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FAN7383

Half-Bridge Gate-Drive IC

Features

- Floating Channel Designed for Bootstrap Operation to +600V.
- Typically 350mA/650mA Sourcing/Sinking Current Driving Capability for Both Channels
- Extended Allowable Negative V_S Swing to -9.8V for Signal Propagation at $V_{DD}=V_{BS}=15V$
- High-Side Output in Phase of IN Signal
- Built-in UVLO Functions for Both Channels
- Built-in Common-Mode dv/dt Noise Canceling Circuit
- Typically Internal 330ns Minimum Dead-Time
- Programmable Turn-On Delay Time Control (Dead-Time)

Applications

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

Description

The FAN7383 is a half-bridge gate-drive IC with shutdown and programmable dead-time control functions for driving MOSFETs and IGBTs that operate up to +600V.

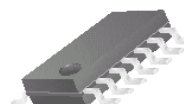
Fairchild's high voltage process and common-mode noise canceling technique give stable operation of high-side drivers under high-dv/dt noise circumstances.

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

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 350mA/650mA, respectively, which is suitable for all kinds of half and full bridge inverter.

14-SOP



Ordering Information

| Part Number | Package | Pb-Free | Operating Temperature Range | Packing Method |
|--------------------------|---------|---------|-----------------------------|----------------|
| FAN7383M ⁽¹⁾ | 14-SOP | Yes | -40°C ~ 125°C | Tube |
| FAN7383MX ⁽¹⁾ | | | | Tape & Reel |

Note:

1. These devices passed wave soldering test by JESD22A-111.



Internal Block Diagram

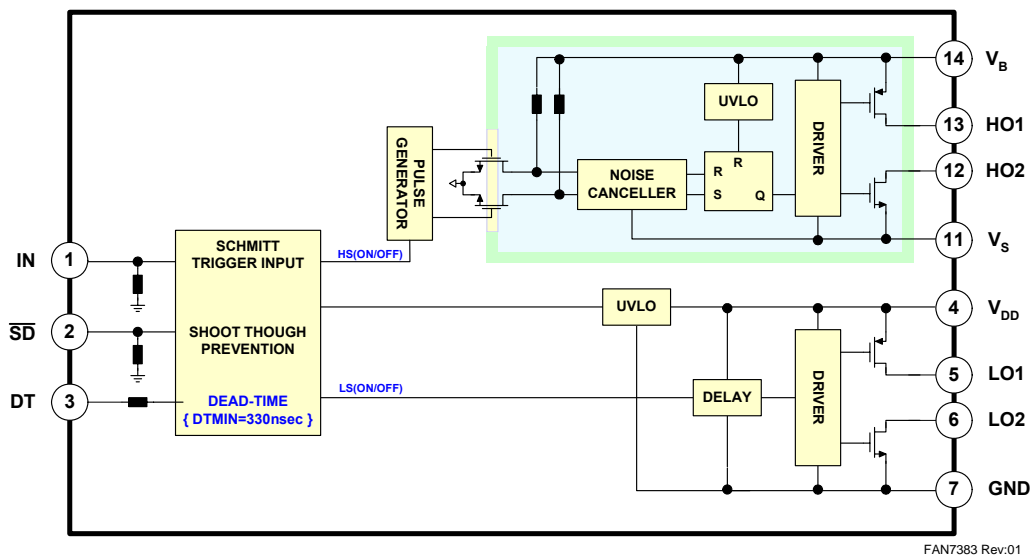


Figure 3. Functional Block Diagram of FAN7383

Pin Configuration

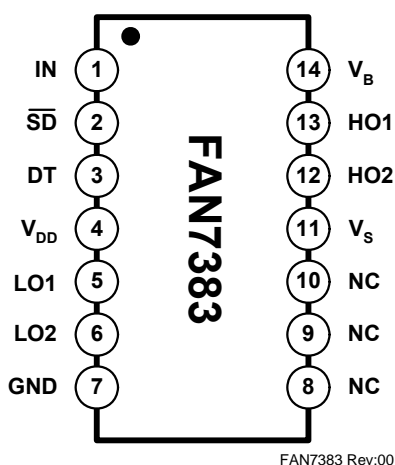


Figure 4. Pin Configuration (Top View)

