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ON Semiconductor®

FODM3011, FODM3012, FODM3022, FODM3023, FODM3052, FODM3053
4-Pin Full Pitch Mini-Flat Package Random-Phase Triac Driver Output Optocouplers

Features

- Compact 4-pin Surface Mount Package (2.4 mm Maximum Standoff Height)
- Peak Blocking Voltage
  - 250V (FODM301X)
  - 400V (FODM302X)
  - 600V (FODM305X)
- Safety and Regulatory Approvals:
  - UL1577, 3,750 VAC_{RMS} for 1 Minute
  - DIN-EN/IEC60747-5-5, 565 V Peak Working Insulation Voltage

Applications

- Industrial Controls
- Traffic Lights
- Vending Machines
- Solid State Relay
- Lamp Ballasts
- Solenoid/Valve Controls
- Static AC Power Switch
- Incandescent Lamp Dimmers
- Motor Control

Description

The FODM301X, FODM302X, and FODM305X series consists of a GaAs infrared emitting diode driving a silicon bilateral switch housed in a compact 4-pin mini-flat package. The lead pitch is 2.54 mm. They are designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 115 V/240 V operations.

Functional Schematic

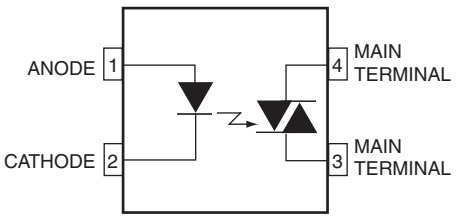


Figure 1. Functional Schematic

Package Outlines

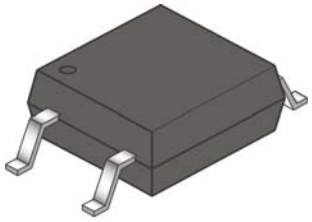


Figure 2. Package Outlines

October-2017, Rev. 2

Publication Order Number:
FODM3053-NF098/D

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–III
Climatic Classification		40/100/21
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	904	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	1060	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	565	V_{peak}
V_{IOTM}	Highest Allowable Over-Voltage	6000	V_{peak}
	External Creepage	≥ 5	mm
	External Clearance	≥ 5	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥ 0.4	mm
T_S	Case Temperature(1)	150	°C
$I_{S,INPUT}$	Input Current(1)	200	mA
$P_{S,OUTPUT}$	Output Power(1)	300	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		Value	Unit
T_{STG}	Storage Temperature		-55 to +150	°C
T_{OPR}	Operating Temperature		-40 to +100	°C
T_J	Junction Temperature		-40 to +125	°C
T_{SOL}	Lead Solder Temperature		260 for 10 sec	°C
EMITTER				
I_F (avg)	Continuous Forward Current		60	mA
I_F (pk)	Peak Forward Current (1 μs pulse, 300 pps.)		1	A
V_R	Reverse Input Voltage		3	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	FODM3011, FODM3012	250	V
		FODM3022, FODM3023	400	
		FODM3052, FODM3053	600	
P_D	Power Dissipation (No derating required over operating temp. range)		300	mW

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 = 10 mA	All		1.20	1.50	V
I_R	Reverse Leakage Current	V_R = 3 V, T_A = 25°C	All		0.01	100	μA
DETECTOR							
I_{DRM}	Peak Blocking Current Either Direction	Rated V_{DRM}, I_F = 0[2]	All		2	100	nA
dV/dt	Critical Rate of Rise of Off-State Voltage	I_F = 0 (Figure 8)[3]	FODM3011, FODM3012, FODM3022, FODM3023		10		V/μs
			FODM3052, FODM3053	1,000			

Notes:

2. Test voltage must be applied within dv/dt rating.
3. This is static dv/dt. See Figure 1 for test circuit Commutating dv/dt is function of the load-driving thyristor(s) only.

