

# High-Current, High & Low-Side, Gate-Drive IC



## FAN7390

### Description

The FAN7390 is a monolithic high- and low-side gate-drive IC, which 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.

ON Semiconductor'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  $V_S = -9.8$  V (typical) for  $V_{BS} = 15$  V.

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 make this device suitable for the PDP sustain pulse driver, motor driver, switching power supply, and high- power DC-DC converter applications.

### Features

- Floating Channels for Bootstrap Operation to +600 V
- Typically 4.5 A / 4.5 A Sourcing / Sinking Current Driving Capability
- Common-Mode dv/dt Noise-Canceling Circuit
- Built-in Under-Voltage Lockout for Both Channels
- Matched Propagation Delay for Both Channels
- Logic ( $V_{SS}$ ) and Power (COM) Ground  $\pm 7$  V Offset
- 3.3 V and 5 V Input Logic Compatible
- Output In-Phase with Input
- This is a Pb-Free Device

### Applications

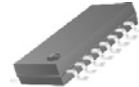
- PDP Sustain Driver
- HID Lamp Ballast
- SMPS
- Motor Driver

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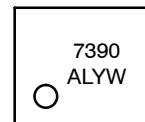


SOIC8  
8-SOP  
CASE 751EG

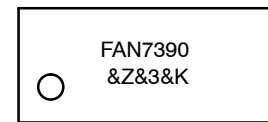


SOIC14  
14-SOP  
CASE 751ER

### MARKING DIAGRAM



FAN7390MX



FAN7390M1X

7390, = Device Code  
FAN7390  
A = Assembly Site  
L = Wafer Lot Number  
YW = Assembly Start Week  
&Z = Assembly Plant Code  
&3 = 3-Digit Date Code  
&K = 2-Digits Lot Run Traceability Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 12 of this data sheet.

# FAN7390

## TYPICAL APPLICATION CIRCUIT

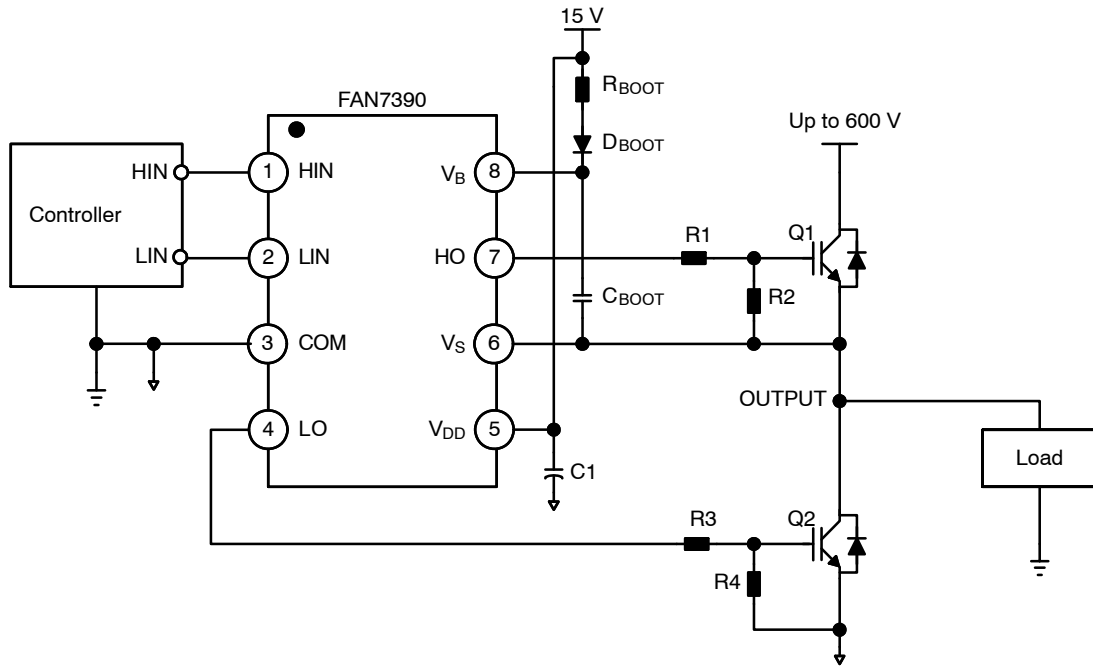


Figure 1. Application Circuit for Half-Bridge (Referenced 8-SOP)

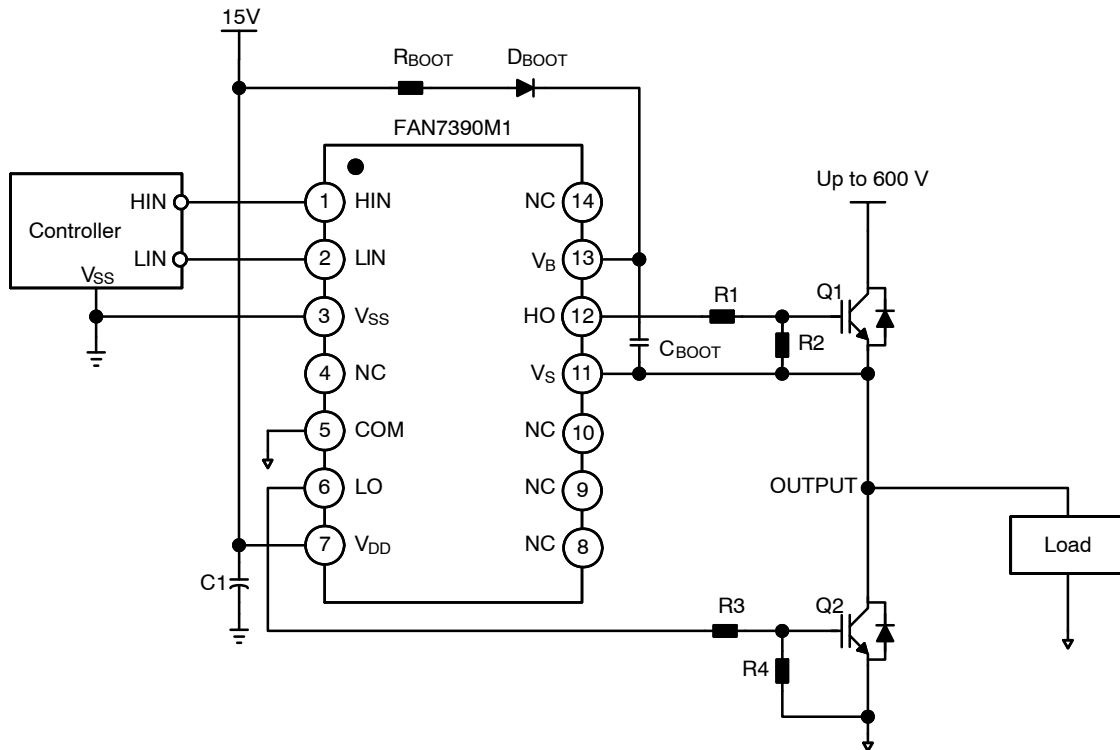


Figure 2. Application Circuit for Half-Bridge (Referenced 14-SOP)

