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 $\mathrm{mA_{peak}}$ 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 $\mathrm{VAC_{RMS}}$ 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

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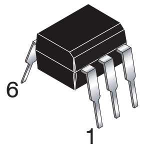
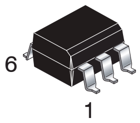
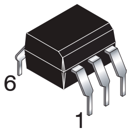


PDIP6 GW
CASE 709AG

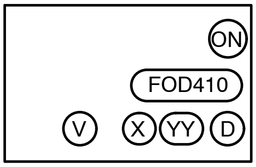


PDIP6 7.3x6.5, 2.54P
CASE 646CE



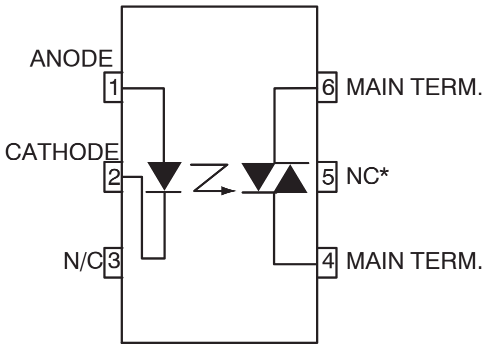
PDIP6 7.3x6.5, 2.54P
CASE 646CF

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



*DO NOT CONNECT
(TRIAC SUBSTRATE)

ORDERING INFORMATION

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

May, 2019 − Rev. 3

SAFETY AND INSULATION RATINGS

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 (Note 1)	175	°C
$I_{S,INPUT}$	Input Current (Note 1)	400	mA
$P_{S,OUTPUT}$	Output Power (Note 1)	700	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V (Note 1)	$> 10^9$	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.

ABSOLUTE MAXIMUM RATINGS (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	mA
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_{peak}
I_{TM}	Peak On−State Current	All	300	mA_{peak}
$P_{D(DETECTOR)}$	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.

ELECTRICAL CHARACTERISTICS (T_A = 25°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 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 (Note 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 A (Note 3)	$V_D = V_{DRM}$	All	10,000	–	–	V/µs

TRANSFER CHARACTERISTICS

Symbol	Parameter	Test Conditions		Device	Min	Typ	Max	Unit
I_{FT}	LED Trigger Current	Main Terminal Voltage = 5 V (Note 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_C	Critical Rate of Rise of Voltage at Current Commutation	V_D = 230 V_{RMS}, I_D = 300 mA_{PK}		All	–	10	–	V/µs
di/dt_C	Critical Rate of Rise of On−State Current Commutation	V_D = 230 V_{RMS}, I_D = 300 mA_{PK}		All	–	9	–	A/ms
$dv_{(IO)}/dt$	Critical Rate of Rise of Coupled Input / Output Voltage	I_T = 0 A, $V_{RM} = V_{DM}$ = 424 VAC		All	10,000	–	–	V/µs

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).

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_{peak}
I_{DRM2}	Leakage in Inhibit State	I_F = Rated $I_{FT,}$ Rated V_{DRM}, Off−State	All	–	20	200	μA

ISOLATION CHARACTERISTICS

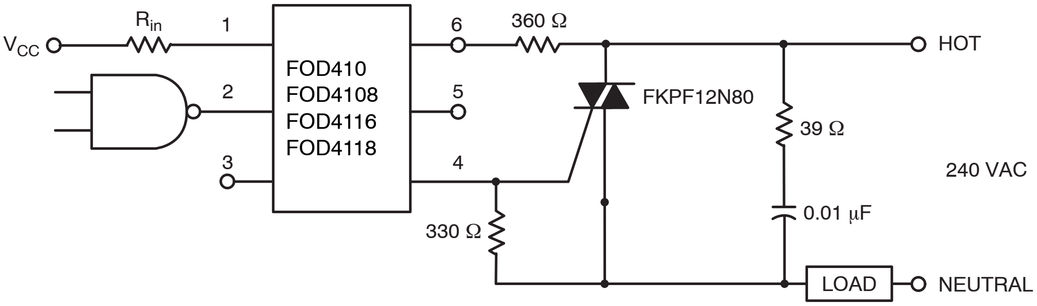
Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
V_{ISO}	Steady State Isolation Voltage	f = 60 Hz, t = 1 Minute (Note 5)	All	5,000	–	–	VAC_{RMS}

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.

