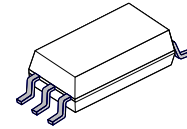


# 2.5 A Output Current, High-Speed, MOSFET/IGBT Gate Drive Optocoupler in OPTOPLANAR® Wide-Body SOP 5-Pin



SOIC6 W LESS PIN 2  
 CASE 752AG

## FOD8384

### Description

The FOD8384 is a 2.5 A output current gate drive optocoupler capable of driving medium-power IGBT/ MOSFETs. It is ideally suited for fast-switching driving of power IGBT and MOSFET used in motor-control inverter applications and high-performance power systems.

The FOD8384 utilizes **onsemi**'s OPTOPLANAR coplanar packaging technology and optimized IC design to achieve reliable high-insulation voltage and high-noise immunity.

It consists of an Aluminum Gallium Arsenide (AlGaAs) Light-Emitting Diode (LED) optically coupled to an integrated circuit with a high-speed driver for push-pull MOSFET output stage. The device is housed in a wide body, 5-pin, small-outline, plastic package.

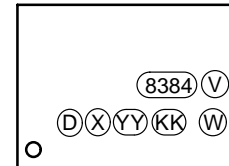
### Features

- Reliable and High-Voltage Insulation with Greater than 8 mm Creepage and Clearance Distance and 0.5 mm Internal Insulation Distance
- 2.5 A Output Current Driving Capability for Medium-Power IGBT/MOSFET
  - ◆ P-Channel MOSFET at Output Stage Enables Output Voltage Swing Close to Supply Rail
- 35 kV/μs Minimum Common Mode Rejection
- Wide Supply Voltage Range: 15 V to 30 V
- Fast Switching Speed Over Full Operating Temperature Range
  - ◆ 210 ns Maximum Propagation Delay
  - ◆ 65 ns Maximum Pulse-Width Distortion
- Under-Voltage Lockout (UVLO) with Hysteresis
- Extended Industrial Temperature Range: -40°C to 100°C
- Safety and Regulatory Approvals:
  - ◆ UL1577, 5,000 VACRMS for 1 Minute
  - ◆ DIN-EN/IEC60747-5-5, 1,414 V Peak Working
- Insulation Voltage
- These are Pb-Free Devices

### Applications

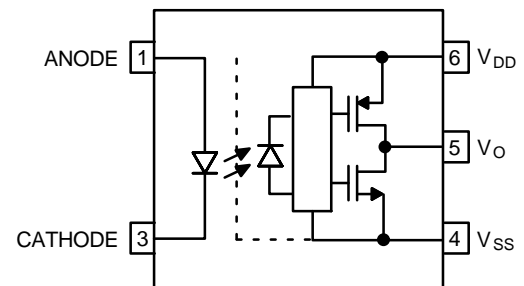
- AC and Brushless DC Motor Drives
- Industrial Inverter
- Uninterruptible Power Supply
- Induction Heating
- Isolated IGBT/Power MOSFET Gate Drive

### MARKING DIAGRAM



- 8384 = Device number, e.g., '8384' for FOD8384  
 V = DIN EN/IEC60747-5-5 Option (Only Appears on Component Ordered with This Option)  
 D = Plant Code  
 X = Last Digit Year Code  
 YY = Two-digit Work Week  
 KK = Lot Traceability Code  
 W = Package Assembly Code

### FUNCTIONAL SCHEMATIC



### ORDERING INFORMATION

See detailed ordering and shipping information on page 14 of this data sheet.

### Related Resources

- [FOD3184](#) – 3 A Output Current, High-Speed MOSFET/IGBT Gate Drive Optocoupler Datasheet
- <https://www.onsemi.com/products/interfaces/igbt-mosfet-gate-drivers-optocouplers>

# FOD8384

## TRUTH TABLE

LED	$V_{DD} - V_{SS}$ "Positive Going" (Turn-on)	$V_{DD} - V_{SS}$ "Positive 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 14.5 V	10 V to 13 V	Transition
On	14.5 V to 30 V	13 V to 30 V	HIGH

## Pin Configuration

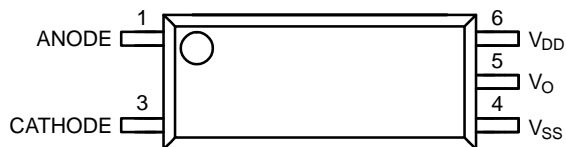


Figure 1. Pin Configuration

## PIN DEFINITIONS

Pin No.	Name	Description
1	Anode	LED Anode
3	Cathode	LED Cathode
4	$V_{SS}$	Negative Supply Voltage
5	$V_O$	Output Voltage
6	$V_{DD}$	Positive Supply Voltage

**SAFETY AND INSULATION RATINGS** (As per DIN EN/IEC60747-5-5, 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	–	
	For Rated Mains Voltage < 300 $V_{RMS}$	–	I–IV	–	
	For Rated Mains Voltage < 450 $V_{RMS}$	–	I–III	–	
	For Rated Mains Voltage < 600 $V_{RMS}$	–	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 b, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ s, Partial Discharge < 5 pC	2651	–	–	
	Input-to-Output Test Voltage, Method a, $V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test with $t_m = 10$ s, Partial Discharge < 5 pC	2262	–	–	
$V_{IORM}$	Maximum Working Insulation Voltage	1414	–	–	$V_{peak}$
$V_{IOTM}$	Highest Allowable Over Voltage	8000	–	–	$V_{peak}$
	External Creepage	8.0	–	–	mm
	External Clearance	8.0	–	–	mm
	Insulation Thickness	0.5	–	–	mm
$T_S$	Safety Limit Values – Maximum Values Allowed in the Event of a Failure Case Temperature	150	–	–	$^{\circ}C$
$I_{S,INPUT}$	Input Current	200	–	–	mA
$P_{S,OUTPUT}$	Output Power	600	–	–	mW
$R_{IO}$	Insulation Resistance at $T_S$ , $V_{IO} = 500$ V	$10^9$	–	–	$\Omega$

# FOD8384

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

Symbol	Parameter	Value	Unit
T <sub>STG</sub>	Storage Temperature	-40 to +125	°C
T <sub>OPR</sub>	Operating Temperature	-40 to +100	°C
T <sub>J</sub>	Junction Temperature	-40 to +125	°C
T <sub>SOL</sub>	Lead Solder Temperature <i>Refer to Reflow Temperature Profile on page 13.</i>	260 for 10 s	°C
I <sub>F(AVG)</sub>	Average Input Current	25	mA
V <sub>R</sub>	Reverse Input Voltage	5.0	V
I <sub>O(PEAK)</sub>	Peak Output Current (Note 1)	3.0	A
V <sub>DD</sub> - V <sub>SS</sub>	Supply Voltage	-0.5 to 35	V
V <sub>O(PEAK)</sub>	Peak Output Voltage	0 to V <sub>DD</sub>	V
PD <sub>I</sub>	Input Power Dissipation (Note 2, 4)	45	mW
PD <sub>O</sub>	Output Power Dissipation (Note 3, 4)	500	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.

