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ON Semiconductor®

October 2016

# FAN7191\_F085 High-Current, High and Low Side Gate Drive IC

## Features

- Floating Channel for Bootstrap Operation to +600V
- 4.5A Sourcing and 4.5A Sinking Current Driving Capability
- Common-Mode dV/dt Noise Cancelling Circuit
- Built-in Under-Voltage Lockout for Both Channels
- Matched Propagation Delay for Both Channels
- 3.3V and 5V Input Logic Compatible
- Output In-phase with Input
- Qualified to AEC Q100

## Applications

- Advanced Fuel Injection Systems
- Automotive high voltage DC-DC converters
- Starter/Alternator
- Electric Power Steering
- Motor Control (fans, pumps, compressors)
- MOSFET and IGBT driver applications

## Description

The FAN7191\_F085 is a monolithic high- and low-side gate-drive IC, which can drive high speed MOSFETs and IGBTs that operate up to +600V. It has a buffered output stage with all NMOS transistors designed for high pulse driving capability and minimum cross-conduction.

Fairchild's high-voltage process and common-mode noise canceling technique provide stable operation of high-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 circuit prevents malfunction when  $V_{DD}$  and  $V_{BS}$  are lower than the specified threshold voltage.

The high current and low output voltage drop features make this device suitable for controlling direct injection actuators and for use in many automotive DC-DC converter and motor control applications.

8-SOP



Figure 1. Package Options

## Ordering Information

Part Number	Operating Temperature Range	Package	 Eco Status	Packing Method
FAN7191MX_F085	-40°C to +125°C	8-SOP	RoHS	Tape & Reel

 For Fairchild's definition of "green" Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

FAN7191\_F085 – High-Current, High and Low Side Gate Drive IC

### Typical Application Circuit

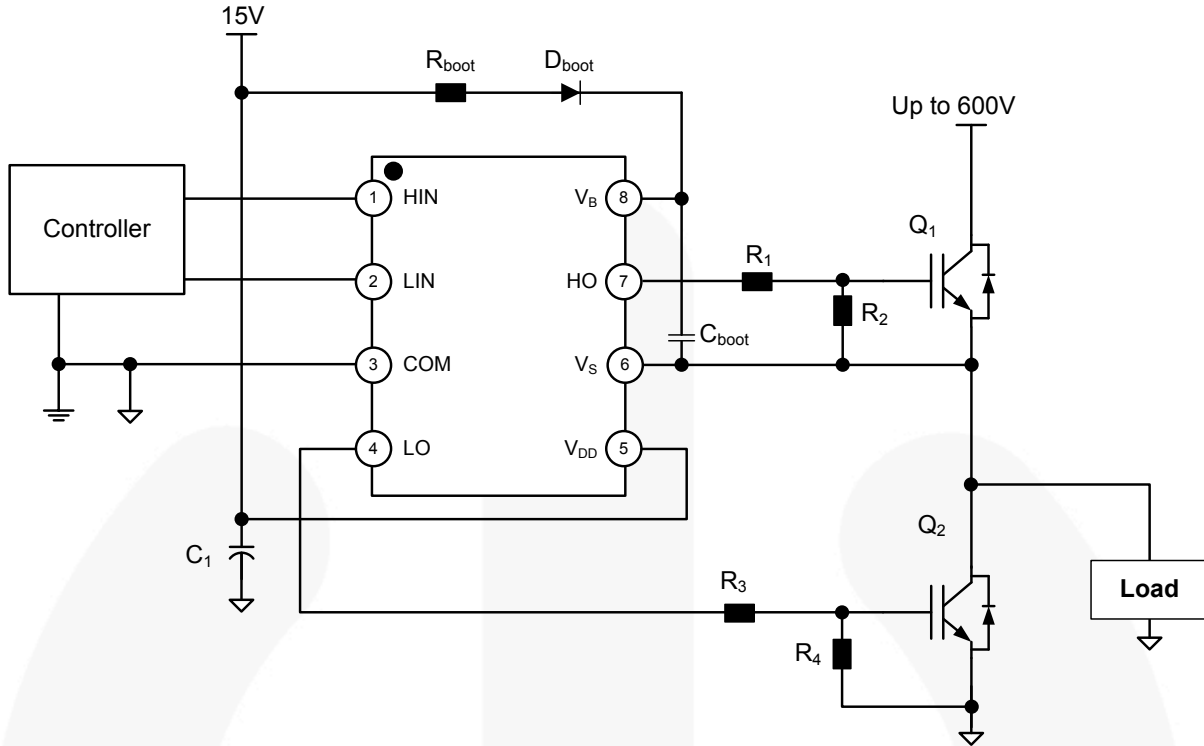


Figure 2. Half-Bridge Application Circuit (8-SOP)

