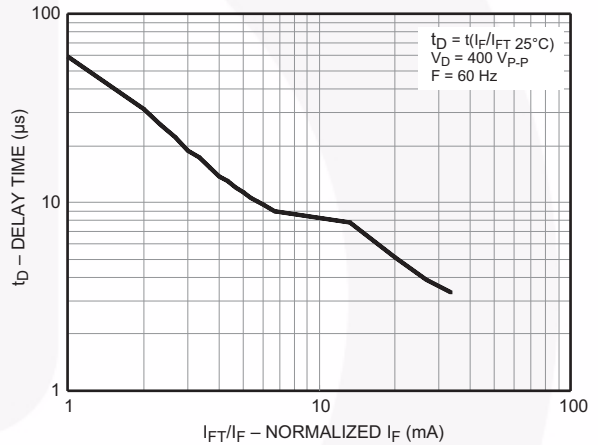


Figure 7. Trigger Delay Time

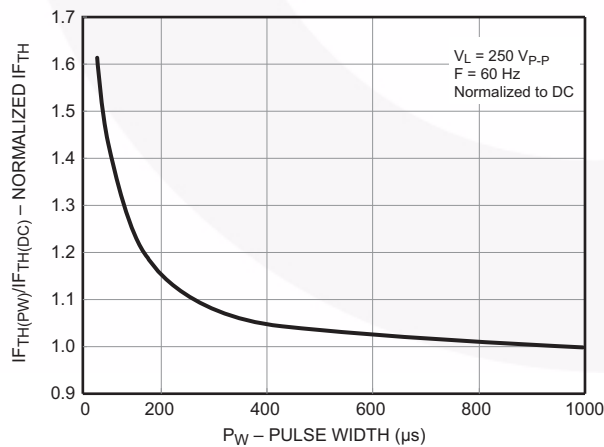


Figure 8. Pulse Trigger Current

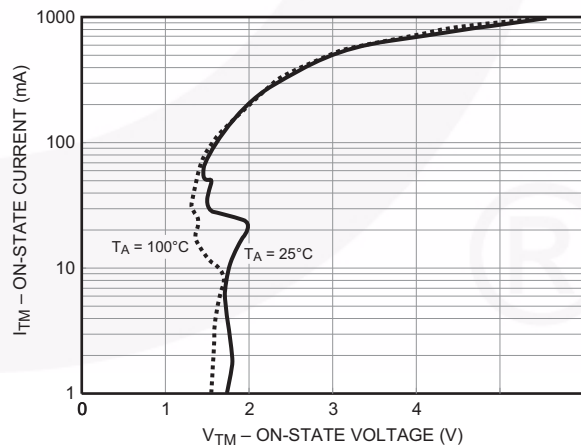


Figure 9. On-State Voltage (V_{TM}) vs. On-State Current (I_{TM})

Typical Performance Characteristics (Continued)

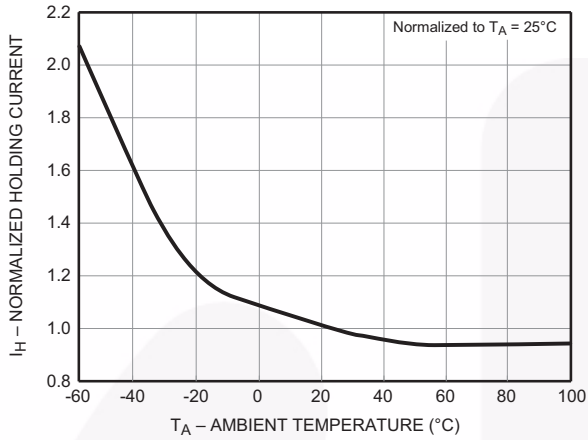


Figure 10. Normalized Holding Current (I_H) vs. Ambient Temperature (T_A)

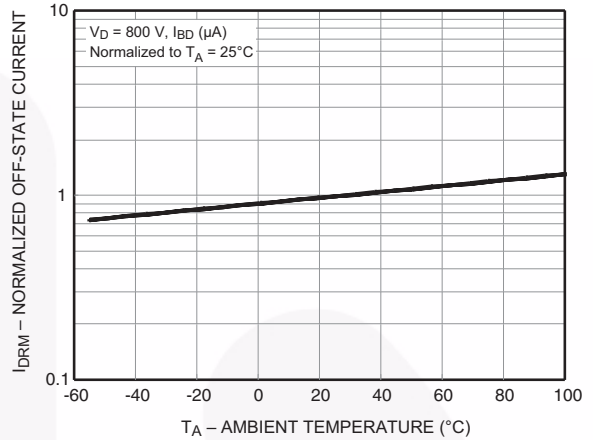


Figure 11. Normalized Off-State Current (I_{DRM}) vs. Ambient Temperature (T_A)

