

**HIGH-SIDE AND LOW-SIDE GATE DRIVERS IN SO-16 (TYPE TH)**
**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.

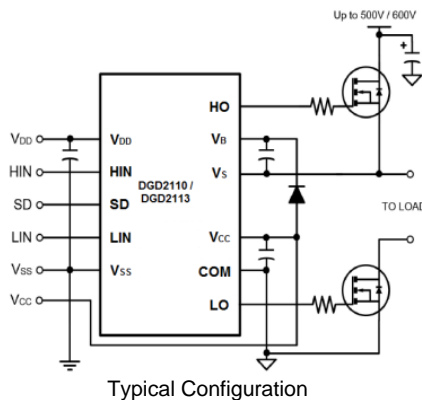
The DGD2110 and DGD2113 are offered in a 16-pin SO (Type TH) package. They operate over an extended -40°C to +125°C temperature range.

**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)**

**Applications**

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


**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)

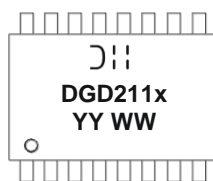


SO-16 (Type TH)  
Top View

**Ordering Information (Note 4)**

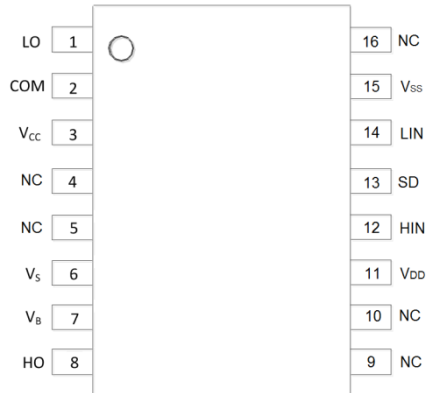
Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
DGD2110S16-13	DGD2110	13	16	1,500
DGD2113S16-13	DGD2113	13	16	1,500

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) 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: 16 = 2016)
- WW = Week (01 - 53)

**Pin Diagrams**

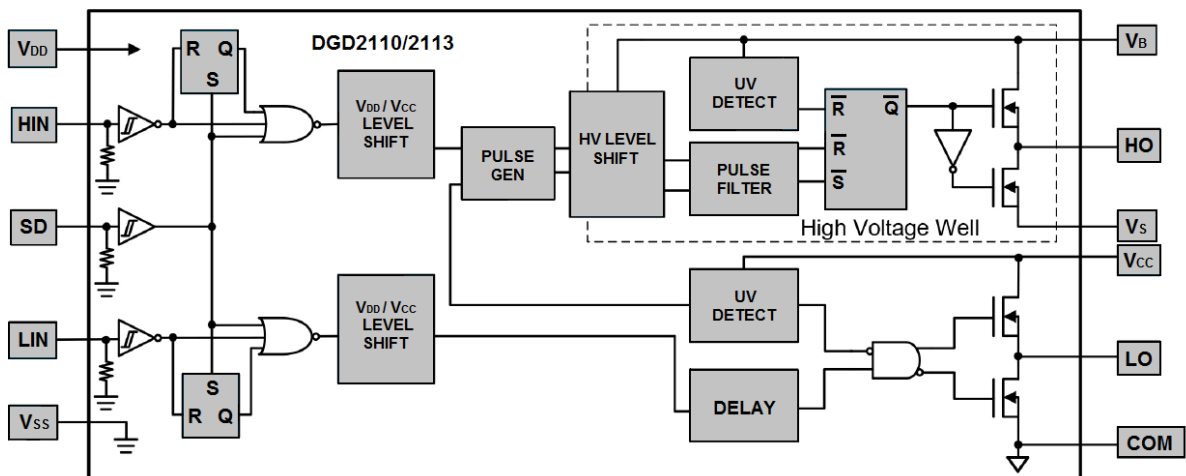


Top view: SO-16 (Type TH)

**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 <sub>CC</sub>	Low-side gate driver power supply pin
4,5,9,10,16	NC	"No connect" pin (No Internal Connection)
6	V <sub>S</sub>	High-side gate driver floating power supply return pin
7	V <sub>B</sub>	High-side gate driver floating power supply pin
8	HO	High-side gate drive output pin
11	V <sub>DD</sub>	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 <sub>SS</sub>	Logic ground pin