### Internal Block Diagram

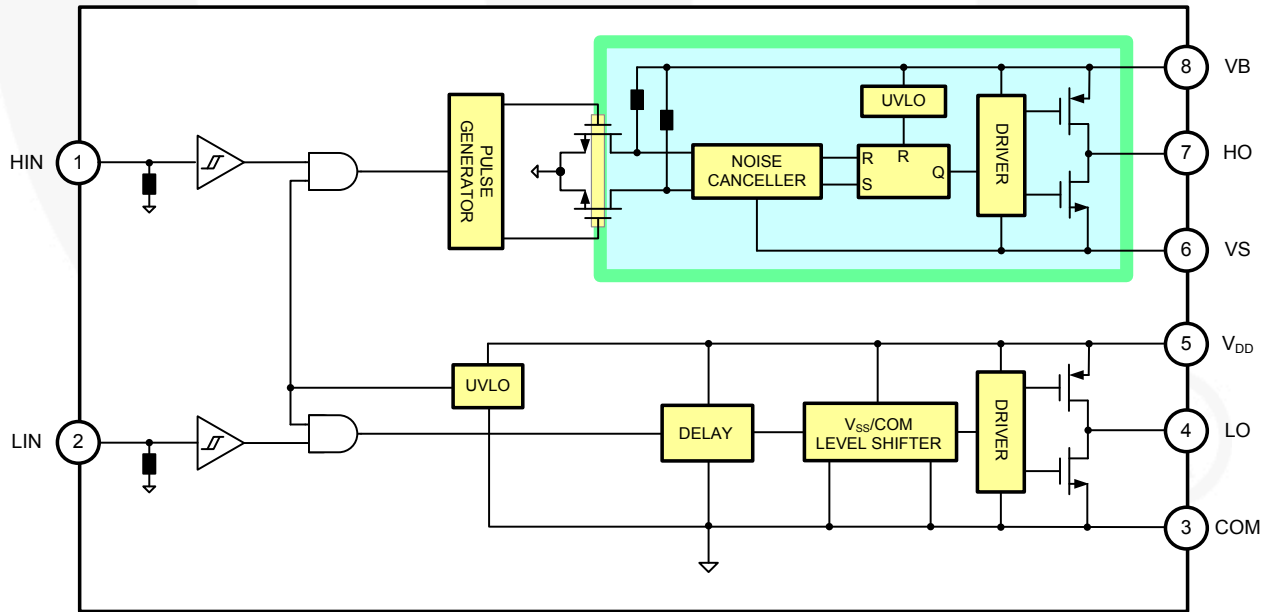


Figure 3. Functional Block Diagram (8-SOP)

## Pin Assignment

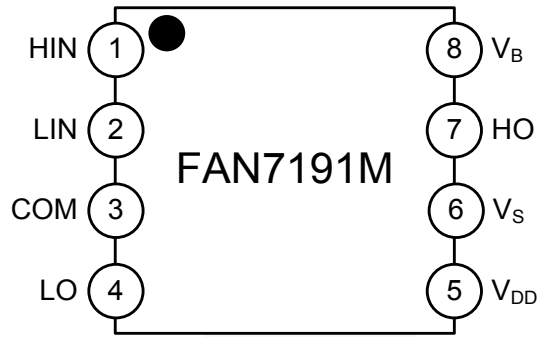


Figure 4. Pin Assignments (Top View)

## Pin Definitions

8-Pin	Name	Description
1	HIN	Logic Input for High-Side Gate Driver Output
2	LIN	Logic Input for Low-Side Gate Driver Output
3	COM	Low-side Driver Return
4	LO	Low-Side Driver Output
5	$V_{DD}$	Low-Side and Logic Power Supply Voltage
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.

TA = 25°C, unless otherwise specified. VB, VDD and VIN are referenced to COM for FAN7191M (8-SOP).

Symbol	Parameter		Min.	Max.	Unit
VS	High-side offset voltage VS		VB-25	VB+0.3	V
VB	High-side floating supply voltage VB		-0.3	625	V
VHO	High-side floating output voltage		VS-0.3	VB+0.3	V
VDD	Low-side and logic-fixed supply voltage		-0.3	25	V
VIN	Logic Input voltage (HIN, LIN, EN)		-0.3	VDD+0.3	V
VLO	Low-Side Output Voltage LO		COM-0.3	VDD+0.3	V
t <sub>pulse</sub>	Minimum Pulse Width <sup>(4)</sup>		80		ns
d <sub>VS/dt</sub>	Allowable offset voltage slew rate			50	V/ns
PD <sup>(1)(2)(3)</sup>	Power dissipation		8-SOP	0.625	W
	Thermal Resistance, junction-to-ambient		8-SOP	200	°C/W
θ <sub>JA</sub>	Thermal Resistance, junction-to-ambient		8-SOP	200	°C/W
T <sub>J</sub>	Junction temperature			+150	°C
T <sub>S</sub>	Storage temperature		-55	+150	°C
ESD	Electrostatic Discharge Capability	Human Body Model, ANSI/ESDA/JEDEC JS-001-2012		3000	V
		Charged Device Model, JESD22-C101		2000	

### Notes:

1. Mounted on 76.2 x 114.3 x 1.6mm 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 PD under any circumstances.
4. Minimum input pulse which is guaranteed to produce an output pulse.

