# HALF BRIDGE GATE DRIVER IN SO-14

## Description

The DGD21084 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 DGD21084's high-side to switch to 600V in a bootstrap operation.

The DGD21084 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. Programmable dead time, by an external resistor, provides more system level flexibility.

The DGD21084 is offered in SO-14 package, the operating temperature extends from -40°C to +125°C.

## Applications

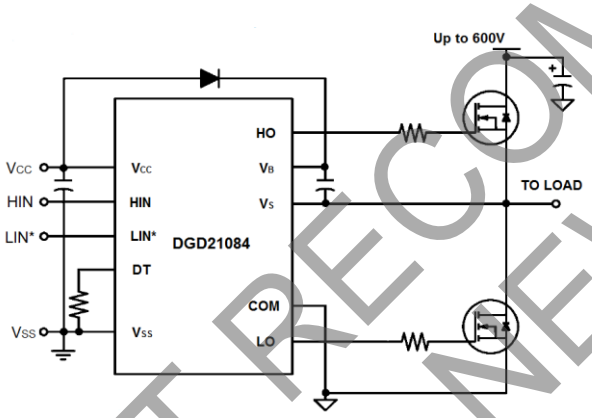
- DC-DC Converters
- DC-AC Inverters
- AC-DC Power Supplies
- Motor Controls
- Class D Power Amplifiers

## Features

- Floating High-Side Driver in Bootstrap Operation to 600V
- Drives Two N-Channel MOSFETs or IGBTs in a Half Bridge Configuation
- Outputs Tolerant to Negative Transients
- Programmable Dead Time to Protect MOSFETs
- Wide Logic and Low-side Gate Driver Supply Voltage: 10V to 20V
- Wide Logic Supply Voltage Offset Voltage: -5V to 5V
- Logic Inputs (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)**

## 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

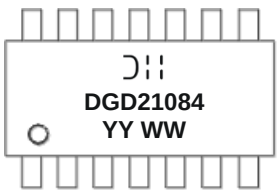
Top View

## Ordering Information (Note 4)

| Product | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---|---|---|---|---|
| DGD21084S14-13 | DGD21084 | 13 | 16 | 2,500 |

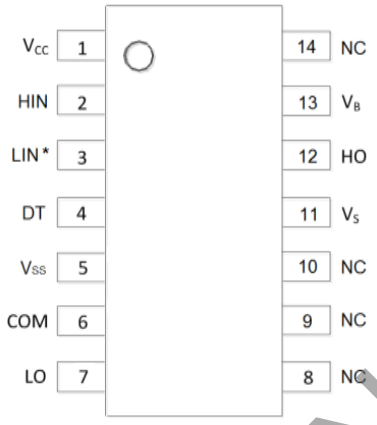
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- 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
DGD21084 = Product Type Marking Code
YY = Year (ex: 19 = 2019)
WW = Week (01 to 53)

