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September 2015

FAN7380_OP Half-Bridge Gate Driver

Features

- Floating Channel Designed for Bootstrapping Operation to +600 V
- Typically 90 mA / 180 mA Sourcing/Sinking Current Driving Capability for Both Channels
- Common-Mode dv/dt Noise Cancelling Circuit
- Extended Allowable Negative V_S Swing to -9.8 V for Signal Propagation at $V_{CC}=V_{BS}=15$ V
- V_{CC} & V_{BS} Supply Range from 10 V to 20 V
- UVLO Functions for Both Channels
- TTL-Compatible Input Logic Threshold Levels
- Matched Propagation Delay Below 50 ns
- Built-in 100 ns Dead-Time Control Function
- Output In-Phase with Input Signal

Typical Applications

- SMPS
- Motor Driver
- PDP Scan Driver
- Industrial Application

Related Resources

- [AN-6076 - Design and Application Guide of Bootstrap Circuit for High-Voltage Gate-Drive IC](#)
- [AN-9052 - Design Guide for Selection of Bootstrap Components](#)
- [AN-8102 - Recommendations to Avoid Short Pulse Width Issues in HVIC Gate Driver Applications](#)

Description

The FAN7380_OP is a monolithic half-bridge gate-drive IC for MOSFETs and IGBTs that operate up to +600 V. Fairchild's high-voltage process and common-mode noise cancelling 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 input logic level is compatible with standard TTL-series logic gates. The internal shoot-through protection circuit provides 100 ns dead-time to prevent output switching devices from both conducting during transition periods. UVLO circuits for both channels prevent malfunction when V_{CC} and V_{BS} are lower than the specified threshold voltage. Output drivers typically source / sink at 90 mA / 180 mA, respectively, which is suitable for fluorescent / compact fluorescent lamp ballast applications and systems requiring low di/dt noise.

8-SOP



Ordering Information

| Device | Package | Pb-Free | Operating Temperature | Packing | Description |
|-----------------------------|---------|---------|-----------------------|-------------|---------------------|
| FAN7380MX_OP ⁽¹⁾ | 8-SOP | Yes | -40°C ~ +125°C | Tape & Reel | General Application |

Note:

