HIGH FREQUENCY HIGH-SIDE AND LOW-SIDE GATE DRIVER IN W-DFN3030-10 (Type TH)

Description

The DGD05473 is a high-frequency gate driver capable of driving N-channel MOSFETs. The floating high-side driver is rated up to 50V.

The DGD05473 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with MCUs. UVLO for high-side and low-side will protect a MOSFET with loss of supply. To protect MOSFETs, cross conduction prevention logic prevents the HO and LO outputs from being on at the same time.

Fast and well-matched propagation delays allow a higher switching frequency, enabling a smaller, more compact power switching design, using smaller associated components. To minimize space an internal bootstrap diode is included. The DGD05473 is offered in the W-DFN3030-10 (Type TH) package and operates over an extended -40°C to +125°C temperature range.

Features

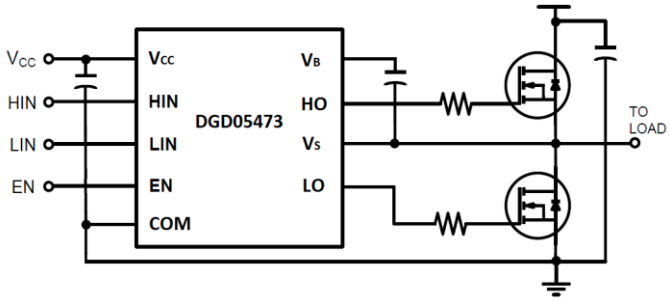
- 50V Floating High-Side Driver
- Drives Two N-channel MOSFETs in a Half-Bridge Configuration
- 1.5A Source / 2.5A Sink Output Current Capability
- Internal Bootstrap Diode Included
- Undervoltage Lockout for High-Side and Low-Side Drivers
- Delay Matching Maxmimum of 5ns
- Propagation Delay Typical of 20ns
- Logic Input (HIN, LIN and EN) 3.3V Capability
- Ultra Low Standby Currents (<1µA)
- Extended Temperature Range: -40°C to +125°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

- DC-DC Converters
- Motor Controls
- Battery Powered Hand Tools
- eCig Devices
- Class D Power Amplifiers

Mechanical Data

- Case: W-DFN3030-10 (Type TH)
- Case Material: Molded Plastic. "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 3 per J-STD-020
- Terminals: Finish – Matte Tin Finish. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.017 grams (Approximate)



Typical Configuration

Top View Bottom View

W-DFN3030-10 (Type TH)

Ordering Information (Note 4)

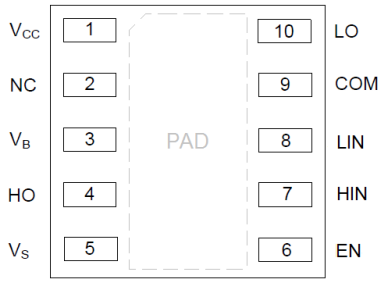
Product	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
DGD05473FN-7	DGD05473	7	8	3,000

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

DGD05473 = Product Type Marking Code
YY = Year (ex: 18 = 2018)
WW = Week (01 to 53)

Pin Assignments

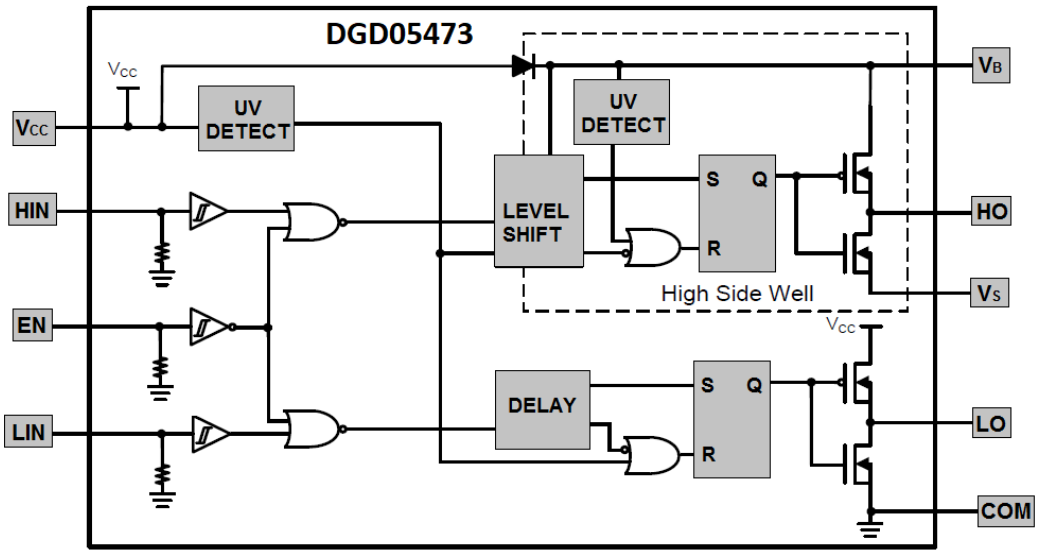


Top View: W-DFN3030-10 (Type TH)