Pin Definitions

| Pin # | Name | Description |
|-------|------------------------|---|
| 1 | IN | Logic Input for Gate Driver |
| 2 | $\overline{\text{SD}}$ | Logic Input for Shutdown (Active Low) |
| 3 | DT | Programmable Dead-Time Control with External Resistor |
| 4 | V_{DD} | Low-Side Supply Voltage |
| 5 | LO1 | Low-Side Driver Source Output |
| 6 | LO2 | Low-Side Driver Sink Output |
| 7 | GND | Ground |
| 8 | N.C. | Not connected |
| 9 | N.C. | Not connected |
| 10 | N.C. | Not connected |
| 11 | V_{S} | High-Side Floating Supply Return |
| 12 | HO2 | High-Side Driver Sink Output |
| 13 | HO1 | High-Side Driver Source Output |
| 14 | 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 HO1, HO2 | $V_S-0.3$ | $V_B+0.3$ | V |
| V_{DD} | Low-side and logic fixed supply voltage | -0.3 | 25 | V |
| V_{LO} | Low-side output voltage LO1, LO2 | -0.3 | $V_{DD}+0.3$ | V |
| V_{IN} | Logic input voltage (IN) | -0.3 | $V_{DD}+0.3$ | V |
| V_{SD} | Shutdown logic input voltage | -0.3 | $V_{DD}+0.3$ | V |
| V_{DT} | Dead-time control voltage | -0.3 | 5.0 | V |
| GND | Logic ground | $V_{DD}-25$ | $V_{DD}+0.3$ | V |
| dV_S/dt | Allowable offset voltage slew rate | | 50 | V/ns |
| $P_D^{(2)(3)(4)}$ | Power dissipation | | 1.0 | W |
| θ_{JA} | Thermal resistance, junction-to-ambient | | 110 | $^\circ\text{C}/\text{W}$ |
| T_J | Junction temperature | | 150 | $^\circ\text{C}$ |
| T_{STG} | Storage temperature | | 150 | $^\circ\text{C}$ |

Notes:

2. When mounted on 76.2 x 114.3 x 1.6mm PCB. (FR-4 glass epoxy material).

3. Please refer to:

JESD51-2: Integral circuits thermal test method environmental conditions - Natural convection

JESD51-3: Low effective thermal conductivity test board for leaded surface mount packages

4. 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 | Condition | Min. | Max. | Unit |
|----------|--|-----------|------------|----------|------------------|
| V_B | High-side floating supply voltage | | V_S+15 | V_S+20 | V |
| V_S | High-side floating supply offset voltage | | $6-V_{DD}$ | 600 | V |
| V_{DD} | Low-side supply voltage | | 15 | 20 | V |
| V_{HO} | High-side (HO) output voltage | | V_S | V_B | V |
| V_{LO} | Low-side (LO) output voltage | | GND | V_{DD} | V |
| V_{IN} | Logic input voltage (IN) | | GND | V_{DD} | V |
| T_A | Ambient temperature | | -40 | 125 | $^\circ\text{C}$ |

Electrical Characteristics

V_{BIAS} (V_{DD} , V_{BS}) = 15.0V, R_{DT} = GND, T_A = 25°C, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to GND. The V_O and I_O parameters are referenced to V_S and GND and are applicable to the respective outputs HO and LO.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--|---|---|------|------|------|------|
| SUPPLY CURRENT SECTION | | | | | | |
| I _{QBS} | Quiescent V _{BS} supply current | V _{IN} =0V or 5V | | 35 | 90 | μA |
| I _{QDD} | Quiescent V _{DD} supply current | V _{IN} =0V or 5V, R _{DT} =0Ω | | 650 | 900 | |
| I _{SD} ⁽⁵⁾ | V _{DD} supply current at shutdown mode | SD=GND | | 650 | 900 | |
| I _{PBS} | Operating V _{BS} supply current | f _{IN} =20kHz,rms value | | 400 | 700 | |
| I _{PDD} | Operating V _{DD} supply current | f _{IN} =20kHz,rms value, R _{DT} =0Ω | | 950 | 1200 | |
| I _{LK} | Offset supply leakage current | V _B =V _S =600V | | | 10 | |
| POWER SUPPLY SECTION | | | | | | |
| V _{DDUV+} V _{BSUV+} | V _{DD} and V _{BS} supply under-voltage positive going threshold | | 10.7 | 11.6 | 12.5 | V |
| V _{DDUV-} V _{BSUV-} | V _{DD} and V _{BS} supply under-voltage negative going threshold | | 10.0 | 10.8 | 11.6 | |
| V _{DDUVH} V _{BSUVH} | V _{DD} and V _{BS} supply under-voltage lockout hysteresis | | | 0.8 | | |
| GATE DRIVER OUTPUT SECTION | | | | | | |
| V _{OH} | High-level output voltage, V _{BIAS} -V _O | I _O =20mA | | | 1.0 | V |
| V _{OL} | Low-level output voltage, V _O | | | | 0.6 | V |
| I _{O+} | Output high short-circuit pulse current | V _O =0V, V _{IN} =5V with PW<10μs | 250 | 350 | | mA |
| I _{O-} | Output low short-circuit pulsed current | V _O =15V, V _{IN} =0V with PW<10μs | 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 | | 2.9 | | | V |
| V _{IL} | Logic "0" input voltage | | | | 1.2 | V |
| I _{IN+} | Logic "1" input bias current | V _{IN} =5V | | 50 | 100 | μA |
| I _{IN-} | Logic "0" input bias current | V _{IN} =0V | | | 2.0 | μA |
| SD+ | Shutdown "1" input voltage | | | | 1.2 | V |
| SD- | Shutdown "0" input voltage | | 2.9 | | | V |
| R _{PD} | Input pull-down resistance | | | 100 | | KΩ |

Note:

5.This parameter guaranteed by design.

