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# Gate Drive Optocoupler, High Noise Immunity, 2.5 A Output Current

## FOD3120

### Description

The FOD3120 is a 2.5 A Output Current Gate Drive Optocoupler, capable of driving most medium power IGBT/MOSFET. It is ideally suited for fast switching driving of power IGBT and MOSFETs used in motor control inverter applications, and high performance power system.

It utilizes **onsemi's** coplanar packaging technology, OPTOPLANAR<sup>®</sup>, and optimized IC design to achieve high noise immunity, characterized by high common mode rejection.

It consists of a gallium aluminum arsenide (AlGaAs) light emitting diode optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage.

### Features

- High Noise Immunity Characterized by 35 kV/μs Minimum Common Mode Rejection
- 2.5 A Peak Output Current Driving Capability for Most 1200 V/20 A IGBT
- Use of P-Channel MOSFETs at Output Stage Enables Output Voltage Swing Close to the Supply Rail
- Wide Supply Voltage Range from 15 V to 30 V
- Fast Switching Speed

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**Table 1. TRUTH TABLE**

LED	$V_{DD} - V_{SS}$ "Positive Going" (Turn-on)	$V_{DD} - V_{SS}$ "Negative Going" (Turn-off)	$V_O$
Off	0 V to 30 V	0 V to 30 V	Low
On	0 V to 11.5 V	0 V to 10 V	Low
On	11.5 V to 13.5 V	10 V to 12 V	Transition
On	13.5 V to 30 V	12 V to 30 V	High

**Table 2. PIN DEFINITIONS**

Pin #	Name	Description
1	NC	Not Connected
2	Anode	LED Anode
3	Cathode	LED Cathode
4	NC	Not Connected
5	$V_{SS}$	Negative Supply Voltage
6	$V_{O2}$	Output Voltage 2 (internally connected to $V_{O1}$ )
7	$V_{O1}$	Output Voltage 1
8	$V_{DD}$	Positive Supply Voltage

**Table 3. 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.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	< 150 $V_{RMS}$		I-IV	
		< 300 $V_{RMS}$		I-IV	
		< 450 $V_{RMS}$		I-III	
		< 600 $V_{RMS}$		I-III	
		< 1000 $V_{RMS}$ (Option T, TS)		I-III	
	Climatic Classification		40/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
$V_{PR}$	Input to Output Test Voltage, Method A, $V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test with $t_m$				

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**Table 4. ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified.)

Symbol	Parameter	Value	Units
$T_{STG}$	Storage Temperature	-55 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature	-40 to +100	$^\circ\text{C}$
$T_J$	Junction Temperature	-40 to +125	$^\circ\text{C}$
$T_{SOL}$	Lead Wave Solder Temperature (refer to page 13 for reflow solder profile)	260 for 10 s	$^\circ\text{C}$
$I_{F(AVG)}$	Average Input Current	25	mA
$I_{F(PEAK)}$	Peak Transient Forward Current (Note 2)	1	A
f	Operating Frequency (Note 3)	50	kHz
$V_R$	Reverse Input Voltage	5	V
$I_{O(PEAK)}$	Peak Output Current (Note 4)	3.0	A
$V_{DD} - V_{SS}$	Supply Voltage		0 to 35
		$T_A \geq 90^\circ\text{C}$	0 to 30
$V_{O(PEAK)}$	Peak Output Voltage	0 to $V_{DD}$	V
$t_{R(IN)}, t_{F(IN)}$	Input Signal Rise and Fall Time	500	ns
$PD_I$	Input Power Dissipation (Note 5, Note 7)	45	mW
$PD_O$	Output Power Dissipation (Note 6, Note 7)	250	mW

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.

