HIGH-SIDE AND LOW-SIDE GATE DRIVERS IN SO-16

Description

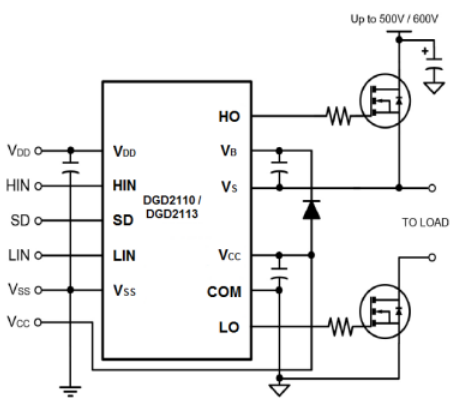
The DGD2110 and DGD2113 are high-voltage/high-speed MOSFET and IGBT drivers with independent high-side and low-side outputs. The high-side driver features floating supply for operation at up to 500V/600V. The 10ns (max)/20ns (max) propagation delay matching between the high- and the low side drivers allows high-frequency operation.

The DGD2110 and DGD2113 logic inputs are compatible with standard CMOS levels (as low as 3.3V) while driver outputs feature high-pulse current buffers designed for minimum driver cross conduction.

The DGD2110 and DGD2113 are offered in a SO-16 package. They operate over an extended -40°C to +125°C temperature range.

Applications

- DC-DC Converters
- DC-AC Inverters
- AC-DC Power Supplies
- Motor Controls
- Class D Power Amplifiers



Typical Configuration

Features

- Drives two N-Channel MOSFETs or IGBTs in High-Side/Low-Side Configuration
- Floating High-Side Operates to 600V
- 2.5A Sink/2.5A Source Typical Output Currents
- Outputs Tolerant To Negative Transients
- Wide Gate Driver Supply Voltage Range: 10V to 20V
- Wide Logic Input Supply Voltage Range: 3.3V to 20V
- Wide Logic Supply Offset Voltage Range: -5V to 5V
- 15ns (typ) Rise/13ns (typ) Fall Times with 1000pF load
- 105ns (typ) Turn-On/94ns (typ) Turn-Off Delay Times
- Cycle-by-Cycle Edge-Triggered Shutdown Circuitry
- 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)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

Mechanical Data

- Case: SO-16 (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 Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.130 grams (Approximate)

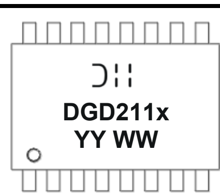
SO-16
Top View

Ordering Information (Note 4)

Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
DGD2110S16-13	DGD2110	13	16	1500
DGD2113S16-13	DGD2113	13	16	1500

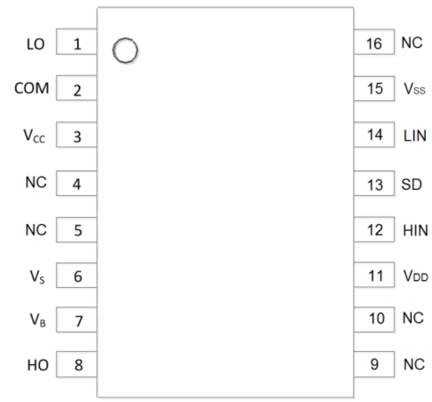
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- 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 http://www.diodes.com/products/packages.html.

Marking Information



= Manufacturer’s Marking
DGD211x = Product Type Marking Code (See Table Above)
YY = Year (ex: 19 = 2019)
WW = Week (01 - 53)

Pin Diagrams

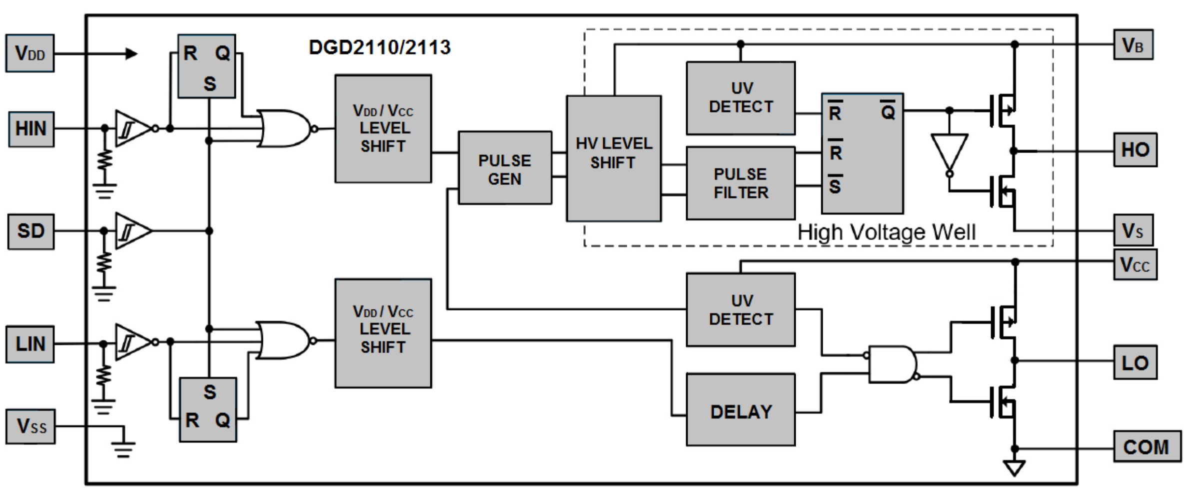


Top view: SO-16

Pin Descriptions

Pin Number	Pin Name	Function
1	LO	Low-side gate driver output pin
2	COM	Low-side gate driver power supply return pin
3	V_{CC}	Low-side gate driver power supply pin
4,5,9,10,16	NC	No connect pin (No Internal Connection)
6	V_S	High-side gate driver floating power supply return pin
7	V_B	High-side gate driver floating power supply pin
8	HO	High-side gate drive output pin
11	V_{DD}	Logic power supply pin
12	HIN	Logic input pin for high-side gate driver output. HIN and HO are in phase
13	SD	Logic input shutdown pin
14	LIN	Logic input pin for low-side gate driver output. LIN and LO are in phase
15	V_{SS}	Logic ground pin

