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FAN73932

Half-Bridge Gate Drive IC

Features

- Floating Channel for Bootstrap Operation to +600V
- Typically 2.5A/2.5A Sourcing/Sinking Current Driving Capability
- Extended Allowable Negative V_S Swing to -9.8V for Signal Propagation at $V_{BS}=15V$
- High-Side Output in Phase of IN Input Signal
- 3.3V and 5V Input Logic Compatible
- Matched Propagation Delay for Both Channels
- Built-in Shutdown Function
- Built-in UVLO Functions for Both Channels
- Built-in Common-Mode dv/dt Noise Canceling Circuit
- Internal 400ns Minimum Dead-Time

Applications

- High-Speed Power MOSFET and IGBT Gate Driver
- Induction Heating
- High-Power DC-DC Converter
- Synchronous Step-Down Converter
- Motor Drive Inverter

Description

The FAN73932 is a half-bridge, gate-drive IC with shutdown and dead-time functions which can drive high-speed MOSFETs and IGBTs that operate up to +600V. It has a buffered output stage with all NMOS transistors designed for high pulse current driving capability and minimum cross-conduction.

Fairchild's high-voltage process and common-mode noise canceling techniques provide stable operation of the high-side driver under high dv/dt noise circumstances. An advanced level-shift circuit offers high-side gate driver operation up to $V_S=-9.8V$ (typical) for $V_{BS}=15V$.


The UVLO circuit prevents malfunction when V_{DD} and V_{BS} are lower than the specified threshold voltage.

The high-current and low-output voltage drop feature makes this device suitable for all kinds of half- and full-bridge inverters, like motor drive inverter, switching mode power supply, induction heating, and high-power DC-DC converter applications.

8-SOP



Ordering Information

| Part Number | Package | Operating Temperature Range |  Eco Status | Packing Method |
|-------------|---------|-----------------------------|--|----------------|
| FAN73932M | 8-SOP | -40°C to +125°C | RoHS | Tube |
| FAN73932MX | | | | Tape & Reel |



For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Typical Application Diagrams