1. This device has passed wave soldering test by JESD22A-111.

Typical Application Circuit

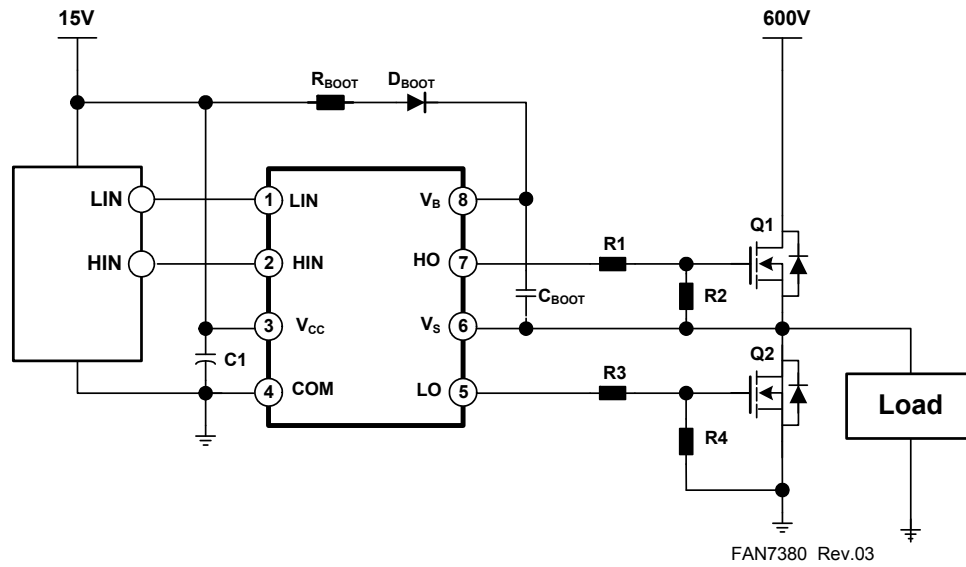


Figure 1. Application Circuit for Half-Bridge

Internal Block Diagram

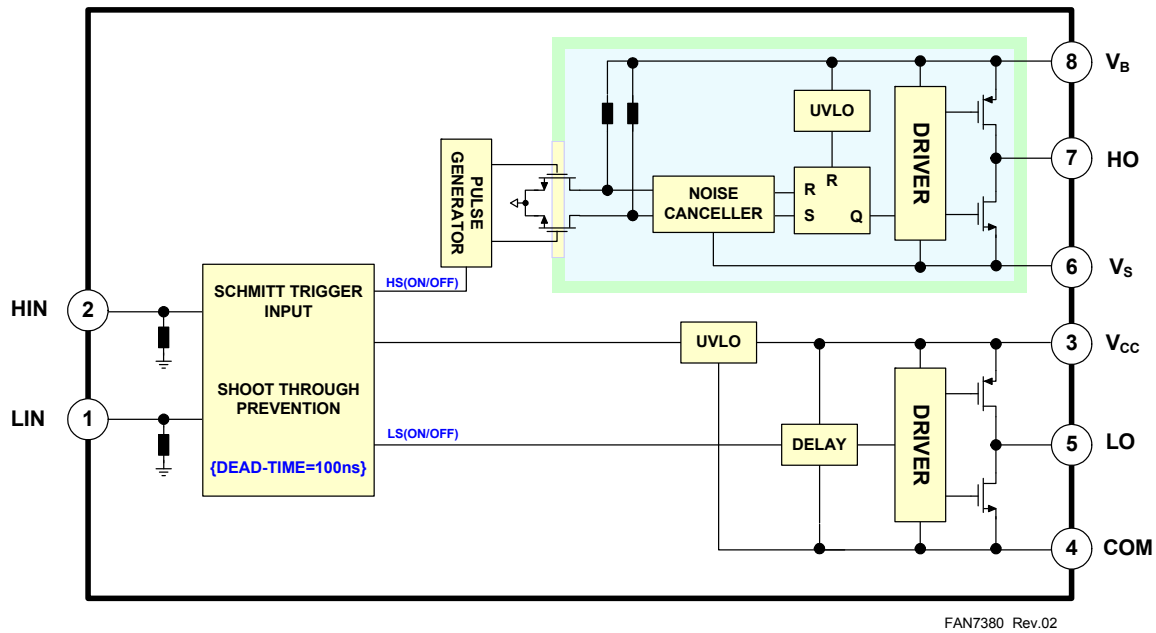


Figure 2. Functional Block Diagram

Pin Configuration

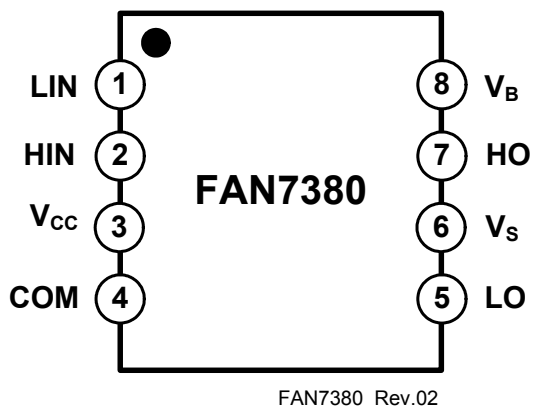


Figure 3. Pin Configuration (Top View)

Pin Definitions

| Pin # | Name | I/O | Description |
|-------|-----------------|-----|--|
| 1 | LIN | I | Logic Input for Low-Side Gate Driver Output |
| 2 | HIN | I | Logic Input for High-Side Gate Driver Output |
| 3 | V _{CC} | I | Low-Side Supply Voltage |
| 4 | COM | | Logic Ground and Low-Side Driver Return |
| 5 | LO | O | Low-Side Driver Output |
| 6 | V _S | I | High-Voltage Floating Supply Return |
| 7 | HO | O | High-Side Driver Output |
| 8 | V _B | I | 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 | 625.0 | |
| V_{HO} | High-side floating output voltage HO | $V_S-0.3$ | $V_B+0.3$ | |
| V_{CC} | Low-side and logic-fixed supply voltage | -0.3 | 25.0 | |
| V_{LO} | Low-side output voltage LO | -0.3 | $V_{CC}+0.3$ | |
| V_{IN} | Logic input voltage (HIN, LIN) | -0.3 | $V_{CC}+0.3$ | |
| COM | Logic ground | $V_{CC}-25$ | $V_{CC}+0.3$ | |
| dV_S/dt | Allowable offset voltage slew rate | | 50 | V/ns |
| $P_D^{(2)(3)(4)}$ | Power dissipation | | 0.625 | W |
| θ_{JA} | Thermal resistance, junction-to-ambient | | 200 | $^{\circ}\text{C}/\text{W}$ |
| T_J | Junction temperature | | 150 | $^{\circ}\text{C}$ |
| T_S | Storage temperature | -50 | 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 Ratings

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance. 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 | $6-V_{CC}$ | 600 | |
| V_{HO} | High-side (HO) output voltage | V_S | V_B | |
| V_{LO} | Low-side (LO) output voltage | COM | V_{CC} | |
| V_{IN} | Logic input voltage (HIN, LIN) | COM | V_{CC} | |
| V_{CC} | Low-side supply voltage | 10 | 20 | |
| T_A | Ambient temperature | -40 | 125 | $^{\circ}\text{C}$ |

Static Electrical Characteristics

$V_{BIAS}(V_{CC}, V_{BS}) = 15.0\text{ V}$, $T_A = 25^\circ\text{C}$, 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 the respective outputs HO and LO.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------------------|---|--|------|------|------|---------------|
| V_{CCUV+} V_{BSUV+} | V_{CC} & V_{BS} supply under-voltage positive going threshold | | 8.2 | 9.2 | 10.0 | V |
| V_{CCUV-} V_{BSUV-} | V_{CC} & V_{BS} supply under-voltage negative going threshold | | 7.6 | 8.7 | 9.6 | |
| V_{CCUVH} V_{BSUVH} | V_{CC} supply under-voltage lockout hysteresis | | | 0.5 | | |
| I_{LK} | Offset supply leakage current | $V_B = V_S = 600\text{ V}$ | | | 50 | μA |
| I_{QBS} | Quiescent V_{BS} supply current | $V_{IN} = 0\text{ V or } 5\text{ V}$ | | 44 | 100 | |
| I_{QCC} | Quiescent V_{CC} supply current | $V_{IN} = 0\text{ V or } 5\text{ V}$ | | 70 | 180 | |
| I_{PBS} | Operating V_{BS} supply current | $f_{IN} = 20\text{ kHz, rms value}$ | | | 600 | μA |
| I_{PCC} | Operating V_{CC} supply current | $f_{IN} = 20\text{ kHz, rms value}$ | | | 610 | |
| V_{IH} | Logic "1" input voltage | | 2.5 | | | V |
| V_{IL} | Logic "0" input voltage | | | | 0.8 | |
| V_{OH} | High-level output voltage, $V_{BIAS} - V_O$ | $I_O = 20\text{ mA}$ | | | 2.8 | V |
| V_{OL} | Low-level output voltage, V_O | | | | 1.2 | |
| I_{IN+} | Logic "1" input bias current | $V_{IN} = 5\text{ V}$ | | 5 | 40 | μA |
| I_{IN-} | Logic "0" input bias current | $V_{IN} = 0\text{ V}$ | | 1.0 | 2.0 | |
| I_{O+} | Output HIGH short-circuit pulse current | $V_O = 0\text{ V}, V_{IN} = 5\text{ V with } PW \leq 10\text{ }\mu\text{s}$ | 60 | 90 | | mA |
| I_{O-} | Output LOW short-circuit pulsed current | $V_O = 15\text{ V}, V_{IN} = 0\text{ V with } PW \leq 10\text{ }\mu\text{s}$ | 130 | 180 | | |
| V_S | Allowable negative V_S pin voltage for HIN signal propagation to HO | | | -9.8 | -7.0 | V |

