



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<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5

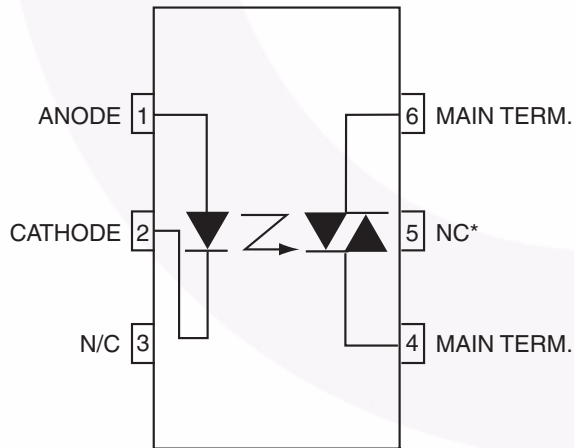
## Description

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

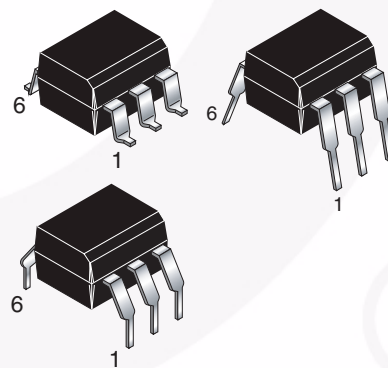


Figure 2. Package Outlines

FOD420, FOD4208, FOD4216, FOD4218 — 6-Pin DIP 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 <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	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/ $^\circ\text{C}$
<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	$I_F = 0^{(3)}$ (Figure 13)	All	10,000			V/ $\mu\text{s}$

**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<sub>A</sub> = 25°C unless otherwise specified.**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
I <sub>FT</sub>	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 <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> = 3 V	All		200	500	μA
I <sub>L</sub>	Latching Current	V <sub>T</sub> = 2.2 V	All		5		mA
t <sub>ON</sub>	Turn-On Time	PF = 1.0, I <sub>T</sub> = 300 mA	V <sub>RM</sub> = V <sub>DM</sub> = 424 VAC	FOD420, FOD4216, FOD4218	60		μs
			V <sub>RM</sub> = V <sub>DM</sub> = 565 VAC	FOD4208			
t <sub>OFF</sub>	Turn-Off Time	PF = 1.0, I <sub>T</sub> = 300 mA	V <sub>RM</sub> = V <sub>DM</sub> = 424 VAC	FOD420, FOD4216, FOD4218	52		μs
			V <sub>RM</sub> = V <sub>DM</sub> = 565 VAC	FOD4208			
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		V/μs
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> = 0 A, V <sub>RM</sub> = V <sub>DM</sub> = 424 VAC	All		10,000		V/μs

**Note:**

4. All devices are guaranteed to trigger at an I<sub>F</sub> value less than or equal to max I<sub>FT</sub>. Therefore, recommended operating I<sub>F</sub> lies between max I<sub>FT</sub> (2 mA for FOD420 and FOD4208 and 1.3 mA for FOD4216 and FOD4218) and the absolute max I<sub>F</sub> (60 mA).

**Isolation Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
V <sub>ISO</sub>	Steady State Isolation Voltage	f = 60 Hz, t = 1 Minute <sup>(5)</sup>	All	5,000			VAC <sub>RMS</sub>

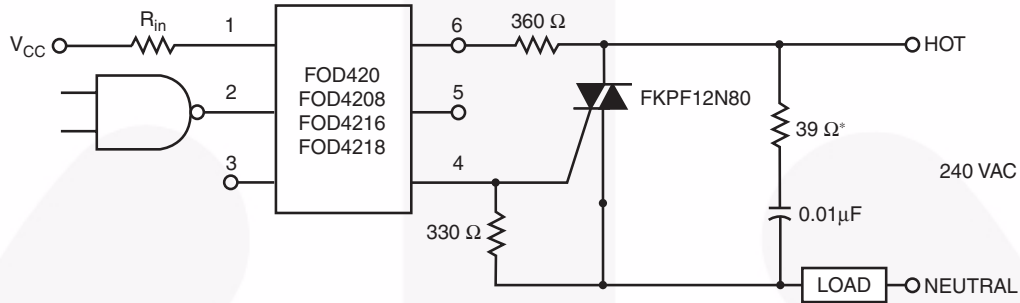
**Note:**

5. Isolation voltage, V<sub>ISO</sub>, 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 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.