Functional Block Diagram



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

Characteristic	Symbol	Value	Unit
High-Side Floating Supply Voltage (DGD2110)	V_B	-0.3 to +524	V
High-Side Floating Supply Voltage (DGD2113)	V_B	-0.3 to +624	V
High-Side Floating Supply Offset Voltage	V_S	V_B-24 to V_B+0.3	V
High-Side Floating Output Voltage	V_{HO}	V_S-0.3 to V_S+0.3	V
Offset Supply Voltage Transient	dV_S / dt	50	V/ns
Low-Side Fixed Supply Voltage	V_{CC}	-0.3 to +24	V
Low-Side Output Voltage	V_{LO}	-0.3 to V_{CC}+0.3	V
Logic Supply Voltage	V_{DD}	-0.3 to V_{SS}+24	V
Logic Supply Offset Voltage	V_{SS}	V_{CC}-24 to V_{CC}+0.3	V
Logic Input Voltage (HIN, LIN, and SD)	V_{IN}	V_{SS}-0.3 to V_{DD}+0.3	V

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

Characteristic	Symbol	Value	Unit
Power Dissipation Linear Derating Factor (Note 5)	P_D	1.25	W
Thermal Resistance, Junction to Ambient (Note 5)	$R_{\theta JA}$	90	°C/W
Thermal Resistance, Junction to Case (Note 5)	$R_{\theta JC}$	45	°C/W
Operating Temperature	T_J	+150	°C
Lead Temperature (Soldering, 10 seconds)	T_L	+300	°C
Storage Temperature Range	T_{STG}	-55 to +150	°C

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 Absolute Voltage		V_B	V_S + 10	V_S + 20	V
High-Side Floating Supply Offset Voltage	DGD2110	V_S	(Note 6)	500	V
High-Side Floating Supply Offset Voltage	DGD2113	V_S	(Note 6)	600	V
High-Side Floating Output Voltage		V_{HO}	V_S	V_B	V
Low-Side Fixed Supply Voltage		V_{CC}	10	20	V
Low-Side Output Voltage		V_{LO}	0	V_{CC}	V
Logic Supply Voltage		V_{DD}	V_{SS} + 3	V_{SS} + 20	V
Logic Supply Offset Voltage		V_{SS}	-5 (Note 7)	5	V
Logic Input Voltage (HIN, LIN, and SD)		V_{IN}	V_{SS}	V_{DD}	V
Ambient Temperature		T_A	-40	+125	°C

Notes: 6. Logic operation for V_S = -4V to +500V.
7. When V_{DD} <5V, the minumum V_{SS} offset is limited to -V_{DD}.

DC Electrical Characteristics (V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, V_{SS} = COM, @T_A = +25°C unless otherwise specified.) (Note 8)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Logic "1" Input Voltage (Note 9)	V_{IH}	9.5	—	—	V	—
Logic "0" Input Voltage (Note 9)	V_{IL}	—	–	6.0	V	—
High Level Output Voltage, V_{BIAS} - V_O	V_{OH}	—	–	1.4	V	I_O = 0mA
Low Level Output Voltage, V_O	V_{OL}	—	–	0.15	V	I_O = 20mA
Offset Supply Leakage Current	I_{LK}	—	–	50	µA	V_B = V_S = 500V/600V
Quiescent V_{BS} Supply Current	I_{BSQ}	—	55	230	µA	V_{IN} = 0V or V_{DD}
Quiescent V_{CC} Supply Current	I_{CCQ}	—	56	340	µA	V_{IN} = 0V or V_{DD}
Quiescent V_{DD} Supply Current	I_{DDQ}	—	0.6	30	µA	V_{IN} = 0V or V_{DD}
Logic "1" Input Bias Current	I_{IN+}	—	20	40	µA	V_{IN} = V_{DD}
Logic "0" Input Bias Current	I_{IN-}	—	–	5.0	µA	V_{IN} = 0V
V_{BS} Supply Undervoltage Positive Going Threshold	V_{BSUV+}	7.5	8.6	9.7	V	—
V_{BS} Supply Undervoltage Negative Going Threshold	V_{BSUV-}	7.0	8.2	9.4	V	—
V_{CC} Supply Undervoltage Positive Going Threshold	V_{CCUV+}	7.4	8.5	9.6	V	—
V_{CC} Supply Undervoltage Negative Going Threshold	V_{CCUV-}	7.0	8.2	9.4	V	—
Output High Short Circuit Pulsed Current	I_{O+}	2.0	2.5	—	A	V_O = 0V, V_{IN} = V_{DD}, PW ≤ 10µs
Output Low Short Circuit Pulsed Current	I_{O-}	2.0	2.5	—	A	V_O = 15V, V_{IN} = 0V, PW ≤ 10µs

Note: 8. The V_{IN} and I_{IN} parameters are referenced to V_{SS} and are applicable to all three logic input pins: HIN, LIN, and SD. The V_O and I_O parameters are referenced to COM and are applicable to the respective output pins: HO and LO.
9. For optimal operation, it is recommended that the input pulses (HIN and LIN) should have a minimum amplitude of 9.5V (VDD = 15V) with a minimum pulse width of 200ns.

