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June 2016

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

Features

- 300 mA On-State Current
- Zero-Voltage Crossing
- High Blocking Voltage
  – 600 V (FOD410, FOD4116)
  – 800 V (FOD4108, FOD4118)
- High Trigger Sensitivity
  – 1.3 mA (FOD4116, FOD4118)
  – 2 mA (FOD410, FOD4108)
- 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

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.

Functional Schematic

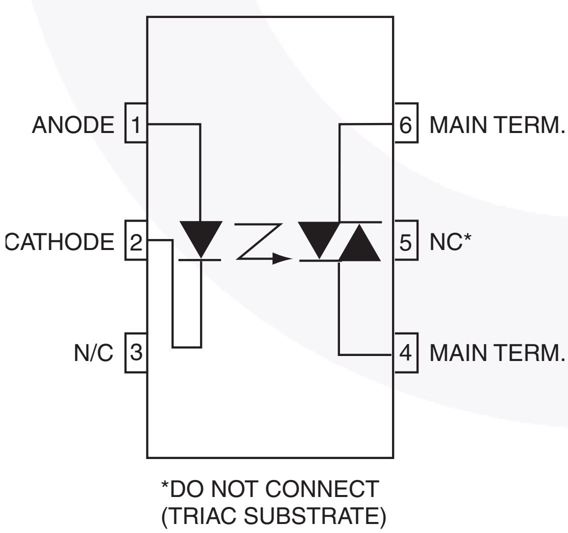


Figure 1. Schematic

Package Outlines

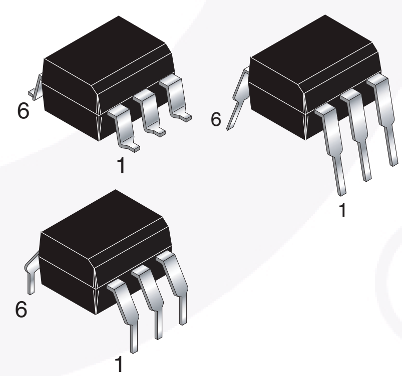


Figure 2. Package Outlines

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} 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[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°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	A
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	FOD410, FOD4116	600	V
		FOD4108, FOD4118	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°C Ambient	All	450	mW
	Derate Above 25°C	All	5.9	mW/°C

Electrical Characteristics

T_A = 25°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 mA		All		1.25	1.50	V
I_R	Reverse Leakage Current	V_R = 6 V		All		0.0001	10	µA
DETECTOR								
$I_{D(RMS)}$	Peak Blocking Current Either Direction	I_F = 0, T_A = 100°C$^{(2)}$	V_D = 600 V	FOD410, FOD4116		3	100	µA
			V_D = 800 V	FOD4108, FOD4118				
$I_{R(RMS)}$	Reverse Current	T_A = 100°C	V_D = 600 V	FOD410, FOD4116		3	100	µA
			V_D = 800 V	FOD4108, FOD4118				
dv/dt	Critical Rate of Rise of Off-State Voltage	I_F = 0$^{(3)}$ (Figure 15)		All	10,000			V/µs

Notes:

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt. See Figure 15 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.

Electrical Characteristics (Continued)

T_A = 25°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)]		FOD410, FOD4108		0.65	2.0	mA
				FOD4116, FOD4118		0.65	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	FOD410, FOD4116, FOD4118		60		µs
			V_{RM} = V_{DM} = 565 VAC	FOD4108				
t_{OFF}	Turn-Off Time		V_{RM} = V_{DM} = 424 VAC	FOD410, FOD4116, FOD4118		52		µs
			V_{RM} = V_{DM} = 565 VAC	FOD4108				
dv/dt_{crq}	Critical Rate of Rise of Voltage at Current Commutation	V_D = 0.67 V_{DRM}, di/dt_{crq} ≤ 15 A/ms	T_J = 25°C	All	10,000			V/µs
			T_J = 80°C		5,000			V/µs
di/dt_{cr}	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_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 FOD410 and FOD4108 and 1.3 mA for FOD4116 and FOD4118) and the absolute max I_F (60 mA).

