

# FOD410, FOD4108, FOD4116, FOD4118

## 6-Pin DIP High dv/dt Zero-Cross Triac Drivers

### 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.

### Features

- 300 mA<sub>peak</sub> 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, FOD4118)
- 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
- These Devices are Pb-Free and are RoHS Compliant

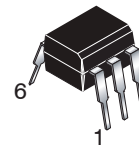
### Applications

- Solid-State Relays
- Industrial Controls
- Lighting Controls
- Static Power Switches
- AC Motor Starters

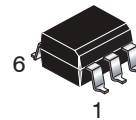


**ON Semiconductor®**

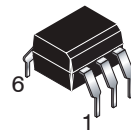
[www.onsemi.com](http://www.onsemi.com)



**PDIP6 GW  
CASE 709AG**

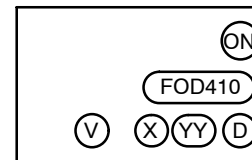


**PDIP6 7.3x6.5, 2.54P  
CASE 646CE**



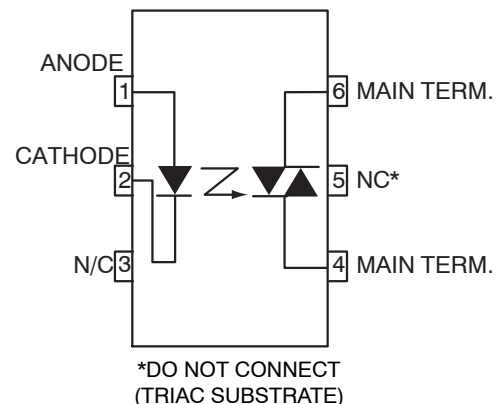
**PDIP6 7.3x6.5, 2.54P  
CASE 646CF**

### MARKING DIAGRAM



- ON = ON Semiconductor Logo
- FOD410 = Device Number
- V = VDE mark. DIN EN/IEC60747-5-5  
Option (only appears on component ordered with this option)
- X = One-Digit Year Code
- YY = Digit Work Week
- D = Assembly Package Code

### FUNCTIONAL SCHEMATIC



### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

# FOD410, FOD4108, FOD4116, FOD4118

## SAFETY AND INSULATION RATINGS

Parameter		Characteristics
Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	< 150 V <sub>RMS</sub>	I-IV
	< 300 V <sub>RMS</sub>	I-IV
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 (Note 1)	175	°C
I <sub>S,INPUT</sub>	Input Current (Note 1)	400	mA
P <sub>S,OUTPUT</sub>	Output Power (Note 1)	700	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V (Note 1)	> 10 <sup>9</sup>	Ω

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.

1. Safety limit values – maximum values allowed in the event of a failure.

# FOD410, FOD4108, FOD4116, FOD4118

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, Unless otherwise specified)

Symbol	Parameter	Device	Value	Unit
T <sub>STG</sub>	Storage Temperature	All	-55 to +150	°C
T <sub>OPR</sub>	Operating Temperature	All	-55 to +100	°C
T <sub>J</sub>	Junction Temperature	All	-55 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature	All	260 for 10 sec	°C
P <sub>D(TOTAL)</sub>	Total Device Power Dissipation @ 25°C	All	500	mW
	Derate Above 25°C	All	6.6	mW/°C

## EMITTER

I <sub>F</sub>	Continuous Forward Current	All	30	mA
V <sub>R</sub>	Reverse Voltage	All	6	V
P <sub>D(EMITTER)</sub>	Total Power Dissipation 25°C Ambient	All	50	mW
	Derate Above 25°C	All	0.71	mW/°C

## DETECTOR

V <sub>DRM</sub>	Off-State Output Terminal Voltage	FOD410, FOD4116	600	V
		FOD4108, FOD4118	800	
I <sub>TSM</sub>	Peak Non-Repetitive Surge Current (single cycle 60 Hz sine wave)	All	3	A <sub>peak</sub>
I <sub>TM</sub>	Peak On-State Current	All	300	mA <sub>peak</sub>
P <sub>D(DETECTOR)</sub>	Total Power Dissipation @ 25°C Ambient	All	450	mW
	Derate Above 25°C	All	5.9	mW/°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

# FOD410, FOD4108, FOD4116, FOD4118

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
--------	-----------	-----------------	--------	-----	-----	-----	------

