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# FAN73832

## Half-Bridge Gate-Drive IC

### Features

- Floating Channel 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
- Internal 400ns Minimum Dead-Time at  $R_{DT}=20K\Omega$
- Programmable Turn-on Delay-Time Control (Dead-Time)

### Applications

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

### Description

The FAN73832 is a half-bridge, gate-drive IC with shut-down and programmable dead-time control functions for driving MOSFETs and IGBTs, operating up to +600V.

Fairchild's high-voltage process and common-mode noise canceling 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  $V_S=-9.8V$  (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 inverters.

8-SOP



8-DIP



### Ordering Information

Part Number	Package	Pb-Free	Operating Temperature Range	Packing Method
FAN73832M <sup>(1)</sup>	8-SOP	Yes	-40°C ~ 125°C	Tube
FAN73832MX <sup>(1)</sup>				Tape & Reel
FAN73832N	8-DIP			Tube

#### Note:

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

Typical Application Diagrams

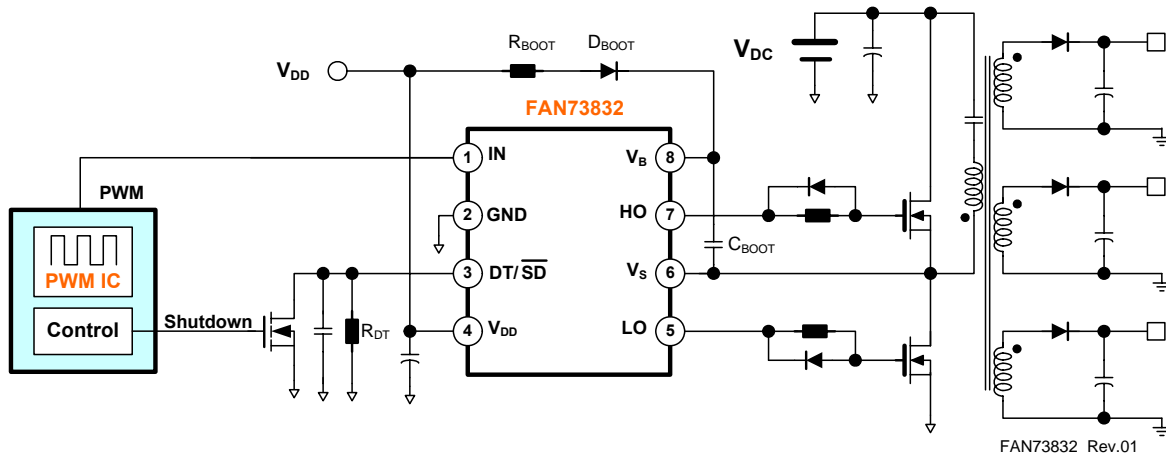


Figure 1. Application Circuit for Half-Bridge Switching Power Supply

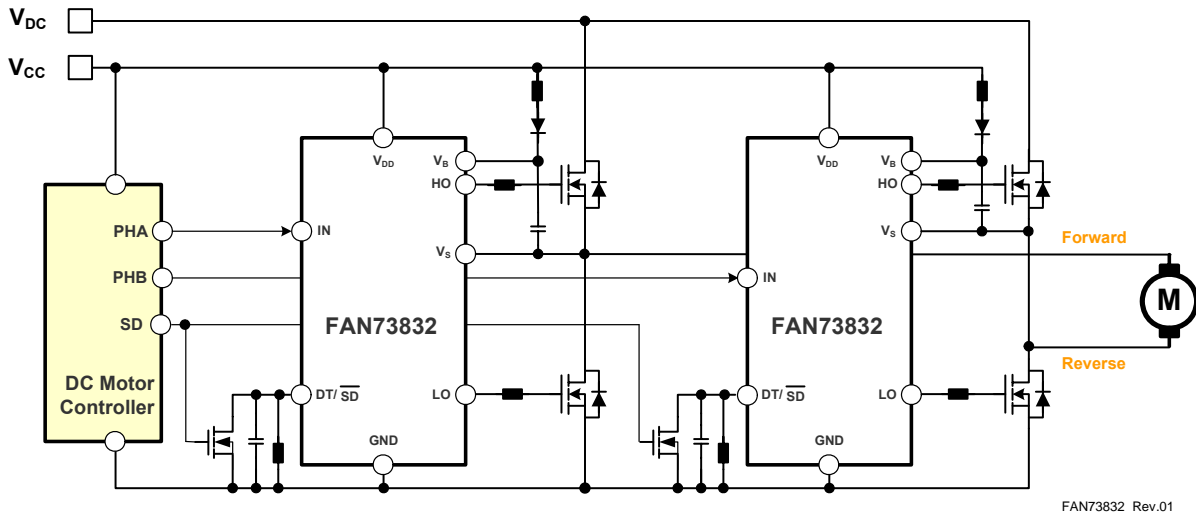


Figure 2. Application Circuit for Full-Bridge DC Motor Driver

Internal Block Diagram

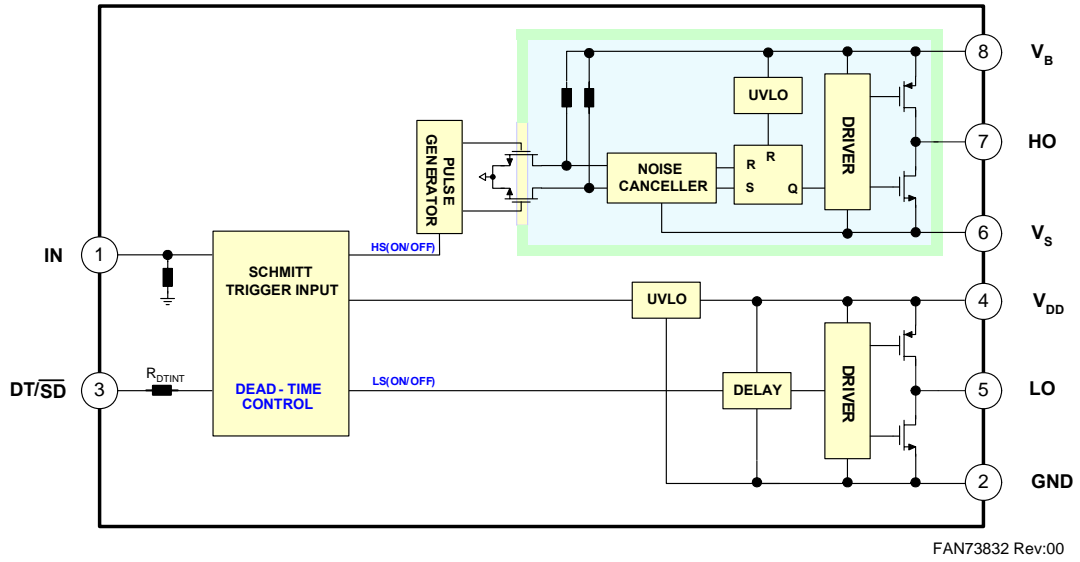


Figure 3. Functional Block Diagram of FAN73832

## Pin Assignments

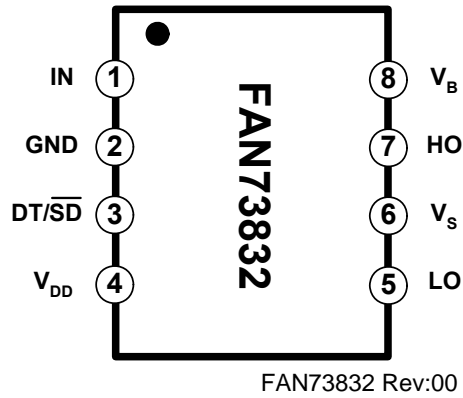


Figure 4. Pin Configuration (Top View)

## Pin Definitions

Pin #	Name	Description
1	IN	Logic Input
2	GND	Ground
3	DT/SD	Dead-Time Control with External Resistor and Shutdown Function
4	V <sub>DD</sub>	Low-Side Supply Voltage
5	LO	Low-Side Driver Output
6	V <sub>S</sub>	High-Side Floating Supply Return
7	HO	High-Side Driver Output
8	V <sub>B</sub>	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 HO	$V_S-0.3$	$V_B+0.3$	V
$V_{DD}$	Low-side and logic-fixed supply voltage	-0.3	25	V
$V_{LO}$	Low-side output voltage LO	-0.3	$V_{DD}+0.3$	V
$V_{IN}$	Logic input voltage (IN)	-0.3	$V_{DD}+0.3$	V
