

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

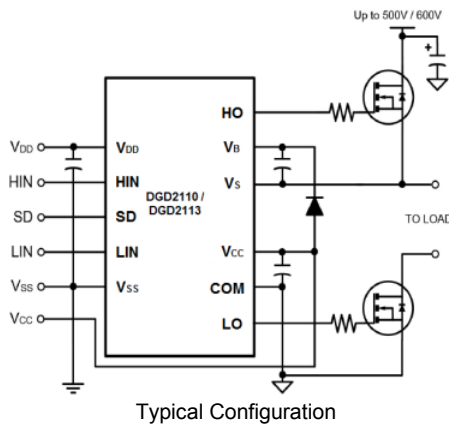
The DGD2110 and DGD2113 are high-voltage/high-speed MOSFET and IGBT drivers with independent high-side and low-side outputs. The high-side driver features floating supply for operation at up to 500V/600V. The 10ns (max)/20ns (max) propagation delay matching between the high- and the low side drivers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



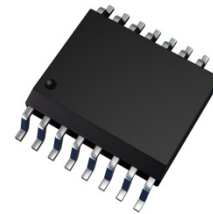
Typical Configuration

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](mailto:contact@diodes.com) 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)

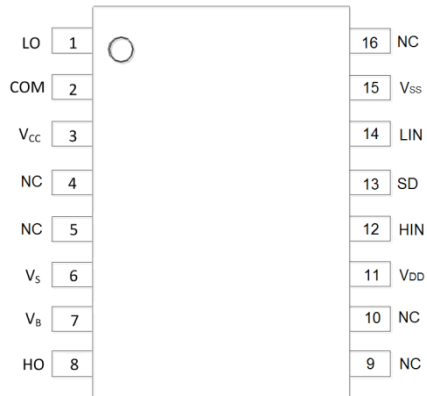
| Product | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---------------|---------|--------------------|-----------------|-------------------|
| DGD2110S16-13 | DGD2110 | 13 | 16 | 1500 |
| DGD2113S16-13 | DGD2113 | 13 | 16 | 1500 |