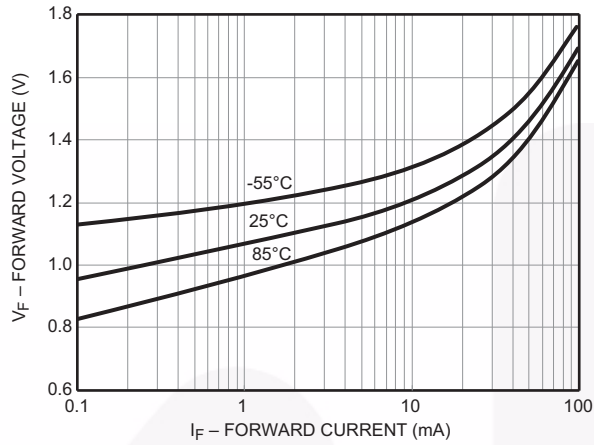
$R_{in}$  is calculated so that  $I_F$  is equal to the rated  $I_{FT}$  of the part, 2 mA for FOD420 and FOD4208, 1.3 mA for FOD4216 and FOD4218. The 39  $\Omega$  resistor and 0.01  $\mu F$  capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac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



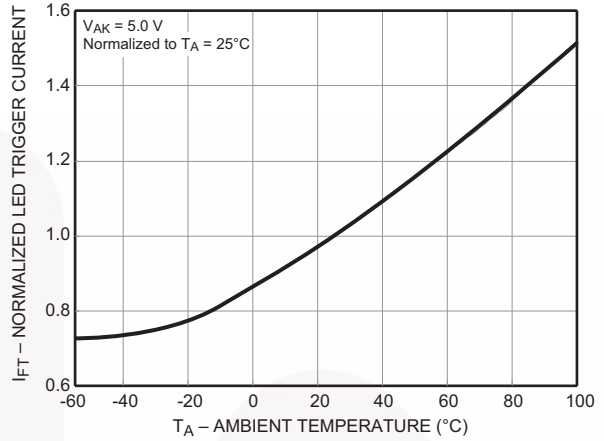
\* For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

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

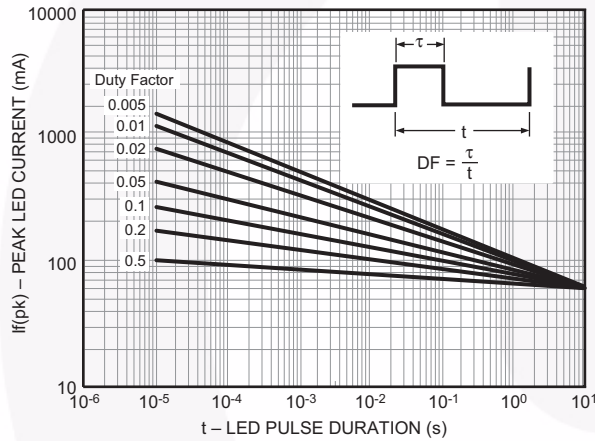
## Typical Performance Characteristics



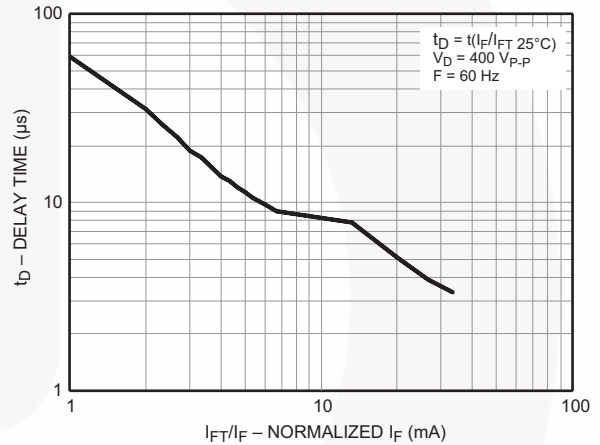
**Figure 4. Forward Voltage ( $V_F$ ) vs. Forward Current ( $I_F$ )**



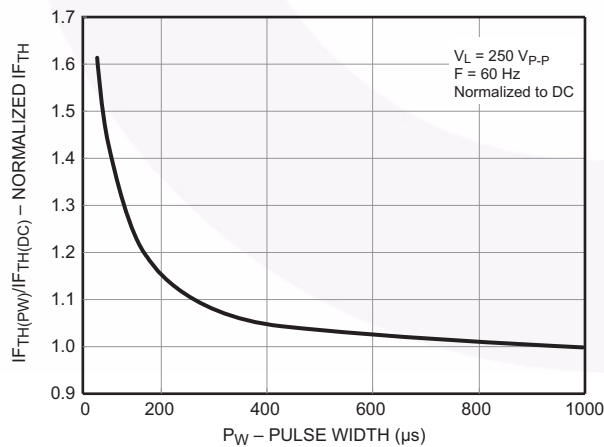
**Figure 5. Normalized LED Trigger Current ( $I_{FT}$ ) vs. Ambient Temperature ( $T_A$ )**