Pin Descriptions

Pin Number	Pin Name	Function
1	V_{CC}	Low-Side and Logic Supply
2	NC	No Connect (No Internal Connection)
3	V_B	High-Side Floating Supply
4	HO	High-Side Gate Drive Output
5	V_S	High-Side Floating Supply Return
6	EN	Logic Input Enable, a Logic Low turns off Gate Driver
7	HIN	Logic Input for High-Side Gate Driver, in Phase with HO
8	LIN	Logic Input for Low-Side Gate Driver, in Phase with LO
9	COM	Low-Side and Logic Return
10	LO	Low-Side Gate Drive Output
PAD	Substrate	Connect to COM on PCB

Functional Block Diagram



Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
High-Side Floating Positive Supply Voltage	V_B	-0.3 to +60	V
High-Side Floating Negative Supply Voltage	V_S	V_B-14 to V_B+0.3	V
High-Side Floating Output Voltage	V_{HO}	V_S-0.3 to V_B+0.3	V
Offset Supply Voltage Transient	dV_S / dt	50	V/ns
Logic and Low-Side Fixed Supply Voltage	V_{CC}	-0.3 to +14	V
Low-Side Output Voltage	V_{LO}	-0.3 to V_{CC}+0.3	V
Logic Input Voltage (HIN, LIN and EN)	V_{IN}	-0.3 to V_{CC}+0.3	V
Bootstrap Diode Current (Pulsed <10µs)	I_{BD}	1	A

Thermal Characteristics (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Power Dissipation Linear Derating Factor (Note 5)	P_D	0.4	W
Thermal Resistance, Junction to Ambient (Note 5)	$R_{\theta JA}$	64	°C/W
Thermal Resistance, Junction to Case (Note 5)	$R_{\theta JC}$	42	°C/W
Operating Temperature	T_J	+150	°C
Lead Temperature (Soldering, 10s)	T_L	+300	
Storage Temperature Range	T_{STG}	-55 to +150	

Note: 5. When mounted on a standard JEDEC 2-layer FR-4 board.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
High-Side Floating Supply	V_B	V_S + 4.2	V_S + 14	V
High-Side Floating Supply Offset Voltage	V_S	(Note 6)	50 (Note 7)	V
High-Side Floating Output Voltage	V_{HO}	V_S	V_B	V
Logic and Low Side Fixed Supply Voltage	V_{CC}	4.5 (Note 8)	14	V
Low-Side Output Voltage	V_{LO}	0	V_{CC}	V
Logic Input Voltage (HIN, LIN and EN)	V_{IN}	0	5	V
Ambient Temperature	T_A	-40	+125	°C

Notes: 6. Logic operation for V_S of -5V to +50V.
7. Provided V_B doesn't exceed absolute maximum rating of 60V.
8. For operation of V_{CC} = 4.5V to 4.9V, an external bootstrap Schottky diode (0.3V Vfd, 1A) is necessary, see Figure 4. For operation $V_{CC} \geqslant$ 4.9V, the external Schottky diode is not required.