## Pin Diagrams

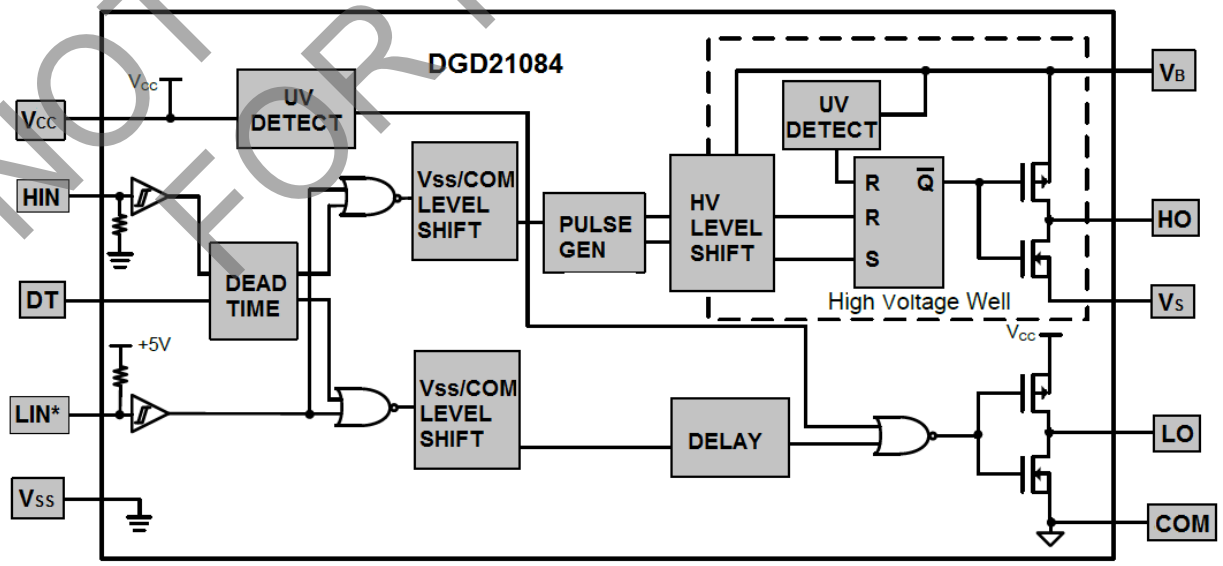



Top View: SO-14

## Pin Descriptions

| Pin Number | Pin Name | Function |
|---|---|---|
| 1 | $V_{CC}$ | Low-side and logic fixed supply |
| 2 | HIN | Logic input for high-side gate driver output, in phase with HO (Referenced to $V_{SS}$) |
| 3 | LIN* | Logic input for low-side gate driver output, out of phase with LO (Referenced to $V_{SS}$) |
| 4 | DT | Programmable dead time lead, referenced to $V_{SS}$ |
| 5 | $V_{SS}$ | Logic ground |
| 6 | COM | Low-side return |
| 7 | LO | Low-side gate drive output |
| 8, 9, 10, 14 | NC | No Connect (No Internal Connection) |
| 11 | $V_S$ | High-side floating supply return |
| 12 | HO | High-side gate drive output |
| 13 | $V_B$ | High-side floating supply |

## Functional Block Diagram



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

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| High-side Floating Supply Voltage | $V_B$ | -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 $V_B$+0.3 | V |
| Offset Supply Voltage Transient | $dV_S$ / dt | 50 | V/ns |
| Programmable Dead Time Pin Voltage | $V_{DT}$ | $V_{SS}$-0.3 to $V_B$+0.3 | V |
| 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 | $V_{CC}$ | -0.3 to $V_{SS}$+24 | V |
| Logic Supply Offset Voltage | $V_{SS}$ | $V_{CC}$-25 to $V_{CC}$+0.3 | V |
| Logic Input Voltage (HIN and LIN*) | $V_{IN}$ | $V_{SS}$-0.3 to $V_{CC}$+0.3 | V |

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

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation Linear Derating Factor (Note 5) | $P_D$ | 1.0 | W |
| Thermal Resistance, Junction to Ambient (Note 5) | $R_{\theta JA}$ | 120 | °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 Absolute Voltage | $V_B$ | $V_S$ + 10 | $V_S$ + 20 | 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 Input Voltage (HIN & LIN*) | $V_{IN}$ | $V_{SS}$ | $V_{CC}$ | V |
| Programmable Dead Time Pin Voltage | $V_{DT}$ | $V_{SS}$ | $V_{CC}$ | V |
| Logic Ground | $V_{SS}$ | -5 | 5 | V |
| Ambient Temperature | $T_A$ | -40 | +125 | °C |

Note: 6. Logic operation for $V_S$ = -5V to +600V.

## DC Electrical Characteristics ($V_{BIAS}$ ($V_{CC}$, $V_{BS}$) = 15V, $V_{SS}$ = COM, @$T_A$ = +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) | $V_{IL}$ | – | – | 0.6 | V | $V_{CC}$ = 10V to 20V |
| High-level Output Voltage, $V_{BIAS}$ - $V_O$ | $V_{OH}$ | – | 0.02 | 0.2 | V | $I_O$ = 2mA |
| Low-level Output Voltage, $V_O$ | $V_{OL}$ | – | 0.02 | 0.1 | V | $I_O$ = 2mA |
| Offset Supply Leakage Current | $I_{LK}$ | – | – | 50 | µA | $V_B$ = $V_S$ = 600V |
| Quiescent $V_{BS}$ Supply Current | $I_{BSQ}$ | 20 | 75 | 130 | µA | $V_{IN}$ = 0V or 5V |
| Quiescent $V_{CC}$ Supply Current | $I_{CCQ}$ | 0.4 | 1.0 | 1.6 | mA | $V_{IN}$ = 0V or 5V, $R_{DT}$ = 0Ω |
| Logic "1" Input Bias Current | $I_{IN+}$ | – | 5 | 20 | µA | HIN = 5V, LIN* = 0V |
| Logic "0" Input Bias Current | $I_{IN-}$ | – | – | 5 | µA | HIN = 0V, LIN* = 5V |
| $V_{BS}$ Supply Under-voltage Positive Going Threshold | $V_{BSUV+}$ | 8.0 | 8.9 | 9.8 | V | – |
| $V_{BS}$ Supply Under-voltage Negative Going Threshold | $V_{BSUV-}$ | 7.4 | 8.2 | 9.0 | V | – |
| $V_{CC}$ Supply Under-voltage Positive Going Threshold | $V_{CCUV+}$ | 8.0 | 8.9 | 9.8 | V | – |
| $V_{CC}$ Supply Under-voltage Negative Going Threshold | $V_{CCUV-}$ | 7.4 | 8.2 | 9.0 | V | – |
| Hysteresis | $V_{CCUV+}$ | 0.3 | 0.7 | – | V | – |
| | $V_{BSUV+}$ | | | | | – |
| Output High Short Circuit Pulsed Current | $I_{O+}$ | 120 | 200 | – | mA | $V_O$ = 0V, PW ≤ 10µs |
| Output Low Short Circuit Pulsed Current | $I_{O-}$ | 250 | 600 | – | mA | $V_O$ = 15V, PW ≤ 10µs |

Note: 7. The $V_{IN}$ and $I_{IN}$ parameters are referenced to $V_{SS}$ and are applicable to the two logic input pins: HIN and LIN*. The $V_O$ and $I_O$ parameters are referenced to COM and 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 an minimum amplitude of 2.5V with a minimum pulse width of 2 x Deadtime.