1. Maximum pulse width = 10 μs, maximum duty cycle = 0.2%.
2. No derating required across operating temperature range.
3. Derate linearly from 25°C at a rate of 5.2 mW/°C.
4. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
T <sub>A</sub>	Ambient Operating Temperature	-40	100	°C
V <sub>DD</sub> - V <sub>SS</sub>	Supply Voltage	15	30	V
I <sub>F(ON)</sub>	Input Current (ON)	10	16	mA
V <sub>F(OFF)</sub>	Input Voltage (OFF)	0	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.

## ISOLATION CHARACTERISTICS (Apply over all recommended conditions; typical value is measured at T<sub>A</sub> = 25°C.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>ISO</sub>	Input-Output Isolation Voltage	T <sub>A</sub> = 25°C, R.H. < 50%, t = 60 s, I <sub>I-O</sub> ≤ 20 μA, 50 Hz (Note 5, 6)	5,000	-	-	V <sub>RMS</sub>
R <sub>ISO</sub>	Isolation Resistance	V <sub>I-O</sub> = 500 V (Note 5)	-	10 <sup>11</sup>	-	Ω
C <sub>ISO</sub>	Isolation Capacitance	V <sub>I-O</sub> = 0 V, Frequency = 1.0 MHz (Note 6)	-	1	-	pF

5. Device is considered a two-terminal device: pins 1 and 3 are shorted together and pins 4, 5 and 6 are shorted together.
6. 5,000 VAC<sub>RMS</sub> for 1 minute duration is equivalent to 6,000 VAC<sub>RMS</sub> for 1 second duration.

# FOD8384

**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	Test Condition	Min	Typ	Max	Unit	Figure
$V_F$	Input Forward Voltage	$I_F = 10\text{ mA}$	1.10	1.43	1.80	V	17
$\Delta(V_F / T_A)$	Temperature Coefficient of Forward Voltage		-	-1.5	-	mV/°C	
$BV_R$	Input Reverse Breakdown Voltage	$I_R = 10\ \mu\text{A}$	5	-	-	V	
$C_{IN}$	Input Capacitance	$f = 1\text{ MHz}$ , $V_F = 0\text{ V}$	-	60	-	pF	
$I_{OH}$	High Level Output Current (Note 1)	$V_{OH} = V_{DD} - 1\text{ V}$	-	-0.9	-0.5	A	2, 4
		$V_{OH} = V_{DD} - 6\text{ V}$	-	-	-2.5	A	2, 4, 20
$I_{OL}$	Low Level Output Current (Note 1)	$V_{OL} = V_{SS} + 1\text{ V}$	0.5	1.0	-	A	5, 7
		$V_{OL} = V_{SS} + 6\text{ V}$	2.5	-	-	A	5, 7, 219
$V_{OH}$	High Level Output Voltage (Note 7, 8)	$I_F = 10\text{ mA}$ , $I_O = -2.5\text{ A}$	$V_{DD} - 7.0$	-	-	V	2
		$I_F = 10\text{ mA}$ , $I_O = -100\text{ mA}$	$V_{DD} - 0.5$	-	-	V	4, 3, 21
$V_{OL}$	Low Level Output Voltage (Note 7, 8)	$I_F = 0\text{ mA}$ , $I_O = 2.5\text{ A}$	-	-	$V_{SS} + 7.0$	V	5
		$I_F = 0\text{ mA}$ , $I_O = 100\text{ mA}$	-	-	$V_{SS} + 0.5$	V	6, 22
$I_{DDH}$	High Level Supply Current	$V_O = \text{Open}$ , $I_F = 7\text{ to }16\text{ mA}$	-	2.9	3.5	mA	8, 9, 23
$I_{DDL}$	Low Level Supply Current	$V_O = \text{Open}$ , $V_F = 0\text{ to }0.8\text{ V}$	-	2.8	3.5	mA	8, 9, 24
$I_{FLH}$	Threshold Input Current Low-to-High	$I_O = 0\text{ mA}$ , $V_O > 5\text{ V}$	-	3.1	7.5	mA	10, 16, 25
$V_{FHL}$	Threshold Input Voltage High-to-Low	$I_O = 0\text{ mA}$ , $V_O < 5\text{ V}$	0.8	-	-	V	26
$V_{UVLO+}$	Under-Voltage Lockout Threshold	$I_F = 10\text{ mA}$ , $V_O > 5\text{ V}$	11.5	13.0	14.5	V	18, 27
$V_{UVLO-}$		$I_F = 10\text{ mA}$ , $V_O < 5\text{ V}$	10.0	11.5	13.0	V	18, 27
$UVLO_{HYS}$	Under-Voltage Lockout Threshold Hysteresis		-	1.5	-	V	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

7. In this test,  $V_{OH}$  is measured with a dc load current of 100 mA. When driving capacitive load  $V_{OH}$  will approach  $V_{DD}$  as  $I_{OH}$  approaches 0 A.  
 8. Maximum pulse width = 1 ms, maximum duty cycle = 20%.

# FOD8384

**SWITCHING 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	Test Condition	Min	Typ	Max	Unit	Figure
$t_{PHL}$	Propagation Delay Time to Logic LOW Output (Note 9)	$I_F = 7\text{ mA to }16\text{ mA}$ , $R_g = 10\ \Omega$ , $C_g = 10\text{ nF}$ , $f = 250\text{ kHz}$ , Duty Cycle = 50%	50	145	210	ns	11, 12, 13, 14, 15, 28
$t_{PLH}$	Propagation Delay Time to Logic HIGH Output (Note 10)		50	135	210	ns	11, 12, 13, 14, 15, 28
PWD	Pulse Width Distortion (Note 11) $ t_{PHL} - t_{PLH} $		–	25	65	ns	
PDD (Skew)	Propagation Delay Difference Between Any Two Parts (Note 12)		–90	–	90		
$t_R$	Output Rise Time (10% to 90%)		–	35	–	ns	28
$t_F$	Output Fall Time (90% to 10%)		–	25	–	ns	28
$t_{ULVO\ ON}$	ULVO Turn-On Delay		$I_F = 10\text{ mA}$ , $V_O > 5\text{ V}$	–	1.7	–	$\mu\text{s}$
$t_{ULVO\ OFF}$	ULVO Turn-Off Delay	$I_F = 10\text{ mA}$ , $V_O < 5\text{ V}$	–	0.1	–	$\mu\text{s}$	
$ CM_H $	Common Mode Transient Immunity at Output HIGH	$T_A = 25^\circ\text{C}$ , $V_{DD} = 30\text{ V}$ , $I_F = 10\text{ to }16\text{ mA}$ , $V_{CM} = 1500\text{ V}$ (Note 13)	35	50	–	$\text{kV}/\mu\text{s}$	29
$ CM_L $	Common Mode Transient Immunity at Output LOW	$T_A = 25^\circ\text{C}$ , $V_{DD} = 30\text{ V}$ , $V_F = 0\text{ V}$ , $V_{CM} = 1500\text{ V}$ (Note 14)	35	50	–	$\text{kV}/\mu\text{s}$	29

9. Propagation delay  $t_{PHL}$  is measured from the 50% level on the falling edge of the input pulse to the 50% level of the falling edge of the  $V_O$  signal.

10. Propagation delay  $t_{PLH}$  is measured from the 50% level on the rising edge of the input pulse to the 50% level of the rising edge of the  $V_O$  signal.