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.

Rin 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 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 Ω.

Figure 1. Hot−Line Switching Application Circuit

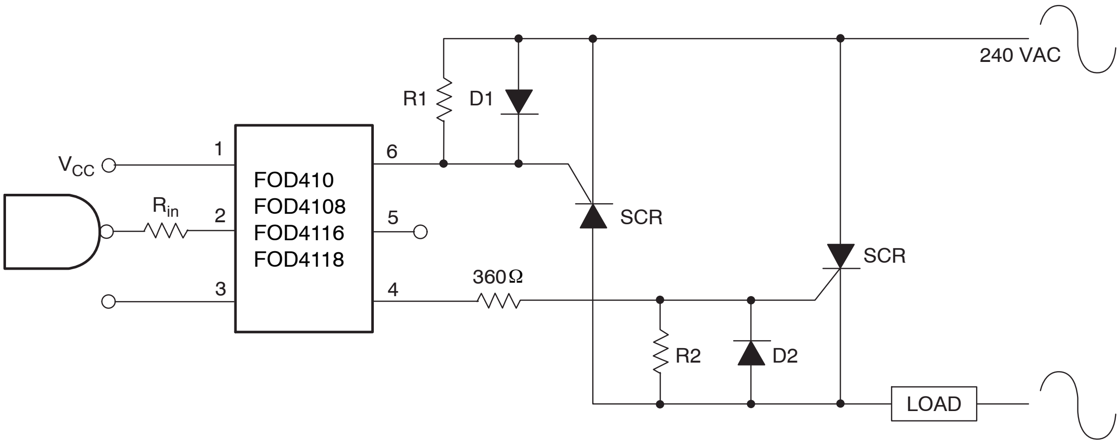


Figure 2. Inverse−Parallel SCR Driver Circuit

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 Ω.

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

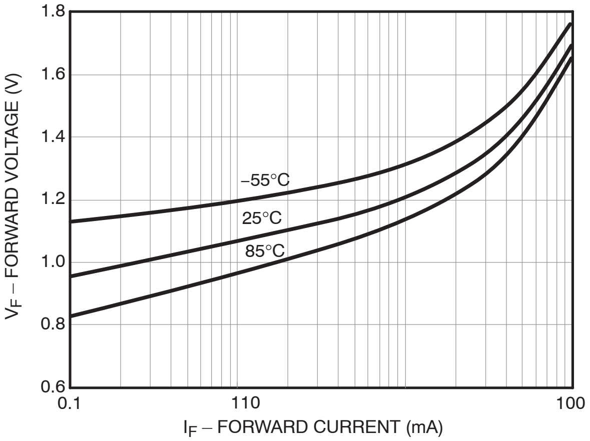


Figure 3. Forward Voltage (V_F) vs. Forward Current (I_F)

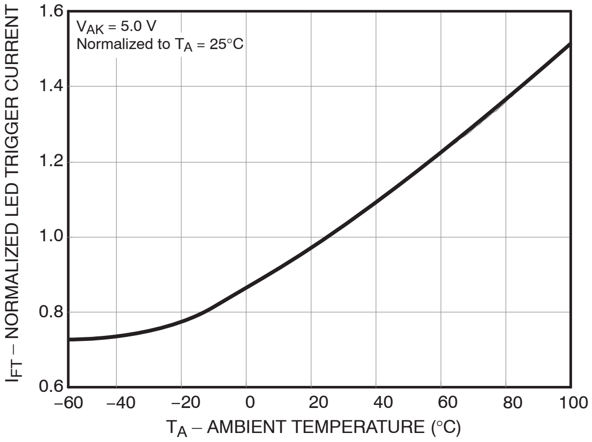


Figure 4. Normalized LED Trigger Current (I_{FT}) vs. Ambient Temperature (T_A)