- Pulse Width,  $PW \leq 1 \mu\text{s}$ , 300 pps
- Exponential Waveform,  $I_{O(PEAK)} \leq |2.5 \text{ A}| (\leq 0.3 \mu\text{s})$
- Maximum pulse width = 10  $\mu\text{s}$ , maximum duty cycle = 1.1%
- Derate linearly above 87 $^\circ\text{C}$ , free air temperature at a rate of 0.77 mW/ $^\circ\text{C}$
- No derating required across temperature range.
- Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

**Table 5. RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Units
$T_A$	Ambient Operating Temperature	-40 to +100	$^\circ\text{C}$
$V_{DD} - V_{SS}$	Power Supply	15 to 30	V
$I_{F(ON)}$	Input Current (ON)	7 to 16	mA
$V_{F(OFF)}$	Input Voltage (OFF)	0 to 0.8	V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

**Table 6. ISOLATION CHARACTERISTICS**

Apply over all recommended conditions, typical value is measured at  $T_A = 25^\circ\text{C}$

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_{ISO}$	Input-Output Isolation Voltage	$T_A = 25^\circ\text{C}$ , R.H. < 50 %, $t = 1.0 \text{ min.}$ , $I_{I-O} \leq 10 \mu\text{A}$ , 50 Hz (Note 8, Note 9)	5000			$V_{RMS}$
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500 \text{ V}$ (Note 8)		$10^{11}$		$\Omega$
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0 \text{ V}$ , Frequency = 1.0 MHz (Note 8)		1		pF

- Device is considered a two terminal device: pins 2 and 3 are shorted together

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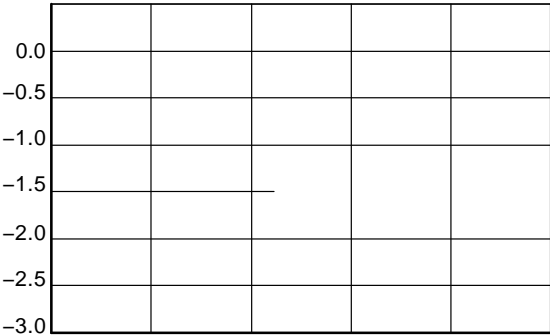
**Table 7. ELECTRICAL CHARACTERISTICS**

Apply over all recommended conditions, typical value is measured at  $V_{DD} = 30\text{ V}$ ,  $V_{SS} = \text{Ground}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_F$	Input Forward Voltage	$I_F = 10\text{ mA}$	1.2	1.5	1.8	V
$\Delta(V_F/T_A)$	Temperature Coefficient of Forward Voltage			-1.8		mV/°C
$BV_R$	Input Reverse Breakdown Voltage	$I_R = 10\text{ }\mu\text{A}$	5			V
$C_{IN}$	Input Capacitance	$f = 1\text{ MHz}$ , $V_F = 0\text{ V}$		60		pF
$I_{OH}$	High Level Output Current (Note 3)	$V_O = V_{DD} - 3\text{ V}$	-1.0	-2.0	-2.5	A
		$V_O = V_{DD} - 6\text{ V}$	-2.0		-2.5	
$I_{OL}$	Low Level Output Current (Note 3)	$V_O = V_{SS} + 3\text{ V}$	1.0	2.0	2.5	A
		$V_O = V_{SS} + 6\text{ V}$	2.0		2.5	
$V_{OH}$	High Level Output Voltage	$I_F$				

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TYPICAL PERFORMANCE CHARACTERISTICS



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## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

**Figure 7. Output Low Current vs. Ambient Temperature**

**Figure 8. Output Low Current vs. Ambient Temperature**







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## TEST CIRCUIT

Figure 20. I<sub>OL</sub>

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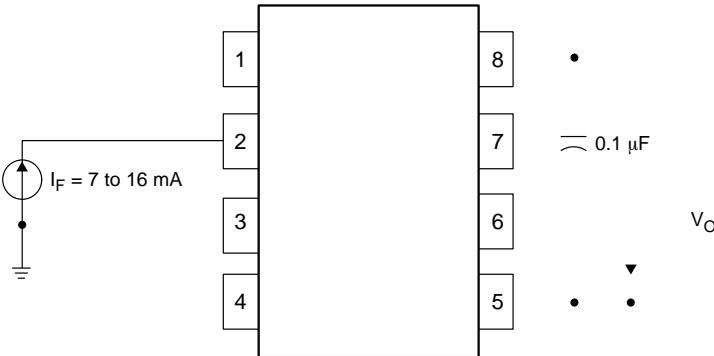