**Functional Block Diagram**



**Absolute Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
High-side floating supply voltage (DGD2110)	V <sub>B</sub>	-0.3 to +524	V
High-side floating supply voltage (DGD2113)	V <sub>B</sub>	-0.3 to +624	V
High-side floating supply offset voltage	V <sub>S</sub>	V <sub>B</sub> -24 to V <sub>B</sub> +0.3	V
High-side floating output voltage	V <sub>HO</sub>	V <sub>S</sub> -0.3 to V <sub>S</sub> +0.3	V
Offset supply voltage transient	dV <sub>S</sub> /dt	50	V/ns
Low-side fixed supply voltage	V <sub>CC</sub>	-0.3 to +24	V
Low-side output voltage	V <sub>LO</sub>	-0.3 to V <sub>CC</sub> +0.3	V
Logic supply voltage	V <sub>DD</sub>	-0.3 to V <sub>SS</sub> +24	V
Logic supply offset voltage	V <sub>SS</sub>	V <sub>CC</sub> -24 to V <sub>CC</sub> +0.3	V
Logic input voltage (HIN, LIN and SD)	V <sub>IN</sub>	V <sub>SS</sub> -0.3 to V <sub>DD</sub> +0.3	V

**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Power Dissipation Linear derating factor (Note 5)	P <sub>D</sub>	1.25	W
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	90	°C/W
Thermal Resistance, Junction to Case (Note 5)	R <sub>θJC</sub>	45	°C/W
Operating Temperature	T <sub>J</sub>	+150	°C
Lead Temperature (soldering, 10 seconds)	T <sub>L</sub>	+300	
Storage Temperature Range	T <sub>STG</sub>	-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 absolute voltage	V <sub>B</sub>	V <sub>S</sub> + 10	V <sub>S</sub> + 20	V
High-side floating supply offset voltage	DGD2110 V <sub>S</sub>	(Note 6)	500	V
High-side floating supply offset voltage	DGD2113 V <sub>S</sub>	(Note 6)	600	V
High-side floating output voltage	V <sub>HO</sub>	V <sub>S</sub>	V <sub>B</sub>	V
Low-side fixed supply voltage	V <sub>CC</sub>	10	20	V
Low-side output voltage	V <sub>LO</sub>	0	V <sub>CC</sub>	V
Logic supply voltage	V <sub>DD</sub>	V <sub>SS</sub> + 3	V <sub>SS</sub> + 20	V
Logic supply offset voltage	V <sub>SS</sub>	-5 (Note 7)	5	V
Logic input voltage (HIN, LIN and SD)	V <sub>IN</sub>	V <sub>SS</sub>	V <sub>DD</sub>	V
Ambient temperature	T <sub>A</sub>	-40	+125	°C

Notes: 6. Logic operation for V<sub>S</sub> = -4V to +500V. Logic state held for V<sub>S</sub> = -4V to -V<sub>BS</sub>.

7. When V<sub>DD</sub> < 5V, the minimum V<sub>SS</sub> offset is limited to -V<sub>DD</sub>.

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

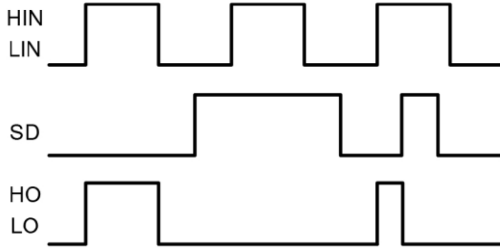
Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Logic "1" input voltage	$V_{IH}$	9.5	–	–	V	–
Logic "0" input voltage	$V_{IL}$	–	–	6.0	V	–
High level output voltage, $V_{BIAS} - V_O$	$V_{OH}$	–	–	1.4	V	$I_O = 0mA$
Low level output voltage, $V_O$	$V_{OL}$	–	–	0.15	V	$I_O = 20mA$
Offset supply leakage current	$I_{LK}$	–	–	50	$\mu A$	$V_B = V_S = 500V/600V$
Quiescent $V_{BS}$ supply current	$I_{BSQ}$	–	55	230	$\mu A$	$V_{IN} = 0V$ or $V_{DD}$
Quiescent $V_{CC}$ supply current	$I_{CCQ}$	–	56	340	$\mu A$	$V_{IN} = 0V$ or $V_{DD}$
Quiescent $V_{DD}$ supply current	$I_{DDQ}$	–	0.6	30	$\mu A$	$V_{IN} = 0V$ or $V_{DD}$
Logic "1" input bias current	$I_{IN+}$	–	20	40	$\mu A$	$V_{IN} = V_{DD}$
Logic "0" input bias current	$I_{IN-}$	–	–	5.0	$\mu A$	$V_{IN} = 0V$
$V_{BS}$ 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	$V_O = 0V, V_{IN} = V_{DD}, PW \leq 10\mu s$
Output low short circuit pulsed current	$I_{O-}$	2.0	2.5	–	A	$V_O = 15V, V_{IN} = 0V, PW \leq 10\mu s$

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.