## 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. VDD is referenced to COM for FAN7191M (8-SOP).

Symbol	Parameter	Min.	Max.	Unit
VB	High-side floating supply voltage	VS+10	VS+22	V
VS	High-side Floating Supply Offset Voltage	6-VDD	600	V
VHO	High-side Output Voltage	VS	VB	V
VDD	Low-side and Logic Supply voltage	10	22	V
VLO	Low-side output voltage	COM	VDD	V
VIN	Logic input voltage (HIN, LIN)	COM	VDD	V
COM	Power Ground	VSS-0.5	VSS+0.5	V
TA	Ambient Temperature	-40	+125	°C

## Electrical Characteristics

$V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ ) = 15.0V,  $V_S$  = COM,  $T_A$  = 25°C, unless otherwise specified. The  $V_{IL}$ ,  $V_{IH}$  and  $I_{IN}$  parameters are referenced to COM and are applicable to the respective input signals HIN and LIN. The  $V_O$  and  $I_O$  parameters are referenced to COM.  $V_S$  and GND and are applicable to the respective outputs HO and LO.

Symbol	Characteristic	Condition	Min.	Typ.	Max.	Unit
<b>POWER SUPPLY SECTION (<math>V_{DD}</math> and <math>V_{BS}</math>)</b>						
$V_{DDUV+}$ $V_{BSUV+}$	$V_{DD}$ and $V_{BS}$ Supply Under-Voltage Positive-going Threshold		7.8	8.8	9.8	V
$V_{DDUV-}$ $V_{BSUV-}$	$V_{DD}$ and $V_{BS}$ Supply Under-Voltage Negative Going Threshold		7.2	8.3	9.1	
$V_{DDHYS}$	$V_{DD}$ supply under-voltage lockout hysteresis			0.5		
$I_{LK}$	Offset Supply Leakage Current	$V_B = V_S = 600V$			50	$\mu A$
$I_{QBS}$	Quiescent $V_{BS}$ Supply Current	$V_{IN} = 0V$ or 5V		45	110	
$I_{QDD}$	Quiescent $V_{DD}$ Supply Current	$V_{IN} = 0V$ or 5V		75	150	
$I_{PBS}$	Operating $V_{BS}$ Supply Current	$f_{IN} = 20kHz$ , rms value		400	800	$\mu A$
$I_{PDD}$	Operating $V_{DD}$ Supply Current	$f_{IN} = 20kHz$ , rms value		400	800	
<b>LOGIC INPUT SECTION (HIN, LIN, EN)</b>						
$V_{IH}$	Logic "1" Input Voltage		2.5			V
$V_{IL}$	Logic "0" Input Voltage				1.2	
$I_{IN+}$	Logic "1" Input Bias Current (HIN/LIN)	$V_{IN} = 5V$		25	50	$\mu A$
$I_{IN-}$	Logic "0" Input Bias Current (HIN/LIN)	$V_{IN} = 0V$		1.0	2.0	
$R_{IN}$	Input Pull-down Resistance		100	200		k $\Omega$
<b>GATE DRIVER OUTPUT SECTION (HO, LO)</b>						
$V_{OH}$	High-level Output Voltage, $V_{BIAS}-V_O$	No Load			1.35	V
$V_{OL}$	Low-level Output Voltage, $V_O$	No Load			35	mV
$I_{O+}$	Output HIGH, Short-circuit Pulsed Current	$V_O=0V$ , $V_{IN}=5V$ with $PW<10\mu s$	3.5	4.5		A
$I_{O-}$	Output LOW Short-circuit Pulsed Current	$V_O=15V$ , $V_{IN}=0V$ 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

### Note:

5. This parameter guaranteed by design.

## Dynamic Electrical Characteristics

$V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ ) = 15.0V,  $V_S$  = COM = 0V,  $T_A$  = 25°C,  $C_{LOAD}=1000pF$  unless otherwise specified.

Symbol	Characteristic	Condition	Min.	Typ.	Max.	Unit
$t_{on}$	Turn-on Propagation Delay	$V_S=0V$		140	200	ns
$t_{off}$	Turn-off Propagation Delay	$V_S=0V$		140	200	ns
MT	Delay Matching				55	ns
$t_r$	Turn-off Rise Time			25	50	ns
$t_f$	Turn-off Fall Time			25	50	ns

