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FAN73833

Half-Bridge Gate-Drive IC

Features

- Floating Channel for Bootstrap Operation to +600V
- Typically 350 mA / 650 mA Sourcing/Sinking Current Driving Capability for Both Channels
- Extended Allowable Negative V_S Swing to -9.8 V for Signal Propagation at $V_{DD}=V_{BS}=15$ V
- 3.3 V and 5 V Input Logic Compatible
- Outputs in Phase with Input Signals
- Built-in UVLO Functions for Both Channels
- Built-on Shoot-Through Prevention Circuit
- Built-in Common-Mode dv/dt Noise Canceling Circuit
- Internal Dead-Time Typically 400 ns

Applications

- SMPS
- Motor Drive Inverter
- Fluorescent Lamp Ballast
- HID Ballast

Description

The FAN73833 is a half-bridge gate-drive IC for driving MOSFETs and IGBTs, operating up to +600 V.

Fairchild's high-voltage process and common-mode noise canceling technique provide stable operation of high-side driver under high dv/dt noise circumstances.

An advanced level-shift circuit allows high-side gate driver operation up to $V_S=-9.8$ V (typical) for $V_{BS}=15$ V.

The UVLO circuits for both channels prevent malfunction when V_{DD} and V_{BS} are lower than the specified threshold voltage.

Output drivers typically source/sink 350 mA / 650 mA, respectively, which is suitable for all kinds of half- and full-bridge inverters.

8-SOP



Ordering Information

| Part Number | Package | Operating Temperature Range | Packing Method |
|-------------|---------|-----------------------------|----------------|
| FAN73833M | 8-SOP | -40°C to +125°C | Tube |
| FAN73833MX | | | Tape & Reel |

