

**HIGH-SIDE AND LOW-SIDE GATE DRIVER IN SO-14**

### Description

The DGD21904 is a high voltage / high speed gate driver capable of driving N-Channel MOSFETs and IGBTs in a half bridge configuration. High voltage processing techniques enable the DGD21904's high-side to switch to 600V in a bootstrap operation under high dV/dt conditions.

The DGD21904 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) for easy interfacing with controlling devices. The driver outputs feature high pulse current buffers designed for minimum driver cross conduction.

The DGD21904 is available in SO-14 package. The operating temperature extends from -40°C to +125°C.

### Applications

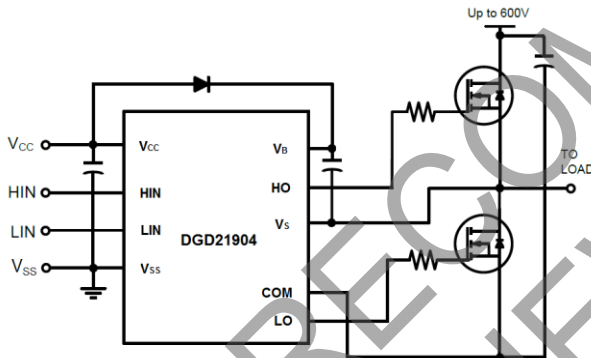
- DC-DC Converters
- DC-AC Inverters
- AC-DC Power Supplies
- Motor Controls
- Class D Power Amplifiers

### Features

- Floating High-Side Driver in Bootstrap Operation to 600V
- Drives Two N-Channel MOSFETs or IGBTs in a Half Bridge Configuration
- Output Drivers Capable of 4.5A/4.5A Typ Sink/Source
- Logic Input (HIN and LIN) 3.3V Capability
- Schmitt Triggered Logic Inputs with Internal Pull Down
- Undervoltage Lockout for High and Low-Side Drivers
- 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-Q101, 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-14 (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: 0.142 grams (Approximate)



Typical Configuration



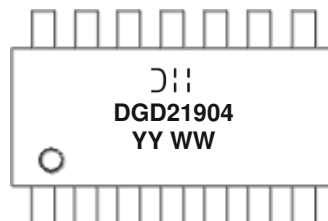
Top View

### Ordering Information (Note 4)

Part Number	Marking	Reel Size (inches)	Tape Width (mm)	Quantity Per Reel
DGD21904S14-13	DGD21904	13	16	2,500

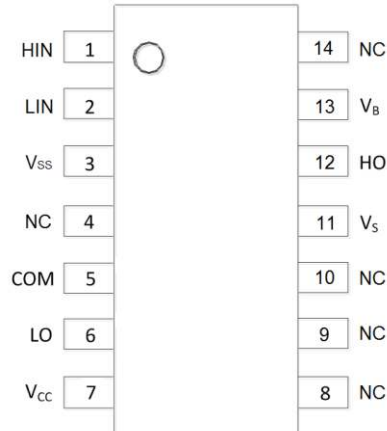
- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
  2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3.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



☺ = Manufacturer's Marking  
 DGD21904 = Product Type Marking Code  
 YY = Year (ex: 19 = 2019)  
 WW = Week (01 to 53)