Dynamic Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|---|------|------|------|------|
| t_{on} | Turn-on propagation delay | $V_S = 0\text{ V}$ | 70 | 135 | 200 | ns |
| t_{off} | Turn-off propagation delay | $V_S = 0\text{ V or } 600\text{ V}^{(5)}$ | 60 | 130 | 190 | |
| t_r | Turn-on rise time | | 160 | 230 | 290 | |
| t_f | Turn-off fall time | | 20 | 90 | 160 | |
| DT | Dead time | | 80 | 120 | 190 | |
| MT | Delay matching, HS & LS turn-on/off | | | | 50 | |

Note:

5. This parameter guaranteed by design.

Typical Performance Characteristics

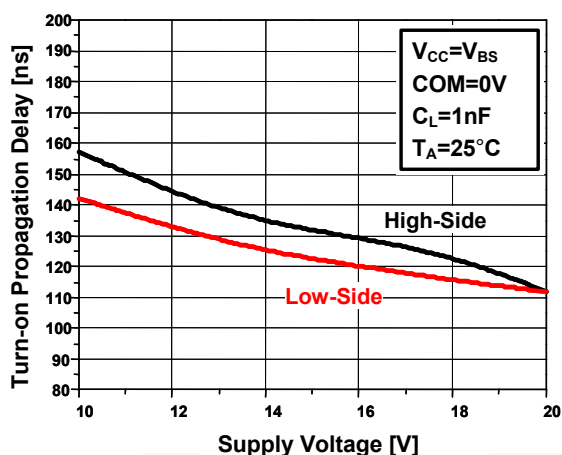


Figure 4. Turn-On Propagation Delay vs. Supply Voltage

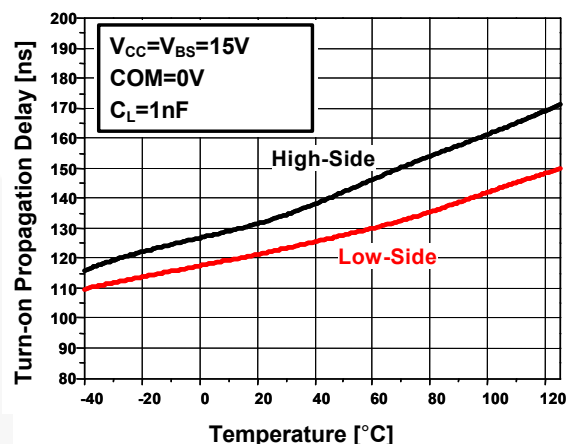


Figure 5. Turn-On Propagation Delay vs. Temp.

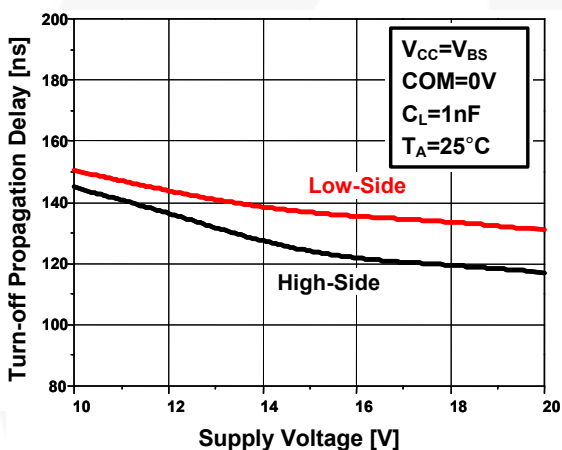


Figure 6. Turn-Off Propagation Delay vs. Supply Voltage

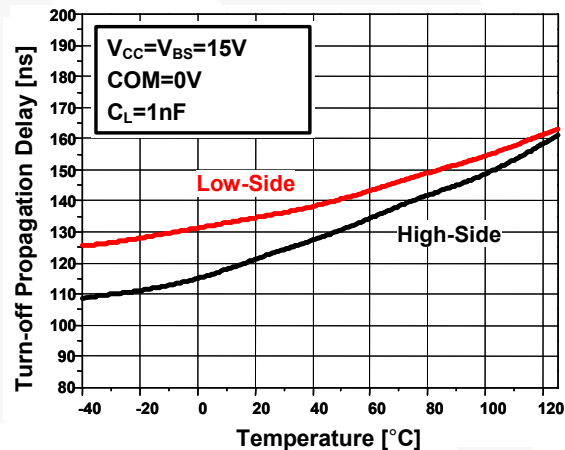


Figure 7. Turn-Off Propagation Delay vs. Temp.

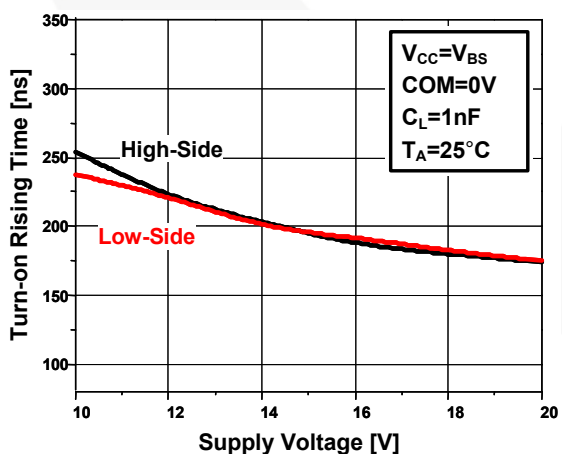


Figure 8. Turn-On Rising Time vs. Supply Voltage

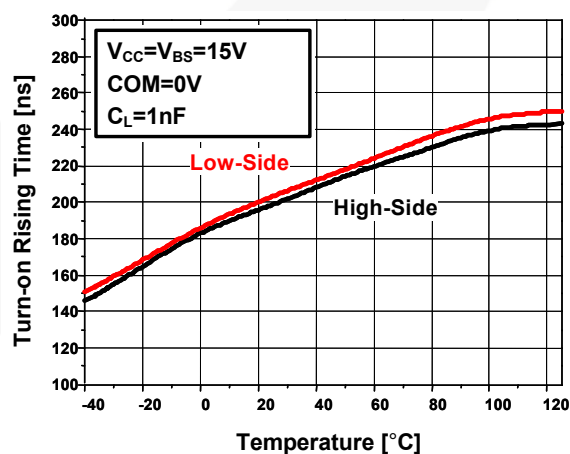


Figure 9. Turn-On Rising Time vs. Temp.