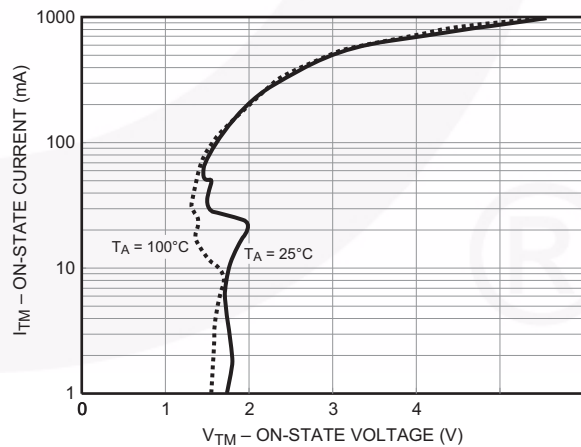
**Figure 6. Peak LED Current vs. Duty Factor, Tau**



**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)

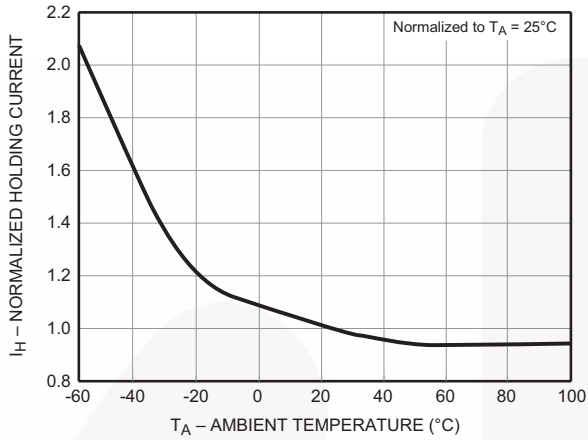


Figure 10. Normalized Holding Current (I<sub>H</sub>) vs. Ambient Temperature (T<sub>A</sub>)

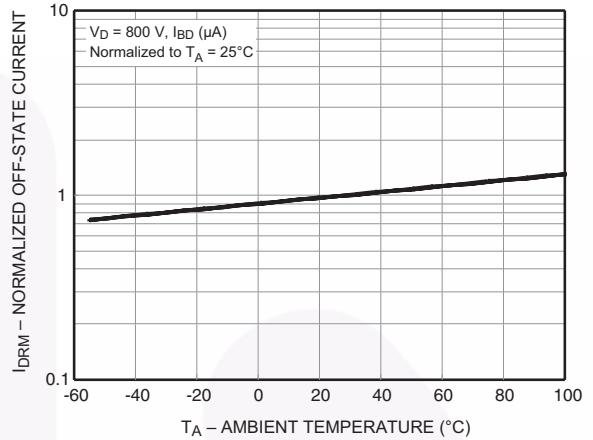


Figure 11. Normalized Off-State Current (I<sub>DRM</sub>) vs. Ambient Temperature (T<sub>A</sub>)

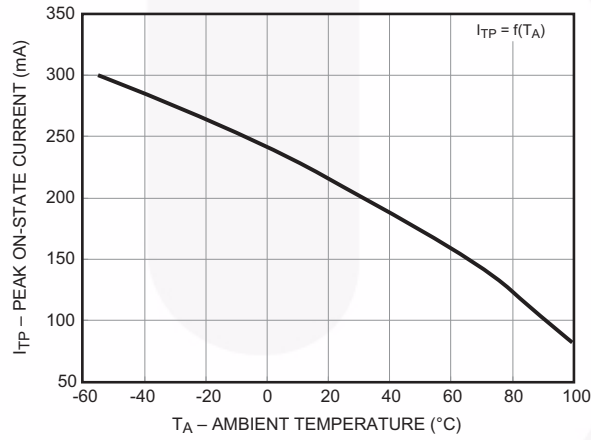
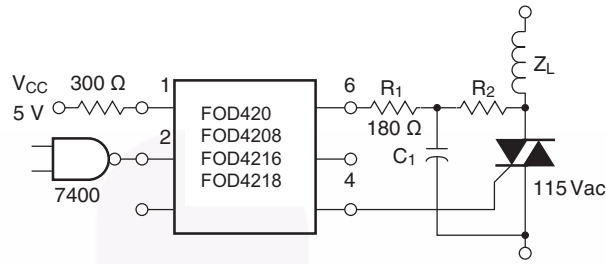