AC Electrical Characteristics (V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, C_L = 1000pF, V_{SS} = COM, @T_A = +25°C, unless otherwise specified.)

Parameter		Symbol	Min	Typ	Max	Unit	Conditions
Turn-On Propagation Delay		t_{ON}	—	105	150	ns	V_S = 0V
Turn-Off Propagation Delay		t_{OFF}	—	94	125	ns	V_S = 500V/600V
Shut Down Propagation Delay		t_{SD}	—	70	140	ns	V_S = 500V/600V
Turn-On Rise Time		t_r	—	15	35	ns	—
Turn-Off Fall Time		t_f	—	13	25	ns	—
Delay Matching	DGD2110	t_{DM}	—	—	10	—	–
Delay Matching	DGD2113	t_{DM}	—	—	20	—	–

Timing Waveforms

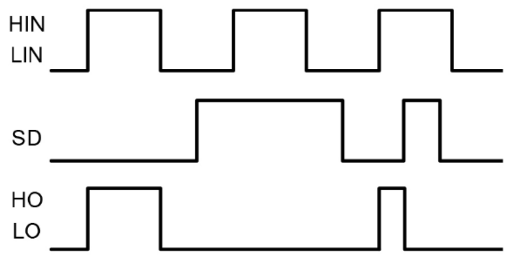


Figure 1. Input / Output Timing Diagram

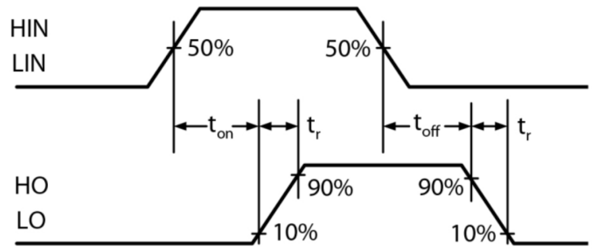


Figure 2. Switching Time Waveform Definitions

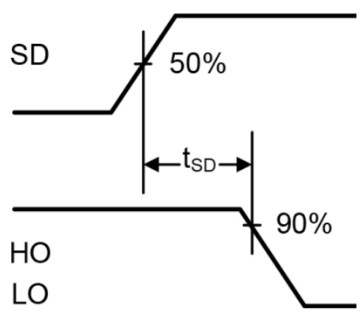


Figure 3. Shutdown Waveform Definitions

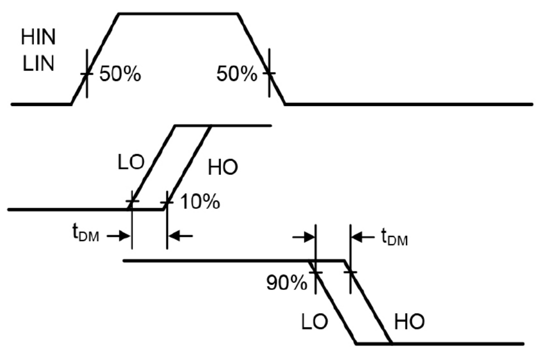


Figure 4. Delay Matching Waveform Definitions

Typical Performance Characteristics (Vcc=15V, @T_A = +25°C, unless otherwise specified.)

