

HIGH FREQUENCY HIGH-SIDE AND LOW-SIDE GATE DRIVER IN U-DFN3030-10
Description

The DGD05473 is a high-frequency gate driver capable of driving N-channel MOSFETs. The floating high-side driver is rated up to 50V.

The DGD05473 logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with MCUs. UVLO for high-side and low-side protects a MOSFET with loss of supply. To protect MOSFETs, cross conduction prevention logic prevents the HO and LO outputs from being on at the same time.

Fast and well-matched propagation delays allow a higher switching frequency, enabling a smaller, more compact power switching design, using smaller associated components. To minimize space an internal bootstrap diode is included. The DGD05473 is offered in the U-DFN3030-10 package and operates over an extended -40°C to +125°C temperature range.

Applications

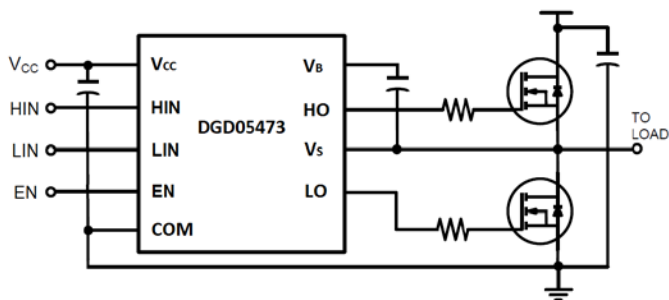
- DC-DC Converters
- Motor Controls
- Battery Powered Hand Tools
- eCig Devices
- Class D Power Amplifiers

Features

- 50V Floating High-Side Driver
- Drives Two N-Channel MOSFETs in a Half-Bridge Configuration
- 1.5A Source / 2.5A Sink Output Current Capability
- Internal Bootstrap Diode Included
- Undervoltage Lockout for High-Side and Low-Side Drivers
- Delay Matching Maximum of 5ns
- Propagation Delay Typical of 20ns
- Logic Input (HIN, LIN and EN) 3.3V Capability
- Ultra Low Standby Currents (<1µA)
- 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)**
- **Qualified to AEC-Q100 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

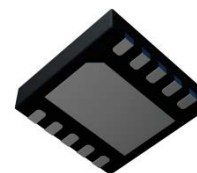
- Case: U-DFN3030-10
- Case Material: Molded Plastic. "Green" Molding Compound
- UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 3 per J-STD-020
- Terminals: Finish—NiPdAu
- Solderable per MIL-STD-202, Method 208
- Weight: 0.017 grams (Approximate)



Typical Configuration



Top View



Bottom View

Ordering Information (Note 4 & 5)

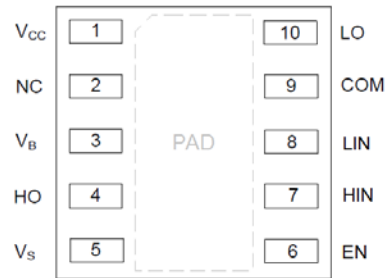
| Product | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---------------|------------|----------|--------------------|-----------------|-------------------|
| DGD05473FNQ-7 | Automotive | DGD05473 | 7 | 8 | 3000 |

- 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. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to http://www.diodes.com/quality/product_compliance_definitions/.
 5. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Marking Information


DGD05473 = Product Type Marking Code
 YY = Year (ex: 18 = 2018)
 WW = Week (01 to 53)

