FAIRCHILD SEMICONDUCTOR®

September 2010

FODM3062, FODM3063, FODM3082, FODM3083 4-Pin Full Pitch Mini-Flat Package Zero-Cross Triac Driver Output Optocouplers

Features

- dv/dt of 600V/µs guaranteed
- Compact 4-pin surface mount package (2.4mm maximum standoff height)
- Zero voltage crossing
- Peak blocking voltage: 600V (FODM306X)
800V (FODM308X)
- Available in tape and reel quantities of 2500
- C-UL, UL and VDE certifications pending

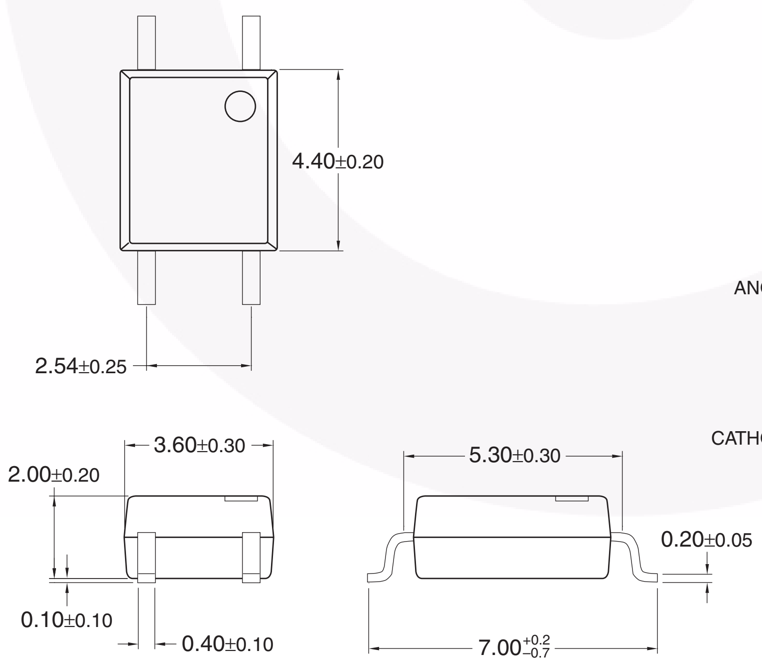
Applications

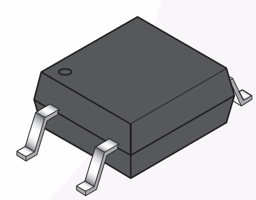
- Solenoid/valve controls
- Lighting controls
- Static power switches
- AC motor drives
- Temperature controls
- E.M. contactors
- AC motor starters
- Solid state relays

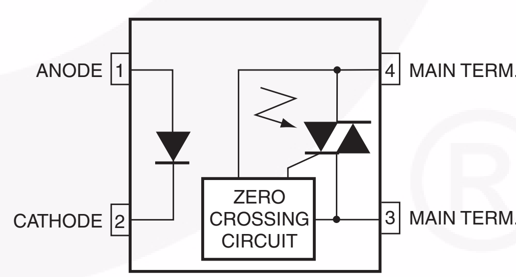
Description

The FODM306X and FODM308X series consist of an infrared emitting diode optically coupled to a monolithic silicon detector performing the function of a zero voltage crossing bilateral triac driver, and is housed in a compact 4-pin mini-flat package. The lead pitch is 2.54mm. They are designed for use with a triac in the interface of logic systems to equipment powered from 115/240 VAC lines, such as solid state relays, industrial controls, motors, solenoids and consumer appliances.

Package Dimensions







Note:
All dimensions are in millimeters.