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

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Turn-on Propagation Delay | $t_{ON}$ | – | 220 | 300 | ns | $V_S$ = 0V |
| Turn-off Propagation Delay | $t_{OFF}$ | – | 200 | 280 | ns | $V_S$ = 0V or 600V |
| Delay Matching, \| $t_{ON}$ - $t_{OFF}$\| | $t_{DMON}$ | – | 0 | 30 | ns | – |
| Turn-on Rise Time | $t_R$ | – | 100 | 220 | ns | $V_S$ = 0V |
| Turn-off Fall Time | $t_F$ | – | 35 | 80 | ns | $V_S$ = 0V |
| Deadtime: $t_{DT\ LO\text{-}HO}$ & $t_{DT\ HO\text{-}LO}$ | $t_{DT}$ | 400 | 540 | 680 | ns | $R_{DT}$ = 0Ω |
| | | 4 | 5 | 6 | us | $R_{DT}$ = 200kΩ (Note 9) |
| Deadtime Matching = $t_{DT\ LO\text{-}HO}$ - $t_{DT\ HO\text{-}LO}$ | $t_{MDT}$ | – | 0 | 60 | ns | $R_{DT}$ = 0Ω |
| | | – | 0 | 600 | ns | $R_{DT}$ = 200kΩ |

Note: 9. Guaranted by design, not tested in production.