Pin Assignments

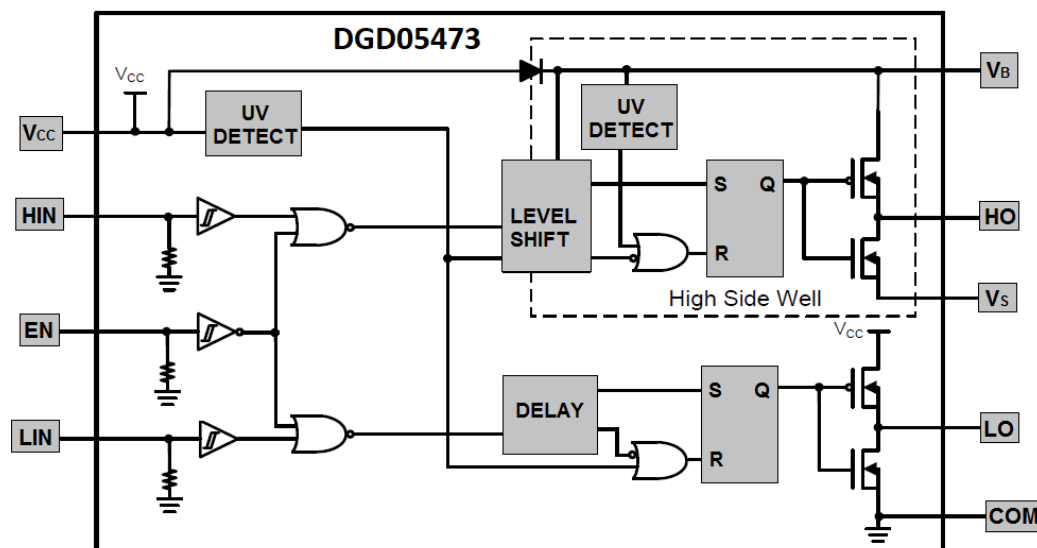


Top View: U-DFN3030-10

Pin Descriptions

| Pin Number | Pin Name | Function |
|------------|-----------------|---|
| 1 | V _{CC} | Low-Side and Logic Supply |
| 2 | NC | No connect (No Internal Connection) |
| 3 | V _B | High-Side Floating Supply |
| 4 | HO | High-Side Gate Drive Output |
| 5 | V _S | High-Side Floating Supply Return |
| 6 | EN | Logic Input Enable, a Logic Low turns off Gate Driver |
| 7 | HIN | Logic Input for High-Side Gate Driver, in Phase with HO |
| 8 | LIN | Logic Input for Low-Side Gate Driver, in Phase with LO |
| 9 | COM | Low-Side and Logic Return |
| 10 | LO | Low-Side Gate Drive Output |
| PAD | Substrate | Connect to COM on PCB |

Functional Block Diagram



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

| Characteristic | Symbol | Value | Unit |
|--|----------------------|--|------|
| High-Side Floating Positive Supply Voltage | V _B | -0.3 to +60 | V |
| High-Side Floating Negative Supply Voltage | V _S | V _B -14 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 |
| Logic and Low-Side Fixed Supply Voltage | V _{CC} | -0.3 to +14 | V |
| Low-Side Output Voltage | V _{LO} | -0.3 to V _{CC} +0.3 | V |
| Logic Input Voltage (HIN, LIN and EN) | V _{IN} | -0.3 to V _{CC} +0.3 | V |
| Bootstrap Diode Current (Pulsed <10μs) | I _{BD} | 1 | A |

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

| Characteristic | Symbol | Value | Unit |
|---|------------------|-------------|------|
| Power Dissipation Linear Derating Factor (Note 5) | P _D | 0.4 | W |
| Thermal Resistance, Junction to Ambient (Note 5) | R _{θJA} | 64 | °C/W |
| Thermal Resistance, Junction to Case (Note 5) | R _{θJC} | 42 | °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 | V _B | V _S + 4.4 | V _S + 14 | V |
| High-Side Floating Supply Offset Voltage | V _S | (Note 6) | 50 (Note 7) | V |
| High-Side Floating Output Voltage | V _{HO} | V _S | V _B | V |
| Logic and Low Side Fixed Supply Voltage | V _{CC} | 4.7 (Note 8) | 14 | V |
| Low-Side Output Voltage | V _{LO} | 0 | V _{CC} | V |
| Logic Input Voltage (HIN, LIN and EN) | V _{IN} | 0 | 5 | V |
| Ambient Temperature | T _A | -40 | +125 | °C |

Notes: 6. Logic operation for V_S of -5V to +50V.

7. Provided V_B doesn't exceed absolute maximum rating of 60V.

8. For operation of V_{CC} = 4.7V to 4.9V, an external bootstrap Schottky diode (0.3V V_{fd}, 1A) is necessary, see Figure 4. For operation V_{CC} ≥ 4.9V, the external Schottky diode is not required.

DC Electrical Characteristics ($V_{CC} = V_{BS} = 12V$, $COM = V_S = 0V$, $@T_A = +25^\circ C$, unless otherwise specified.) (Note 9)