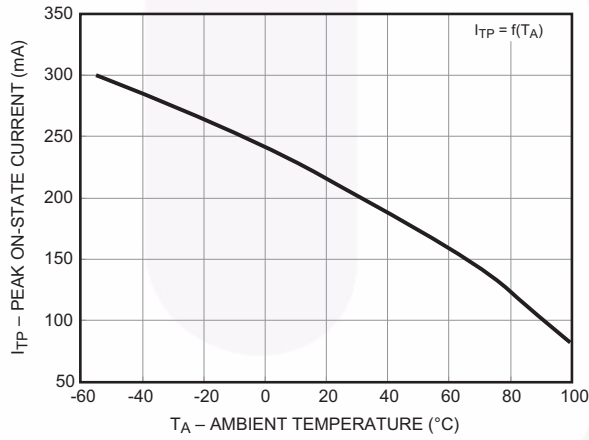
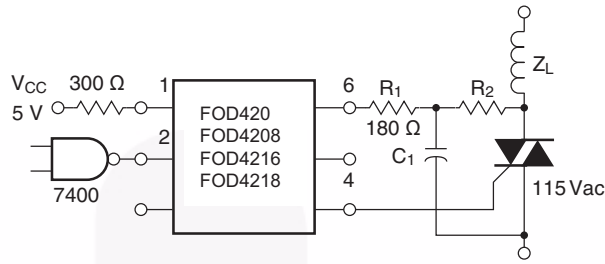
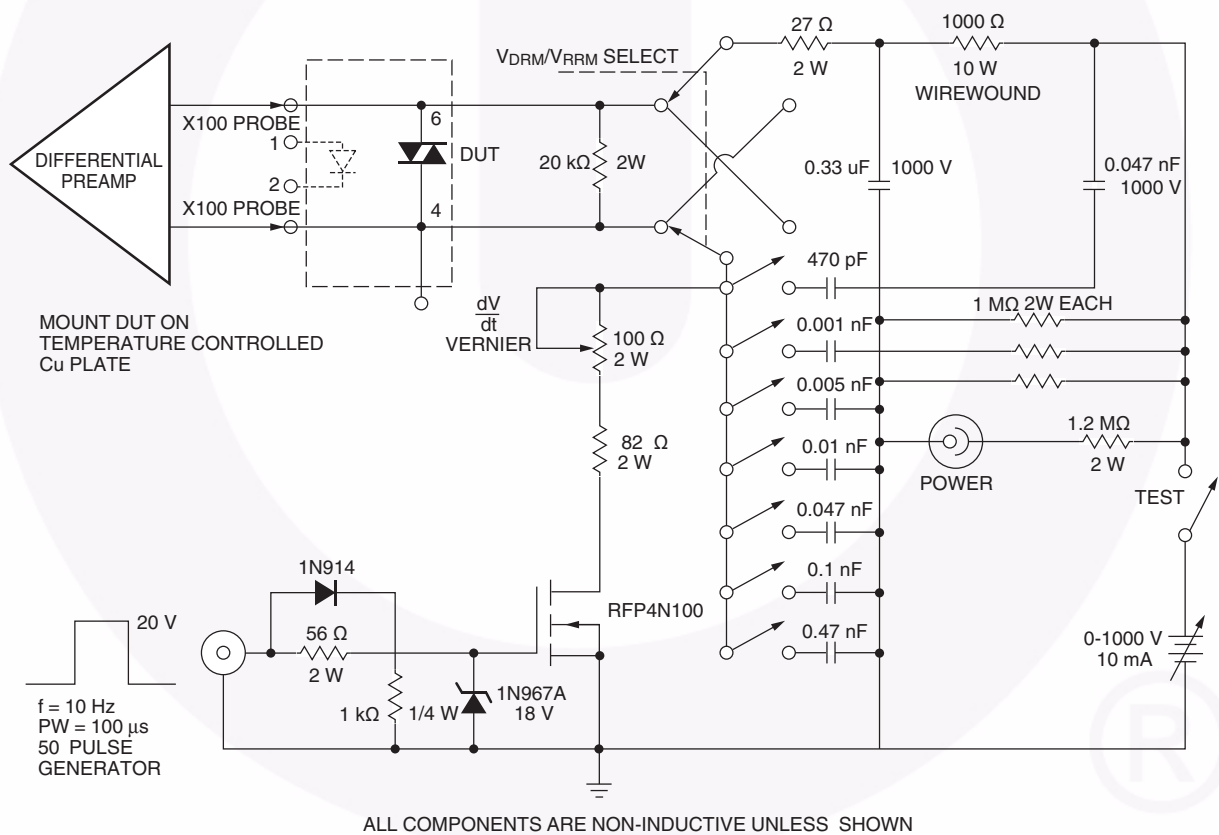