## Timing Waveforms

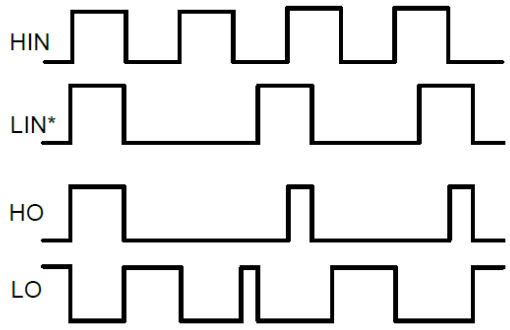



**Figure 1.** Input / Output Timing Diagram

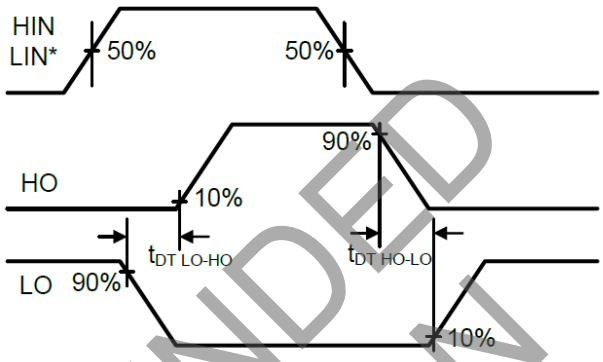



**Figure 2.** Deadtime Waveform Definitions

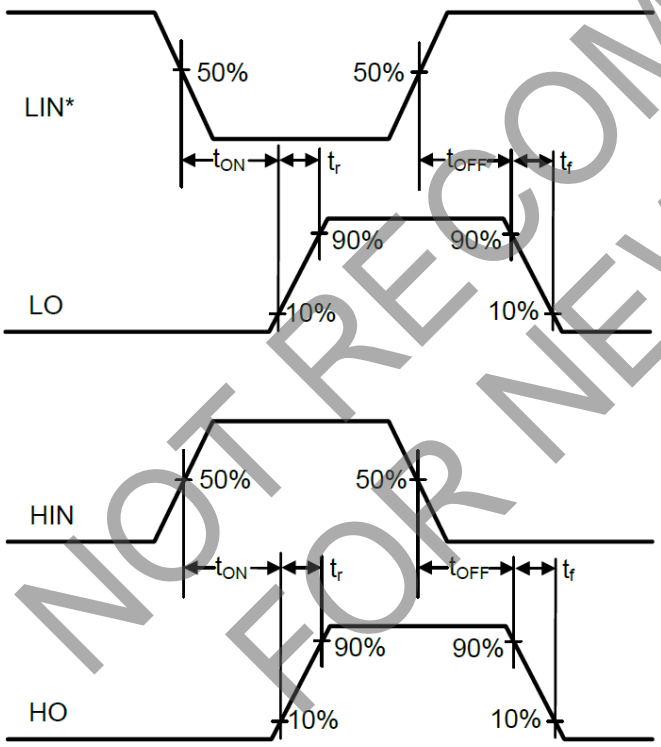



**Figure 3.** Switching Time Waveform Definitions

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

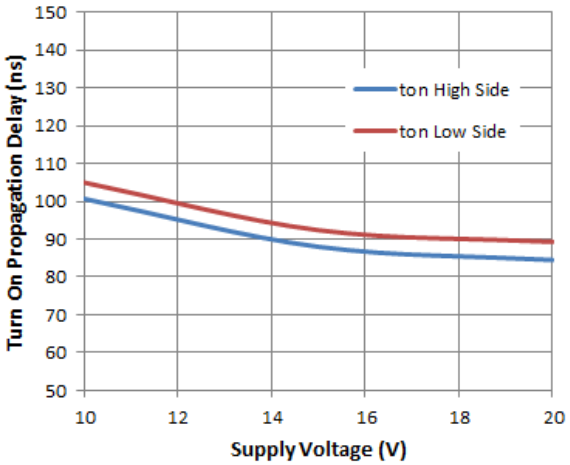



**Figure 4.** Turn-on Propagation Delay vs. Supply Voltage

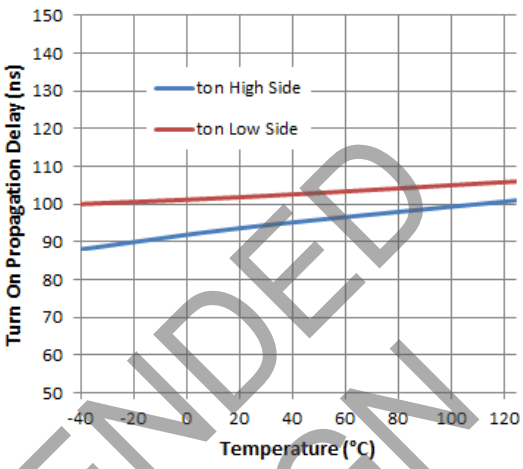



**Figure 5.** Turn-on Propagation Delay vs. Temperature

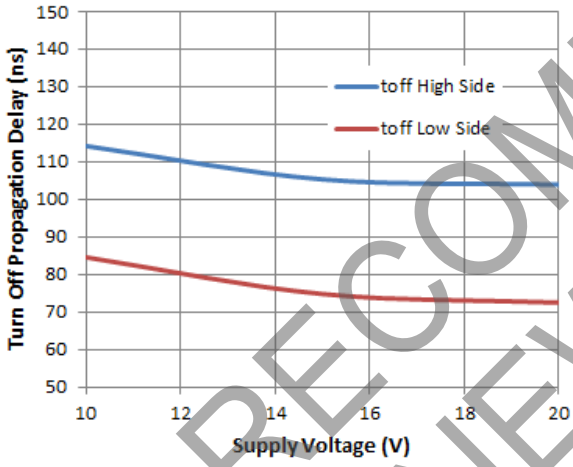



**Figure 6.** Turn-off Propagation Delay vs. Supply Voltage

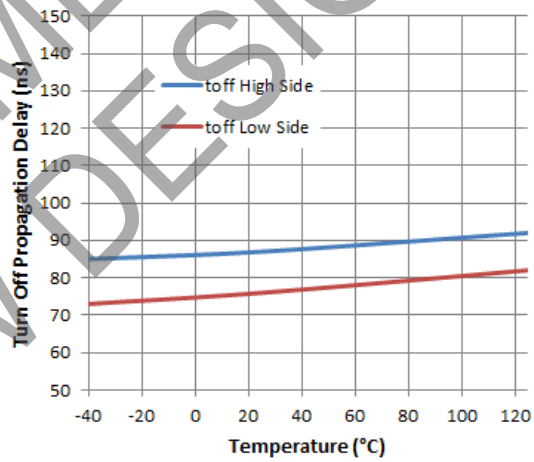