- 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

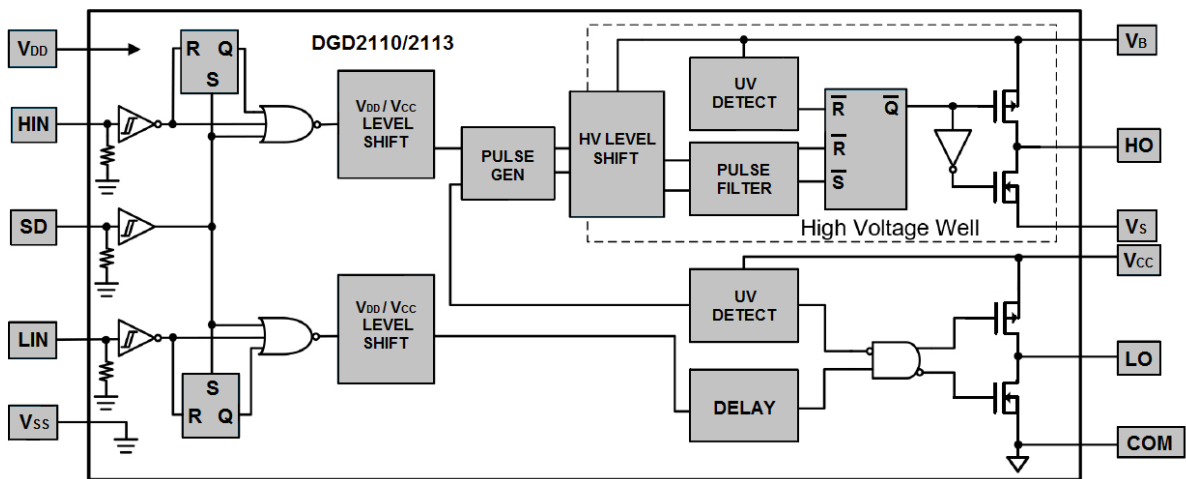


Top view: SO-16

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 _{θJA} | 90 | °C/W |
| Thermal Resistance, Junction to Case (Note 5) | R _{θJC} | 45 | °C/W |
| Operating Temperature | T _J | +150 | °C |
| Lead Temperature (Soldering, 10 seconds) | 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 Absolute Voltage | V _B | V _S + 10 | V _S + 20 | V |
| High-Side Floating Supply Offset Voltage | V _S | (Note 6) | 500 | V |
| High-Side Floating Supply Offset Voltage | 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 minimum 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 | $I_O = 0\text{mA}$ |
| Low Level Output Voltage, V_O | V_{OL} | — | — | 0.15 | V | $I_O = 20\text{mA}$ |
| Offset Supply Leakage Current | I_{LK} | — | — | 50 | μA | $V_B = V_S = 500\text{V}/600\text{V}$ |
| Quiescent V_{BS} Supply Current | I_{BSQ} | — | 55 | 230 | μA | $V_{IN} = 0\text{V}$ or V_{DD} |
| Quiescent V_{CC} Supply Current | I_{CCQ} | — | 56 | 340 | μA | $V_{IN} = 0\text{V}$ or V_{DD} |
| Quiescent V_{DD} Supply Current | I_{DDQ} | — | 0.6 | 30 | μA | $V_{IN} = 0\text{V}$ 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 | $V_{IN} = 0\text{V}$ |
| 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 | $V_O = 0\text{V}$, $V_{IN} = V_{DD}$, $PW \leq 10\mu\text{s}$ |
| Output Low Short Circuit Pulsed Current | I_{O-} | 2.0 | 2.5 | — | A | $V_O = 15\text{V}$, $V_{IN} = 0\text{V}$, $PW \leq 10\mu\text{s}$ |

- Note:
- 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.
 - For optimal operation, it is recommended that the input pulses (HIN and LIN) should have a minimum amplitude of 9.5V ($V_{DD} = 15\text{V}$) with a minimum pulse width of 200ns.

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

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|-----------------------------|-----------|----------|-----|-----|------|---------------------------------|
| Turn-On Propagation Delay | t_{ON} | — | 105 | 150 | ns | $V_S = 0\text{V}$ |
| Turn-Off Propagation Delay | t_{OFF} | — | 94 | 125 | ns | $V_S = 500\text{V}/600\text{V}$ |
| Shut Down Propagation Delay | t_{SD} | — | 70 | 140 | ns | $V_S = 500\text{V}/600\text{V}$ |
| 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