Figure 12. Current Reduction





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)	$R_2$ ( $\Omega$ )	$C_1$ ( $\mu\text{F}$ )
15	2400	0.1
30	1200	0.2
50	800	0.3

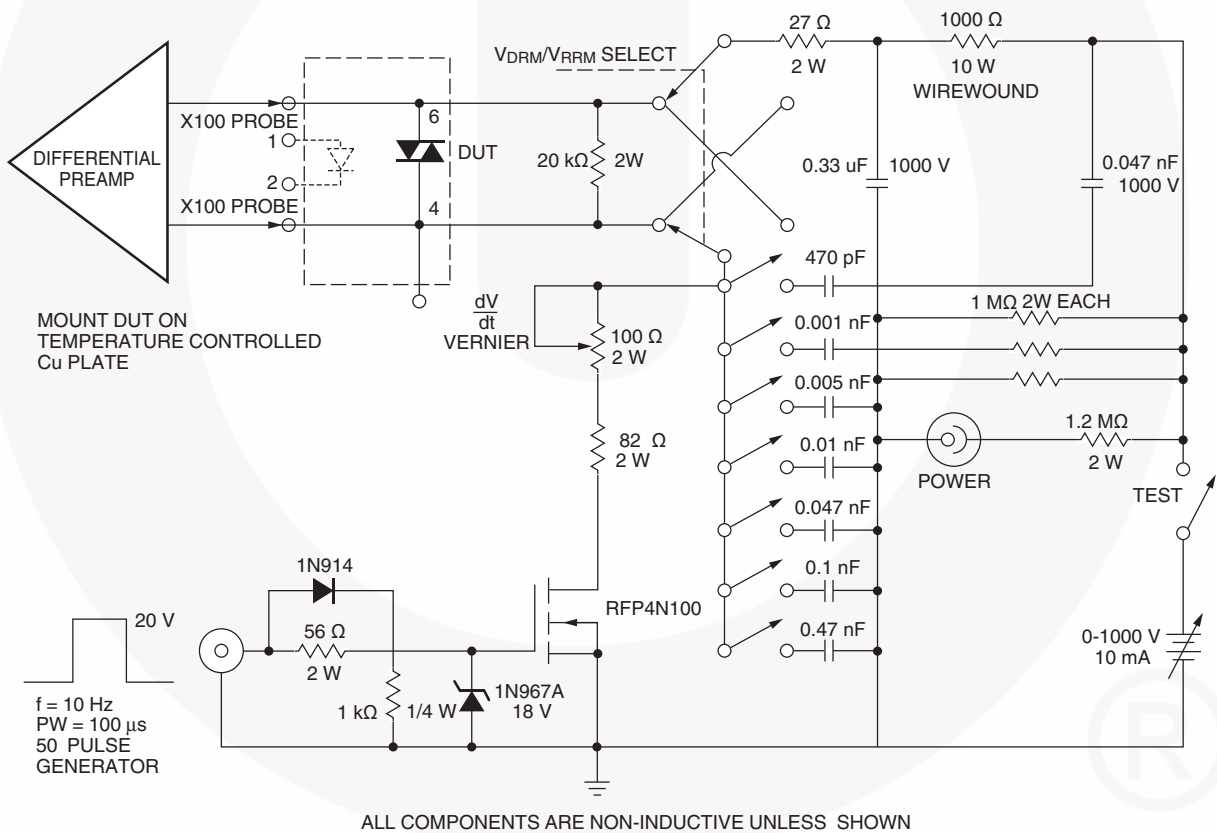
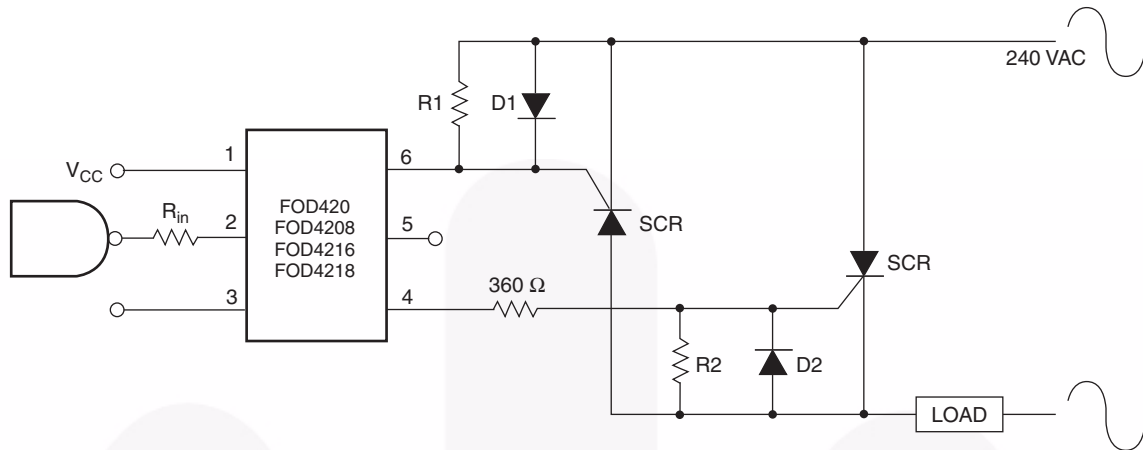