**Figure 7.** Turn-off Propagation Delay vs. Temperature

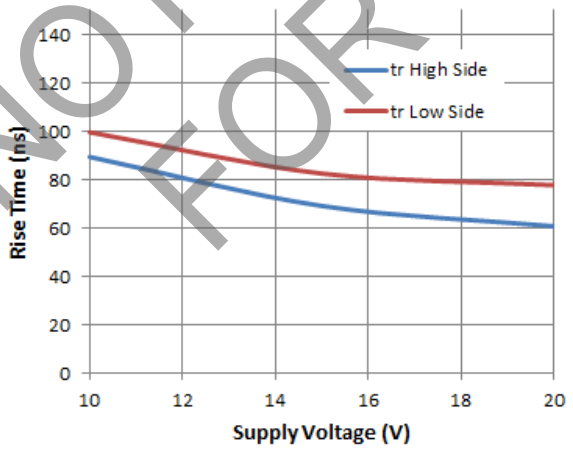



**Figure 8.** Rise Time vs. Supply Voltage

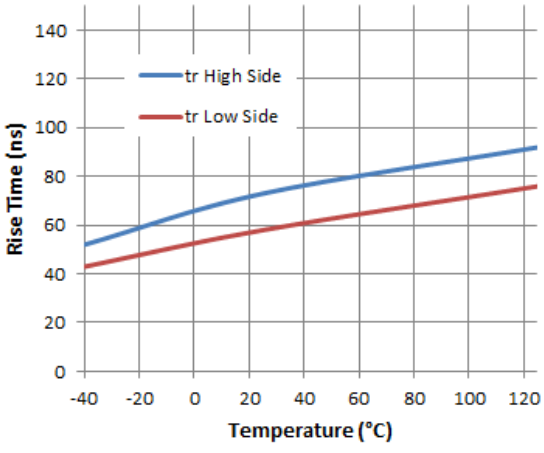



**Figure 9.** Rise Time vs. Temperature

## Typical Performance Characteristics (continued)

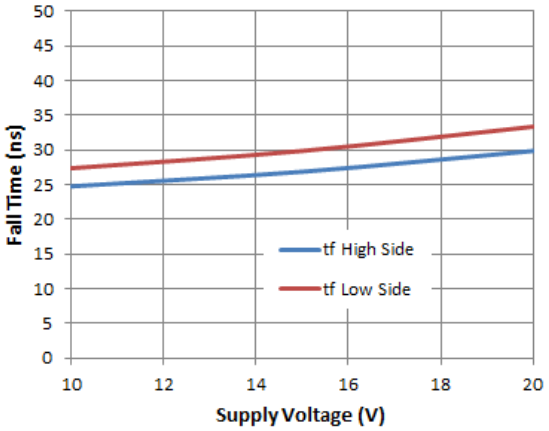



**Figure 10.** Fall Time vs. Supply Voltage

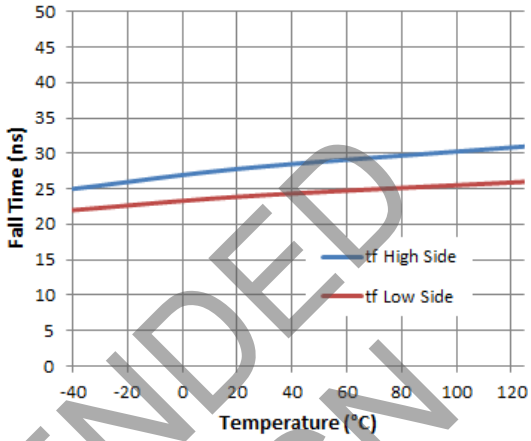



**Figure 11.** Fall Time vs. Temperature

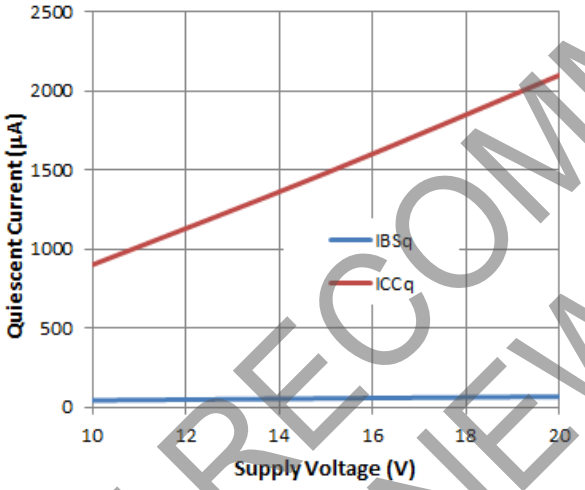



**Figure 12.** Quiescent Current vs. Supply Voltage

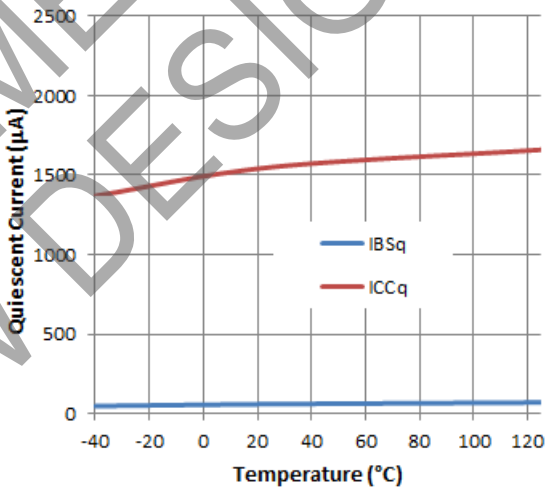



**Figure 13.** Quiescent Current vs. Temperature

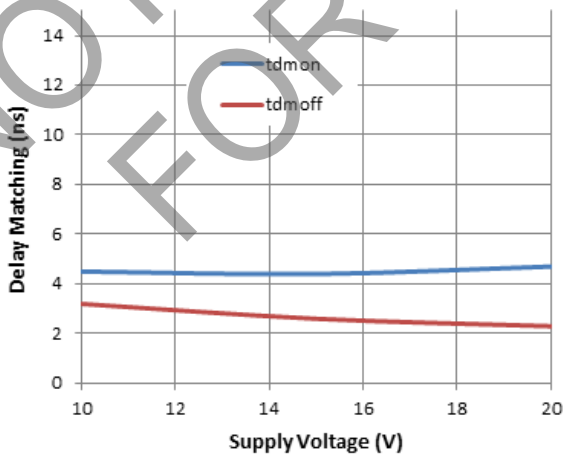