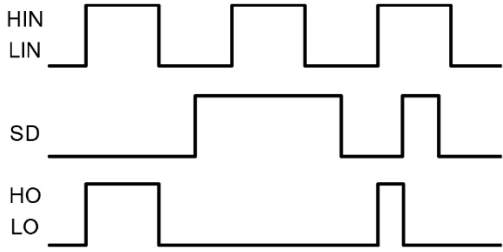


Figure 1. Input / Output Timing Diagram

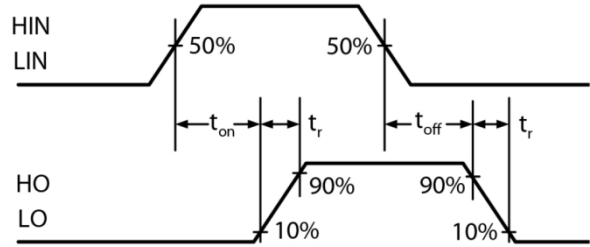


Figure 2. Switching Time Waveform Definitions

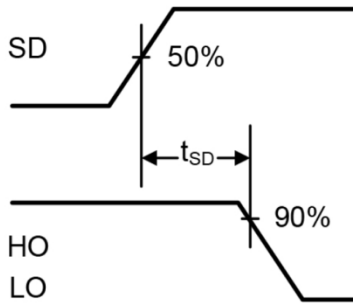


Figure 3. Shutdown Waveform Definitions

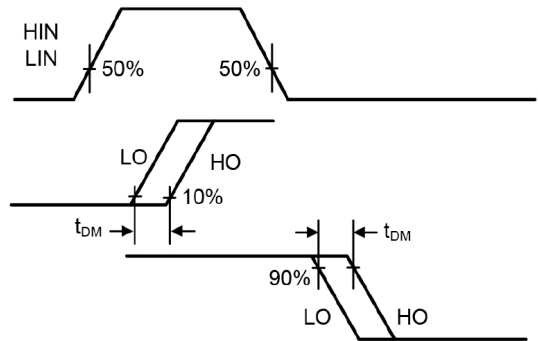


Figure 4. Delay Matching Waveform Definitions

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

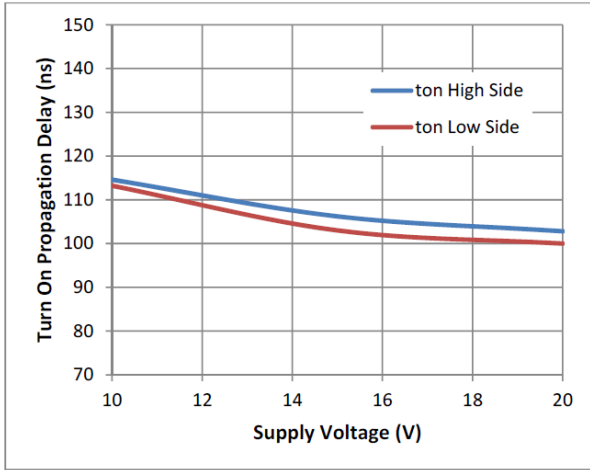


Figure 5. Turn-on Propagation Delay vs. Supply Voltage