Dynamic Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------|--|---------------------------------|------|------|------|---------|
| t_{ON} | Turn-on propagation delay | $V_S=0V$ | | 500 | 670 | ns |
| t_{OFF} | Turn-off propagation delay | $V_S=0V$ or 600V ⁽⁵⁾ | | 170 | 250 | |
| t_R | Turn-on rise time | | | 50 | 100 | |
| t_F | Turn-off fall time | | | 30 | 80 | |
| $t_{SD}^{(5)}$ | Shutdown propagation delay | | | 100 | 180 | |
| DT1, DT2 | Dead-time LO OFF to HO ON and HO OFF to LO ON | $R_{DT}=0\Omega$ | 250 | 330 | 420 | ns |
| | | $R_{DT}=200K\Omega$ | 1.20 | 1.68 | 2.30 | μs |
| DMT | Dead-time matching | $R_{DT}=0\Omega$ | | 0 | 60 | ns |
| | | $R_{DT}=200K\Omega$ | | 0 | 150 | |

Note:

5. These parameters guaranteed by design.

Typical Characteristics

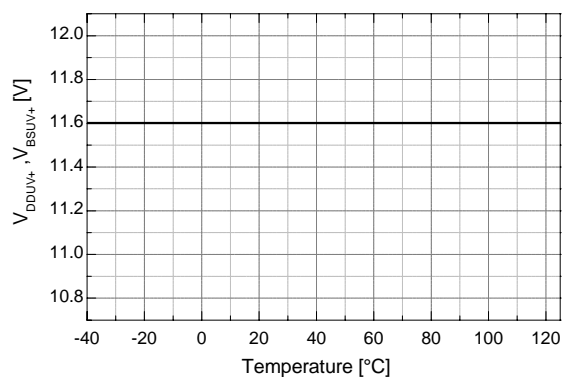


Figure 5. V_{DD}/V_{BS} UVLO (+) vs. Temperature

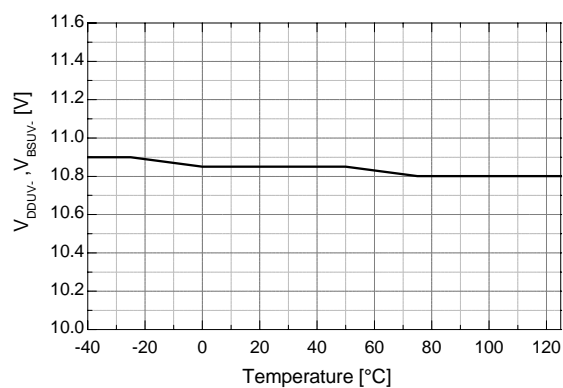


Figure 6. V_{DD}/V_{BS} UVLO (-) vs. Temperature

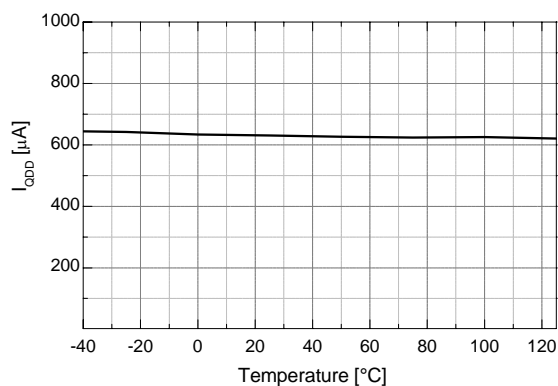


Figure 7. V_{DD} Quiescent Current vs. Temperature

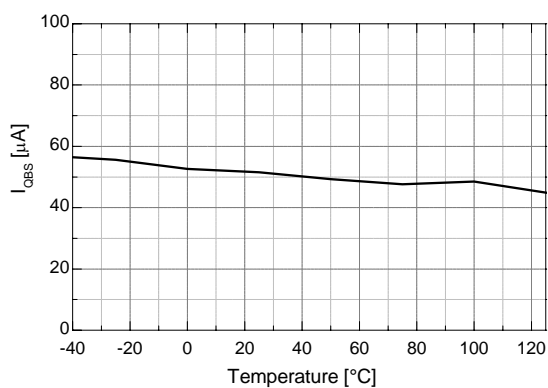


Figure 8. V_{BS} Quiescent Current vs. Temperature

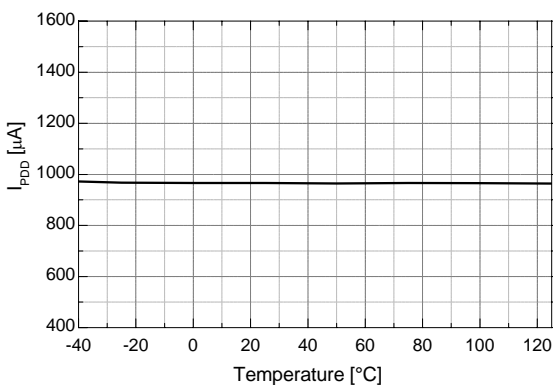


Figure 9. V_{DD} Operating Current vs. Temperature

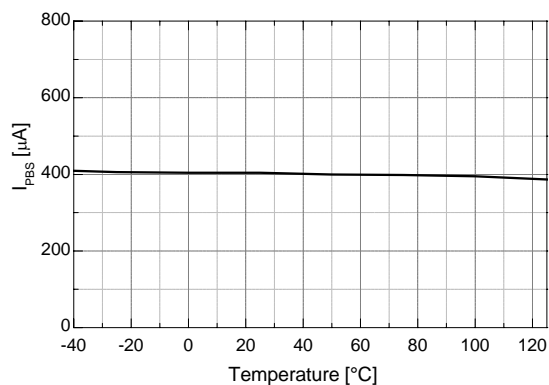


Figure 10. V_{BS} Operating Current vs. Temperature

Typical Characteristics (Continued)