# FAN7390

## INTERNAL BLOCK DIAGRAM

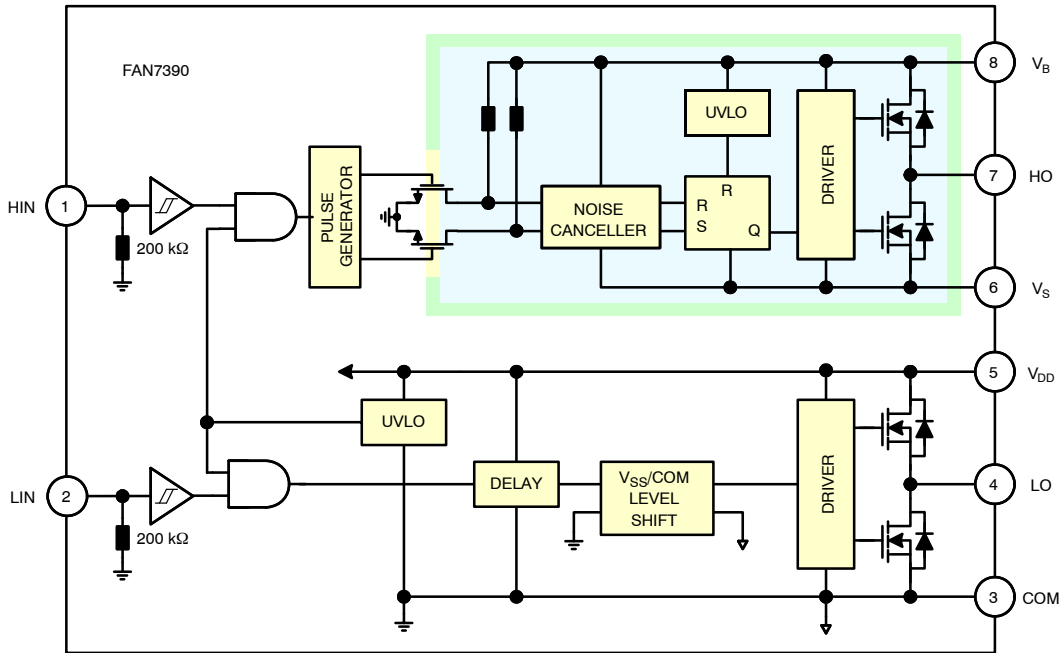


Figure 3. Functional Block Diagram (Referenced 8-SOP)

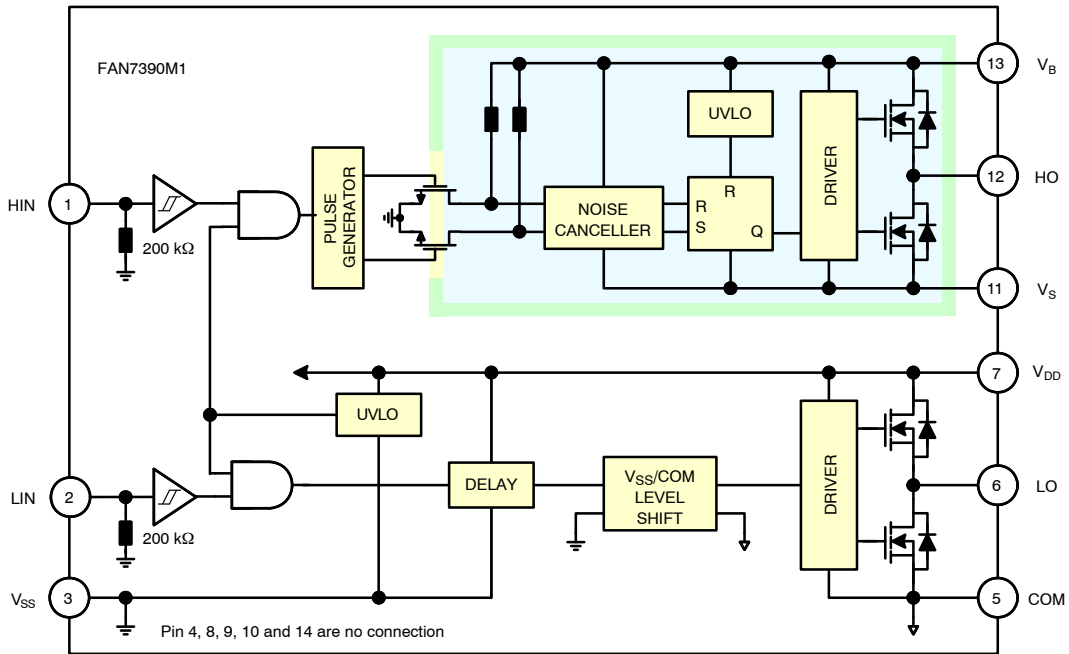


Figure 4. Functional Block Diagram (Referenced 14-SOP)

# FAN7390

## PIN CONFIGURATION

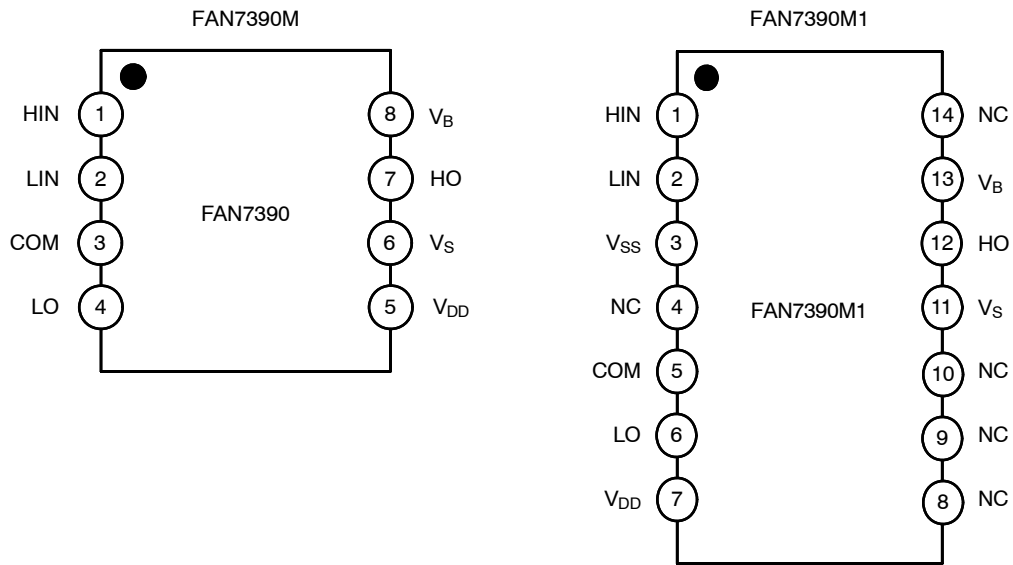


Figure 5. Pin Assignments (Top View)