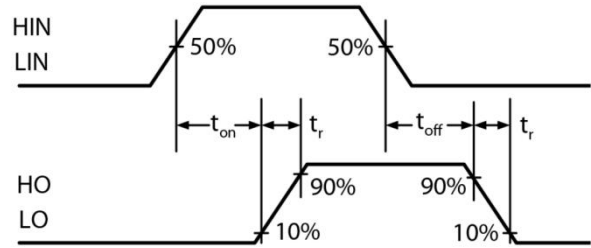
**AC Electrical Characteristics** ( $V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, C_L = 1000pF, V_{SS} = COM, @T_A = +25^\circ C$ , unless otherwise specified.)

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	ns	–
Delay matching	DGD2113	$t_{DM}$	–	–	20	ns	–

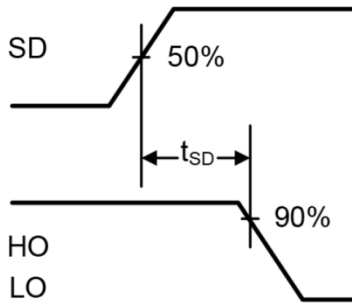
**Timing Waveforms**



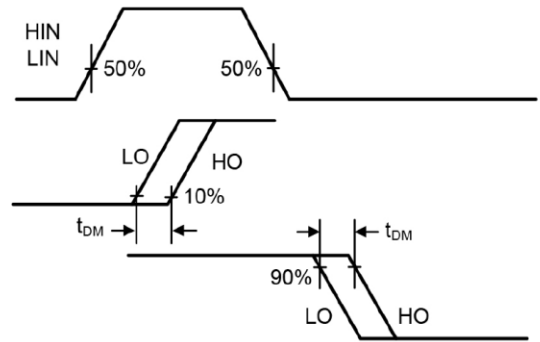
**Figure 1.** Input / Output Timing Diagram



**Figure 2.** Switching Time Waveform Definitions

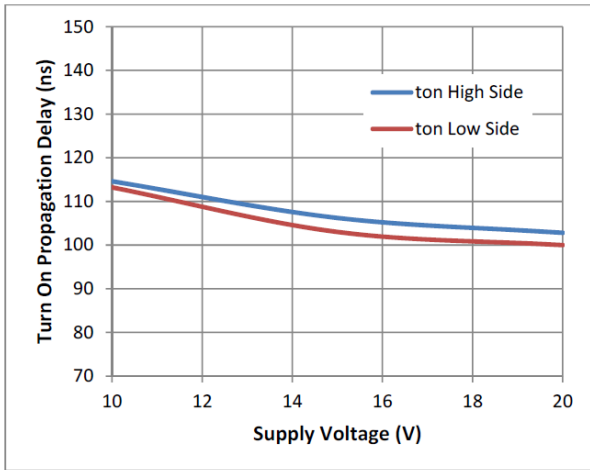


**Figure 3.** Shutdown Waveform Definitions

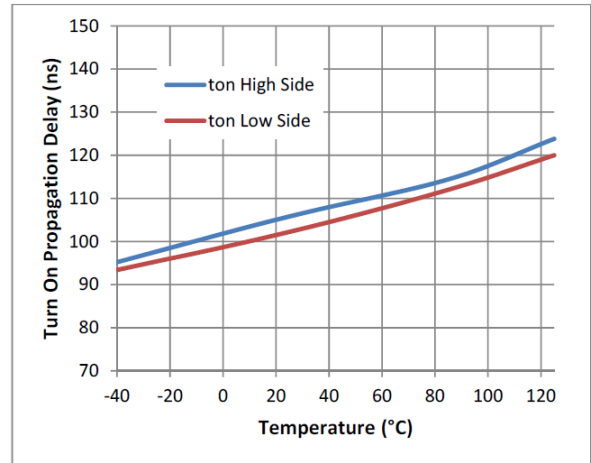


**Figure 4.** Delay Matching Waveform Definitions

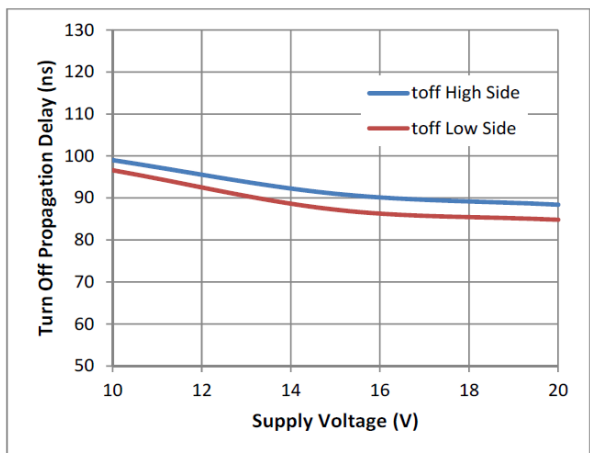
**Typical Performance Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



