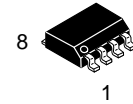


600 V / 4 A, High-Side Automotive Gate Driver IC

FAD7171MX



SOIC-8 NB
CASE 751-07

Description

The FAD7171MX is a monolithic high-side gate drive IC that can drive high-speed MOSFETs and IGBTs that operate up to +600 V. It has a buffered output stage with all NMOS transistors designed for high pulse current driving capability and minimum cross-conduction. onsemi'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 $V_S = -11$ V for $V_{BS} = 15$ V.

The UVLO circuit prevents malfunction when V_{BS} is lower than the specified threshold voltage. The high-current and low-output voltage-drop feature make this device suitable for sustaining switch drivers and energy-recovery switch drivers in automotive motor drive inverters, switching power supplies, and high-power DC-DC converter applications.

Features

- Floating Channel for Bootstrap Operation to +600 V
- 4 A Sourcing and 4 A Sinking Current Driving Capability
- Common-Mode dv/dt Noise-Cancelling Circuit
- 3.3 V and 5 V Input Logic Compatible
- Output In-phase with Input Signal
- Under-Voltage Lockout for V_{BS}
- 8-SOIC Package, Case 751-07 (JEDEC MS-012, 0.150 inch Narrow Body)
- AEC-Q100 Qualified and PPAP Capable for Ambient Operating Temperature from -40°C to 125°C

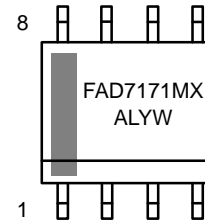
Applications

- Common Rail Injection Systems
- DC-DC Converter
- Motor Drive (Electric Power Steering, Fans)

Related Product Resources

- [FAN7171 Product Folder](#)
- [FAD7171 Product Folder](#)
- [AND9674](#) Design and Application Guide of Bootstrap Circuit for High-Voltage Gate-Drive IC
- [AN-8102](#) Recommendations to Avoid Short Pulse Width Issues in HVIC Gate Driver Applications
- [AN-9052](#) Design Guide for Selection of Bootstrap Components

MARKING DIAGRAM



FAD7171MX = Device
A = Assembly Site
L = Wafer Lot Number
YW = Assembly Start Week

ORDERING INFORMATION

| Device | Package | Shipping† |
|-----------|-----------------------------------|--------------------|
| FAD7171MX | SOIC8 (Pb-Free / Halogen Free) | 2500 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

FAD7171MX

TYPICAL APPLICATION

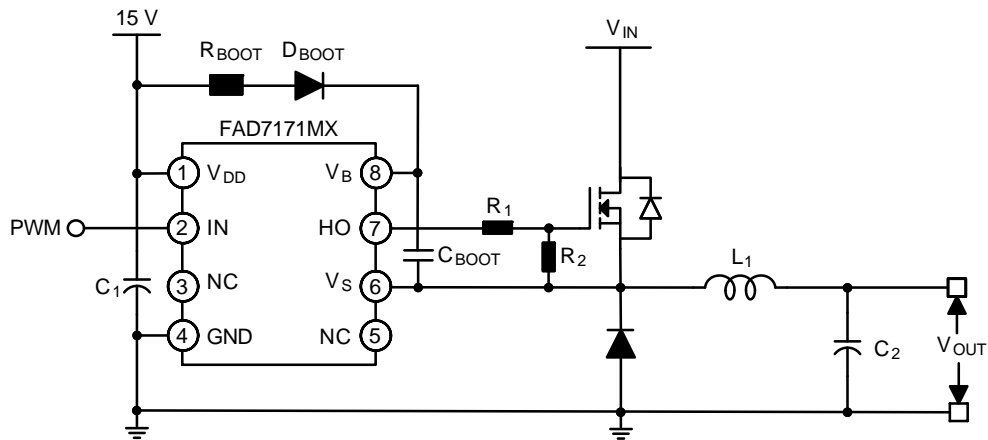


Figure 1. Typical Application

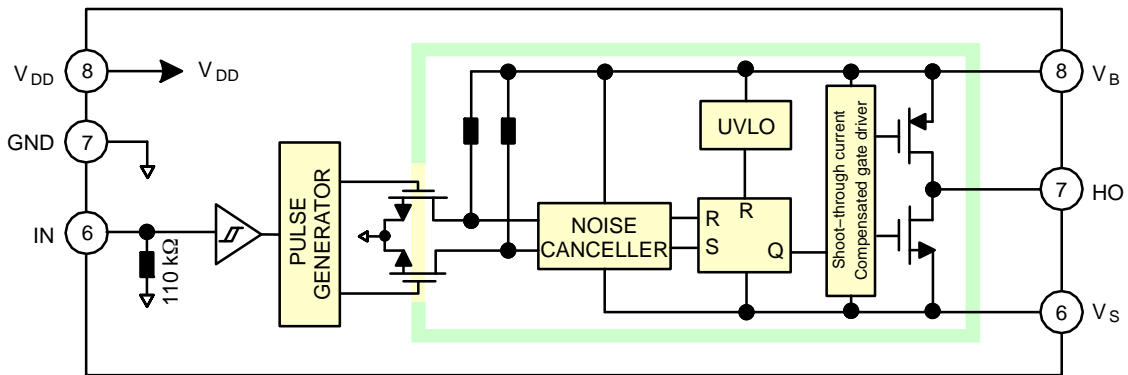


Figure 2. Block Diagram

PIN CONFIGURATION

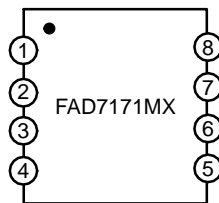


Figure 3. Pin Assignment (Top Through View)