11. PWD is defined as  $|t_{PHL} - t_{PLH}|$  for any given device.

12. The difference between  $t_{PHL}$  and  $t_{PLH}$  between any two FOD8384 parts under the same operating conditions, with equal loads.

13. Common mode transient immunity at output high is the maximum tolerable negative  $dV_{cm}/dt$  on the trailing edge of the common mode impulse signal,  $V_{CM}$ , to ensure that the output remains high (i.e.,  $V_O > 15.0\text{ V}$ ).

14. Common mode transient immunity at output low is the maximum tolerable positive  $dV_{cm}/dt$  on the leading edge of the common pulse signal,  $V_{CM}$ , to ensure that the output remains low (i.e.,  $V_O < 1.0\text{ V}$ ).

TYPICAL PERFORMANCE CHARACTERISTICS

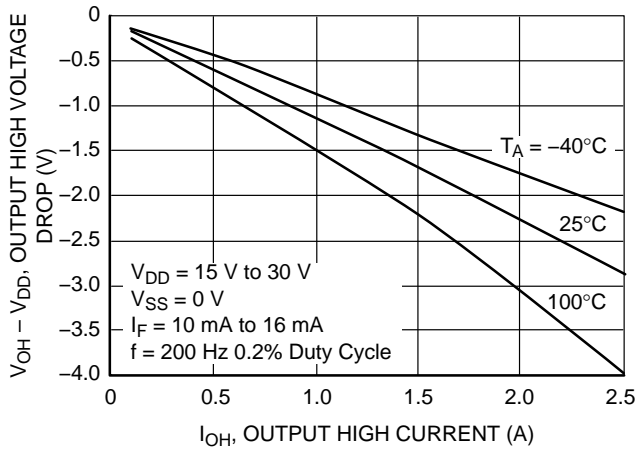


Figure 2. Output High Voltage Drop vs. Output High Current

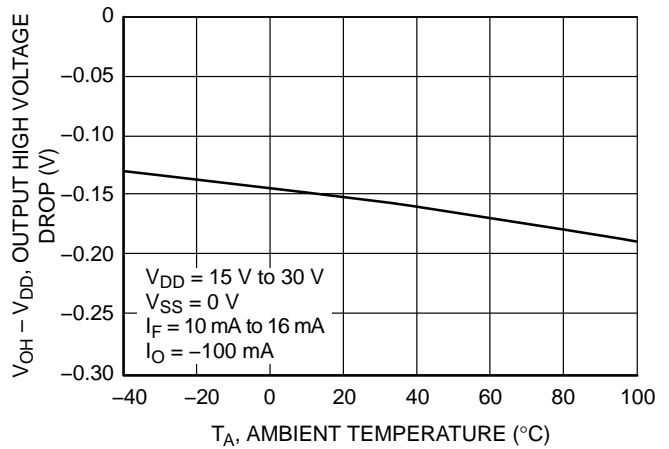


Figure 3. Output High Voltage Drop vs. Ambient Temperature

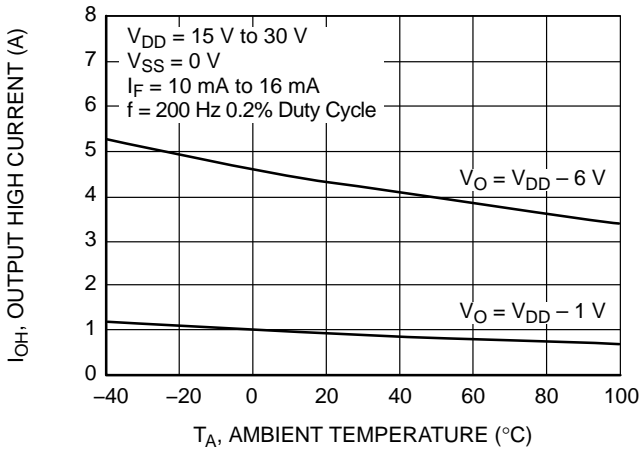


Figure 4. Output High Current vs. Ambient Temperature

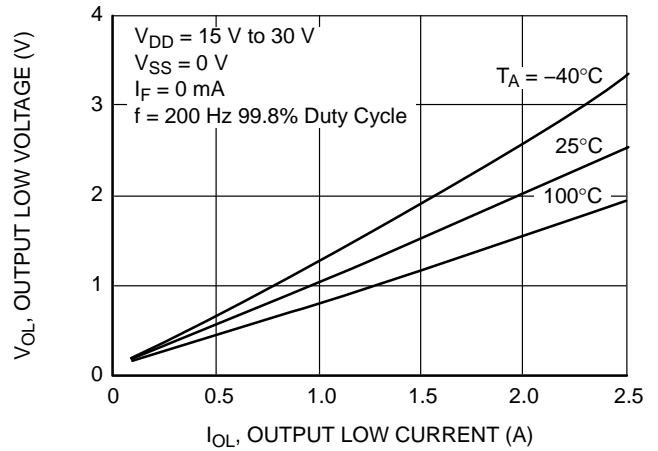


Figure 5. Output Low Voltage vs. Output Low Current

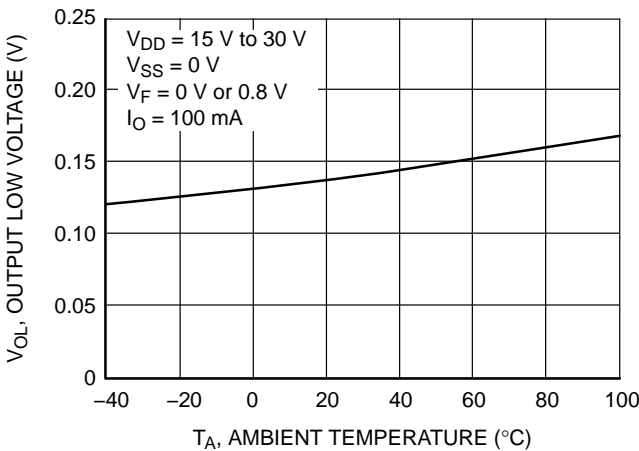


Figure 6. Output Low Voltage vs. Ambient Temperature

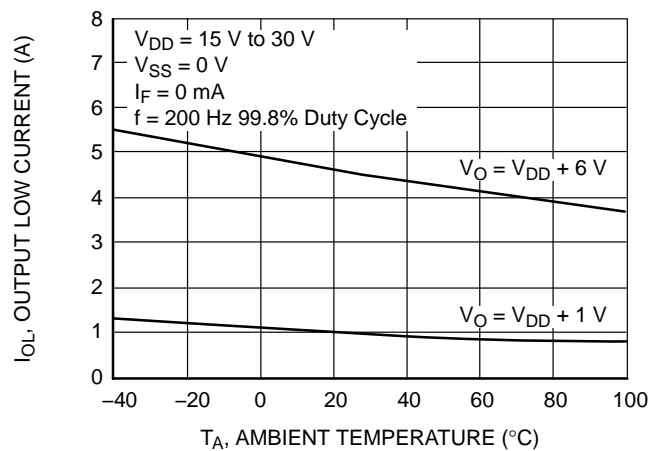


Figure 7. Output Low Current vs. Ambient Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