## Pin Diagrams

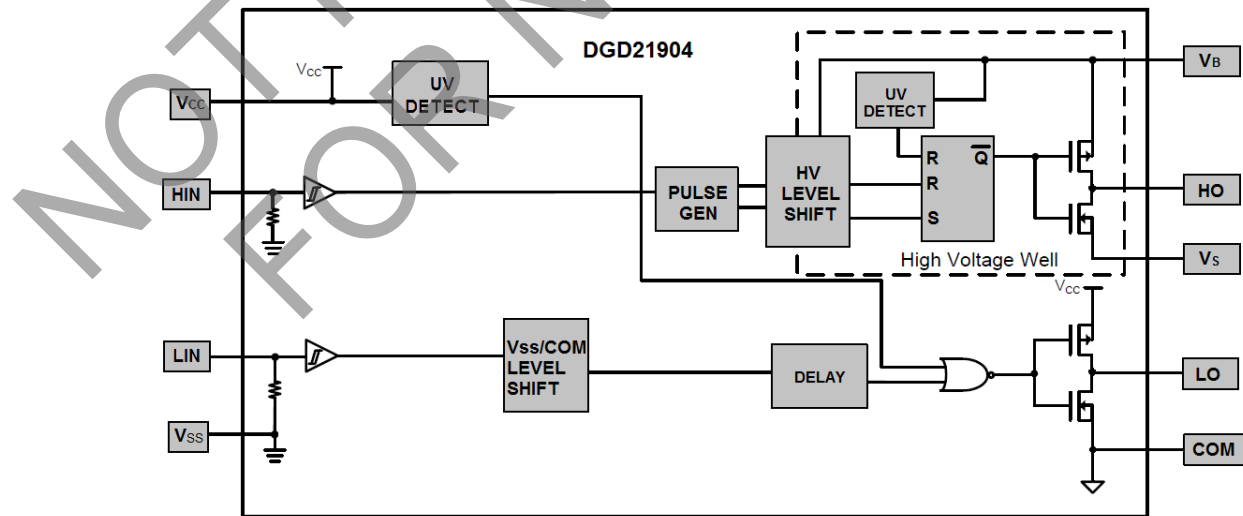


Top View: SO-14

## Pin Descriptions

Pin Number	Pin Name	Function
1	HIN	Logic input for high-side gate driver output, in phase with HO
2	LIN	Logic input for low-side gate driver output, in phase with LO
3	V <sub>SS</sub>	Logic ground
4, 8, 9, 10, 14	NC	No connection (No Internal Connection)
5	COM	Low-side and logic return
6	LO	Low-side gate drive output
7	V <sub>CC</sub>	Low-side and logic fixed supply
11	V <sub>S</sub>	High-side floating supply return
12	HO	High-side gate drive output
13	V <sub>B</sub>	High-side floating supply

## Functional Block Diagram



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

Characteristic	Symbol	Value	Unit
High-Side Floating Supply Voltage	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
Logic Supply Offset Voltage	V <sub>SS</sub>	V <sub>CC</sub> -24 to V <sub>CC</sub> +0.3	V
High-Side Floating Output Voltage	V <sub>HO</sub>	V <sub>S</sub> -0.3 to V <sub>B</sub> +0.3	V
Offset Supply Voltage Transient	dV <sub>S</sub> / dt	50	V/ns
Low-Side and Logic 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 Input Voltage (HIN and LIN)	V <sub>IN</sub>	-0.3 to V <sub>CC</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>	0.862	W
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	145	°C/W
Operating Temperature	T <sub>J</sub>	+150	°C
Lead Temperature (Soldering, 10s)	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	V <sub>S</sub>	(Note 6)	600	V
Logic Ground	V <sub>SS</sub>	-5	5	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 Input Voltage (HIN and LIN)	V <sub>IN</sub>	0	5	V
Ambient Temperature	T <sub>A</sub>	-40	+125	°C

Note: 6. Logic operation for V<sub>S</sub> of -5V to +600V.

**DC Electrical Characteristics** ( $V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 15V, @ $T_A$  = +25°C, unless otherwise specified.) (Note 7)

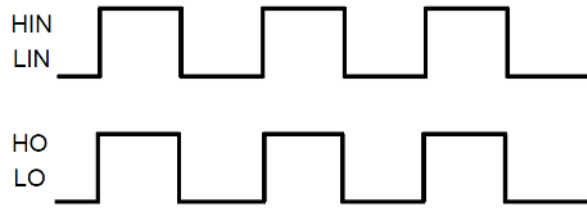
Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Logic "1" Input Voltage (Note 8)	$V_{IH}$	2.5	—	—	V	$V_{CC} = 10V$ to 20V
Logic "0" Input Voltage (Note 8)	$V_{IL}$	—	—	0.8	V	$V_{CC} = 10V$ to 20V
High Level Output Voltage, $V_{BIAS} - V_O$	$V_{OH}$	—	—	0.1	V	$I_O = 0mA$
Low Level Output Voltage, $V_O$	$V_{OL}$	—	—	0.035	V	$I_O = 0mA$
Offset Supply Leakage Current	$I_{LK}$	—	—	50	$\mu A$	$V_B = V_S = 600V$
Quiescent $V_{BS}$ Supply Current	$I_{BSQ}$	—	45	80	$\mu A$	$V_{IN} = 0V$ or 5V
Quiescent $V_{CC}$ Supply Current	$I_{CCQ}$	—	75	200	$\mu A$	$V_{IN} = 0V$ or 5V
Logic "1" Input Bias Current	$I_{IN+}$	—	25	50	$\mu A$	$V_{IN} = 5V$
Logic "0" Input Bias Current	$I_{IN-}$	—	1.0	2.0	$\mu A$	$V_{IN} = 0V$
$V_{BS}$ Supply Undervoltage Positive Going Threshold	$V_{BSUV+}$	7.6	8.4	9.8	V	—
$V_{BS}$ Supply Undervoltage Negative Going Threshold	$V_{BSUV-}$	6.9	7.8	9.0	V	—
$V_{CC}$ Supply Undervoltage Positive Going Threshold	$V_{CCUV+}$	7.6	8.4	9.8	V	—
$V_{CC}$ Supply Undervoltage Negative Going Threshold	$V_{CCUV-}$	6.9	7.8	9.0	V	—
$V_{CC}$ and $V_{BS}$ Undervoltage Hysteresis	$V_{CCUVH}$	—	0.6	—	V	—
	$V_{BSUVH}$	—	0.6	—	V	—
Output High Short Circuit Pulsed Current	$I_{O+}$	3.5	4.5	—	A	$V_O = 0V$ , $PW \leq 10ms$
Output Low Short Circuit Pulsed Current	$I_{O-}$	3.5	4.5	—	A	$V_O = 15V$ , $PW \leq 10ms$