### PIN DEFINITIONS

| 8-Pin | 14-Pin          | Name            | Description                                  |
|-------|-----------------|-----------------|--|
| 1     | 1               | HIN             | Logic Input for High-Side Gate Driver Output |
| 2     | 2               | LIN             | Logic Input for Low-Side Gate Driver Output  |
|       | 3               | V <sub>SS</sub> | Logic Ground (FAN7390M1 only)                |
| 3     | 5               | COM             | Low-Side Driver Return                       |
| 4     | 6               | LO              | Low-Side Driver Output                       |
| 5     | 7               | V <sub>DD</sub> | Low-Side and Logic Part Supply Voltage       |
| 6     | 11              | V <sub>S</sub>  | High-Voltage Floating Supply Return          |
| 7     | 12              | HO              | High-Side Driver Output                      |
| 8     | 13              | V <sub>B</sub>  | High-Side Floating Supply                    |
|       | 4, 8, 9, 10, 14 | NC              | No Connect                                   |

# FAN7390

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C, unless otherwise noted)

| Symbol                           | Characteristics                          | Min                   | Max                   | Unit |
|----------------------------------|--|-----------------------|-----------------------|------|
| V <sub>S</sub>                   | High-Side Floating Supply Offset Voltage | V <sub>B</sub> - 25   | V <sub>B</sub> + 0.3  | V    |
| V <sub>B</sub>                   | High-Side Floating Supply Voltage        | -0.3                  | 625.0                 | V    |
| V <sub>HO</sub>                  | High-Side Floating Output Voltage HO     | V <sub>S</sub> - 0.3  | V <sub>B</sub> + 0.3  | V    |
| V <sub>DD</sub>                  | Low-Side and Logic Fixed Supply Voltage  | -0.3                  | 25.0                  | V    |
| V <sub>LO</sub>                  | Low-Side Output Voltage LO               | -0.3                  | V <sub>DD</sub> + 0.3 | V    |
| V <sub>IN</sub>                  | Logic Input Voltage (HIN and LIN)        | V <sub>SS</sub> - 0.3 | V <sub>DD</sub> + 0.3 | V    |
| V <sub>SS</sub>                  | Logic Ground (FAN7390M1 only)            | V <sub>DD</sub> - 25  | V <sub>DD</sub> + 0.3 | V    |
| dV <sub>S</sub> /dt              | Allowable Offset Voltage Slew Rate       | -                     | 50                    | V/ns |
| P <sub>D</sub><br>(Note 1, 2, 3) | Power Dissipation                        | 8-SOP                 | 0.625                 | W    |
|                                  |  | 14-SOP                | 1.000                 |      |
| θ <sub>JA</sub>                  | Thermal Resistance, Junction-to-Ambient  | 8-SOP                 | 200                   | °C/W |
|                                  |  | 14-SOP                | 110                   |      |
| T <sub>J</sub>                   | Junction Temperature                     | -                     | +150                  | °C   |
| T <sub>STG</sub>                 | Storage Temperature                      | -                     | +150                  | °C   |

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.

1. Mounted on 76.2 x 114.3 x 1.6 mm PCB (FR-4 glass epoxy material).
2. 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.
3. Do not exceed P<sub>D</sub> under any circumstances.

## RECOMMENDED OPERATING CONDITIONS

| Symbol          | Parameter                                | Min                 | Max                 | Unit |
|-----------------|--|---------------------|---------------------|------|
| V <sub>B</sub>  | High-Side Floating Supply Voltage        | V <sub>S</sub> + 10 | V <sub>S</sub> + 22 | V    |
| V <sub>S</sub>  | High-Side Floating Supply Offset Voltage | 6 - V <sub>DD</sub> | 600                 | V    |
| V <sub>HO</sub> | High-Side Output Voltage                 | V <sub>S</sub>      | V <sub>B</sub>      | V    |
| V <sub>DD</sub> | Low-Side and Logic Supply Voltage        | 10                  | 22                  | V    |
| V <sub>LO</sub> | Low-Side Output Voltage                  | COM                 | V <sub>DD</sub>     | V    |
| V <sub>IN</sub> | Logic Input Voltage (HIN and LIN)        | V <sub>SS</sub>     | V <sub>DD</sub>     | V    |
| T <sub>A</sub>  | Operating Ambient Temperature            | -40                 | +125                | °C   |

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.

# FAN7390

**ELECTRICAL CHARACTERISTICS** ( $V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ ) = 15.0 V,  $V_S = V_{SS} = COM$ ,  $T_A = 25^\circ C$ , unless otherwise specified. The  $V_{IL}$ ,  $V_{IH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}/COM$  and are applicable to the respective input signals HIN and LIN. The  $V_O$  and  $I_O$  parameters are referenced to COM and  $V_S$  is applicable to the respective output signals HO and LO.)

| Symbol | Characteristics | Test Condition | Min | Typ | Max | Unit |
|--------|-----------------|----------------|-----|-----|-----|------|
|--------|-----------------|----------------|-----|-----|-----|------|

## POWER SUPPLY SECTION ( $V_{DD}$ AND $V_{BS}$ )

|                            |   |                               |     |     |     |         |
|----------------------------|---|-------------------------------|-----|-----|-----|---------|
| $V_{DDUV+}$<br>$V_{BSUV+}$ | $V_{DD}$ and $V_{BS}$ Supply Under-Voltage Positive-going Threshold   |                               | 8.0 | 8.8 | 9.8 | V       |
| $V_{DDUV-}$<br>$V_{BSUV-}$ | $V_{DD}$ and $V_{BS}$ Supply Under-Voltage Negative-going Threshold   |                               | 7.4 | 8.3 | 9.0 |         |
| $V_{DDUVH}$<br>$V_{BSUVH}$ | $V_{DD}$ and $V_{BS}$ Supply Under-Voltage Lockout Hysteresis Voltage |                               | -   | 0.5 | -   |         |
| $I_{LK}$                   | Offset Supply Leakage Current   | $V_B = V_S = 600 V$           | -   | -   | 50  | $\mu A$ |
| $I_{QBS}$                  | Quiescent $V_{BS}$ Supply Current                                     | $V_{IN} = 0 V$ or $5 V$       | -   | 45  | 80  |         |
| $I_{QDD}$                  | Quiescent $V_{DD}$ Supply Current                                     | $V_{IN} = 0 V$ or $5 V$       | -   | 75  | 110 |         |
| $I_{PBS}$                  | Operating $V_{BS}$ Supply Current                                     | $f_{IN} = 20 kHz$ , rms value | -   | 530 | 640 | $\mu A$ |
| $I_{PDD}$                  | Operating $V_{DD}$ Supply Current                                     | $f_{IN} = 20 kHz$ , rms value | -   | 530 | 640 |         |