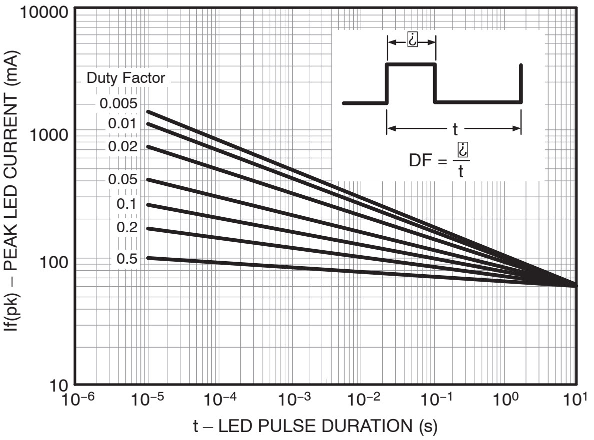


Figure 5. Peak LED Current vs. Duty Factor, Tau

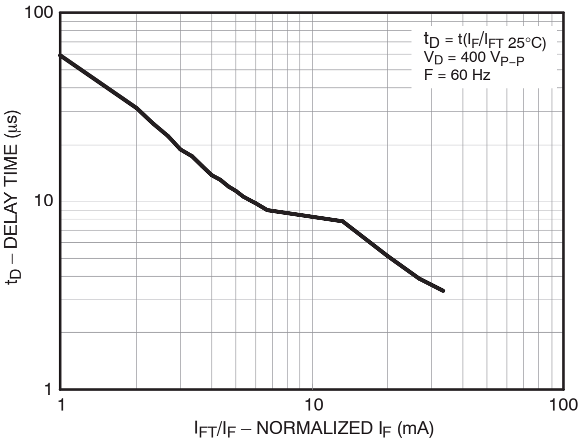


Figure 6. Trigger Delay Time

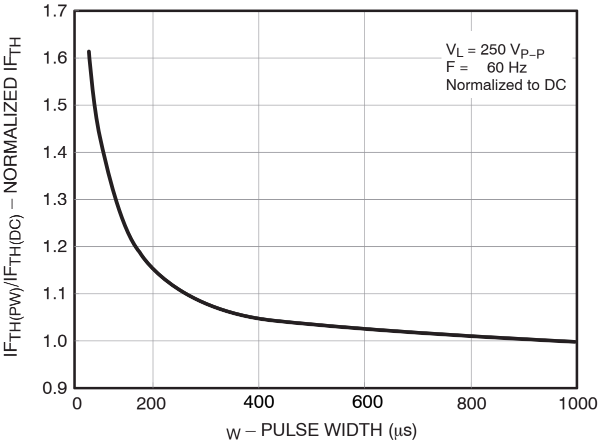


Figure 7. Pulse Trigger Current

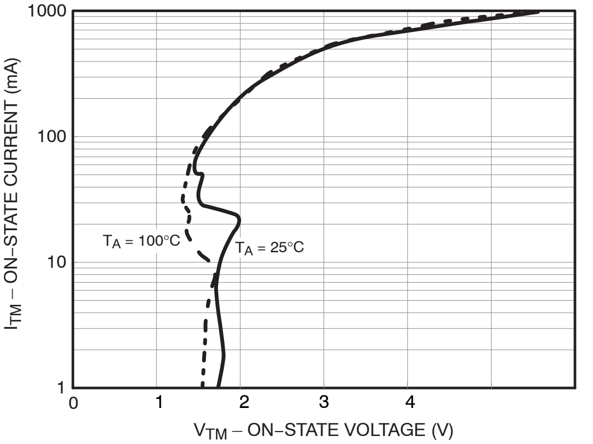


Figure 8. On-State Voltage (V_{TM}) vs. On-State Current (I_{TM})

TYPICAL CHARACTERISTICS (continued)

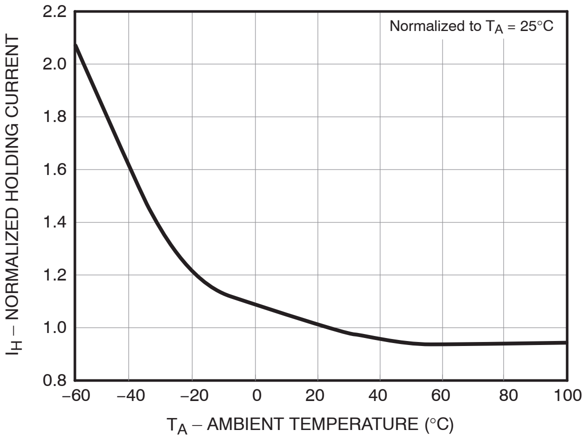


Figure 9. Normalized Holding Current (I_H) vs. Ambient Temperature (T_A)