Notes: 7. The  $V_{IN}$  and  $I_{IN}$  parameters are applicable to the two logic pins;  $HIN$  and  $LIN$ . The  $V_O$  and  $I_O$  parameters are applicable to the respective output pins:  $HO$  and  $LO$ .  
8. For optimal operation, it is recommended that the input pulses ( $HIN$  and  $LIN$ ) should have a minimum amplitude of 2.5V with a minimum pulse width of 280ns.

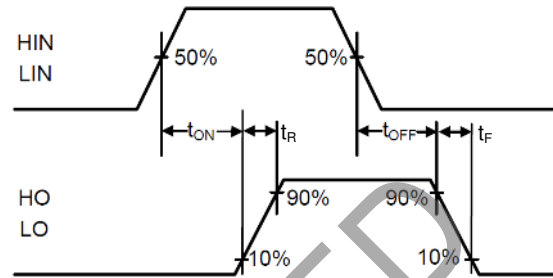
**AC Electrical Characteristics** ( $V_{BIAS}$  ( $V_{CC}$ ,  $V_{BS}$ ) = 15V,  $C_L = 1000pF$ , @ $T_A$  = +25°C, unless otherwise specified.)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Turn-On Propagation Delay	$t_{ON}$	—	140	200	ns	$V_S = 0V$
Turn-Off Propagation Delay	$t_{OFF}$	—	140	200	ns	$V_S = 0V$
Delay Matching, $HO$ & $LO$ Turn On/Off	$t_{DM}$	—	0	50	ns	—
Turn-On Rise Time	$t_R$	—	25	50	ns	$V_S = 0V$
Turn-Off Fall Time	$t_F$	—	20	45	ns	$V_S = 0V$

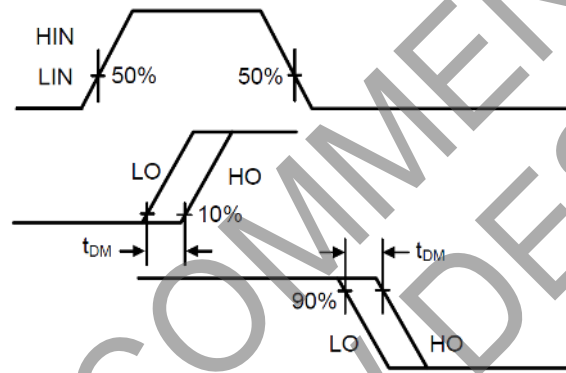
**Timing Waveforms**



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



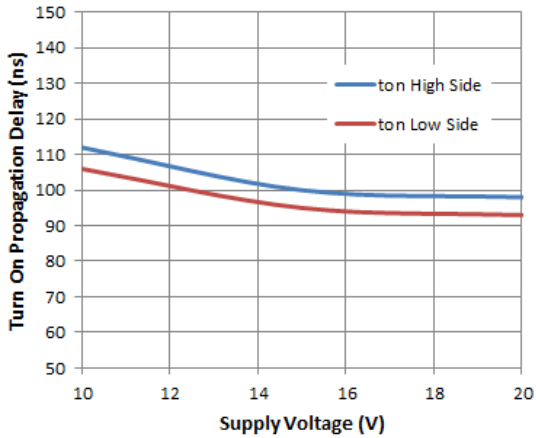
**Figure 2.** Switching Time Waveform Definitions