$V_{DT/\overline{SD}}$	Dead-time and shutdown 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	8-SOP	0.625	W
		8-DIP	1.25	
$\theta_{JA}$	Thermal resistance, junction-to-ambient	8-SOP	200	$^{\circ}\text{C/W}$
		8-DIP	100	
$T_J$	Junction temperature		150	$^{\circ}\text{C}$
$T_{STG}$	Storage temperature		150	$^{\circ}\text{C}$

### Notes:

- Mounted on 76.2 x 114.3 x 1.6mm 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 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,  $R_{DT}$ =20K $\Omega$ ,  $T_A$ =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 COM and are applicable to the respective outputs HO and LO.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>SUPPLY CURRENT SECTION</b>						
$I_{QBS}$	Quiescent $V_{BS}$ supply current	$V_{IN}=0V$ or 5V		35	90	$\mu A$
$I_{QDD}$	Quiescent $V_{DD}$ supply current	$V_{IN}=0V$ or 5V, $R_{DT}=20K\Omega$		300	450	
$I_{SD}^{(5)}$	Shutdown supply current	$DT/\overline{SD}=GND$		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		650	850	
$I_{LK}$	Offset supply leakage current	$V_B=V_S=600V$			10	
<b>POWER SUPPLY SECTION</b>						
$V_{DDUV+}$ $V_{BSUV+}$	$V_{DD}$ 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
$V_{DDUVH}$ $V_{BSUVH}$	$V_{DD}$ supply under-voltage lockout hysteresis			0.8		V
<b>DEAD-TIME CONTROL SECTION</b>						
$R_{DTINT}$	Internal dead-time setting resistance			20		K $\Omega$
$V_{DT}$	Normal voltage at DT	$R_{DT}=20K\Omega$		3.0		V
<b>GATE DRIVER OUTPUT SECTION</b>						
$V_{OH}$	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 $PW<10\mu s$	250	350		mA
$I_{O-}$	Output low short-circuit pulsed current	$V_O=15V$ , $V_{IN}=0V$ with $PW<10\mu s$	500	650		mA
$V_S$	Allowable negative $V_S$ pin voltage for IN signal propagation to HO			-9.8	-7.0	V
<b>LOGIC INPUT SECTION (INPUT and SHUTDOWN)</b>						
$V_{IH}$	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	$\mu A$
$I_{IN-}$	Logic "0" input bias current	$V_{IN}=0V$			2.0	$\mu A$
$\overline{SD+}$	Shutdown "1" input voltage				1.2	V
$\overline{SD-}$	Shutdown "0" input voltage		2.9			V
$R_{PD}$	Input pull-down resistance			100		K $\Omega$