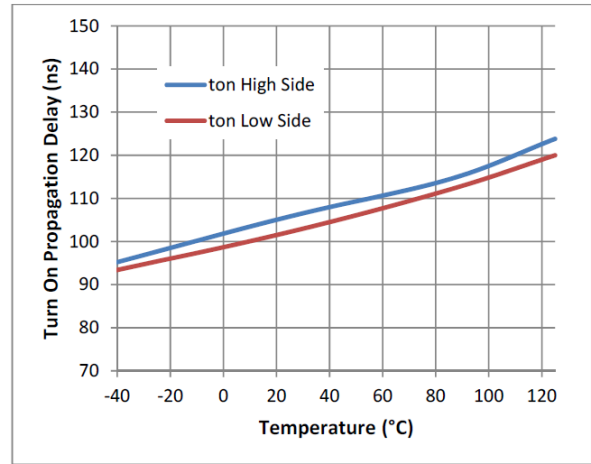


Figure 6. Turn-on Propagation Delay vs. Temperature

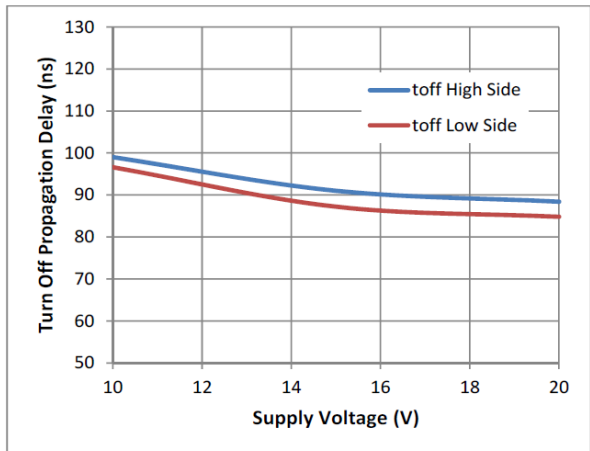


Figure 7. Turn-off Propagation Delay vs. Supply Voltage

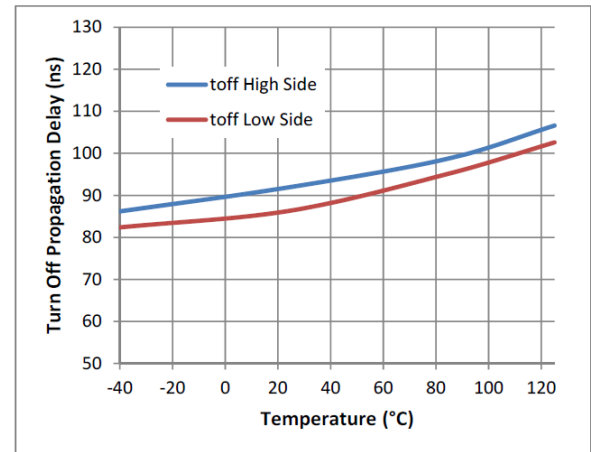


Figure 8. Turn-off Propagation Delay vs. Temperature

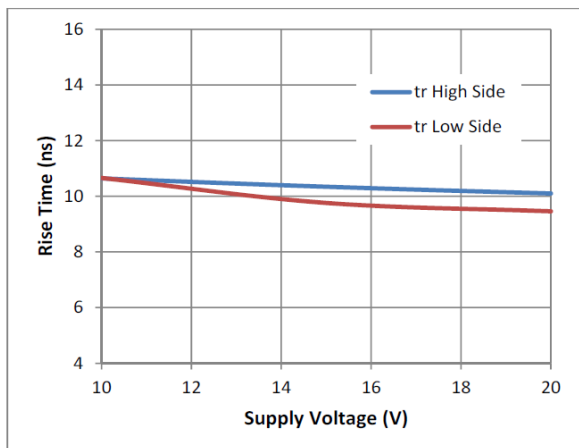


Figure 9. Rise Time vs. Supply Voltage

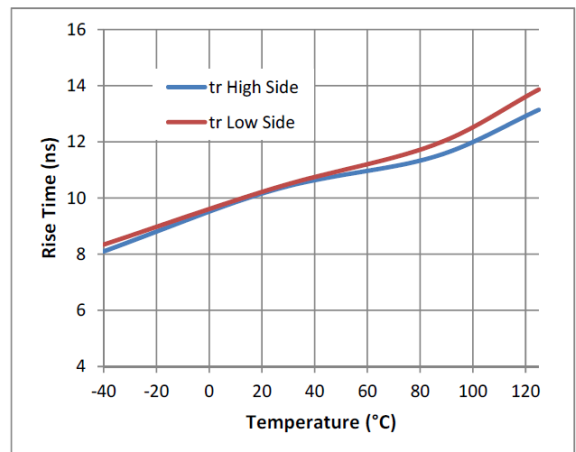


Figure 10. Rise Time vs. Temperature

Typical Performance Characteristics (continued)