## Typical Characteristics

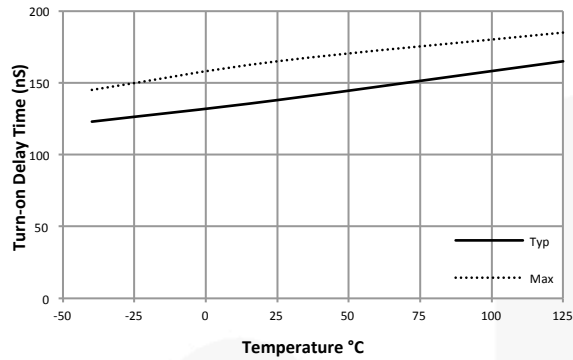


Figure 7. Turn-on Propagation Delay vs. Temperature

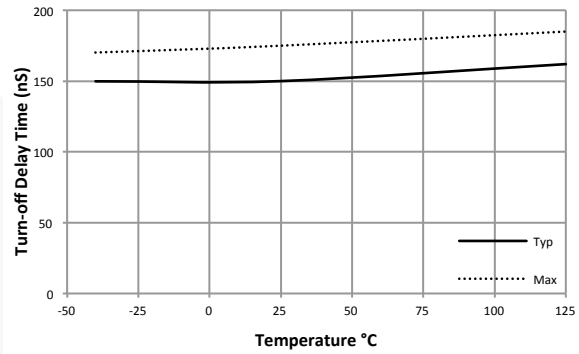


Figure 8. Turn-off Propagation Delay vs. Temperature

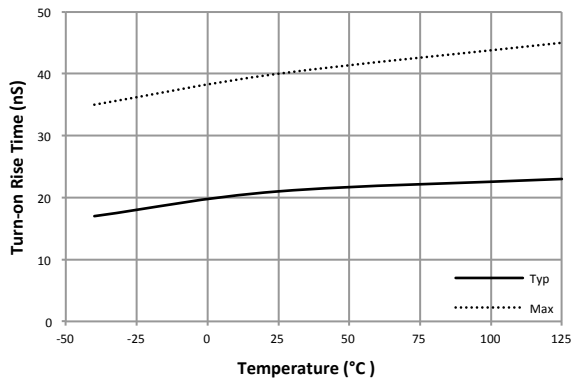


Figure 9. Turn-on Rise Time vs. Temperature

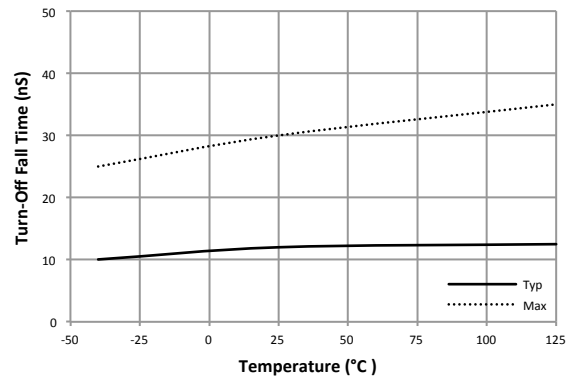


Figure 10. Turn-off Fall Time vs. Temperature

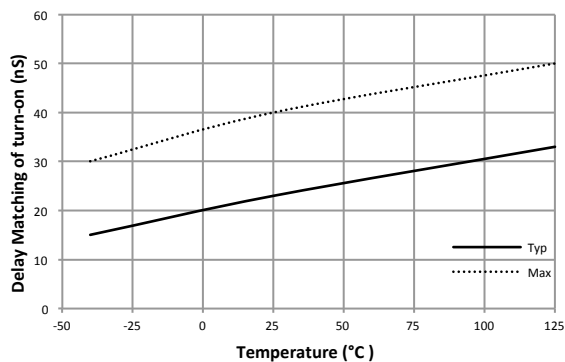


Figure 11. Turn-on Delay Matching vs. Temperature

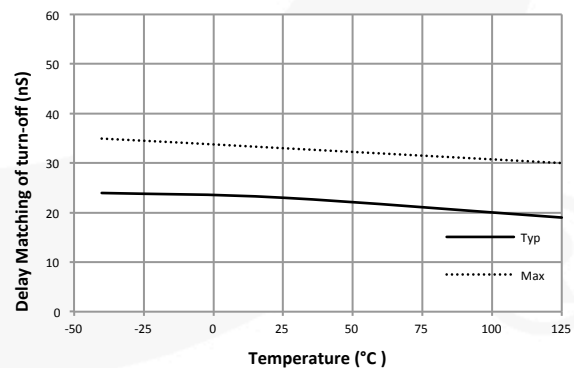


Figure 12. Turn-off Delay Matching vs. Temperature

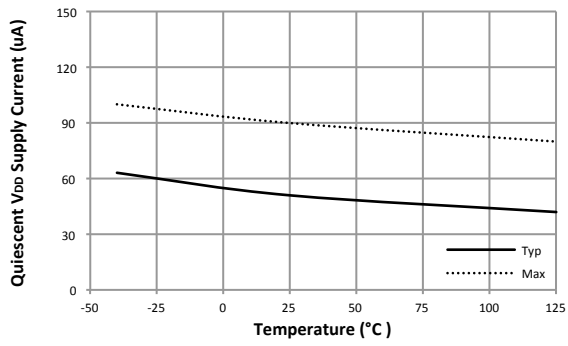


Figure 13. Quiescent  $V_{DD}$  Supply Current vs. Temperature