Figure 13. Circuit for Static  $\frac{dv}{dt}$  Measurement of Power Thyristors

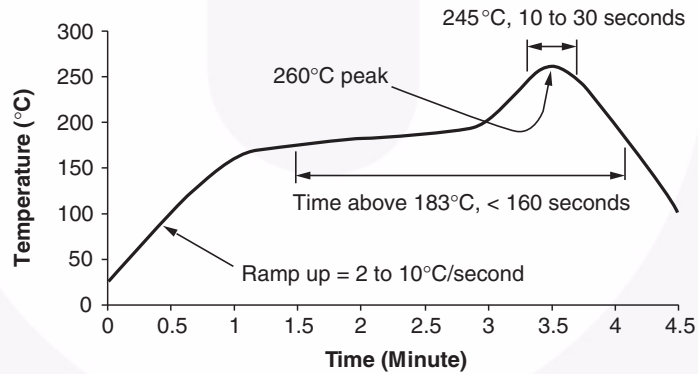


**Figure 14. Inverse-Parallel SCR Driver Circuit**

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

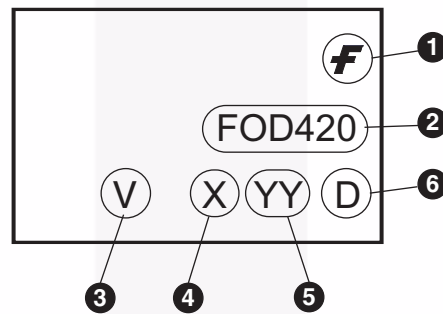
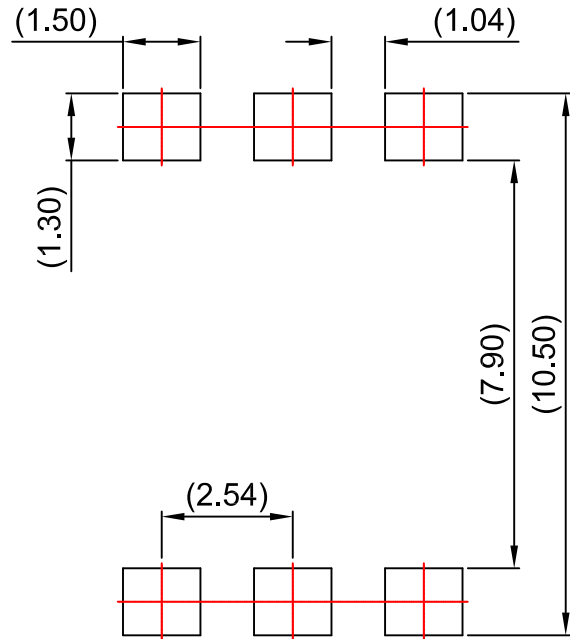
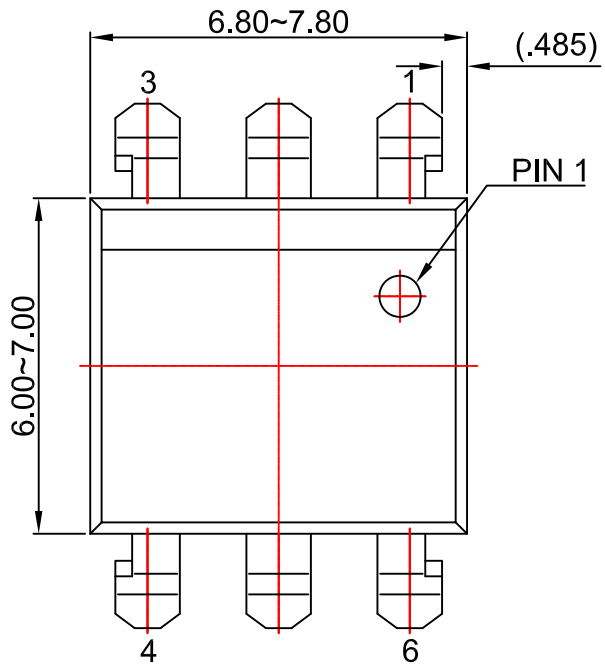