Typical Application Circuit

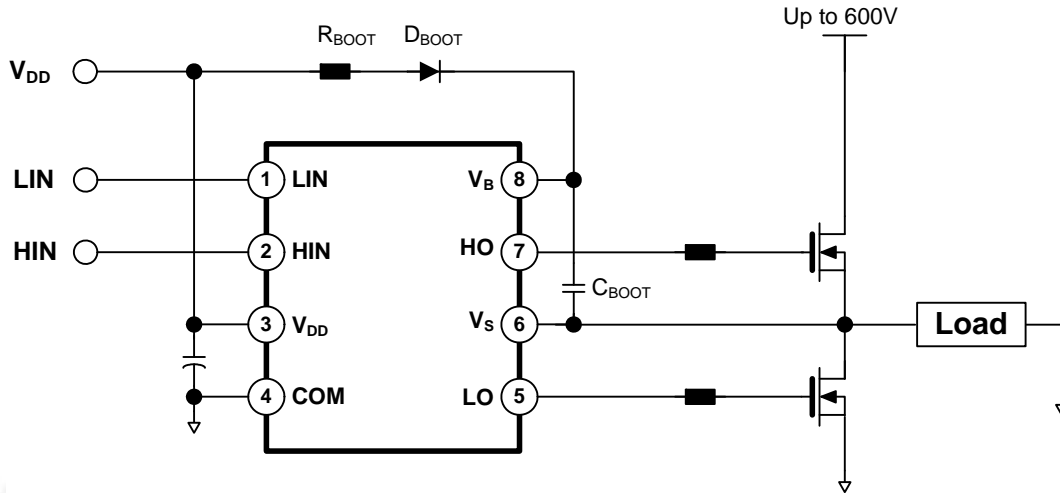


Figure 1. Application Circuit for Half-Bridge

Internal Block Diagram

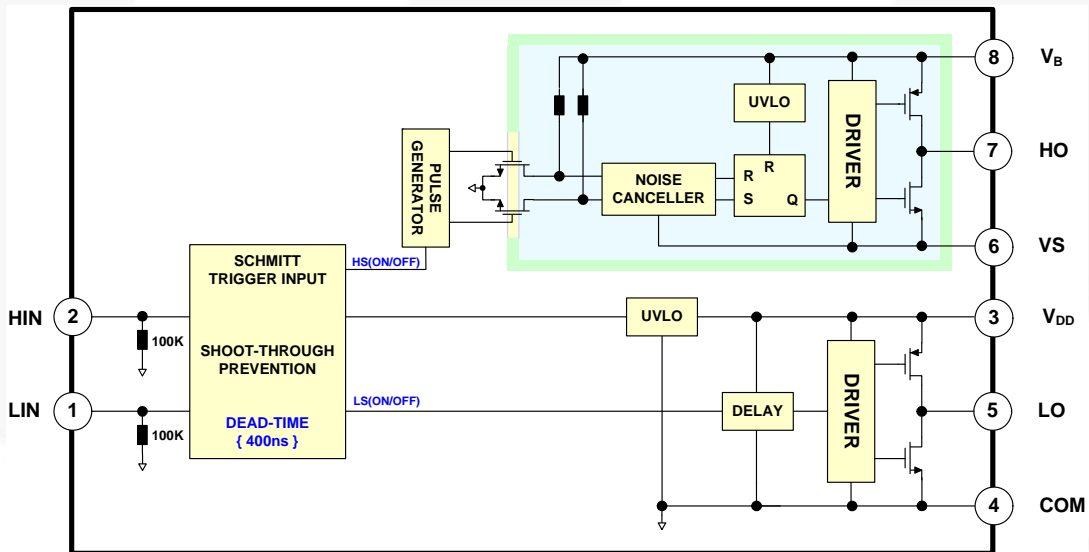


Figure 2. Functional Block Diagram

Pin Configuration

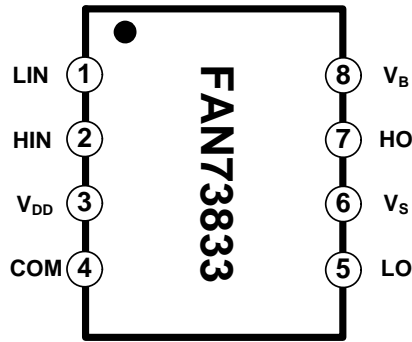


Figure 3. Pin Configuration (Top View)

Pin Definitions

| Pin # | Name | Description |
|-------|-----------------|---|
| 1 | LIN | Logic Input for Low-Side Driver |
| 2 | HIN | Logic Input for High-Side Driver |
| 3 | V _{DD} | Low-Side Supply Voltage |
| 4 | COM | Logic Ground and Low-Side Driver Return |
| 5 | LO | Low-Side Driver Output |
| 6 | V _S | High-Side 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_S | High-side offset voltage | V_B-25 | $V_B+0.3$ | V |
| V_B | High-side floating supply voltage | -0.3 | 625 | V |
| V_{HO} | High-side floating output voltage HO | $V_S-0.3$ | $V_B+0.3$ | V |
| V_{DD} | Low-side and logic-fixed supply voltage | -0.3 | 25 | V |
| V_{LO} | Low-side output voltage LO | -0.3 | $V_{DD}+0.3$ | V |
| V_{IN} | Logic input voltage (HIN/LIN) | -0.3 | $V_{DD}+0.3$ | V |
| COM | Logic ground and low-side driver return | $V_{DD}-25$ | $V_{DD}+0.3$ | V |
| dV_S/dt | Allowable offset voltage slew rate | | 50 | V/ns |
| $P_D^{(1)(2)(3)}$ | Power dissipation | | 0.625 | W |
| θ_{JA} | Thermal resistance, junction-to-ambient | | 200 | $^{\circ}\text{C/W}$ |
| 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 1.6 mm 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+11 | V_S+20 | V |
| V_S | High-side floating supply offset voltage | $6-V_{DD}$ | 600 | V |
| V_{DD} | Low-side supply voltage | 11 | 20 | V |
| V_{HO} | High-side (HO) output voltage | V_S | V_B | V |
| V_{LO} | Low-side (LO) output voltage | COM | V_{DD} | V |
| V_{IN} | Logic input voltage (HIN/LIN) | COM | V_{DD} | V |
| T_A | Ambient temperature | -40 | 125 | $^{\circ}\text{C}$ |