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Absolute Maximum Ratings (T_A = 25°C unless otherwise specified)

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	Parameter		Rating	Units
TOTAL PACKAGE				
T_{STG}	Storage Temperature		-55 to +150	°C
T_{OPR}	Operating Temperature		-40 to +100	°C
EMITTER				
$I_{F\ (avg)}$	Continuous Forward Current		60	mA
$I_{F\ (pk)}$	Peak Forward Current (1µs pulse, 300pps.)		1	A
V_R	Reverse Input Voltage		6	V
P_D	Power Dissipation (No derating required over operating temp. range)		100	mW
DETECTOR				
$I_{T(RMS)}$	On-State RMS Current		70	mA (RMS)
V_{DRM}	Off-State Output Terminal Voltage	FODM3062/FODM3063	600	V
		FODM3082/FODM3083	800	
P_D	Power Dissipation (No derating required over operating temp. range)		300	mW

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Electrical Characteristics (T_A = 25°C)

Individual Component Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.*	Max.	Units
EMITTER						
V_F	Input Forward Voltage	I_F = 30mA			1.5	V
I_R	Reverse Leakage Current	V_R = 6V			100	µA
DETECTOR						
I_{DRM1}	Peak Blocking Current, Either Direction	Rated V_{DRM}, I_F = 0(1)			500	nA
dV/dt	Critical Rate of Rise of Off-State Voltage	I_F = 0 (Figure 1)(2)	600			V/µs

Transfer Characteristics

Symbol	DC Characteristics	Test Conditions	Device	Min.	Typ.*	Max.	Units
I_{FT}	LED Trigger Current	Main Terminal Voltage = 3V(3)	FODM3062			10	mA
			FODM3082				
			FODM3063			5	
			FODM3083				
I_H	Holding Current, Either Direction		All		300		µA
V_{TM}	Peak On-State Voltage, Either Direction	I_F = Rated I_{FT}, I_{TM} = 100mA peak	All			3	V

Zero Crossing Characteristics

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.*	Max.	Units
V_{IH}	Inhibit Voltage, MT1-MT2 Voltage above which device will not trigger	I_F = Rated I_{FT}	All			20	V
IDRM2	Leakage in Inhibit State	I_F = Rated I_{FT}, Rated VDRM, Off-State	All			2	mA

Isolation Characteristics

Characteristics	Test Conditions	Symbol	Device	Min.	Typ.*	Max.	Units
Steady State Isolation Voltage(4)	(1 Minute) R.H. = 40% to 60%	V_{ISO}	All	3750			VRMS

*All typicals at 25°C.

Notes:
1. Test voltage must be applied within dv/dt rating.
2. This is static dv/dt. See Figure 1 for test circuit. Commutating dv/dt is function of the load-driving thyristor(s) only.
3. 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} (10mA for FODM3062/82, 5mA for FODM3063/83) and absolute max I_F (60 mA).
4. Steady state isolation voltage, V_{ISO}, is an internal device dielectric breakdown rating. For this test, pins 1 & 2 are common, and pins 3 & 4 are common.

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Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