Typical Performance Characteristics (Continued)

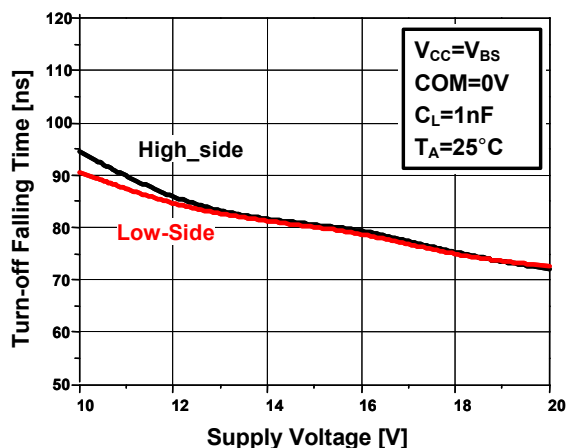


Figure 10. Turn-Off Falling Time vs. Supply Voltage

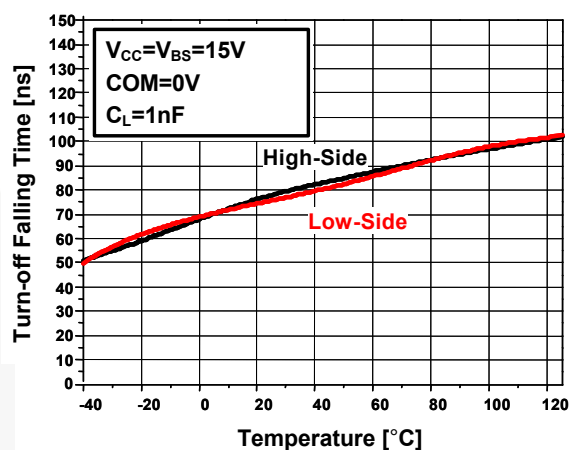


Figure 11. Turn-Off Falling Time vs. Temp.

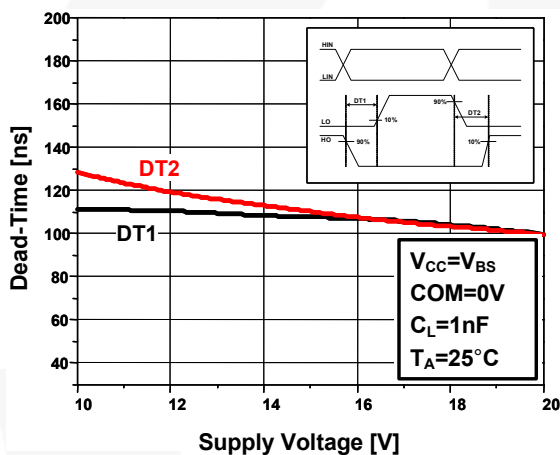


Figure 12. Dead-Time vs. Supply Voltage

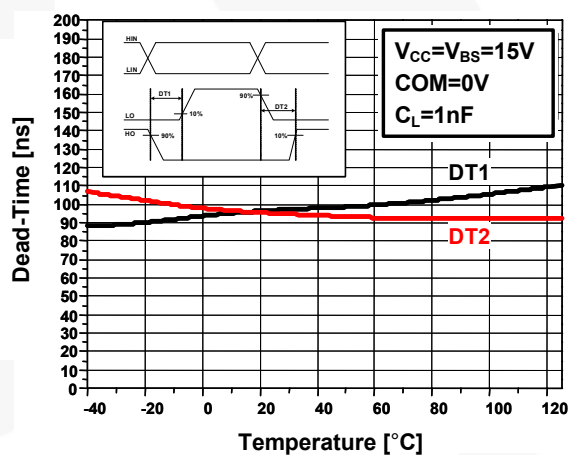


Figure 13. Dead-Time vs. Temp.

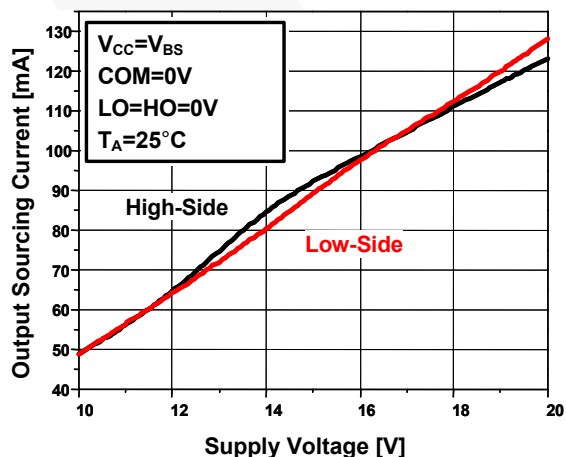


Figure 14. Output Sourcing Current vs. Supply Voltage

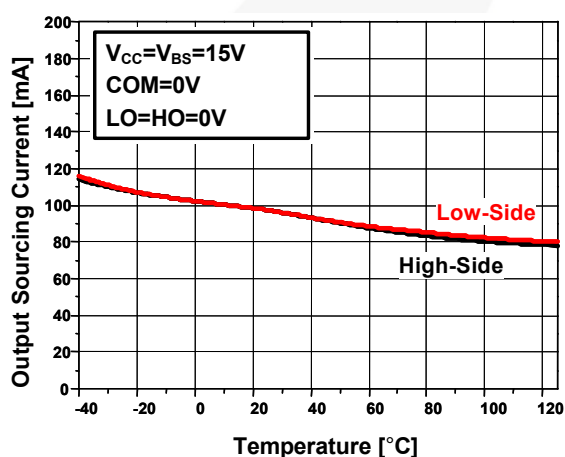


Figure 15. Output Sourcing Current vs. Temp.