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---|---------------|-----|------|------|---------|---------------------------------------|
| Logic "1" Input Voltage | V_{IH} | 2.4 | — | — | V | — |
| Logic "0" Input Voltage | V_{IL} | — | — | 0.8 | V | — |
| Enable Logic "1" Input Voltage | V_{ENIH} | 1.6 | — | — | V | — |
| Enable Logic "0" Input Voltage | V_{ENIL} | — | — | 0.7 | V | — |
| Input Voltage Hysteresis | V_{INHYS} | — | 0.6 | — | V | — |
| Enable Input Voltage Hysteresis | $V_{ENINHYS}$ | — | 0.1 | — | V | — |
| High Level Output Voltage, $V_{BIAS} - V_O$ | V_{OH} | — | 0.45 | 0.6 | V | $I_{O+} = 100mA$ |
| Low Level Output Voltage, V_O | V_{OL} | — | 0.15 | 0.22 | V | $I_{O-} = 100mA$ |
| Offset Supply Leakage Current | I_{LK} | — | 1 | 5 | μA | $V_B = V_S = 60V$ |
| V_{CC} Shutdown Supply Current | I_{CCSD} | — | 0 | 1 | μA | $V_{IN} = 0V$ or $5V$, $V_{EN} = 0V$ |
| V_{CC} Quiescent Supply Current | I_{CCQ} | — | 130 | 200 | μA | $V_{IN} = 0V$ or $5V$ |
| V_{CC} Operating Supply Current | I_{CCOP} | — | 7.3 | — | mA | $f_s = 500kHz$, $C_L = 1000pF$ |
| V_{BS} Quiescent Supply Current | I_{BSQ} | — | 40 | 100 | μA | $V_{IN} = 0V$ or $5V$ |
| V_{BS} Operating Supply Current | I_{BSOP} | — | 7.3 | — | mA | $f_s = 500kHz$, $C_L = 1000pF$ |
| Logic "1" Input Bias Current | I_{IN+} | — | — | 50 | μA | $V_{IN} = 5V$ |
| Logic "0" Input Bias Current | I_{IN-} | — | — | 5 | μA | $V_{IN} = 0V$ |
| Enable Logic "1" Input Bias Current | I_{ENIN+} | — | 43 | 60 | μA | $V_{IN} = 5V$ |
| Enable Logic "0" Input Bias Current | I_{ENIN-} | — | 0 | 5 | μA | $V_{IN} = 0V$ |
| V_{BS} Supply Undervoltage Positive Going Threshold | V_{BSUV+} | 3.3 | 3.8 | 4.4 | V | — |
| V_{BS} Supply Undervoltage Negative Going Threshold | V_{BSUV-} | 2.9 | 3.3 | 3.9 | V | — |
| V_{CC} Supply Undervoltage Positive Going Threshold | V_{CCUV+} | 3.3 | 3.8 | 4.4 | V | — |
| V_{CC} Supply Undervoltage Negative Going Threshold | V_{CCUV-} | 2.9 | 3.3 | 3.9 | V | — |
| Output High Short Circuit Pulsed Current | I_{O+} | 1.0 | 1.5 | — | A | $V_O = 0V$, $PW \leq 10\mu s$ |
| Output Low Short Circuit Pulsed Current | I_{O-} | 1.9 | 2.5 | — | A | $V_O = 15V$, $PW \leq 10\mu s$ |
| Forward Voltage of Bootstrap Diode | V_{F1} | — | 0.67 | — | V | $I_F = 100\mu A$ |
| Forward Voltage of Bootstrap Diode | V_{F2} | — | 1.2 | — | V | $I_F = 100mA$ |

Note: 9. The V_{IN} and I_{IN} parameters are applicable to the logic pins: HIN, LIN and EN. The V_O and I_O parameters are applicable to the respective output pins: HO and LO.

AC Electrical Characteristics ($V_{CC} = V_{BS} = 12V$, $COM = V_S = 0V$, $C_L = 1000pF$, $@T_A = +25^\circ C$, unless otherwise specified.)

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---------------------------------|-----------|-----|-----|-----|------|-------------|
| Turn-on Propagation Delay | t_{ON} | — | 20 | 35 | ns | — |
| Turn-off Propagation Delay | t_{OFF} | — | 23 | 56 | ns | $V_S = 50V$ |
| Delay Matching, HO & LO Turn-on | t_{DM} | — | — | 5 | ns | — |
| Turn-on Rise Time | t_r | — | 16 | 30 | ns | — |
| Turn-off Fall Time | t_f | — | 12 | 25 | ns | — |