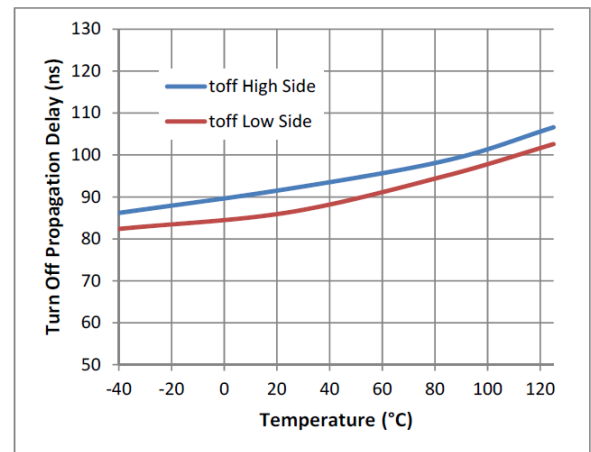
**Figure 5.** Turn-on Propagation Delay vs. Supply Voltage



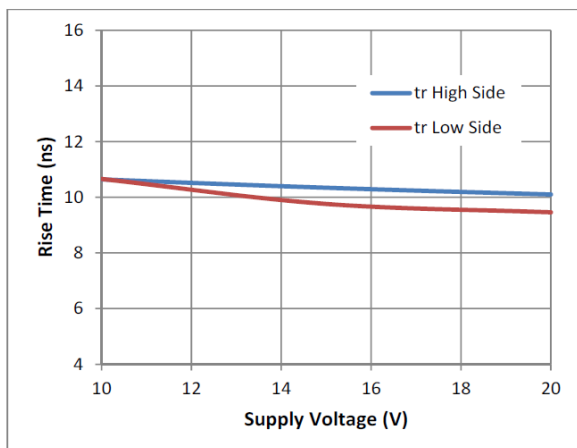
**Figure 6.** Turn-on Propagation Delay vs. Temperature



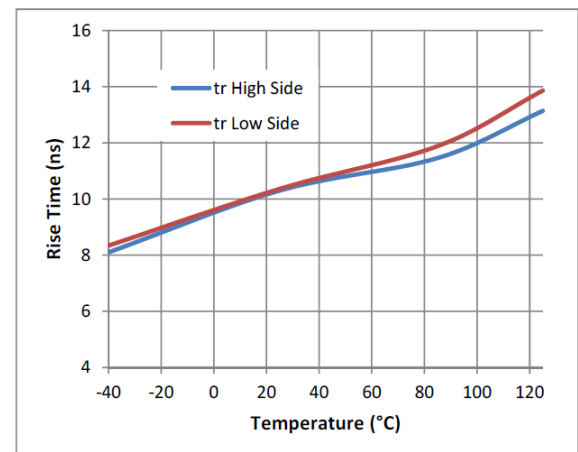
**Figure 7.** Turn-off Propagation Delay vs. Supply Voltage