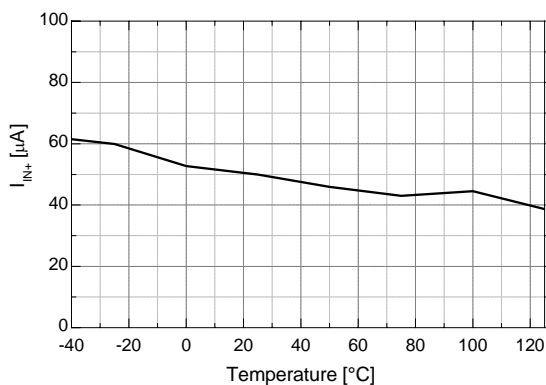


Figure 11. Logic Input Current vs. Temperature

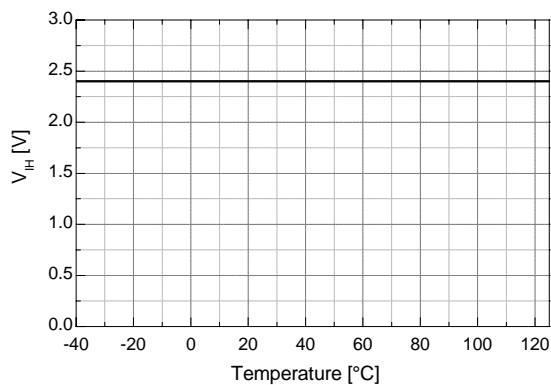


Figure 12. Logic Input High Voltage vs. Temperature

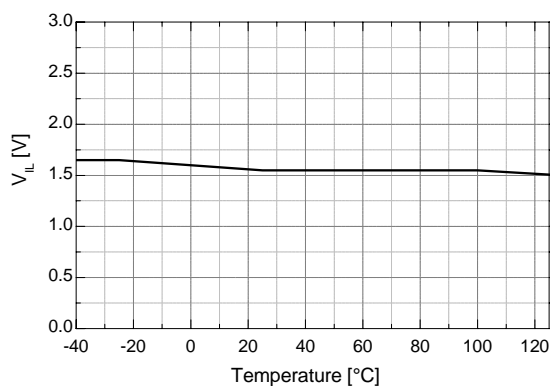


Figure 13. Logic Input Low Voltage vs. Temperature

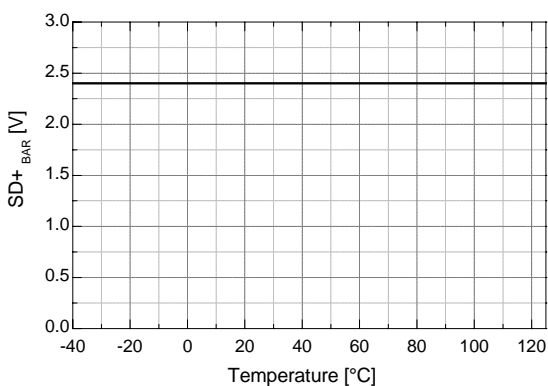
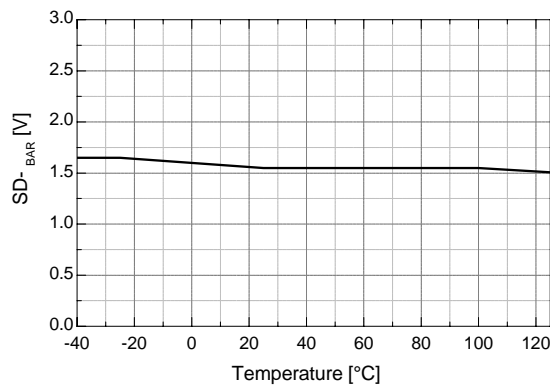
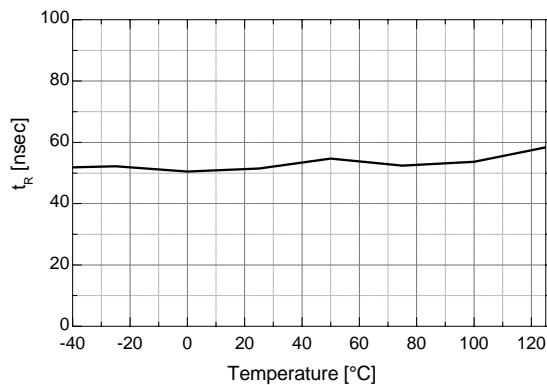
Figure 14. \overline{SD} Positive Threshold vs. TemperatureFigure 15. \overline{SD} Negative Threshold vs. Temperature