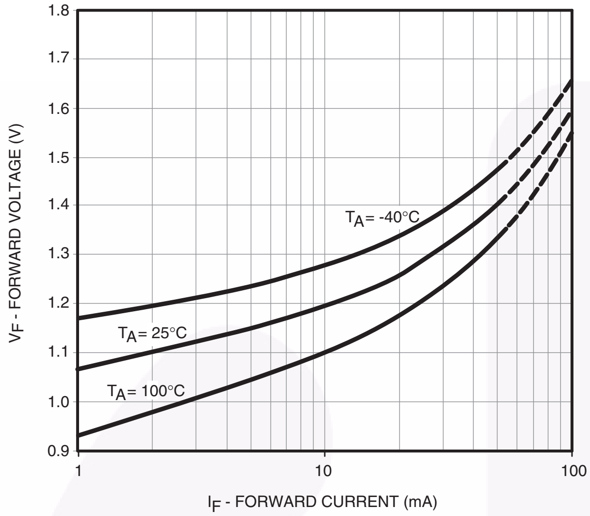


Fig. 2 Leakage Current vs. Ambient Temperature

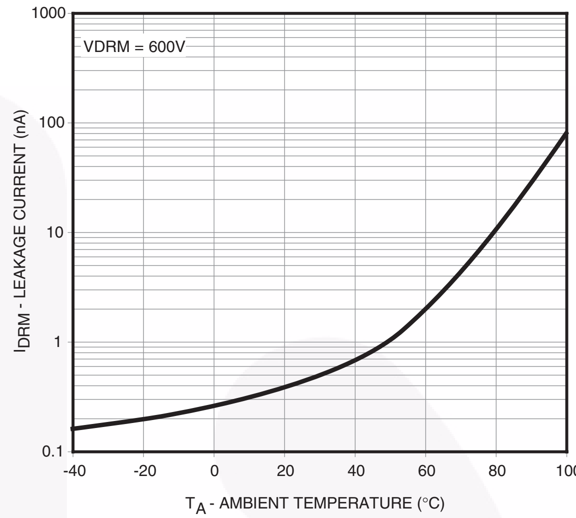


Fig. 3 Holding Current vs. Ambient Temperature

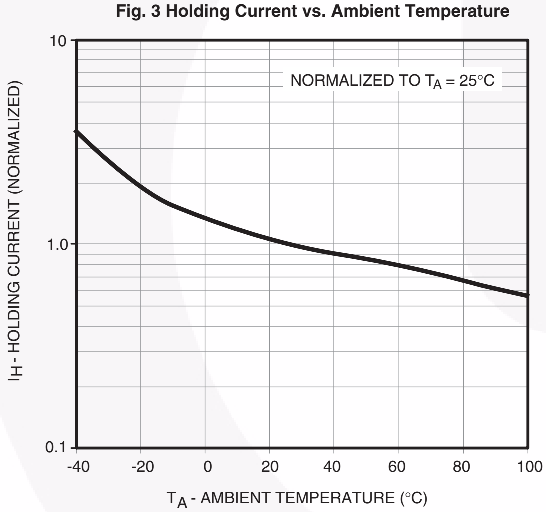
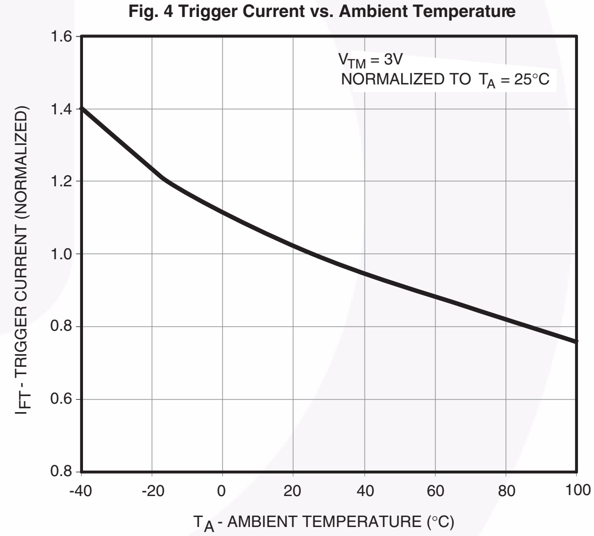


Fig. 4 Trigger Current vs. Ambient Temperature



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Typical Performance Curves (Continued)