FAD7171MX

PIN DESCRIPTION

| Pin No. | Symbol | Description |
|---------|-----------------|--|
| 1 | V _{DD} | Supply Voltage |
| 2 | IN | Logic Input for High-Side Gate Driver Output |
| 3 | NC | No Connection |
| 4 | GND | Ground |
| 5 | NC | No Connection |
| 6 | V _S | High-Voltage Floating Supply Return |
| 7 | HO | High-Side Driver Output |
| 8 | V _B | High-Side Floating Supply |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Characteristics | Min | Max | Unit |
|---------------------|------------------------------------|----------------------|-----------------------|------|
| V _S | High-Side Floating Offset Voltage | V _B - 25 | V _B + 0.3 | V |
| V _B | High-Side Floating Supply Voltage | -0.3 | 625.0 | V |
| V _{HO} | High-Side Floating Output Voltage | V _S - 0.3 | V _B + 0.3 | V |
| V _{DD} | Low-Side and Logic Supply Voltage | -0.3 | 25 | V |
| V _{IN} | Logic Input Voltage | -0.3 | V _{DD} + 0.3 | V |
| dV _S /dt | Allowable Offset Voltage Slew Rate | - | ±50 | V/ns |
| P _D | Power Dissipation (Notes 2, 3, 4) | - | 0.625 | W |
| θ _{JA} | Thermal Resistance | - | 200 | °C/W |
| T _J | Junction Temperature | -55 | 150 | °C |
| T _{STG} | Storage Temperature | -55 | 150 | °C |
| T _A | Operating Ambient Temperature | -40 | 125 | °C |
| ESD | Human Body Model (HBM) | - | 2000 | V |
| | Charge Device Model (CDM) | - | 500 | |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

3. Refer to the following standards:

JESD51-2: Integral circuits thermal test method environmental conditions, natural convection, and

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

4. Do not exceed power dissipation (P_D) under any circumstances.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Characteristics | Min | Max | Unit |
|--------------------|--|----------------|-----------------|------|
| V _{BS} | High-Side Floating Supply Voltage | 10 | 20 | V |
| V _S | High-Side Floating Supply Offset Voltage (DC) @ V _{BS} = 15 V | -11 | 600 | V |
| V _{HO} | High-Side Output Voltage | V _S | V _B | V |
| V _{IN} | Logic Input Voltage | GND | V _{DD} | V |
| V _{DD} | Supply Voltage | 10 | 20 | V |
| T _{PULSE} | Minimum Input Pulse Width | 80 | - | ns |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

FAD7171MX

ELECTRICAL CHARACTERISTICS (V_{BIAS} (V_{DD} , V_{BS}) = 15 V, $-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to GND. The V_O and I_O parameters are relative to V_S and are applicable to the respective output HO)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------|-----------|------------|-----|-----|-----|------|
|--------|-----------|------------|-----|-----|-----|------|

POWER SUPPLY SECTION

| | | | | | | |
|-----------|-----------------------------------|---|---|-----|-----|---------------|
| I_{QDD} | Quiescent V_{DD} Supply Current | $V_{IN} = 0\text{ V or }5\text{ V}$ | – | 85 | 200 | μA |
| I_{PDD} | Operating V_{DD} Supply Current | $C_{LOAD} = 1\text{ nF}$, $f_{IN} = 20\text{ kHz}$ | – | 105 | 170 | μA |

BOOTSTRAPPED SUPPLY SECTION

| | | | | | | |
|-------------|--|---|-----|-----|------|---------------|
| V_{BSUV+} | V_{BS} Supply Under-Voltage Positive-Going Threshold Voltage | $V_{BS} = \text{Sweep}$ | 8.4 | 9.4 | 10.1 | V |
| V_{BSUV-} | V_{BS} Supply Under-Voltage Negative-Going Threshold Voltage | $V_{BS} = \text{Sweep}$ | 7.7 | 8.7 | 9.3 | V |
| V_{BSHYS} | V_{BS} Supply UVLO Hysteresis Voltage | $V_{BS} = \text{Sweep}$ | – | 0.7 | – | V |
| I_{LK} | Offset Supply Leakage Current | $V_B = V_S = 600\text{ V}$ | – | – | 50 | μA |
| I_{QBS} | Quiescent V_{BS} Supply Current | $V_{IN} = 0\text{ V or }5\text{ V}$ | – | 43 | 95 | μA |
| I_{PBS} | Operating V_{BS} Supply Current | $C_{LOAD} = 1\text{ nF}$, $f_{IN} = 20\text{ kHz}$ | – | 620 | 1200 | μA |