Figure 16. Rising Time vs. Temperature

Typical Characteristics (Continued)

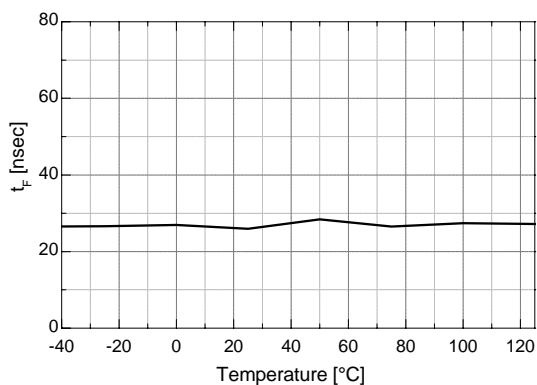


Figure 17. Falling Time vs. Temperature

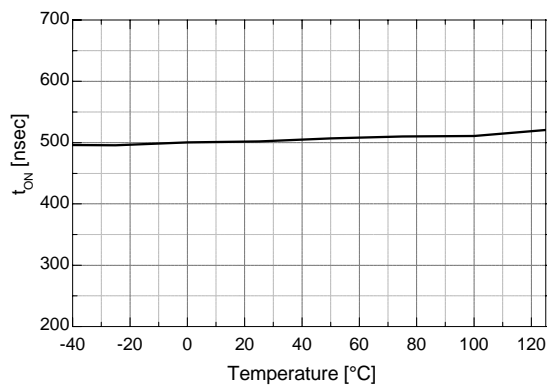


Figure 18. Turn-on Delay Time vs. Temperature

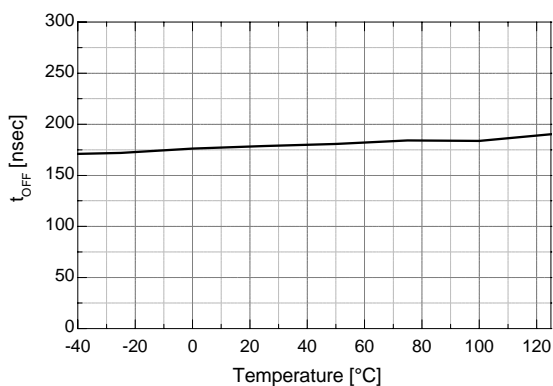
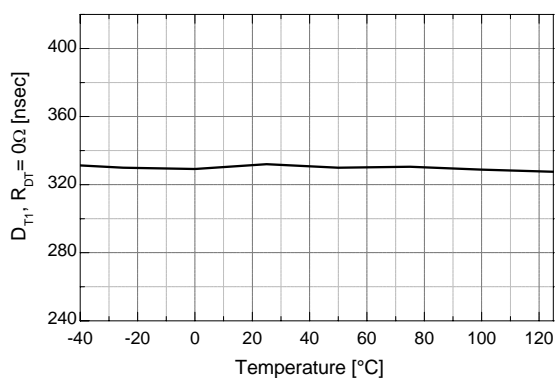
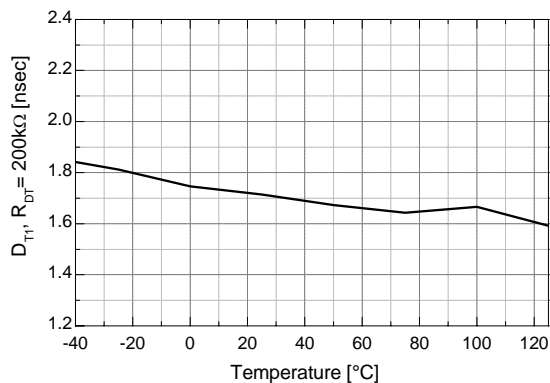
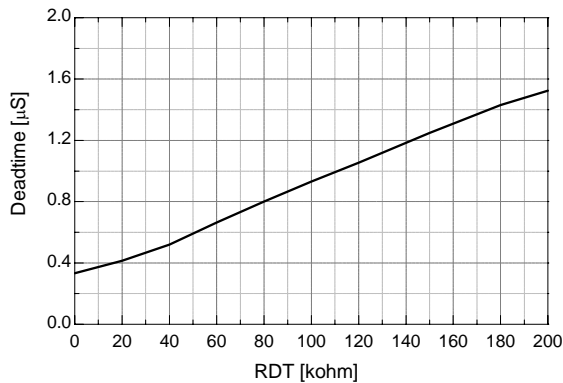