Typical Performance Characteristics (Continued)

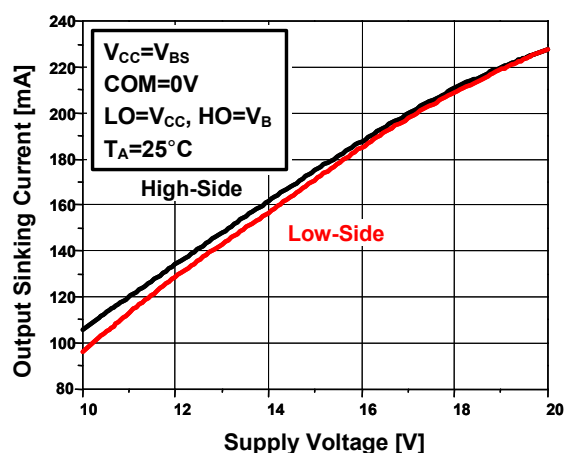


Figure 16. Output Sinking Current vs. Supply Voltage

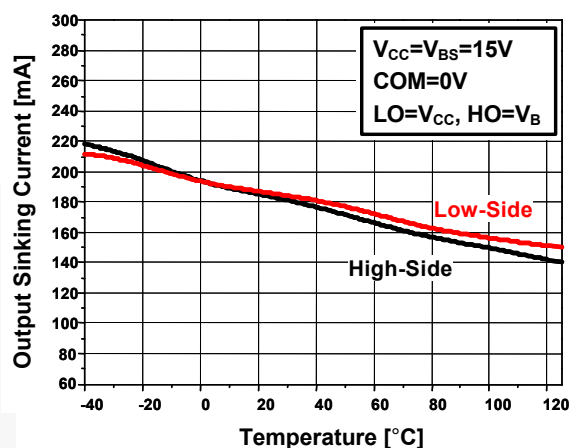
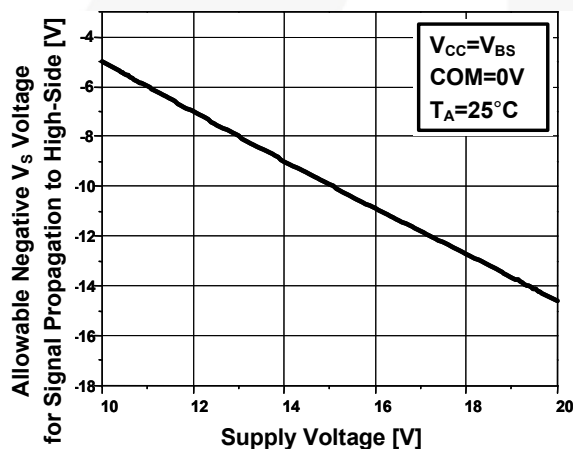
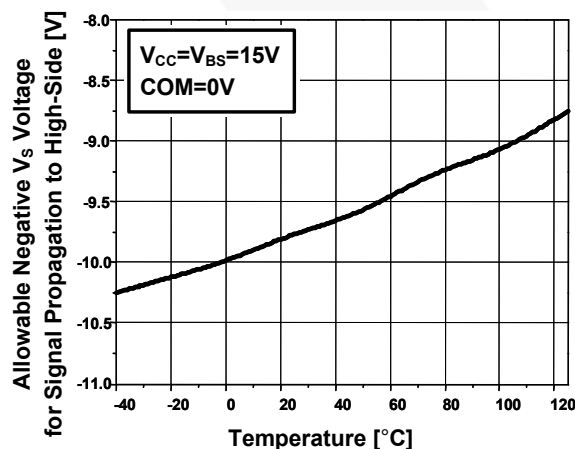
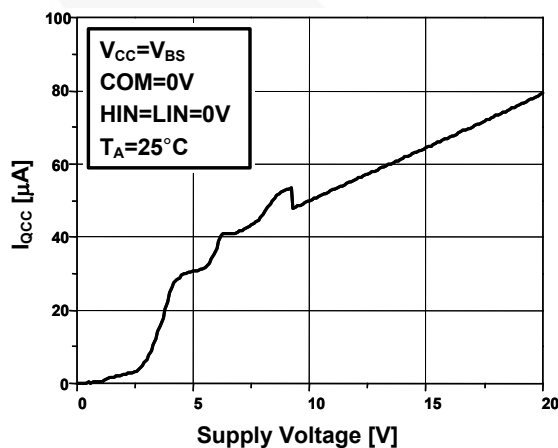
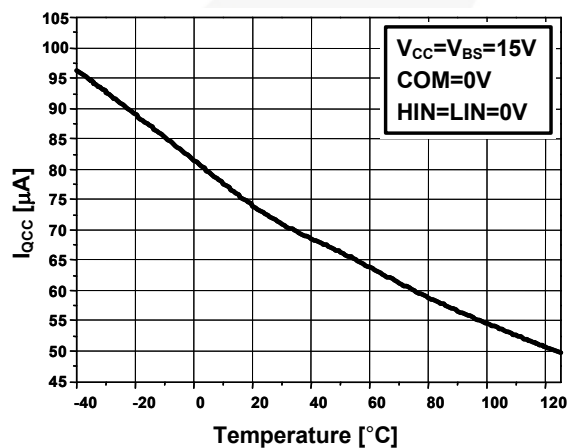


Figure 17. Output Sinking Current vs. Temp.