Electrical Characteristics

V_{BIAS} (V_{DD} , V_{BS}) = 15.0 V, and $T_A=25^\circ\text{C}$, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to COM. The V_O and I_O parameters are referenced to V_S and COM and are applicable to respective outputs HO and LO.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|---|--|---|------|------|------|------------------|
| SUPPLY CURRENT SECTION | | | | | | |
| I_{QBS} | Quiescent V_{BS} supply current | $V_{IN}=0$ V or 5 V | | 35 | 100 | μA |
| I_{QDD} | Quiescent V_{DD} supply current | $V_{IN}=0$ V or 5 V | | 80 | 200 | μA |
| I_{PBS} | Operating V_{BS} supply current | $f_{IN}=20$ kHz, rms value | | 420 | 750 | μA |
| I_{PDD} | Operating V_{DD} supply current | $f_{IN}=20$ kHz, rms value | | 420 | 750 | μA |
| I_{LK} | Offset supply leakage current | $V_B=V_S=600$ V | | | 10 | μA |
| POWER SUPPLY SECTION | | | | | | |
| V_{DDUV+} V_{BSUV+} | V_{DD} and V_{BS} supply under-voltage positive going threshold | | 8.2 | 9.2 | 10.1 | V |
| V_{DDUV-} V_{BSUV-} | V_{DD} and V_{BS} supply under-voltage negative going threshold | | 7.2 | 8.3 | 9.2 | V |
| V_{DDUVH} V_{BSUVH} | V_{DD} supply under-voltage lockout hysteresis | | | 0.9 | | V |
| GATE DRIVER OUTPUT SECTION | | | | | | |
| V_{OH} | High-level output voltage, $V_{BIAS}-V_O$ | $I_O=20$ mA | | | 1.0 | V |
| V_{OL} | Low-level output voltage, V_O | | | | 0.6 | V |
| $I_{O+}^{(4)}$ | Output high short-circuit pulse current | $V_O=0$ V, $V_{IN}=5$ V with $PW<10$ μs | 250 | 350 | | mA |
| $I_{O-}^{(4)}$ | Output low short-circuit pulsed current | $V_O=15$ V, $V_{IN}=0$ V with $PW<10$ μs | 500 | 650 | | mA |
| V_S | Allowable negative V_S pin voltage for IN signal propagation to HO | | | -9.8 | -7.0 | V |
| LOGIC INPUT SECTION (INPUT and SHUTDOWN) | | | | | | |
| V_{IH} | Logic "1" input voltage | | 2.5 | | | V |
| V_{IL} | Logic "0" input voltage | | | | 1.2 | V |
| I_{IN+} | Logic "1" input bias current | $V_{IN}=5$ V | | 50 | 100 | μA |
| I_{IN-} | Logic "0" input bias current | $V_{IN}=0$ V | | | 2.0 | μA |
| R_{PD} | Input pull-down resistance | | | 100 | | $\text{K}\Omega$ |

Note:

4. This parameter is guaranteed by design.

Dynamic Electrical Characteristics

V_{BIAS} (V_{DD} , V_{BS})=15.0 V, V_S =COM, C_L =1000 pF, and T_A = 25°C, unless otherwise specified.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|---------------------------------|------------|------|------|------|------|
| t_{ON} | Turn-on propagation delay time | $V_S=0$ V | | 150 | 270 | ns |
| t_{OFF} | Turn-off propagation delay time | $V_S=0$ V | | 140 | 250 | ns |
| t_R | Turn-on rising time | | | 50 | 100 | ns |
| t_F | Turn-off falling time | | | 30 | 80 | ns |
| DT | Dead-time | | 330 | 450 | 580 | ns |

Typical Characteristics

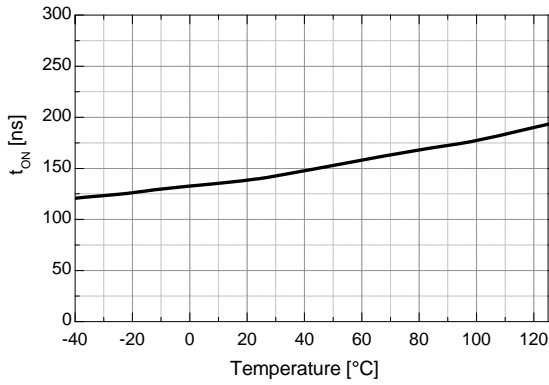


Figure 4. Turn-on Propagation Delay vs. Temp.