**Figure 8.** Turn-off Propagation Delay vs. Temperature

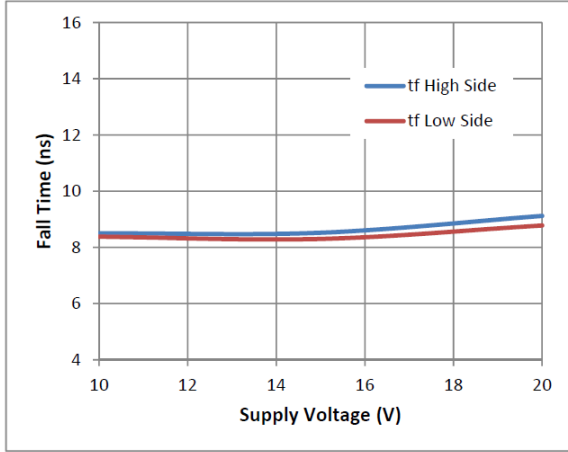


**Figure 9.** Rise Time vs. Supply Voltage

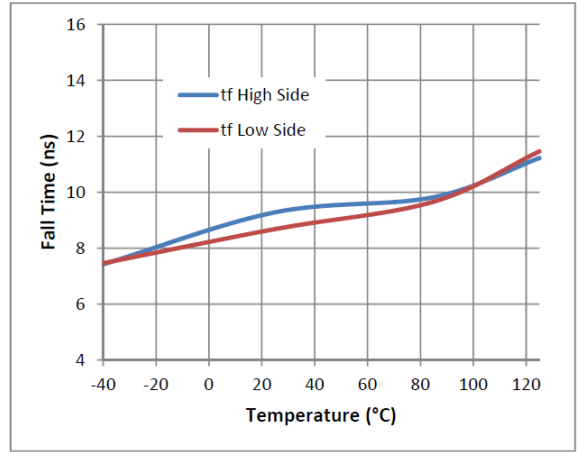


**Figure 10.** Rise Time vs. Temperature

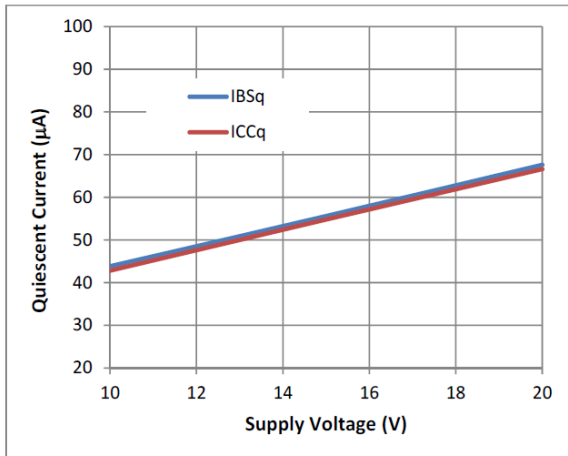
**Typical Performance Characteristics** (continued)



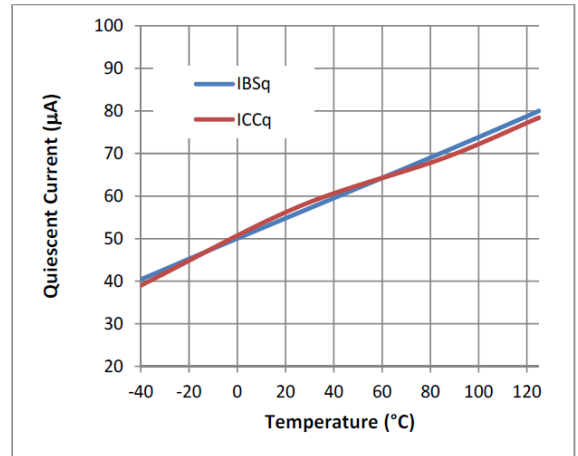
**Figure 11.** Fall Time vs. Supply Voltage



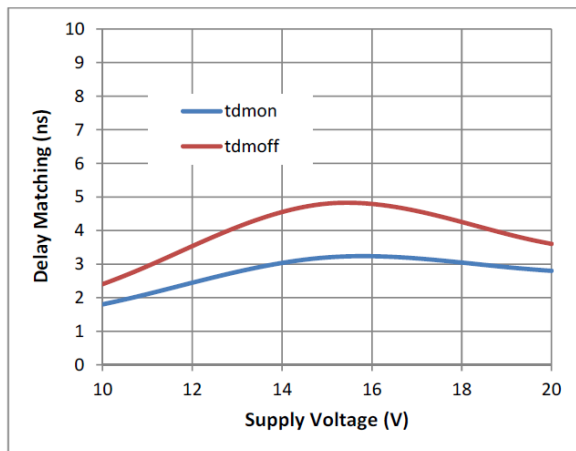
**Figure 12.** Fall Time vs. Temperature



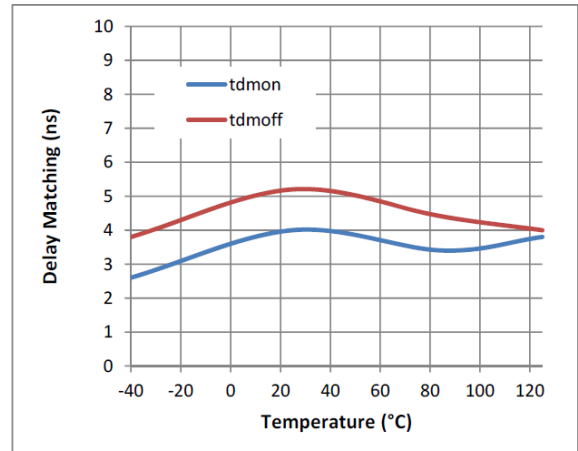
**Figure 13.** Quiescent Current vs. Supply Voltage