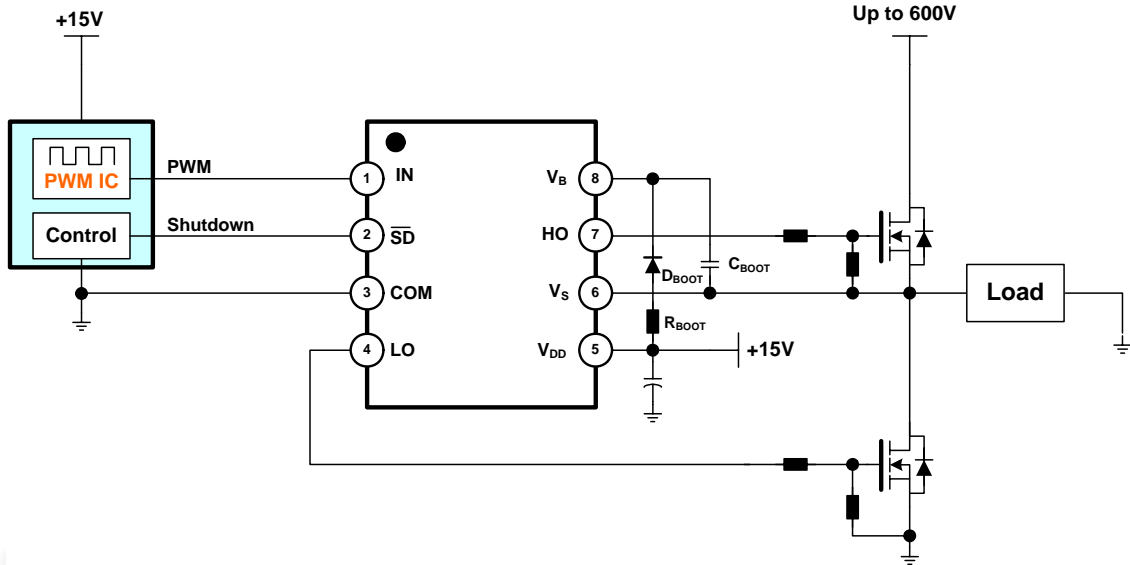


Figure 1. Typical Application Circuit

Internal Block Diagram

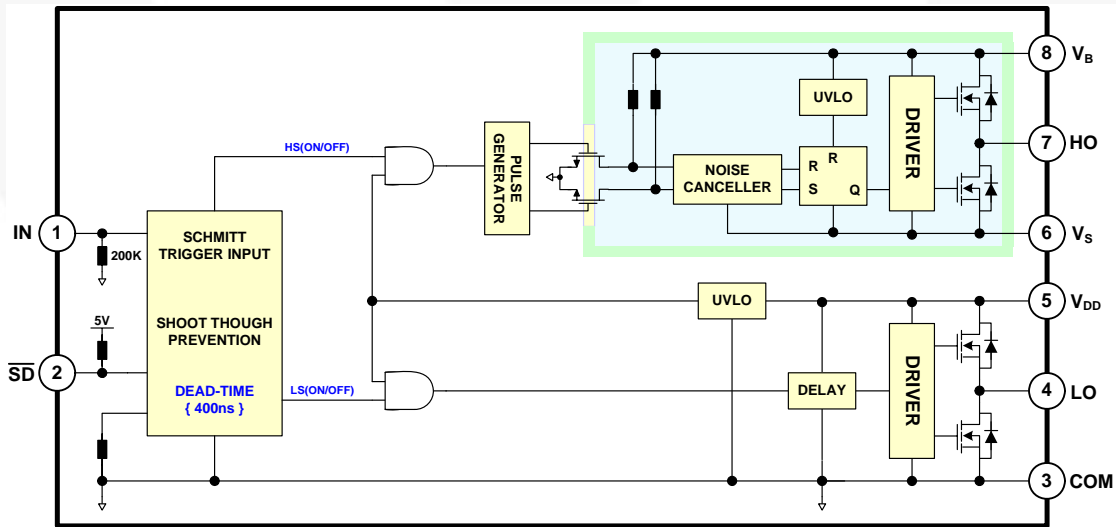


Figure 2. Functional Block Diagram

Pin Configuration

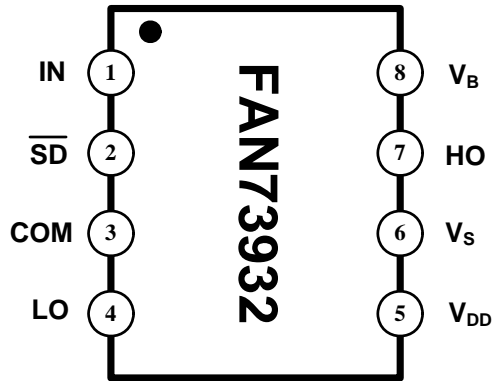


Figure 3. Pin Configuration (Top View)

Pin Definitions

| Pin # | Name | Description |
|-------|------------------------|---|
| 1 | IN | Logic Input for High-Side and Low-Side Gate Driver Output, In-Phase with HO |
| 2 | $\overline{\text{SD}}$ | Logic Input for Shutdown |
| 3 | COM | Ground |
| 4 | LO | Low-Side Driver Return |
| 5 | V_{DD} | Supply Voltage |
| 6 | V_{S} | High-Voltage Floating Supply Return |
| 7 | HO | High-Side Driver Output |
| 8 | V_{B} | High-Side Floating Supply |

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. $T_A=25^{\circ}\text{C}$ unless otherwise specified.

| Symbol | Parameter | Min. | Max. | Unit |
|---------------|---|---------------|--------------|-----------------------------|
| V_B | High-Side Floating Supply Voltage | -0.3 | 625.0 | V |
| V_S | High-Side Floating Offset Voltage | $V_B-25.0$ | $V_B+0.3$ | V |
| V_{HO} | High-Side Floating Output Voltage | $V_S-0.3$ | $V_B+0.3$ | V |
| V_{LO} | Low-Side Output Voltage | -0.3 | $V_{DD}+0.3$ | V |
| V_{DD} | Low-Side and Logic Fixed Supply Voltage | -0.3 | 25.0 | V |
| V_{IN} | Logic Input Voltage (IN) | -0.3 | $V_{DD}+0.3$ | V |
| V_{SD} | Logic Input Voltage (\overline{SD}) | -0.3 | 5.5 | V |
| COM | Logic Ground and Low-Side Driver Return | $V_{DD}-25.0$ | $V_{DD}+0.3$ | V |
| dV_S/dt | Allowable Offset Voltage Slew Rate | | ± 50 | V/ns |
| P_D | Power Dissipation ^(1, 2, 3) | | 0.625 | W |
| θ_{JA} | Thermal Resistance | | 200 | $^{\circ}\text{C}/\text{W}$ |
| T_J | Junction Temperature | | +150 | $^{\circ}\text{C}$ |
| T_{STG} | Storage Temperature | -55 | +150 | $^{\circ}\text{C}$ |

Notes:

- Mounted on 76.2 x 114.3 x 1.6mm PCB (FR-4 glass epoxy material).
- Refer to the following standards:
 JESD51-2: Integral circuits thermal test method environmental conditions - natural convection;
 JESD51-3: Low effective thermal conductivity test board for leaded surface mount packages
- Do not exceed P_D under any circumstances.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol | Parameter | Min. | Max. | Unit |
|----------|--|------------|----------|--------------------|
| V_B | High-Side Floating Supply Voltage | V_S+10 | V_S+20 | V |
| V_S | High-Side Floating Supply Offset Voltage | $6-V_{DD}$ | 600 | V |
| V_{HO} | High-Side Output Voltage | V_S | V_B | V |
| V_{DD} | Low-Side and Logic Fixed Supply Voltage | 10 | 20 | V |
| V_{LO} | Low-Side Output Voltage | COM | V_{DD} | V |
| V_{IN} | Logic Input Voltage (IN) | COM | V_{DD} | V |
| V_{SD} | Logic Input Voltage (\overline{SD}) ⁽⁴⁾ | COM | 5 | V |
| T_A | Operating Ambient Temperature | -40 | +125 | $^{\circ}\text{C}$ |

Note:

- Shutdown (\overline{SD}) input is internally clamped with 5.2V.

Electrical Characteristics

$V_{BIAS}(V_{DD}, V_{BS})=15.0V$, $COM=0V$, and $T_A = 25^\circ C$, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to COM and are applicable to the respective input leads: IN and SD. The V_O and I_O parameters are referenced to COM and are applicable to the respective output leads: HO and LO.