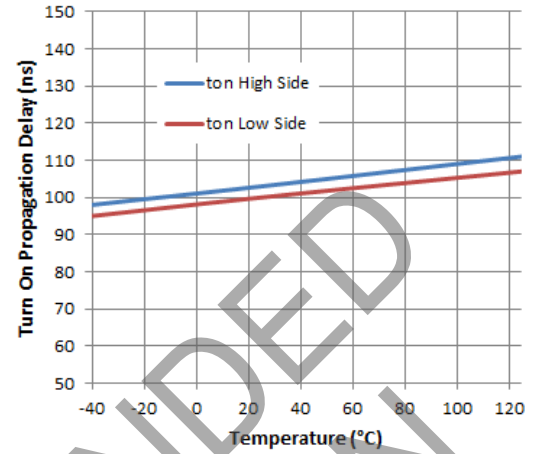
**Figure 3.** Delay Matching Waveform Definitions

NOT RECOMMENDED FOR NEW DESIGN

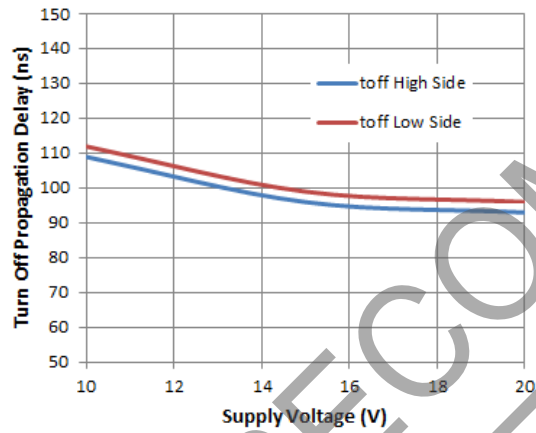
**Typical Performance Characteristics** ( $V_{CC} = 15V$ ,  $@T_A = +25^\circ C$ , unless otherwise specified.)



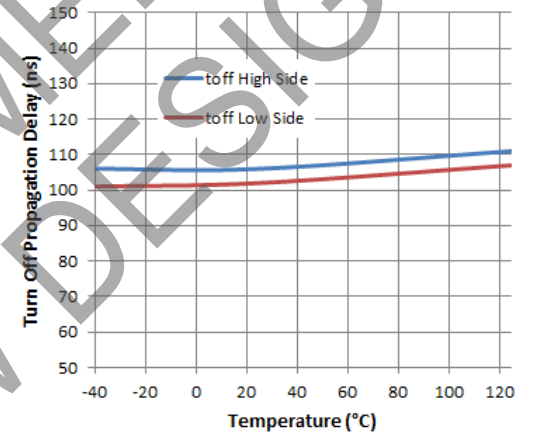
**Figure 4.** Turn-on Propagation Delay vs. Supply Voltage



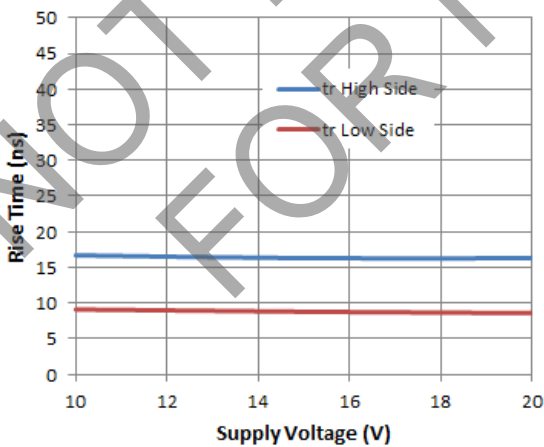
**Figure 5.** Turn-on Propagation Delay vs. Temperature



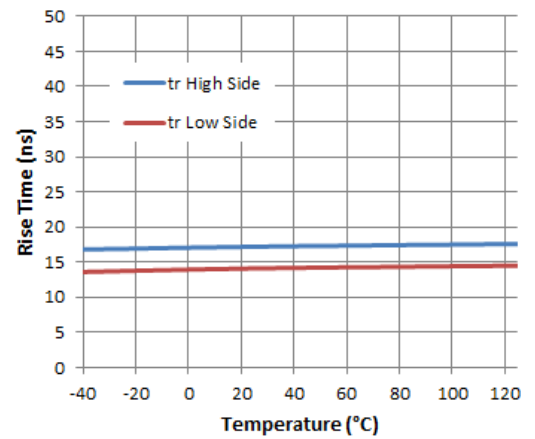
**Figure 6.** Turn-off Propagation Delay vs. Supply Voltage