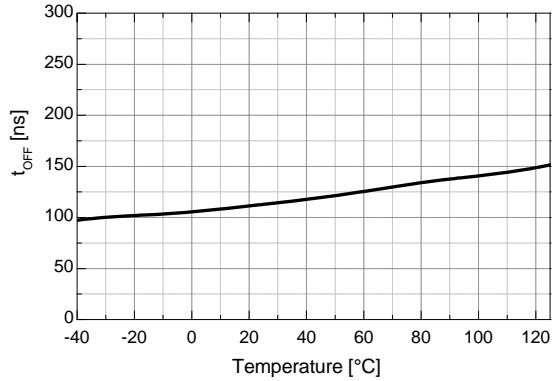


Figure 5. Turn-off Propagation Delay vs. Temp.

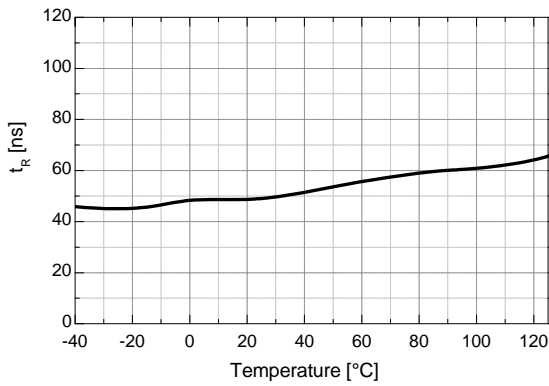


Figure 6. Turn-on Rise Time vs. Temp.

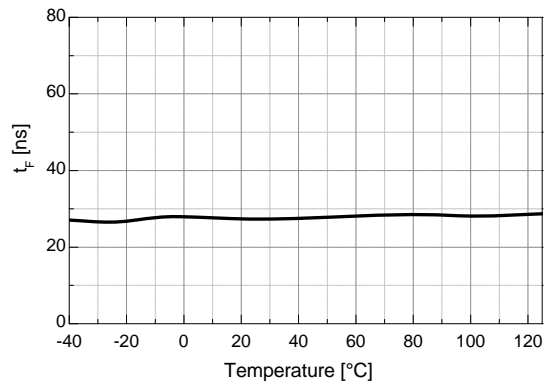


Figure 7. Turn-off Fall Time vs. Temp.

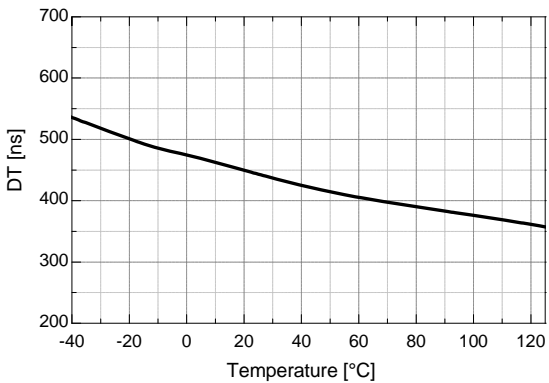


Figure 8. Dead Time vs. Temp.

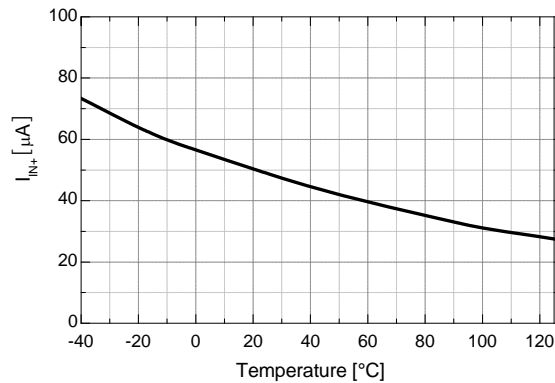


Figure 9. Logic Input High Bias Current vs. Temp.

Typical Characteristics (Continued)

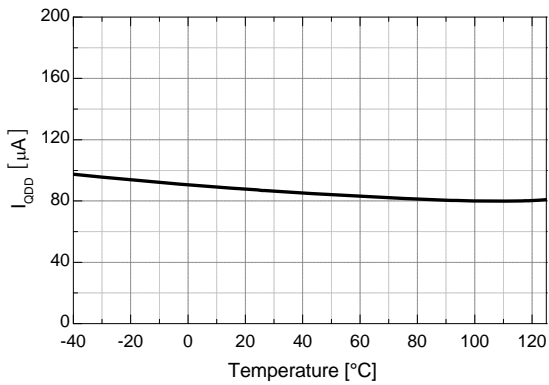


Figure 10. Quiescent V_{DD} Supply Current vs. Temp.