**Figure 14.** Quiescent Current vs. Temperature

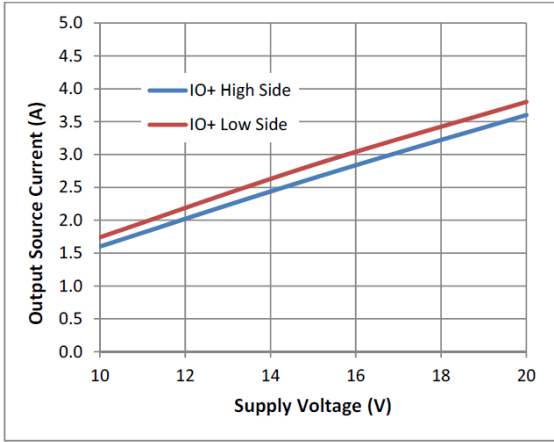


**Figure 15.** Delay Matching vs. Supply Voltage

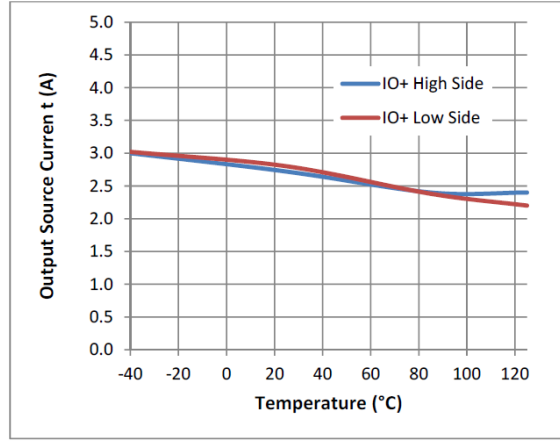


**Figure 16.** Delay Matching vs. Temperature

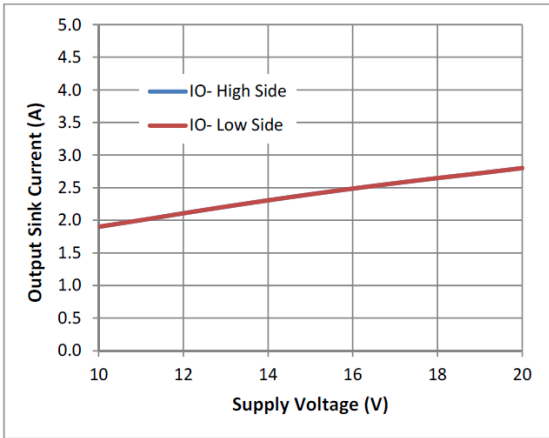
**Typical Performance Characteristics (cont.)**



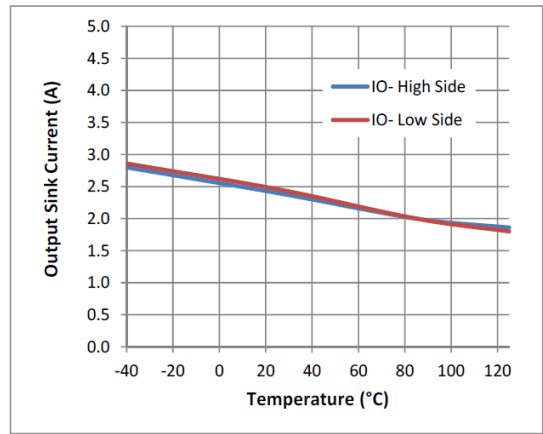
**Figure 17.** Output Source Current vs. Supply Voltage