Fig. 5 LED Current Required to Trigger vs. LED Pulse Width

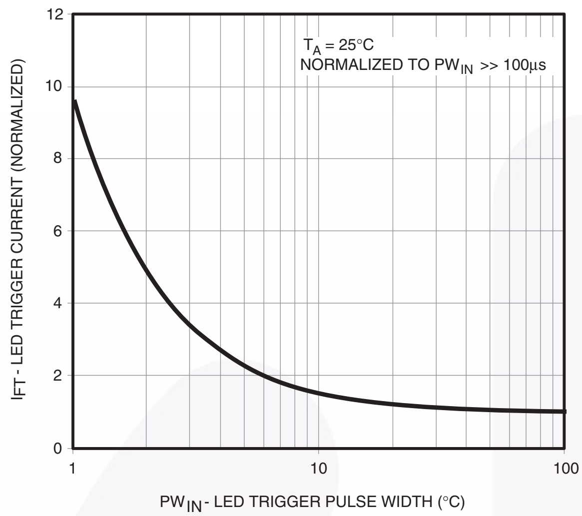


Fig. 6 Off-State Output Terminal Voltage vs. Ambient Temperature

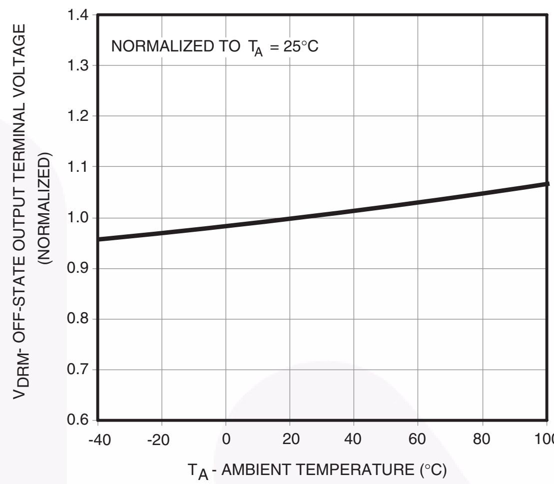
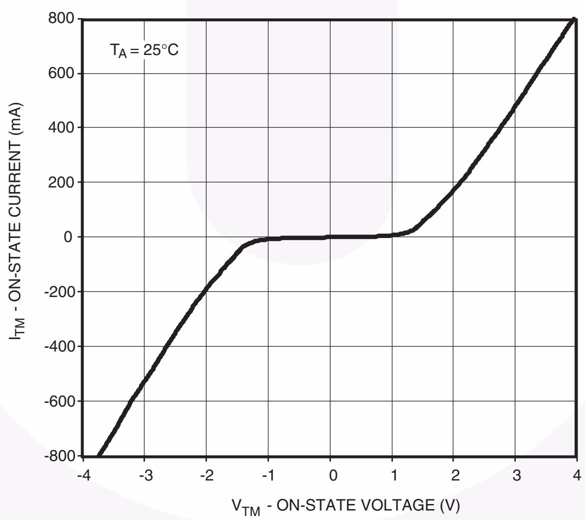


Fig. 7 On-State Characteristics



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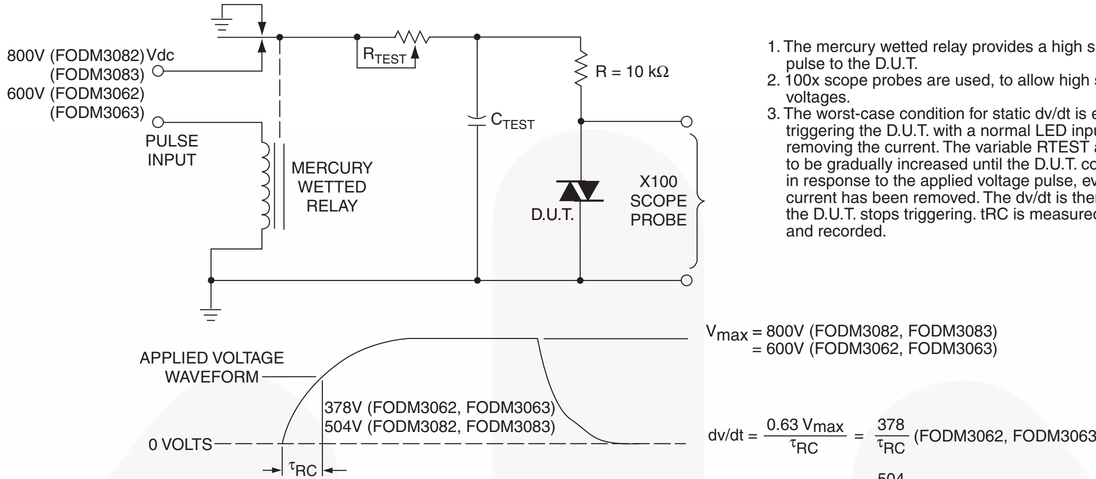
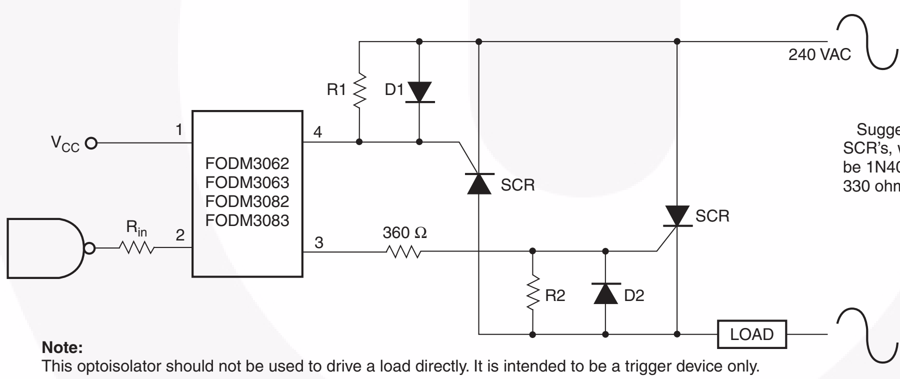
Typical Applications