Timing Waveforms

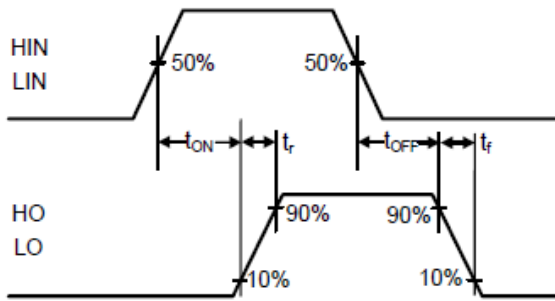


Figure 1. Switching Time Waveform Definitions

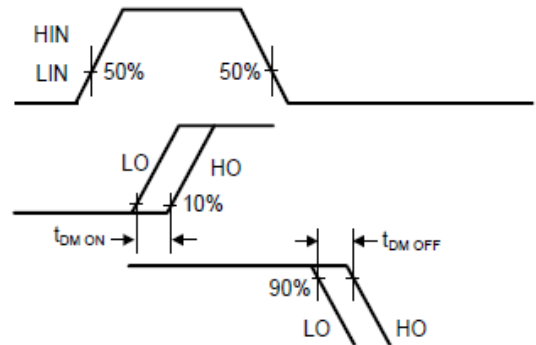


Figure 2. Delay Matching Waveform Definitions

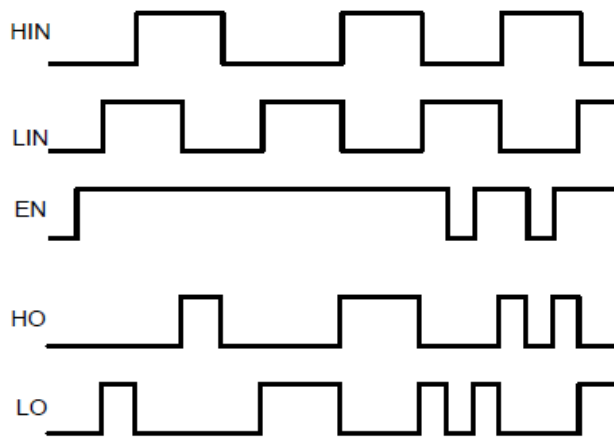


Figure 3. Input / Output Timing Diagram

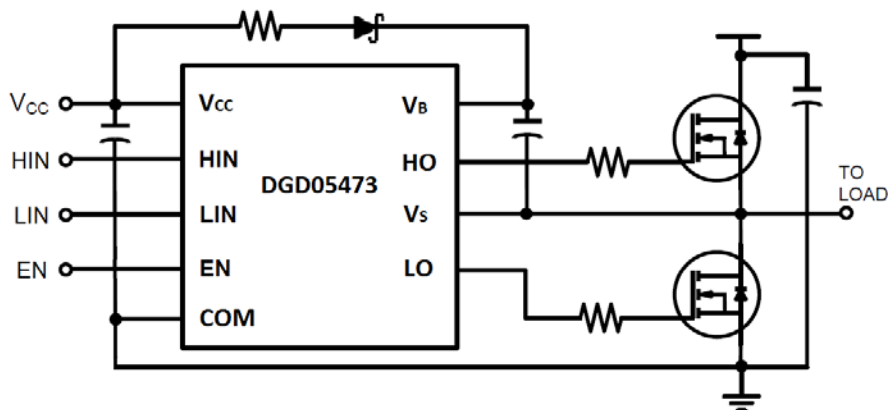


Figure 4. Typical application necessary for $V_{CC} = 4.7V$ to $4.9V$ operation. For $V_{CC} \geq 4.9V$, the bootstrap Schottky diode (0.3V Voltage drop, 1A) and resistor are not required.