Zero Crossing Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
V_{INH}	Inhibit Voltage (MT1-MT2 Voltage above which device will not trigger)	I_F = Rated I_{FT}	All		8	25	V
I_{DRM2}	Leakage in Inhibit State	I_F = Rated I_{FT}, Rated V_{DRM}, Off-State	All		20	200	µA

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}

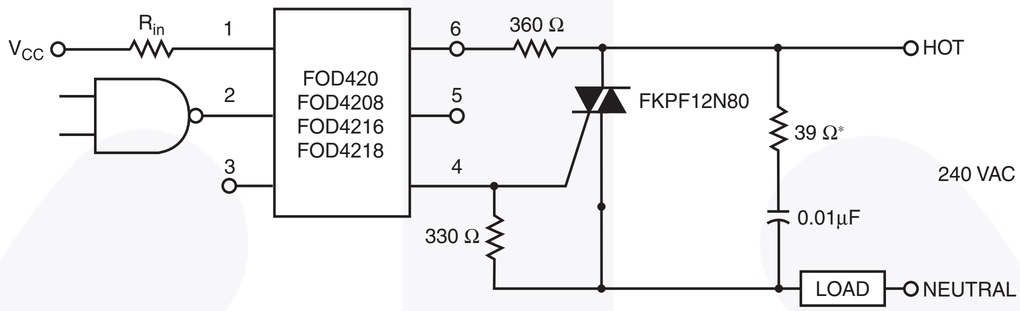
Note:

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

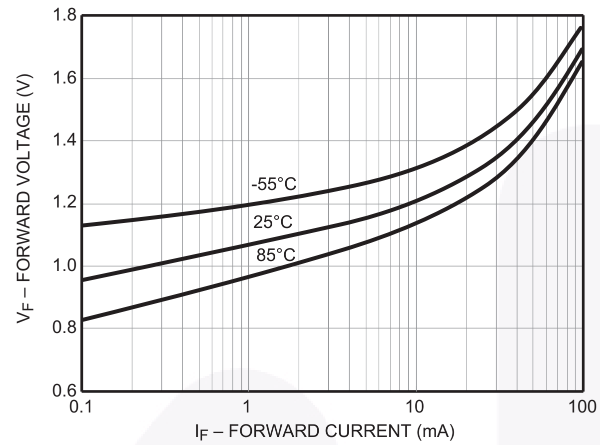


Figure 4. Forward Voltage (V_F) vs. Forward Current (I_F)

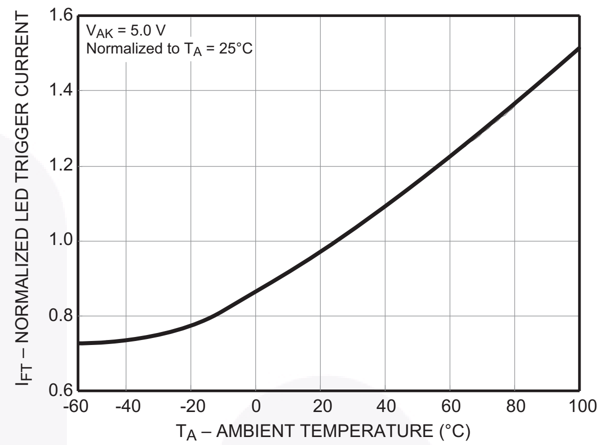


Figure 5. Normalized LED Trigger Current (I_{FT}) vs. Ambient Temperature (T_A)