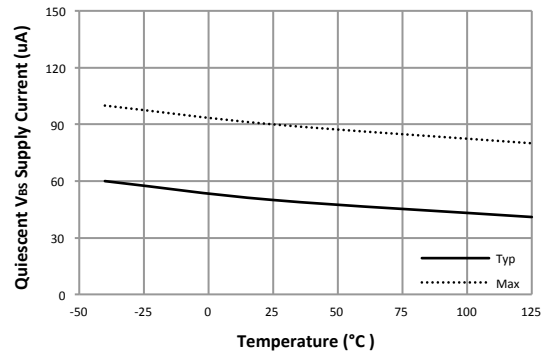


Figure 14. Quiescent  $V_{BS}$  Supply Current vs. Temperature

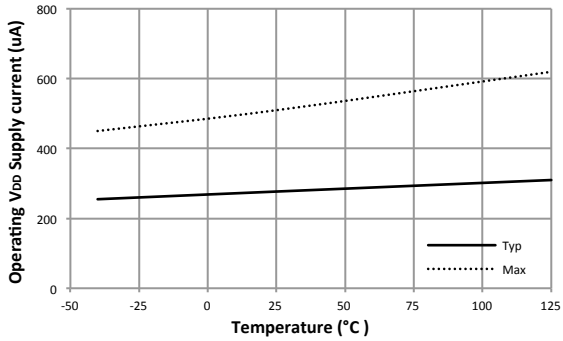


Figure 15. Operating  $V_{DD}$  Supply Current vs. Temperature

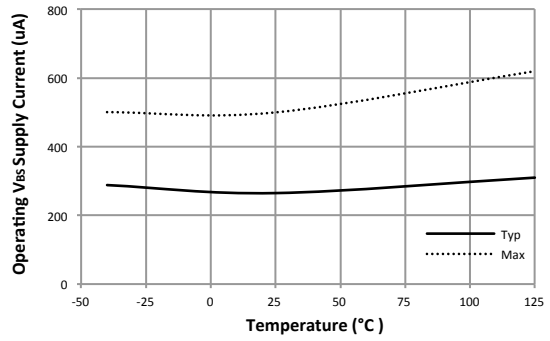


Figure 16. Operating  $V_{BS}$  Supply Current vs. Temperature

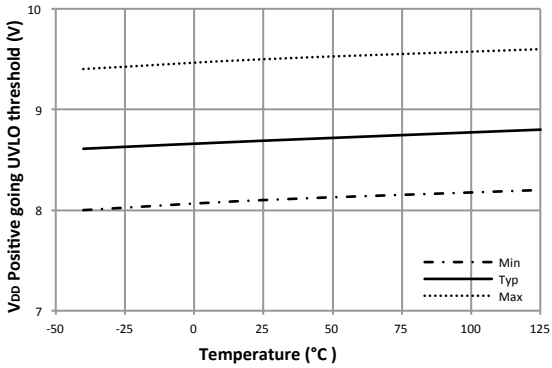


Figure 17.  $V_{DD}$  UVLO+ vs. Temperature

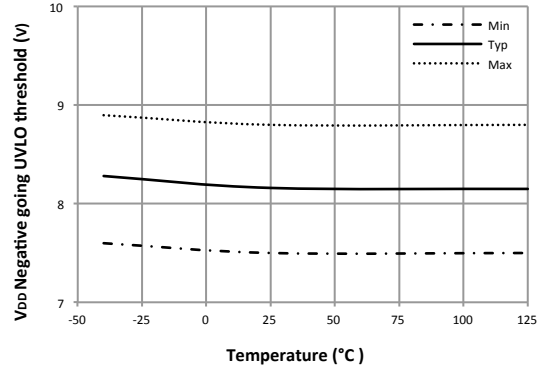


Figure 18.  $V_{DD}$  UVLO- vs. Temperature

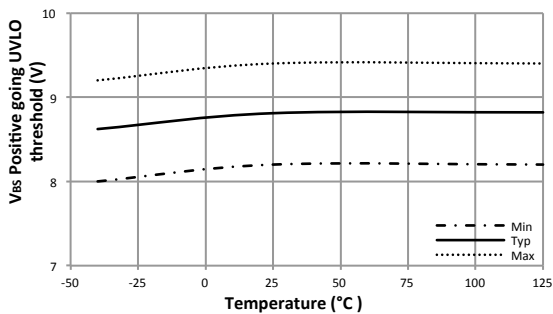


Figure 19.  $V_{BS}$  UVLO+ vs. Temperature

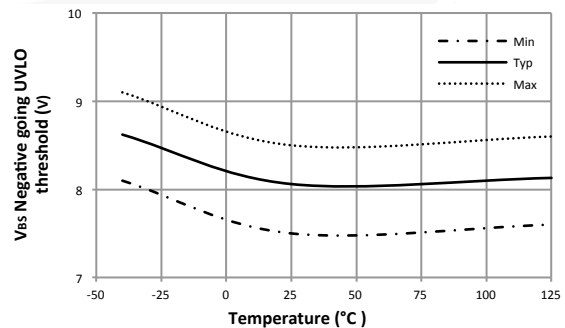


Figure 20.  $V_{BS}$  UVLO- vs. Temperature