DC Electrical Characteristics (V_{CC} = V_{BS} = 12V, COM = V_S = 0V, @T_A = +25°C, unless otherwise specified.) (Note 9)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Logic "1" Input Voltage	V_{IH}	2.4	–	–	V	–
Logic "0" Input Voltage	V_{IL}	–	–	0.8	V	–
Enable Logic "1" Input Voltage	V_{ENIH}	1.6	–	–	V	–
Enable Logic "0" Input Voltage	V_{ENIL}	–	–	0.7	V	–
Input Voltage Hysteresis	V_{INHYS}	–	0.6	–	V	–
Enable Input Voltage Hysteresis	$V_{ENINHYS}$	–	0.1	–	V	–
High Level Output Voltage, V_{BIAS} - V_O	V_{OH}	–	0.45	0.6	V	I_{O+} = 100mA
Low Level Output Voltage, V_O	V_{OL}	–	0.15	0.22	V	I_{O-} = 100mA
Offset Supply Leakage Current	I_{LK}	–	1	5	µA	V_B = V_S = 60V
V_{CC} Shutdown Supply Current	I_{CCSD}	–	0	1	µA	V_{IN} = 0V or 5V, V_{EN} = 0V
V_{CC} Quiescent Supply Current	I_{CCQ}	–	130	200	µA	V_{IN} = 0V or 5V
V_{CC} Operating Supply Current	I_{CCOP}	–	7.3	–	mA	fs = 500kHz, C_L = 1000pF
V_{BS} Quiescent Supply Current	I_{BSQ}	–	40	100	µA	V_{IN} = 0V or 5V
V_{BS} Operating Supply Current	I_{BSOP}	–	7.3	–	mA	fs = 500kHz. C_L = 1000pF
Logic "1" Input Bias Current	I_{IN+}	–	–	50	µA	V_{IN} = 5V
Logic "0" Input Bias Current	I_{IN-}	–	–	5	µA	V_{IN} = 0V
Enable Logic "1" Input Bias Current	I_{ENIN+}	–	43	60	µA	V_{IN} = 5V
Enable Logic "0" Input Bias Current	I_{ENIN-}	–	0	5	µA	V_{IN} = 0V
V_{BS} Supply Undervoltage Positive Going Threshold	V_{BSUV+}	3.3	3.8	4.2	V	–
V_{BS} Supply Undervoltage Negative Going Threshold	V_{BSUV-}	2.9	3.3	3.9	V	–
V_{CC} Supply Undervoltage Positive Going Threshold	V_{CCUV+}	3.3	3.8	4.2	V	–
V_{CC} Supply Undervoltage Negative Going Threshold	V_{CCUV-}	2.9	3.3	3.9	V	–
Output High Short Circuit Pulsed Current	I_{O+}	1.0	1.5	–	A	V_O = 0V, PW ≤ 10µs
Output Low Short Circuit Pulsed Current	I_{O-}	1.9	2.5	–	A	V_O = 15V, PW ≤ 10µs
Forward Voltage of Bootstrap Diode	V_{F1}	–	0.67	–	V	I_F = 100µA
Forward Voltage of Bootstrap Diode	V_{F2}	–	1.2	–	V	I_F = 100mA

Note: 9. The V_{IN} and I_{IN} parameters are applicable to the logic pins: HIN, LIN and EN. The V_O and I_O parameters are applicable to the respective output pins: HO and LO.

AC Electrical Characteristics (V_{CC} = V_{BS} = 12V, COM = V_S = 0V, C_L = 1000pF, @T_A = +25°C, unless otherwise specified.)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Turn-on Propagation Delay	t_{ON}	–	20	35	ns	–
Turn-off Propagation Delay	t_{OFF}	–	23	56	ns	V_S = 50V
Delay Matching, HO & LO Turn-on	t_{DM}	–	–	5	ns	–
Turn-on Rise Time	t_r	–	16	30	ns	–
Turn-off Fall Time	t_f	–	12	25	ns	–