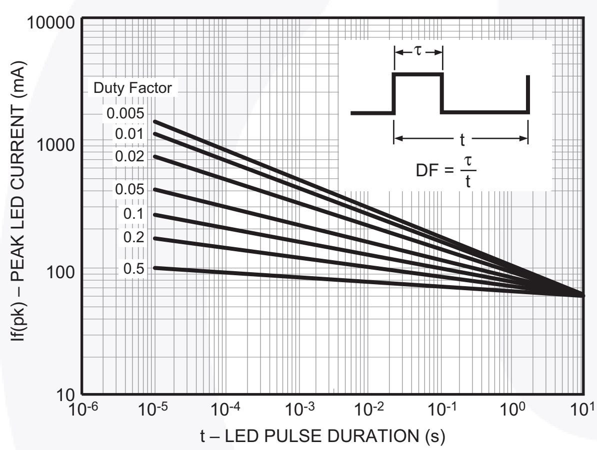


Figure 6. Peak LED Current vs. Duty Factor, Tau

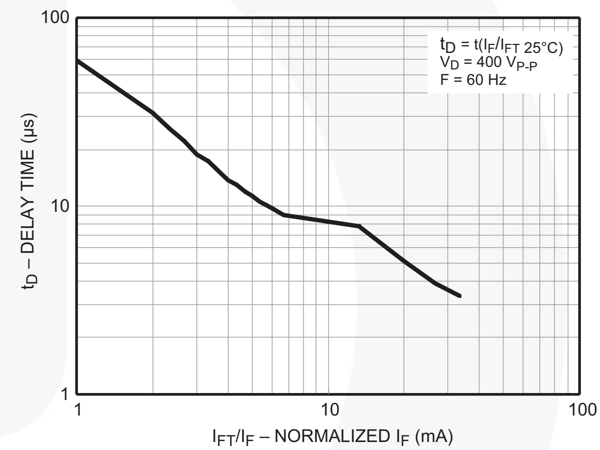


Figure 7. Trigger Delay Time

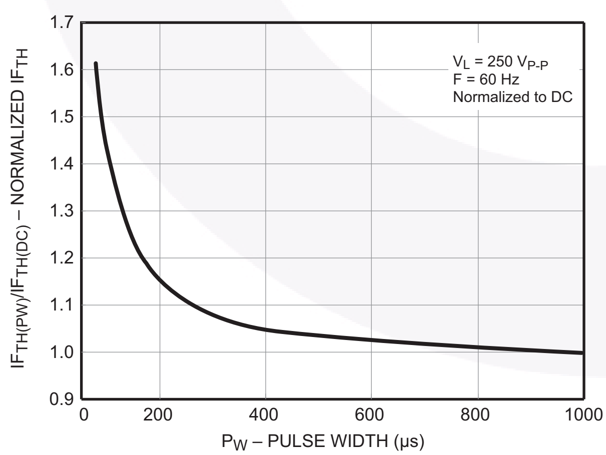


Figure 8. Pulse Trigger Current

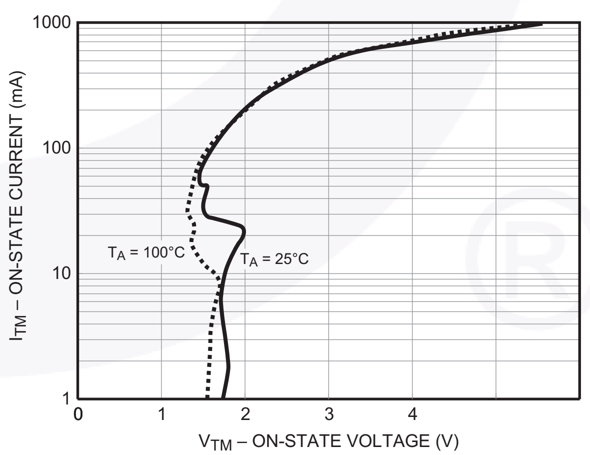


Figure 9. On-State Voltage (V_{TM}) vs. On-State Current (I_{TM})

Typical Performance Characteristics (Continued)

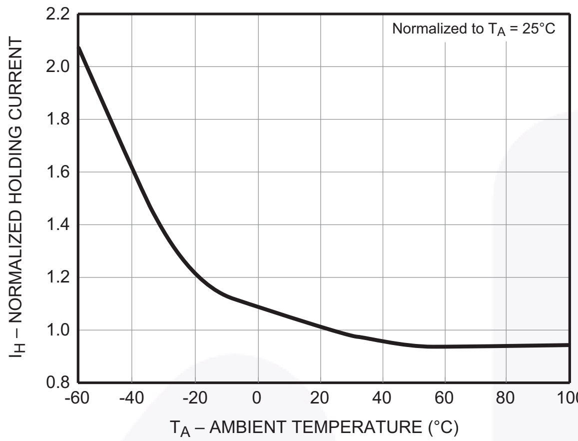


Figure 10. Normalized Holding Current (I_H) vs. Ambient Temperature (T_A)

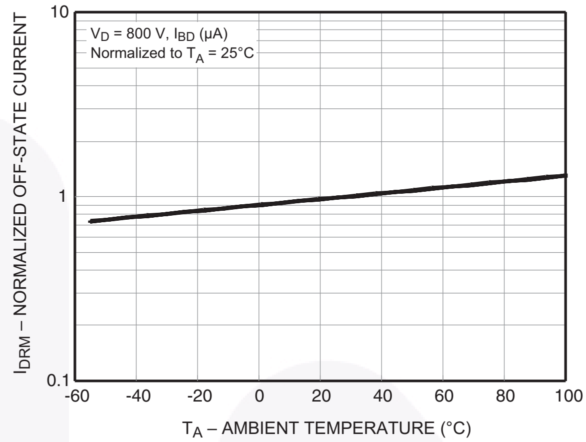


Figure 11. Normalized Off-State Current (I_{DRM}) vs. Ambient Temperature (T_A)