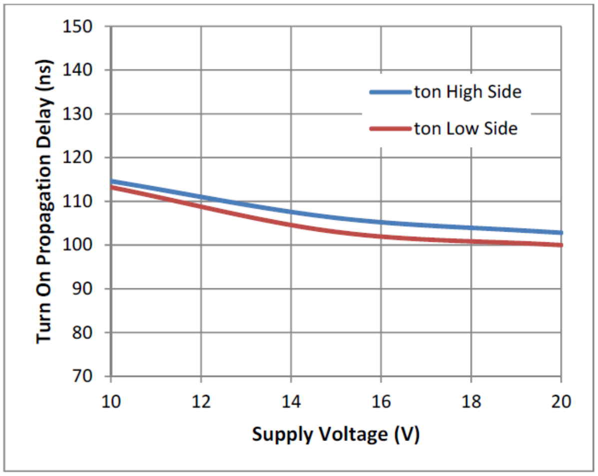


Figure 5. Turn-on Propogation Delay vs. Supply Voltage

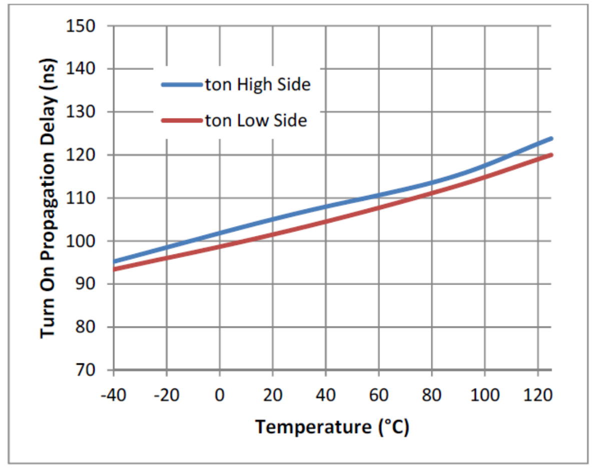


Figure 6. Turn-on Propogation Delay vs. Temperature

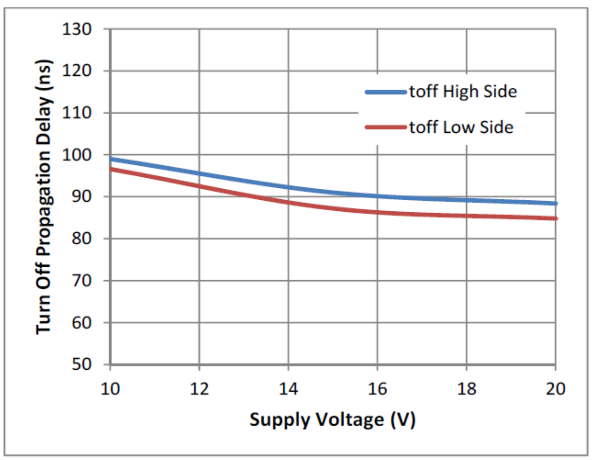


Figure 7. Turn-off Propogation Delay vs. Supply Voltage

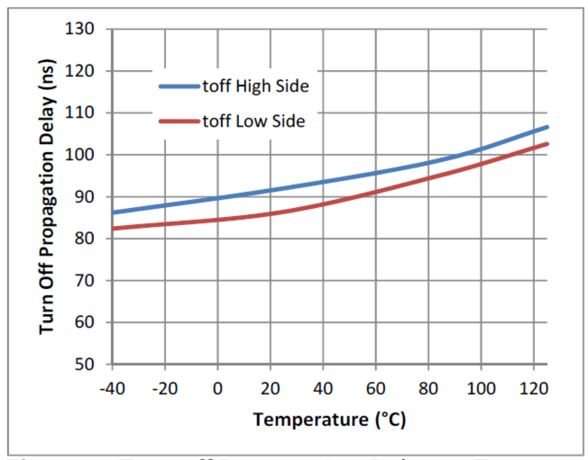


Figure 8. Turn-off Propogation Delay vs. Temperature

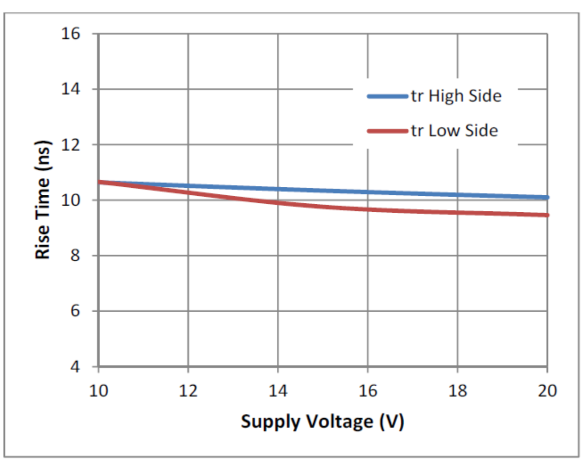


Figure 9. Rise Time vs. Supply Voltage

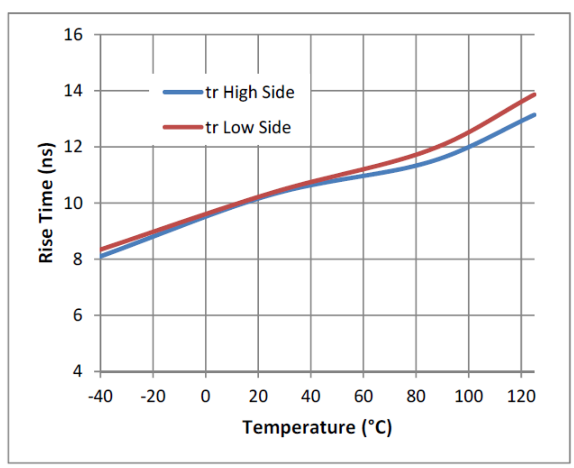


Figure 10. Rise Time vs. Temperature

Typical Performance Characteristics (continued)