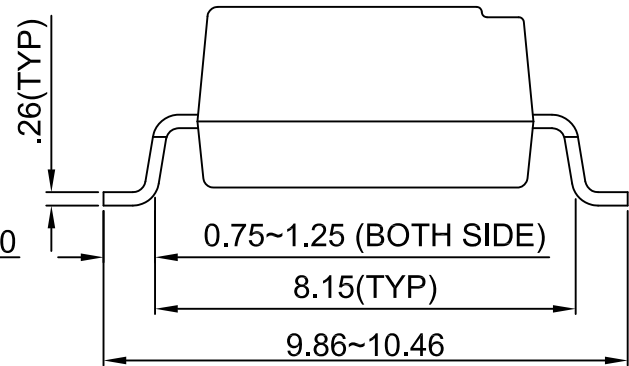
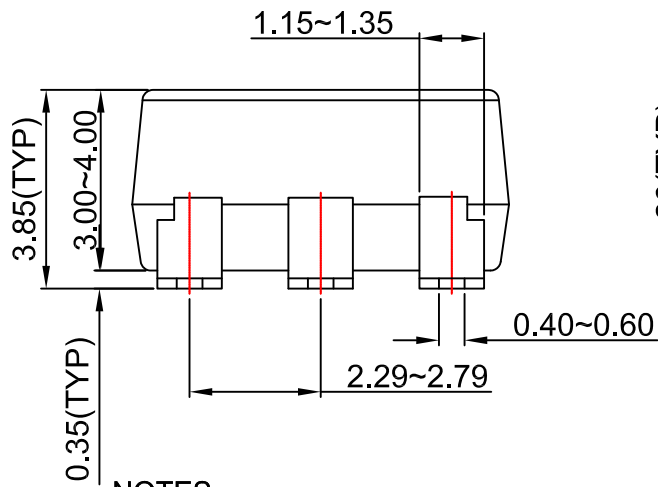
Figure 16. Top Mark

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



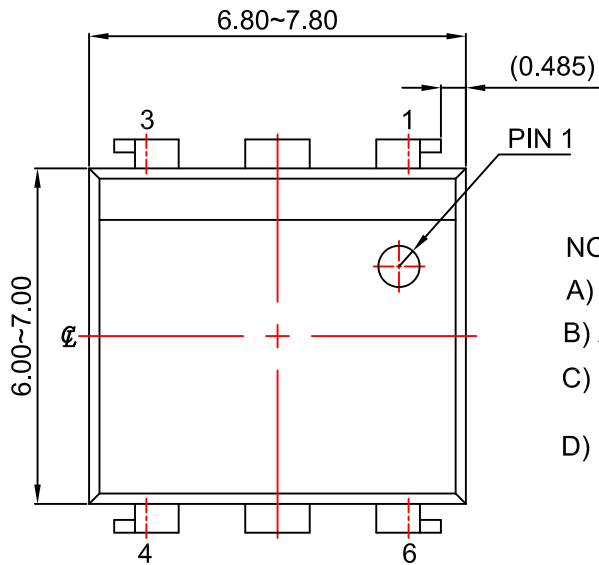
LAND PATTERN RECOMMENDATION



NOTES:

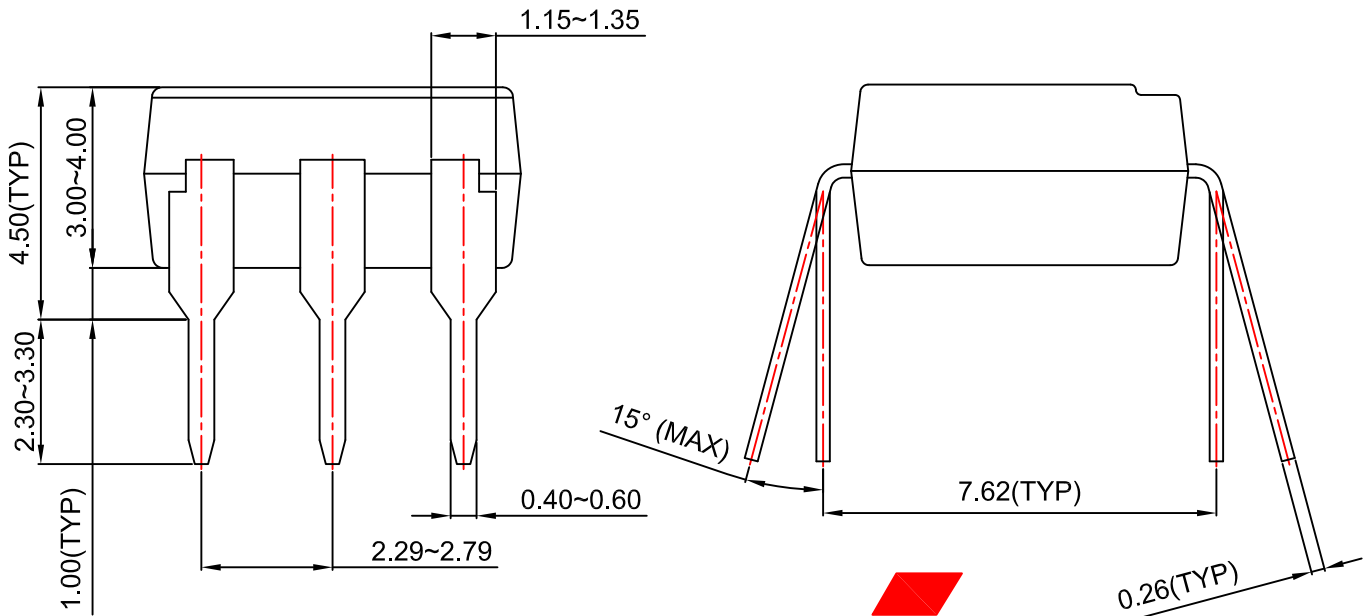
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06rev2.

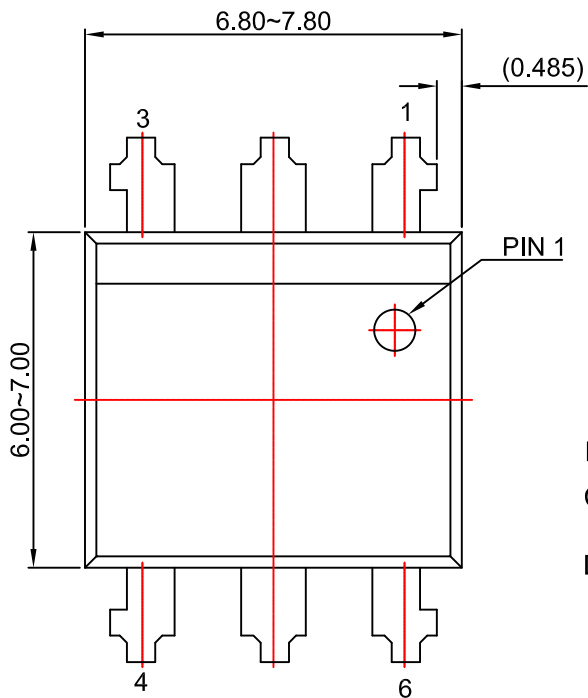




NOTES:

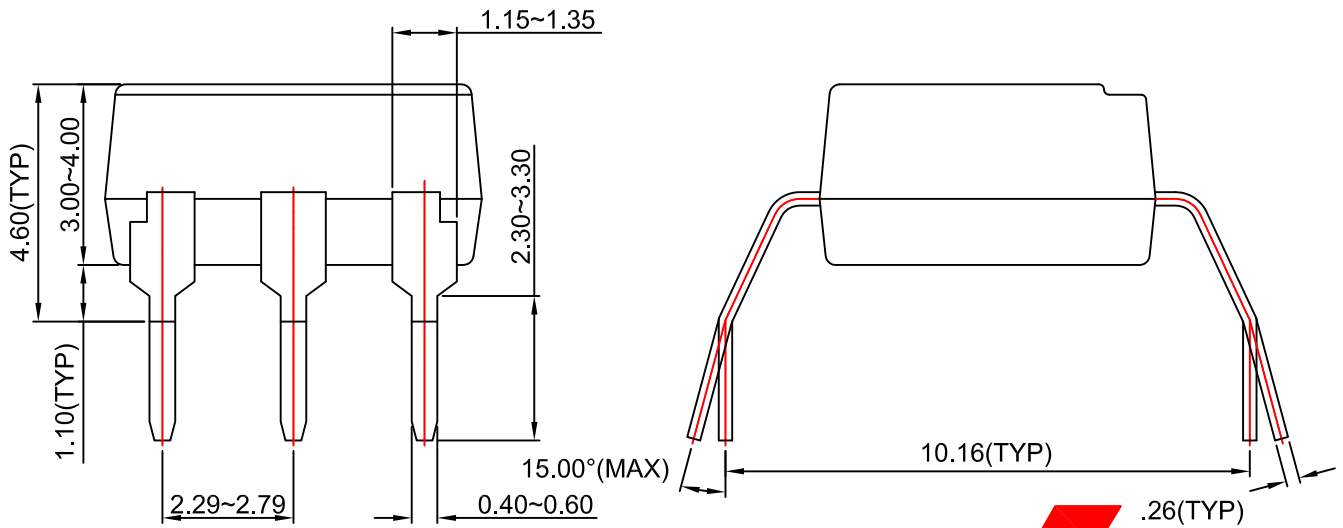
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06Erev2.