Timing Waveforms

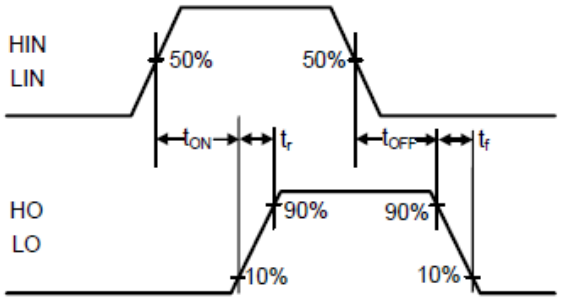


Figure 1. Switching Time Waveform Definitions

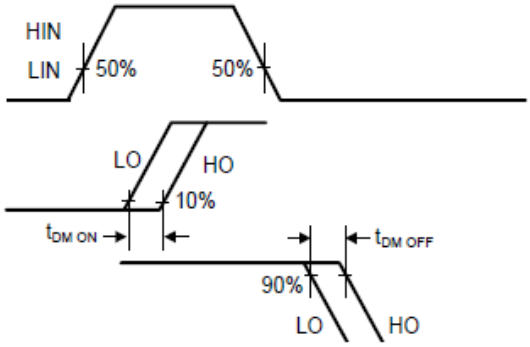


Figure 2. Delay Matching Waveform Definitions

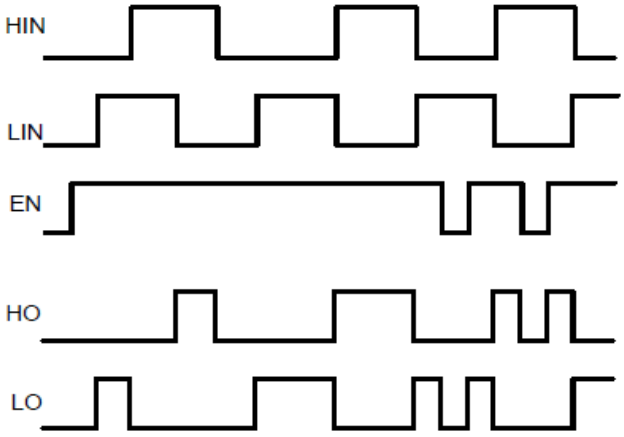


Figure 3. Input / Output Timing Diagram

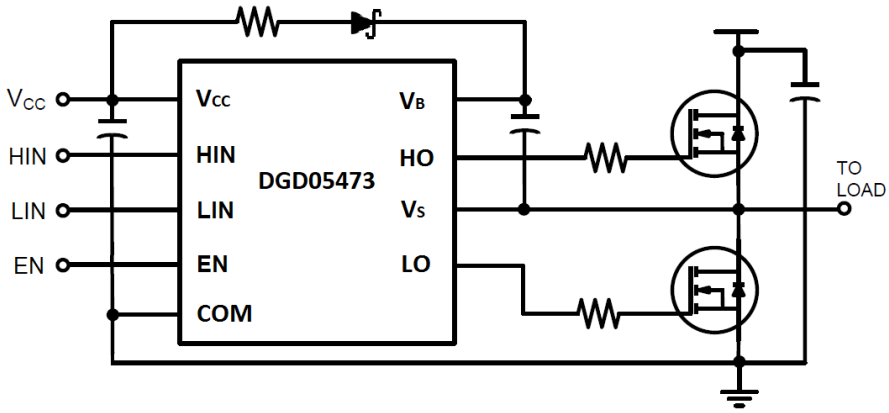


Figure 4. Typical application necessary for V_{CC} = 4.5V to 4.9V operation. For V_{CC} ≥ 4.9V, the bootstrap Schottky diode (0.3V Voltage drop, 1A) and resistor are not required.

Typical Performance Characteristics (@T_A = +25°C, unless otherwise specified.)