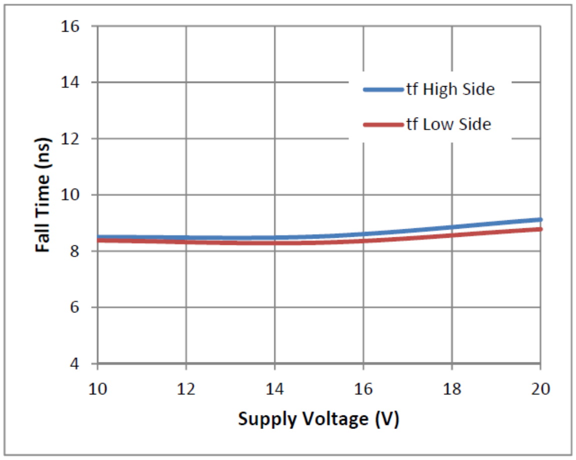


Figure 11. Fall Time vs. Supply Voltage

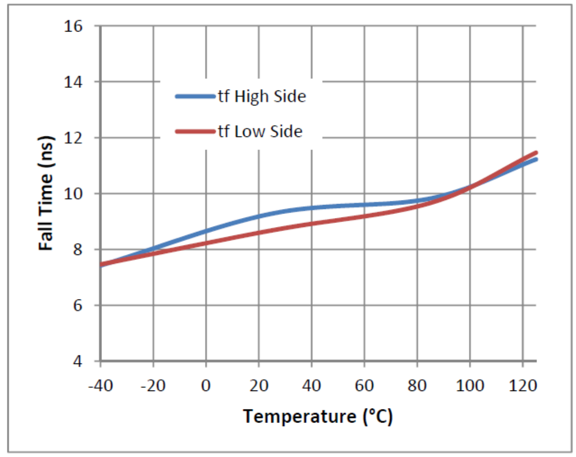


Figure 12. Fall Time vs. Temperature

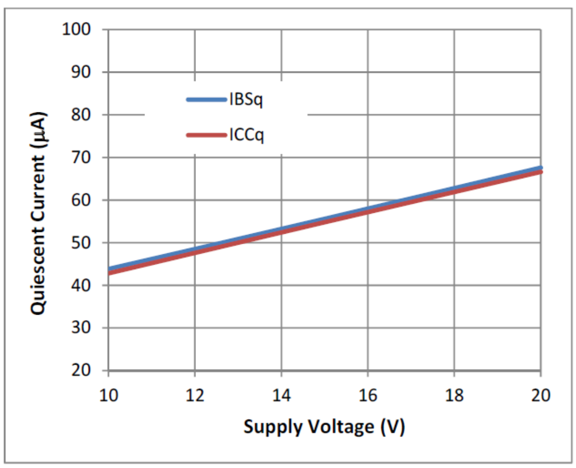


Figure 13. Quiescent Current vs. Supply Voltage

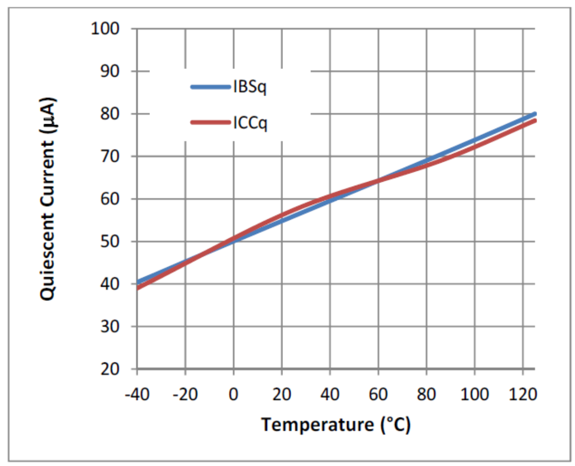


Figure 14. Quiescent Current vs. Temperature

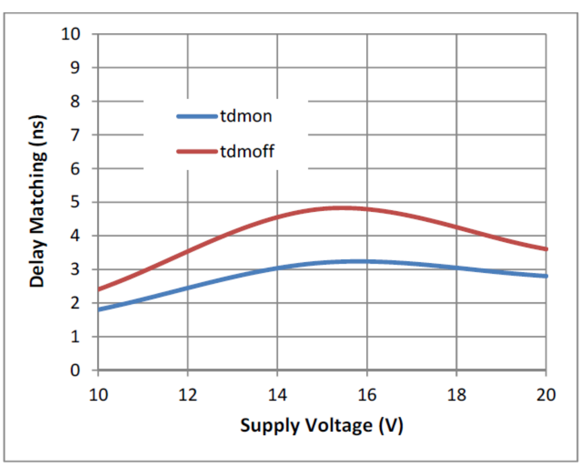


Figure 15. Delay Matching vs. Supply Voltage

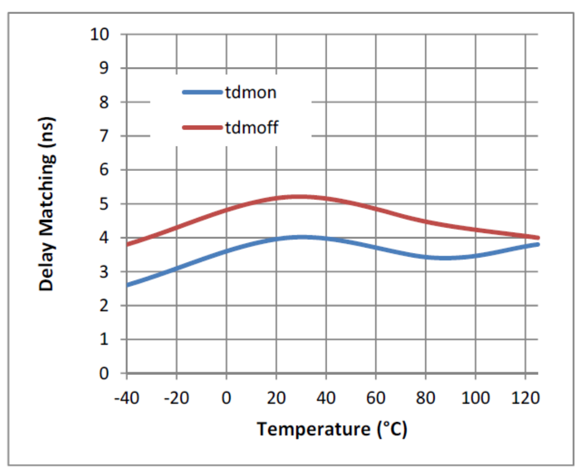


Figure 16. Delay Matching vs. Temperature

Typical Performance Characteristics (cont.)