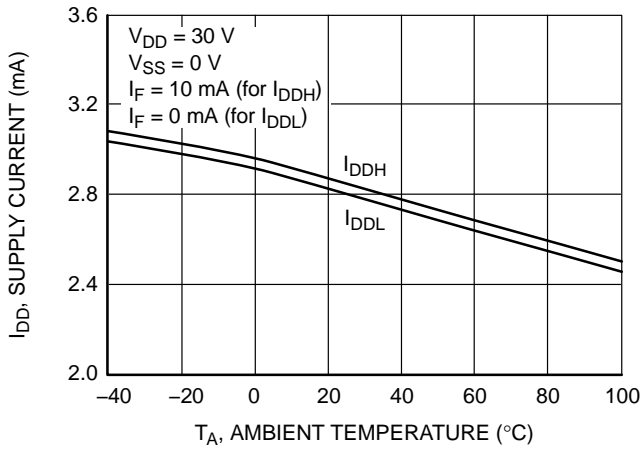


Figure 8. Supply Current vs. Ambient Temperature

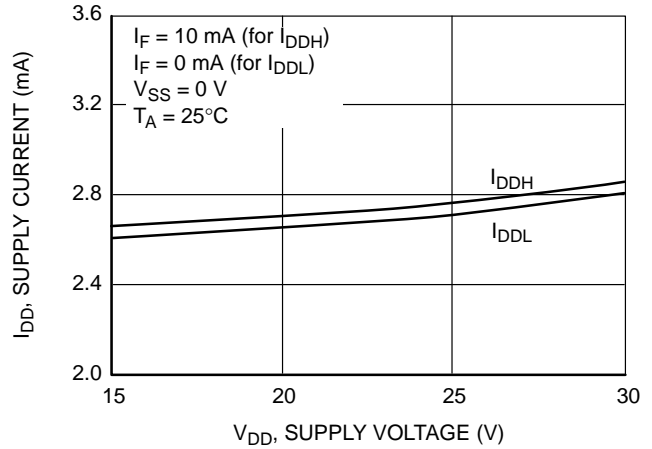


Figure 9. Supply Current vs. Supply Voltage

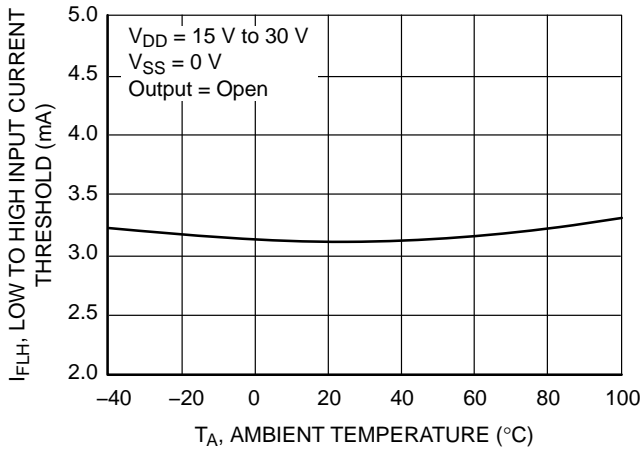


Figure 10. Low-to-High Input Current Threshold vs. Ambient Temperature

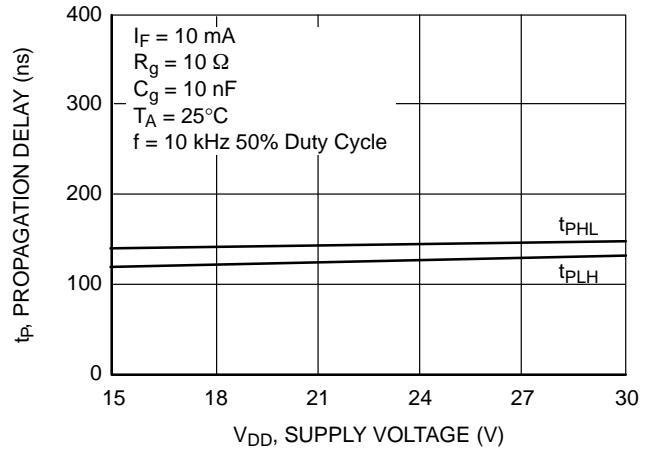


Figure 11. Propagation Delay vs. Supply Voltage

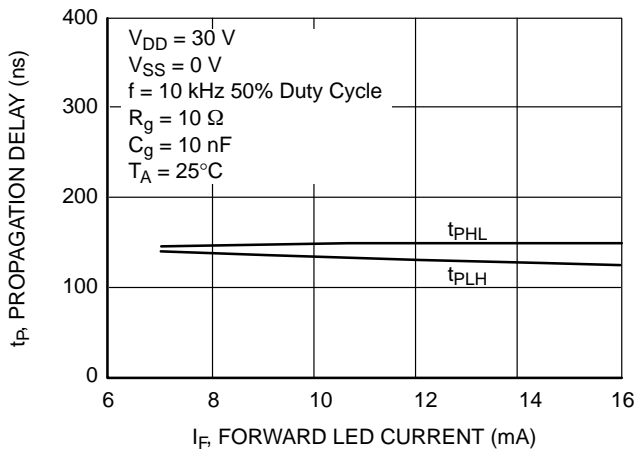


Figure 12. Propagation Delay vs. LED Forward Current

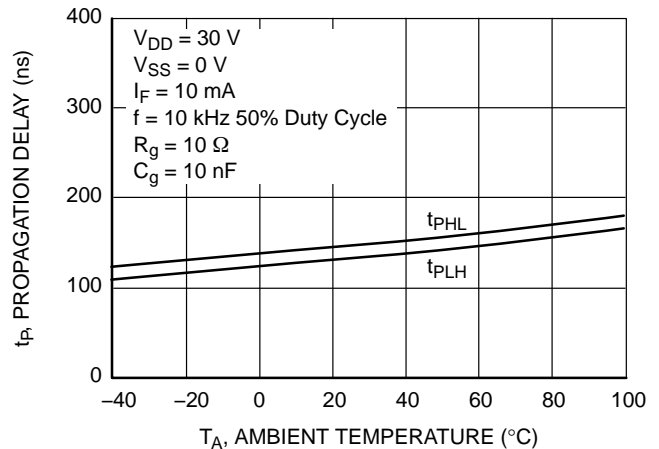


Figure 13. Propagation Delay vs. Ambient Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