### Note:

5. This parameter guaranteed by design.

## Dynamic Electrical Characteristics

$V_{BIAS}$  ( $V_{DD}$ ,  $V_{BS}$ )=15.0V,  $V_S$ =GND,  $C_L$ =1000pF,  $R_{DT}$ =20K $\Omega$  and  $T_A$  = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$t_{ON}$	Turn-on propagation delay	$V_S=0V$ , $R_{DT}=20K\Omega$		580	730	ns
$t_{OFF}$	Turn-off propagation delay	$V_S=0V$ or 600V <sup>(5)</sup> , $R_{DT}=20K\Omega$		180	230	
$t_R$	Turn-on rise time	$C_L=1000pF$		50	100	
$t_F$	Turn-off fall time	$C_L=1000pF$		30	80	
$t_{SD}^{(5)}$	Shutdown propagation delay			100	180	
DT1, DT2	Dead-time LO OFF to HO ON & HO OFF to LO ON	$R_{DT}=20K\Omega$	300	400	500	ns
		$R_{DT}=200K\Omega$	1.20	1.68	2.30	$\mu s$
DMT	Dead-time matching	$R_{DT}=20K\Omega$		0	60	ns
		$R_{DT}=200K\Omega$		0	150	

### Note:

5. These parameters guaranteed by design.

### Typical Characteristics

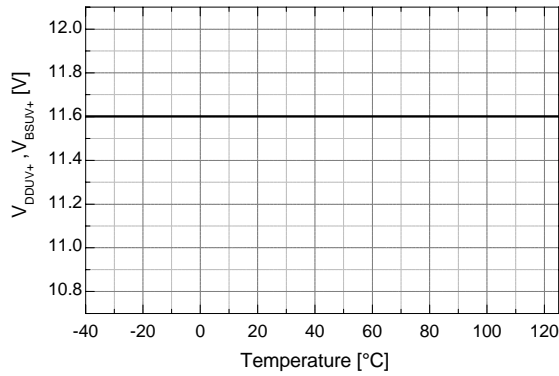


Figure 5.  $V_{DD}/V_{BS}$  UVLO (+) vs. Temperature

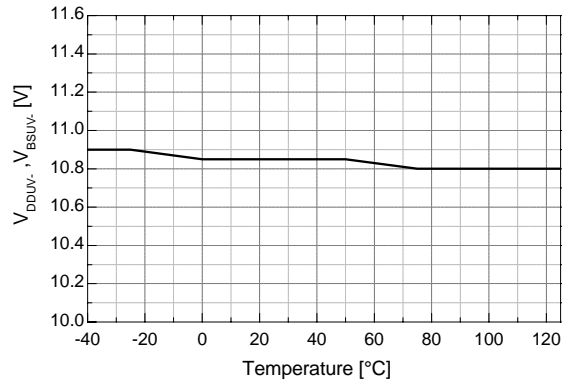


Figure 6.  $V_{DD}/V_{BS}$  UVLO (-) vs. Temperature

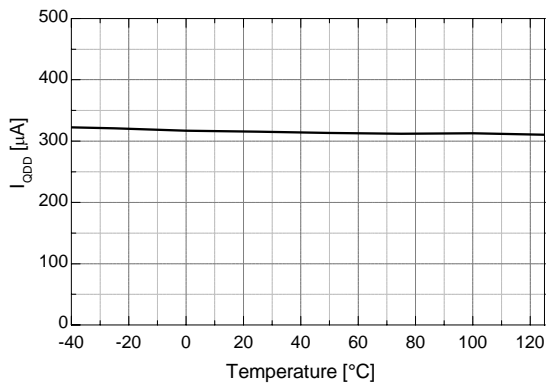


Figure 7.  $V_{DD}$  Quiescent Current vs. Temperature

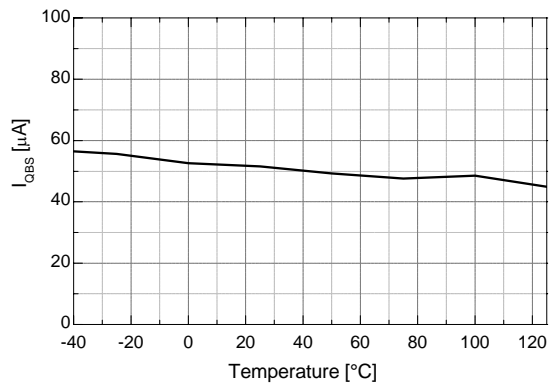


Figure 8.  $V_{BS}$  Quiescent Current vs. Temperature

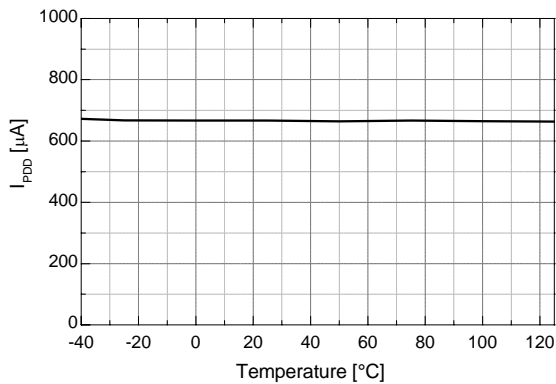


Figure 9.  $V_{DD}$  Operating Current vs. Temperature

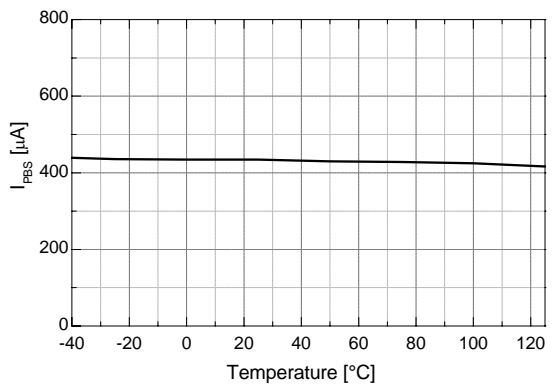


Figure 10.  $V_{BS}$  Operating Current vs. Temperature

Typical Characteristics (Continued)