### INDIVIDUAL COMPONENT CHARACTERISTICS

Emitter								
$V_F$	Input Forward Voltage	$I_F = 20\text{ mA}$	All	–	1.25	1.50	V	
$I_R$	Reverse Leakage Current	$V_R = 6\text{ V}$	All	–	0.0001	10	$\mu\text{A}$	
Detector								
$I_{D(RMS)}$	Peak Blocking Current Either Direction	$I_F = 0,$ $T_A = 100^\circ\text{C}$ (Note 2)	$V_D = 600\text{ V}$	FOD410, FOD4116	–	3	100	$\mu\text{A}$
			$V_D = 800\text{ V}$	FOD4108, FOD4118				
$I_{R(RMS)}$	Reverse Current	$T_A = 100^\circ\text{C}$	$V_D = 600\text{ V}$	FOD410, FOD4116	–	3	100	$\mu\text{A}$
			$V_D = 800\text{ V}$	FOD4108, FOD4118				
dv/dt	Critical Rate of Rise of Off-State Voltage	$I_F = 0\text{ A}$ (Note 3)	$V_D = V_{DRM}$	All	10,000	–	–	V/ $\mu\text{s}$

### TRANSFER CHARACTERISTICS

$I_{FT}$	LED Trigger Current	Main Terminal Voltage = 5 V (Note 4)		FOD410, FOD4108	–	0.65	2.0	mA
				FOD4116, FOD4118				
$V_{TM}$	Peak On-State Voltage, Either Direction	$I_{TM} = 300\text{ mA peak}, I_F = \text{Rated } I_{FT}$		All	–	2.2	3	V
$I_H$	Holding Current, Either Direction	$V_T = 3\text{ V}$		All	–	200	500	$\mu\text{A}$
$I_L$	Latching Current	$V_T = 2.2\text{ V}$		All	–	5	–	mA
$t_{ON}$	Turn-On Time	PF = 1.0, $I_T = 300\text{ mA}$	$V_{RM} = V_{DM} = 424\text{ VAC}$	FOD410, FOD4116, FOD4118	–	60	–	$\mu\text{s}$
			$V_{RM} = V_{DM} = 565\text{ VAC}$	FOD4108				
$t_{OFF}$	Turn-Off Time		$V_{RM} = V_{DM} = 424\text{ VAC}$	FOD410, FOD4116, FOD4118	–	52	–	$\mu\text{s}$
			$V_{RM} = V_{DM} = 565\text{ VAC}$	FOD4108				
dv/dt <sub>C</sub>	Critical Rate of Rise of Voltage at Current Commutation	$V_D = 230\text{ V}_{RMS}, I_D = 300\text{ mA}_{PK}$		All	–	10	–	V/ $\mu\text{s}$
di/dt <sub>C</sub>	Critical Rate of Rise of On-State Current Commutation	$V_D = 230\text{ V}_{RMS}, I_D = 300\text{ mA}_{PK}$		All	–	9	–	A/ms
dv(I <sub>O</sub> )/dt	Critical Rate of Rise of Coupled Input / Output Voltage	$I_T = 0\text{ A}, V_{RM} = V_{DM} = 424\text{ VAC}$		All	10,000	–	–	V/ $\mu\text{s}$

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt. Commutating dv/dt is a function of the load-driving thyristor(s) only.
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  $I_F$  (30 mA).

# FOD410, FOD4108, FOD4116, FOD4118

## 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)	$I_F = \text{Rated } I_{FT}$	All	–	8	25	$V_{peak}$
$I_{DRM2}$	Leakage in Inhibit State	$I_F = \text{Rated } I_{FT}, \text{ Rated } V_{DRM}, \text{ Off-State}$	All	–	20	200	$\mu A$

## ISOLATION CHARACTERISTICS

$V_{ISO}$	Steady State Isolation Voltage	$f = 60 \text{ Hz}, t = 1 \text{ Minute (Note 5)}$	All	5,000	–	–	$VAC_{RMS}$
-----------	--------------------------------	--	-----	-------	---	---	-------------

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.

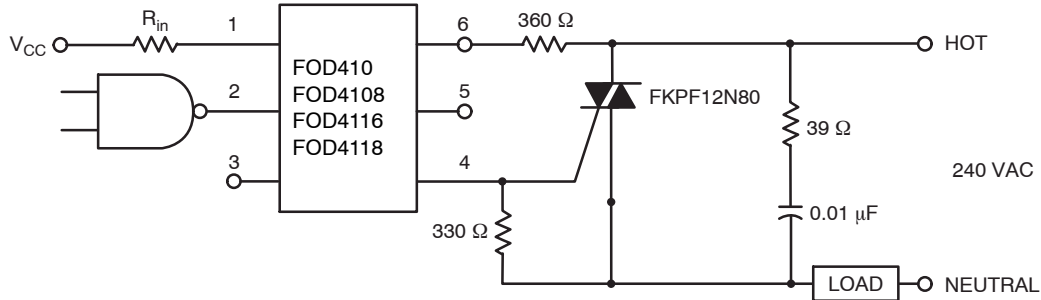
# FOD410, FOD4108, FOD4116, FOD4118

## TYPICAL APPLICATION

Figure 1 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.