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

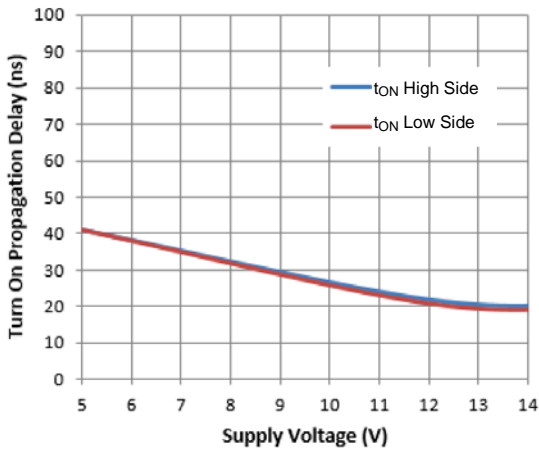


Figure 5. Turn-on Propagation Delay vs. Supply Voltage

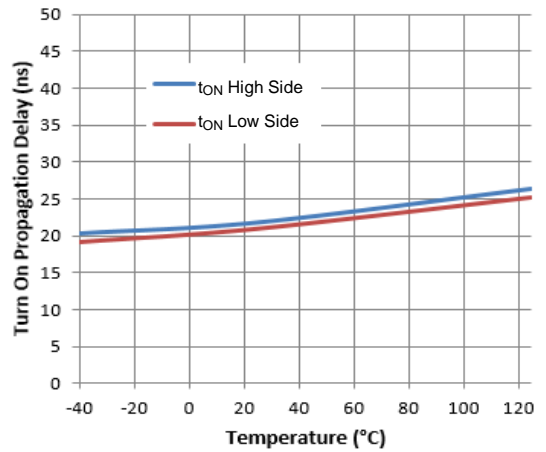


Figure 6. Turn-on Propagation Delay vs. Temperature

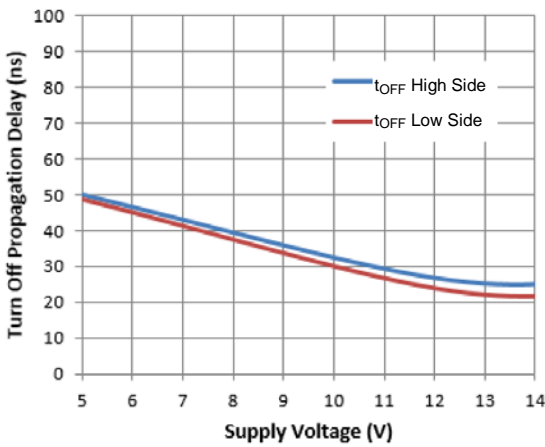


Figure 7. Turn-off Propagation Delay vs. Supply Voltage

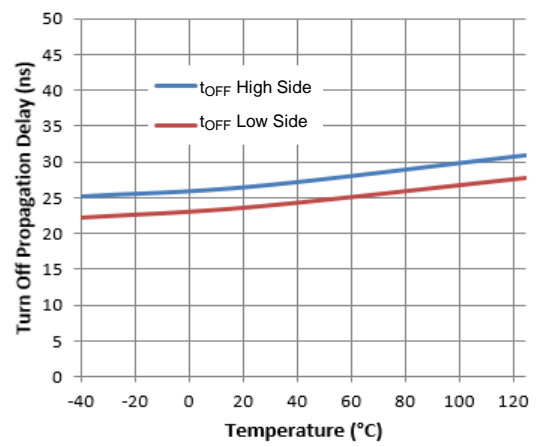


Figure 8. Turn-off Propagation Delay vs. Temperature

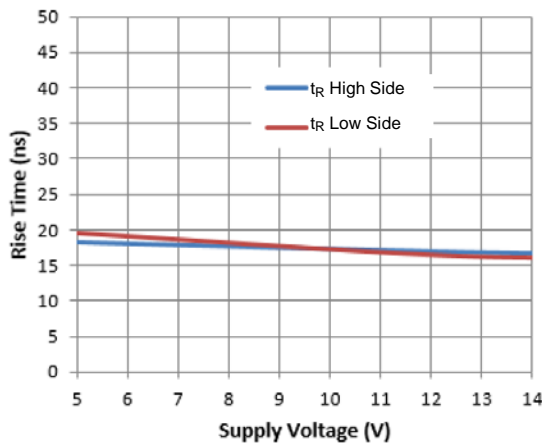


Figure 9. Rise Time vs. Supply Voltage

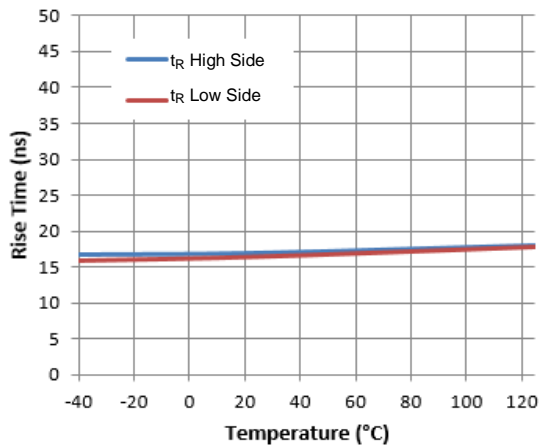


Figure 10. Rise Time vs. Temperature

Typical Performance Characteristics (continued)