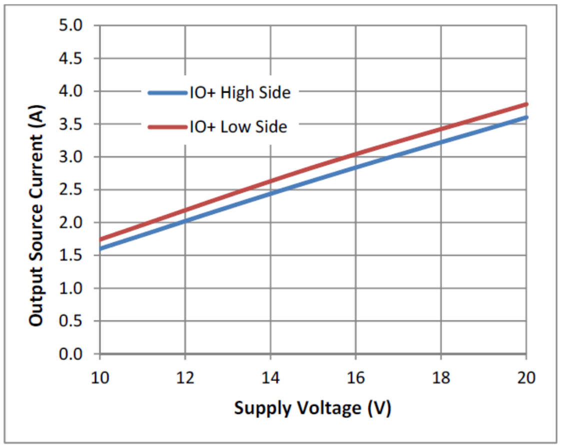


Figure 17. Output Source Current vs. Supply Voltage

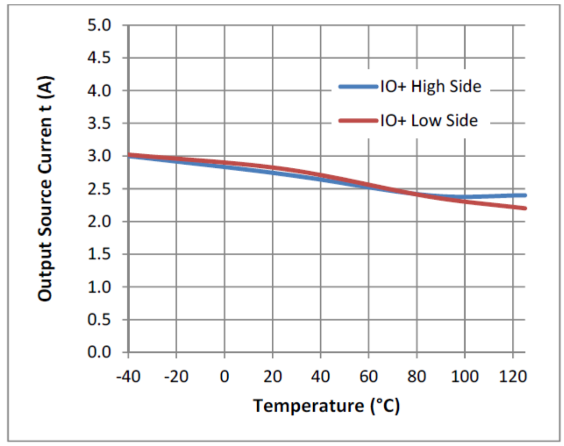


Figure 18. Output Source Current vs. Temperature

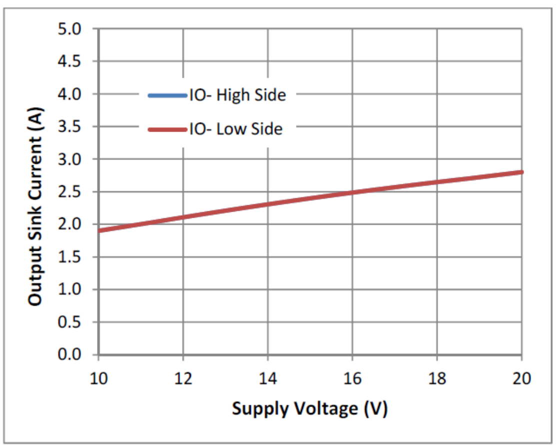


Figure 19. Output Sink Current vs. Supply Voltage

Note: graphs overlap one another

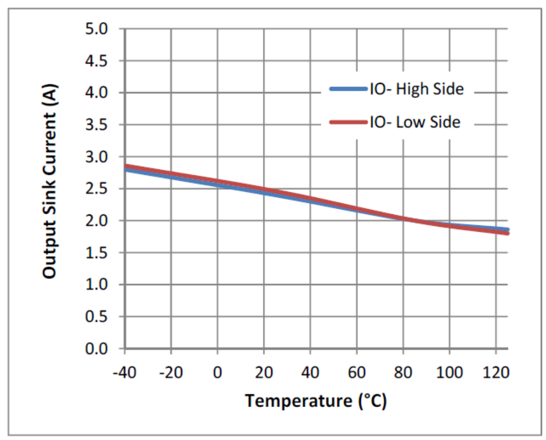


Figure 20. Output Sink Current vs. Temperature

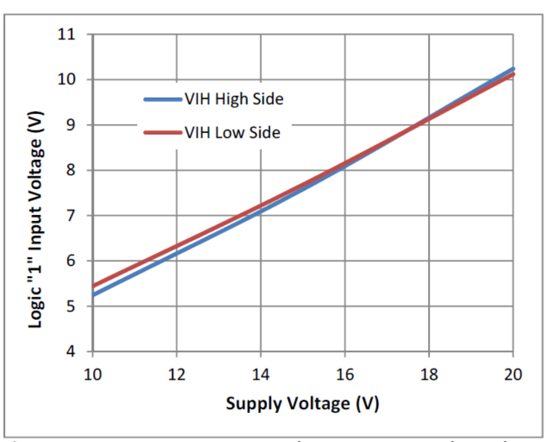


Figure 21. Logic 1 Input Voltage vs. Supply Voltage

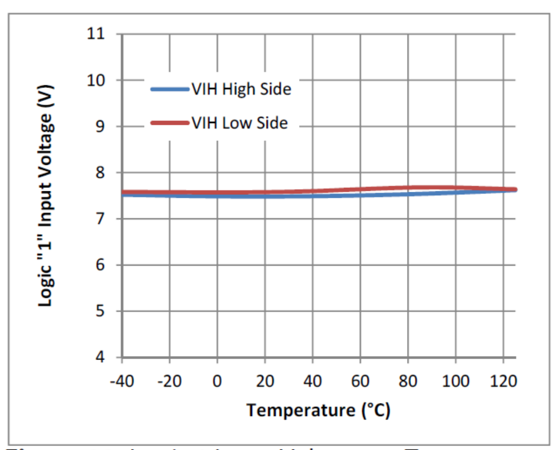


Figure 22. Logic 1 Input Voltage vs. Temperature

Typical Performance Characteristics (cont.)