Transfer Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
I_T	LED Trigger Current	Main Terminal Voltage = 3 V[4]	FODM3011, FODM3022, FODM3052			10	mA
			FODM3012, FODM3023, FODM3053			5	
I_H	Holding Current, Either Direction		All		450		μA
V_{TM}	Peak On-State Voltage Either Direction	I_{TM} = 100 mA peak	All		2.2	3	V

Notes:

4. All devices are guaranteed to trigger at an I_F value of less than or equal to the max I_{FT} specification. For optimum operation over temperature and lifetime of the device, the LED should be biased with an I_F that is at least 50% higher than the maximum I_{FT} specification. The I_{FT} should not exceed the absolute maximum rating of 60 mA.

   Example: For FODM0353M, the minimum I_F bias should be 5 mA x 150% = 7.5 mA

Isolation Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
V_{ISO}	Steady State Isolation Voltage	1 Minute, R.H. = 40% to 60%	All	3,750			VAC_{RMS}

Typical Performance Characteristics

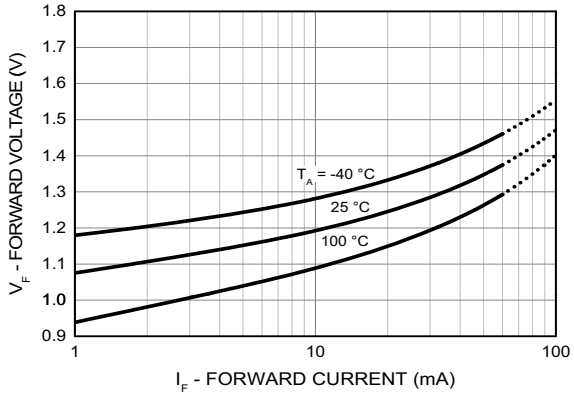


Fig 3. LED Forward Voltage vs. Forward Current

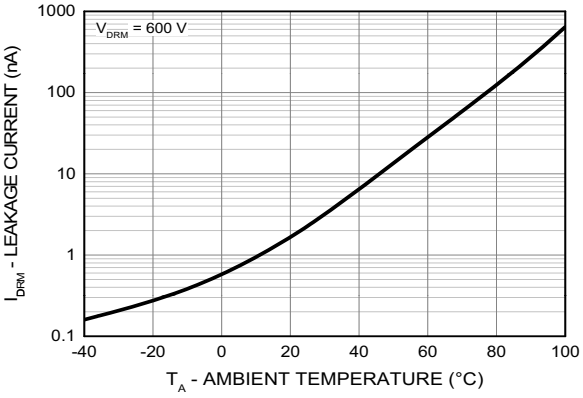


Fig 4. Leakage Current vs. Ambient Temperature

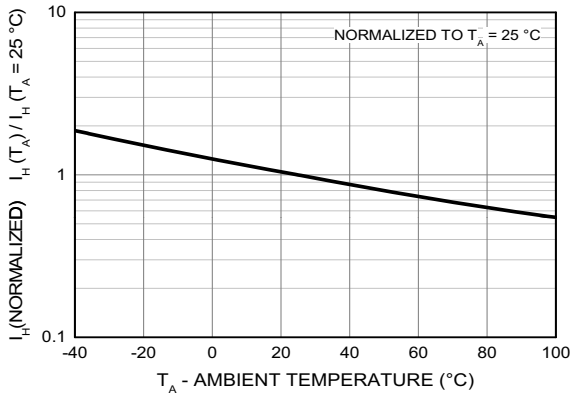


Fig 5. Normalized Holding Current vs. Ambient Temperature

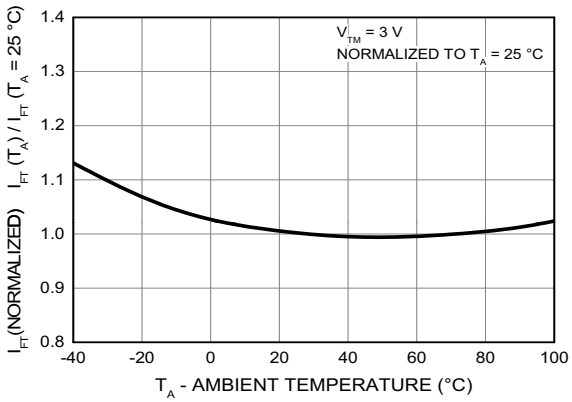


Fig 6. Normalized Trigger Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)