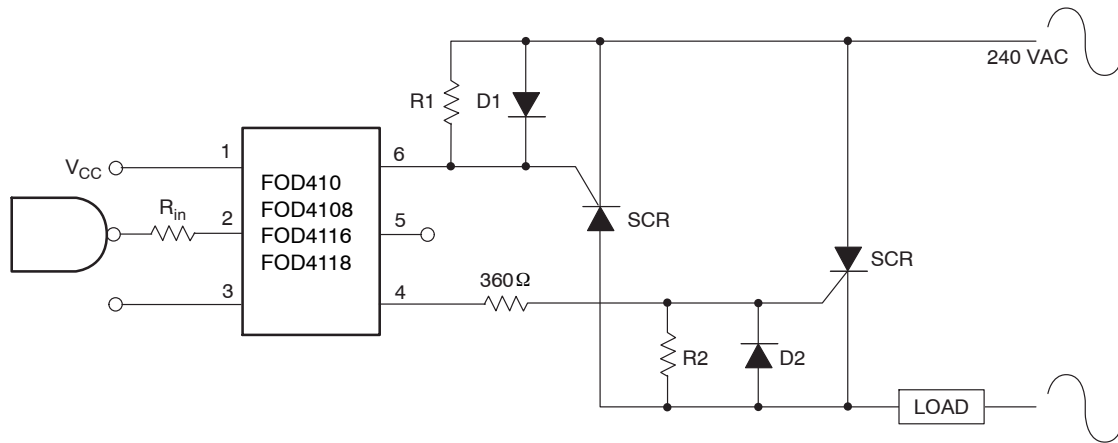
$R_{in}$  is calculated so that IF is equal to the rated IFT of the

part, 2 mA for FOD410 and FOD4108, 1.3 mA for FOD4116 and FOD4118. The  $39\ \Omega$  resistor and  $0.01\ \mu\text{F}$  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  $360\ \Omega$ .

**Figure 1. Hot-Line Switching Application Circuit**



**Figure 2. Inverse-Parallel SCR Driver Circuit**

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

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

TYPICAL CHARACTERISTICS

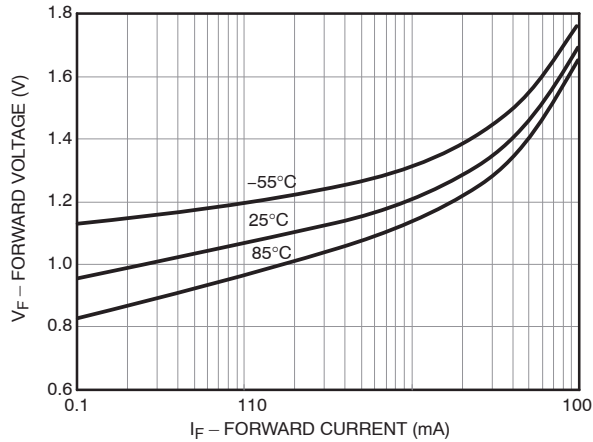


Figure 3. Forward Voltage ( $V_F$ ) vs. Forward Current ( $I_F$ )

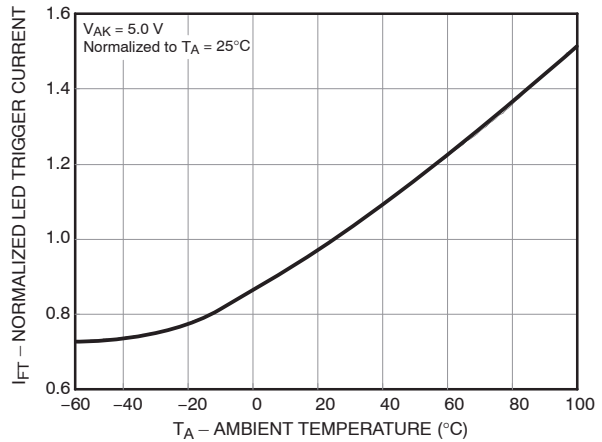


Figure 4. Normalized LED Trigger Current ( $I_{FT}$ ) vs. Ambient Temperature ( $T_A$ )