**Figure 18.** Output Source Current vs. Temperature

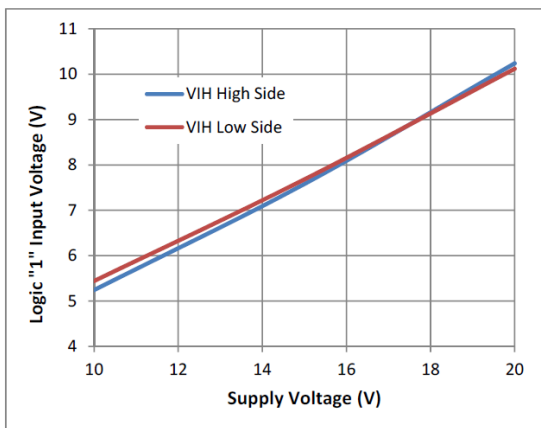


**Figure 19.** Output Sink Current vs. Supply Voltage

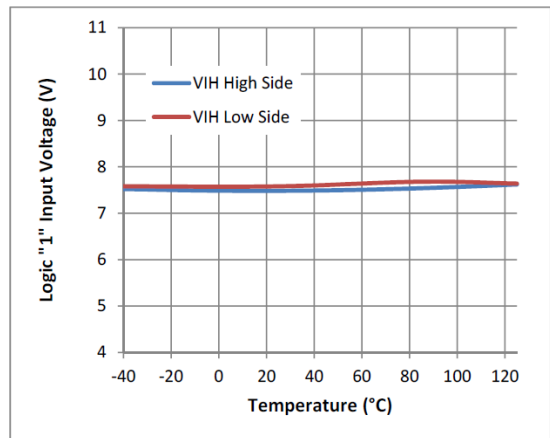


**Figure 20.** Output Sink Current vs. Temperature

Note: graphs overlap one another



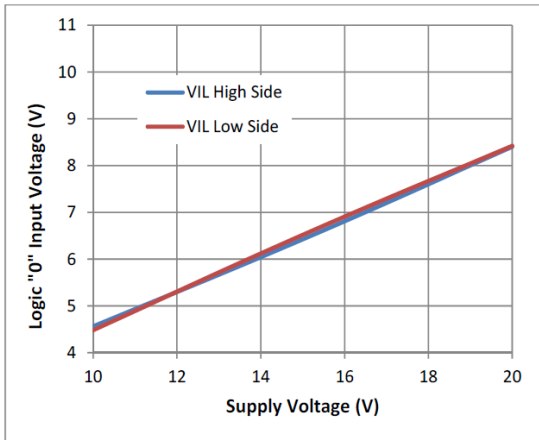
**Figure 21.** Logic 1 Input Voltage vs. Supply Voltage



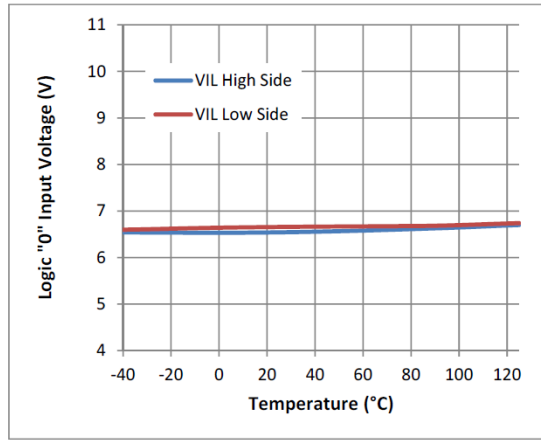
**Figure 22.** Logic 1 Input Voltage vs. Temperature



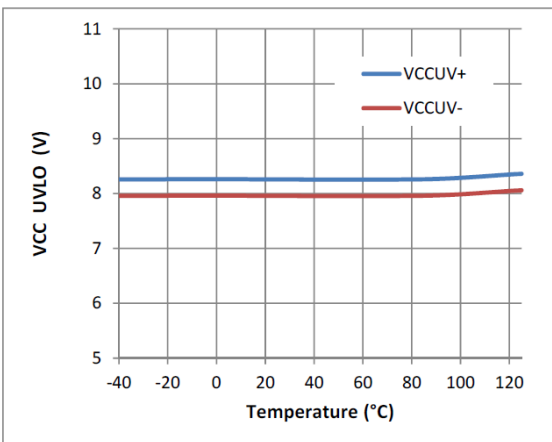
**Typical Performance Characteristics (cont.)**



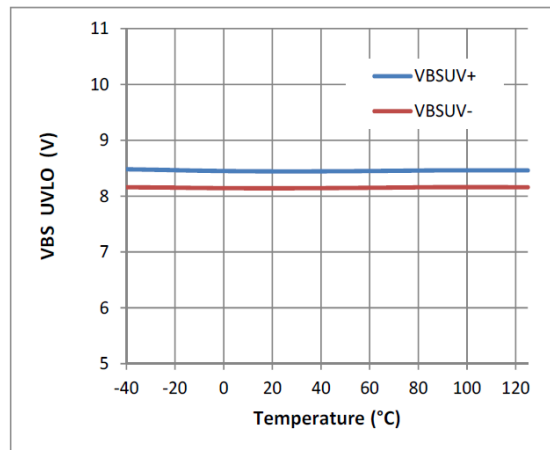
**Figure 23.** Logic 0 Input Voltage vs. Supply Voltage



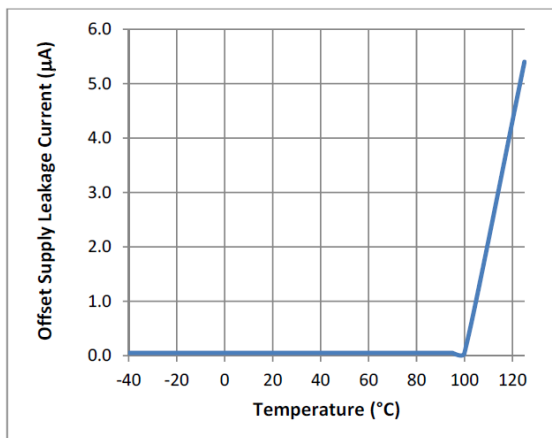
**Figure 24.** Logic 0 Input Voltage vs. Temperature