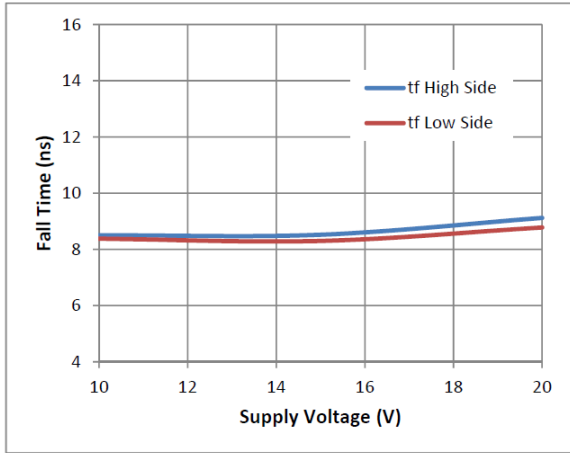


Figure 11. Fall Time vs. Supply Voltage

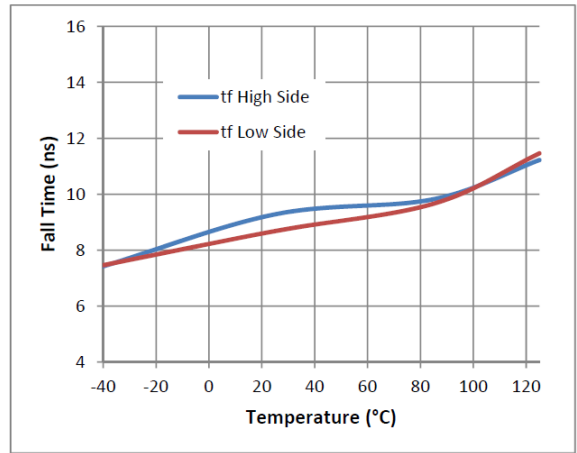


Figure 12. Fall Time vs. Temperature

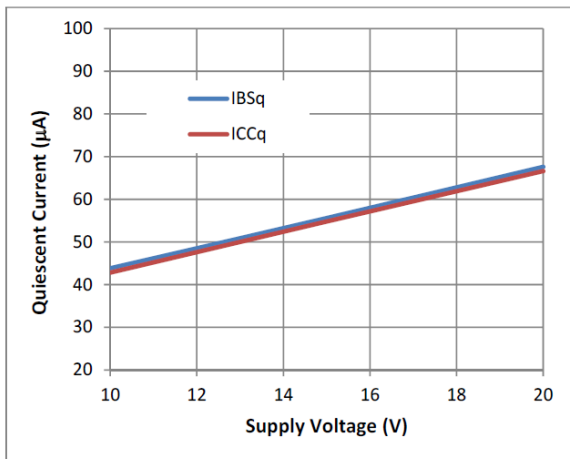


Figure 13. Quiescent Current vs. Supply Voltage

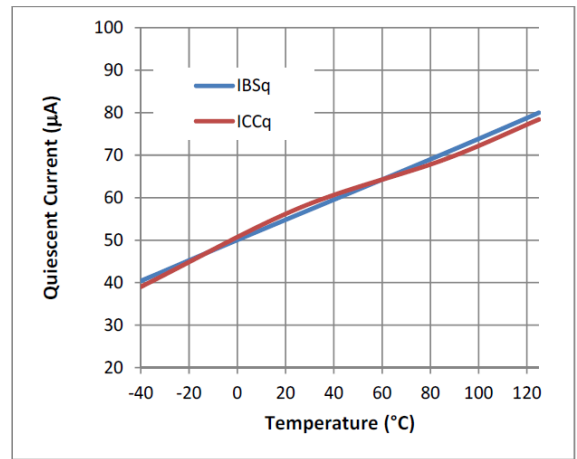


Figure 14. Quiescent Current vs. Temperature

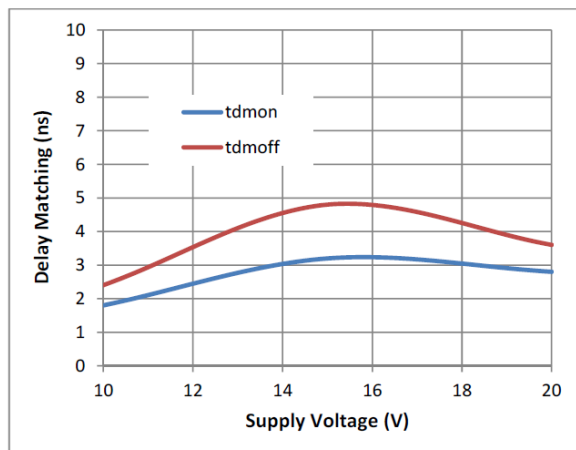


Figure 15. Delay Matching vs. Supply Voltage

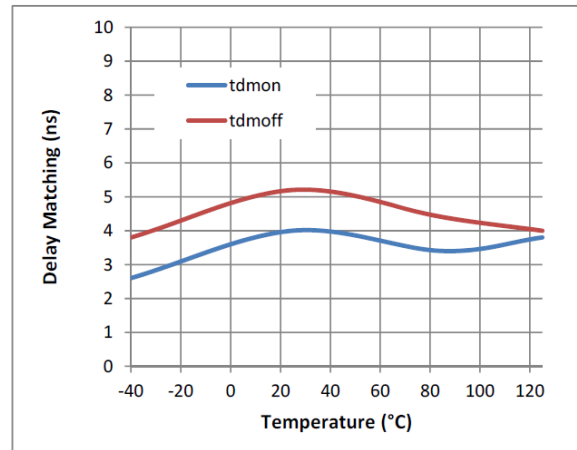


Figure 16. Delay Matching vs. Temperature

Typical Performance Characteristics (cont.)