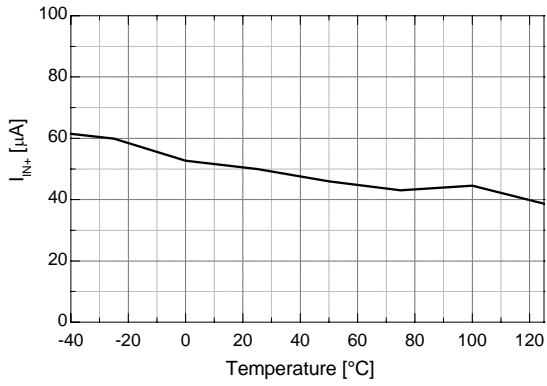


Figure 11. Logic Input Current vs. Temperature

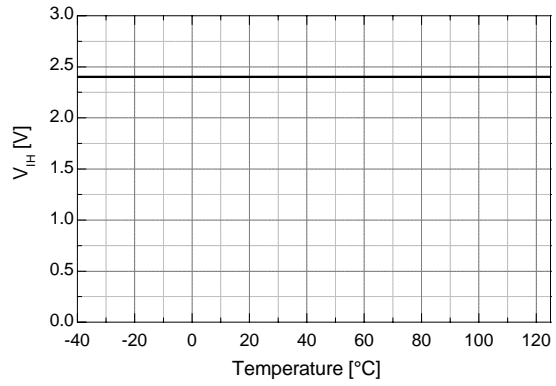


Figure 12. Logic Input High Voltage vs. Temperature

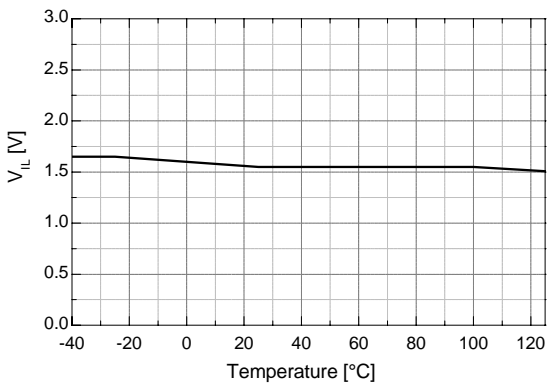


Figure 13. Logic Input Low Voltage vs. Temperature

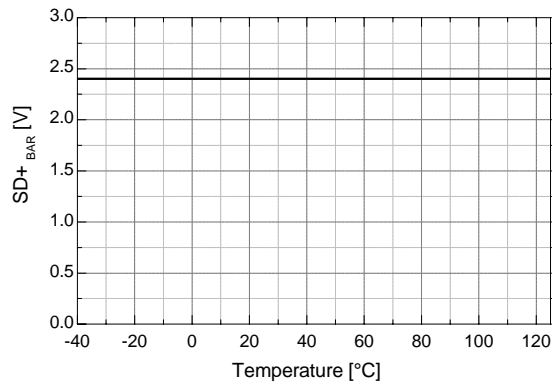


Figure 14.  $\overline{SD}$  Positive Threshold vs. Temperature

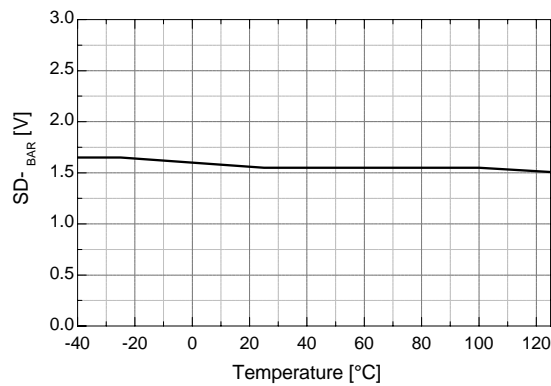


Figure 15.  $\overline{SD}$  Negative Threshold vs. Temperature

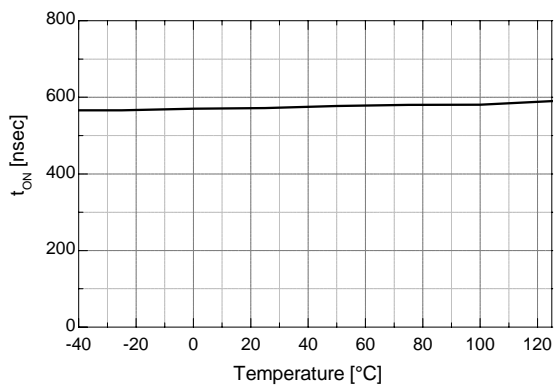


Figure 16. Turn-on Delay Time vs. Temperature

Typical Characteristics (Continued)