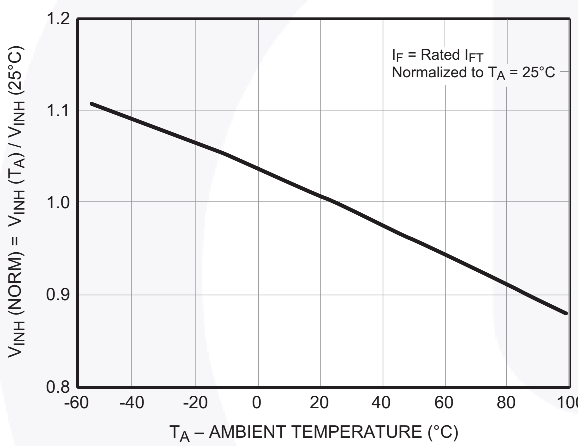


Figure 12. Normalized Inhibit Voltage (V_{INH}) vs. Ambient Temperature (T_A)

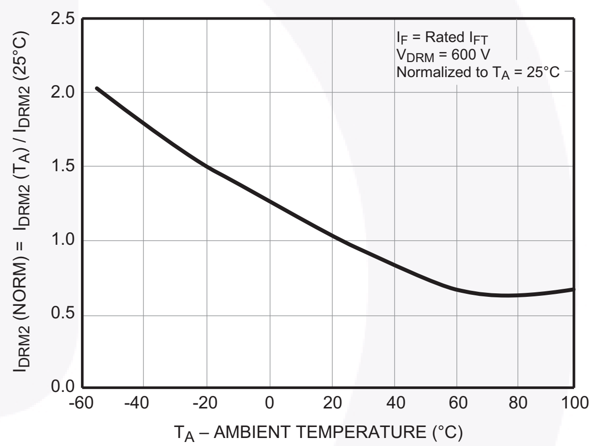


Figure 13. Normalized Leakage in Inhibit State (I_{DRM2}) vs. Ambient Temperature (T_A)