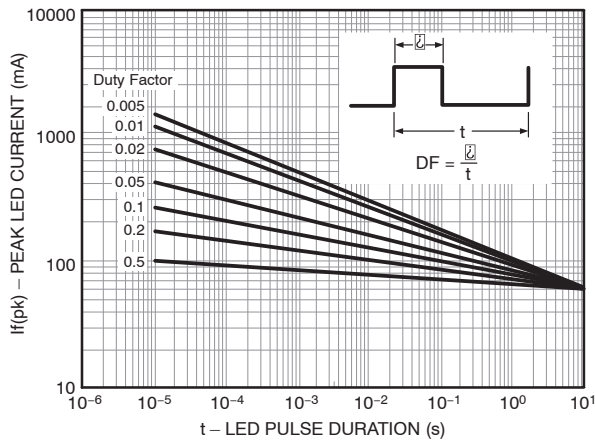


Figure 5. Peak LED Current vs. Duty Factor, Tau

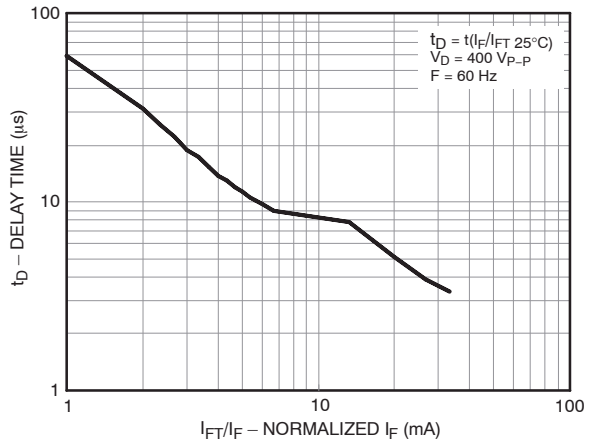


Figure 6. Trigger Delay Time

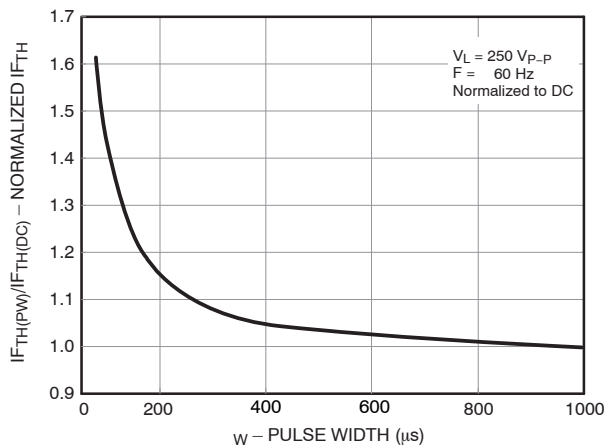


Figure 7. Pulse Trigger Current

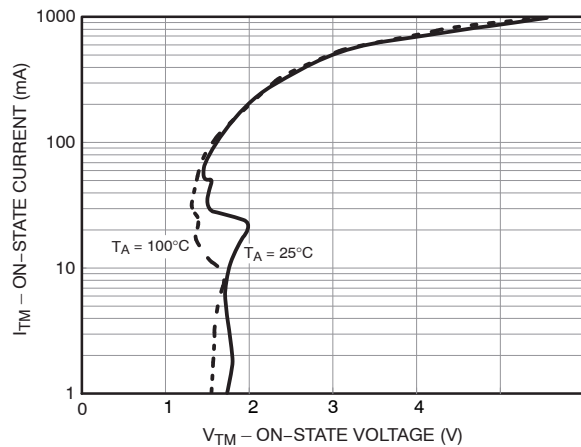


Figure 8. On-State Voltage ( $V_{TM}$ ) vs. On-State Current ( $I_{TM}$ )

TYPICAL CHARACTERISTICS (continued)

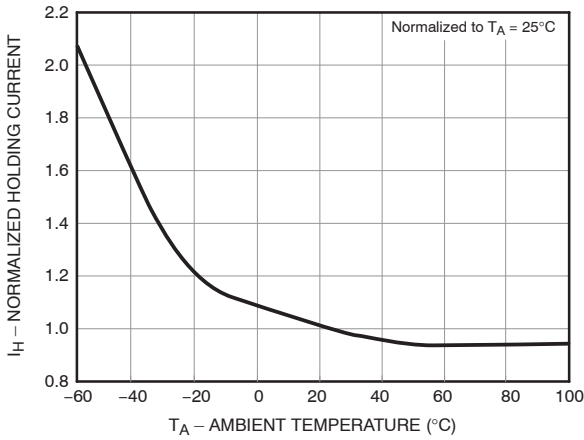


Figure 9. Normalized Holding Current ( $I_H$ ) vs. Ambient Temperature ( $T_A$ )