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|------------------------------------|---|---|------|------|------|-----------|
| POWER SUPPLY SECTION | | | | | | |
| I_{QDD} | Quiescent V_{DD} Supply Current | $V_{IN}=0V, \overline{SD}=5V$ | | 320 | 700 | μA |
| I_{QBS} | Quiescent V_{BS} Supply Current | $V_{IN}=0V$ or $5V, \overline{SD}=5V$ | | 50 | 120 | μA |
| I_{PDD} | Operating V_{DD} Supply Current | $f_{IN}=20KHz$, No Load, $\overline{SD}=5V$ | | 700 | 1300 | μA |
| I_{PBS} | Operating V_{BS} Supply Current | $C_L=1nF, f_{IN}=20KHz, rms,$ $\overline{SD}=5V$ | | 420 | 800 | μA |
| I_{SD} | Shutdown mode Supply Current | $\overline{SD}=0V, \overline{SD}=5V$ | | 400 | 800 | μA |
| I_{LK} | Offset Supply Leakage Current | $V_B=V_S=600V$ | | | 10 | μA |
| BOOTSTRAPPED SUPPLY SECTION | | | | | | |
| V_{DDUV+} V_{BSUV+} | V_{DD} and V_{BS} Supply Under-Voltage Positive Going Threshold Voltage | $V_{DD}=V_{BS}=\text{Sweep}$ | 8 | 9 | 10 | V |
| V_{DDUV-} V_{BSUV-} | V_{DD} and V_{BS} Supply Under-Voltage Negative Going Threshold Voltage | $V_{DD}=V_{BS}=\text{Sweep}$ | 7.4 | 8.4 | 9.4 | V |
| V_{DDUVH-} V_{BSUVH} | V_{DD} and V_{BS} Supply Under-Voltage Lockout Hysteresis Voltage | $V_{DD}=V_{BS}=\text{Sweep}$ | | 0.6 | | V |
| INPUT LOGIC SECTION | | | | | | |
| V_{IH} | Logic "1" Input Voltage for HO & Logic "0" for LO | | 2.5 | | | V |
| V_{IL} | Logic "0" Input Voltage for HO & Logic "1" for LO | | | | 0.8 | V |
| I_{IN+} | Logic Input High Bias Current | $V_{IN}=5V, \overline{SD}=0V$ | | 25 | 60 | μA |
| I_{IN-} | Logic Input Low Bias Current | $V_{IN}=0V, \overline{SD}=5V$ | | | 3 | μA |
| R_{IN} | Logic Input Pull-Down Resistance | | | 200 | | $K\Omega$ |
| $V_{SDCLAMP}$ | Shutdown (\overline{SD}) Input Clamping Voltage | | | 5.0 | 5.5 | V |
| $\overline{SD+}$ | Shutdown (\overline{SD}) input Positive-Going Threshold | | 2.5 | | | V |
| $\overline{SD-}$ | Shutdown (\overline{SD}) input Negative-Going Threshold | | | | 0.8 | V |
| R_{PSD} | Shutdown (\overline{SD}) Input Pull-Up Resistance | | | 200 | | $K\Omega$ |
| GATE DRIVER OUTPUT SECTION | | | | | | |
| V_{OH} | High-level Output Voltage ($V_{BIAS} - V_O$) | No Load | | | 1.5 | V |
| V_{OL} | Low-level Output Voltage | No Load | | | 100 | mV |
| I_{O+} | Output High, Short-Circuit Pulsed Current ⁽⁵⁾ | $V_{HO}=0V, V_{IN}=5V, PW \leq 10\mu s$ | 2.0 | 2.5 | | A |
| I_{O-} | Output Low, Short-Circuit Pulsed Current ⁽⁵⁾ | $V_{HO}=15V, V_{IN}=0V, PW \leq 10\mu s$ | 2.0 | 2.5 | | A |
| V_S | Allowable Negative V_S Pin Voltage for IN Signal Propagation to HO | | | -9.8 | -7.0 | V |

Note:

- 5 These parameters guaranteed by design.

Dynamic Electrical Characteristics

$V_{BIAS}(V_{DD}, V_{BS})=15.0V$, $COM=0V$, $C_L=1000pF$, and $T_A=25^\circ C$, unless otherwise specified.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|------------|--|------------|------|------|------|------|
| t_{ON} | Turn-On Propagation Delay Time ⁽⁶⁾ | $V_S=0V$ | | 600 | 850 | ns |
| t_{OFF} | Turn-Off Propagation Delay Time | $V_S=0V$ | | 200 | 350 | ns |
| t_{SD} | Shutdown Propagation Delay Time | | | 140 | 220 | ns |
| Mt_{ON} | Delay Matching, HO and LO Turn-On | | | 0 | 50 | ns |
| Mt_{OFF} | Delay Matching, HO and LO Turn-Off | | | 0 | 50 | ns |
| t_R | Turn-On Rise Time | $V_S=0V$ | | 25 | 50 | ns |
| t_F | Turn-Off Fall Time | $V_S=0V$ | | 20 | 35 | ns |
| DT | Dead-Time: LO Turn-Off to HO Turn-On and HO Turn-Off to LO Turn-On | | 300 | 400 | 500 | ns |
| MDT | Dead-time matching= $ DT_{LO-HO} - DT_{HO-LO} $ | | | 0 | 50 | ns |

Note:

6. The turn-on propagation delay time included dead-time.

Typical Characteristics

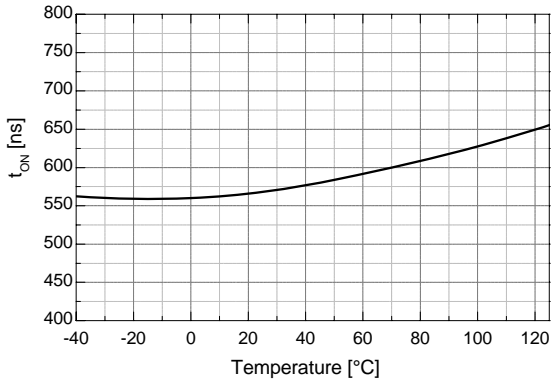


Figure 4. Turn-On Propagation Delay vs. Temperature

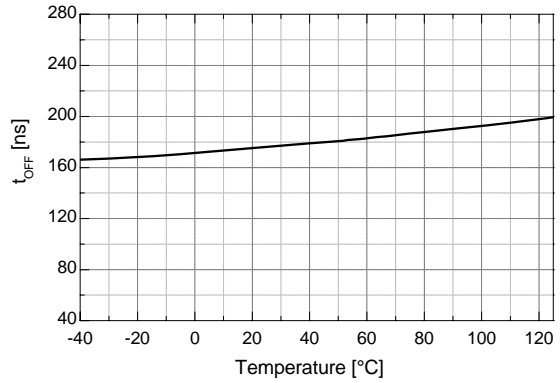


Figure 5. Turn-Off Propagation Delay vs. Temperature

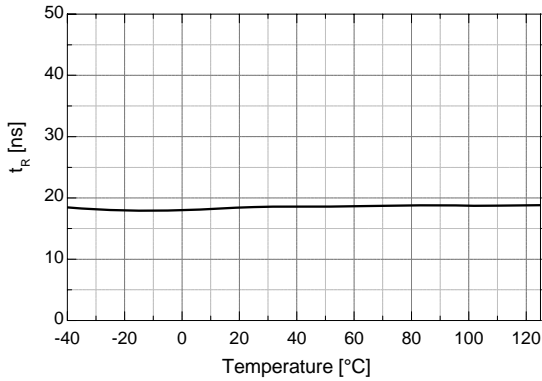


Figure 6. Turn-On Rise Time vs. Temperature

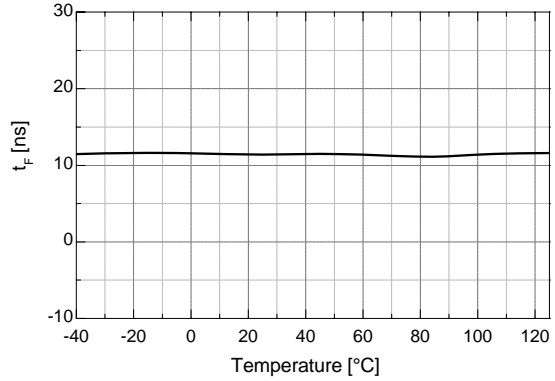


Figure 7. Turn-Off Fall Time vs. Temperature

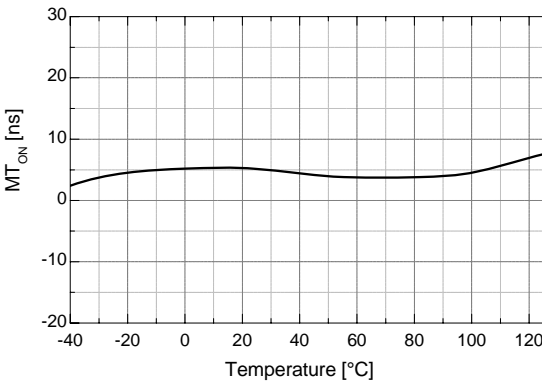


Figure 8. Turn-On Delay Matching vs. Temperature

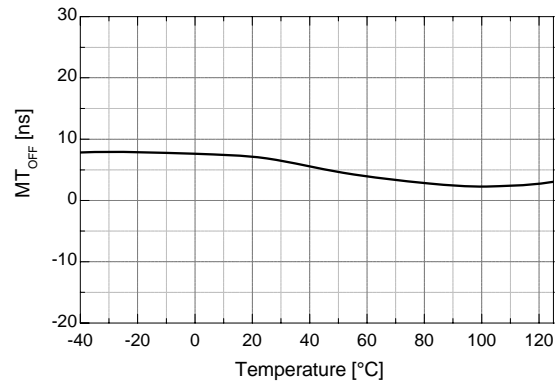


Figure 9. Turn-Off Delay Matching vs. Temperature

Typical Characteristics (Continued)