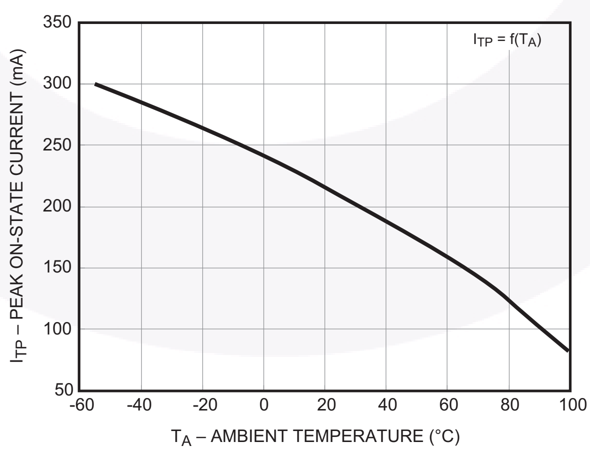
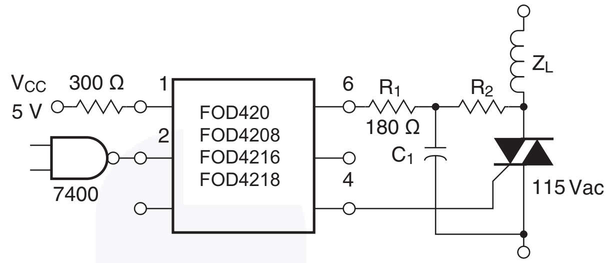
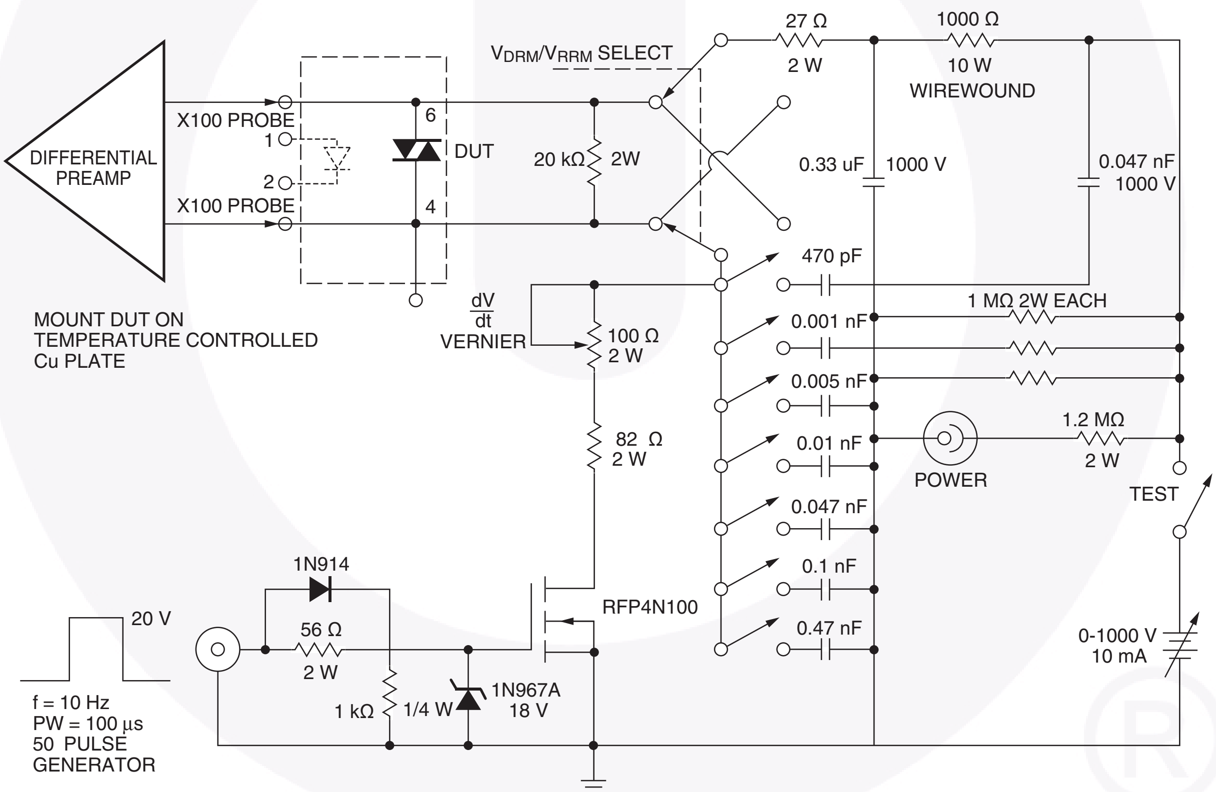


Figure 14. Current Reduction



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

TRIAC		
I_{GT} (mA)	R_2 (Ω)	C_1 (uF)
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

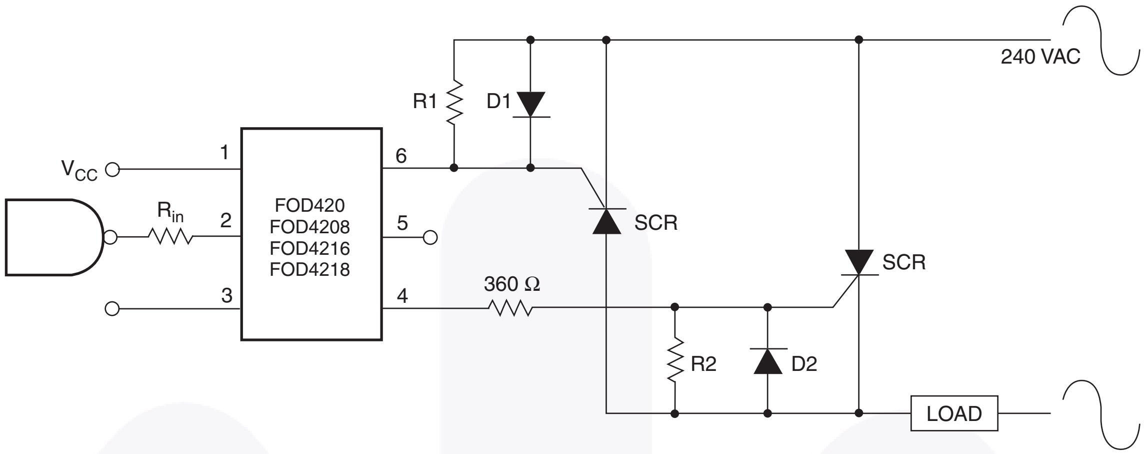
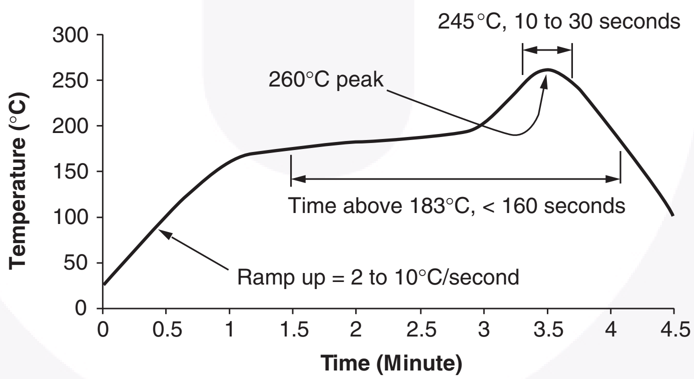