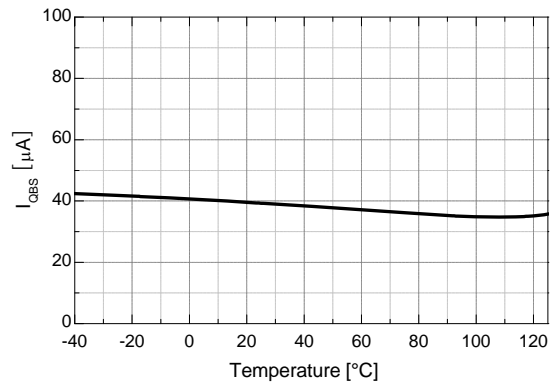


Figure 11. Quiescent V_{BS} Supply Current vs. Temp.

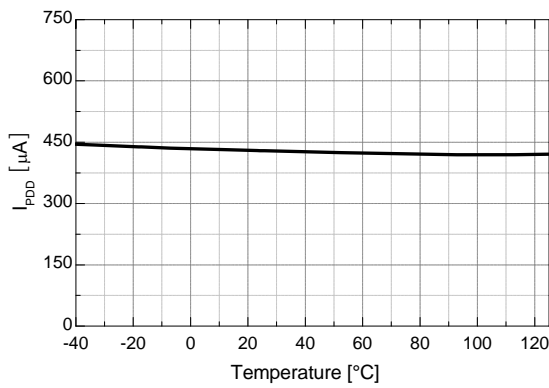


Figure 12. Operating V_{DD} Supply Current vs. Temp.

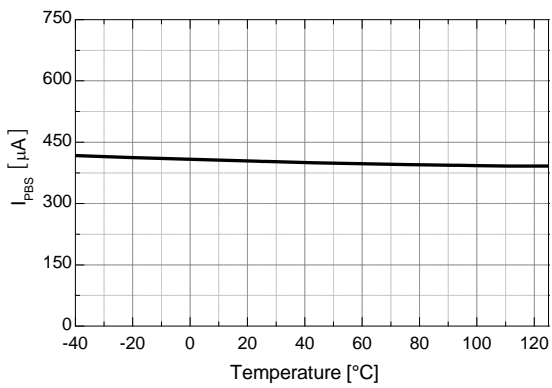


Figure 13. Operating V_{BS} Supply Current vs. Temp.

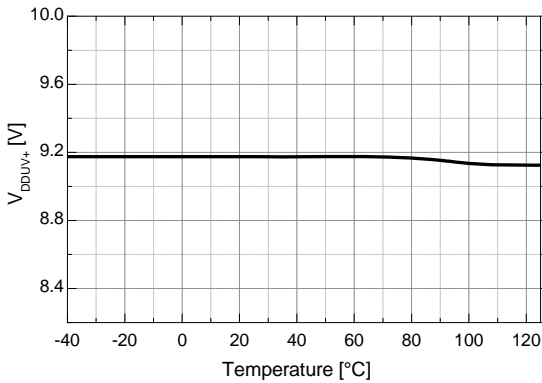


Figure 14. V_{DD} UVLO+ vs. Temp.

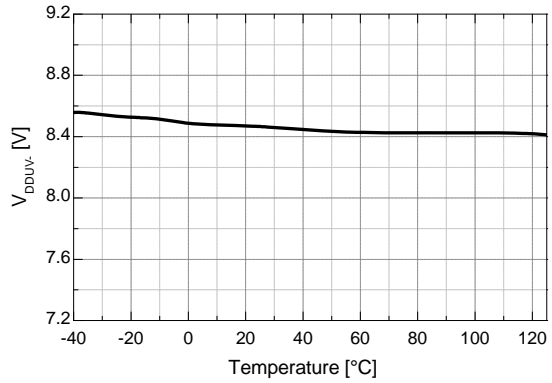


Figure 15. V_{DD} UVLO- vs. Temp.