Figure 12. Current Reduction



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

TRIAC		
I_{GT} (mA)	R_2 (Ω)	C_1 (μF)
15	2400	0.1
30	1200	0.2
50	800	0.3



ALL COMPONENTS ARE NON-INDUCTIVE UNLESS SHOWN

Figure 13. Circuit for Static $\frac{dv}{dt}$ Measurement of Power Thyristors

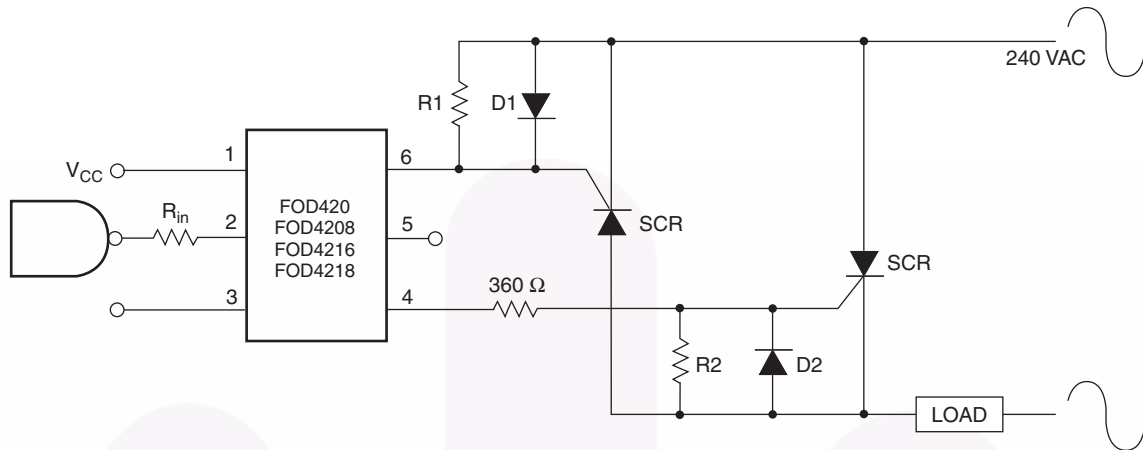
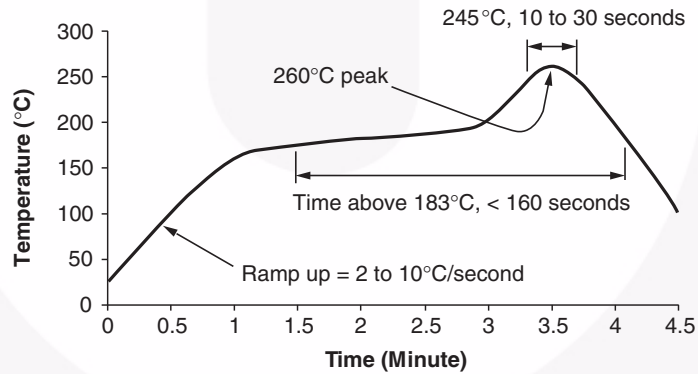


Figure 14. Inverse-Parallel SCR Driver Circuit

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.