Figure 14. Inverse-Parallel SCR Driver Circuit

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
FOD410	DIP 6-Pin	Tube (50 Units)
FOD410S	SMT 6-Pin (Lead Bend)	Tube (50 Units)
FOD410SD	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
FOD410V	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
FOD410SV	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
FOD410SDV	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
FOD410TV	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 FOD4108, FOD4116, and FOD4118 product families.

Marking Information

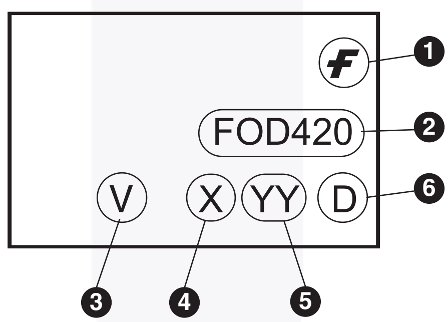
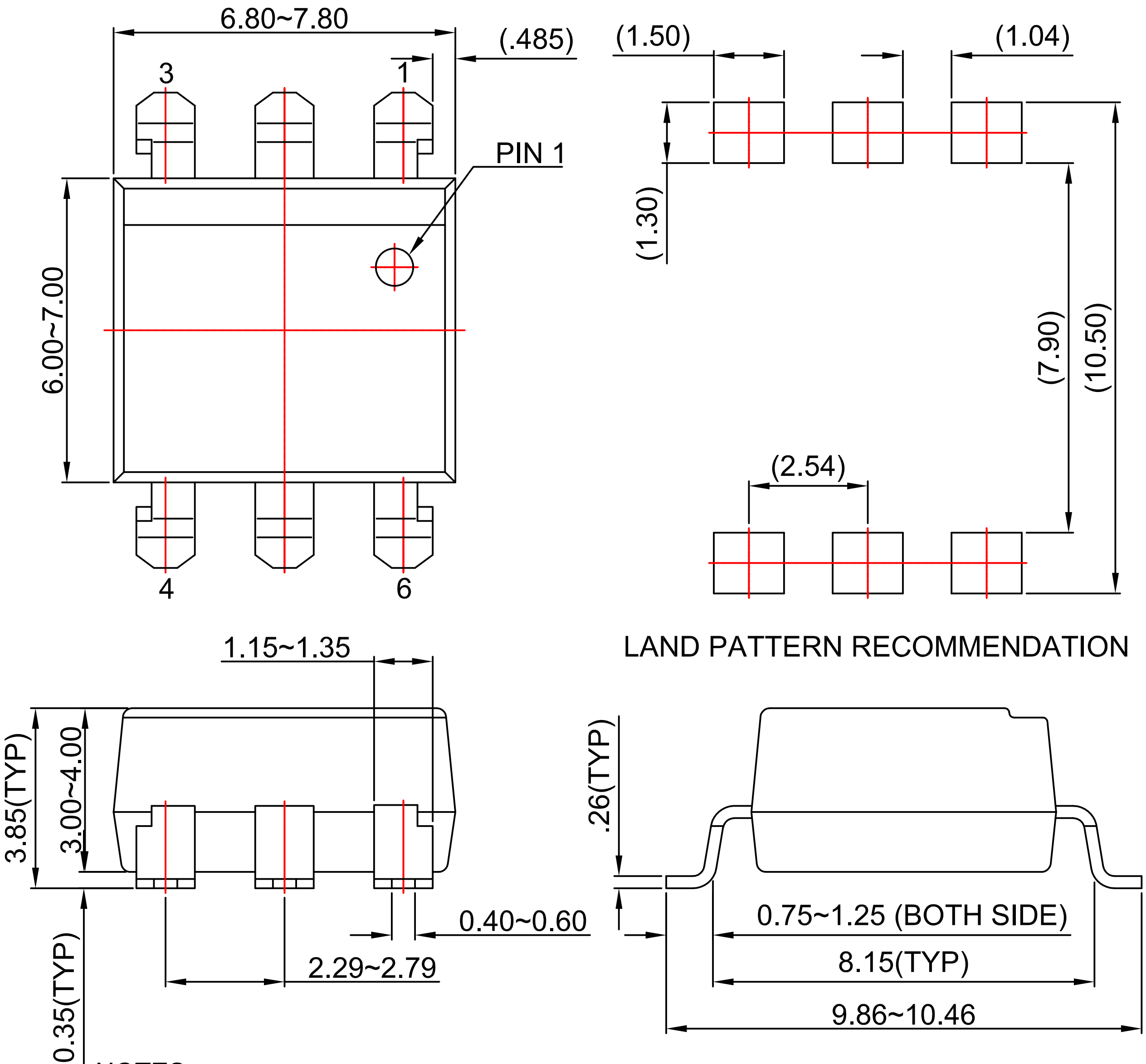