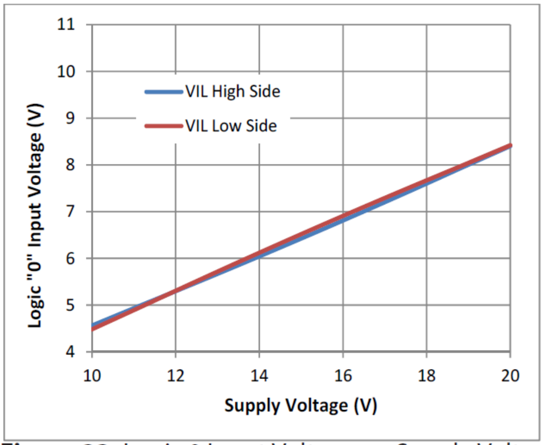


Figure 23. Logic 0 Input Voltage vs. Supply Voltage

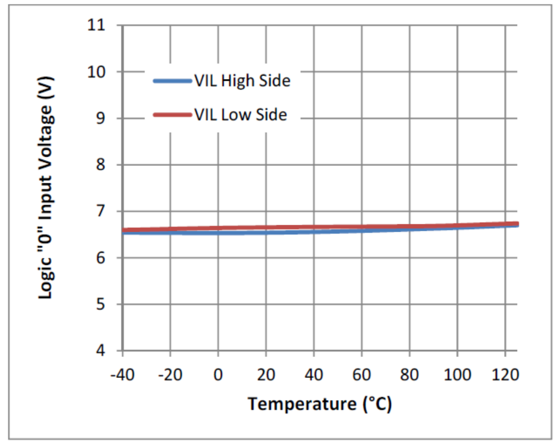


Figure 24. Logic 0 Input Voltage vs. Temperature

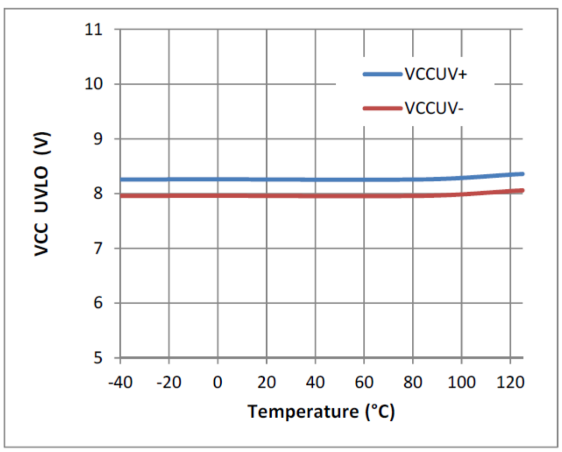


Figure 25. V_{CC} UVLO vs. Temperature

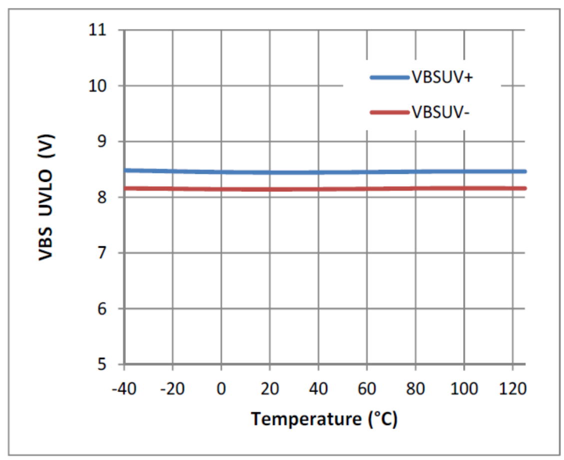


Figure 26. V_{BS} UVLO vs. Temperature

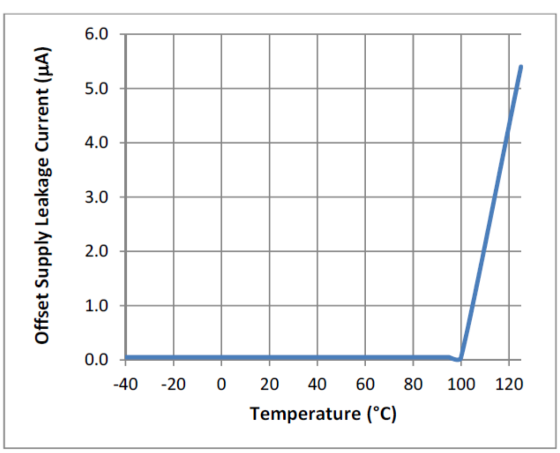


Figure 27. Offset Supply Leakage Current vs. Temperature

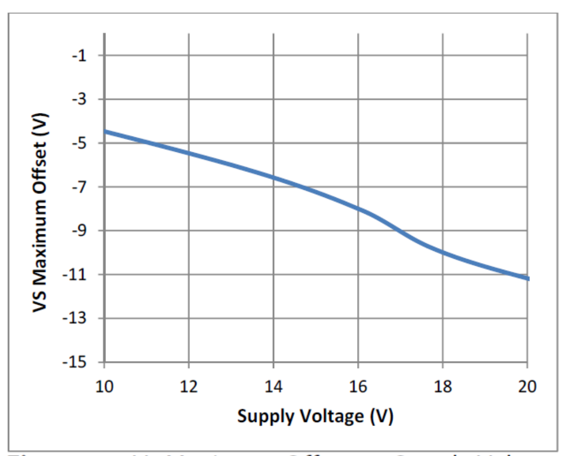


Figure 28. V_S Maximum Offset vs. Supply Voltage

Typical Performance Characteristics (cont.)