**Figure 7.** Turn-off Propagation Delay vs. Temperature



**Figure 8.** Rise Time vs. Supply Voltage



**Figure 9.** Rise Time vs. Temperature

**Typical Performance Characteristics** (continued)

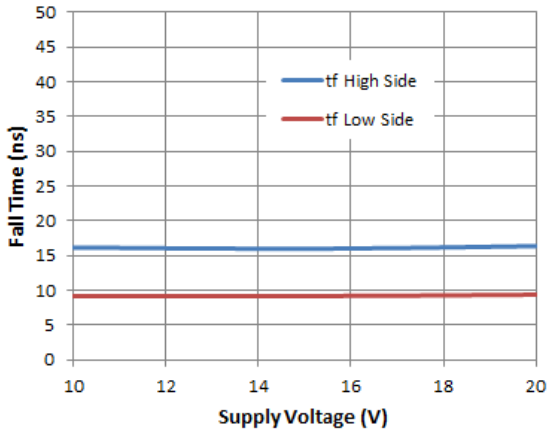


Figure 10. Fall Time vs. Supply Voltage

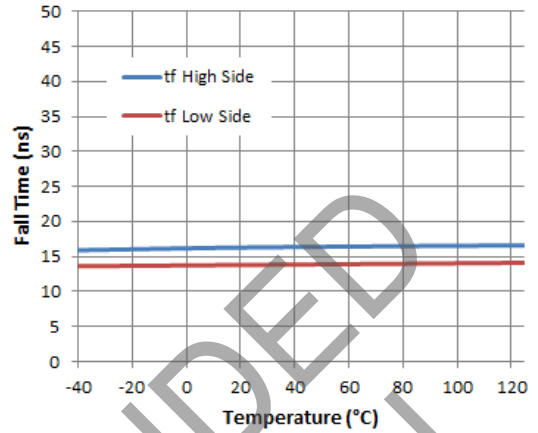


Figure 11. Fall Time vs. Temperature

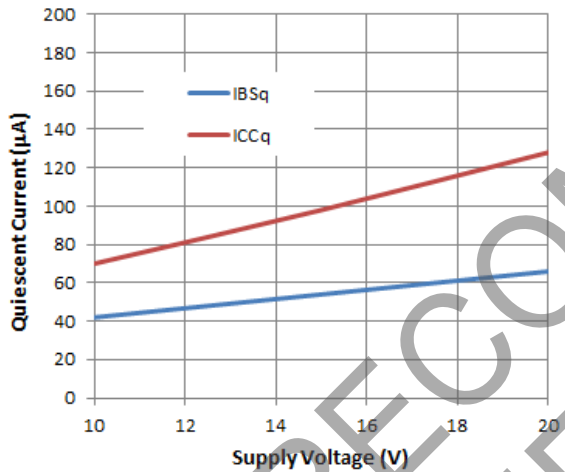


Figure 12. Quiescent Current vs. Supply Voltage

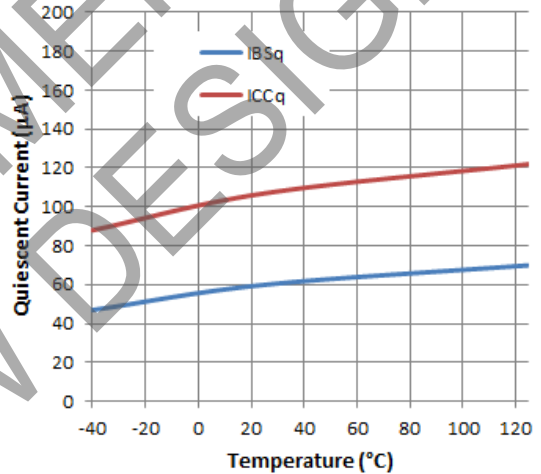