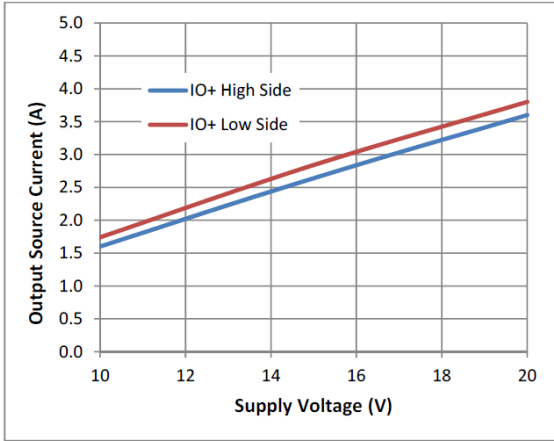


Figure 17. Output Source Current vs. Supply Voltage

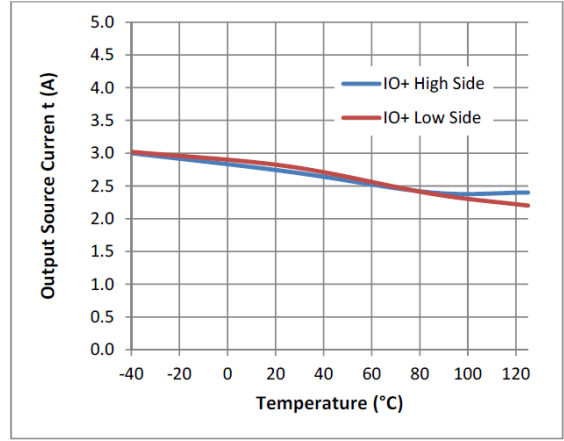


Figure 18. Output Source Current vs. Temperature

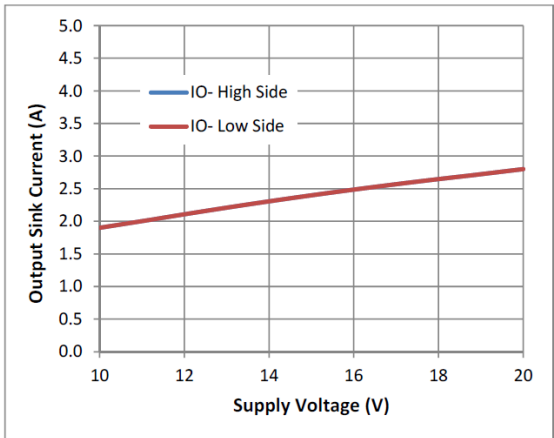


Figure 19. Output Sink Current vs. Supply Voltage

Note: graphs overlap one another

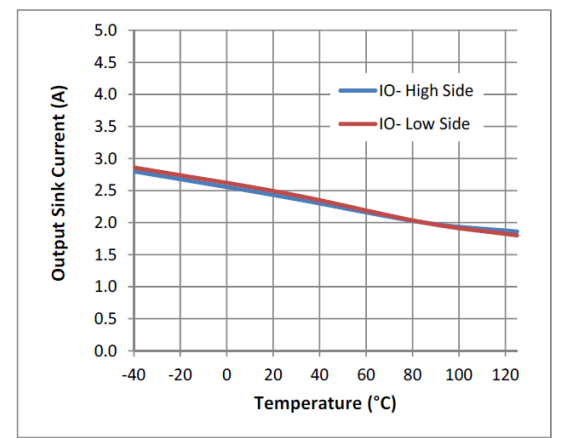


Figure 20. Output Sink Current vs. Temperature

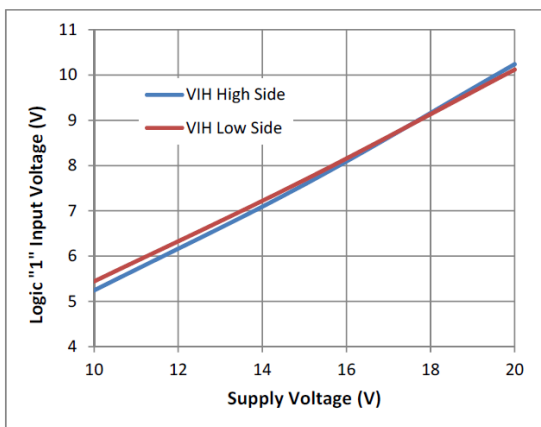


Figure 21. Logic 1 Input Voltage vs. Supply Voltage

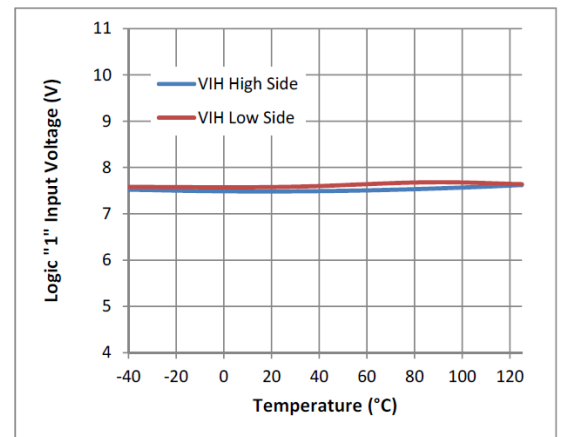


Figure 22. Logic 1 Input Voltage vs. Temperature

Typical Performance Characteristics (cont.)