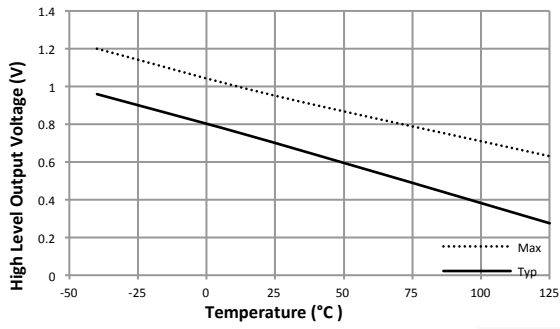


Figure 21. High-Level Output Voltage vs. Temperature

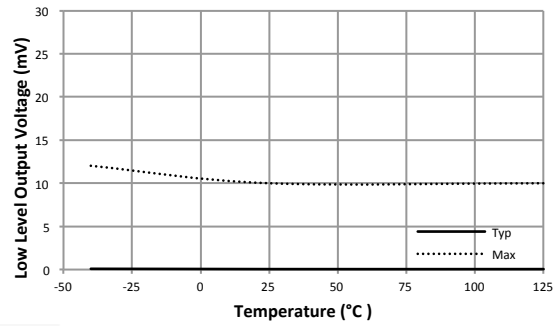


Figure 22. Low-Level Output Voltage vs. Temperature

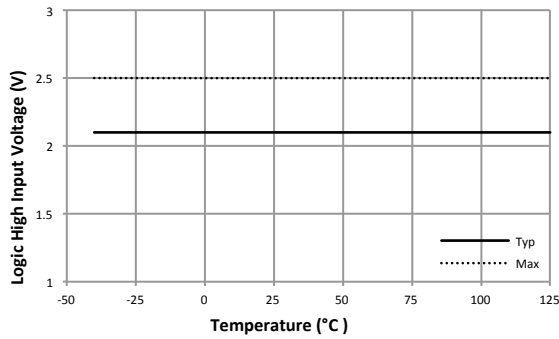


Figure 23. Logic High Input Voltage vs. Temperature

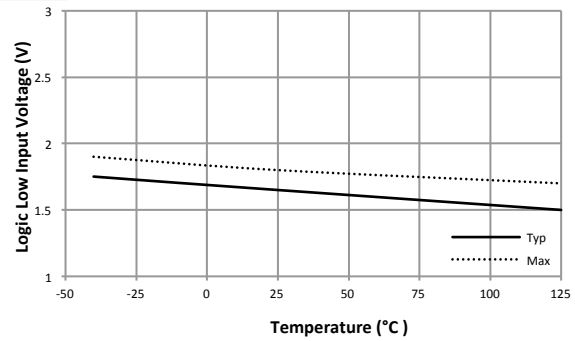


Figure 24. Logic Low Input Voltage vs. Temperature

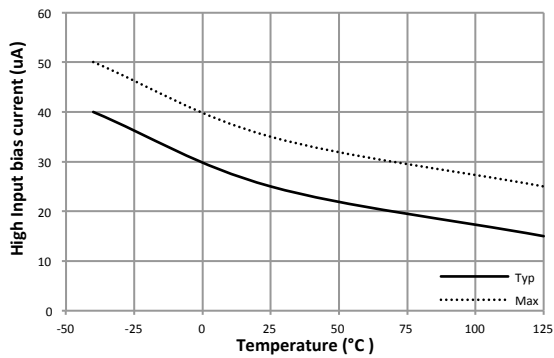


Figure 25. Logic "1" Input Bias Current vs. Temperature

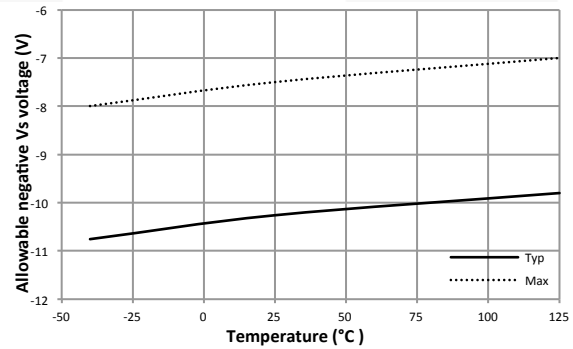


Figure 26. Allowable Negative  $V_S$  Voltage vs. Temperature

## Switching Time Definitions

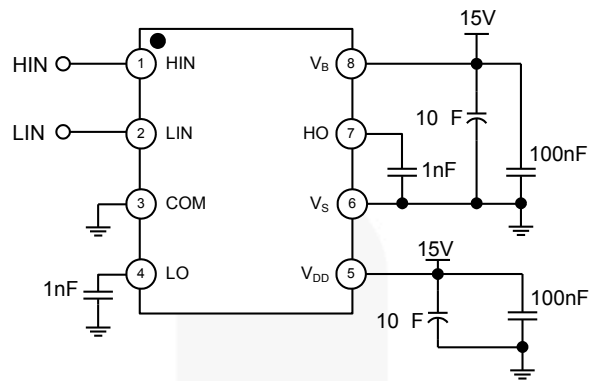


Figure 27. Switching Time Test Circuit (8-SOP)