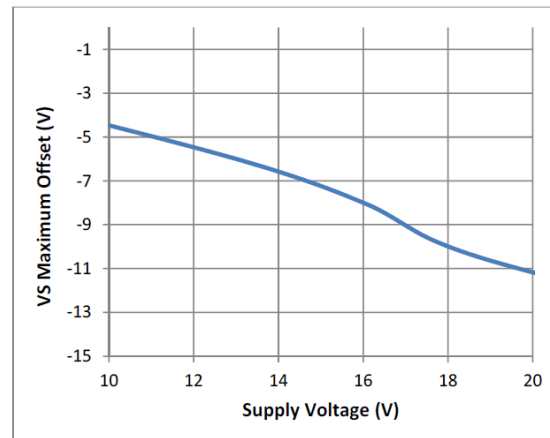
**Figure 25.**  $V_{CC}$  UVLO vs. Temperature



**Figure 26.**  $V_{BS}$  UVLO vs. Temperature

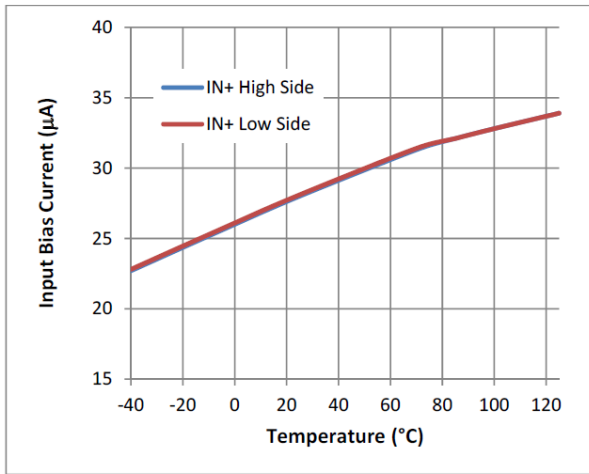


**Figure 27.** Offset Supply Leakage Current vs. Temperature



**Figure 28.**  $V_S$  Maximum Offset vs. Supply Voltage

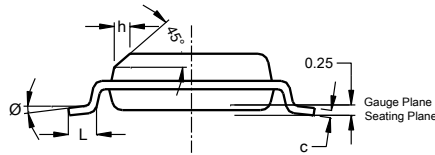
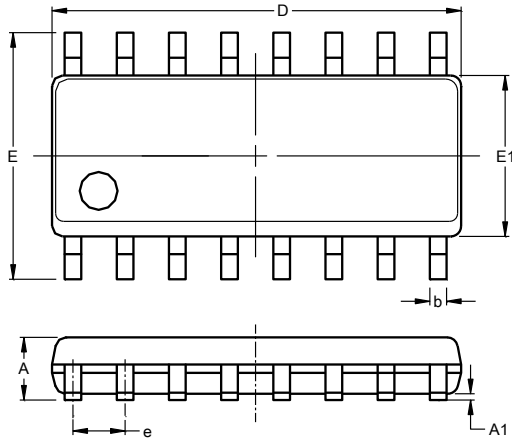
**Typical Performance Characteristics** (cont.)



**Figure 29.** Input Bias Current vs. Temperature

**Package Outline Dimensions**

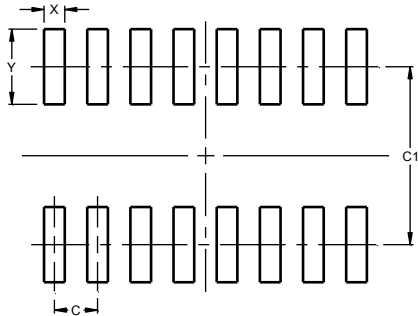
Please see AP02001 at [http://www.diodes.com/\\_files/datasheets/ap02001.pdf](http://www.diodes.com/_files/datasheets/ap02001.pdf) for the latest version.



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	--
Ø	0°	8°	--
All Dimensions in mm			

**Suggested Pad Layout**

Please see AP02001 at [http://www.diodes.com/\\_files/datasheets/ap02001.pdf](http://www.diodes.com/_files/datasheets/ap02001.pdf) for the latest version.



Dimensions	Value (in mm)
C	1.27
C1	5.20
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.

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