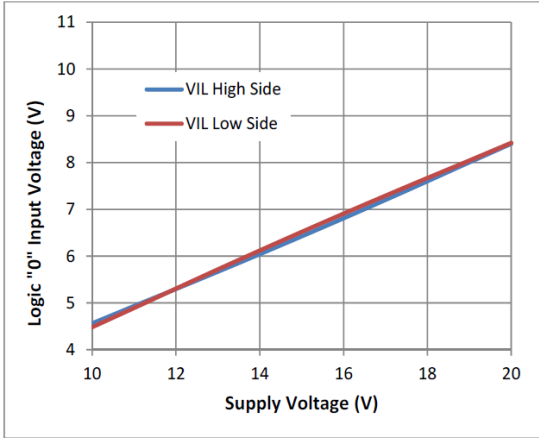


Figure 23. Logic 0 Input Voltage vs. Supply Voltage

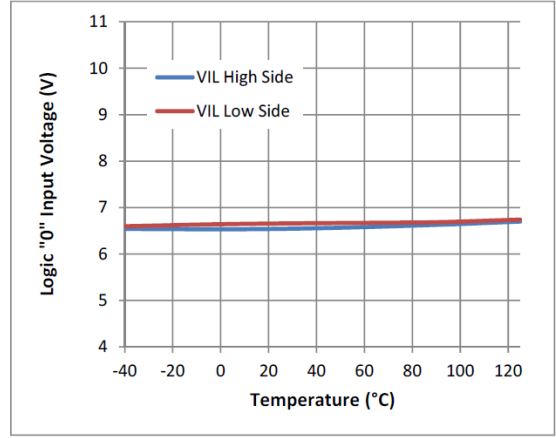


Figure 24. Logic 0 Input Voltage vs. Temperature

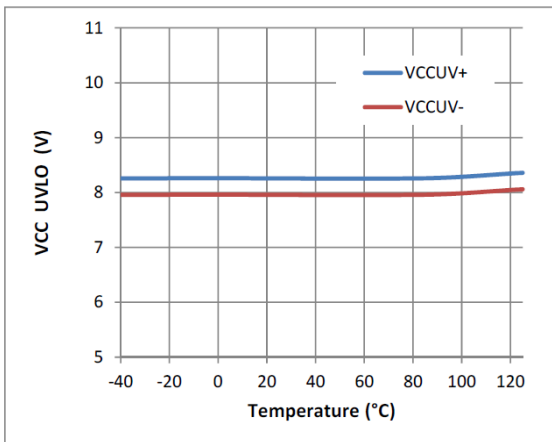


Figure 25. V_{CC} UVLO vs. Temperature

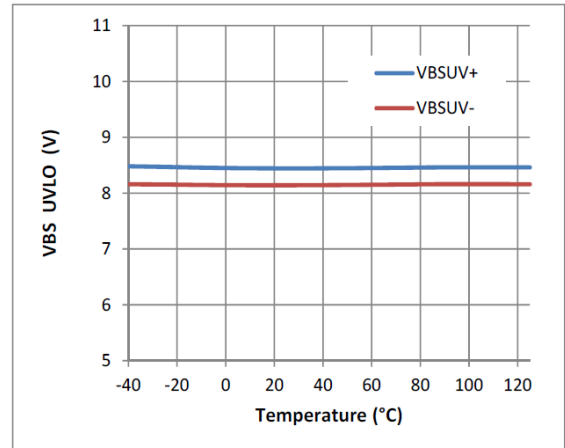


Figure 26. V_{BS} UVLO vs. Temperature

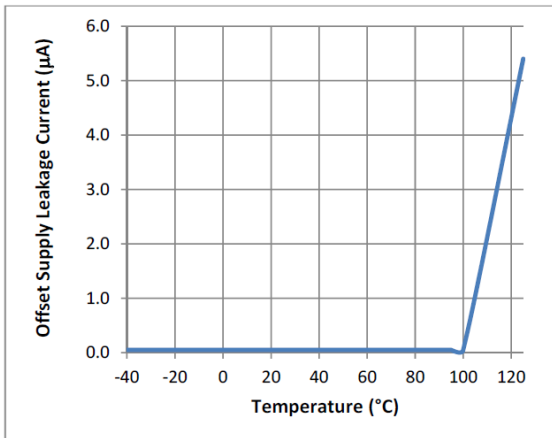


Figure 27. Offset Supply Leakage Current vs. Temperature

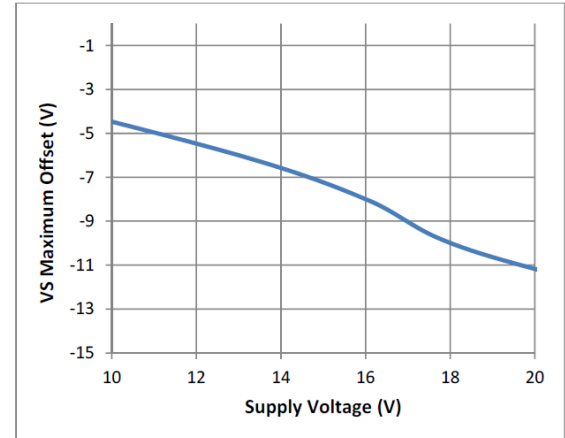


Figure 28. V_S Maximum Offset vs. Supply Voltage

Typical Performance Characteristics (cont.)