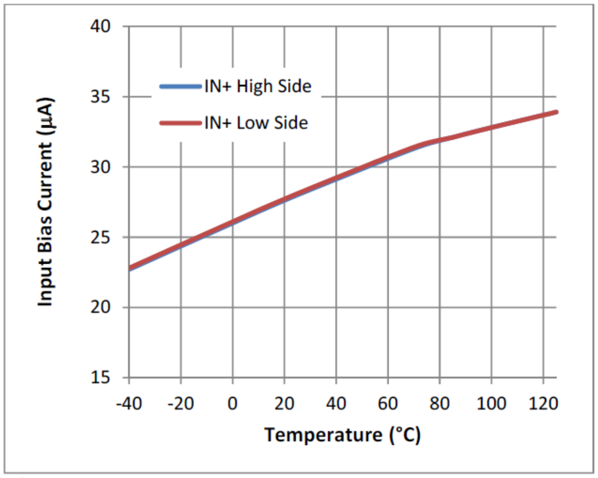


Figure 29. Input Bias Current vs. Temperature

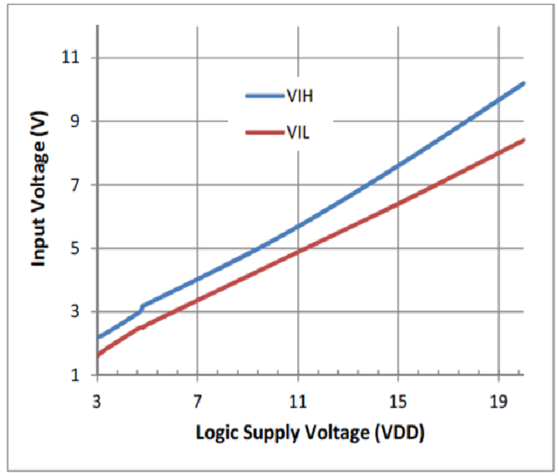


Figure 30. Input Voltage vs. Logic Supply Voltage

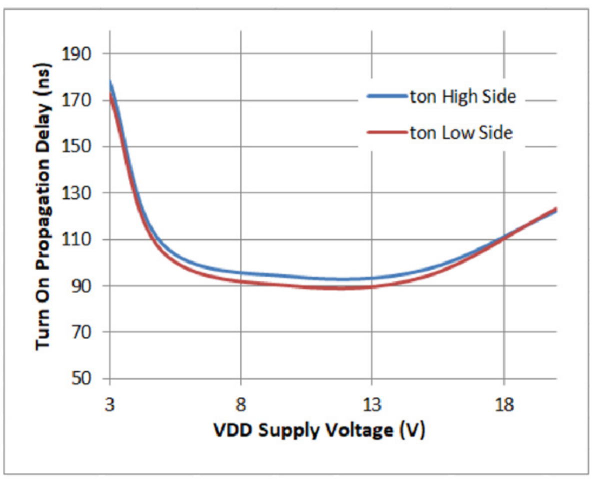


Figure 31. Turn-On Propagation Delay vs. Logic Supply Voltage

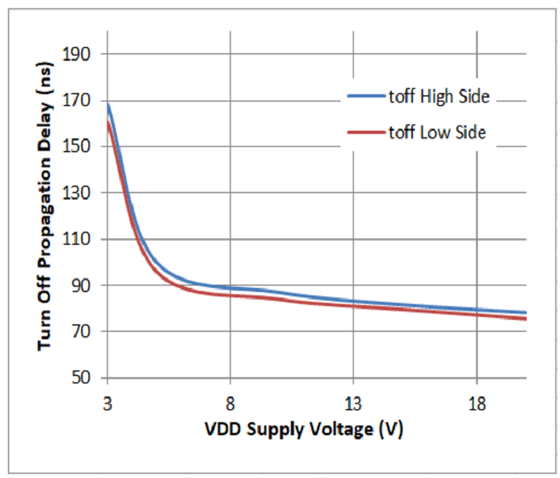


Figure 32. Turn-Off Propagation Delay vs. Logic Supply Voltage

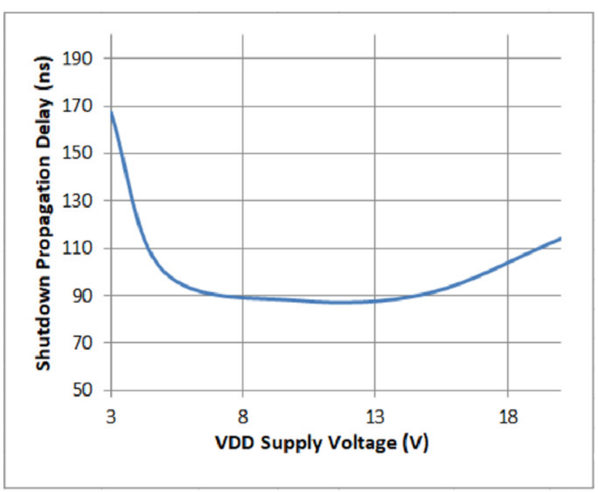
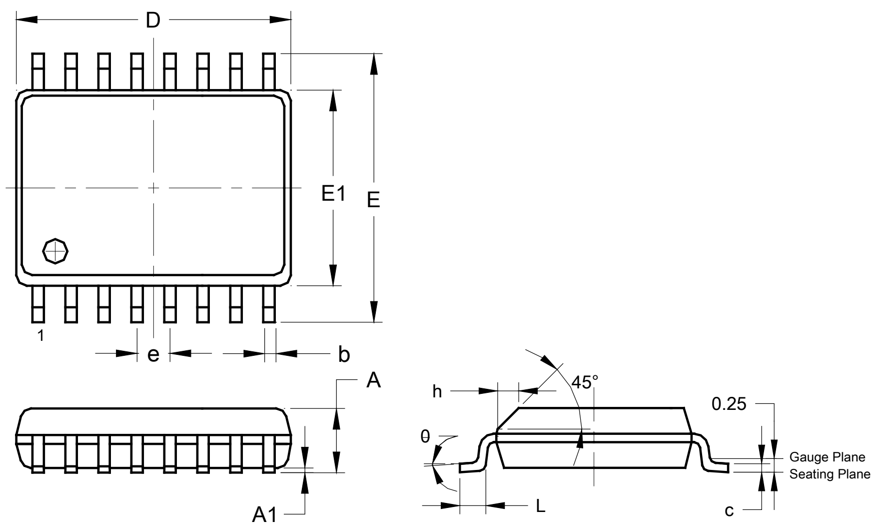


Figure 33. Shutdown Propagation Delay vs. Logic Supply Voltage

Package Outline Dimensions

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

SO-16 (Type TH)

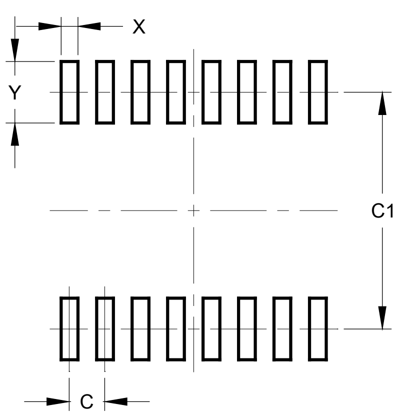


SO-16 (Type TH)			
Dim	**Min**	**Max**	**Typ**
A	2.36	2.64	--
A1	0.10	0.30	--
b	0.33	0.51	--
c	0.229	0.318	--
D	10.11	10.46	10.29
E	10.01	10.64	10.33
E1	7.42	7.59	7.52
e	--	--	1.27
h	--	--	0.48
L	0.41	1.27	--
θ	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

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

SO-16 (Type TH)



Dimensions	Value (in mm)
C	1.27
C1	8.46
X	0.60
Y	2.20

Note: For high voltage applications, the appropriate industry sector guidelines should be considered with regards to creepage and clearance distances between device Terminals and PCB tracking.