**Figure 14.** Delay Matching vs. Supply Voltage

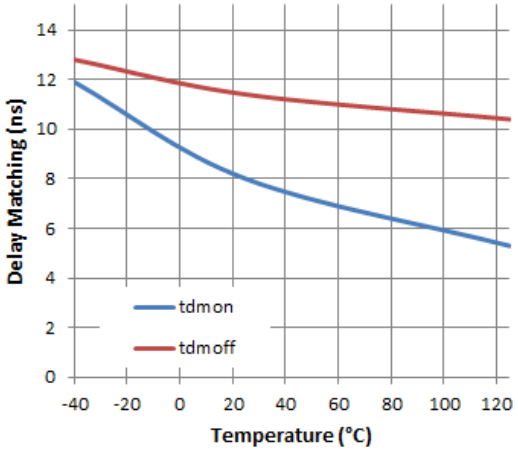



**Figure 15.** Delay Matching vs. Temperature

## Typical Performance Characteristics (continued)

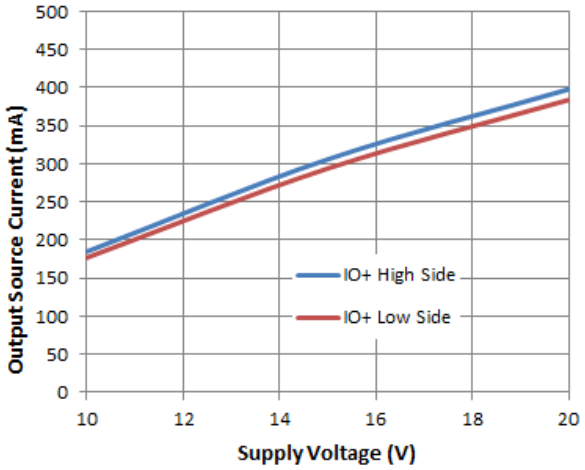



**Figure 16.** Output Source Current vs. Supply Voltage

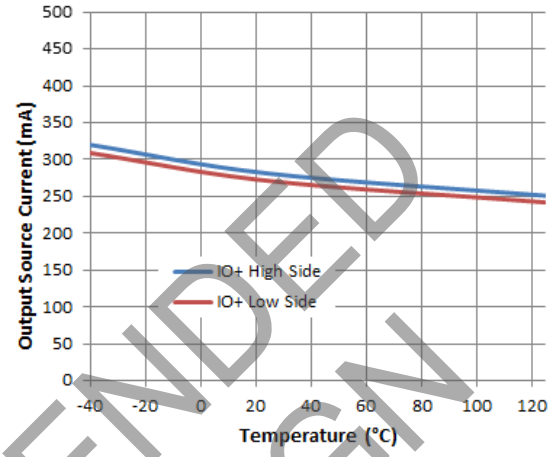



**Figure 17.** Output Source Current vs. Temperature

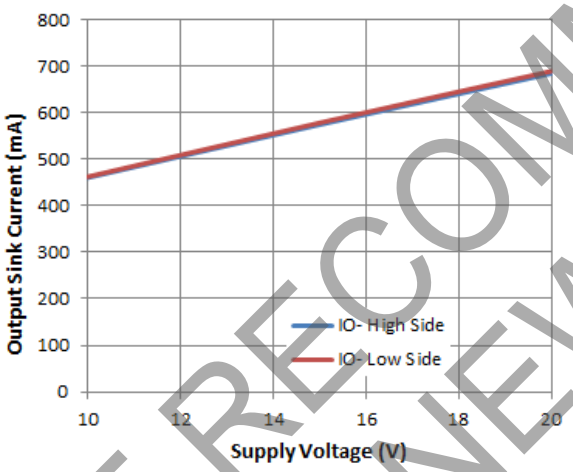



**Figure 18.** Output Sink Current vs. Supply Voltage

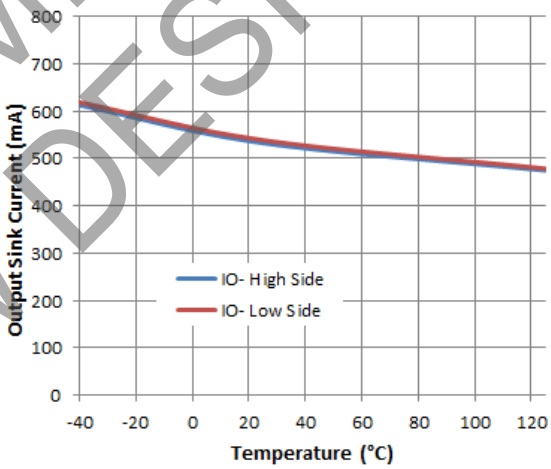



**Figure 19.** Output Sink Current vs. Temperature

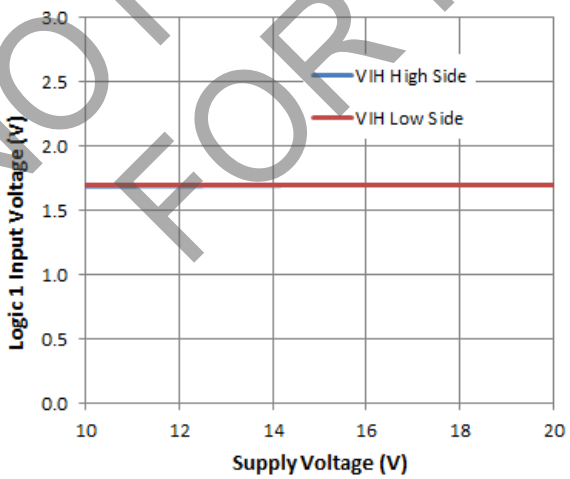



**Figure 20.** Logic 1 Input Voltage vs. Supply Voltage

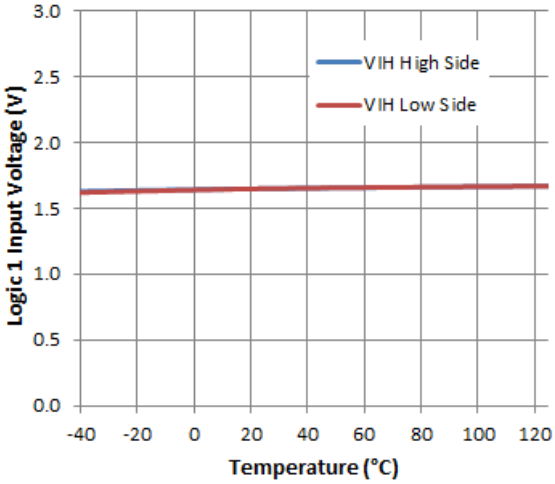