Figure 18. Allowable Negative V_S Voltage for Signal Propagation to High-Side vs. Supply VoltageFigure 19. Allowable Negative V_S Voltage for Signal Propagation to High-Side vs. TemperatureFigure 20. I_{QCC} vs. Supply VoltageFigure 21. I_{QCC} vs. Temperature

Typical Performance Characteristics (Continued)

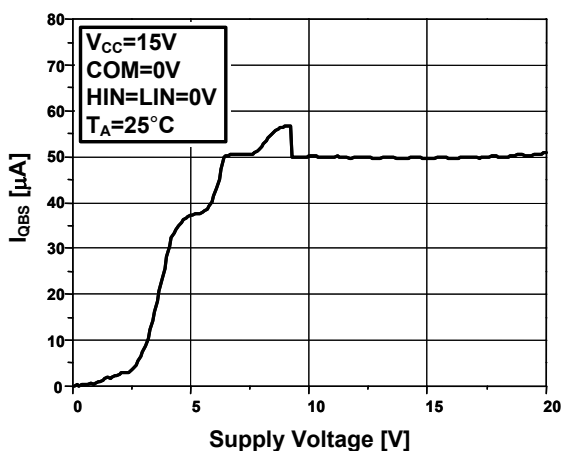
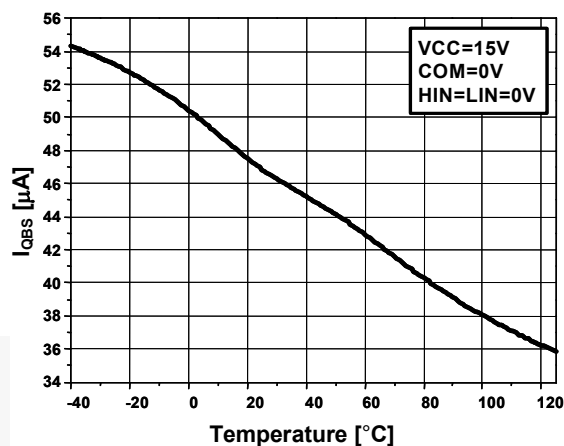
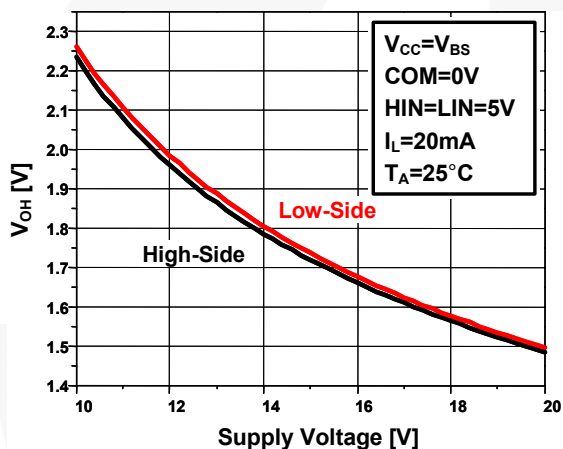
Figure 22. I_{QBS} vs. Supply VoltageFigure 23. I_{QBS} vs. Temperature

Figure 24. High-Level Output Voltage vs. Supply Voltage

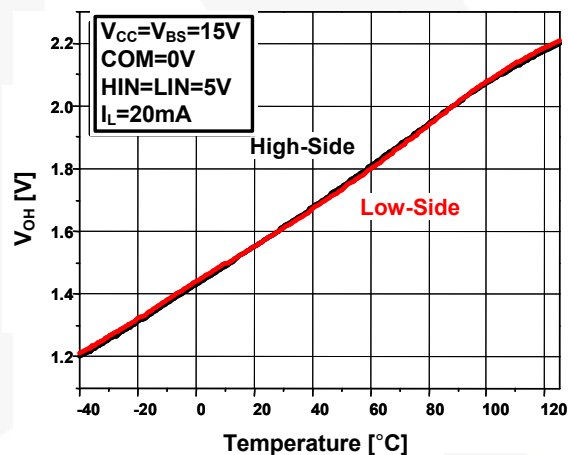


Figure 25. High-Level Output Voltage vs. Temp.

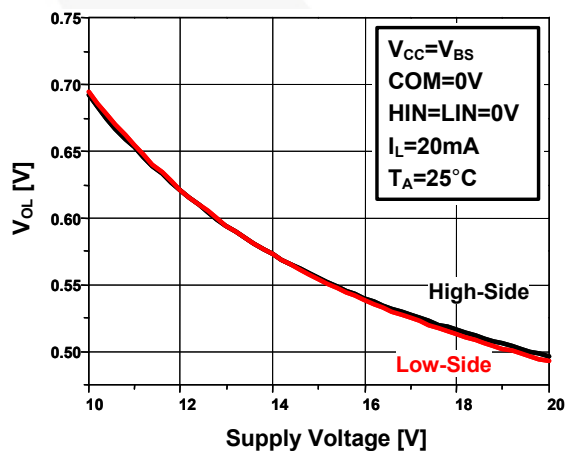


Figure 26. Low-Level Output Voltage vs. Supply Voltage

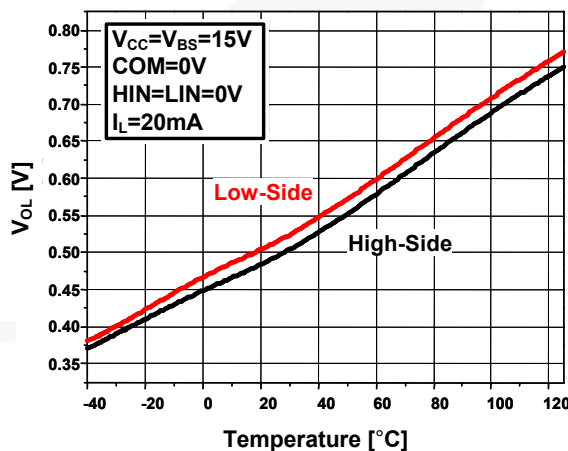


Figure 27. Low-Level Output Voltage vs. Temp.