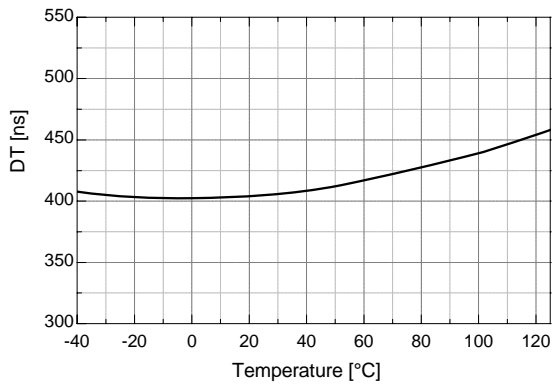


Figure 10. Dead-Time vs. Temperature

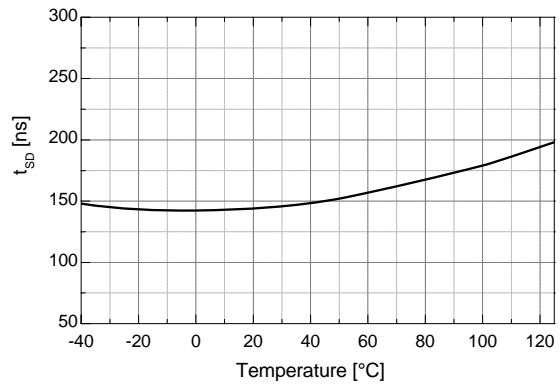


Figure 11. Shutdown Propagation Delay vs. Temperature

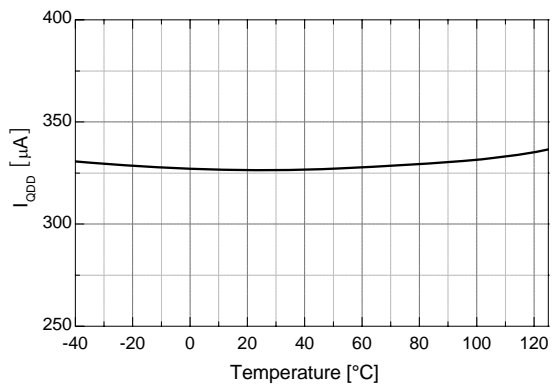


Figure 12. Quiescent V_{DD} Supply Current vs. Temperature

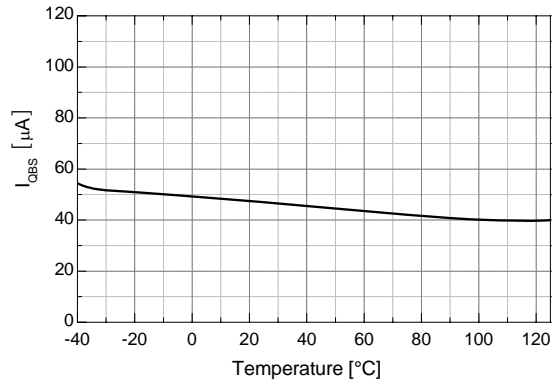


Figure 13. Quiescent V_{BS} Supply Current vs. Temperature

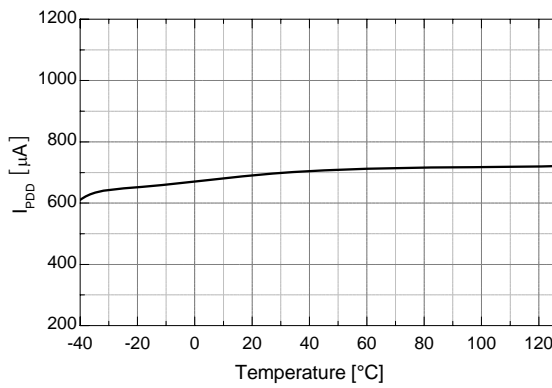


Figure 14. Operating V_{DD} Supply Current vs. Temperature

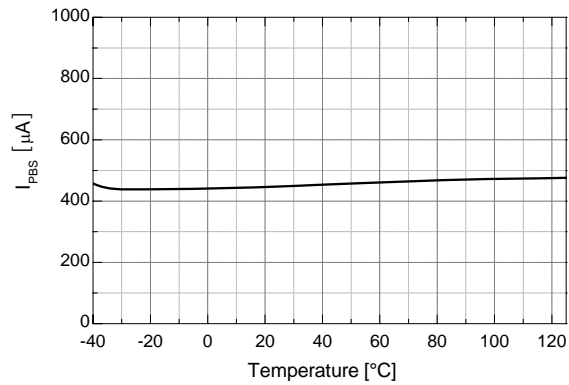


Figure 15. Operating V_{BS} Supply Current vs. Temperature

Typical Characteristics (Continued)