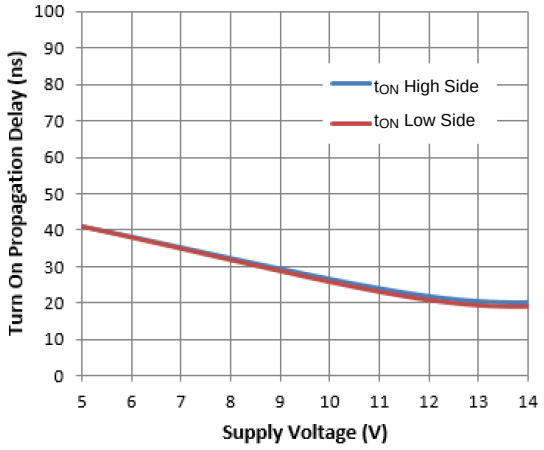


Figure 5. Turn-on Propagation Delay vs. Supply Voltage

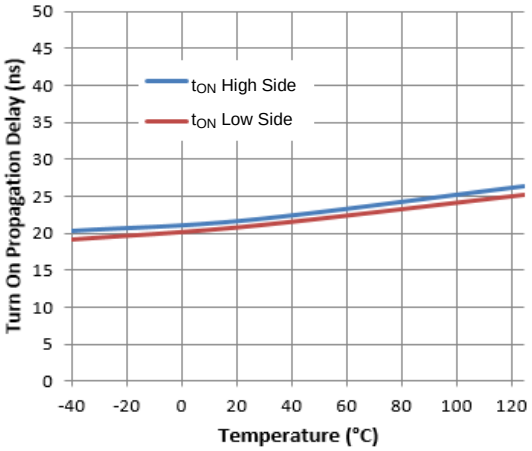


Figure 6. Turn-on Propagation Delay vs. Temperature

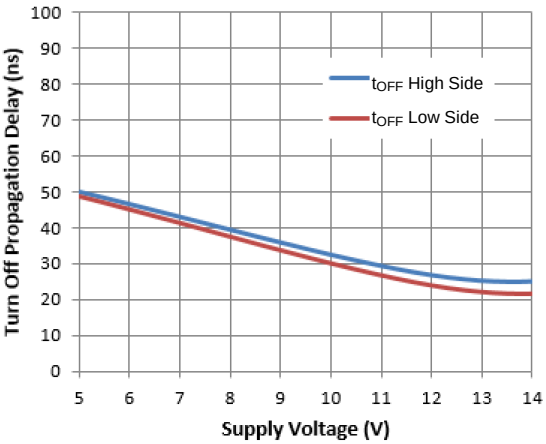


Figure 7. Turn-off Propagation Delay vs. Supply Voltage

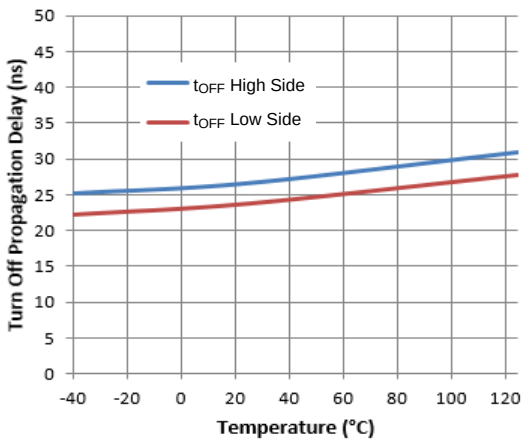


Figure 8. Turn-off Propagation Delay vs. Temperature

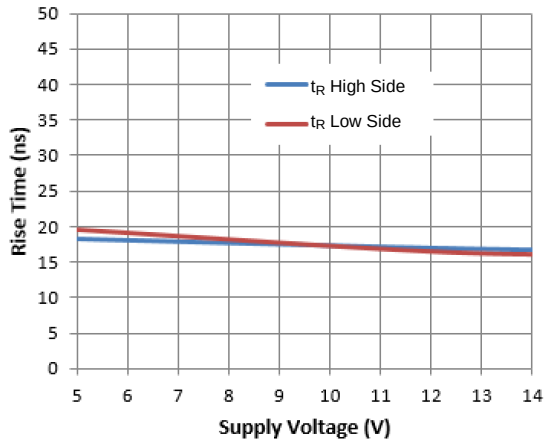


Figure 9. Rise Time vs. Supply Voltage

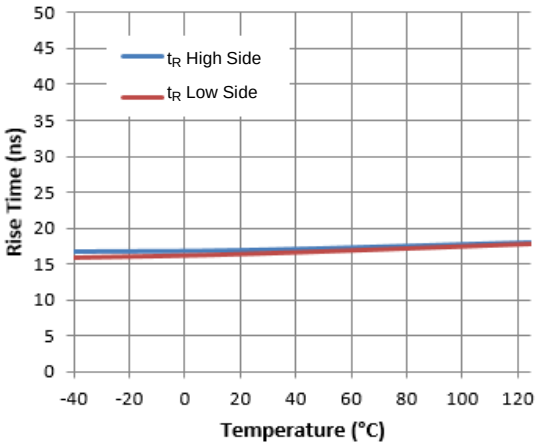


Figure 10. Rise Time vs. Temperature

Typical Performance Characteristics (Cont.)