Figure 19. Turn-off Falling Time vs. Temperature

Figure 20. Dead-Time ($R_{DT}=0k\Omega$) vs. TemperatureFigure 21. Dead Time ($R_{DT}=200k\Omega$) vs. TemperatureFigure 22. R_{DT} vs. Dead Time

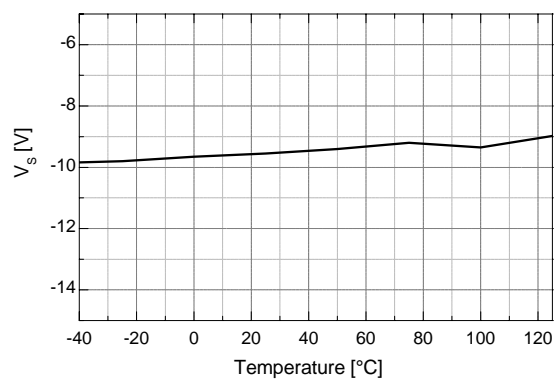
Typical Characteristics (Continued)

Figure 23. Allowable Negative V_S Voltage for Signal Propagation to High Side vs. Temperature

Switching Time Definitions

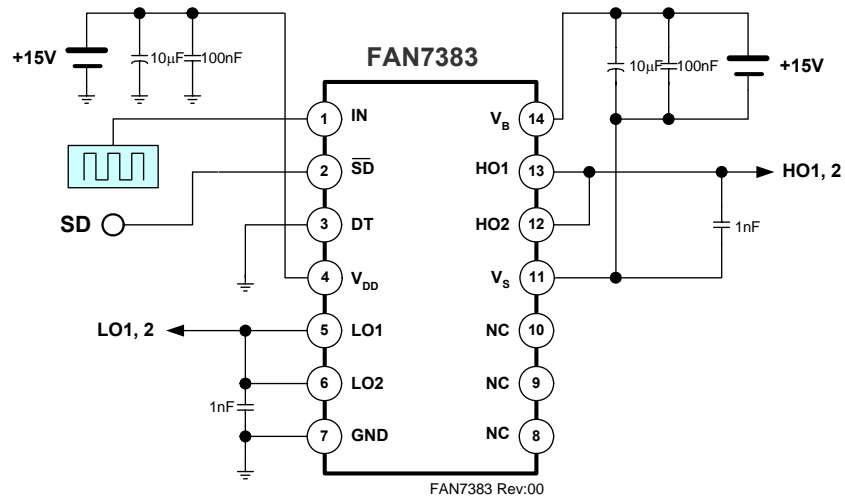


Figure 24. Switching Time Test Circuit

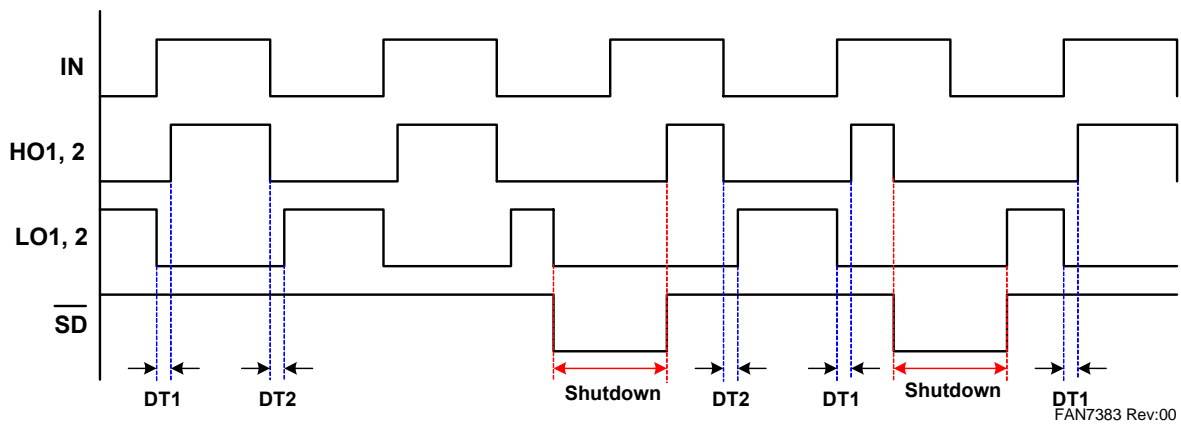


Figure 25. Input / Output Waveforms

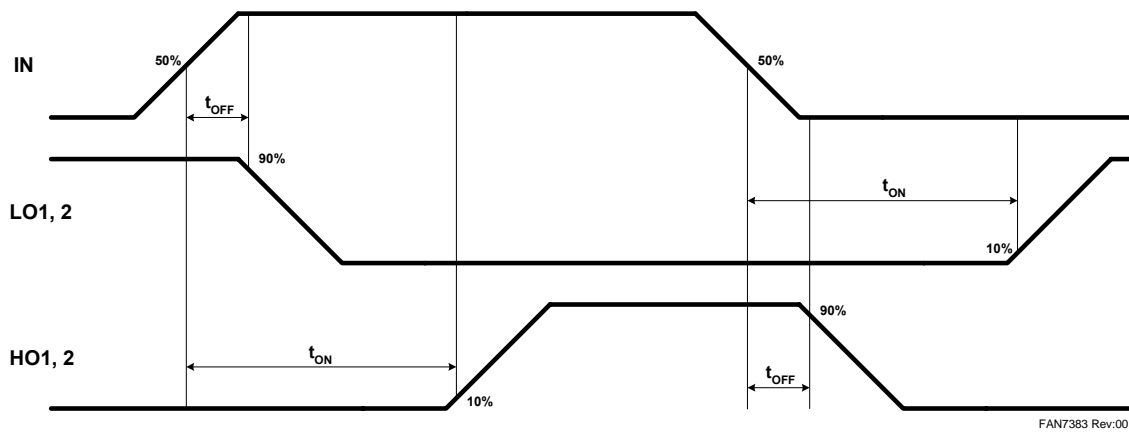