Typical Characteristics (Continued)

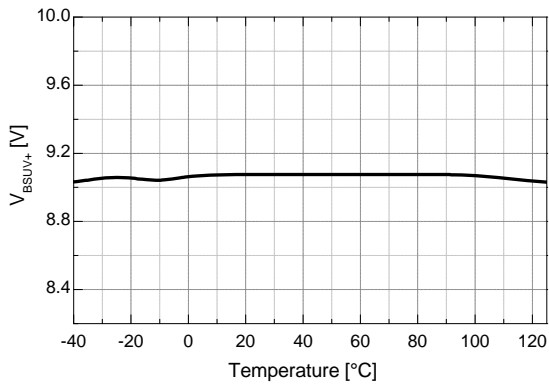


Figure 16. V_{BS} UVLO+ vs. Temp.

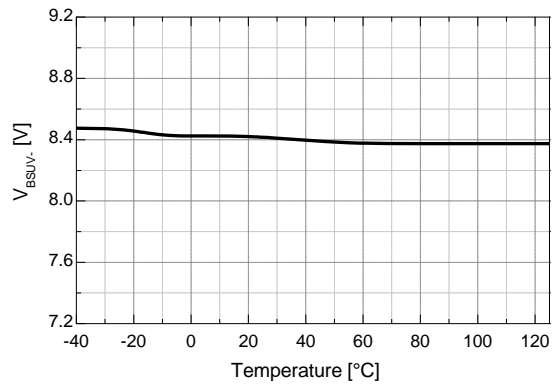


Figure 17. V_{BS} UVLO- vs. Temp.

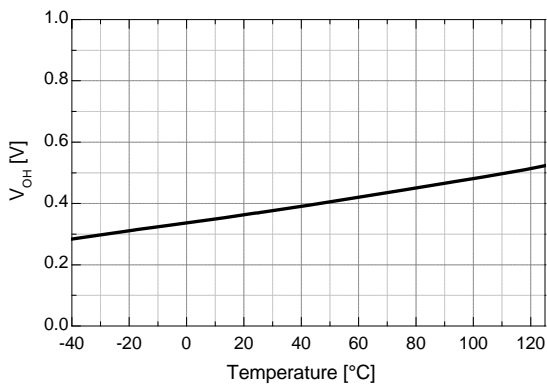


Figure 18. High-Level Output Voltage vs. Temp.

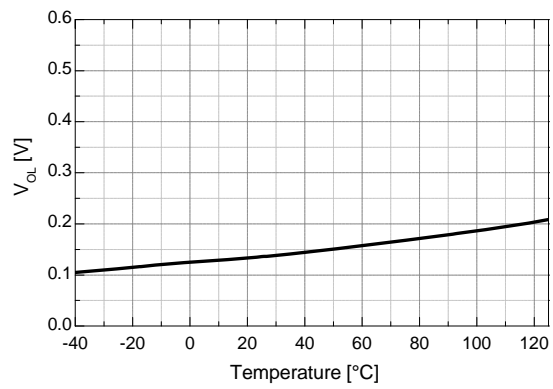


Figure 19. Low-Level Output Voltage vs. Temp.

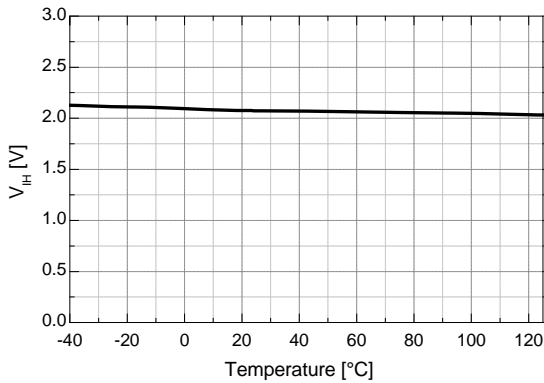


Figure 20. Logic High Input Voltage vs. Temp.