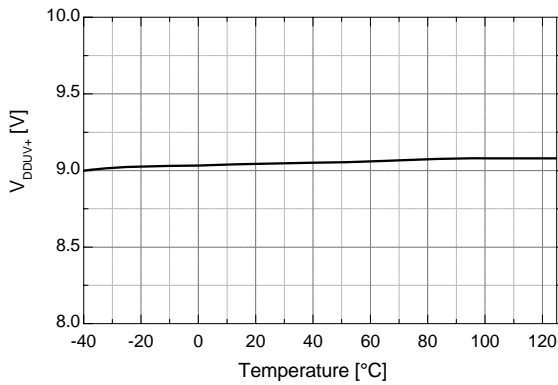


Figure 16. V_{DD} UVLO+ vs. Temperature

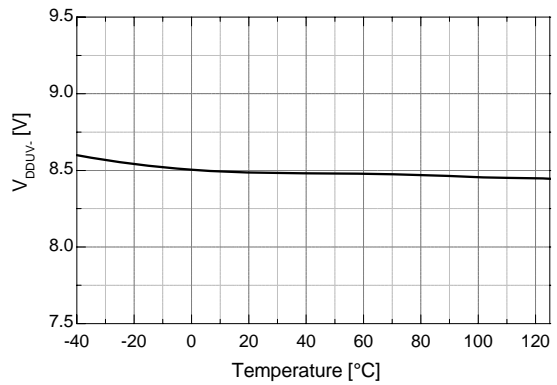


Figure 17. V_{DD} UVLO- vs. Temperature

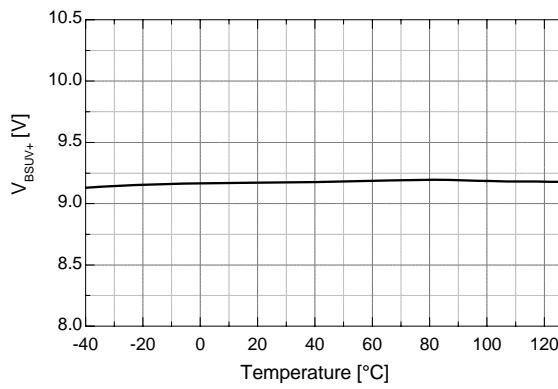


Figure 18. V_{BS} UVLO+ vs. Temperature

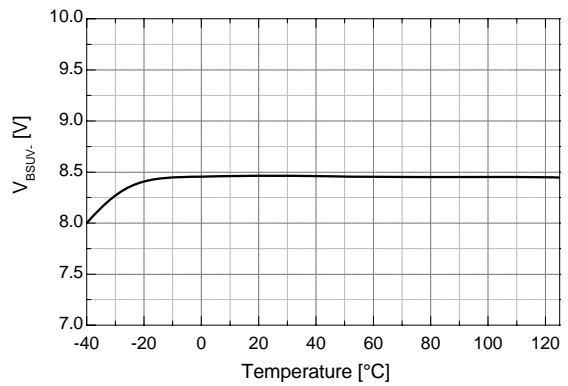


Figure 19. V_{BS} UVLO- vs. Temperature

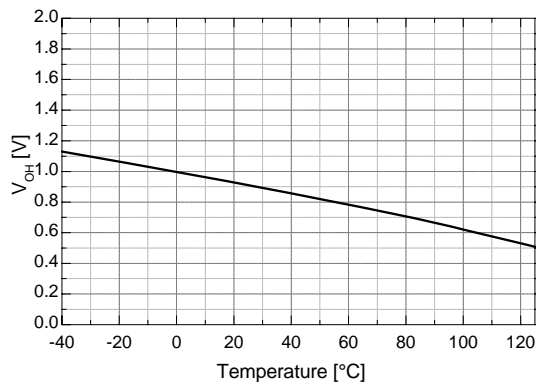


Figure 20. High-Level Output Voltage vs. Temperature

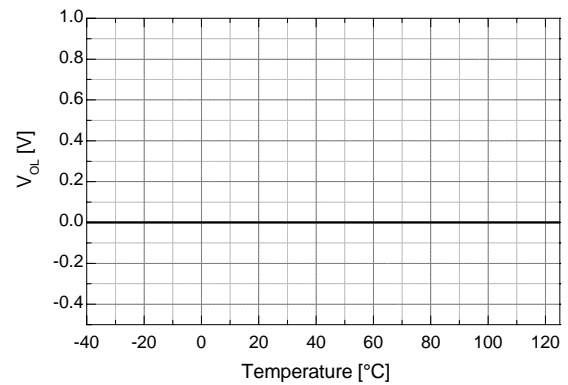


Figure 21. Low-Level Output Voltage vs. Temperature

Typical Characteristics (Continued)