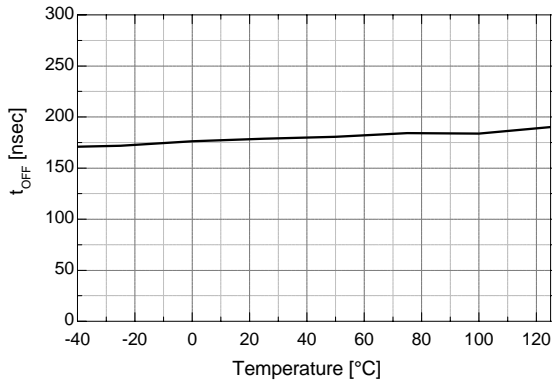


Figure 17. Turn-off Delay Time vs. Temperature

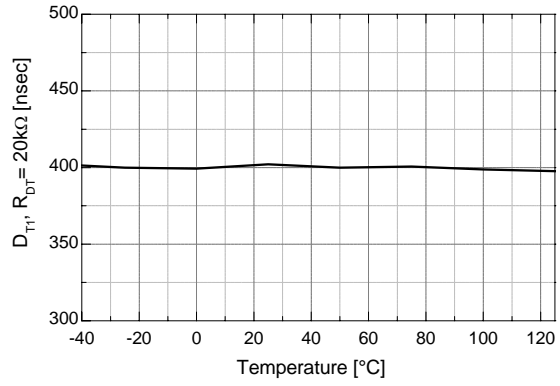


Figure 18. Dead-Time (R<sub>DT</sub>=20kΩ) vs. Temperature

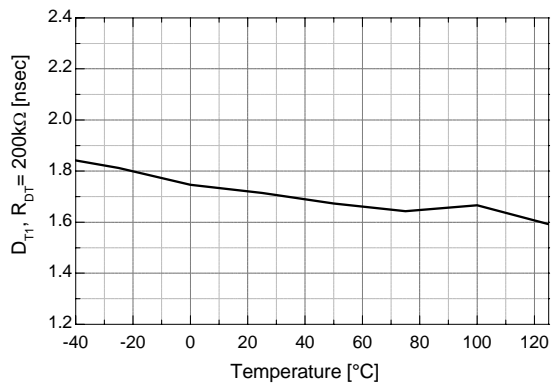


Figure 19. Dead Time (R<sub>DT</sub>=200kΩ) vs. Temperature

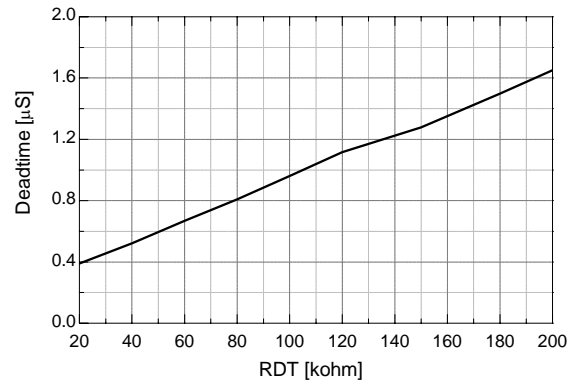


Figure 20. R<sub>DT</sub> vs. Dead-Time

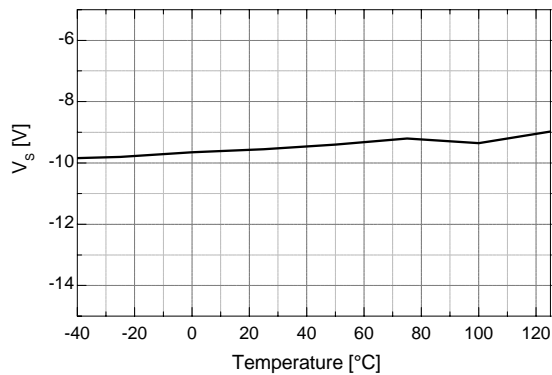
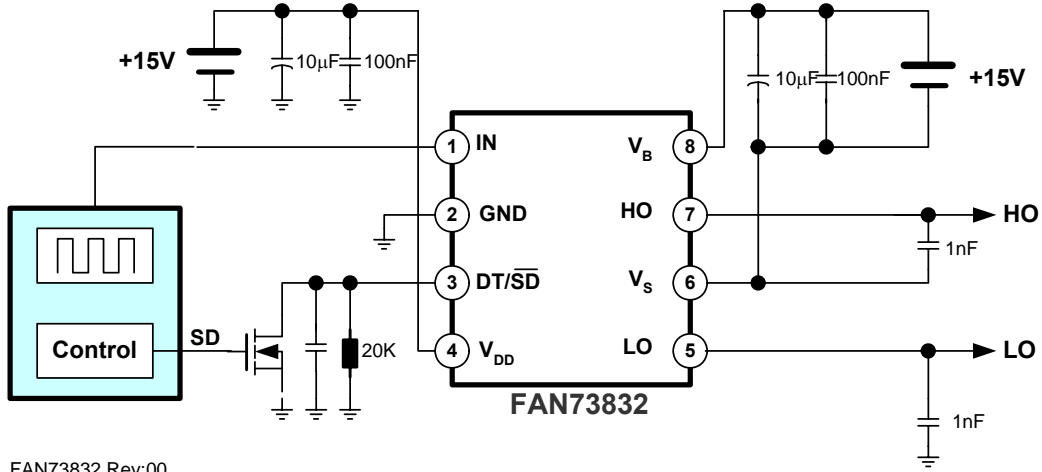


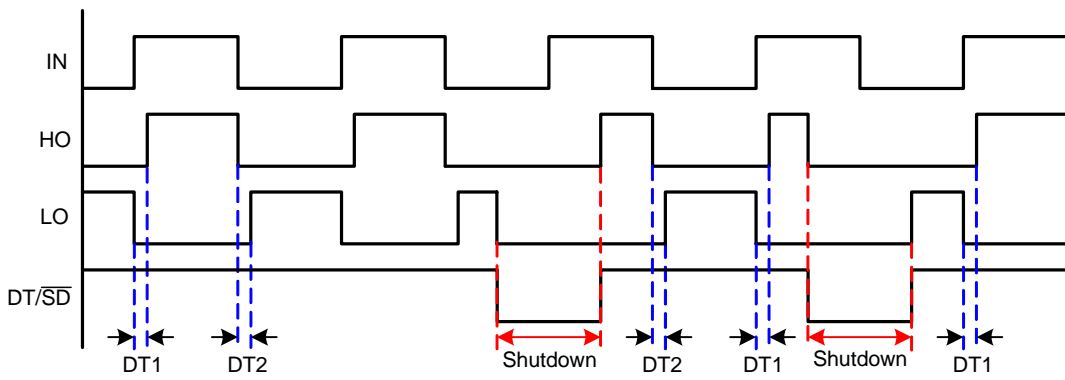
Figure 21. Allowable Negative V<sub>S</sub> Voltage for Signal Propagation to High Side vs. Temperature