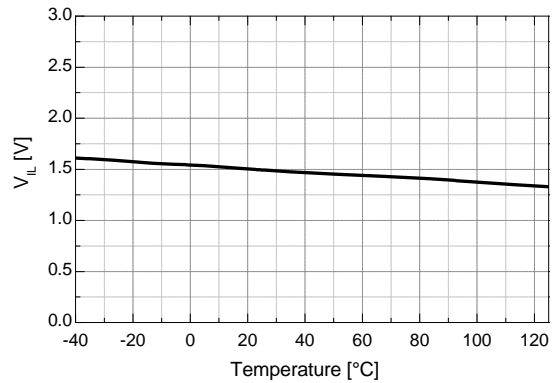


Figure 21. Logic Low Input Voltage vs. Temp.

Typical Characteristics (Continued)

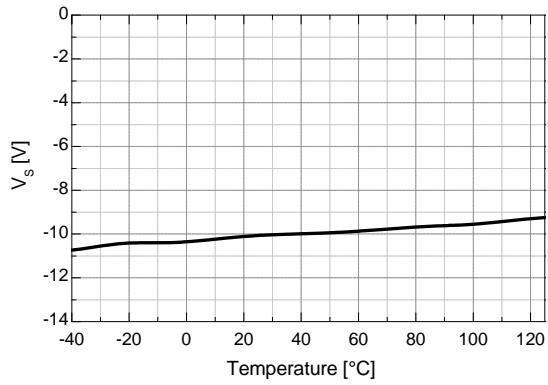


Figure 22. Allowable Negative V_S Voltage vs. Temp.



Application Information

1. Protection Function

1.1 Under-Voltage Lockout (UVLO)

The high- and low-side drivers include under-voltage lockout (UVLO) protection circuitry for each channel that monitors the supply voltage (V_{DD}) and bootstrap capacitor voltage (V_{BS}) independently. It can be designed prevent malfunction when V_{DD} and V_{BS} are lower than the specified threshold voltage. The UVLO hysteresis prevent chattering during power supply transitions.

1.2 Shoot-Through Prevention Function

The FAN73833 has shoot-through prevention circuitry monitoring the high- and low-side control inputs. It can be designed to prevent outputs of high and low side from turning on at same time, as shown Figure 23 and 28.