## LOGIC INPUT SECTION (HIN, LIN)

|           |                              |                |     |     |     |           |
|-----------|------------------------------|----------------|-----|-----|-----|-----------|
| $V_{IH}$  | Logic "1" Input Voltage      |                | 2.5 | -   | -   | V         |
| $V_{IL}$  | Logic "0" Input Voltage      |                | -   | -   | 1.2 |           |
| $I_{IN+}$ | Logic "1" Input Bias Current | $V_{IN} = 5 V$ | -   | 25  | 50  | $\mu A$   |
| $I_{IN-}$ | Logic "0" Input Bias Current | $V_{IN} = 0 V$ | -   | 1.0 | 2.0 |           |
| $R_{IN}$  | Input Pull-down Resistance   |                | 100 | 200 | -   | $k\Omega$ |

## GATE DRIVER OUTPUT SECTION (HO, LO)

|              |   |  |      |      |      |    |
|--------------|---|--|------|------|------|----|
| $V_{OH}$     | High-level Output Voltage, $V_{BIAS}-V_O$                             | No Load  | -    | -    | 1.0  | V  |
| $V_{OL}$     | Low-level Output Voltage, $V_O$                                       | No Load  | -    | -    | 35   | mV |
| $I_{O+}$     | Output High, Short-circuit Pulsed Current (Note 4)                    | $V_O = 0 V$ , $V_{IN} = 5 V$ with $PW < 10 \mu s$  | 3.5  | 4.5  |      | A  |
| $I_{O-}$     | Output Low, Short-circuit Pulsed Current (Note 4)                     | $V_O = 15 V$ , $V_{IN} = 0 V$ with $PW < 10 \mu s$ | 3.5  | 4.5  | -    |    |
| $V_S$        | Allowable Negative $V_S$ Pin Voltage for HIN Signal Propagation to HO |  | -    | -9.8 | -7.0 | V  |
| $V_{SS}-COM$ | $V_{SS}-COM/COM-V_{SS}$ Voltage Endurability                          |  | -7.0 | -    | 7.0  | 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.

4. This parameter guaranteed by design.

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

| Symbol    | Characteristics                     | Test Condition | Min | Typ | Max | Unit |
|-----------|-------------------------------------|----------------|-----|-----|-----|------|
| $t_{on}$  | Turn-on Propagation Delay           | $V_S = 0 V$    | -   | 140 | 220 | ns   |
| $t_{off}$ | Turn-off Propagation Delay          | $V_S = 0 V$    | -   | 140 | 220 |      |
| MT        | Delay Matching, HS & LS Turn-on/off |                | -   | 0   | 50  |      |
| $t_r$     | Turn-on Rise Time                   |                | -   | 25  | 50  |      |
| $t_f$     | Turn-off Fall Time                  |                | -   | 20  | 45  |      |