Typical Performance Characteristics (Continued)

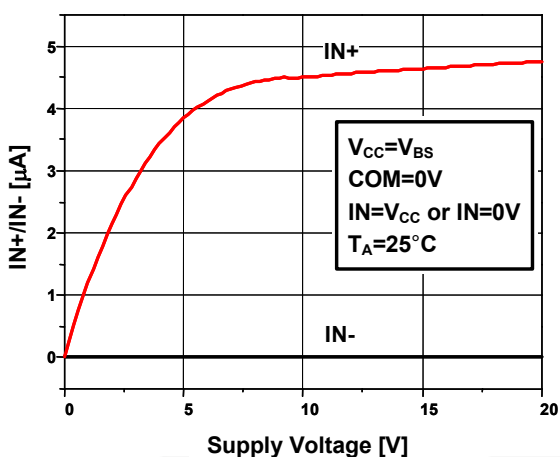


Figure 28. Input Bias Current vs. Supply Voltage

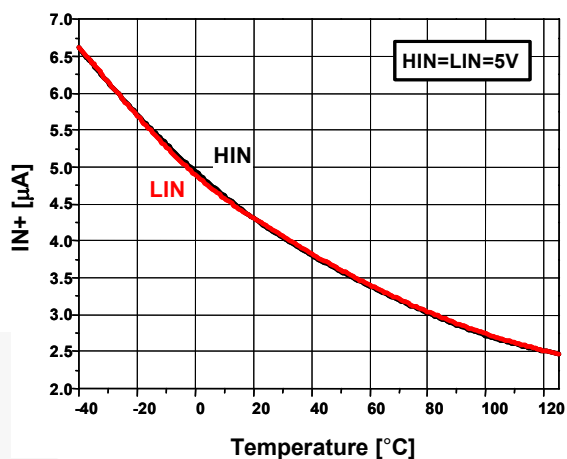


Figure 29. Input Bias Current vs. Temperature

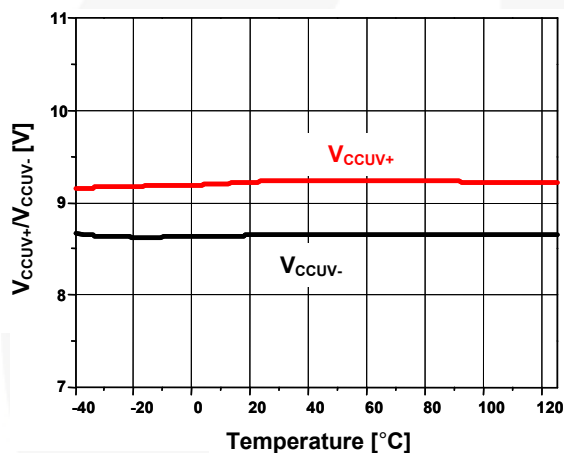
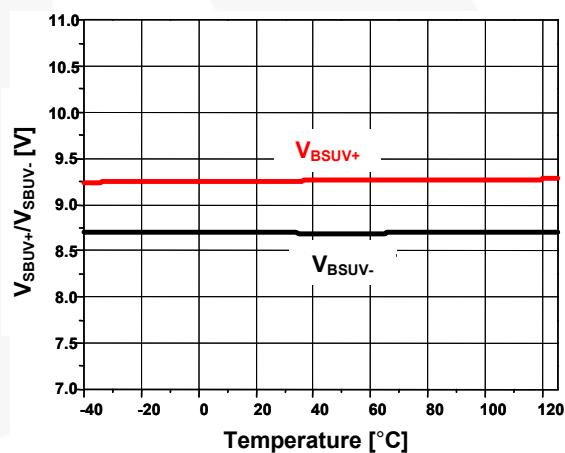
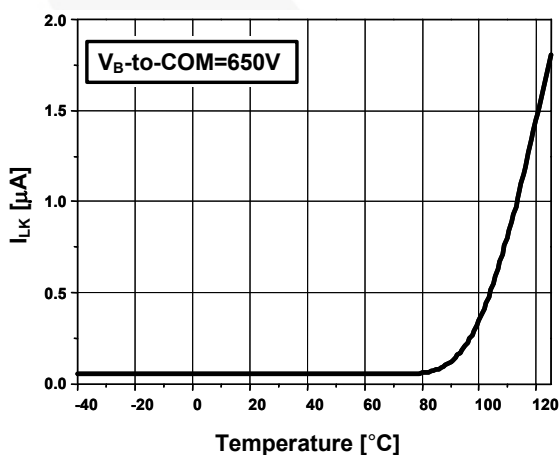
Figure 30. V_{CC} UVLO Threshold Voltage vs. Temp.Figure 31. V_{BS} UVLO Threshold Voltage vs. Temp.

Figure 32. VB to COM Leakage Current vs. Temp.

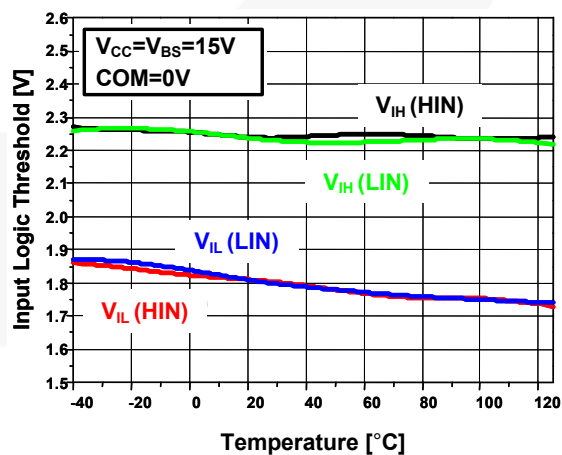


Figure 33. Input Logic Threshold vs. Temp.