Figure 13. Quiescent Current vs. Temperature

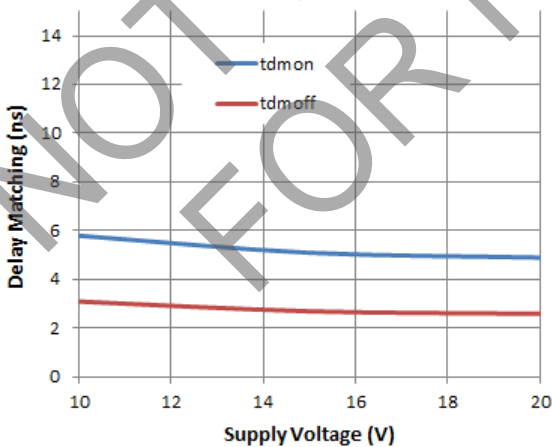


Figure 14. Delay Matching vs. Supply Voltage

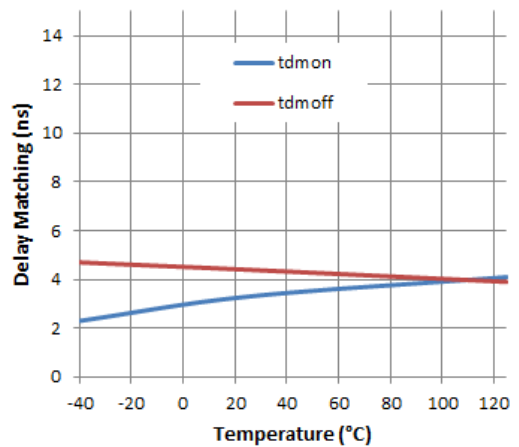
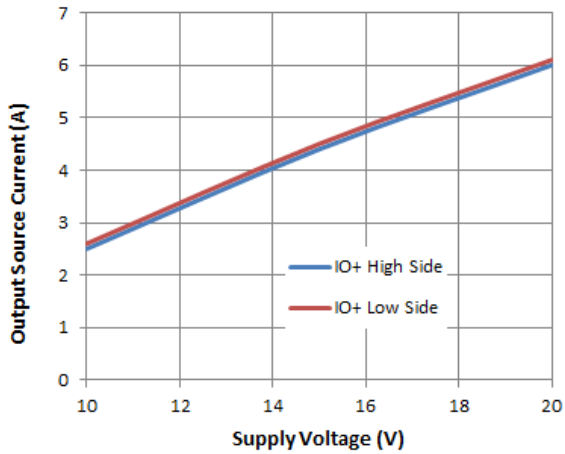
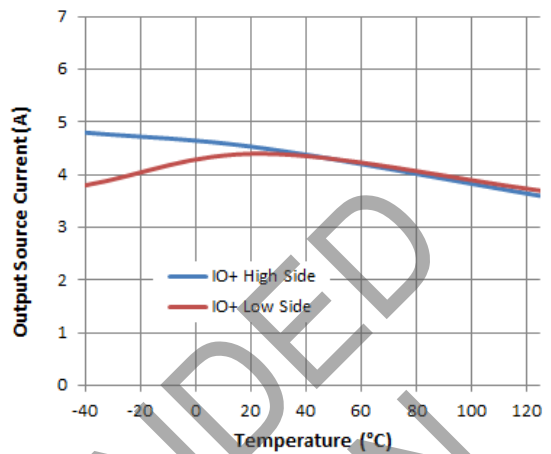


Figure 15. Delay Matching vs. Temperature

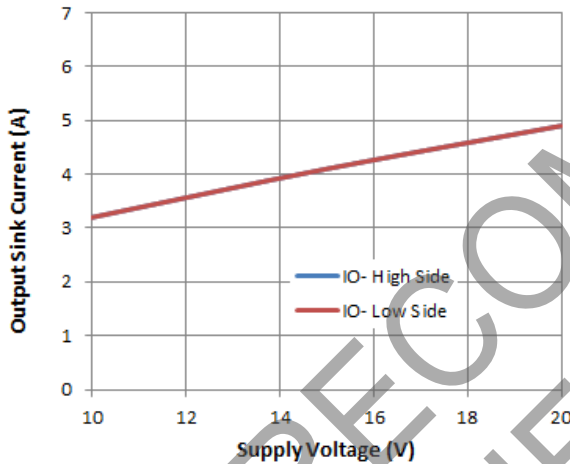
**Typical Performance Characteristics** (continued)



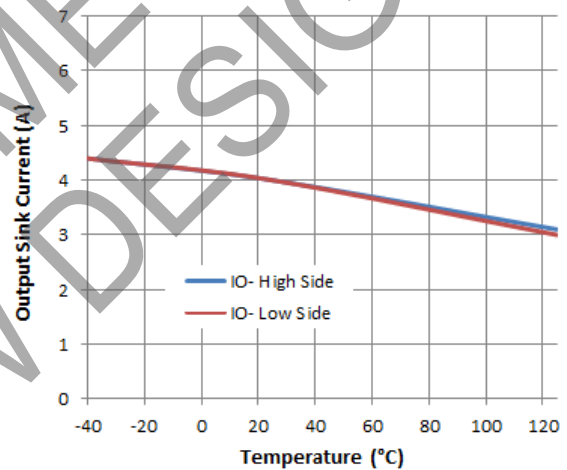
**Figure 16.** Output Source Current vs. Supply Voltage