Figure 18. Top Mark

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



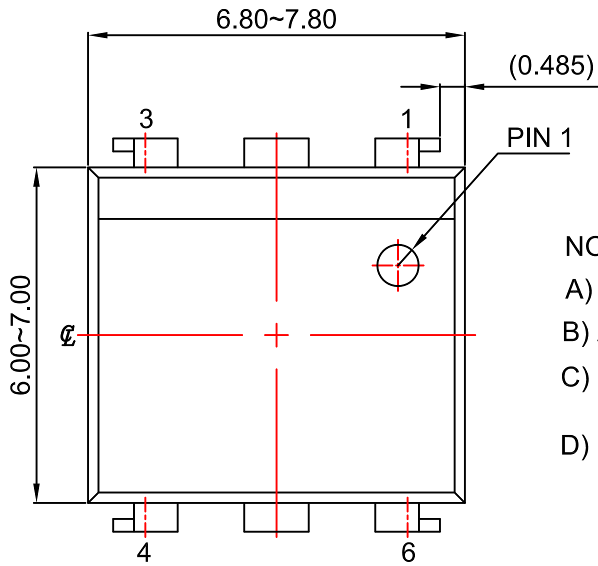
NOTES:

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 REVSION: MKT-N06rev2.



NOTES:

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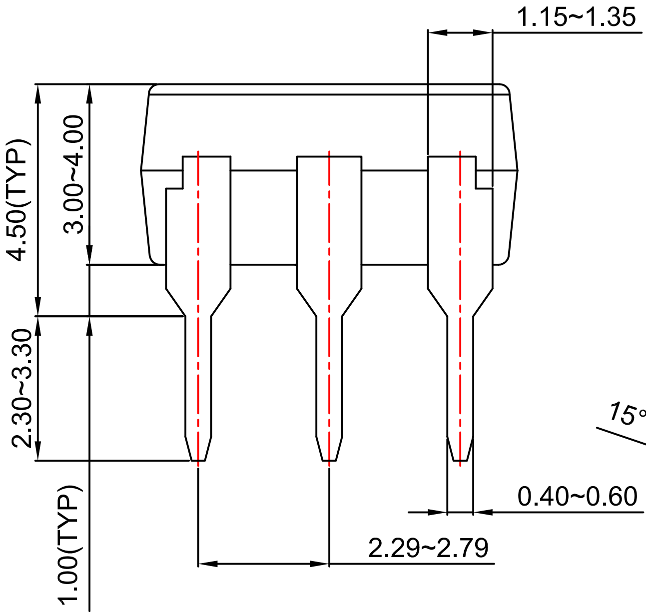