Switching Time Definitions

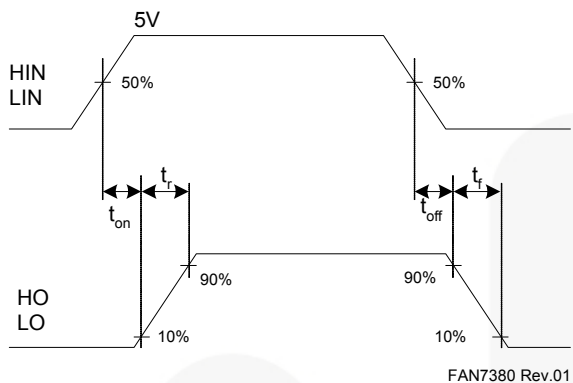


Figure 34. Switching Time Waveforms

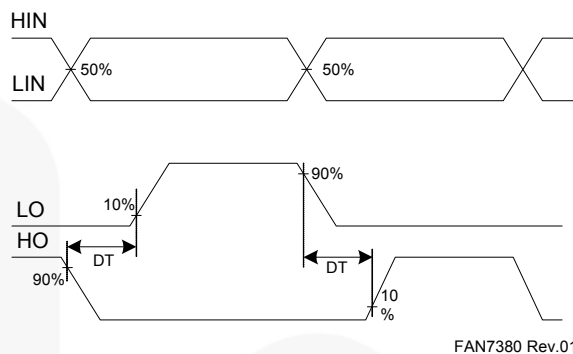
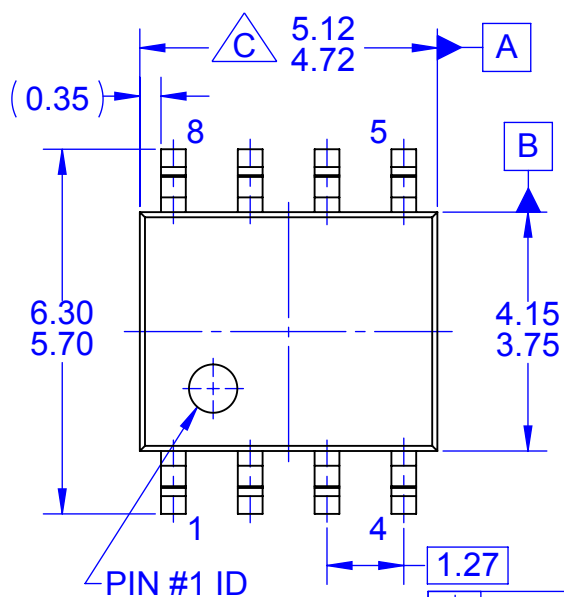
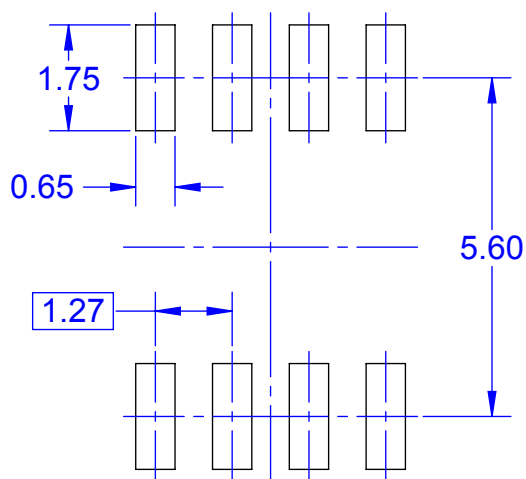


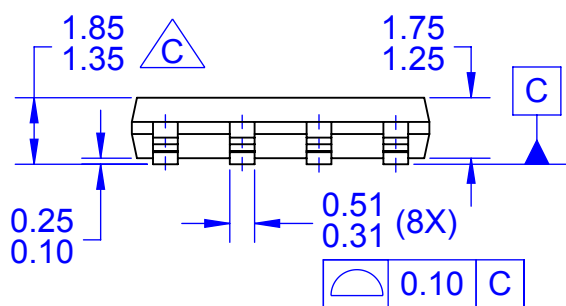
Figure 35. Internal Dead-Time Timing



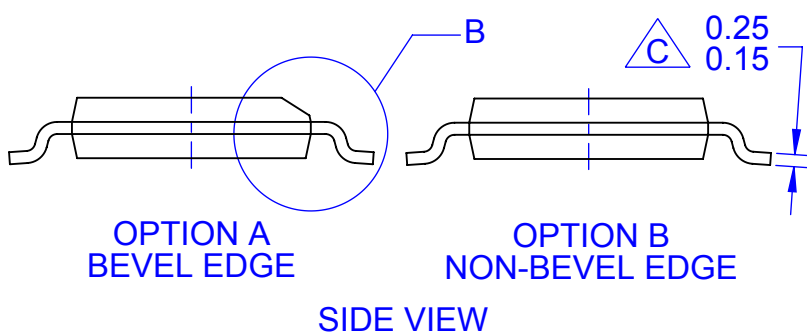
TOP VIEW



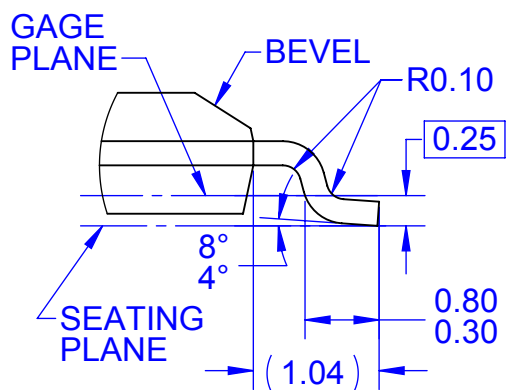
LAND PATTERN RECOMMENDATION



FRONT VIEW



SIDE VIEW



DETAIL "B"
SCALE 2:1

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