Figure 22.  $V_{OH}$  Test Circuit

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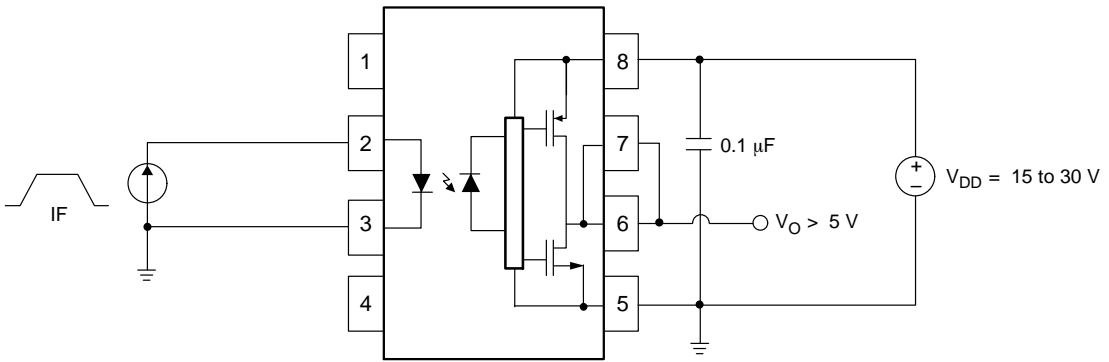