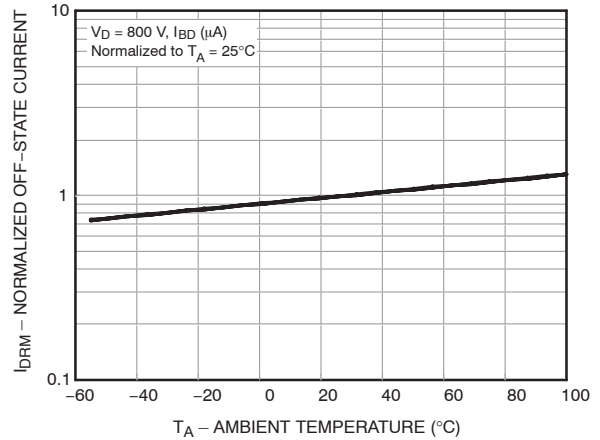


Figure 10. Normalized Off-State Current ( $I_{DRM}$ ) vs. Ambient Temperature ( $T_A$ )

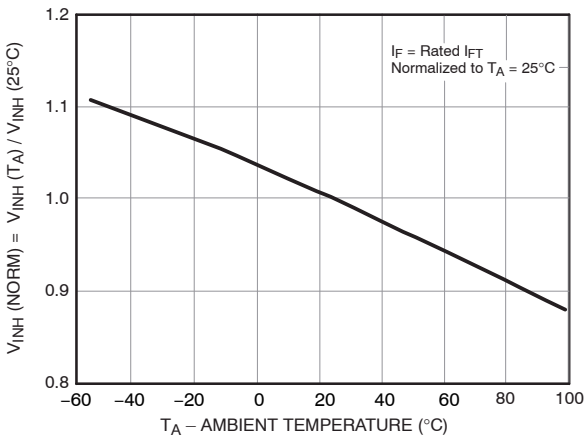


Figure 11. Normalized Inhibit Voltage ( $V_{INH}$ ) vs. Ambient Temperature ( $T_A$ )

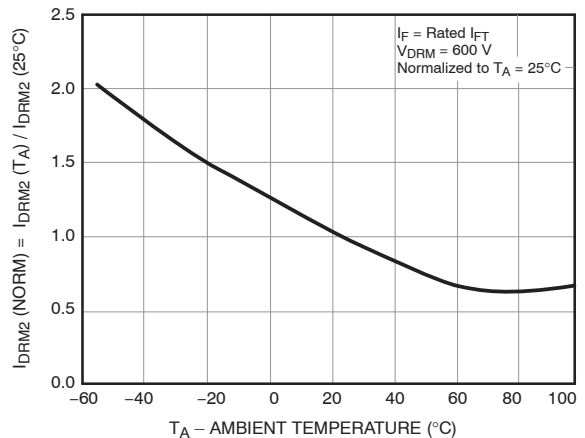


Figure 12. Normalized Leakage in Inhibit State ( $I_{DRM2}$ ) vs. Ambient Temperature ( $T_A$ )

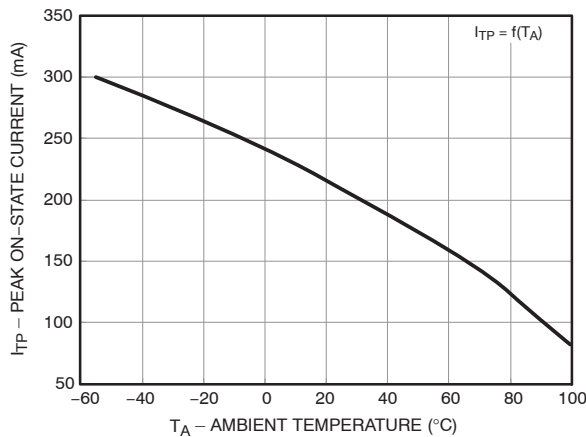
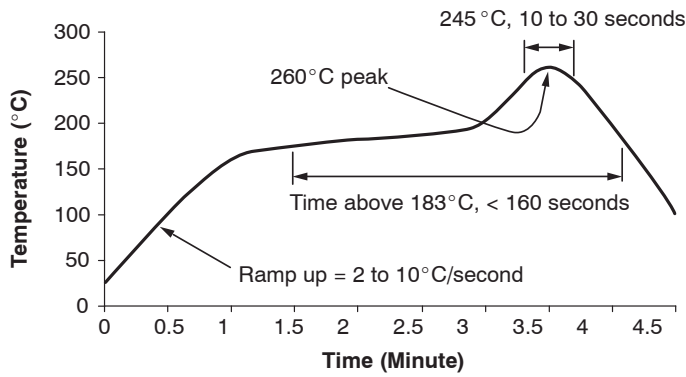