INPUT LOGIC SECTION (IN)

| | | | | | | |
|-------------|--------------------------------|-----------------------|-----|-----|-----|---------------|
| V_{IH} | Logic "1" Input Voltage | | 1.8 | – | – | V |
| V_{IL} | Logic "0" Input Voltage | | | – | 0.8 | V |
| V_{INHYS} | Logic Input Hysteresis Voltage | | – | 0.5 | – | V |
| I_{IN+} | Logic Input High Bias Current | $V_{IN} = 5\text{ V}$ | – | 45 | 100 | μA |
| I_{IN-} | Logic Input Low Bias Current | $V_{IN} = 0\text{ V}$ | – | – | 2 | μA |
| R_{IN} | Input Pull-down Resistance | | 30 | 105 | – | k Ω |

GATE DRIVER OUTPUT SECTION (HO)

| | | | | | | |
|----------|--|--|-----|-----|----|----|
| V_{OH} | High Level Output Voltage ($V_{BIAS} - V_O$) | No Load | – | – | 35 | mV |
| V_{OL} | Low Level Output Voltage | No Load | – | – | 35 | mV |
| I_{O+} | Output High, Short-Circuit Pulsed Current (Note 5) | $V_{HO} = 0\text{ V}$, $V_{IN} = 5\text{ V}$, $PW \leq 10\ \mu\text{s}$ | 2.5 | 4.0 | – | A |
| I_{O-} | Output Low, Short-Circuit Pulsed Current (Note 5) | $V_{HO} = 15\text{ V}$, $V_{IN} = 0\text{ V}$, $PW \leq 10\ \mu\text{s}$ | 2.5 | 4.0 | – | A |
| V_S | Allowable Negative V_S Pin Voltage for IN Signal Propagation to HO | | – | – | 11 | V |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

5. These parameters guaranteed by design.

DYNAMIC ELECTRICAL CHARACTERISTICS (V_{BIAS} (V_{DD} , V_{BS}) = 15 V, $V_S = \text{GND} = 0\text{ V}$, $C_L = 1000\text{ pF}$, and $-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$, unless otherwise specified)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|----------------------------|--------------------|-----|-----|-----|------|
| t_{ON} | Turn-On Propagation Delay | $V_S = 0\text{ V}$ | – | 48 | 100 | ns |
| t_{OFF} | Turn-Off Propagation Delay | $V_S = 0\text{ V}$ | – | 46 | 95 | ns |
| t_R | Turn-On Rise Time | | – | 11 | 18 | ns |
| t_F | Turn-Off Fall Time | | – | 12 | 19 | ns |

