

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 Input Signal
- Built-in UVLO Functions for Both Channels
- Built-in Common-Mode dv/dt Noise Canceling Circuit
- Internal 400nsec 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 ⁽¹⁾	8-SOP	Yes	-40°C ~ 125°C	Tube
FAN73832MX ⁽¹⁾				Tape & Reel
FAN73832N	8-DIP			Tube

Note:

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

Typical Application Diagrams

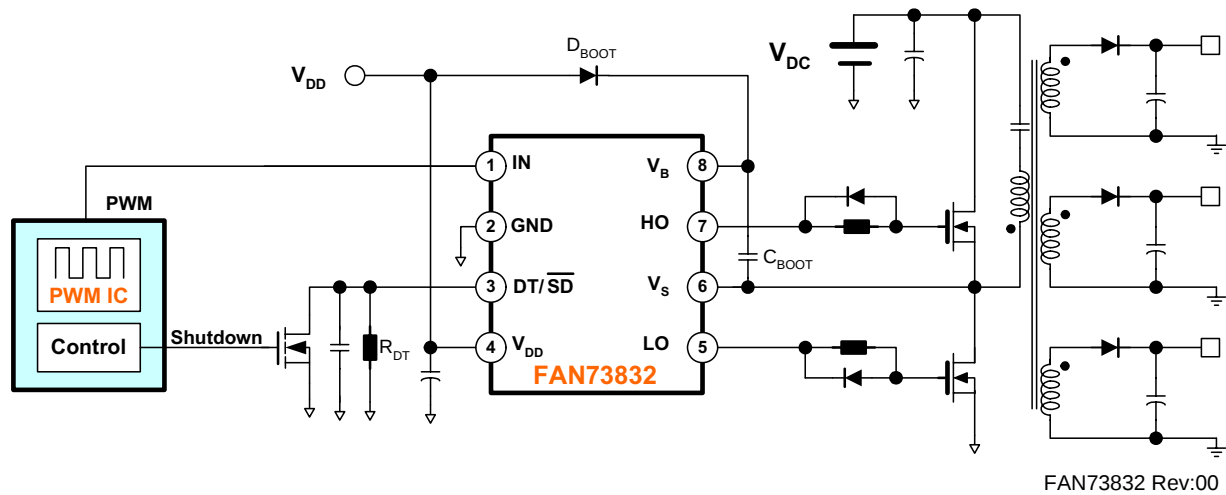


Figure 1. Application Circuit for Half-Bridge Switching Power Supply

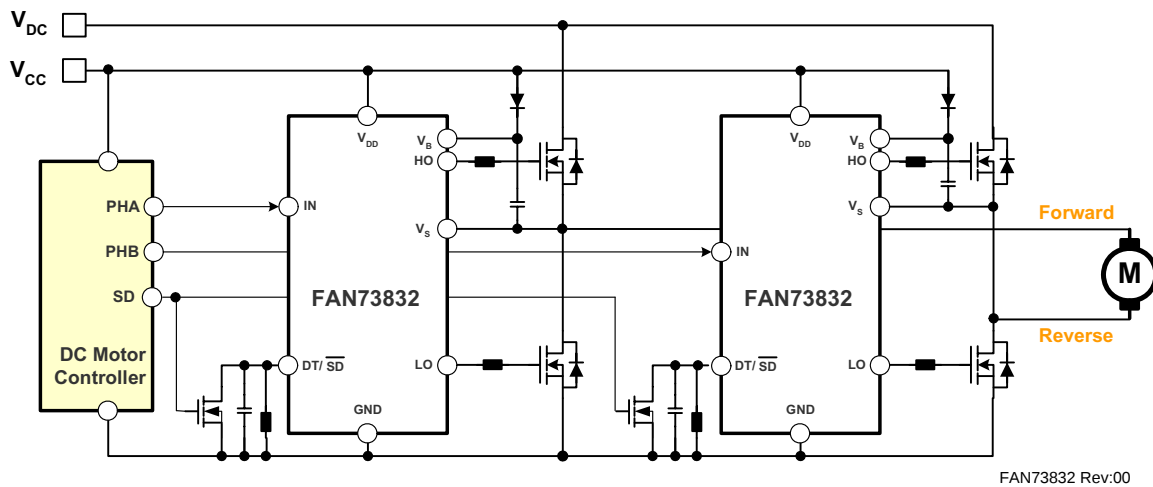


Figure 2. Application Circuit for Full-Bridge DC Motor Driver

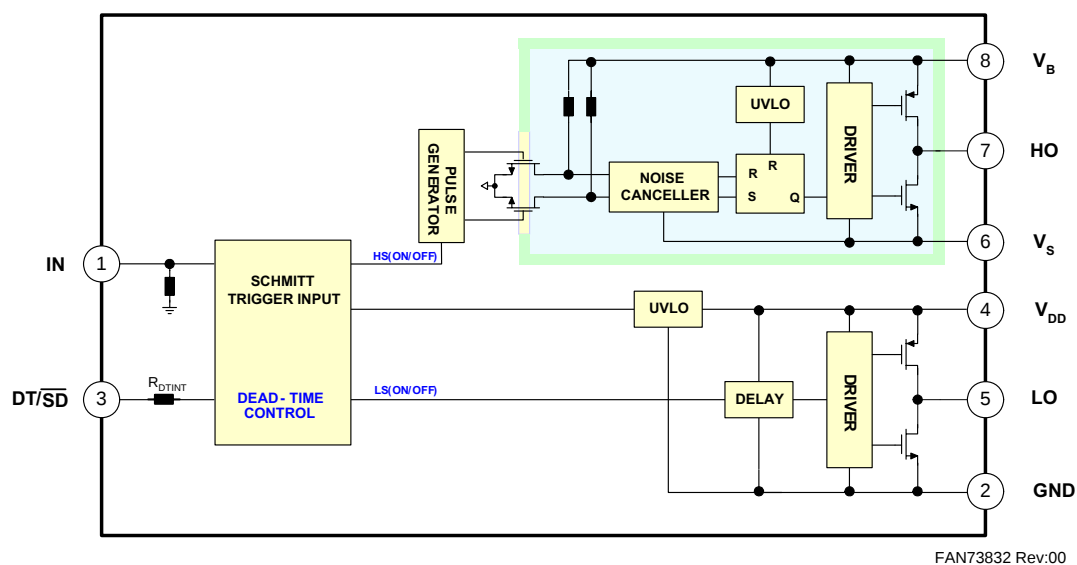
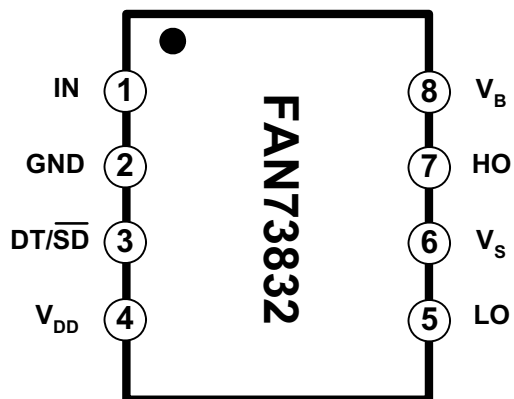


Figure 3. Functional Block Diagram of FAN73832

Pin Assignments



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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 _{DD}	Low-Side Supply Voltage
5	LO	Low-Side Driver Output
6	V _S	High-Side Floating Supply Return
7	HO	High-Side Driver Output
8	V _B	High-Side Floating Supply

Absolute Maximum Ratings

The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table defines the conditions for actual device operation. $T_A=25^{\circ}\text{C}$ unless otherwise specified.

Symbol	Characteristics		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/nsec
$P_D^{(2)(3)(4)}$	Power dissipation	8-SOP		0.625	W
		8-DIP		1.25	
θ_{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

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 Ω , 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 GND and V_S is applicable to HO and LO.