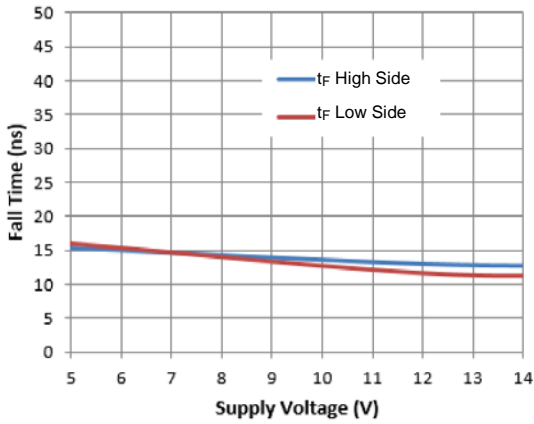


Figure 11. Fall Time vs. Supply Voltage

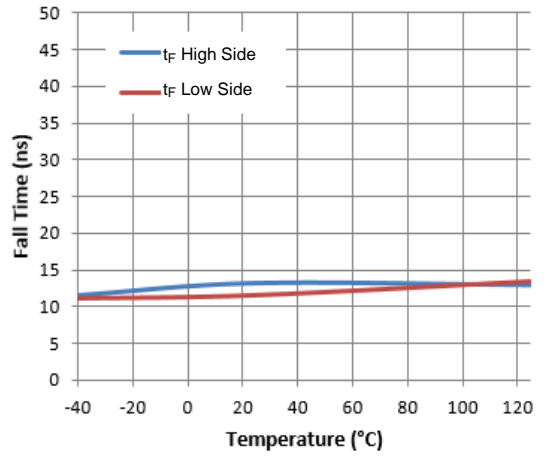


Figure 12. Fall Time vs. Temperature

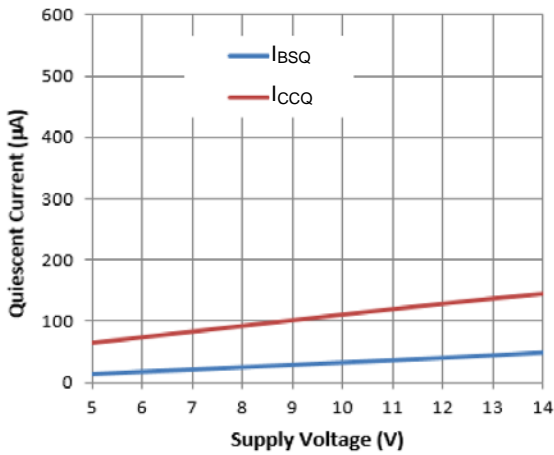


Figure 13. Quiescent Current vs. Supply Voltage

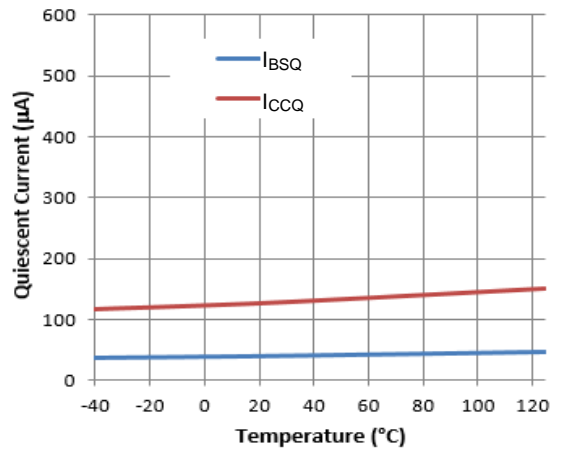


Figure 14. Quiescent Current vs. Temperature

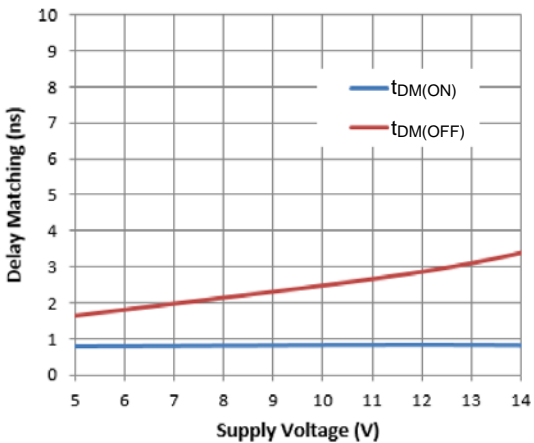


Figure 15. Delay Matching vs. Supply Voltage

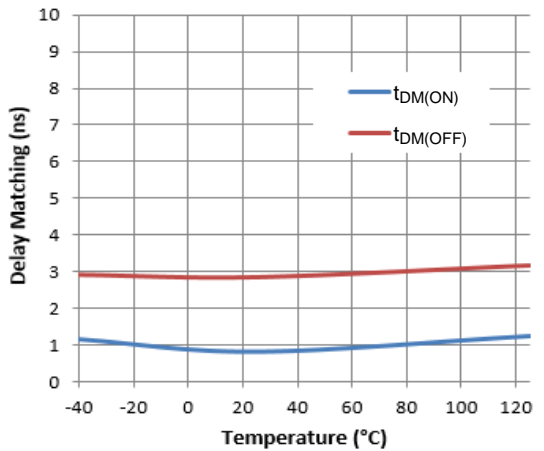


Figure 16. Delay Matching vs. Temperature

Typical Performance Characteristics (continued)