FAD7171MX

TYPICAL PERFORMANCE CHARACTERISTICS

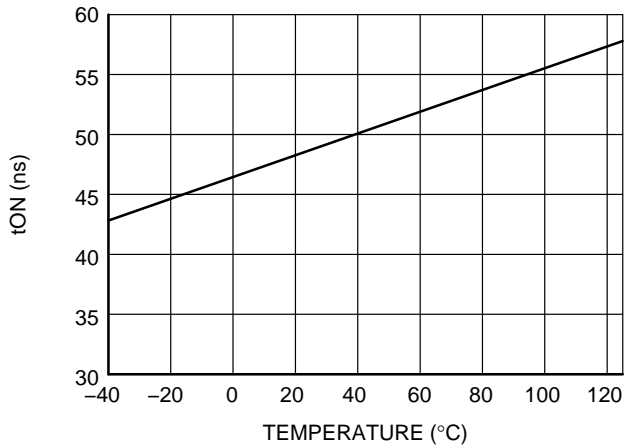


Figure 4. Turn-On Propagation Delay vs. Temperature

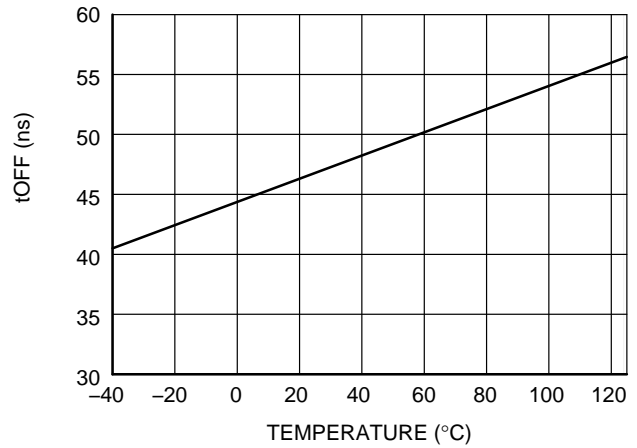


Figure 5. Turn-Off Propagation Delay vs. Temperature

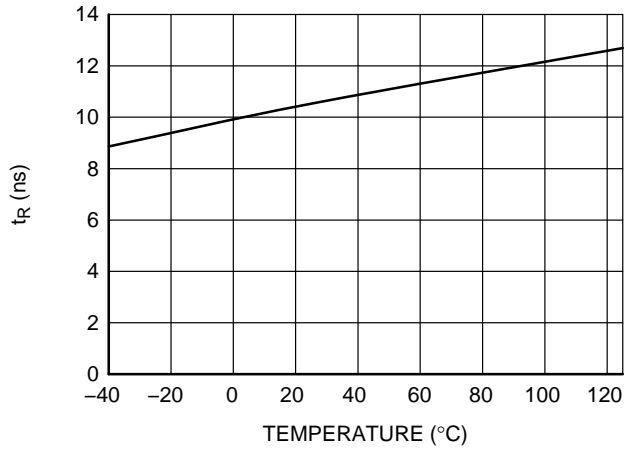


Figure 6. Turn-On Rise Time vs. Temperature

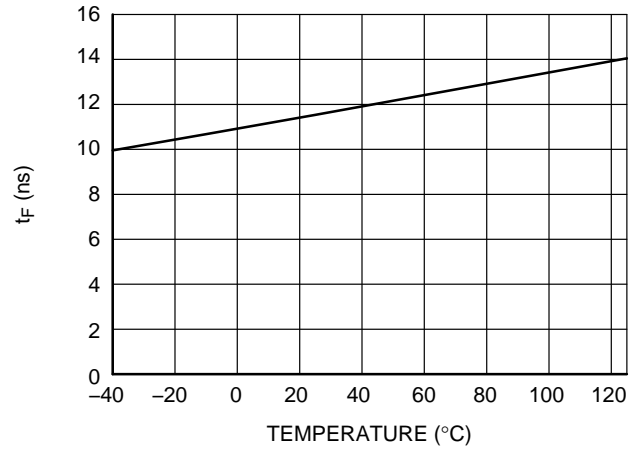


Figure 7. Turn-Off Fall Time vs. Temperature

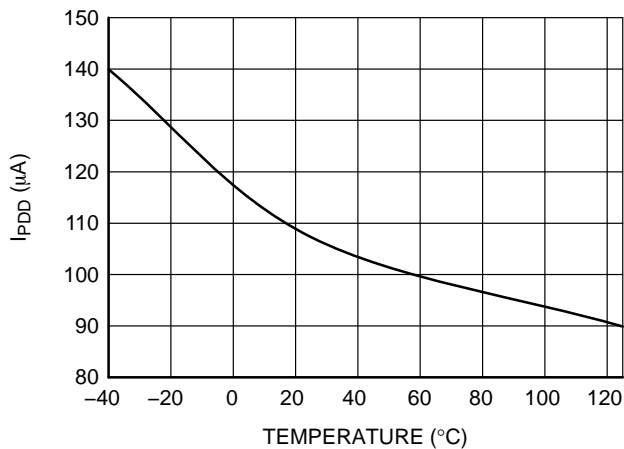


Figure 8. Operating V_{DD} Supply Current vs. Temperature

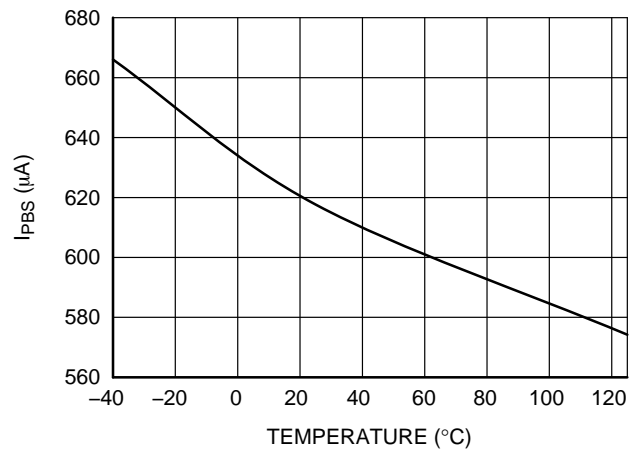


Figure 9. Operating V_{BS} Supply Current vs. Temperature

FAD7171MX

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

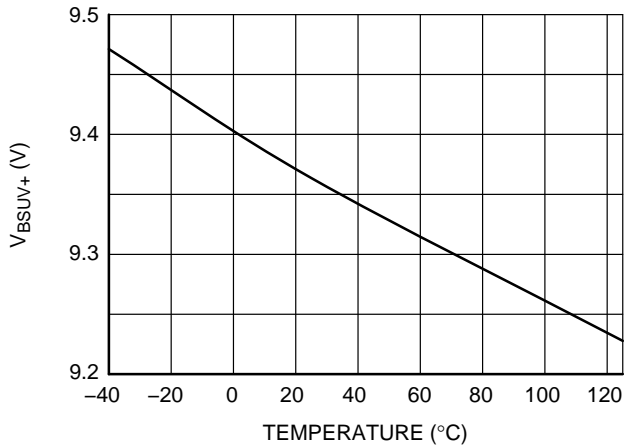