TYPICAL CHARACTERISTICS

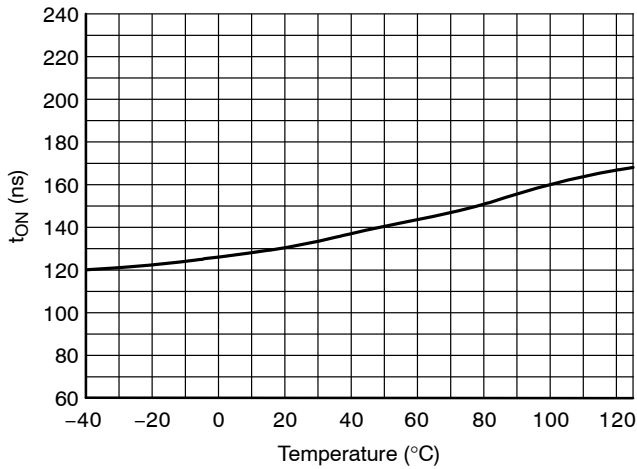


Figure 6. Turn-on Propagation Delay vs. Temperature

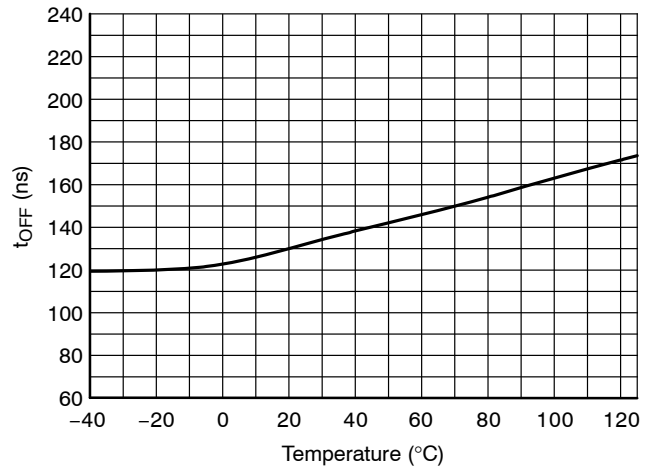


Figure 7. Turn-off Propagation Delay vs. Temperature

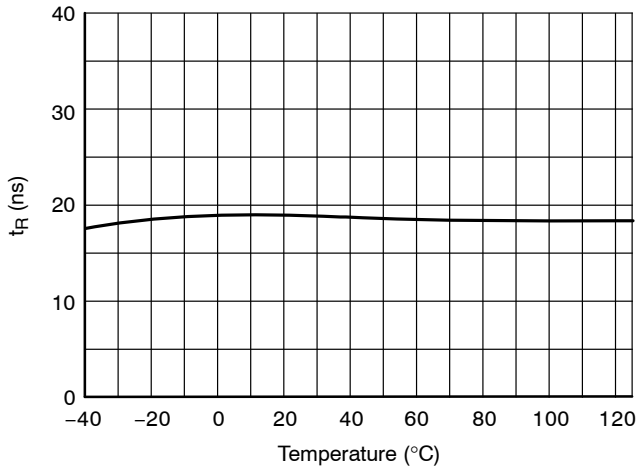


Figure 8. Turn-on Rise Time vs. Temperature

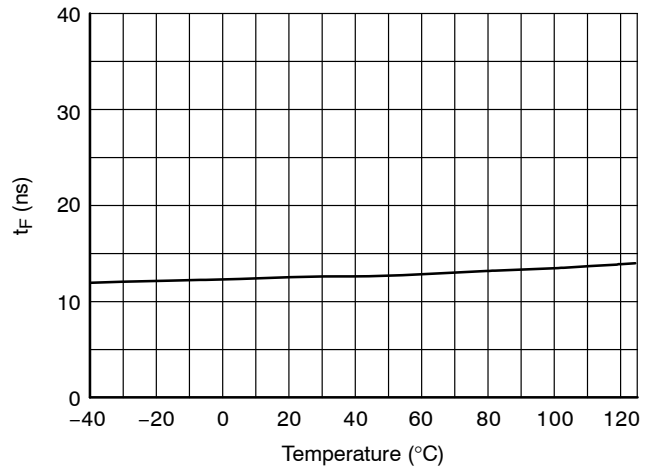


Figure 9. Turn-off Fall Time vs. Temperature

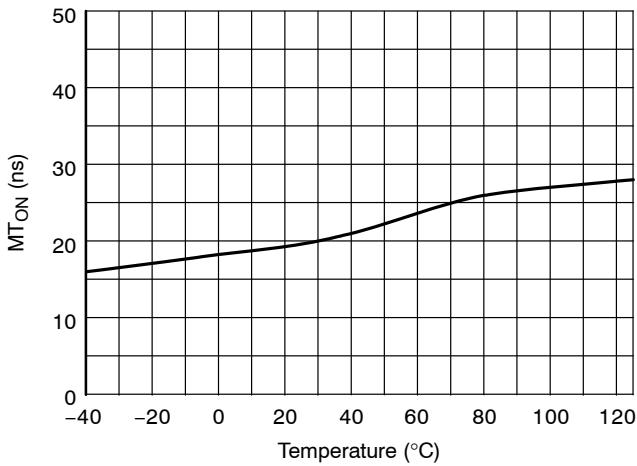


Figure 10. Turn-on Delay Matching vs. Temperature

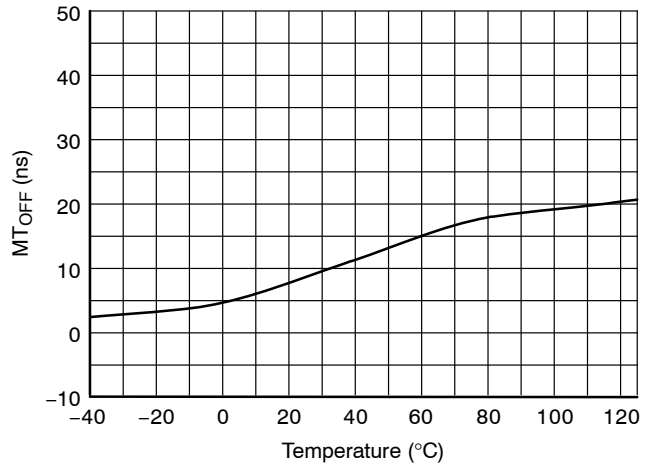


Figure 11. Turn-off Delay Matching vs. Temperature

TYPICAL CHARACTERISTICS (continued)