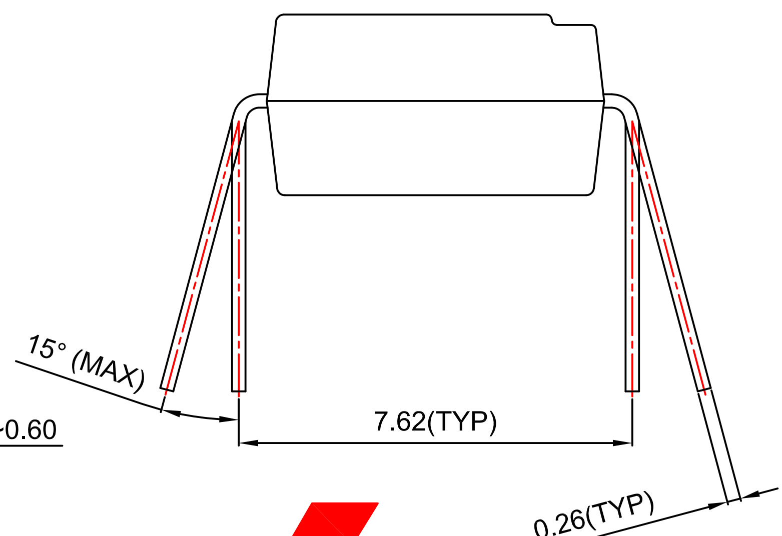

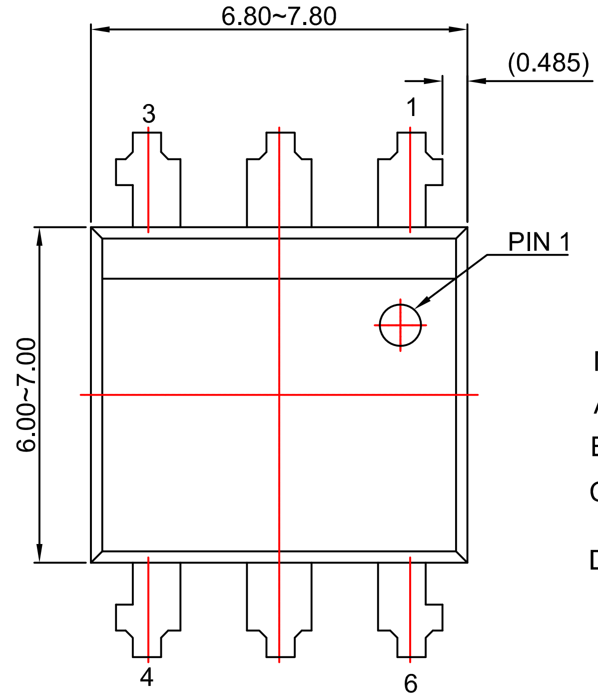

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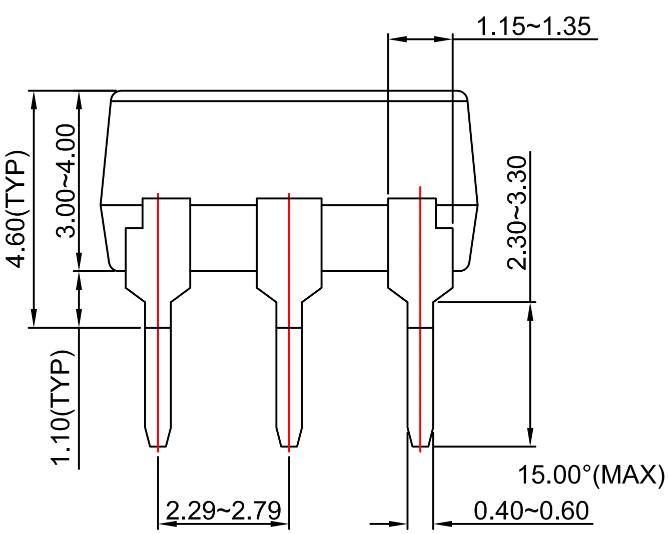
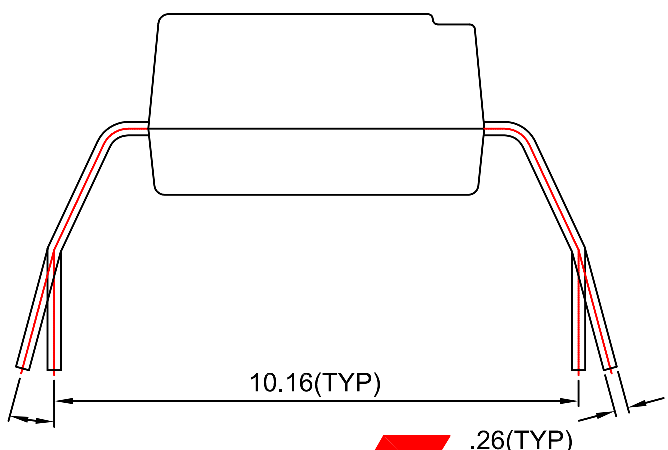
D) DRAWING FILENAME AND REVSION: MKT-N06Grev2.





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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.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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