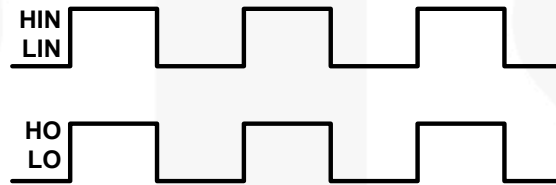


Figure 28. Input/Output Timing Diagram

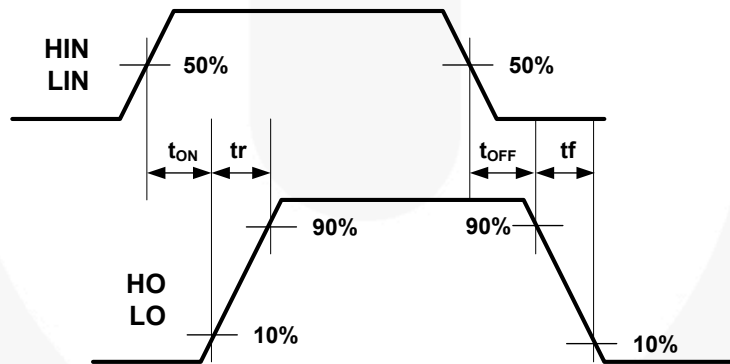


Figure 29. Switching Time Waveform Definitions

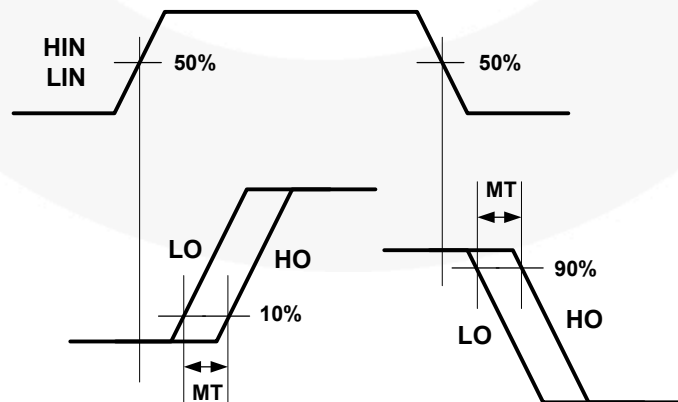


Figure 30. Delay Matching Waveform Definition

### Package Dimensions

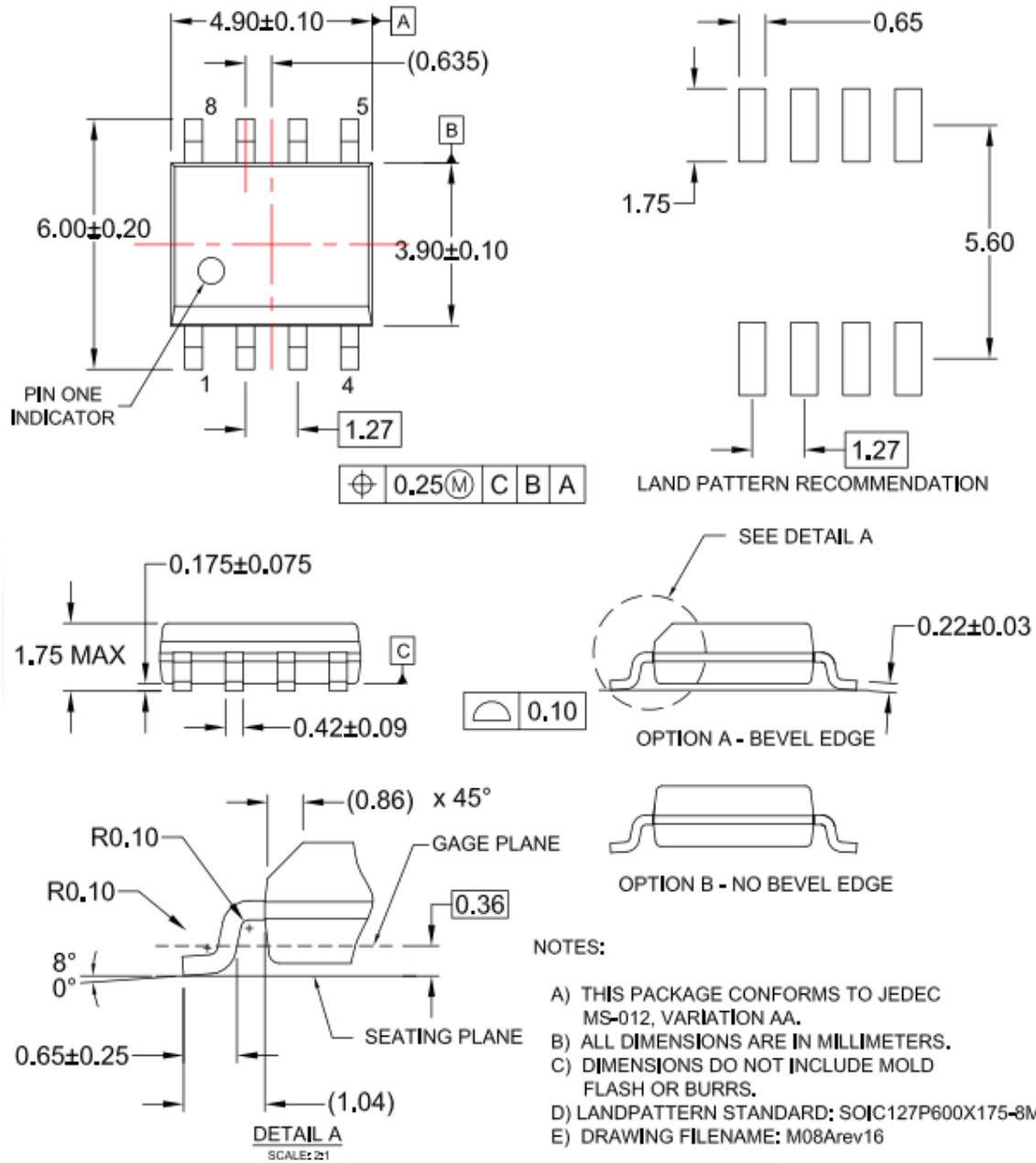



Figure 31. 8-Lead, Small Outline Package (SOP)