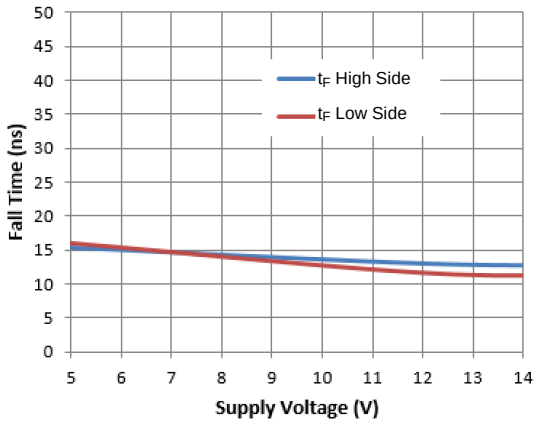


Figure 11. Fall Time vs. Supply Voltage

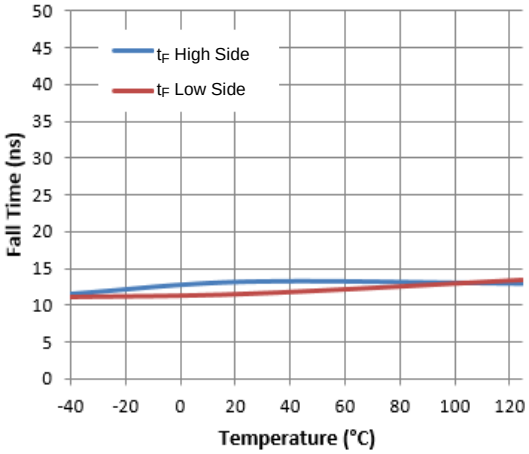


Figure 12. Fall Time vs. Temperature

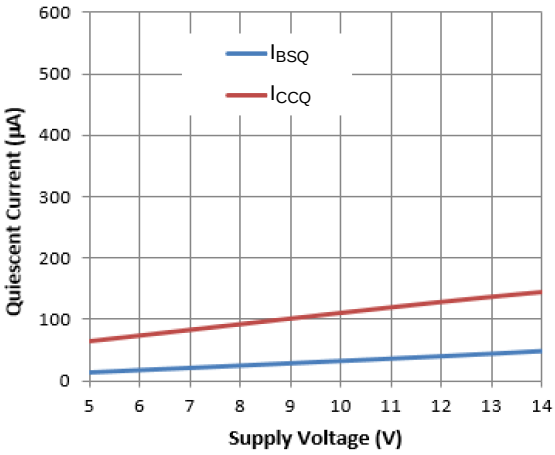


Figure 13. Quiescent Current vs. Supply Voltage

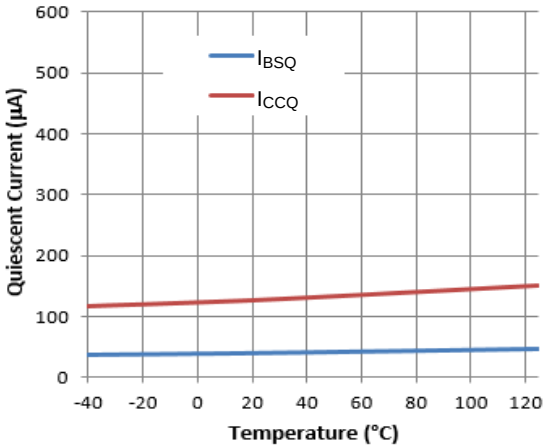


Figure 14. Quiescent Current vs. Temperature

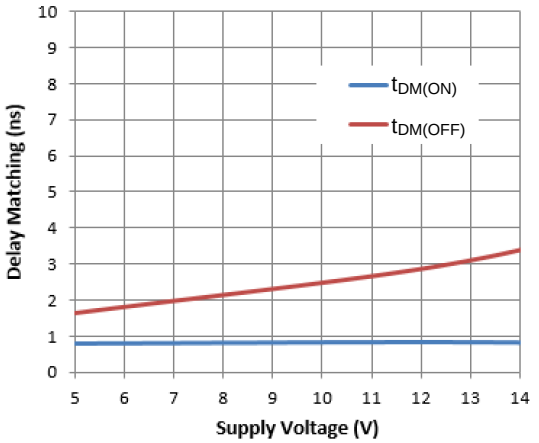


Figure 15. Delay Matching vs. Supply Voltage

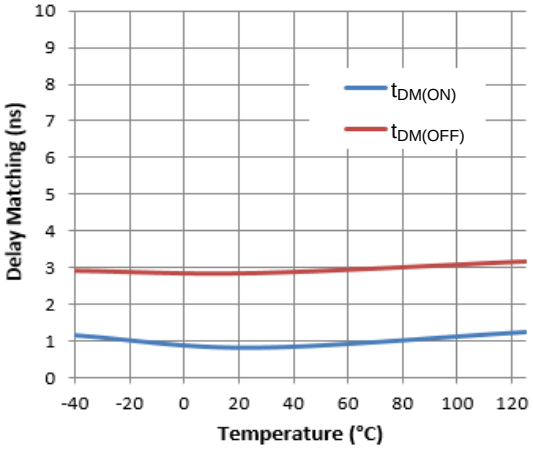


Figure 16. Delay Matching vs. Temperature

Typical Performance Characteristics (Cont.)