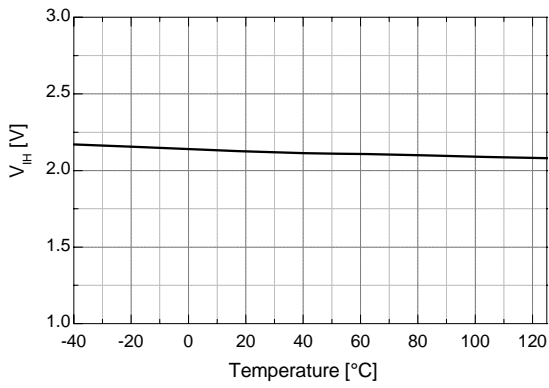


Figure 22. Logic High Input Voltage vs. Temperature

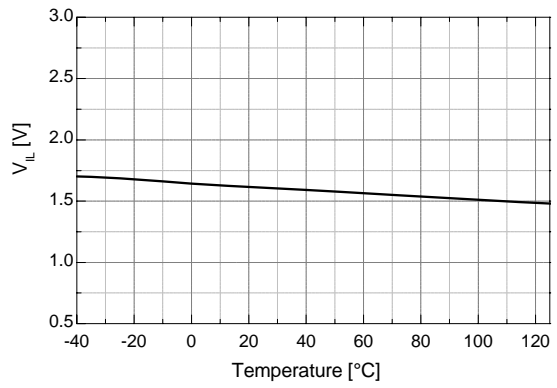


Figure 23. Logic Low Input Voltage vs. Temperature

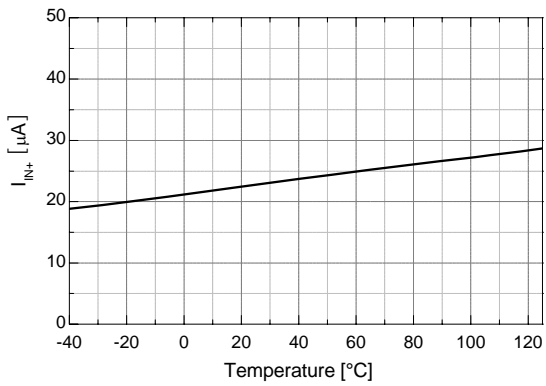


Figure 24. Logic Input High Bias Current vs. Temperature

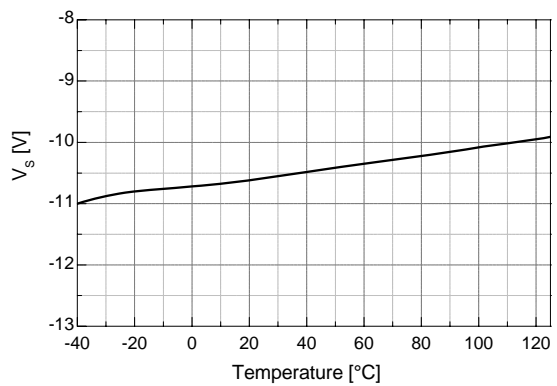


Figure 25. Allowable Negative V_S Voltage vs. Temperature

Switching Time Definitions

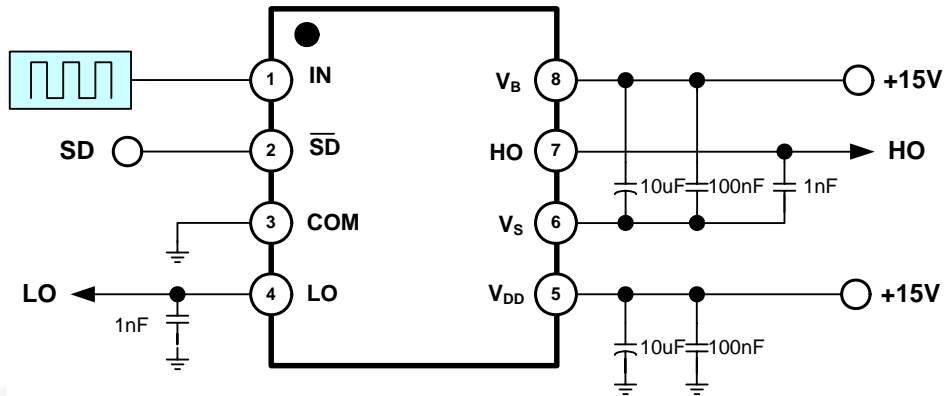


Figure 26. Switching Time Test Circuit

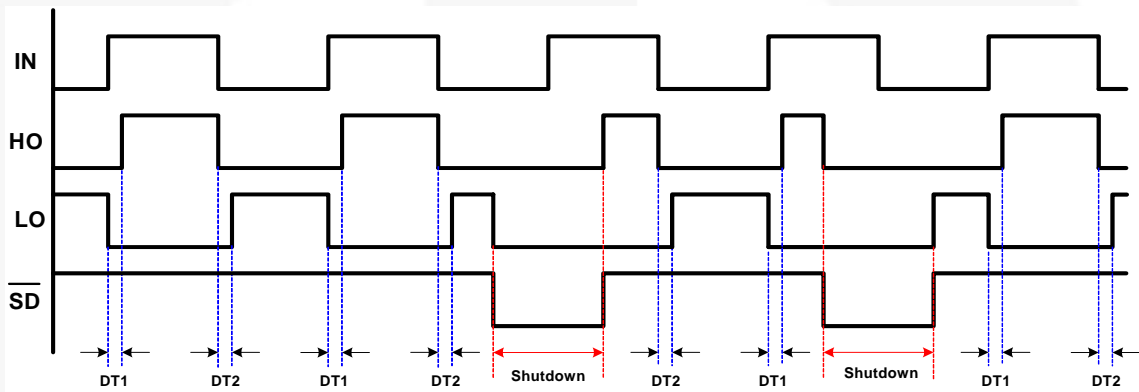