1. The mercury wetted relay provides a high speed repeated pulse to the D.U.T.
2. 100x scope probes are used, to allow high speeds and voltages.
3. The worst-case condition for static dv/dt is established by triggering the D.U.T. with a normal LED input current, then removing the current. The variable RTEST allows the dv/dt to be gradually increased until the D.U.T. continues to trigger in response to the applied voltage pulse, even after the LED current has been removed. The dv/dt is then decreased until the D.U.T. stops triggering. tRC is measured at this point and recorded.

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

Figure 8. Static dv/dt Test 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 ohms.

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

Figure 9. Inverse-Parallel SCR Driver Circuit (240VAC)

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Determining the Power Rating of the Series Resistors Used in a Zero-Cross Opto-TRIAC Driver Application

The following will present the calculations for determining the power dissipation of the current limiting resistors found in an opto-TRIAC driver interface.

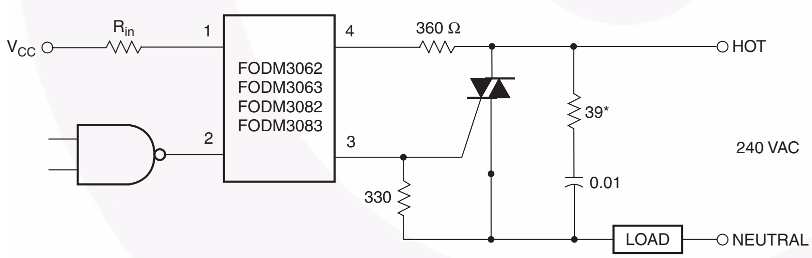
Figure 10 shows a typical circuit to drive a sensitive gate four quadrant power TRIAC. This figure provides typical resistor values for a zero line cross detecting opto-TRIAC when operated from a mains voltage of 20V to 240V. The wattage rating for each resistor is not given because their dissipation is dependent upon characteristics of the power TRIAC being driven.

Recall that the opto-TRIAC is used to trigger a four quadrant power TRIAC. Please note that these opto-TRIACs are not recommended for driving "snubberless" three quadrant power TRIACs.

Under normal operation, the opto-TRIAC will fire when the mains voltage is lower than the minimum inhibit trigger voltage, and the LED is driven at a current greater than the maximum LED trigger current. As an example for the FODM3063, the LED trigger current should be greater than 5mA, and the mains voltage is less than 10V peak. The inhibit voltage has a typical range of 10V minimum and 20V maximum. This means that if a sufficient LED current is flowing when the mains voltage is less than 10V, the device will fire. If a trigger appears between 10V and 20V, the device may fire. If the trigger occurs after the mains voltage has reached 20Vpeak, the device will not fire.

The power dissipated from resistors placed in series with the opto-TRIAC and the gate of the power TRIAC is much smaller than one would expect. These current handling components only conduct current when the mains voltage is less than the maximum inhibit voltage. If the opto-TRIAC is triggered when the mains voltage is greater than the inhibit voltage, only the TRIAC leakage current will flow. The power dissipation in a 360Ω resistor shown in Figure 10 is the product of the resistance (360Ω) times the square of the current sum of main TRIAC's gate current plus the current flowing gate to the MT2 resistor connection (330Ω). This power calculation is further modified by the duty factor of the duration for this current flow. The duty factor is the ratio of the turn-on time of the main TRIAC to the sine of the single cycle time. Assuming a main TRIAC turn-on time of 50µs and a 60Hz mains voltage, the duty cycle is approximately 0.6%. The opto-TRIAC only conducts current while triggering the main TRIAC. Once the main TRIAC fires, its on-state voltage is typically lower than the on-state sustaining voltage of the opto-TRIAC. Thus, once the main TRIAC fires, the opto-TRIAC is often shunted off. This situation results in very low power dissipation for both the 360Ω and 330Ω resistors, when driving a traditional four quadrant power TRIAC.