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

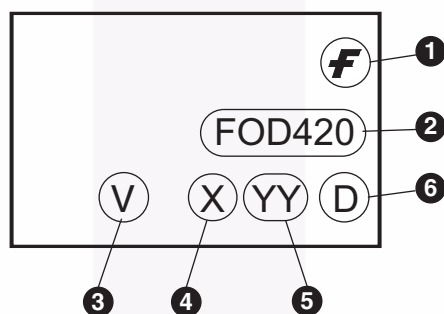
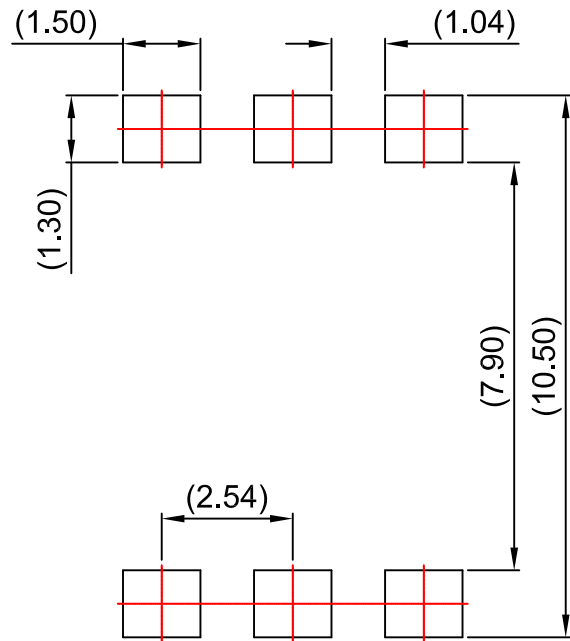
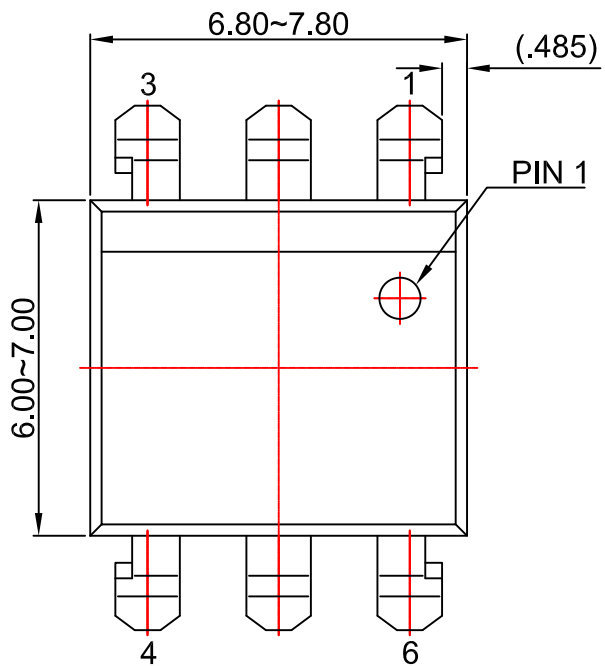


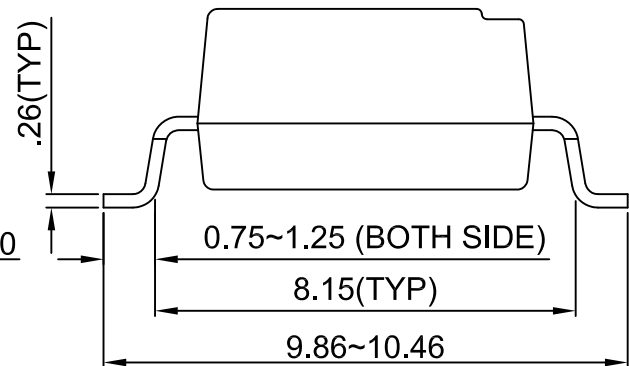
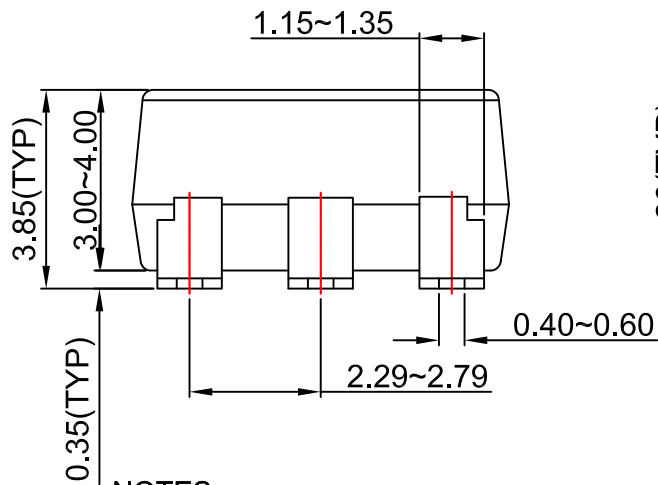
Figure 16. Top Mark

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:

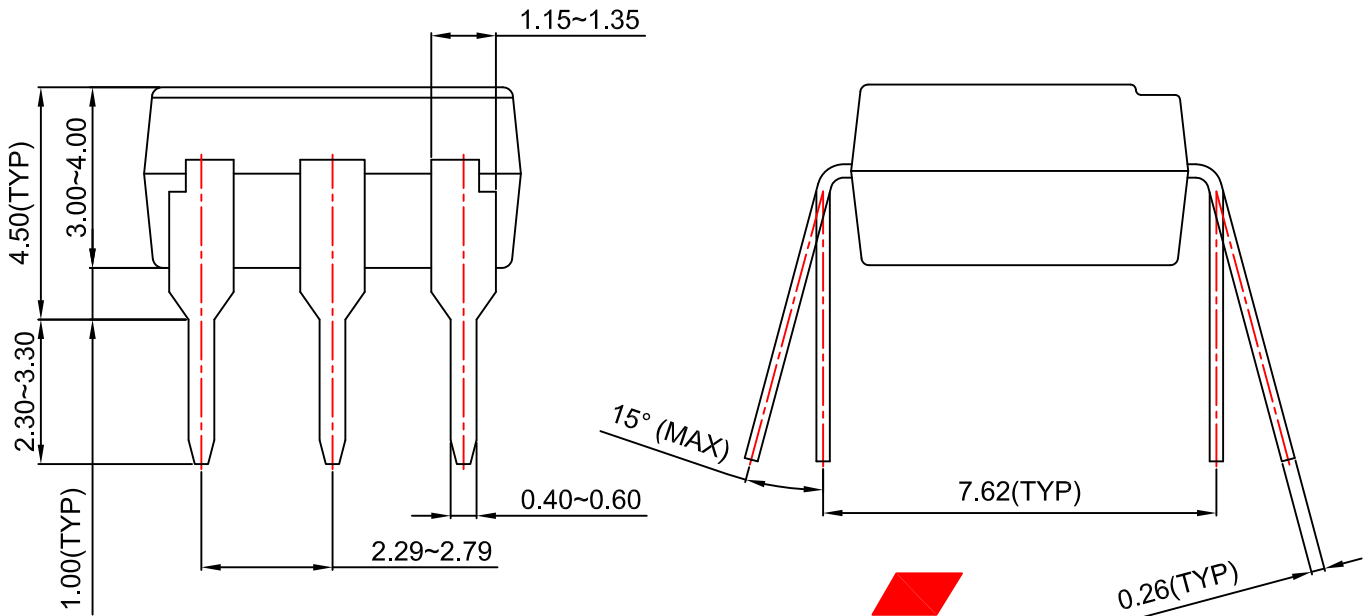
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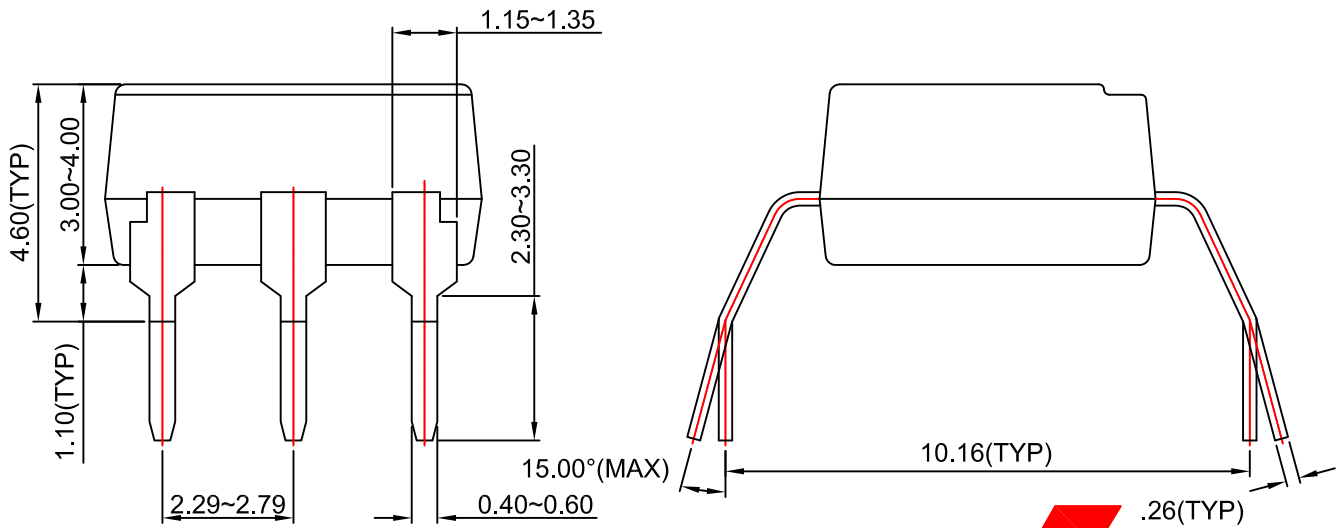
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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	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.