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
SUPPLY CURRENT SECTION						
I _{QBS}	Quiescent V _{BS} supply current	V _{IN} =0V or 5V		35	90	μA
I _{QDD}	Quiescent V _{DD} supply current	V _{IN} =0V or 5V, R _{DT} =20KΩ		300	450	
I _{SD} ⁽⁴⁾	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	
POWER SUPPLY SECTION						
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
DEAD-TIME CONTROL SECTION						
R _{DTINT}	Internal dead-time setting resistance			20		KΩ
V _{DT}	Normal voltage at DT	R _{DT} =20KΩ		3.0		V
GATE DRIVER OUTPUT SECTION						
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<10μs	250	350		mA
I _{O-}	Output low short-circuit pulsed current	V _O =15V, V _{IN} =0V with PW<10μs	500	650		mA
V _S	Allowable negative V _S pin voltage for IN signal propagation to HO			-9.8	-7.0	V
LOGIC INPUT SECTION (INPUT and SHUTDOWN)						
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	μA
I _{IN-}	Logic "0" input bias current	V _{IN} =0V			2.0	μA
$\overline{SD+}$	Shutdown "1" input voltage				1.2	V
$\overline{SD-}$	Shutdown "0" input voltage		2.9			V
R _{PD}	Input pull-down resistance			100		KΩ

Note:

4. This parameter, although guaranteed, is not 100% tested in production.

Dynamic Electrical Characteristics

V_{BIAS} (V_{DD} , V_{BS})=15.0V, V_S =GND, C_L =1000pF, R_{DT} =20K Ω 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	nsec
t_{OFF}	Turn-off propagation delay	$V_S=0V$, $R_{DT}=20K\Omega$		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	
		$R_{DT} = 200K\Omega$	1.20	1.68	2.30	
DMT	Dead-time matching	$R_{DT} = 20K\Omega$		0	60	
		$R_{DT} = 200K\Omega$		0	150	

Note:

5. This parameter, although guaranteed, is not 100% tested in production.

Typical Characteristics

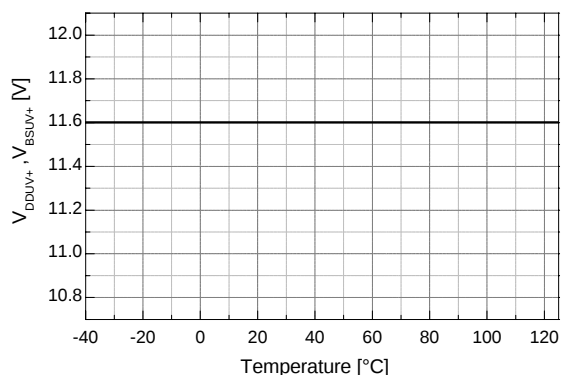


Figure 5. V_{DD}/V_{DD} UVLO (+) vs. Temperature

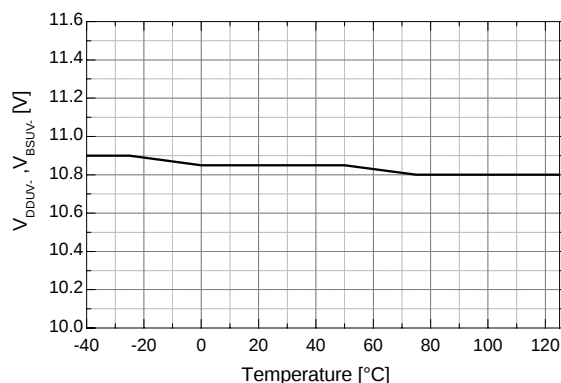


Figure 6. V_{DD}/V_{BS} UVLO (-) vs. Temperature

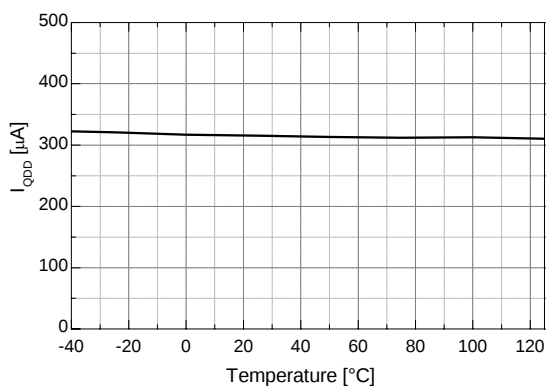


Figure 7. V_{DD} Quiescent Current vs. Temperature

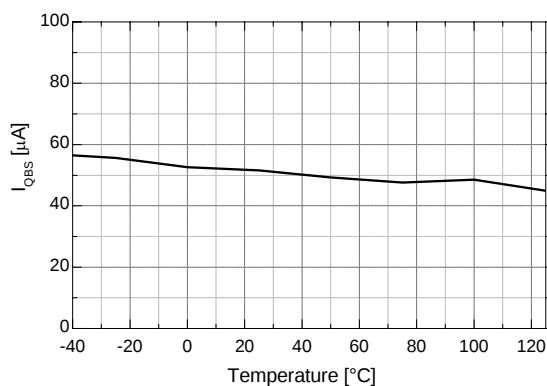


Figure 8. V_{BS} Quiescent Current vs. Temperature

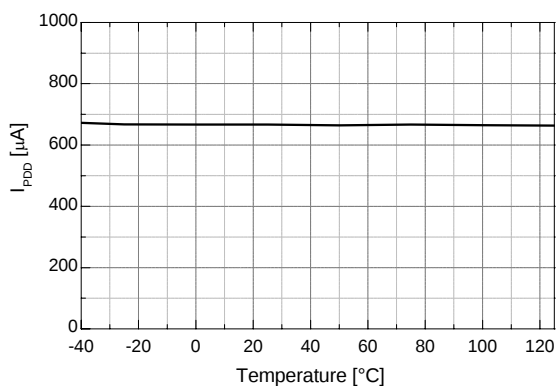


Figure 9. V_{DD} Operating Current vs. Temperature

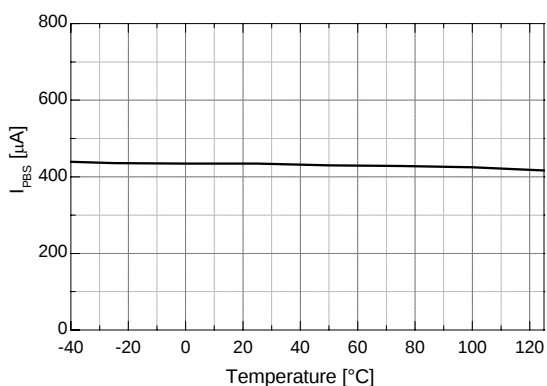


Figure 10. V_{BS} Operating Current vs. Temperature

Typical Characteristics (Continued)