Figure 13. Current Reduction



REFLOW PROFILE



- Peak reflow temperature: 262°C (package surface temperature)
- Time of temperature higher than 185°C for 160 seconds or less
- One time soldering reflow is recommended

Figure 14. Reflow Profile

ORDERING INFORMATION

Part Number	Package	Shipping†
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)

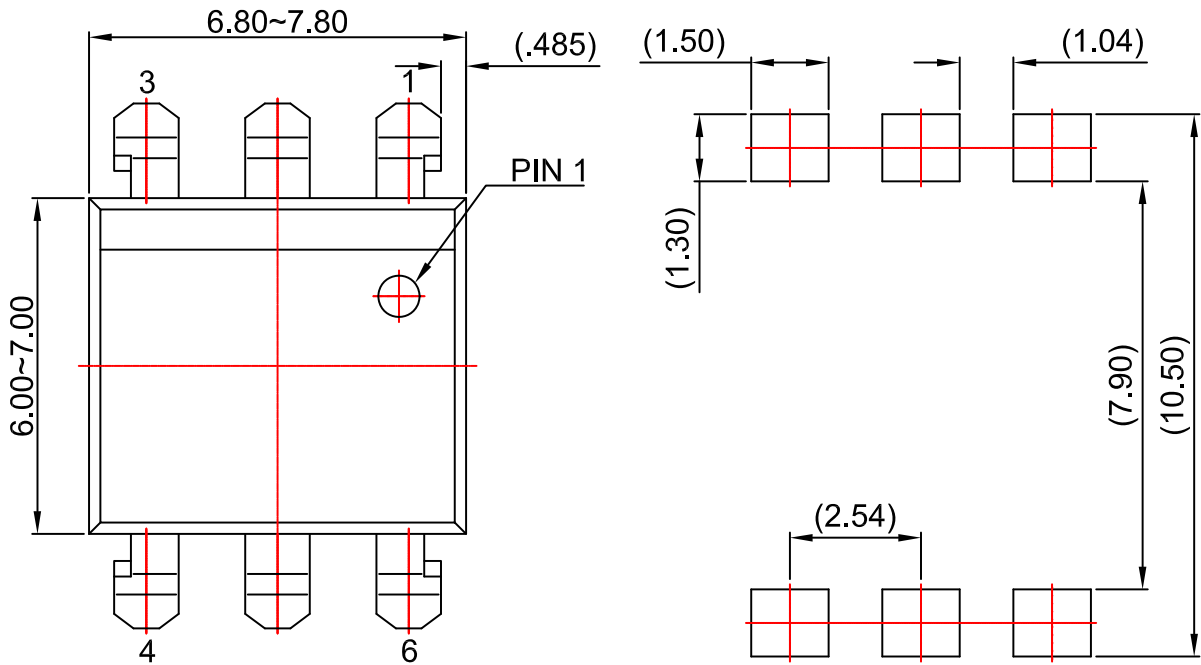
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

6. The product orderable part number system listed in this table also applies to the FOD4108, FOD4116, and FOD4118 product families.

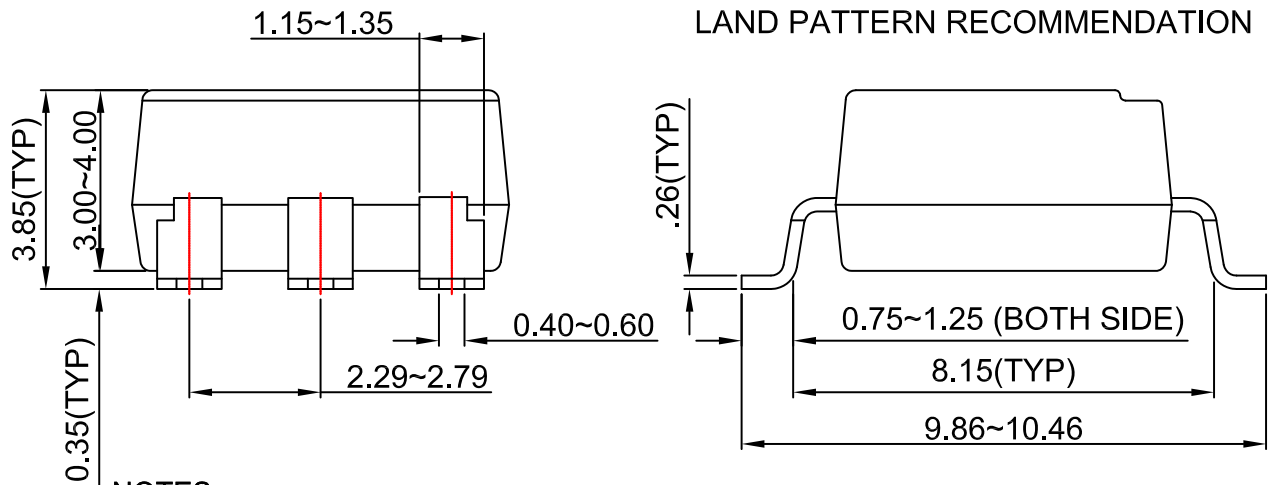
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