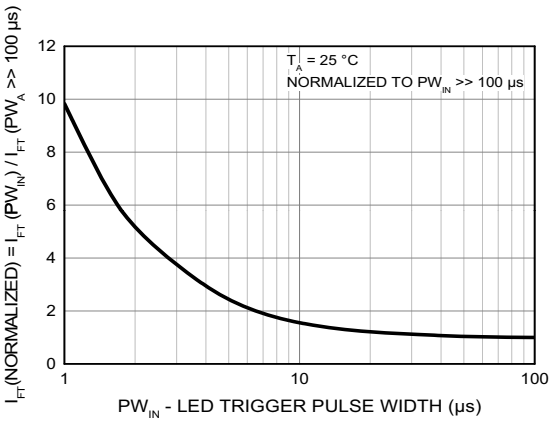


Fig 7. LED Current Required to Trigger vs. LED Pulse Width

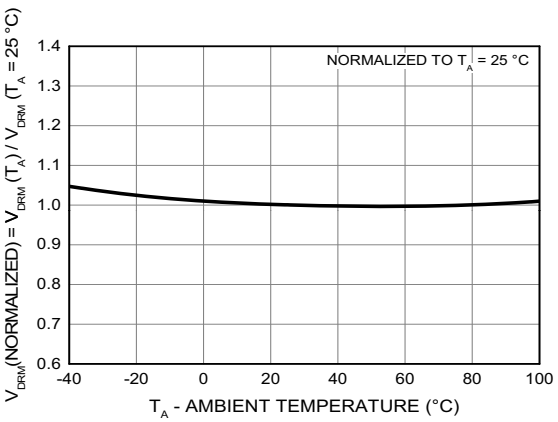


Fig 8. Normalized Off-State Output Terminal Voltage vs. Ambient Temperature

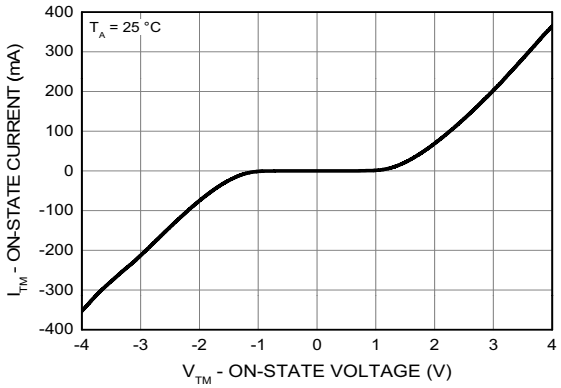
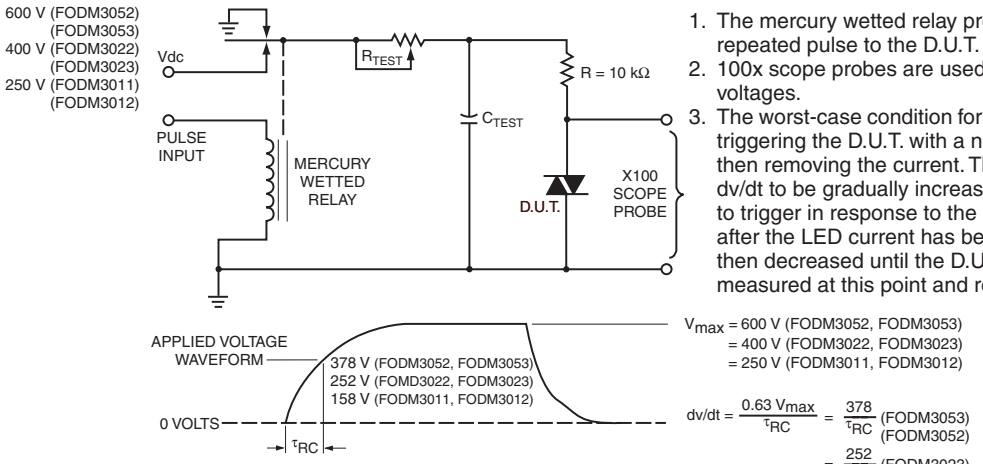


Fig 9. On-State Characteristics

Typical Application Information



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 R_{TEST} 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. τ_{RC} is measured at this point and recorded.