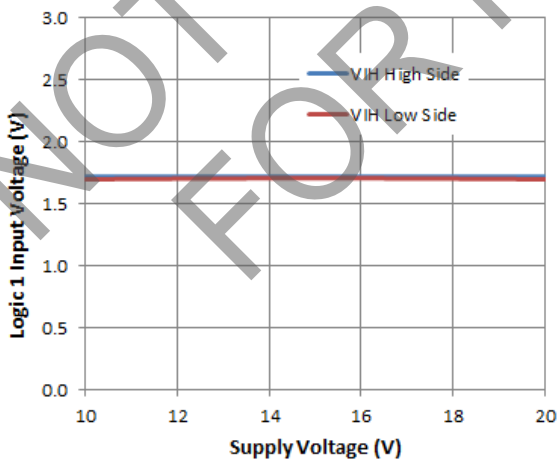
**Figure 17.** Output Source Current vs. Temperature



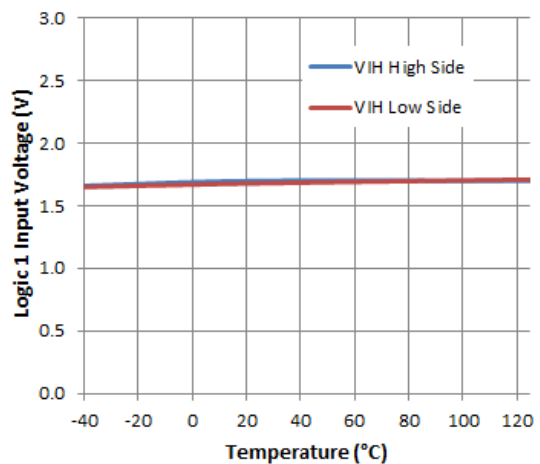
**Figure 18.** Output Sink Current vs. Supply Voltage



**Figure 19.** Output Sink Current vs. Temperature



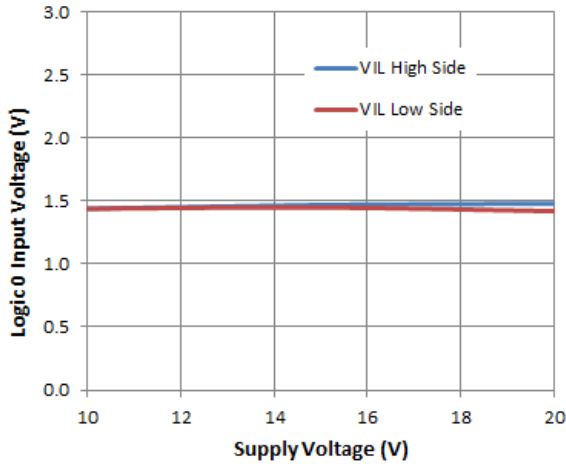
**Figure 20.** Logic 1 Input Voltage vs. Supply Voltage



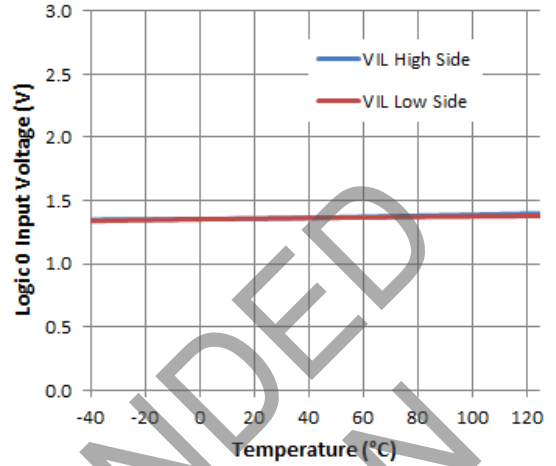
**Figure 21.** Logic 1 Input Voltage vs. Temperature



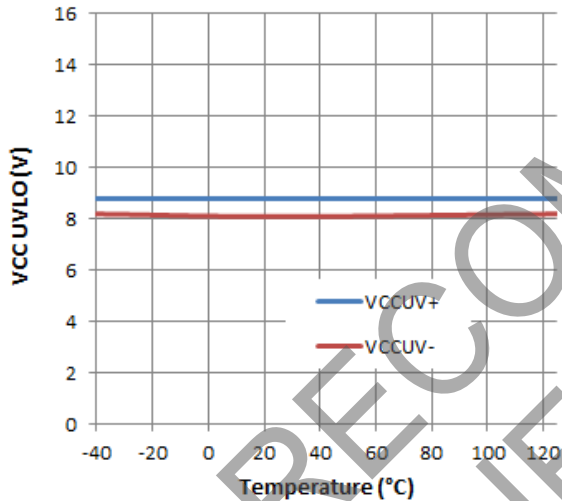
**Typical Performance Characteristics** (continued)