If a three quadrant "snubberless" TRIAC is driven by the opto-TRIAC, the calculations are different. When the main power TRIAC is driving a high power factor (resistive) load, it shuts off during the fourth quadrant.



Typical circuit for use when hot line switching of 240VAC 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, 5mA for the FODM3063/83 and 10mA for the FODM3062/82. The 39Ω resistor and 0.01µF capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load used.

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

Figure 10. Hot-Line Switching Application Circuit

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If sufficient holding current is still flowing through the opto-TRIAC, the opto-TRIAC will turn-on and attempt to carry the power TRIACs load. This situation typically causes the opto-TRIAC to operate beyond its maximum current rating, and product and resistor failures typically result. For this reason, using an opto-TRIAC to drive a three quadrant "snubberless" power TRIAC is not recommended.

Power in the 360Ω resistor, when driving a sensitive gate 4 quadrant power TRIAC:

I_{GT} = 20mA
V_{GT} = 1.5V
DF = 0.6%

$P = (I_{GT} + V_{GT} / 330\Omega)^2 \times 360\Omega \times DF$

$P = (20mA + 1.5 / 330\Omega)^2 \ast x\ 360\Omega \times 0.6\% = 1.3mW$

A 1/4 watt resistor is more than adequate for both the 360Ω and 330Ω resistors.

The real power in the snubber resistor is based upon the integral of the power transient present when the load commutes. A fast commuting transient may allow a peak current of 4A to 8A in the snubbing filter. For best results, the capacitor should be a non-polarized AC unit with a low ESR. The 39Ω series resistor sets a time constant and limits the peak current. For a resistive load with a power factor near unity, the commutating transients will be small. This results in a very small peak current given the 0.01µF capacitor's reactance. Normally, for factional horse-power reactive loads, the resistor found in the snubber circuit will have a power rating from 1/2W to 2W. The resistor should be a low inductance type to adequately filter the high frequency transients.

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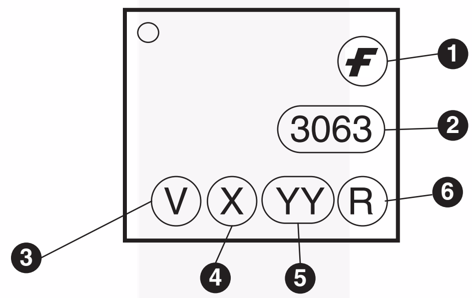
Ordering Information

Option	Description
No option	Bulk (100 units/tube)
V	VDE Approved
R2	Tape and Reel (2500 units)
R2V	Tape and Reel (2500 units) and VDE Approved

Marking Information



Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

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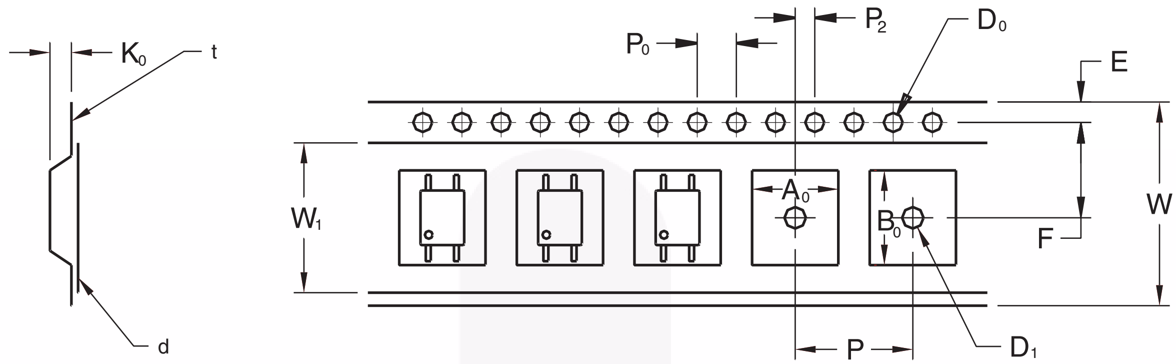
Tape and Reel Information