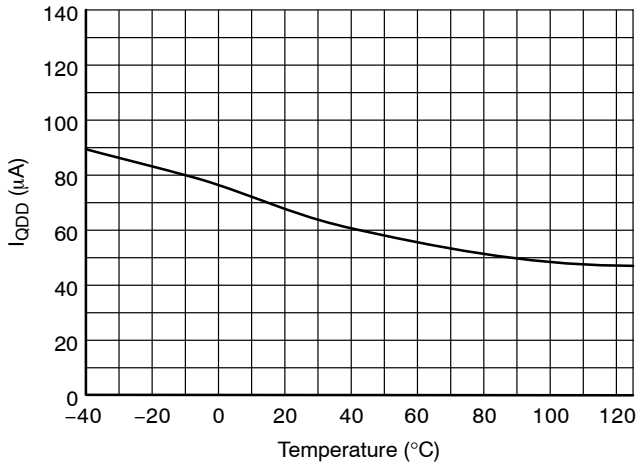


Figure 12. Quiescent  $V_{DD}$  Supply Current vs. Temperature

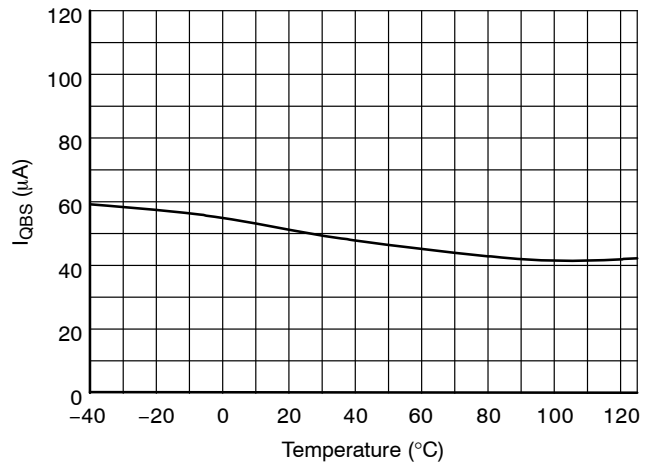


Figure 13. Quiescent  $V_{BS}$  Supply Current vs. Temperature

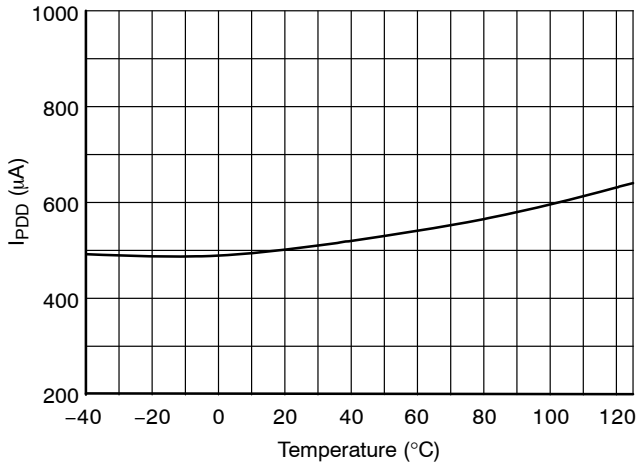


Figure 14. Operating  $V_{DD}$  Supply Current vs. Temperature

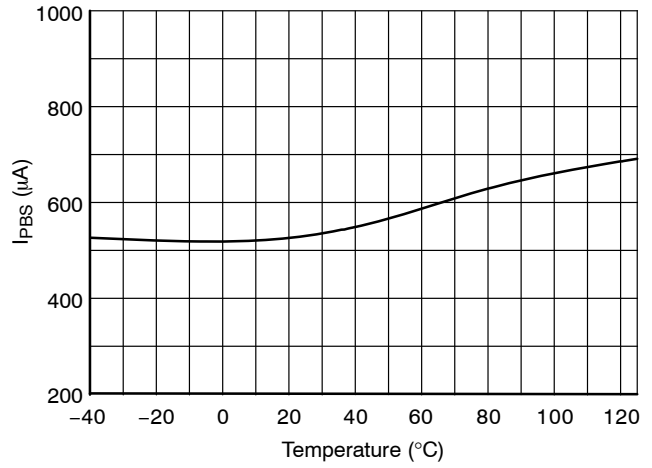


Figure 15. Operating  $V_{BS}$  Supply Current vs. Temperature

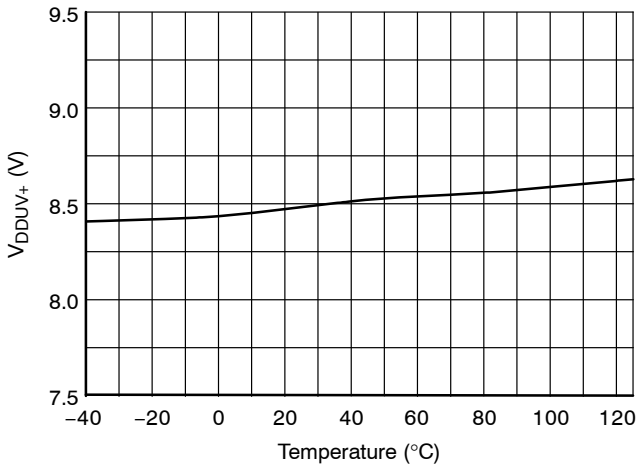


Figure 16.  $V_{DD}$  UVLO+ vs. Temperature

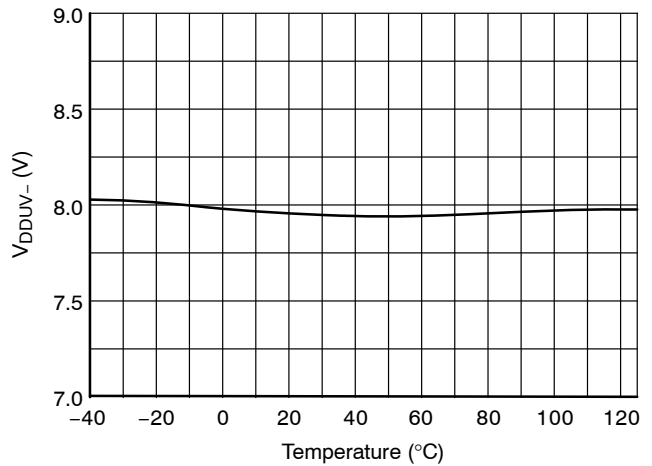


Figure 17.  $V_{DD}$  UVLO- vs. Temperature



TYPICAL CHARACTERISTICS (continued)