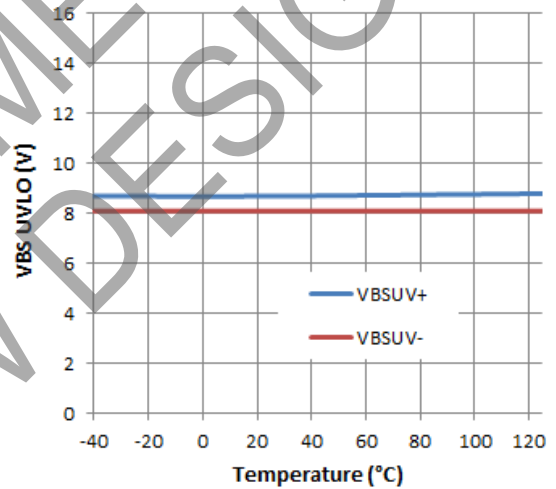
**Figure 22.** Logic 0 Input Voltage vs. Supply Voltage



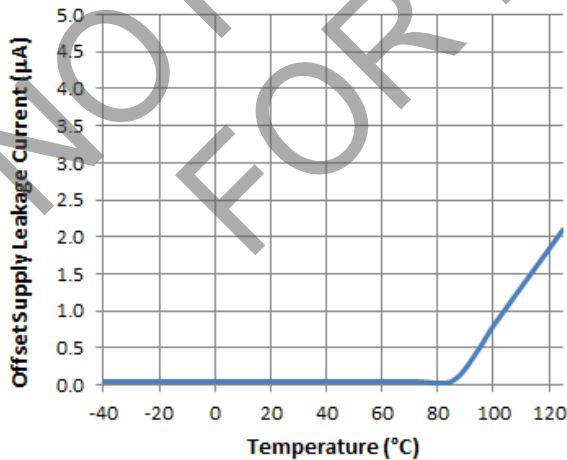
**Figure 23.** Logic 0 Input Voltage vs. Temperature



**Figure 24.** VCC UVLO vs. Temperature



**Figure 25.** VBS UVLO vs. Temperature

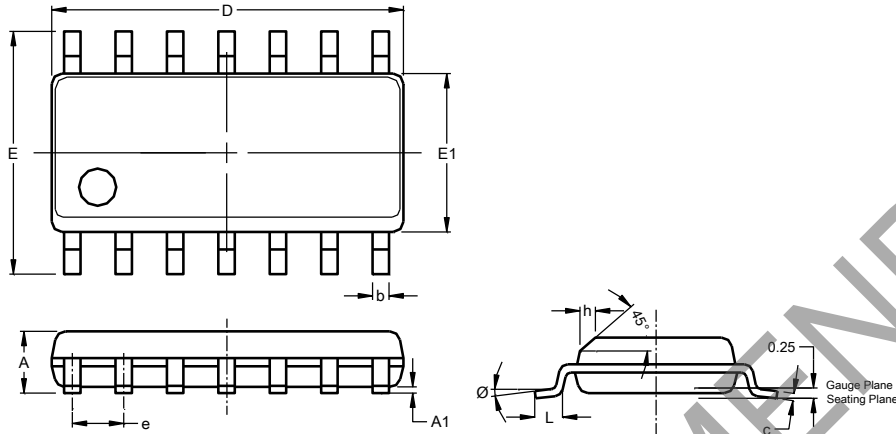


**Figure 26.** Offset Supply Leakage Current vs. Temperature

## Package Outline Dimensions

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

### SO-14 (Type TH)

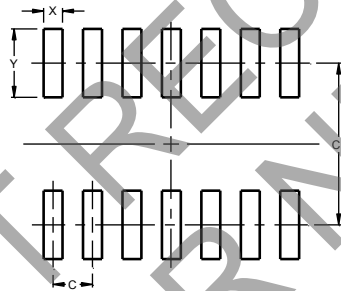


SO-14 (Type TH)			
Dim	Min	Max	Typ
A	1.55	1.73	--
A1	0.10	0.25	--
b	0.35	0.51	--
c	0.190	0.248	--
D	8.56	8.74	8.61
E	5.84	6.20	6.00
E1	3.81	3.99	3.94
e	--	--	1.27
h	--	--	0.33
L	0.41	0.89	--
Ø	0°	8°	--
All Dimensions in mm			

## Suggested Pad Layout

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

### SO-14 (Type TH)



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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