Figure 10. V_{BS} UVLO+ vs. Temperature

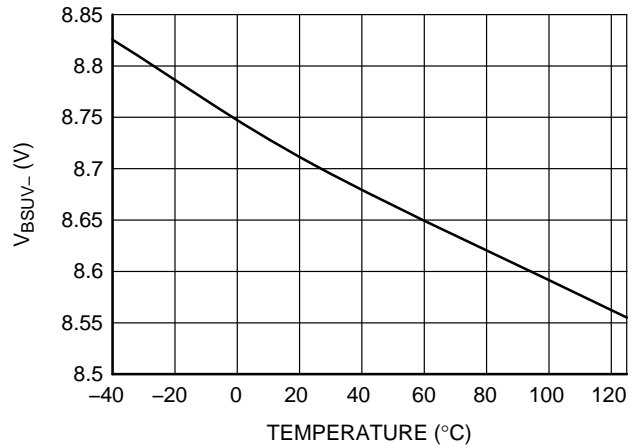


Figure 11. V_{BS} UVLO- vs. Temperature

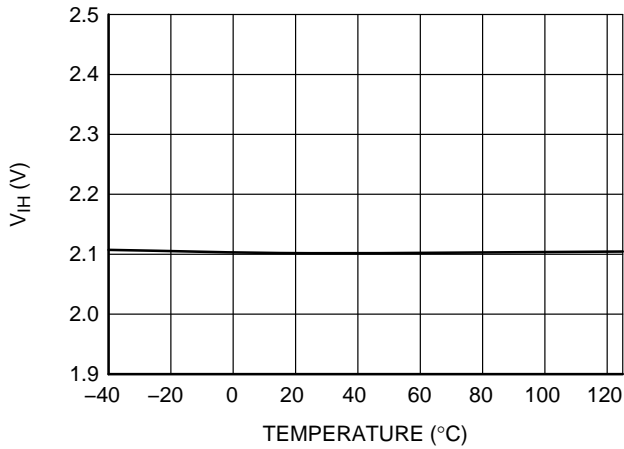


Figure 12. Logic High Input Voltage vs. Temperature

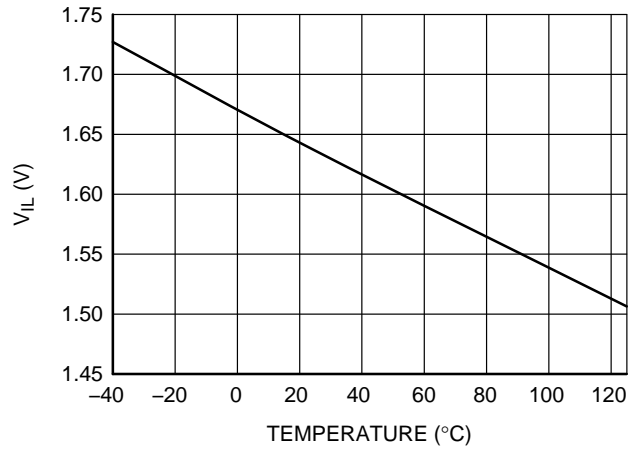


Figure 13. Logic Low Input Voltage vs. Temperature

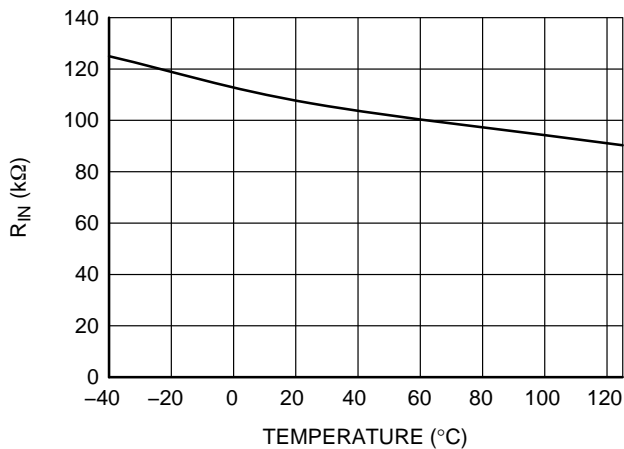


Figure 14. R_{IN} vs. Temperature

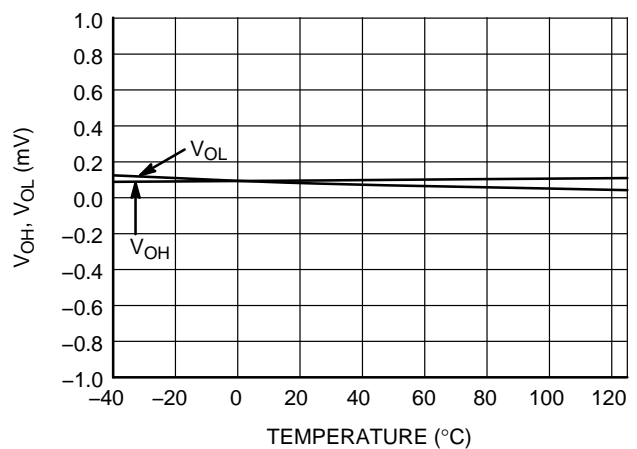


Figure 15. Output Voltage vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

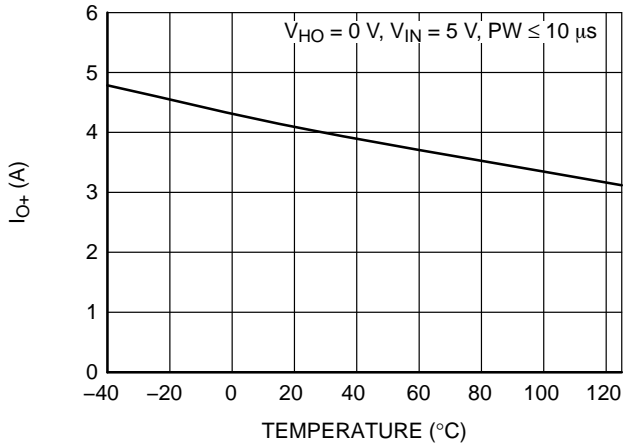


Figure 16. Output High, Short-Circuit Pulsed Current vs. Temperature

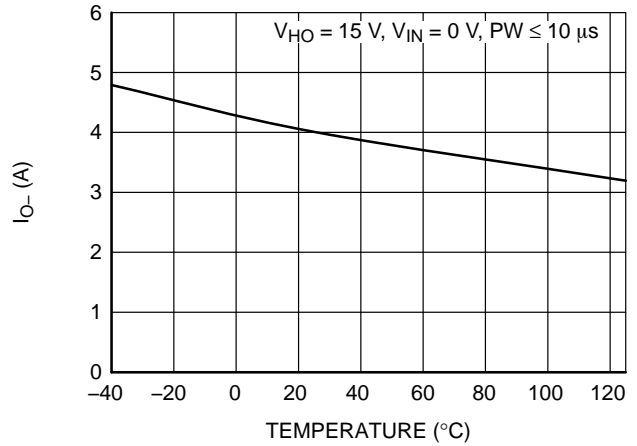


Figure 17. Output Low, Short-Circuit Pulsed Current vs. Temperature