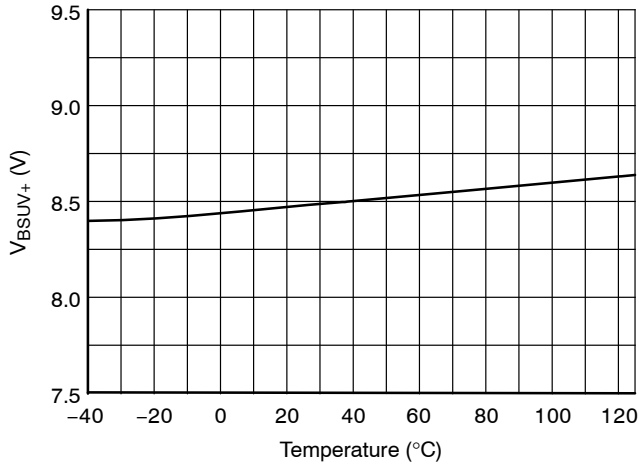


Figure 18.  $V_{BS}$  UVLO+ vs. Temperature

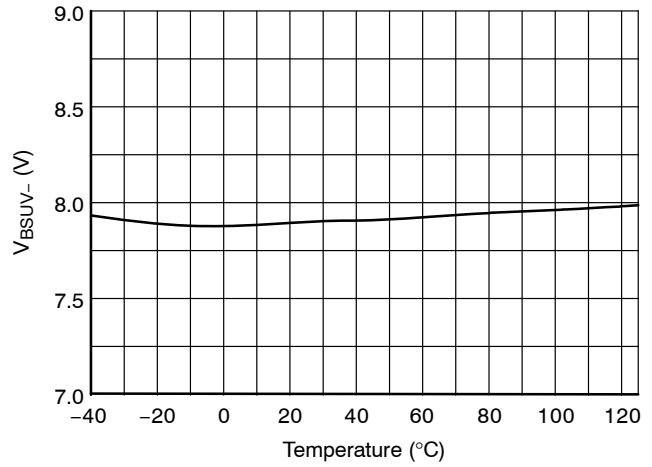


Figure 19.  $V_{BS}$  UVLO- vs. Temperature

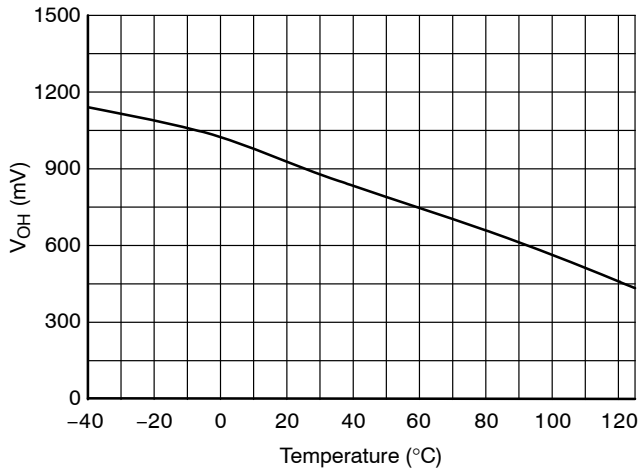


Figure 20. High-Level Output Voltage vs. Temperature

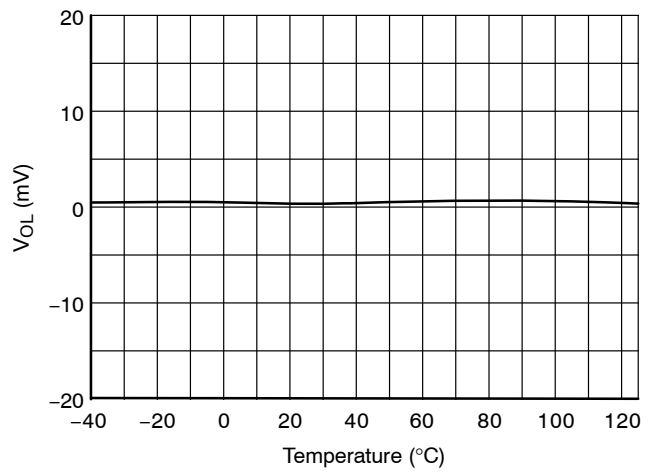


Figure 21. Low-Level Output Voltage vs. Temperature

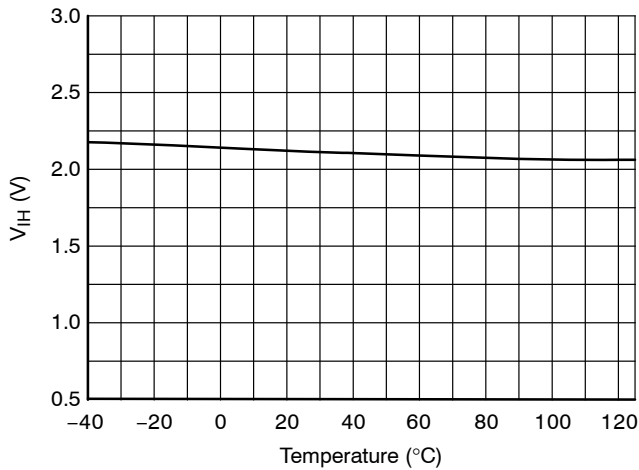


Figure 22. Logic High Input Voltage vs. Temperature

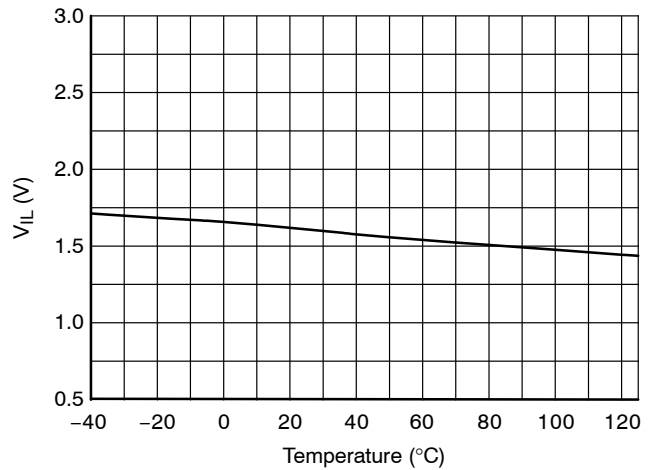
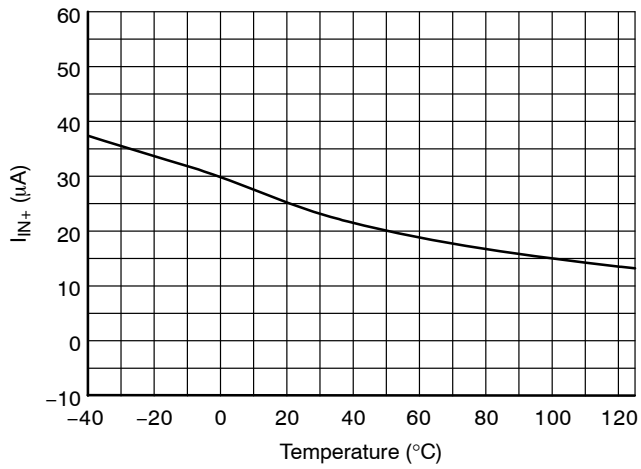


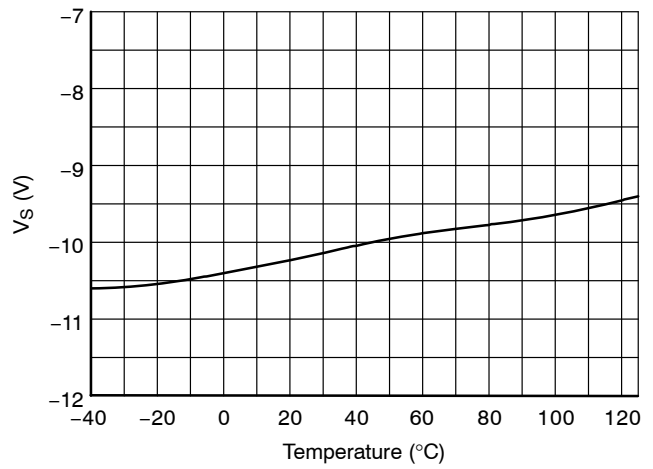
Figure 23. Low Input Voltage vs. Temperature

# FAN7390

## TYPICAL CHARACTERISTICS (continued)



**Figure 24. Logic Input High Bias Current vs. Temperature**



**Figure 25. Allowable Negative  $V_S$  Voltage vs. Temperature**

# FAN7390

## SWITCHING TIME DEFINITIONS

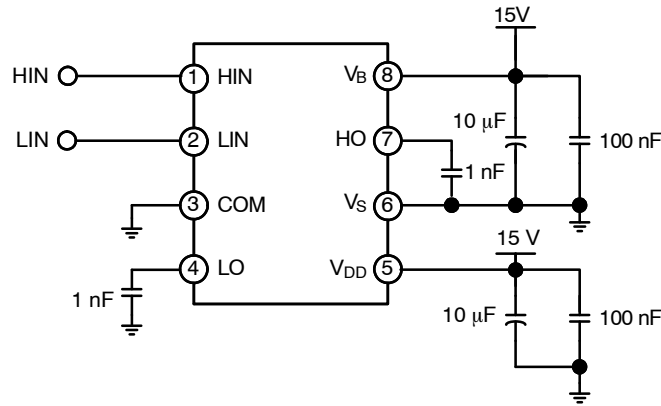


Figure 26. Switching Time Test Circuit (Referenced 8-SOP)