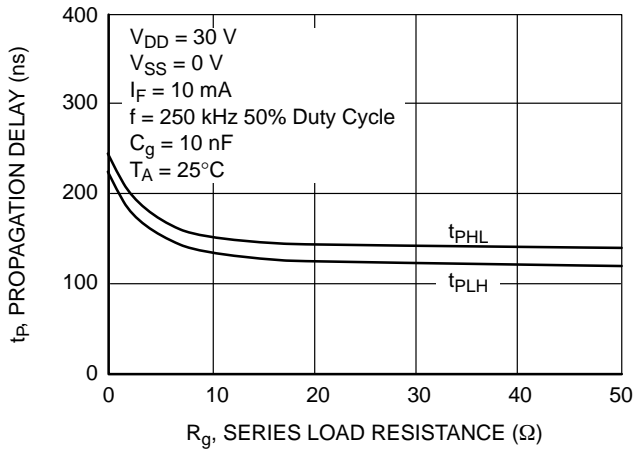


Figure 14. Propagation Delay vs. Series Load Resistance

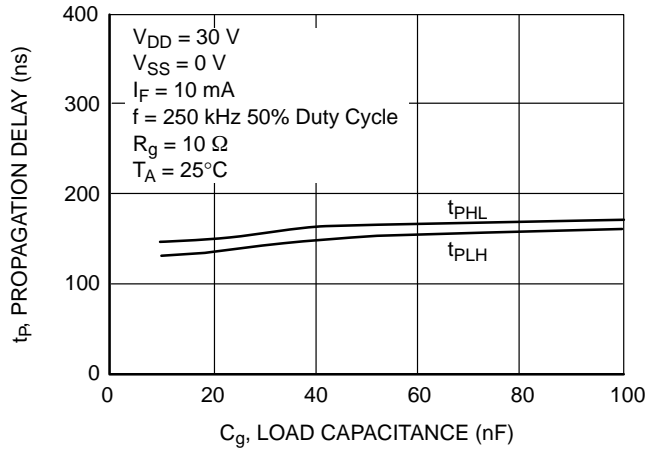


Figure 15. Propagation Delay vs. Load Capacitance

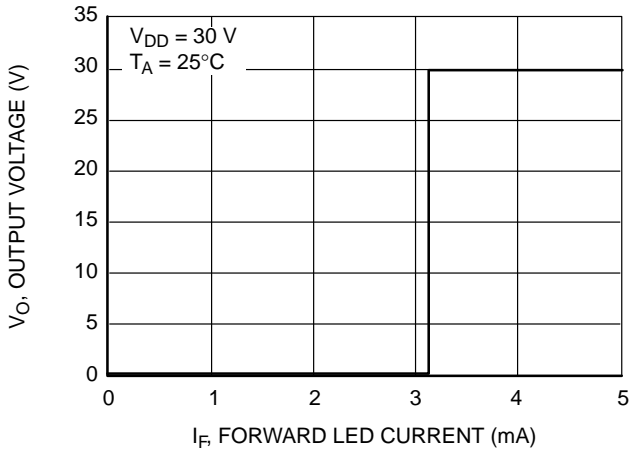


Figure 16. Transfer Characteristics

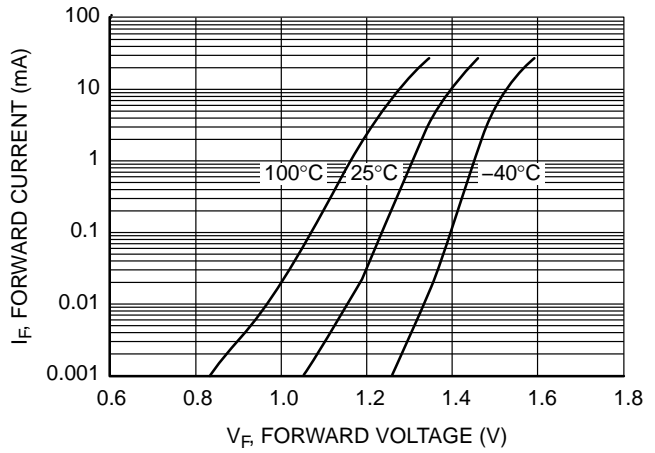


Figure 17. Input Forward Current vs. Forward Voltage

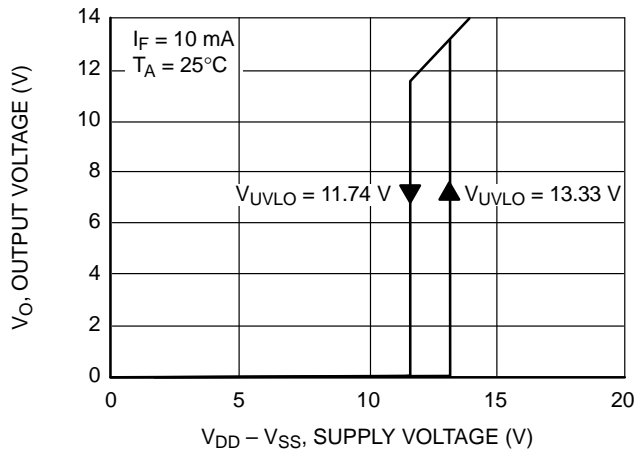
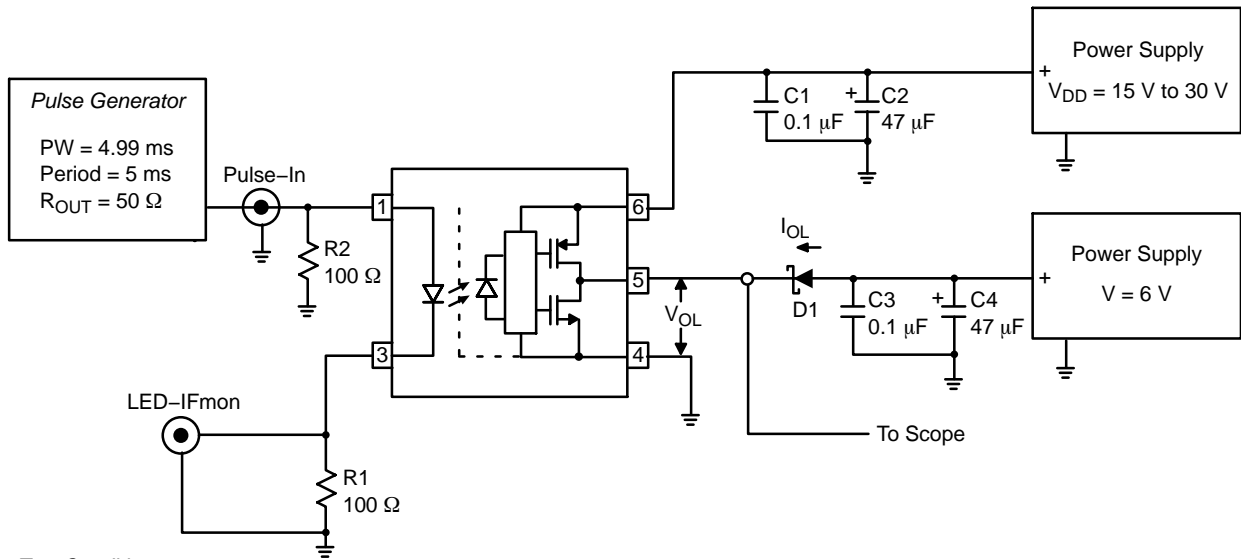