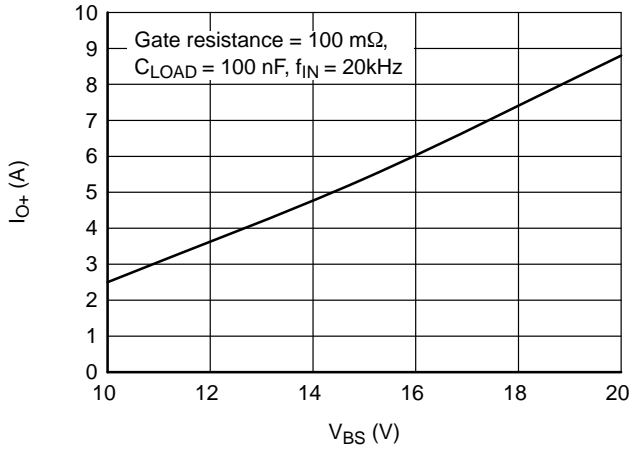


Figure 18. Output High, Short-Circuit Pulsed Current vs. Supply Voltage

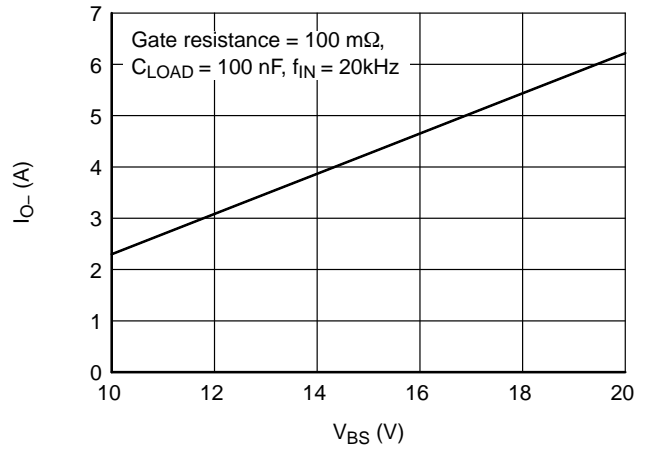


Figure 19. Output Low, Short-Circuit Pulsed Current vs. Supply Voltage

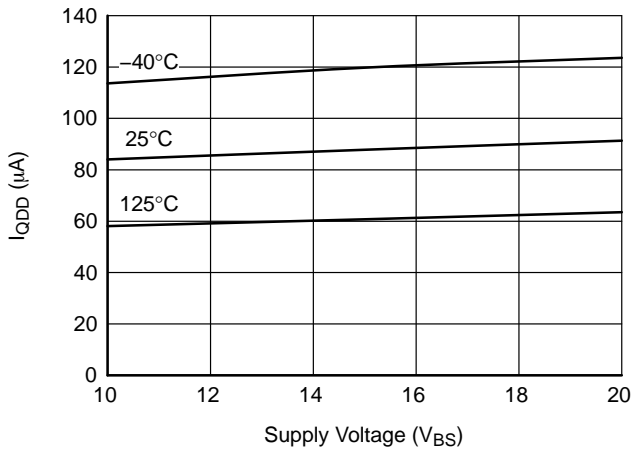


Figure 21. Quiescent VDD Supply Current vs. Supply Voltage

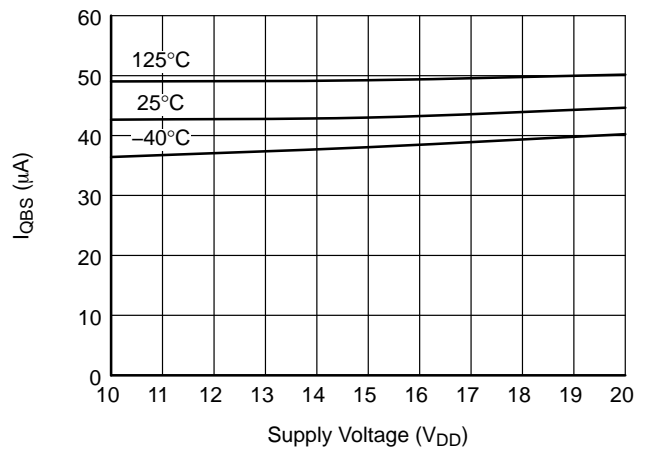


Figure 20. Quiescent VBS Supply Current vs. Supply Voltage

FAD7171MX

SWITCHING TIME DEFINITIONS

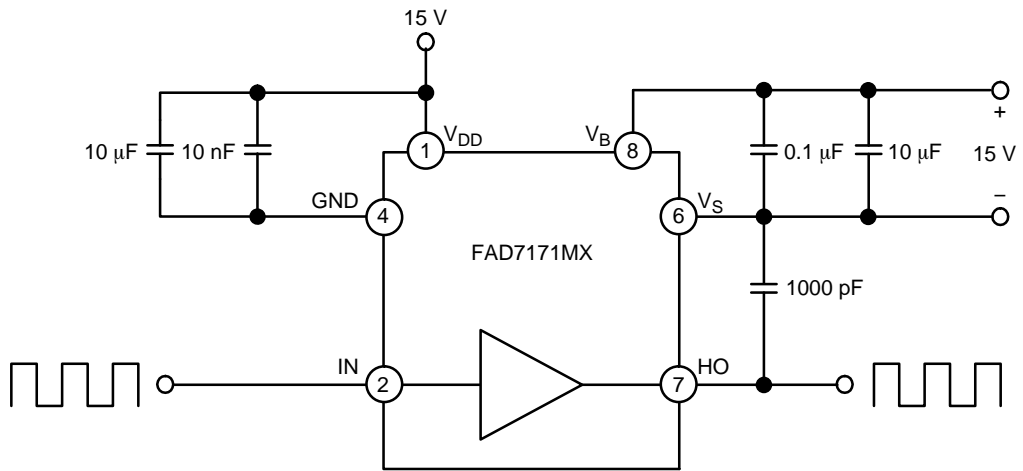


Figure 22. Switching Time Test Circuit (Referenced 8-SOIC)

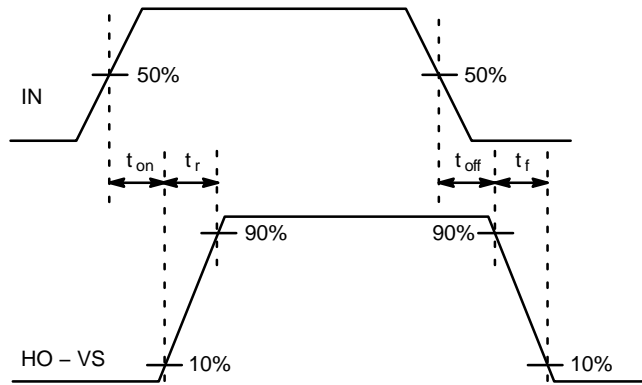


Figure 23. Switching Time Waveform Definitions

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

SOIC-8 NB
CASE 751-07
ISSUE AK

DATE 16 FEB 2011



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
 6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0° | 8° | 0° | 8° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXXXXX = Specific Device Code
 A = Assembly Location
 L = Wafer Lot
 Y = Year
 W = Work Week
 ■ = Pb-Free Package

XXXXXX = Specific Device Code
 A = Assembly Location
 Y = Year
 WW = Work Week
 ■ = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

| | | |
|------------------|-------------|--|
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| DESCRIPTION: | SOIC-8 NB | PAGE 1 OF 2 |

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SOIC-8 NB
CASE 751-07
ISSUE AK