**Figure 21.** Logic 1 Input Voltage vs. Temperature

## Typical Performance Characteristics (continued)

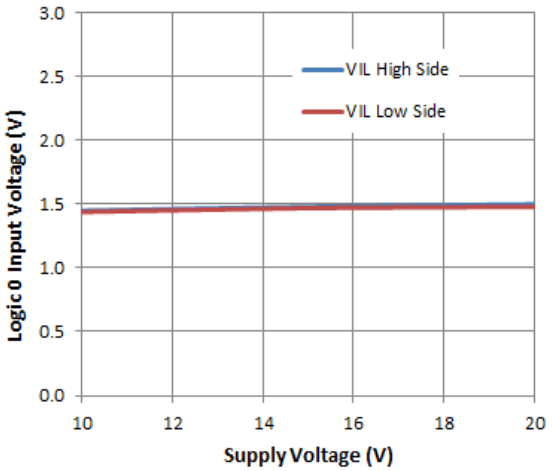



**Figure 22.** Logic 0 Input Voltage vs. Supply Voltage

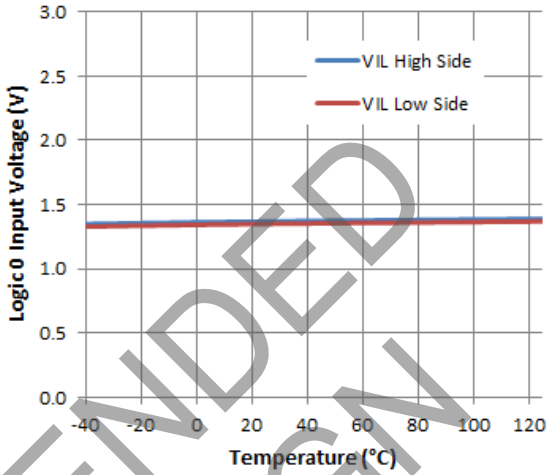



**Figure 23.** Logic 0 Input Voltage vs. Temperature

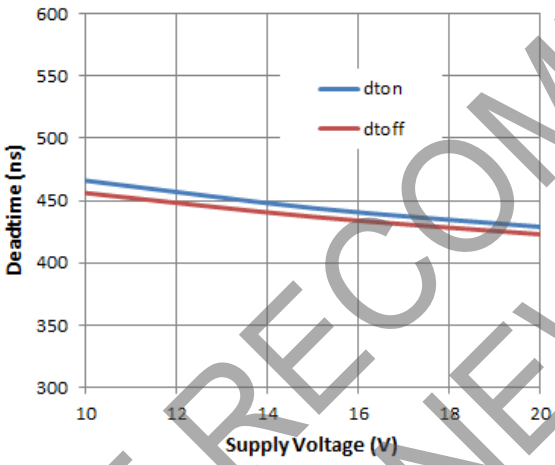



**Figure 24.** Deadtime vs. Supply Voltage

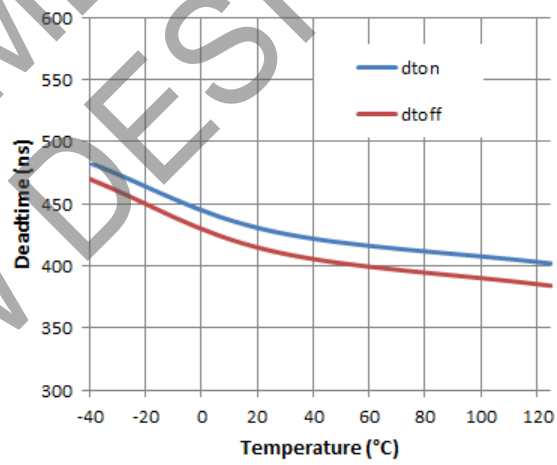



**Figure 25.** Deadtime vs. Temperature

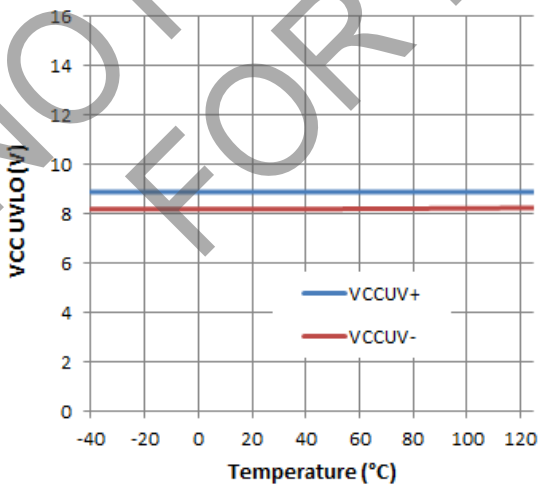



**Figure 26.** VCC UVLO vs. Temperature

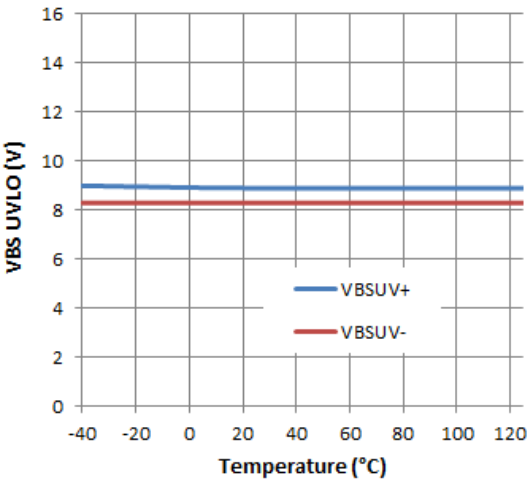



**Figure 27.** VBS UVLO vs. Temperature

## Typical Performance Characteristics (continued)

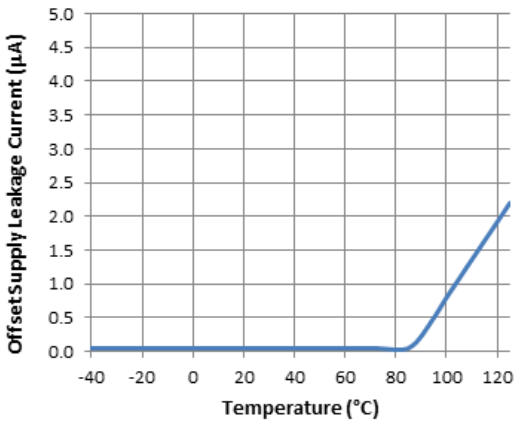