V_{max} = 600 V (FODM3052, FODM3053)
= 400 V (FODM3022, FODM3023)
= 250 V (FODM3011, FODM3012)

$$dv/dt = \frac{0.63\ V_{max}}{\tau_{RC}} = \frac{378}{\tau_{RC}} \text{ (FODM3053) (FODM3052)} = \frac{252}{\tau_{RC}} \text{ (FODM3023) (FODM3022)} = \frac{158}{\tau_{RC}} \text{ (FODM3011) (FODM3012)}$$

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

Figure 10. Static dv/dt Test Circuit

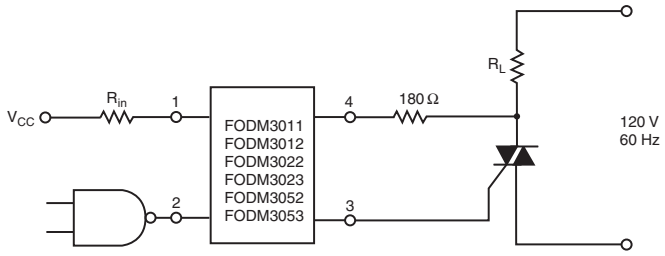


Figure 11. Resistive Load

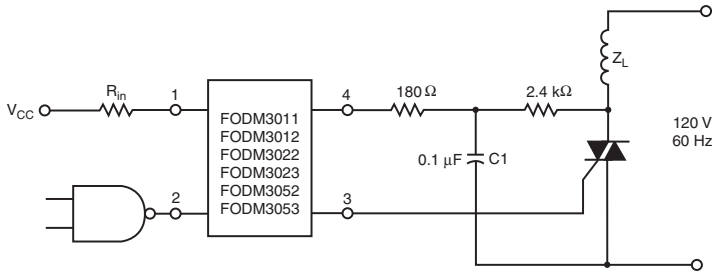
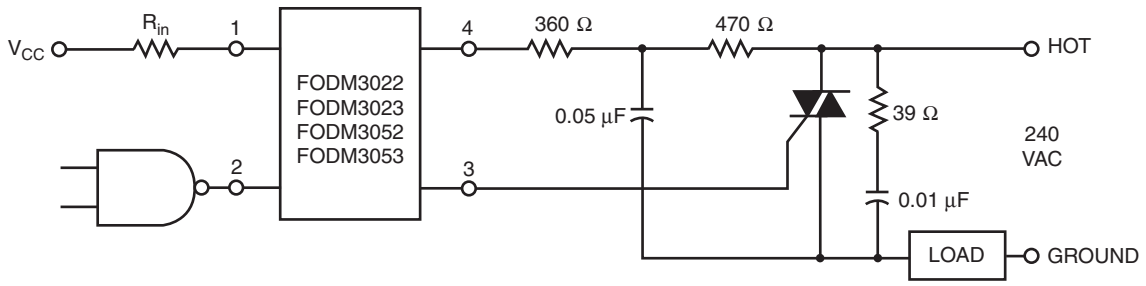


Figure 12. Inductive Load with Sensitive Gate Triac ($I_{GT} \leq 15$ mA)

Typical Application Information (Continued)