**PDIP6 7.3x6.5, 2.54P**  
CASE 646CE  
ISSUE O

DATE 31 JUL 2016



**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

<b>DOCUMENT NUMBER:</b>	<b>98AON13456G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>PDIP6 7.3X6.5, 2.54P</b>	<b>PAGE 1 OF 1</b>

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 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

# MECHANICAL CASE OUTLINE

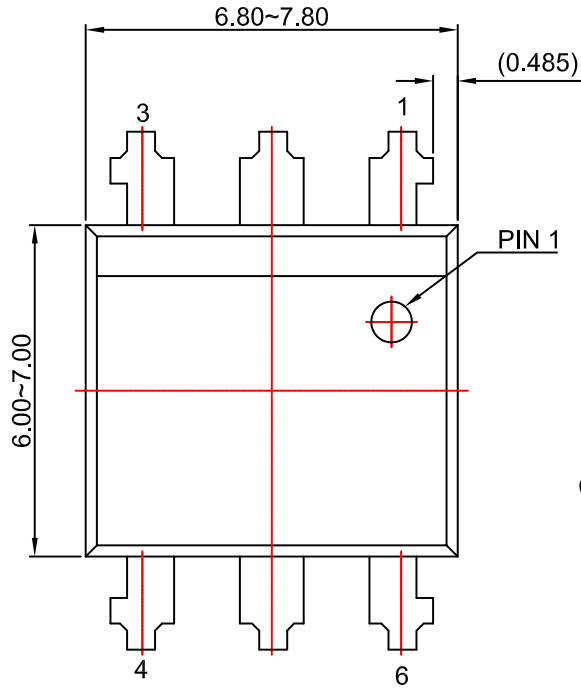
## PACKAGE DIMENSIONS

ON Semiconductor®



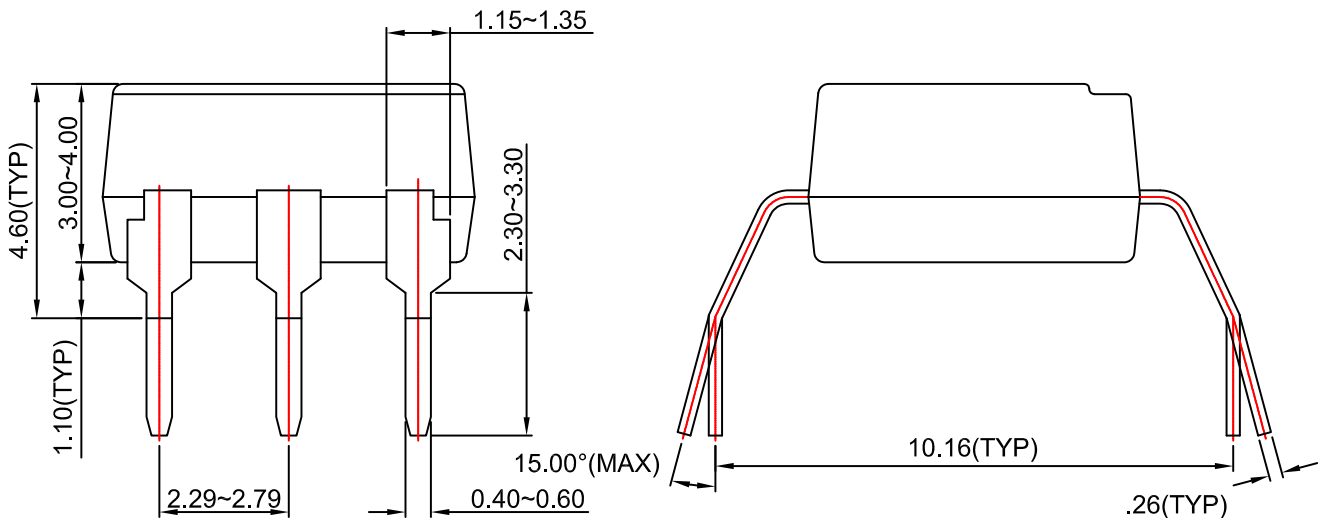
**PDIP6 7.3x6.5, 2.54P**  
CASE 646CF  
ISSUE O