Figure 18. Under-Voltage Lockout



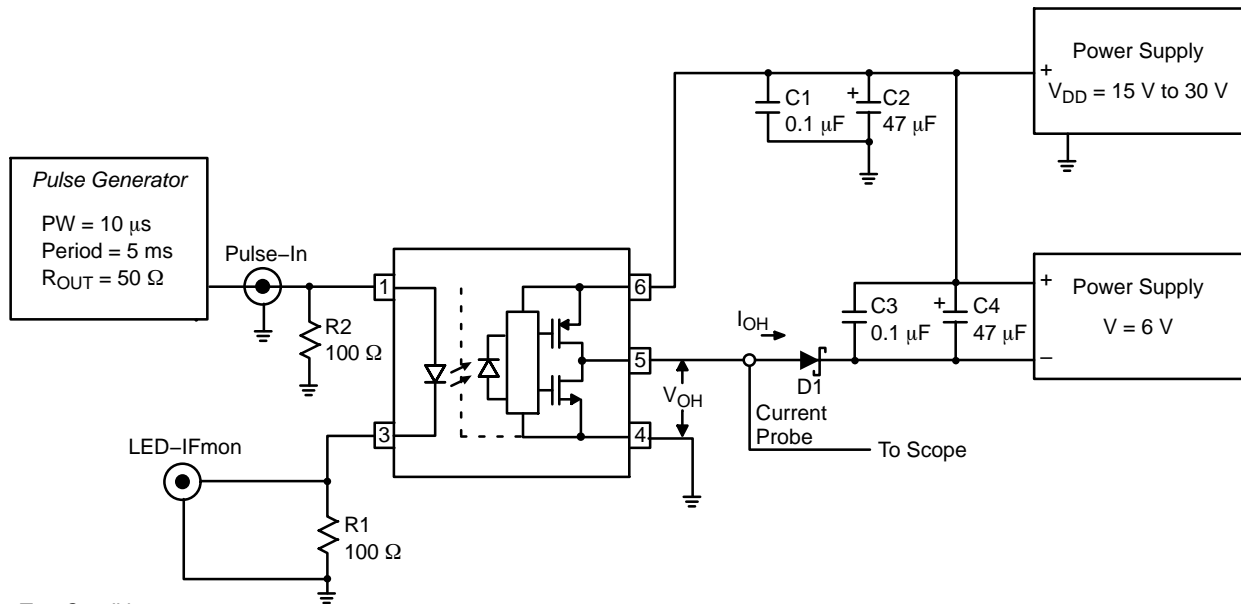
# FOD8384

## TEST CIRCUIT



**Test Conditions:**  
 Frequency = 200 Hz  
 Duty Cycle = 99.8%  
 $V_{DD} = 15\text{ V to }30\text{ V}$   
 $V_{SS} = 0\text{ V}$   
 $I_F = 0\text{ mA}$

Figure 19.  $I_{OL}$  Test Circuit



**Test Conditions:**  
 Frequency = 200 Hz  
 Duty Cycle = 0.2%  
 $V_{DD} = 15\text{ V to }30\text{ V}$   
 $V_{SS} = 0\text{ V}$   
 $I_F = 10\text{ mA to }16\text{ mA}$