Figure 26.  $I_{FLH}$  Test Circuit

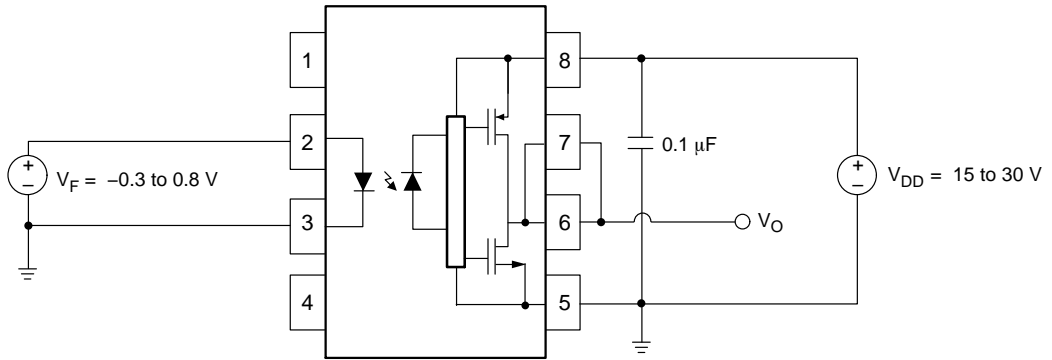


Figure 27.  $V_{FHL}$  Test Circuit

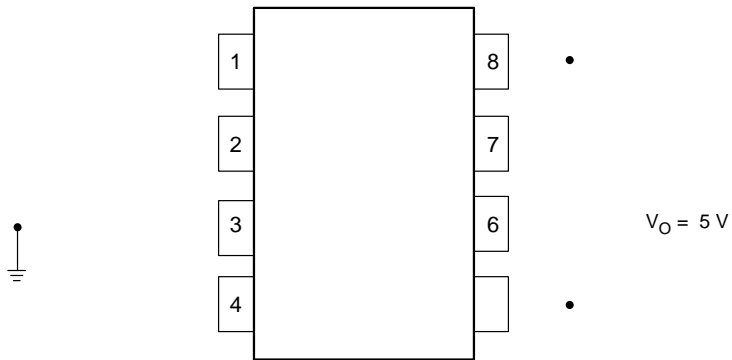
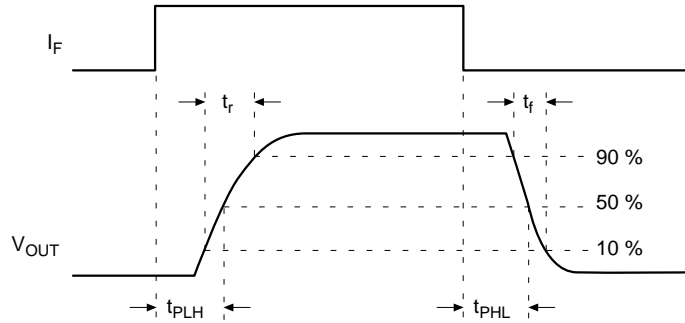
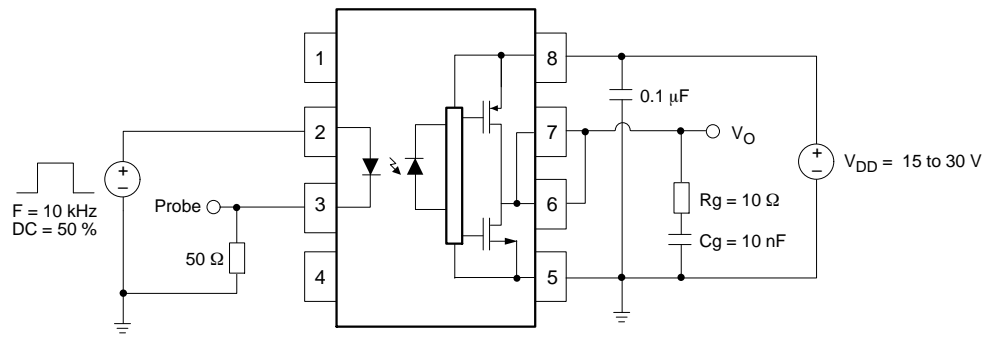
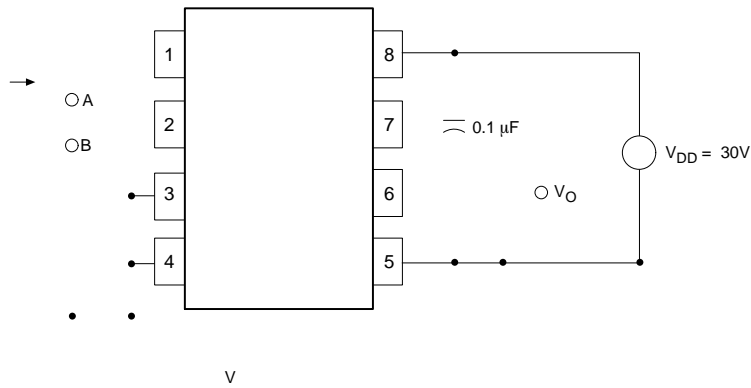


Figure 28. UVLO Test Circuit

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**Figure 29.  $t_{PHL}$ ,  $t_{PLH}$ ,  $t_r$  and  $t_f$  Test Circuit and Waveforms**