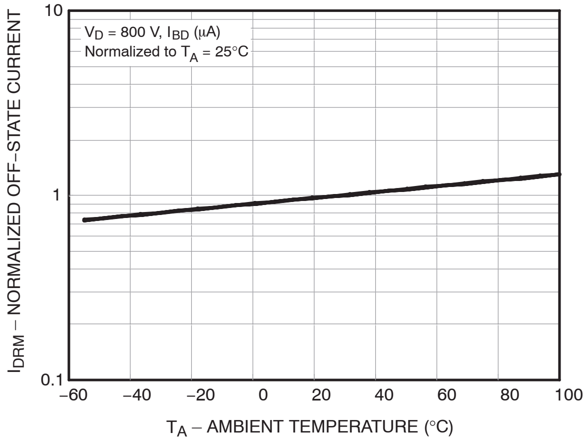


Figure 10. Normalized Off−State Current (I_{DRM}) vs. Ambient Temperature (T_A)

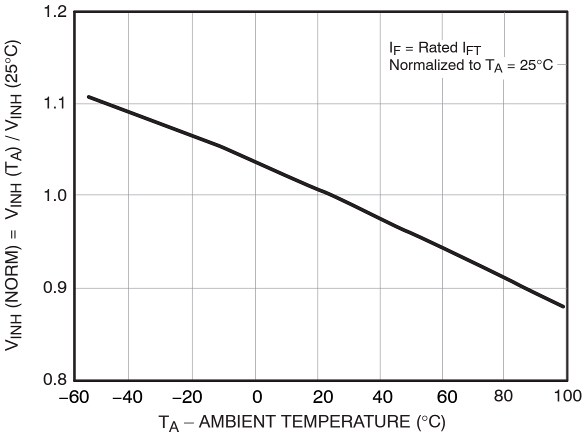


Figure 11. Normalized Inhibit Voltage (V_{INH}) vs. Ambient Temperature (T_A)

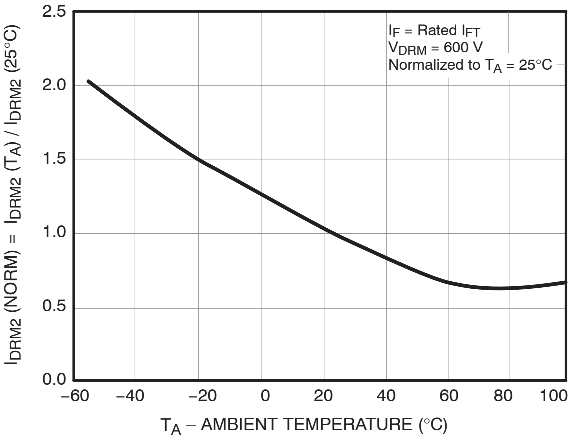


Figure 12. Normalized Leakage in Inhibit State (I_{DRM2}) vs. Ambient Temperature (T_A)

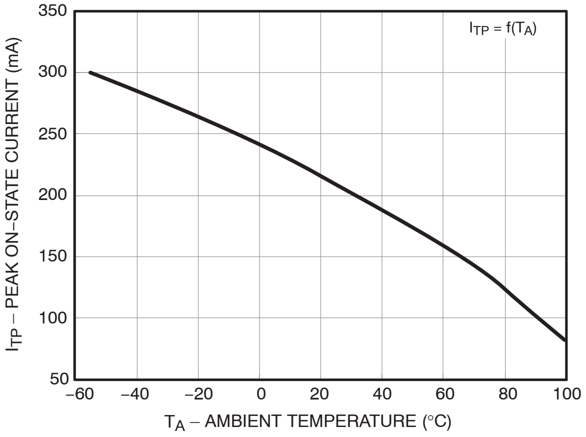
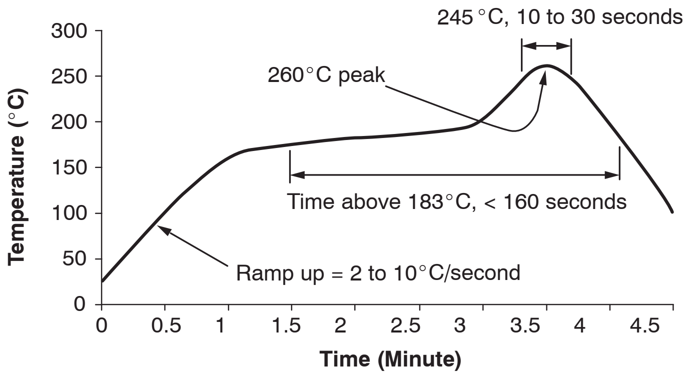