Figure 20.  $I_{OH}$  Test Circuit

# FOD8384

## TEST CIRCUIT (CONTINUED)

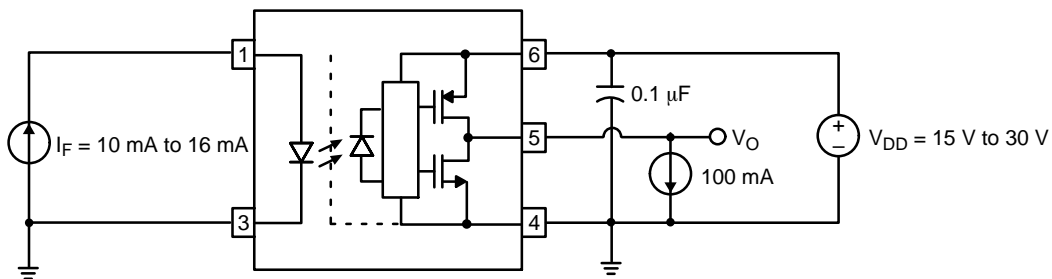


Figure 21.  $V_{OH}$  Test Circuit

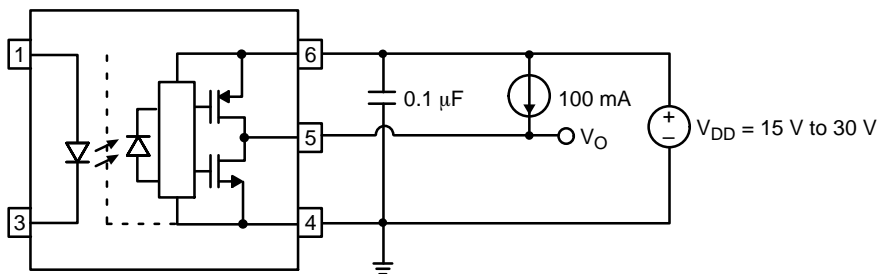


Figure 22.  $V_{OL}$  Test Circuit

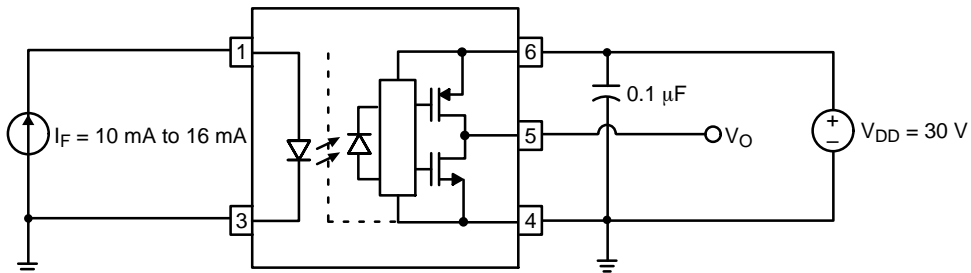


Figure 23.  $I_{DDH}$  Test Circuit

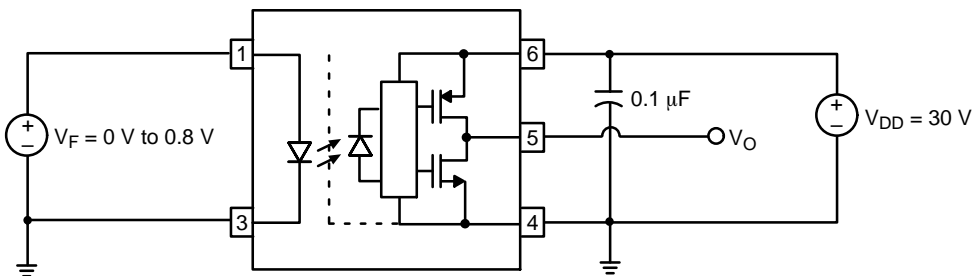


Figure 24.  $I_{DDL}$  Test Circuit

# FOD8384

## TEST CIRCUIT (CONTINUED)

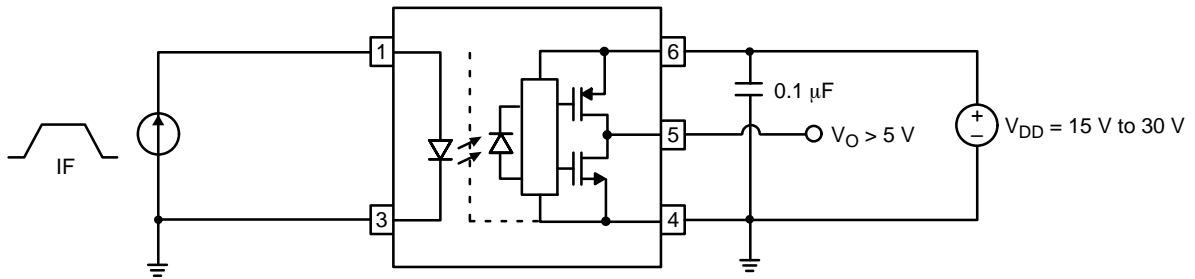


Figure 25.  $I_{FLH}$  Test Circuit

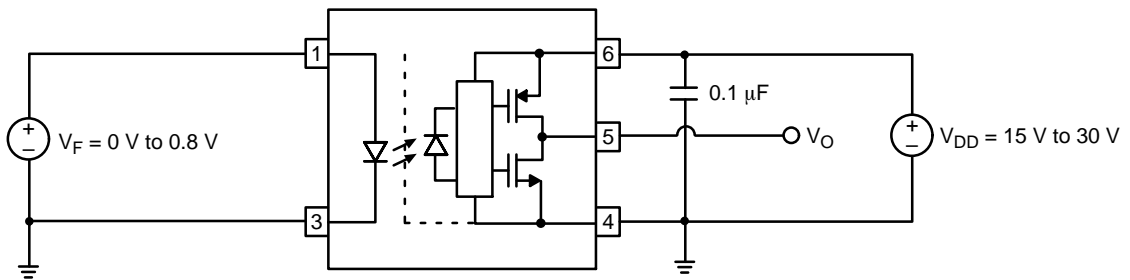


Figure 26.  $V_{FHL}$  Test Circuit

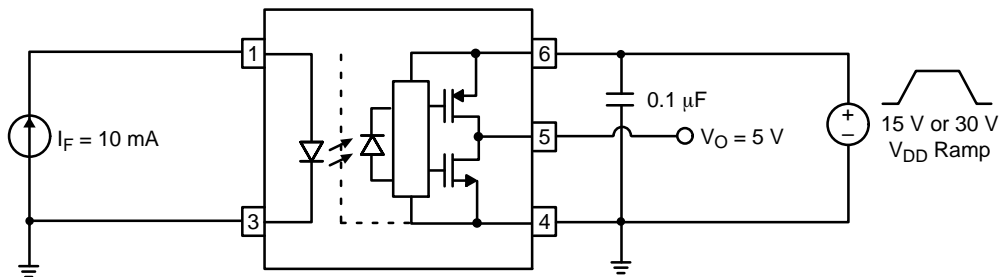
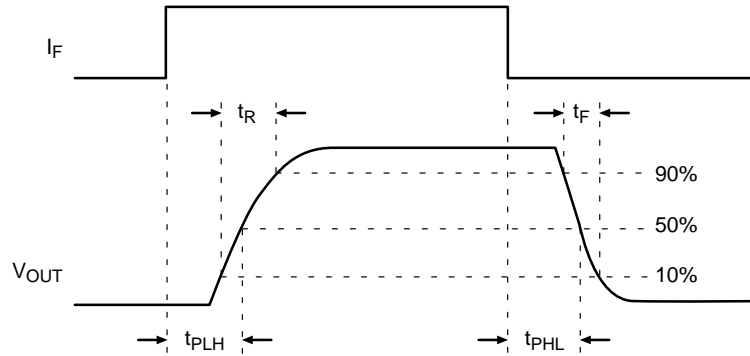
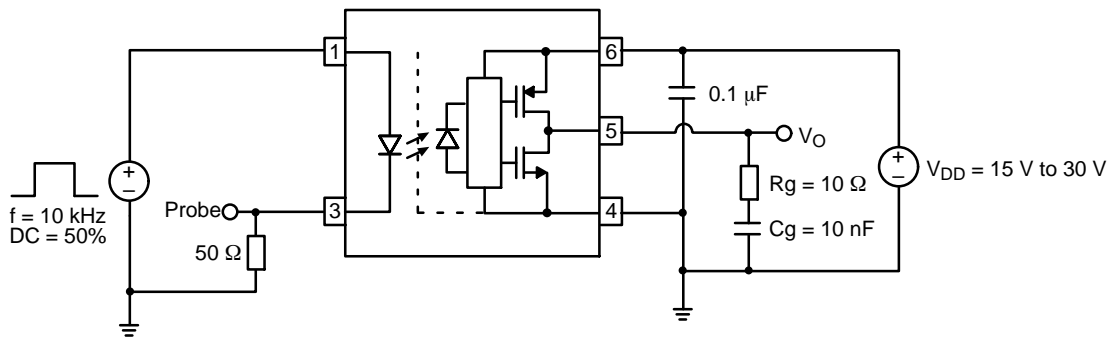


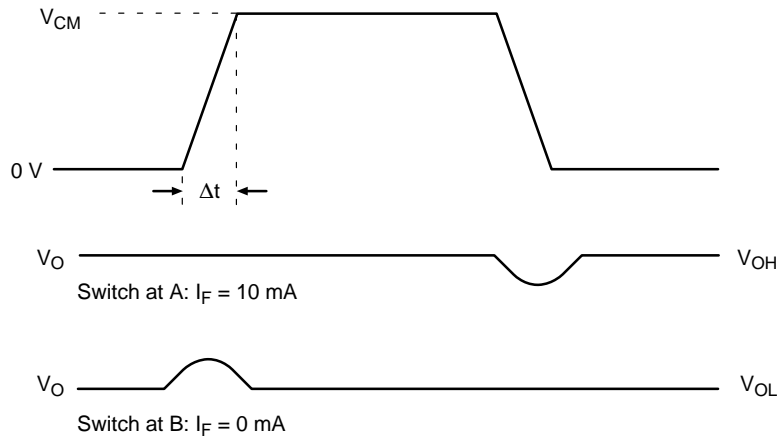
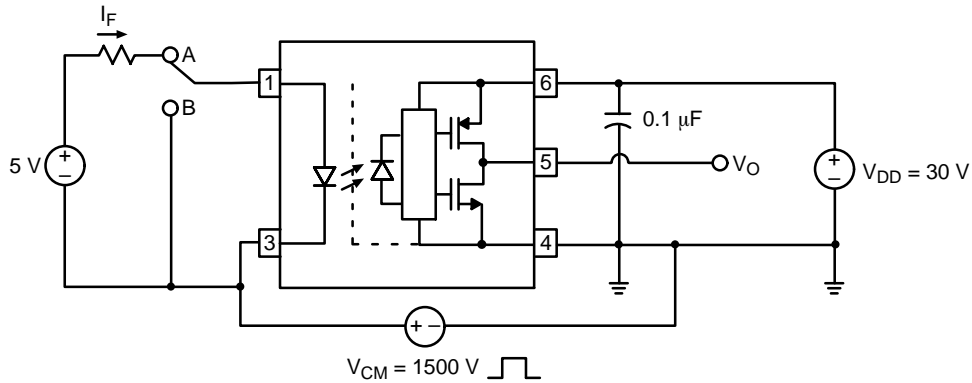
Figure 27. UVLO Test Circuit