DATE 16 FEB 2011

- | | | | |
|--|---|---|---|
| <p>STYLE 1: PIN 1. EMITTER 2. COLLECTOR 3. COLLECTOR 4. EMITTER 5. EMITTER 6. BASE 7. BASE 8. EMITTER</p> | <p>STYLE 2: PIN 1. COLLECTOR, DIE, #1 2. COLLECTOR, #1 3. COLLECTOR, #2 4. COLLECTOR, #2 5. BASE, #2 6. EMITTER, #2 7. BASE, #1 8. EMITTER, #1</p> | <p>STYLE 3: PIN 1. DRAIN, DIE #1 2. DRAIN, #1 3. DRAIN, #2 4. DRAIN, #2 5. GATE, #2 6. SOURCE, #2 7. GATE, #1 8. SOURCE, #1</p> | <p>STYLE 4: PIN 1. ANODE 2. ANODE 3. ANODE 4. ANODE 5. ANODE 6. ANODE 7. ANODE 8. COMMON CATHODE</p> |
| <p>STYLE 5: PIN 1. DRAIN 2. DRAIN 3. DRAIN 4. DRAIN 5. GATE 6. GATE 7. SOURCE 8. SOURCE</p> | <p>STYLE 6: PIN 1. SOURCE 2. DRAIN 3. DRAIN 4. SOURCE 5. SOURCE 6. GATE 7. GATE 8. SOURCE</p> | <p>STYLE 7: PIN 1. INPUT 2. EXTERNAL BYPASS 3. THIRD STAGE SOURCE 4. GROUND 5. DRAIN 6. GATE 3 7. SECOND STAGE Vd 8. FIRST STAGE Vd</p> | <p>STYLE 8: PIN 1. COLLECTOR, DIE #1 2. BASE, #1 3. BASE, #2 4. COLLECTOR, #2 5. COLLECTOR, #2 6. EMITTER, #2 7. EMITTER, #1 8. COLLECTOR, #1</p> |
| <p>STYLE 9: PIN 1. EMITTER, COMMON 2. COLLECTOR, DIE #1 3. COLLECTOR, DIE #2 4. EMITTER, COMMON 5. EMITTER, COMMON 6. BASE, DIE #2 7. BASE, DIE #1 8. EMITTER, COMMON</p> | <p>STYLE 10: PIN 1. GROUND 2. BIAS 1 3. OUTPUT 4. GROUND 5. GROUND 6. BIAS 2 7. INPUT 8. GROUND</p> | <p>STYLE 11: PIN 1. SOURCE 1 2. GATE 1 3. SOURCE 2 4. GATE 2 5. DRAIN 2 6. DRAIN 2 7. DRAIN 1 8. DRAIN 1</p> | <p>STYLE 12: PIN 1. SOURCE 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN</p> |
| <p>STYLE 13: PIN 1. N.C. 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN</p> | <p>STYLE 14: PIN 1. N-SOURCE 2. N-GATE 3. P-SOURCE 4. P-GATE 5. P-DRAIN 6. P-DRAIN 7. N-DRAIN 8. N-DRAIN</p> | <p>STYLE 15: PIN 1. ANODE 1 2. ANODE 1 3. ANODE 1 4. ANODE 1 5. CATHODE, COMMON 6. CATHODE, COMMON 7. CATHODE, COMMON 8. CATHODE, COMMON</p> | <p>STYLE 16: PIN 1. EMITTER, DIE #1 2. BASE, DIE #1 3. EMITTER, DIE #2 4. BASE, DIE #2 5. COLLECTOR, DIE #2 6. COLLECTOR, DIE #2 7. COLLECTOR, DIE #1 8. COLLECTOR, DIE #1</p> |
| <p>STYLE 17: PIN 1. VCC 2. V2OUT 3. V1OUT 4. TXE 5. RXE 6. VEE 7. GND 8. ACC</p> | <p>STYLE 18: PIN 1. ANODE 2. ANODE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. CATHODE 8. CATHODE</p> | <p>STYLE 19: PIN 1. SOURCE 1 2. GATE 1 3. SOURCE 2 4. GATE 2 5. DRAIN 2 6. MIRROR 2 7. DRAIN 1 8. MIRROR 1</p> | <p>STYLE 20: PIN 1. SOURCE (N) 2. GATE (N) 3. SOURCE (P) 4. GATE (P) 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN</p> |
| <p>STYLE 21: PIN 1. CATHODE 1 2. CATHODE 2 3. CATHODE 3 4. CATHODE 4 5. CATHODE 5 6. COMMON ANODE 7. COMMON ANODE 8. CATHODE 6</p> | <p>STYLE 22: PIN 1. I/O LINE 1 2. COMMON CATHODE/VCC 3. COMMON CATHODE/VCC 4. I/O LINE 3 5. COMMON ANODE/GND 6. I/O LINE 4 7. I/O LINE 5 8. COMMON ANODE/GND</p> | <p>STYLE 23: PIN 1. LINE 1 IN 2. COMMON ANODE/GND 3. COMMON ANODE/GND 4. LINE 2 IN 5. LINE 2 OUT 6. COMMON ANODE/GND 7. COMMON ANODE/GND 8. LINE 1 OUT</p> | <p>STYLE 24: PIN 1. BASE 2. EMITTER 3. COLLECTOR/ANODE 4. COLLECTOR/ANODE 5. CATHODE 6. CATHODE 7. COLLECTOR/ANODE 8. COLLECTOR/ANODE</p> |
| <p>STYLE 25: PIN 1. VIN 2. N/C 3. REXT 4. GND 5. IOUT 6. IOUT 7. IOUT 8. IOUT</p> | <p>STYLE 26: PIN 1. GND 2. dv/dt 3. ENABLE 4. ILIMIT 5. SOURCE 6. SOURCE 7. SOURCE 8. VCC</p> | <p>STYLE 27: PIN 1. ILIMIT 2. OVLO 3. UVLO 4. INPUT+ 5. SOURCE 6. SOURCE 7. SOURCE 8. DRAIN</p> | <p>STYLE 28: PIN 1. SW_TO_GND 2. DASIC OFF 3. DASIC_SW_DET 4. GND 5. V_MON 6. VBULK 7. VBULK 8. VIN</p> |
| <p>STYLE 29: PIN 1. BASE, DIE #1 2. EMITTER, #1 3. BASE, #2 4. EMITTER, #2 5. COLLECTOR, #2 6. COLLECTOR, #2 7. COLLECTOR, #1 8. COLLECTOR, #1</p> | <p>STYLE 30: PIN 1. DRAIN 1 2. DRAIN 1 3. GATE 2 4. SOURCE 2 5. SOURCE 1/DRAIN 2 6. SOURCE 1/DRAIN 2 7. SOURCE 1/DRAIN 2 8. GATE 1</p> | | |

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