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.





**TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- |                          |  |                                       |                  |
|--------------------------|--|---------------------------------------|------------------|
| AccuPower™               | F-PFS™   | OPTOPLANAR®                           | SYSTEM GENERAL®  |
| AttitudeEngine™          | FRFET®   | Power Supply WebDesigner™             | TinyBoost®       |
| Awinda®                  | Global Power Resource <sup>SM</sup>            | PowerTrench®                          | TinyBuck®        |
| AX-CAP®*                 | GreenBridge™                                   | PowerXS™                              | TinyCalc™        |
| BitSiC™                  | Green FPS™                                     | Programmable Active Droop™            | TinyLogic®       |
| Build it Now™            | Green FPS™ e-Series™                           | QFET®                                 | TINYOPTO™        |
| CorePLUS™                | Gmax™  | QS™                                   | TinyPower™       |
| CorePOWER™               | GTO™   | Quiet Series™                         | TinyPWM™         |
| CROSSVOL™                | IntelliMAX™                                    | RapidConfigure™                       | TinyWire™        |
| CTL™                     | ISOPLANAR™                                     | Saving our world, 1mW/W/kW at a time™ | TranSiC™         |
| Current Transfer Logic™  | Making Small Speakers Sound Louder and Better™ | SignalWise™                           | TriFault Detect™ |
| DEUXPEED®                | MegaBuck™                                      | SmartMax™                             | TRUECURRENT®*    |
| Dual Cool™               | MICROCOUPLER™                                  | SMART START™                          | μSerDes™         |
| EcoSPARK®                | MicroFET™                                      | Solutions for Your Success™           | UHC®             |
| EfficientMax™            | MicroPak™                                      | SPM®                                  | Ultra FRFET™     |
| ESBC™                    | MicroPak2™                                     | STEALTH™                              | UniFET™          |
| F <sup>®</sup>           | MillerDrive™                                   | SuperFET®                             | VCX™             |
| Fairchild®               | MotionMax™                                     | SuperSOT™-3                           | VisualMax™       |
| Fairchild Semiconductor® | MotionGrid®                                    | SuperSOT™-6                           | VoltagePlus™     |
| FACT Quiet Series™       | MTi®   | SuperSOT™-8                           | XST™             |
| FACT®                    | MTx®   | SupreMOS®                             | Xsens™           |
| FastvCore™               | MVN®   | SyncFET™                              | 仙童®              |
| FETBench™                | mWSaver®                                       | Sync-Lock™                            |                  |
| FPS™                     | OptoHiT™                                       |                                       |                  |
|                          | OPTOLOGIC®                                     |                                       |                  |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT [HTTP://WWW.FAIRCHILDSEMI.COM](http://www.fairchildsemi.com). FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**AUTHORIZED USE**

Unless otherwise specified in this data sheet, this product is a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability. This product may not be used in the following applications, unless specifically approved in writing by a Fairchild officer: (1) automotive or other transportation, (2) military/aerospace, (3) any safety critical application – including life critical medical equipment – where the failure of the Fairchild product reasonably would be expected to result in personal injury, death or property damage. Customer's use of this product is subject to agreement of this Authorized Use policy. In the event of an unauthorized use of Fairchild's product, Fairchild accepts no liability in the event of product failure. In other respects, this product shall be subject to Fairchild's Worldwide Terms and Conditions of Sale, unless a separate agreement has been signed by both Parties.

**ANTI-COUNTERFEITING POLICY**

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Terms of Use

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

**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.

Rev. I77