### Switching Time Definitions



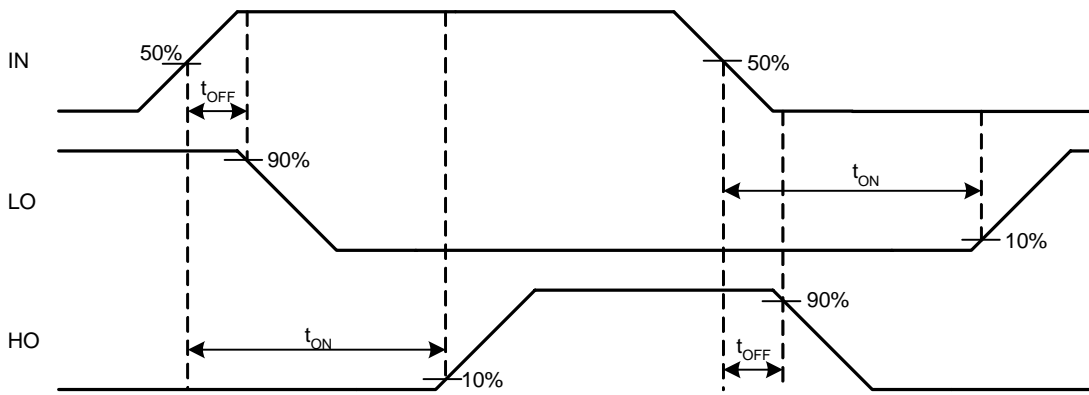
FAN73832 Rev:00

Figure 22. Switching Time Test Circuit



FAN73832 Rev.00

Figure 23. Input / Output Waveforms



FAN73832 Rev.00

Figure 24. Switching Time Waveform Definitions

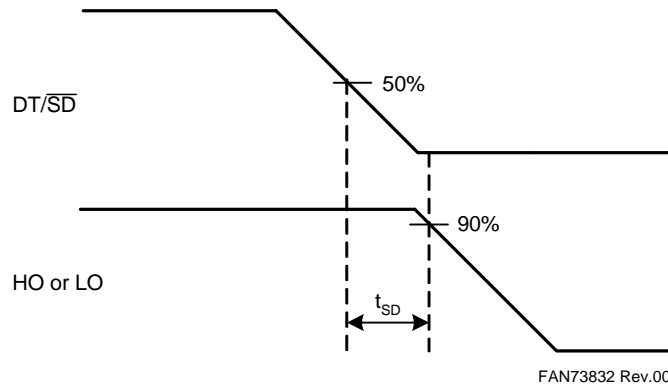


Figure 25. Shutdown Waveform Definition

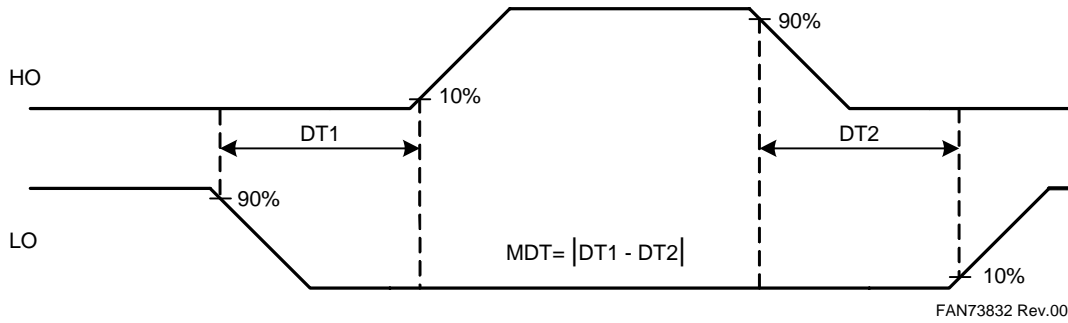


Figure 26. Dead-Time Control Waveform Definition

## Typical Application Information

### 1. Normal Operating Consideration

The FAN73832 is a single PWM input, half-bridge, gate-drive IC with programmable dead-time and shutdown functions.

The dead-time is set with a resistor ( $R_{DT}$ ) at the  $DT/\overline{SD}$  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 20k $\Omega$  to 200k $\Omega$  with a dead-time proportional to the  $R_{DT}$  resistance.

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

The external dead-time setting resistor ( $R_{DT}$ ) is at least above 20K $\Omega$  for normal operation in typical applications.

### 2. Under-Voltage Lockout (UVLO)

The FAN73832 has an under-voltage lockout (UVLO) protection circuit for high- and low-side channels to prevent malfunction when  $V_{DD}$  and  $V_{BS}$  are lower than the specified threshold voltage. The UVLO circuitry monitors the supply voltage ( $V_{DD}$ ) and bootstrap capacitor voltage ( $V_{BS}$ ) antepenult.

### 3. Layout Consideration

For optimum performance of the high- and low-side gate drivers, considerations must be taken during printed circuit board (PCB) layout.

#### 3.1 Supply Capacitors

If the output stages are able to quickly turn-on a switching device with a 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.