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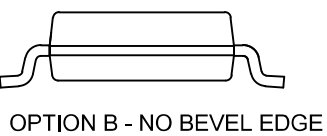
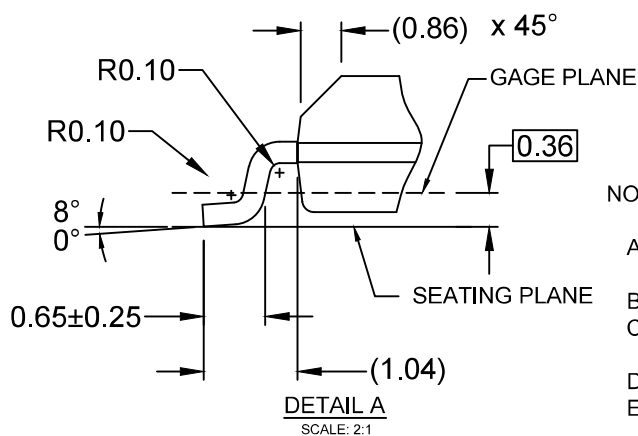
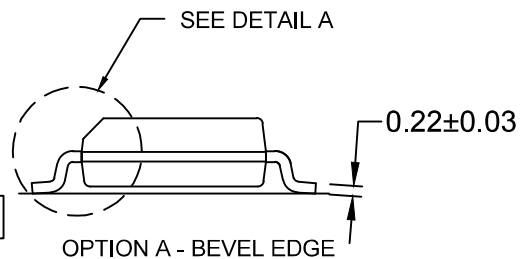
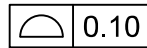
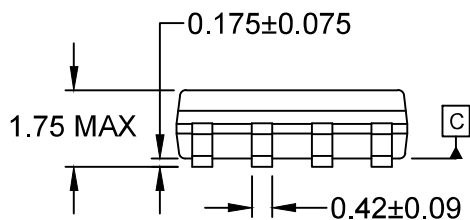
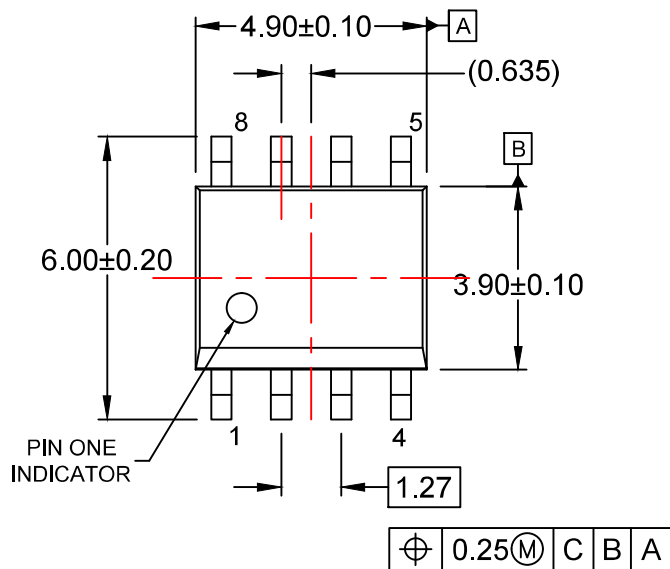
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- D) LANDPATTERN STANDARD: SOIC127P600X175-8M
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