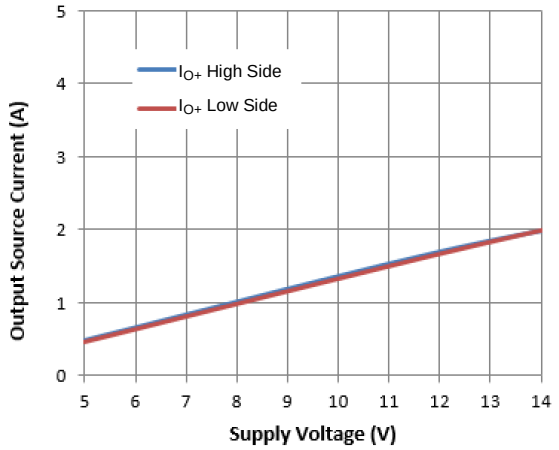


Figure 17. Output Source Current vs. Supply Voltage

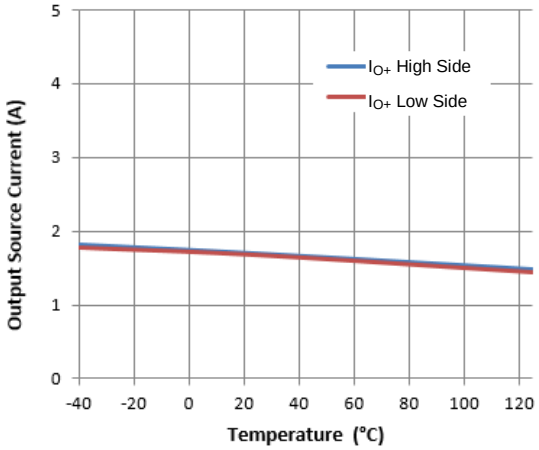


Figure 18. Output Source Current vs. Temperature

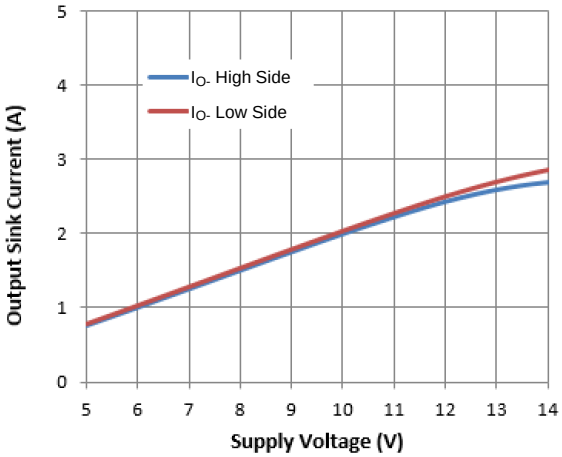


Figure 19. Output Sink Current vs. Supply Voltage

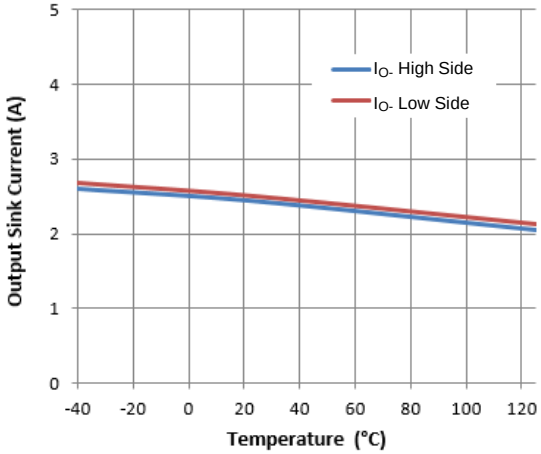


Figure 20. Output Sink Current vs. Temperature

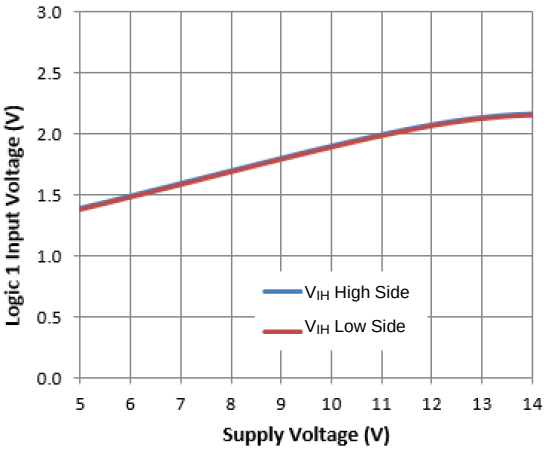


Figure 21. Logic 1 Input Voltage vs. Supply Voltage

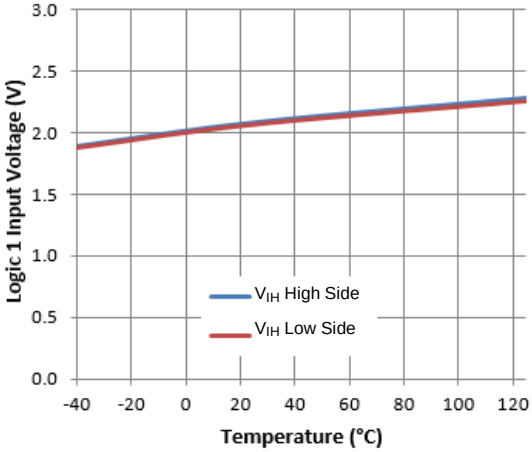


Figure 22. Logic 1 Input Voltage vs. Temperature

Typical Performance Characteristics (Cont.)