DATE 31 JUL 2016



**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



<b>DOCUMENT NUMBER:</b>	<b>98AON13457G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>PDIP6 7.3X6.5, 2.54P</b>	<b>PAGE 1 OF 1</b>

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 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

# MECHANICAL CASE OUTLINE

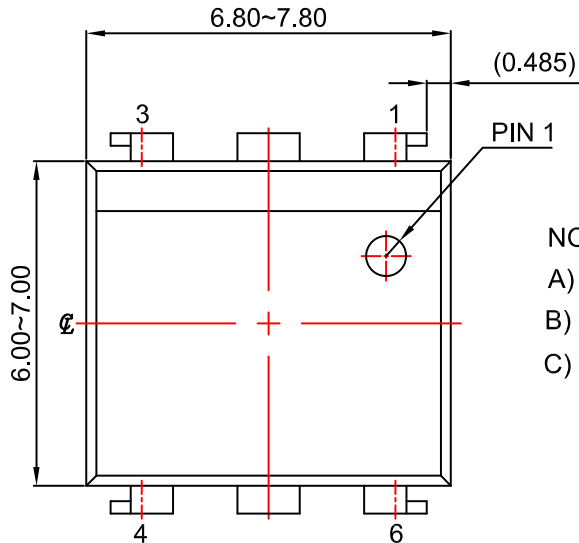
## PACKAGE DIMENSIONS

ON Semiconductor®



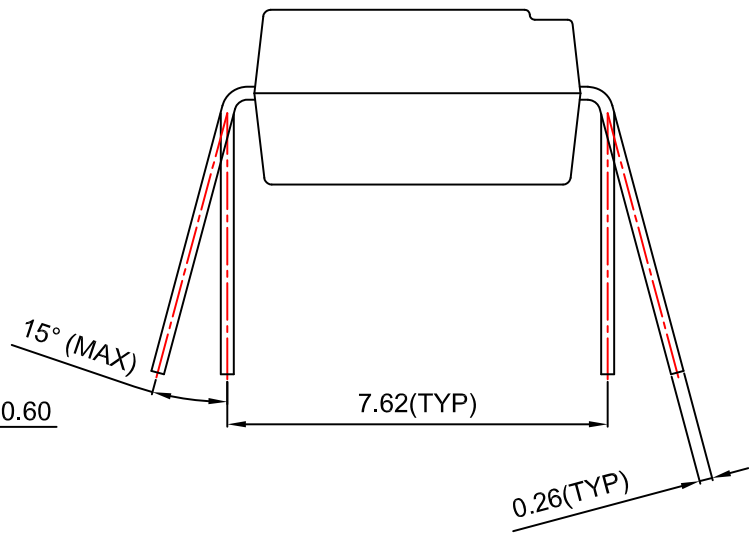
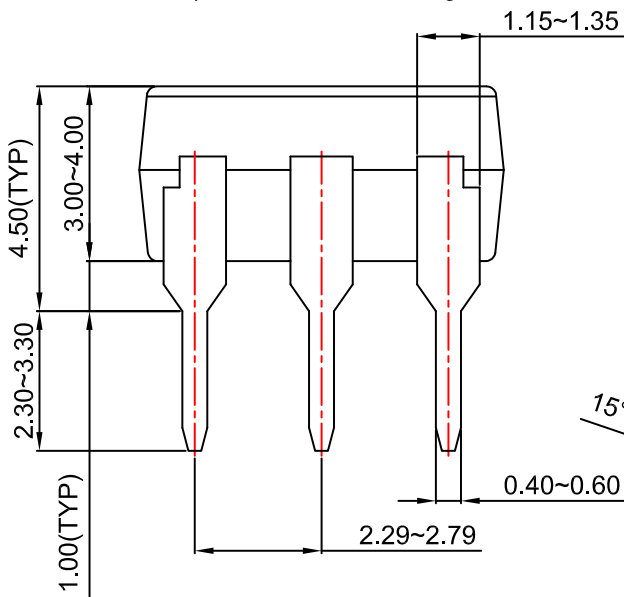
**PDIP6 GW**  
CASE 709AG  
ISSUE A

DATE 31 JUL 2016



**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



<b>DOCUMENT NUMBER:</b>	<b>98AON13455G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>PDIP6 GW</b>	<b>PAGE 1 OF 1</b>

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 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'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). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)