**Figure 30. CMR Test Circuit and Waveforms**

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## REFLOW PROFILE

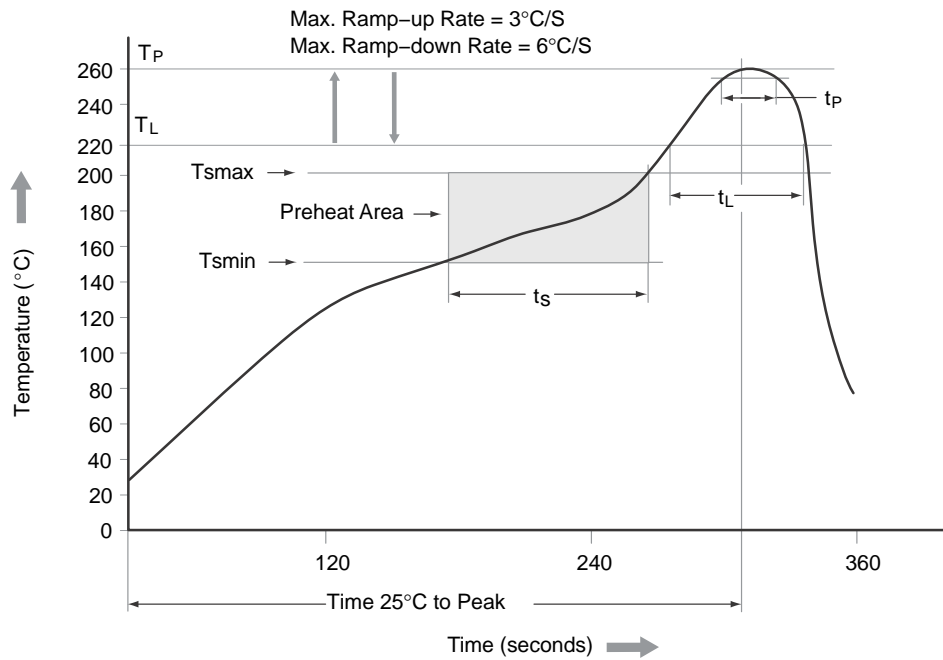


Figure 31. Reflow Profile

Table 9. REFLOW PROFILE

Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmmin)	150°C
Temperature Max. (Tsmmax)	200°C
Time (ts) from (Tsmmin to Tsmmax)	60–120 s
Ramp-up Rate (tL to tp)	3°C/s max.
Liquidous Temperature (TL)	217°C
Time (tL) Maintained Above (TL)	60–150 s
Peak Body Package Temperature	260°C +0°C / -5°C
Time (tp) within 5°C of 260°C	30 s
Ramp-down Rate (TP to TL)	6°C/s max.
Time 25°C to Peak Temperature	8 min. max.

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## ORDERING INFORMATION

Part Number	Package	Shipping†
FOD3120	DIP 8-Pin	50 / Tube
FOD3120S	SMT 8-Pin (Lead Bend)	50 / Tube
FOD3120SD	SMT 8-Pin (Lead Bend)	1000 / Tape & Reel
FOD3120V	DIP 8-Pin, DIN EN/IEC60747-5-5 option	50 / Tube



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ISSUE O

DATE 18 SEP 2017

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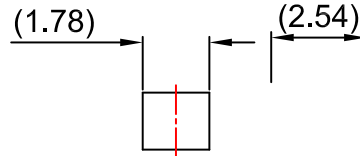
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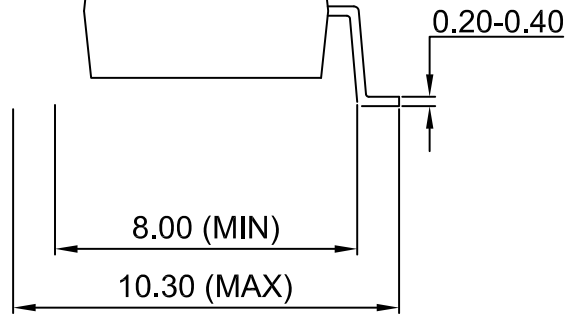
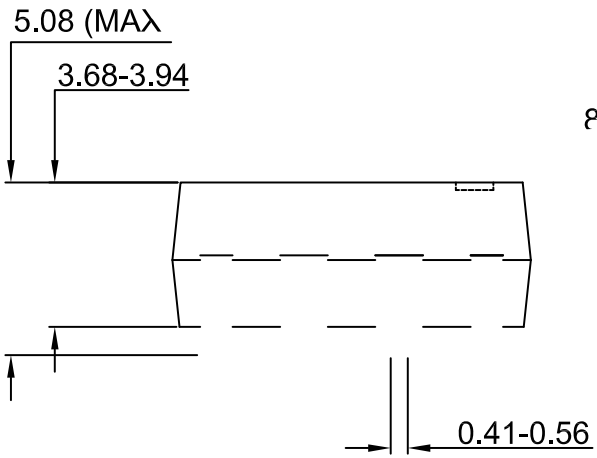
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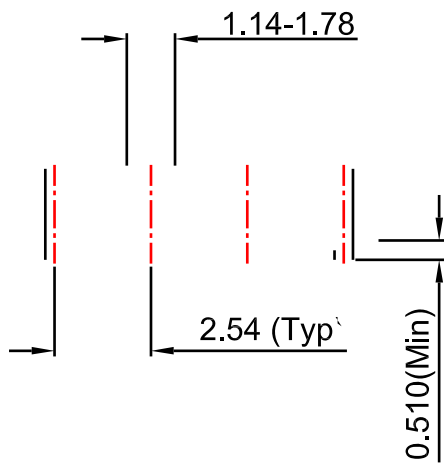


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