Figure 26. Switching Time Waveform Definitions

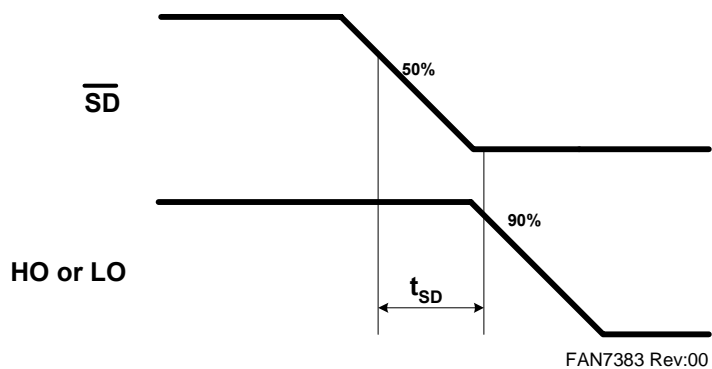


Figure 27. Shutdown Waveform Definition

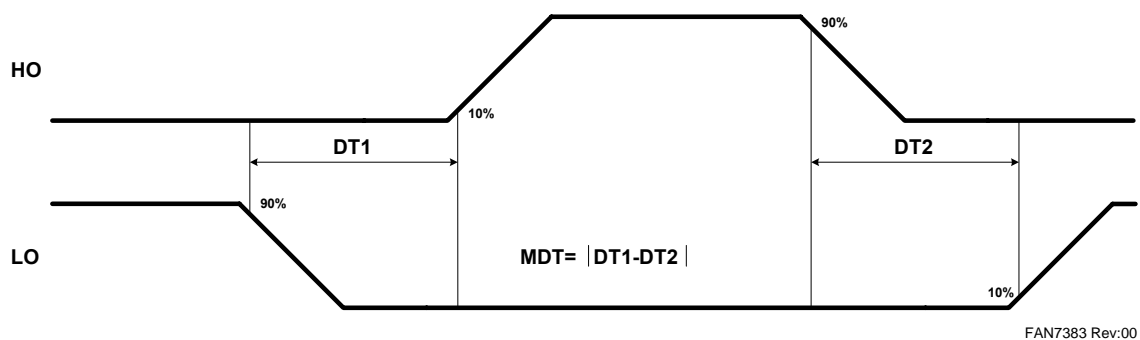


Figure 28. Dead-Time Waveform Definition

Typical Application Information

1. Normal Operating Consideration

The FAN7383 is a single PWM input half-bridge gate-drive IC with programmable dead-time and shutdown function.

The dead-time is set with a resistor (R_{DT}) at the DT pin. The wide dead-time programming range provides the flexibility to optimize drive signal timing for a selection of switching devices (MOSFET or IGBT) and applications.