Figure 27. Input/Output Timing Diagram

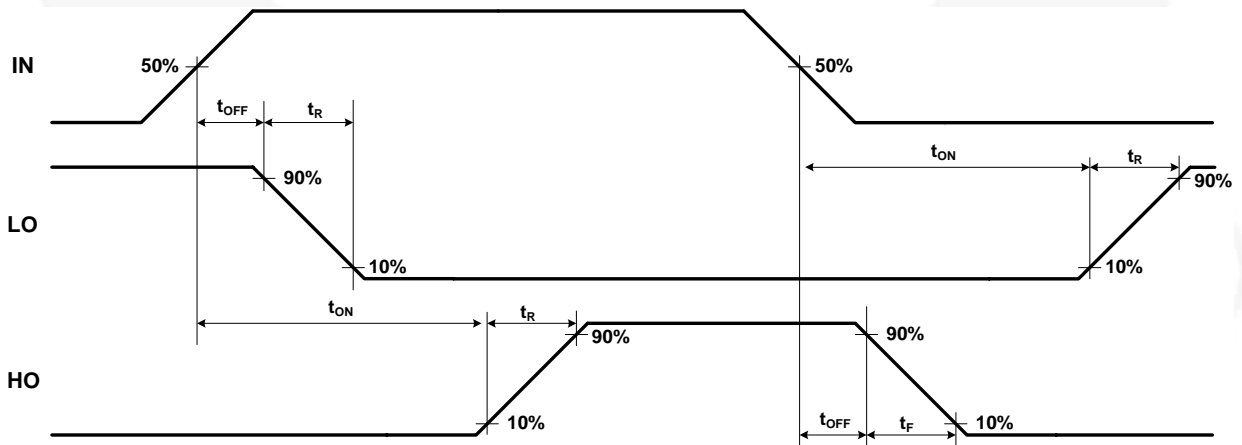


Figure 28. Switching Time Waveform Definition

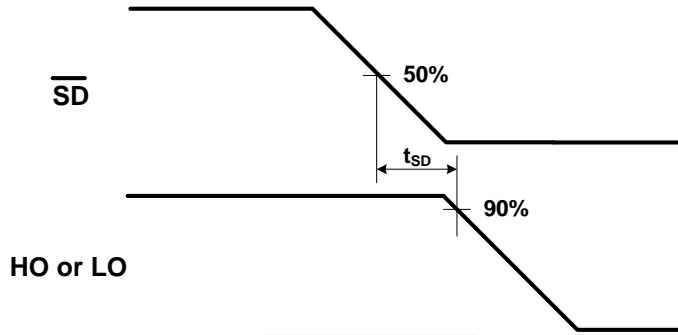


Figure 29. Shutdown Waveform Definition

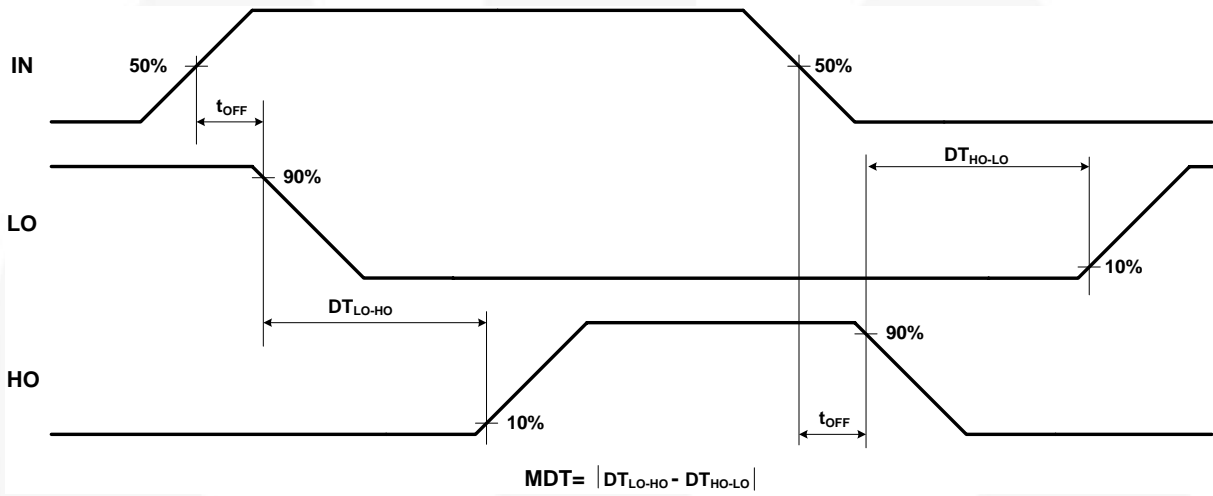


Figure 30. Dead-Time Waveform Definition

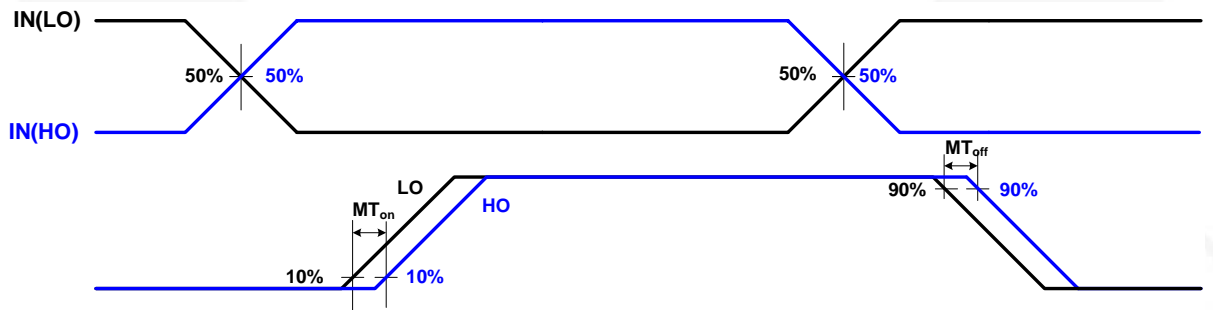


Figure 31. Delay Matching Waveform Definition

Mechanical Dimensions

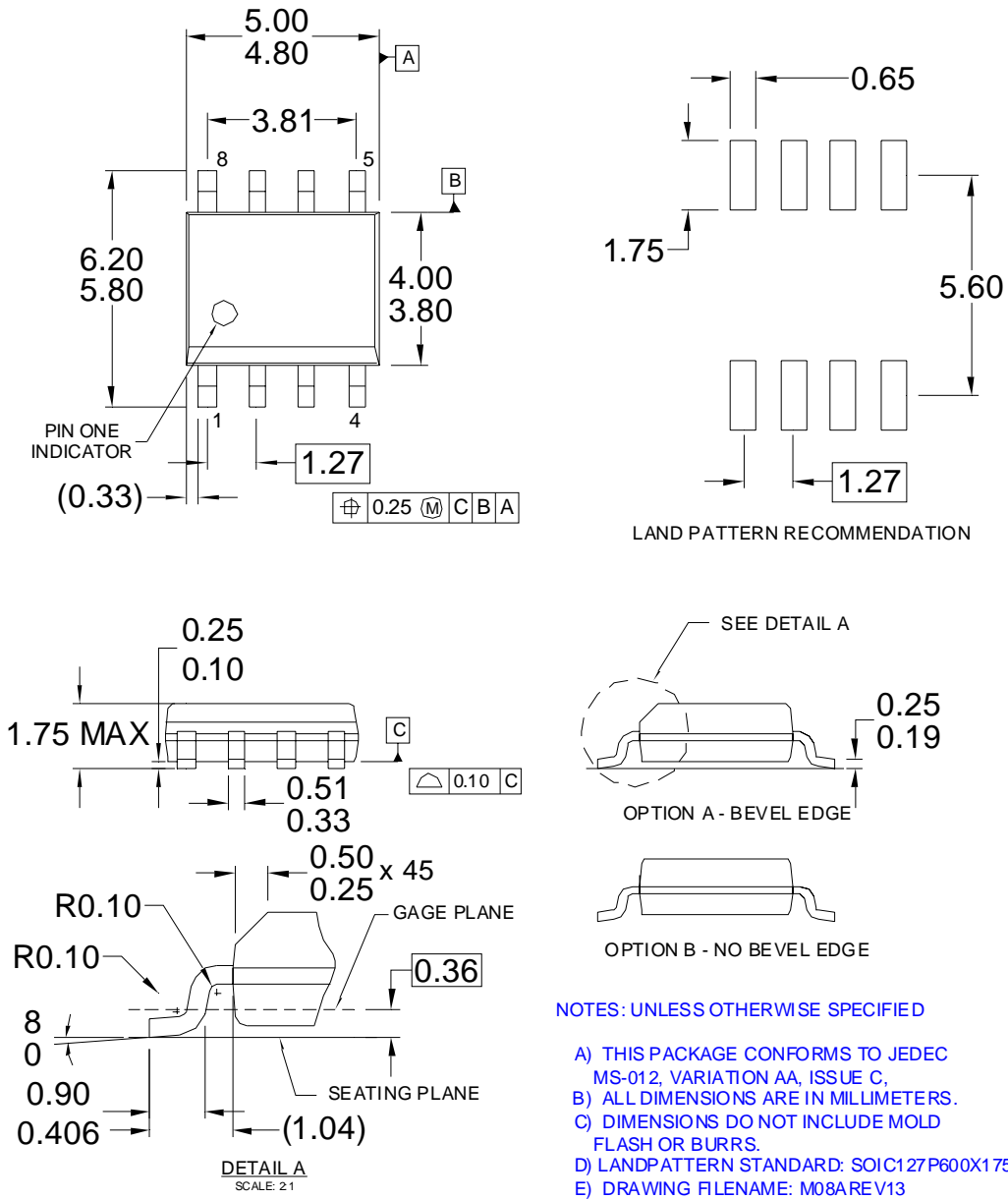


Figure 32. 8-Lead Small Outline Package (SOP)

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