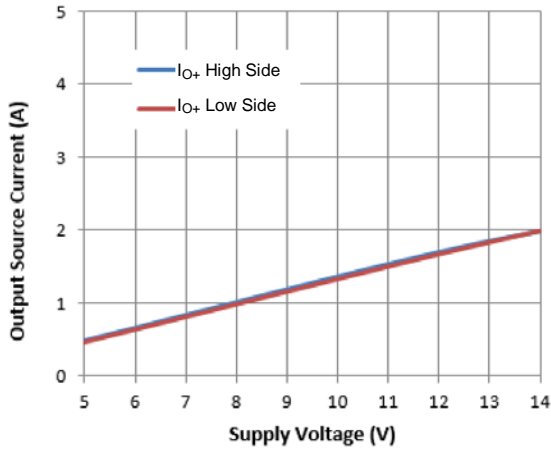


Figure 17. Output Source Current vs. Supply Voltage

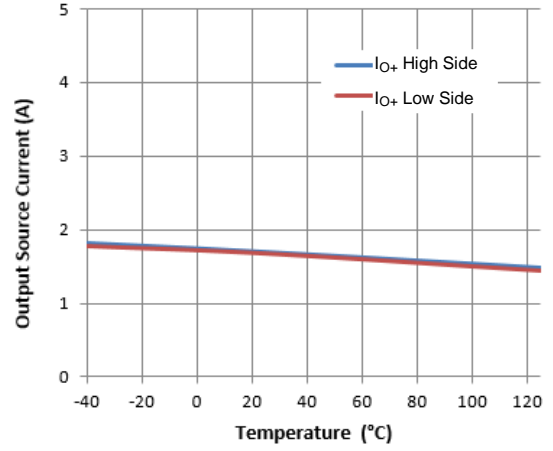


Figure 18. Output Source Current vs. Temperature

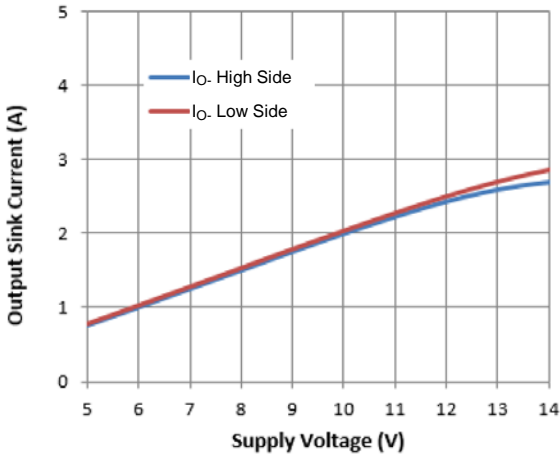


Figure 19. Output Sink Current vs. Supply Voltage

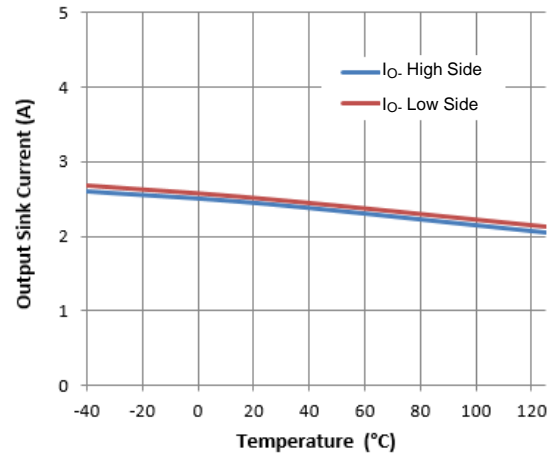


Figure 20. Output Sink Current vs. Temperature

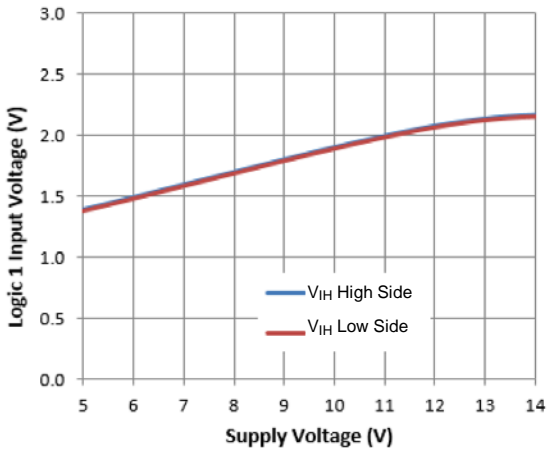


Figure 21. Logic 1 Input Voltage vs. Supply Voltage

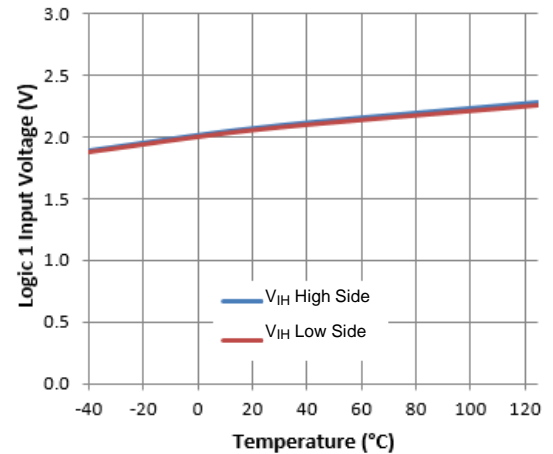


Figure 22. Logic 1 Input Voltage vs. Temperature

Typical Performance Characteristics (continued)