Figure 13. Current Reduction

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

ON Semiconductor®

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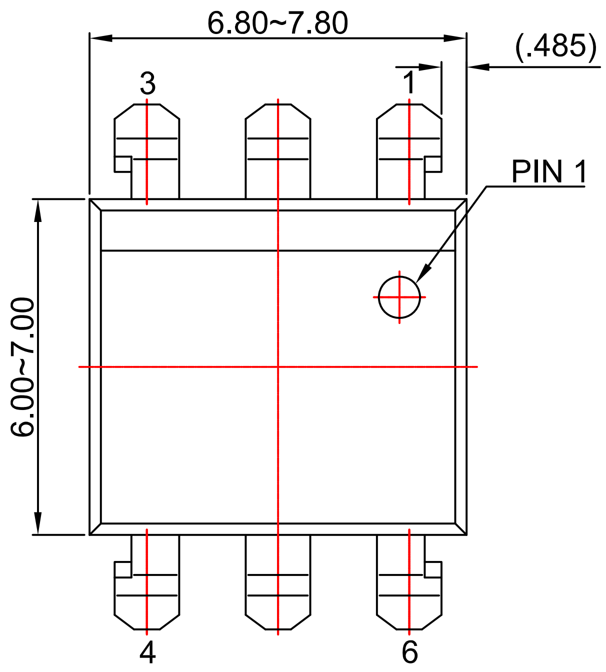
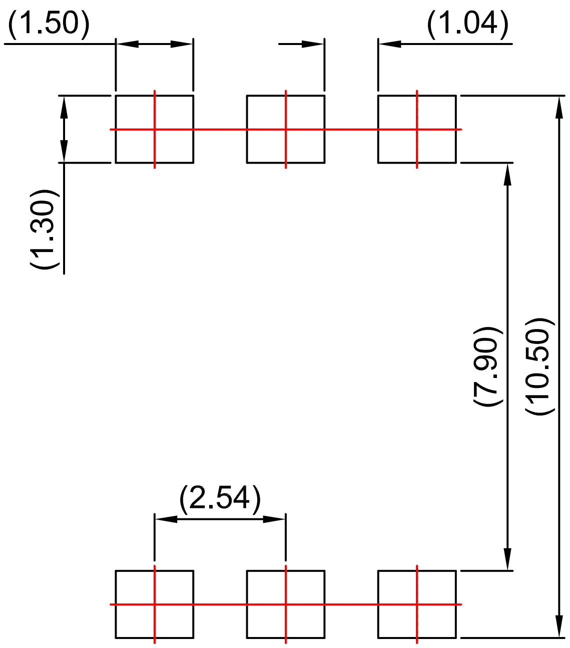
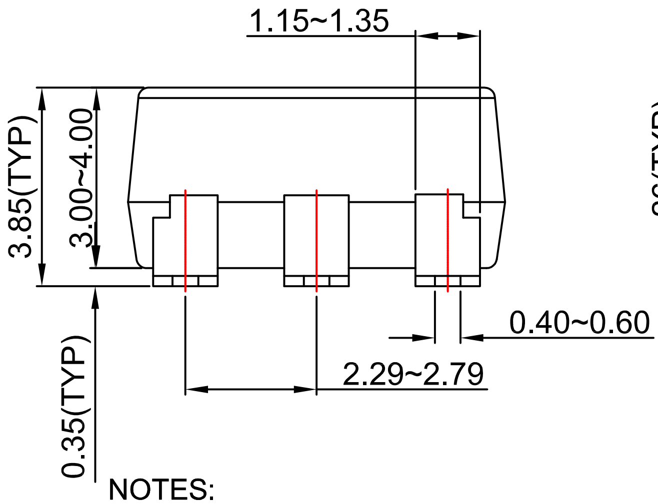
CASE 646CE
ISSUE O