2. Switching Time Definitions

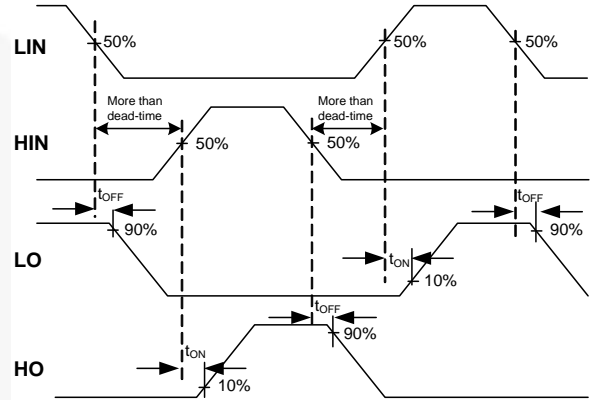


Figure 25. Switching Time Definition

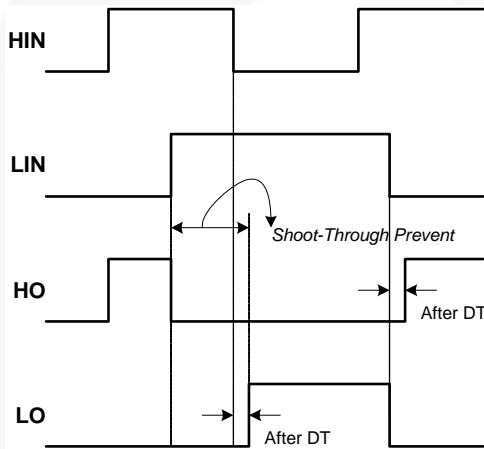


Figure 23. Waveforms for Shoot-Through Prevention

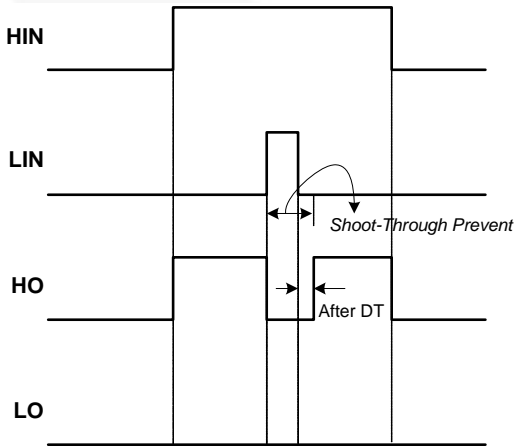


Figure 24. Waveforms for Shoot-Through Prevention

Mechanical Dimensions

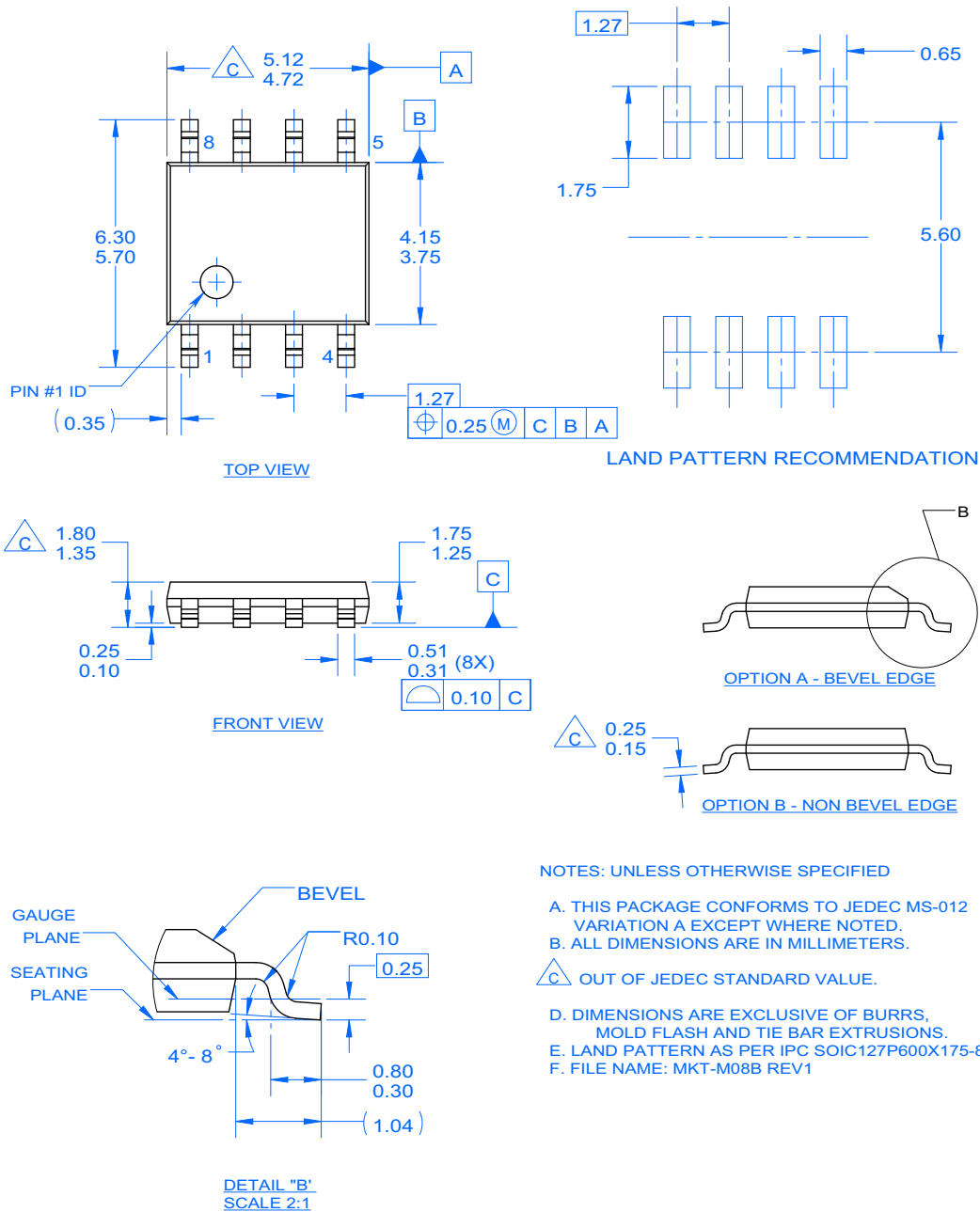


Figure 26. 8-Lead, Small Outline Package (SOP)

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