# FOD8384

## TEST CIRCUIT (CONTINUED)



**Figure 28.  $t_{PHL}$ ,  $t_{PLH}$ ,  $t_R$ , and  $t_F$  Test Circuit and Waveforms**



**Figure 29. CMR Test Circuit and Waveforms**

REFLOW PROFILE

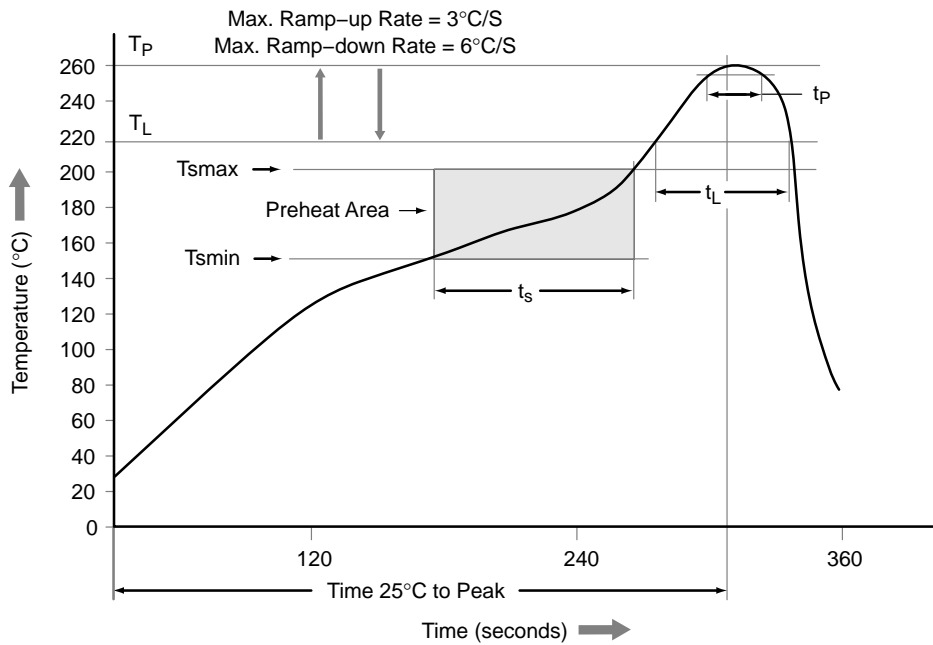


Figure 30. Reflow Profile

Profile Feature	Pb-Free Assembly Profile
Temperature Minimum ( $T_{smin}$ )	150°C
Temperature Maximum ( $T_{smax}$ )	200°C
Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	60 s to 120 s
Ramp-up Rate ( $t_L$ to $t_P$ )	3°C/second maximum
Liquidous Temperature ( $T_L$ )	217°C
Time ( $t_L$ ) Maintained Above ( $T_L$ )	60 s to 150 s
Peak Body Package Temperature	260°C +0°C / -5°C
Time ( $t_p$ ) within 55°C of 260°C	30 s
Ramp-Down Rate ( $T_P$ to $T_L$ )	6°C/s maximum
Time 25°C to Peak Temperature	8 minutes maximum

# FOD8384

## ORDERING INFORMATION

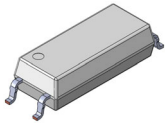
Part Number	Package	Shipping†
FOD8384	SOIC6 W LESS PIN 2, Wide Body SOP 5-Pin (Pb-Free)	100 Units / Tube
FOD8384R2	SOIC6 W LESS PIN 2, Wide Body SOP 5-Pin (Pb-Free)	1,000 Units / Tape & Reel
FOD8384V	SOIC6 W LESS PIN 2, Wide Body SOP 5-Pin, DIN EN/IEC60747-5-5 Option (Pb-Free)	100 Units / Tube
FOD8384R2V	SOIC6 W LESS PIN 2, Wide Body SOP 5-Pin, DIN EN/ IEC60747-5-5 Option (Pb-Free)	1,000 Units / Tape & Reel

†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.

15. All packages are lead free per JEDEC: J-STD-020B standard.

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

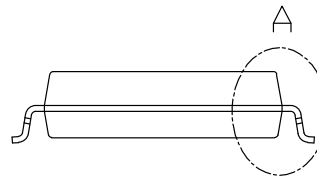
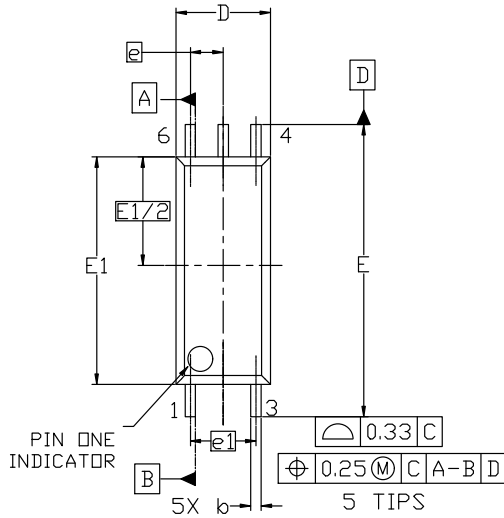


**SOIC5 (6) 3.65x8.80x2.55, 1.27P**  
CASE 752AG  
ISSUE B

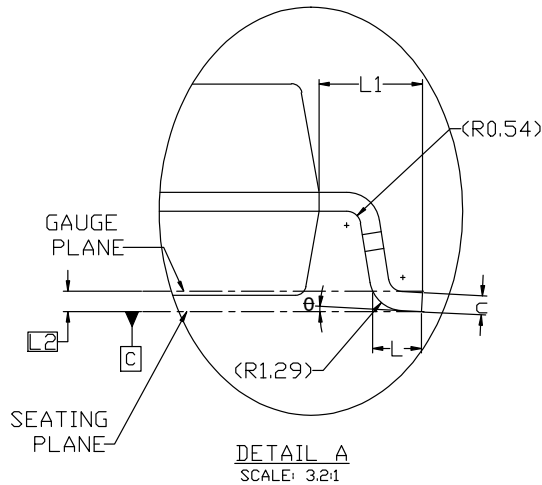
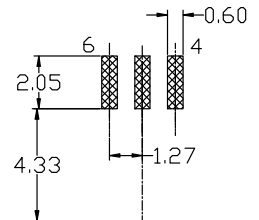
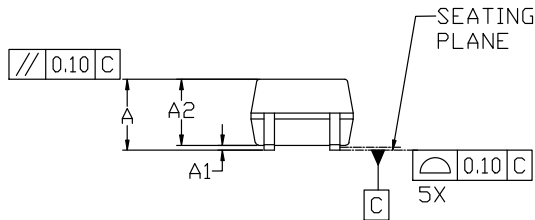
DATE 24 JUL 2023

NOTES: UNLESS OTHERWISE SPECIFIED

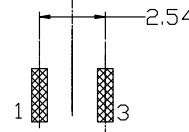
- A) THIS PACKAGE DOES NOT CONFORM TO ANY STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
- D) DRAWING CONFORMS TO ASME Y14.5M-1994



DIM	MILLIMETER		
	MIN.	NOM.	MAX.
A	--	--	2.95
A1	0.10	0.20	0.30
A2	2.45	2.55	2.65
b	0.31	0.41	0.51
c	0.19	0.22	0.25
D	3.55	3.65	3.75
E	11.20	11.30	11.40
E1	8.70	8.80	8.90
E1/2	4.20 BSC		
e	1.27 BSC		
e1	2.54 BSC		
L	0.44	0.59	0.74
L1	1.15	1.25	1.35
L2	0.25 BSC		
θ	0°	--	8°



LAND PATTERN  
RECOMMENDATION



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