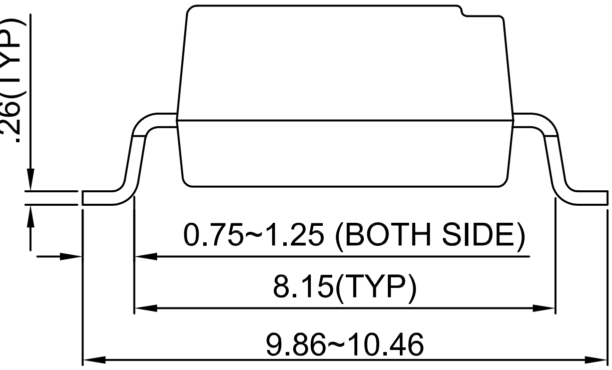
DATE 31 JUL 2016





LAND PATTERN RECOMMENDATION





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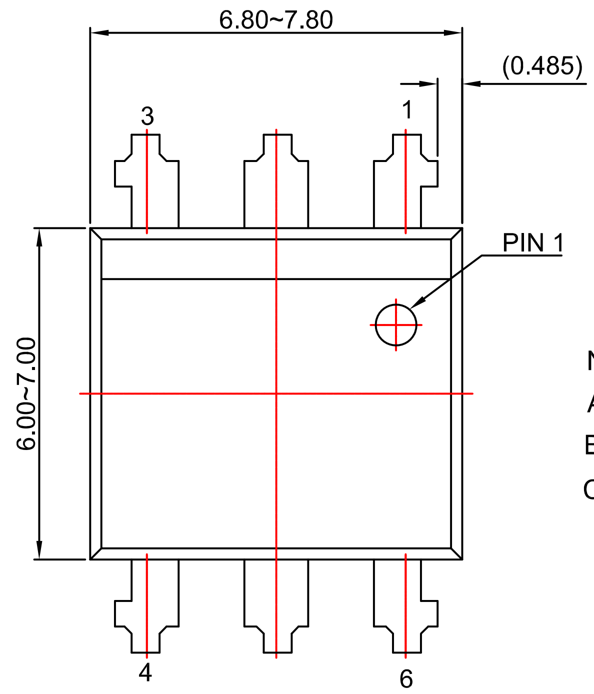
PDIP6 7.3x6.5, 2.54P
CASE 646CF
ISSUE O

DATE 31 JUL 2016



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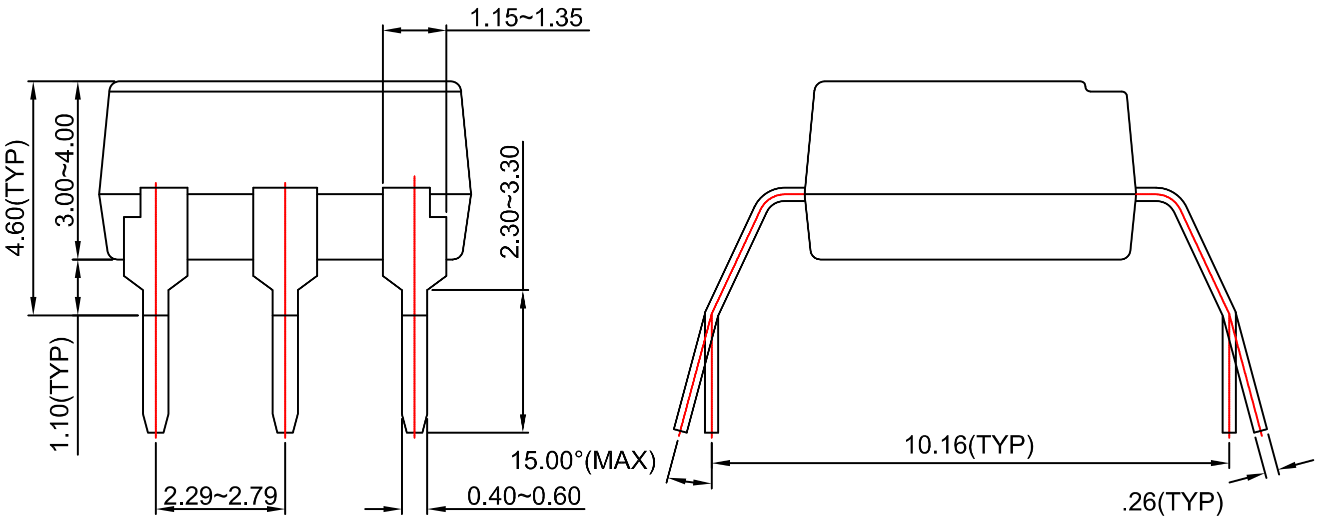