Description	Symbol	2.54 Pitch Dimensions
Tape Width	W	12.00±0.4
Tape Thickness	t	0.35±0.02
Sprocket Hole Pitch	P_0	4.00±0.20
Sprocket Hole Dia.	D_0	1.55±0.20
Sprocket Hole Location	E	1.75±0.20
Pocket Location	F	5.50±0.20
	P_2	2.00±0.20
Pocket Pitch	P	8.00±0.20
Pocket Dimension	A_0	4.75±0.20
	B_0	7.30±0.20
	K_0	2.30±0.20
Pocket Hole Dia.	D_1	1.55±0.20
Cover Tape Width	W_1	9.20
Cover Tape Thickness	d	0.065±0.02
Max. Component Rotation or Tilt		20° max
Devices Per Reel		2500
Reel Diameter		330 mm (13")

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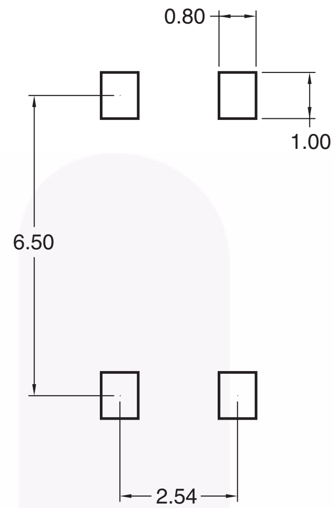
Footprint Drawing for PCB Layout



Note:
All dimensions are in mm.

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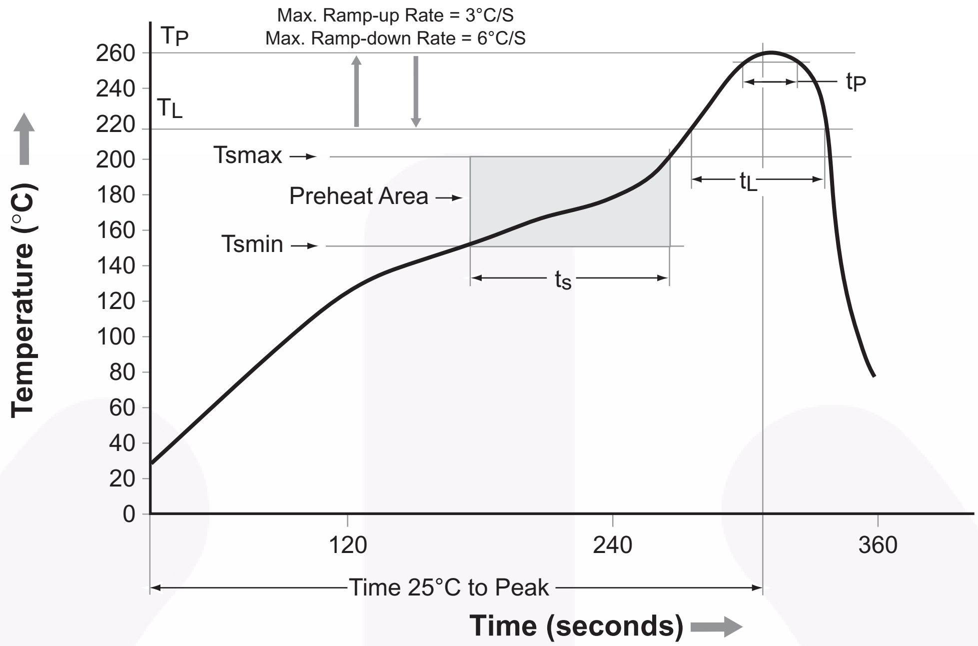
Reflow Profile



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60–120 seconds
Ramp-up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60–150 seconds
Peak Body Package Temperature	260°C +0°C / –5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp-down Rate (T_P to T_L)	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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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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