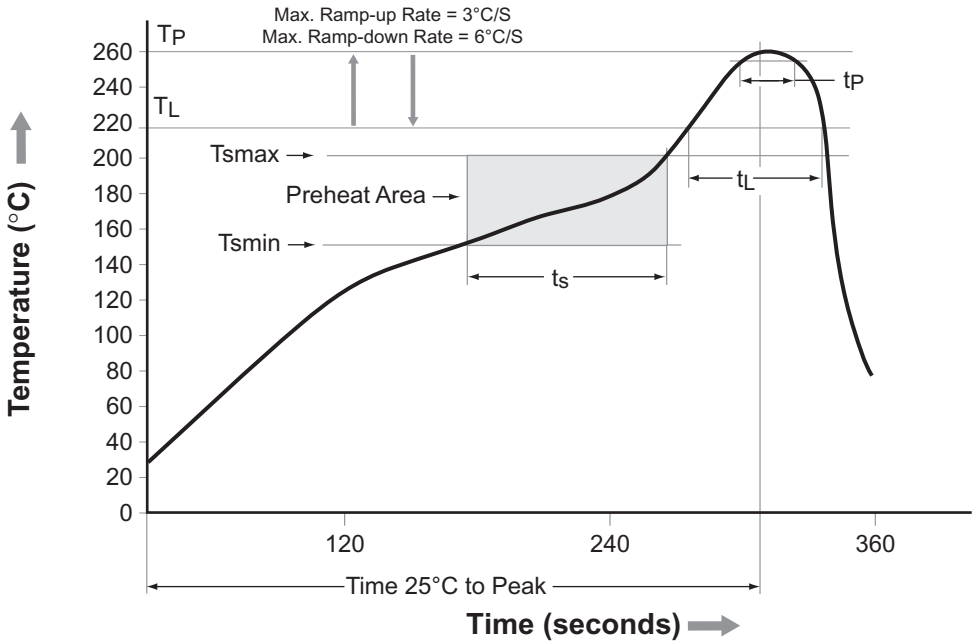


In this circuit the “hot” side of the line is switched and the load connected to the cold or ground side.

The 39 Ω resistor and 0.01μF capacitor are for snubbing of the triac, and the 470 Ω resistor and 0.05 μF capacitor are for snubbing the coupler. These components may or may not be necessary depending upon the particular and load used.

Figure 13. Typical Application Circuit

Reflow Profile



Profile Freature	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.

Ordering Information

Part Number	Package	Packing Method
FODM3011	Full Pitch Mini-Flat 4-Pin	Tube (100 units)
FODM3011R2	Full Pitch Mini-Flat 4-Pin	Tape and Reel (2500 Units)
FODM3011V	Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747-5-5 Option	Tube (100 Units)
FODM3011R2V	Full Pitch Mini-Flat 4-Pin, DIN EN/IEC60747-5-5 Option	Tape and Reel (2500 Units)

Note:
The product orderable part number system listed in this table also applies to the FODM3012, FODM3022, FODM3023, FODM3052, and FODM3053 products.

Marking Information

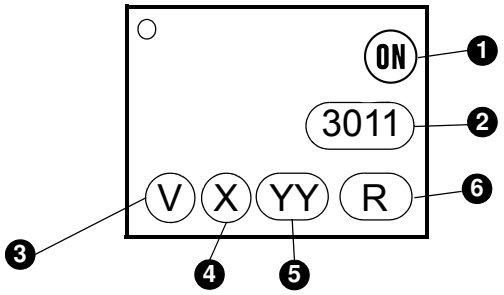
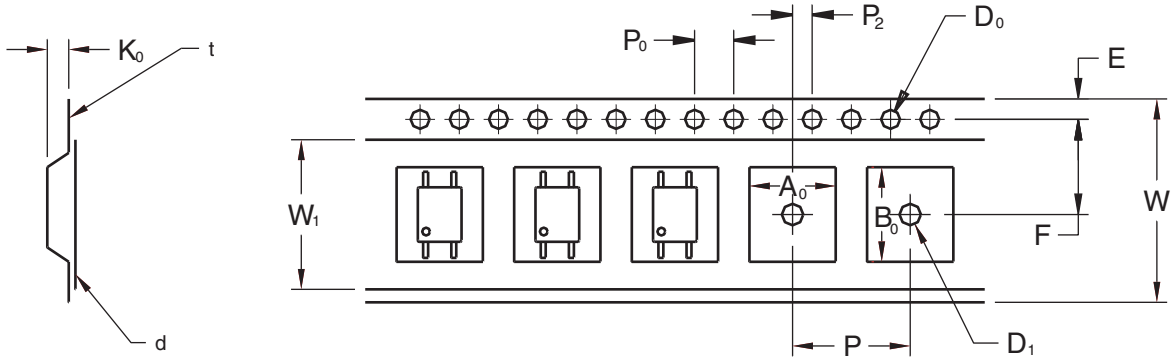


Figure 14. Top Mark

Table 1. Top Mark Definitions

1	ON Semiconductor Logo
2	Device Number
3	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

Tape Specifications



		2.54 Pitch
Description	**Symbol**	**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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