The turn-on time delay circuitry (Dead-Time) accommodates resistor values from 0Ω to $200k\Omega$ with a dead-time proportional to the R_{DT} resistance.

Grounding the DT pin programs the FAN7383 to drive both outputs with minimum dead time.

If the \overline{SD} pin voltage decrease below 1.2V in normal operation, the IC enters the shutdown mode.

2. Under-Voltage Lockout (UVLO)

The FAN7383 has an under-voltage lockout (UVLO) protection circuitry for high and low side channels to prevent malfunction when V_{DD} or V_{BS} is lower than the specified threshold voltage. The UVLO circuitry monitors the supply voltage (V_{DD}) and bootstrap capacitor voltage (V_{BS}) independently.

3. Layout Consideration

For optimum performance of high- and low-side gate drivers, cannot be achieved without taking due considerations must be taken during printed circuit board (PCB) layout.

3.1 Supply Capacitors

If the output stages are able to quickly turn on the switching device with high value of current, the supply capacitors must be placed as close as possible to the device pins (V_{DD} and GND for the ground-tied supply, V_B and V_S for the floating supply) to minimize parasitic inductance and resistance.

3.2 Gate Drive Loop

Current loops behave like an antenna, able to receive and transmit noise. To reduce the noise coupling/emission and improve the power switch turn-on and off performances, gate drive loops must be reduced as much as possible.

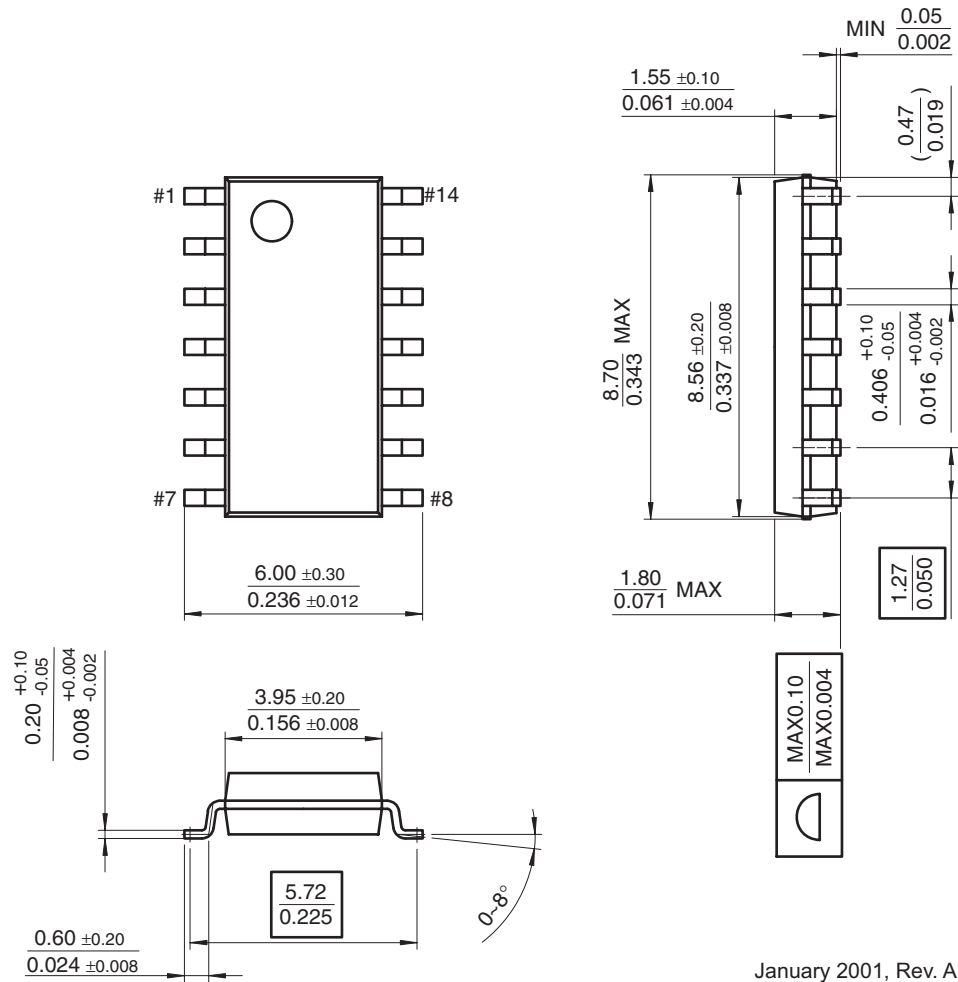
3.3 Ground Plane

Ground plane must not be placed under or nearby the high-voltage floating side to minimize noise coupling.

Package Dimensions

14-SOP

Dimensions are in millimeters unless otherwise noted.




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Figure 29. 14-Lead Small Outline Package (SOP)



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