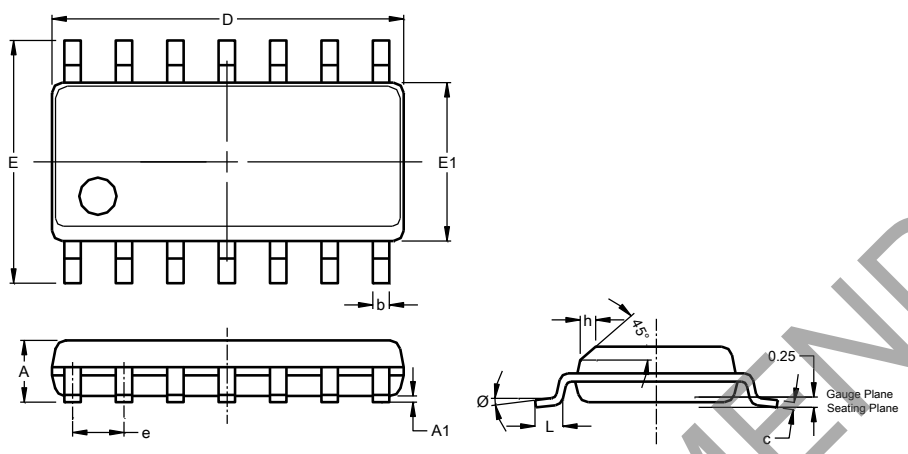



**Figure 28.** Offset Supply Leakage Current vs. Temperature

## Package Outline Dimensions

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

**SO-14 (Type TH)**

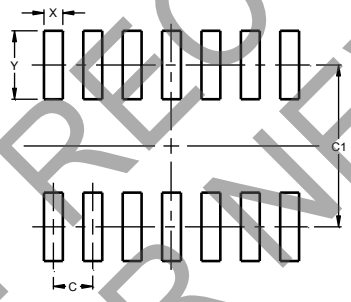



| SO-14 (Type TH) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 1.55 | 1.73 | -- |
| **A1** | 0.10 | 0.25 | -- |
| **b** | 0.35 | 0.51 | -- |
| **c** | 0.190 | 0.248 | -- |
| **D** | 8.56 | 8.74 | 8.61 |
| **E** | 5.84 | 6.20 | 6.00 |
| **E1** | 3.81 | 3.99 | 3.94 |
| **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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