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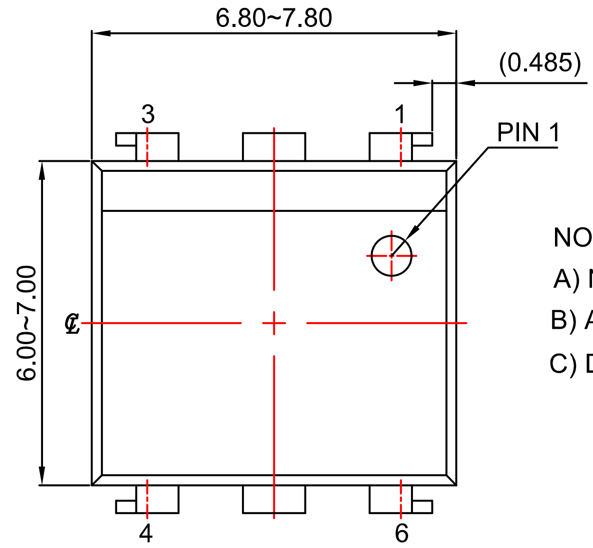
MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

PDIP6 GW
CASE 709AG
ISSUE A

DATE 31 JUL 2016



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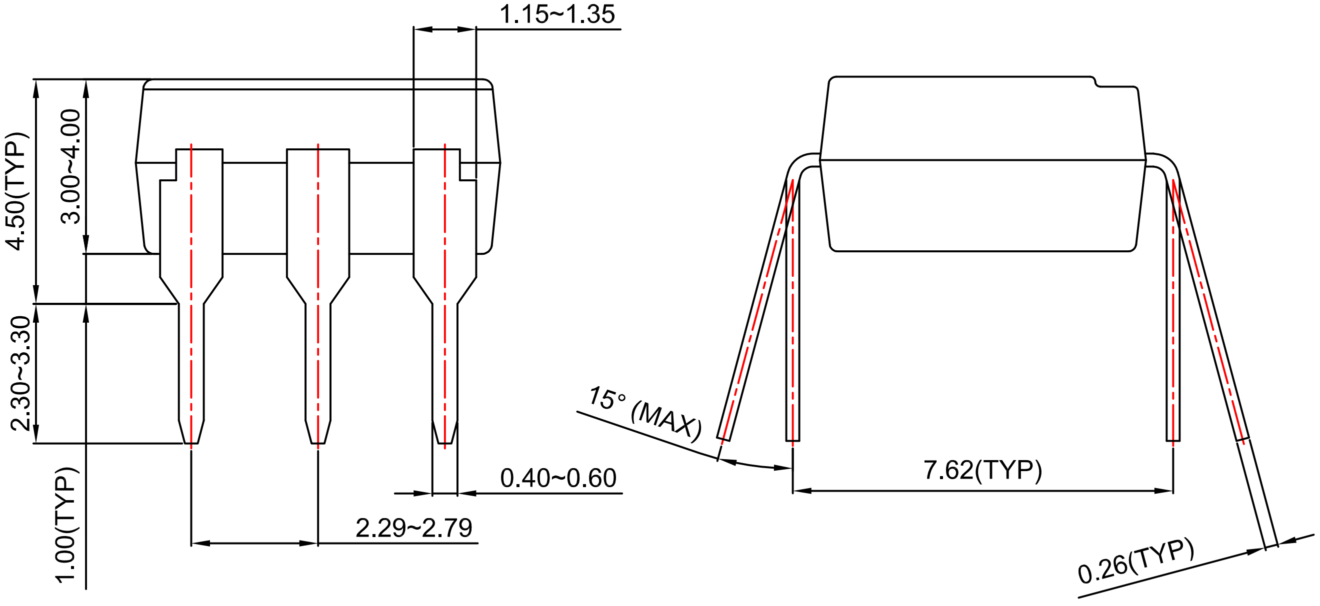

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