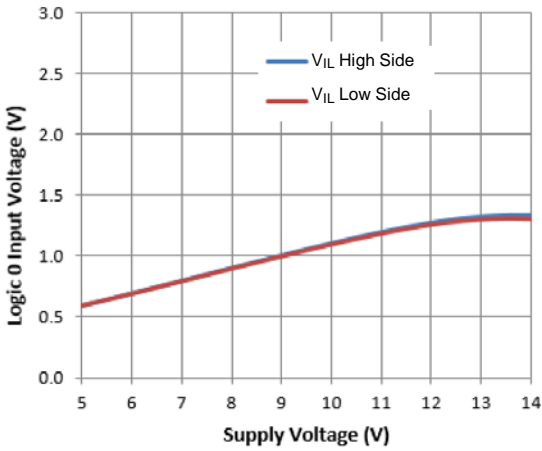


Figure 23. Logic 0 Input Voltage vs. Supply Voltage

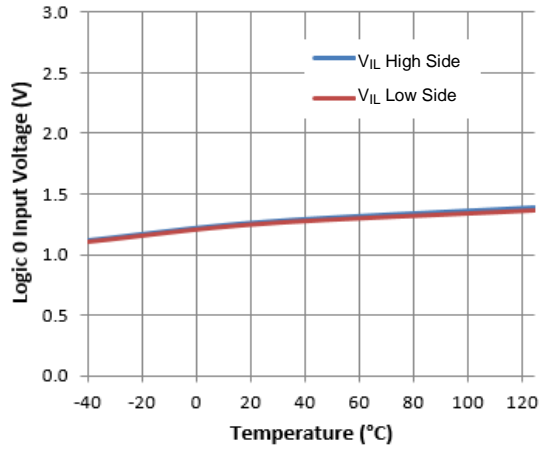


Figure 24. Logic 0 Input Voltage vs. Temperature

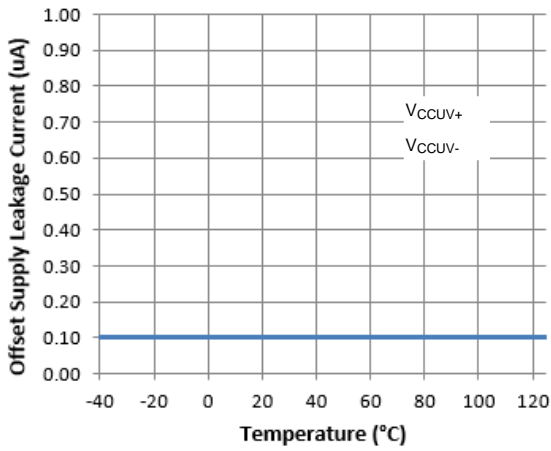
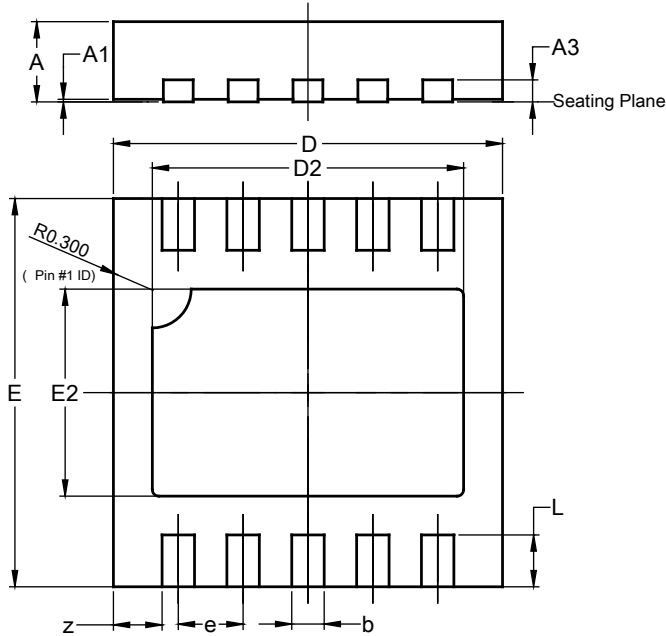


Figure 25. Offset Supply Leakage Current vs. Temperature

Package Outline Dimensions

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

U-DFN3030-10

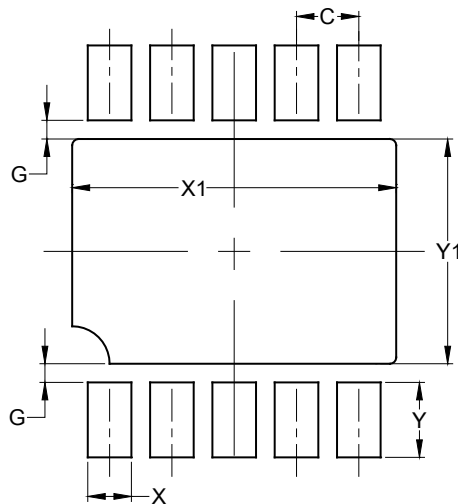


| U-DFN3030-10 | | | |
|----------------------|------|------|-------|
| Dim | Min | Max | Typ |
| A | 0.57 | 0.63 | 0.60 |
| A1 | 0.00 | 0.05 | 0.02 |
| A3 | — | — | 0.15 |
| b | 0.20 | 0.30 | 0.25 |
| D | 2.90 | 3.10 | 3.00 |
| D2 | 2.30 | 2.50 | 2.40 |
| E | 2.90 | 3.10 | 3.00 |
| E2 | 1.50 | 1.70 | 1.60 |
| e | — | — | 0.50 |
| L | 0.25 | 0.55 | 0.40 |
| z | — | — | 0.375 |
| All Dimensions in mm | | | |

Suggested Pad Layout

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

U-DFN3030-10



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.50 |
| G | 0.15 |
| X | 0.35 |
| X1 | 2.60 |
| Y | 0.60 |
| Y1 | 1.80 |

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