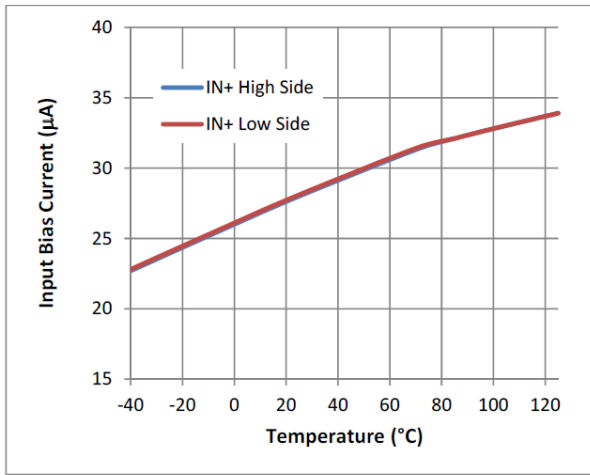


Figure 29. Input Bias Current vs. Temperature

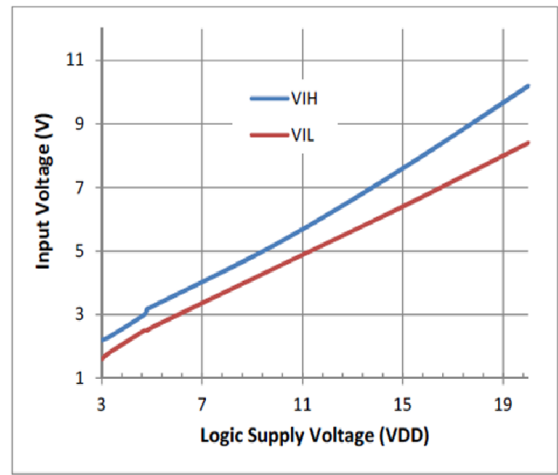


Figure 30. Input Voltage vs. Logic Supply Voltage

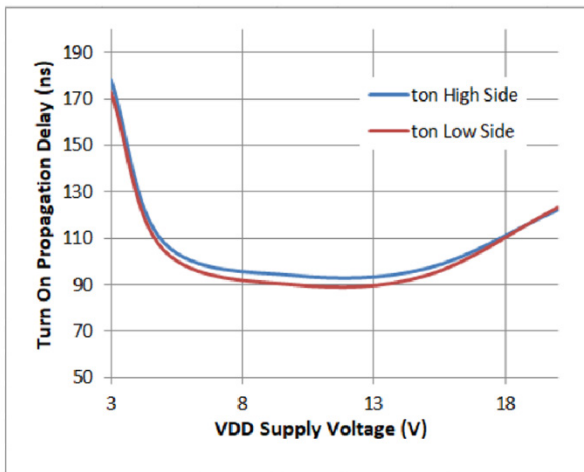


Figure 31. Turn-On Propagation Delay vs. Logic Supply Voltage

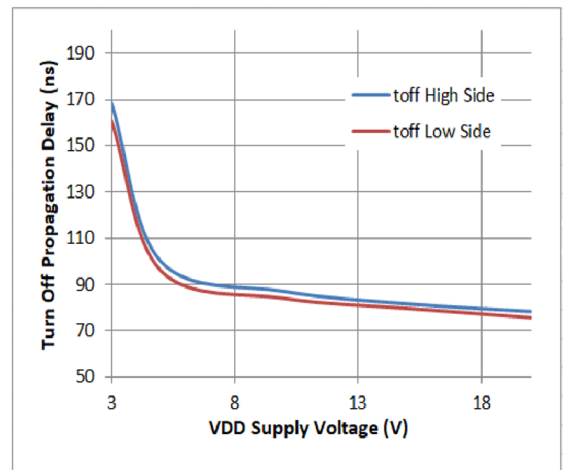


Figure 32. Turn-Off Propagation Delay vs. Logic Supply Voltage

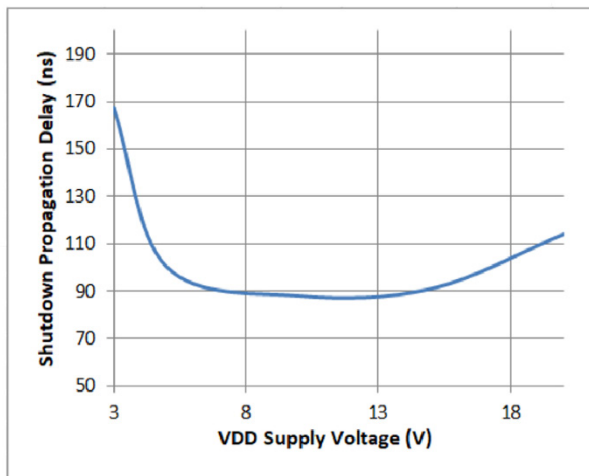
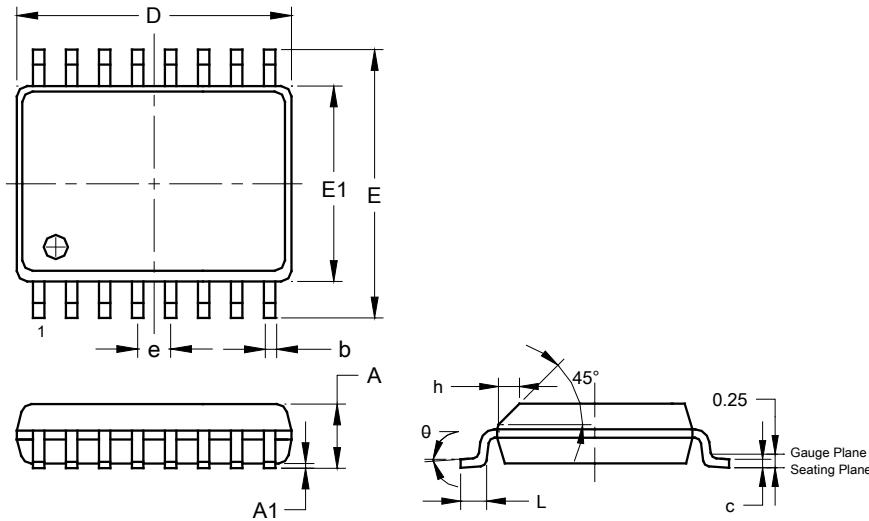


Figure 33. Shutdown Propagation Delay vs. Logic Supply Voltage

Package Outline Dimensions

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

SO-16 (Type TH)

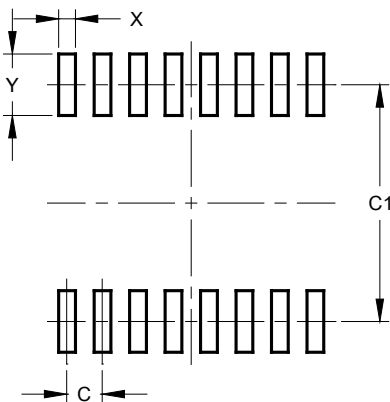


| SO-16 (Type TH) | | | |
|-----------------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | 2.36 | 2.64 | -- |
| A1 | 0.10 | 0.30 | -- |
| b | 0.33 | 0.51 | -- |
| c | 0.229 | 0.318 | -- |
| D | 10.11 | 10.46 | 10.29 |
| E | 10.01 | 10.64 | 10.33 |
| E1 | 7.42 | 7.59 | 7.52 |
| e | -- | -- | 1.27 |
| h | -- | -- | 0.48 |
| L | 0.41 | 1.27 | -- |
| theta | 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.

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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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