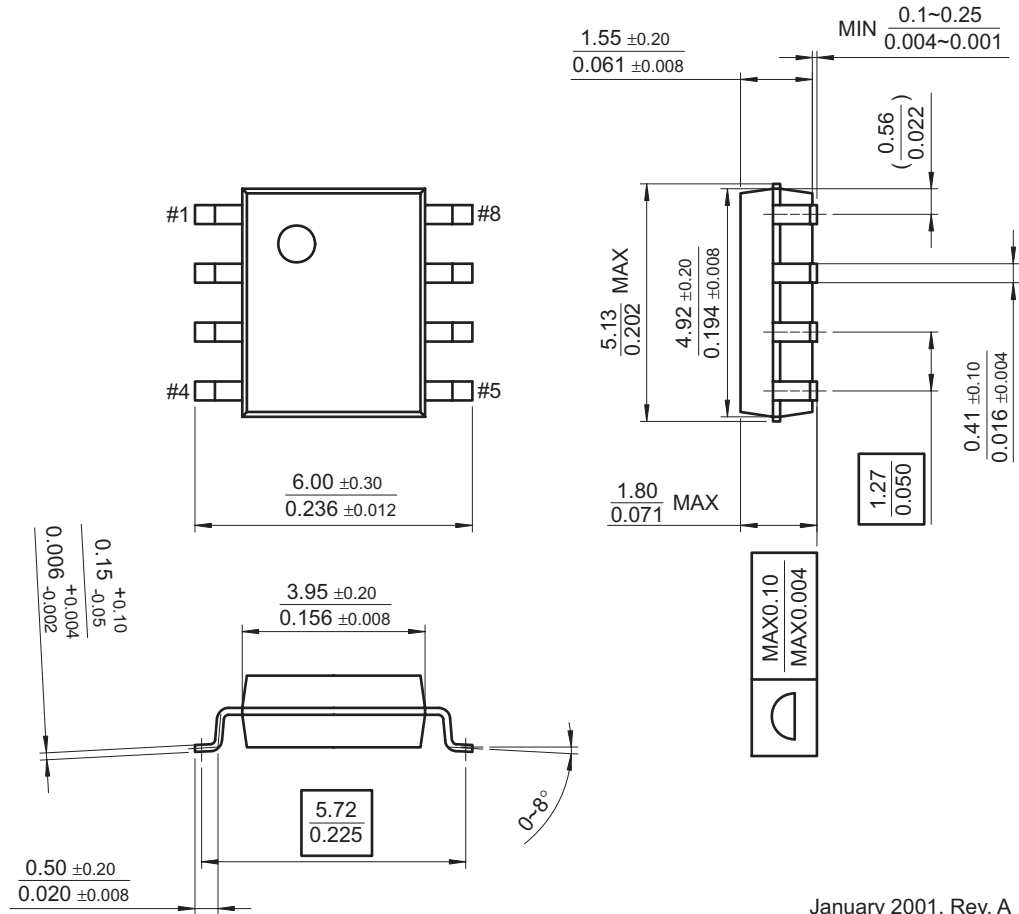
#### 3.3 Ground Plane

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

### Mechanical Dimensions

#### 8-SOP

Dimensions are in millimeters (inches) unless otherwise noted.



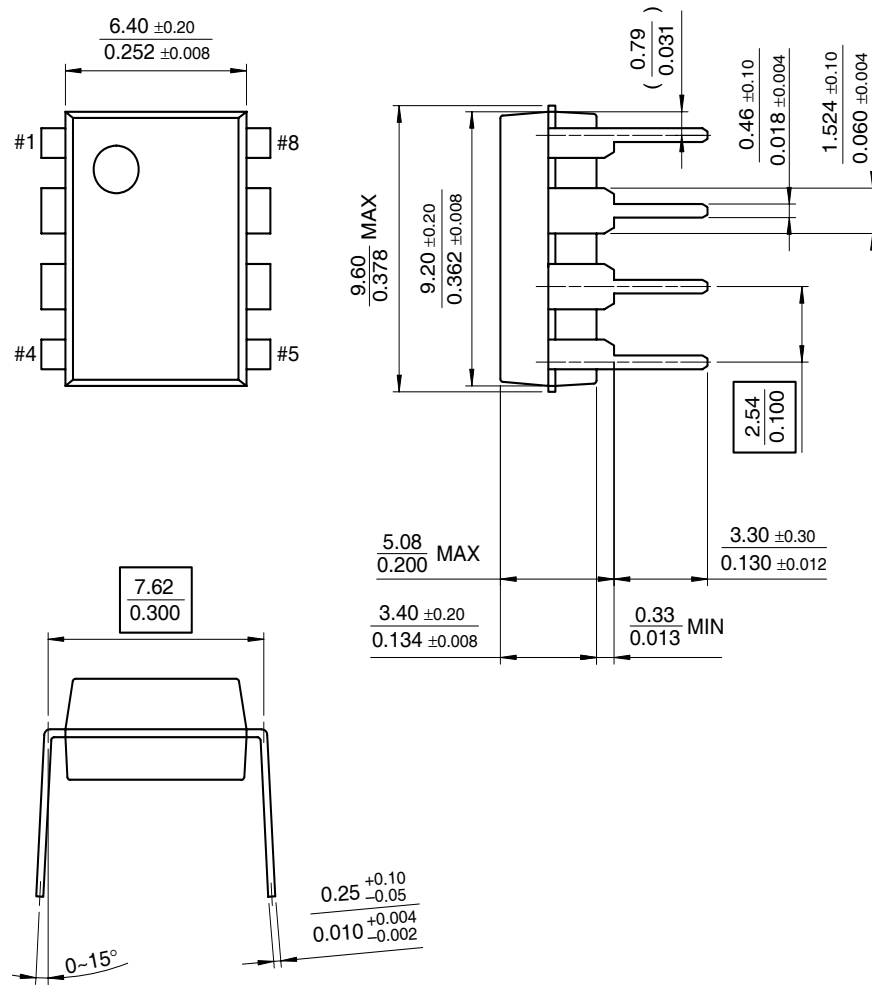
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Figure 27. 8-Lead Small Outline Package (SOP)

**Mechanical Dimensions** (Continued)

**8-DIP**

Dimensions are in millimeters (inches) unless otherwise noted.




September 1999, Rev B  
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**Figure 28. 8-Lead Dual In-Line Package (DIP)**



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EcoSPARK <sup>®</sup>	OCXPro <sup>™</sup>	SuperFET <sup>™</sup>	
EnSigna <sup>™</sup>	OPTOLOGIC <sup>®</sup>	SuperSOT <sup>™</sup> -3	
FACT Quiet Series <sup>™</sup>	OPTOPLANAR <sup>®</sup>	SuperSOT <sup>™</sup> -6	
FACT <sup>®</sup>	PACMAN <sup>™</sup>	SuperSOT <sup>™</sup> -8	
FAST <sup>®</sup>	POP <sup>™</sup>	TCM <sup>™</sup>	
FASTr <sup>™</sup>	Power220 <sup>®</sup>	The Power Franchise <sup>®</sup>	
FPS <sup>™</sup>	Power247 <sup>®</sup>	 ™	
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