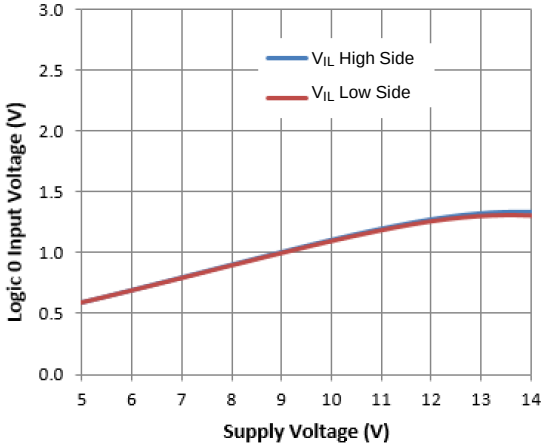


Figure 23. Logic 0 Input Voltage vs. Supply Voltage

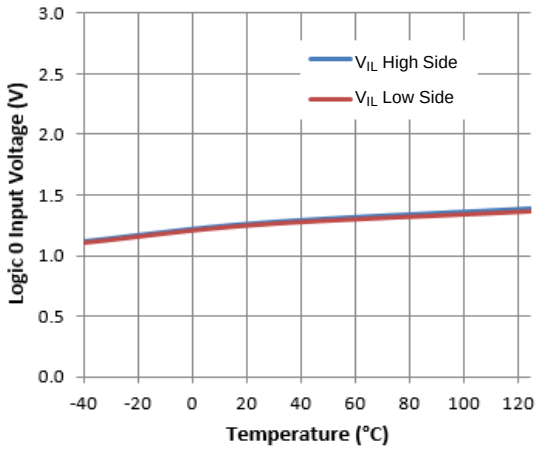


Figure 24. Logic 0 Input Voltage vs. Temperature

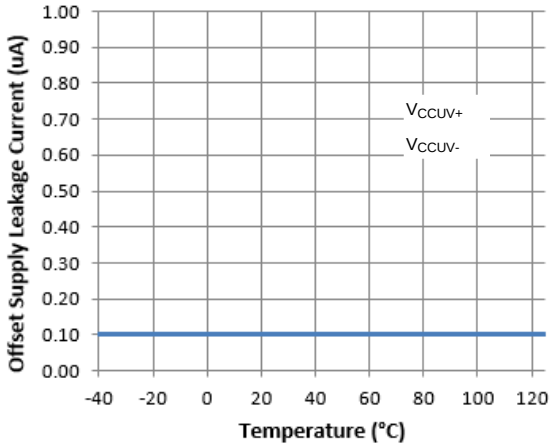
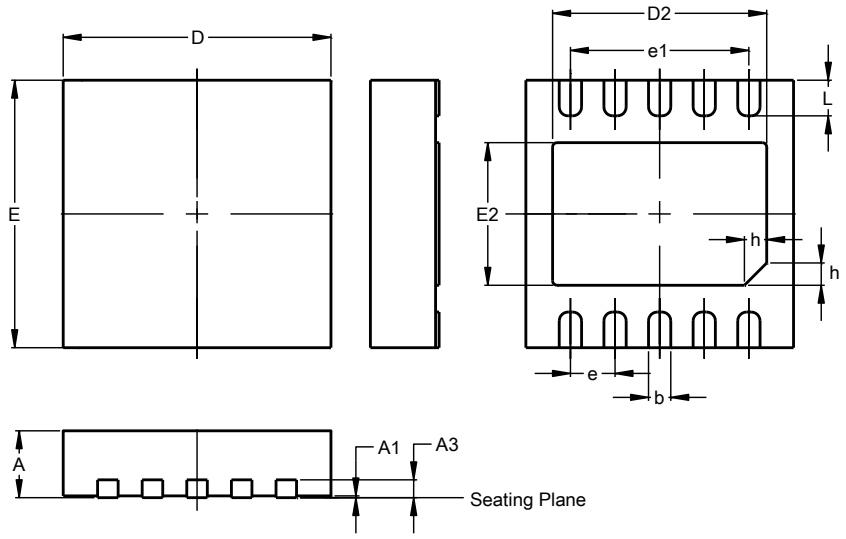


Figure 25. Offset Supply Leakage Current vs. Temperature

Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

W-DFN3030-10 (Type TH)

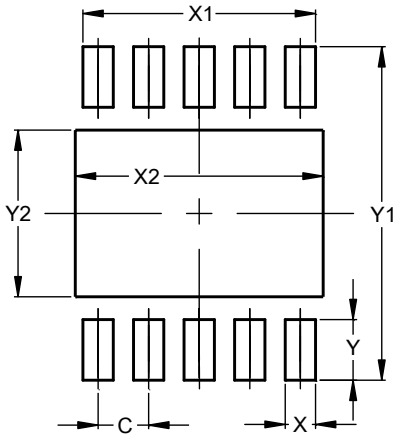


W-DFN3030-10 (Type TH)			
Dim	**Min**	**Max**	**Typ**
A	0.70	0.80	0.75
A1	--	0.05	0.02
A3	0.18	0.25	0.20
b	0.18	0.30	0.25
D	2.90	3.10	3.00
D2	2.40	2.60	2.50
e	0.50BSC		
e1	2.00BSC		
E	2.90	3.10	3.00
E2	1.45	1.65	1.55
h	0.20	0.30	0.25
L	0.30	0.50	0.40
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

W-DFN3030-10 (Type TH)



Dimensions	Value (in mm)
C	0.500
X	0.300
X1	2.300
X2	2.600
Y	0.600
Y1	3.300
Y2	1.650

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LIFE SUPPORT

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or

2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

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