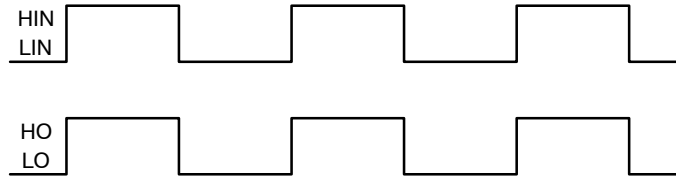


Figure 27. Input/Output Timing Diagram

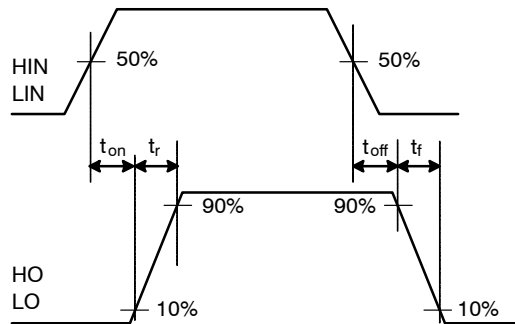


Figure 28. Switching Time Waveform Definitions

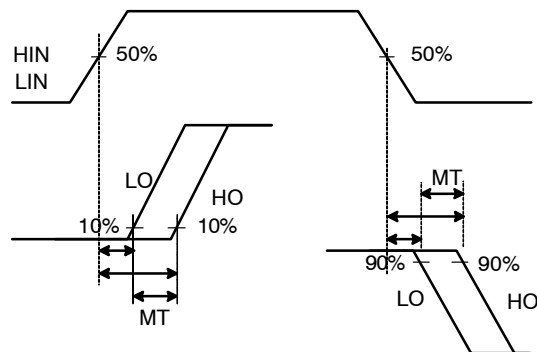


Figure 29. Delay Matching Waveform Definitions

# FAN7390

## ORDERING INFORMATION

| Device     | Package                       | Operating Temperature Range | Shipping <sup>†</sup> |
|------------|-------------------------------|-----------------------------|-----------------------|
| FAN7390MX  | SOIC8<br>8-SOP<br>(Pb-Free)   | -40°C~125°C                 | 3000 / Tape & Reel    |
| FAN7390M1X | SOIC14<br>14-SOP<br>(Pb-Free) |                             | 3000 / Tape & Reel    |

<sup>†</sup>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.

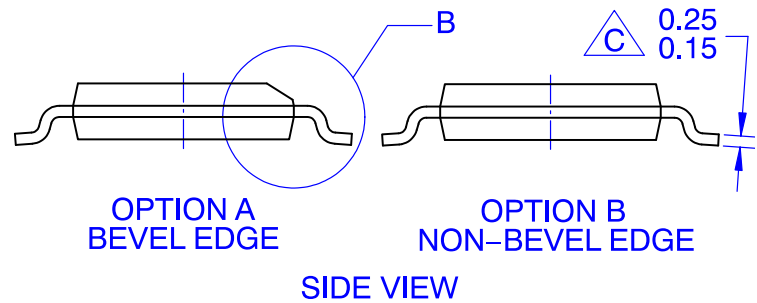
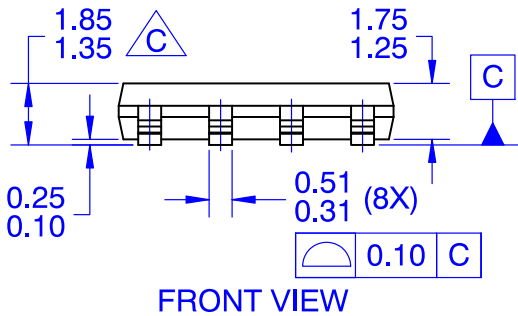
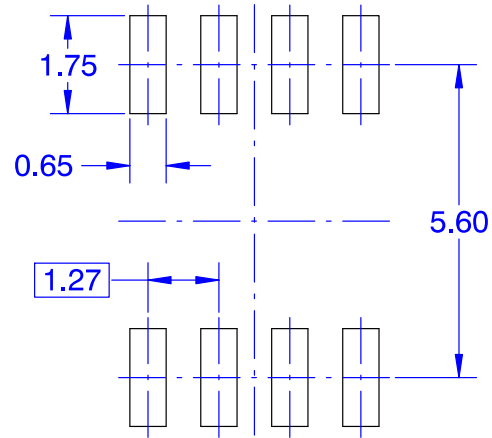
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

ON Semiconductor®



**SOIC8**  
**CASE 751EG**  
**ISSUE O**

DATE 30 SEP 2016



**NOTES: UNLESS OTHERWISE SPECIFIED**

- A. THIS PACKAGE CONFORMS TO JEDEC MS-012 VARIATION A EXCEPT WHERE NOTED.
- B. ALL DIMENSIONS ARE IN MILLIMETERS
- C** OUT OF JEDEC STANDARD VALUE
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- E. LAND PATTERN AS PER IPC SOIC127P600X175-8M

|                         |                    |  |
|-------------------------|--------------------|--|
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# MECHANICAL CASE OUTLINE

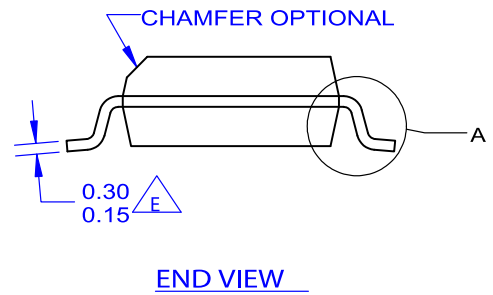
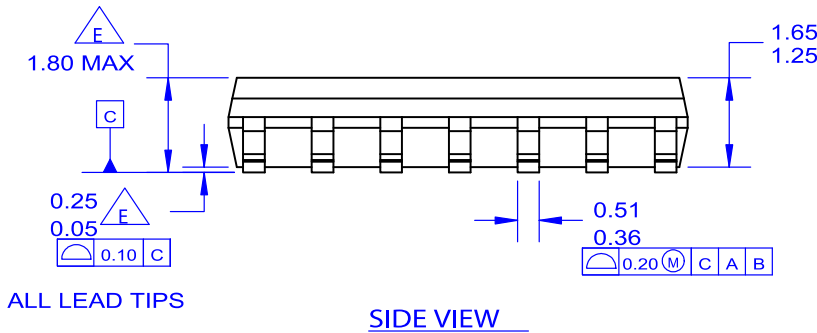
## PACKAGE DIMENSIONS

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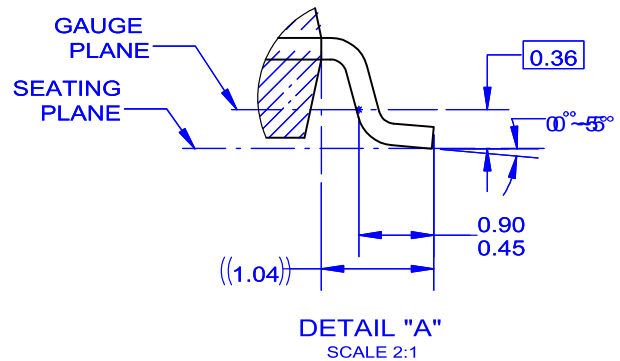
### SOIC14 N CASE 751ER ISSUE O

DATE 31 DEC 2016



**NOTES: UNLESS OTHERWISE SPECIFIED**

- A. THIS PACKAGE REFERENCE TO JEDEC MS-012 VARIATION AB.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-1994.
- E. OUT OF JEDEC STANDARD VALUE.



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