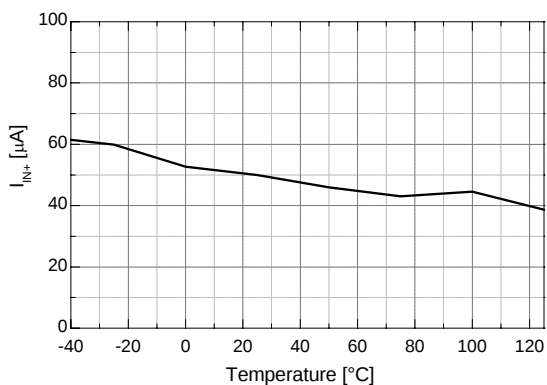


Figure 11. Logic Input Current vs. Temperature

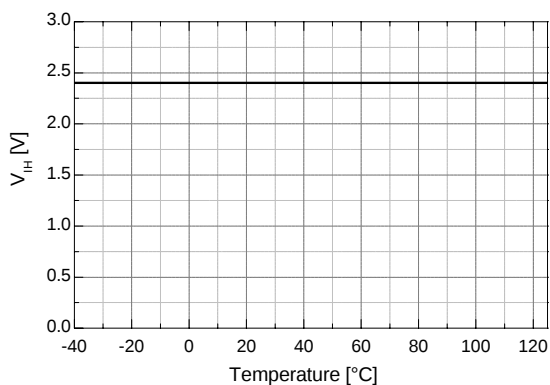


Figure 12. Logic Input High Voltage vs. Temperature

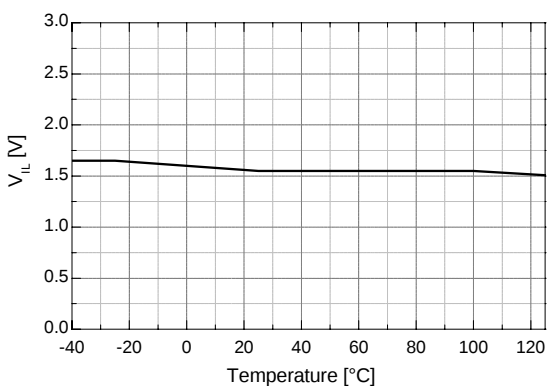


Figure 13. Logic Input Low Voltage vs. Temperature

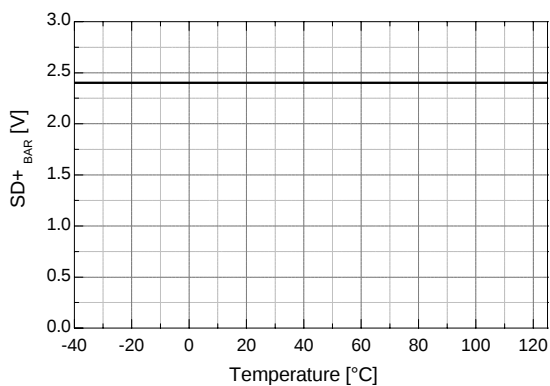
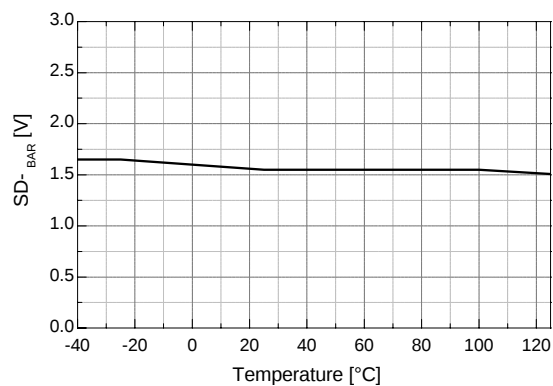
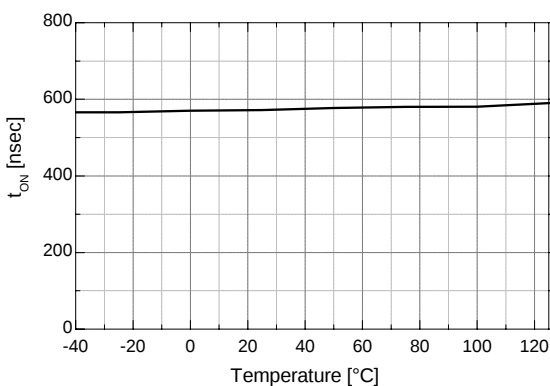
Figure 14. $\overline{SD}$ Positive Threshold vs. TemperatureFigure 15. $\overline{SD}$ Negative Threshold vs. Temperature

Figure 16. Turn-on Delay Time vs. Temperature

Typical Characteristics (Continued)

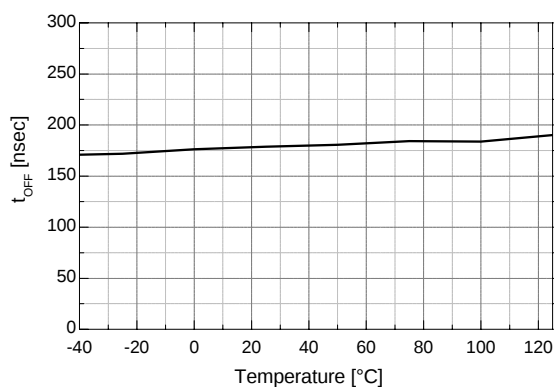


Figure 17. Turn-off Delay Time vs. Temperature

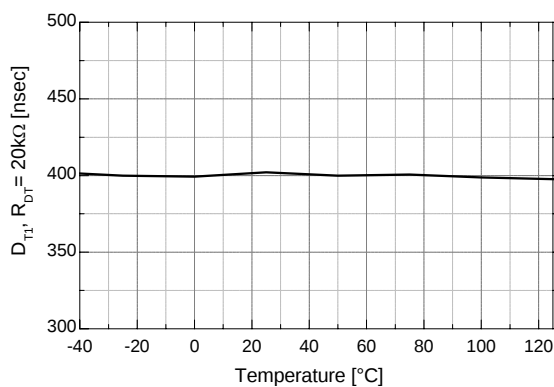


Figure 18. Dead Time ($R_{DT}=20k\Omega$) vs. Temperature

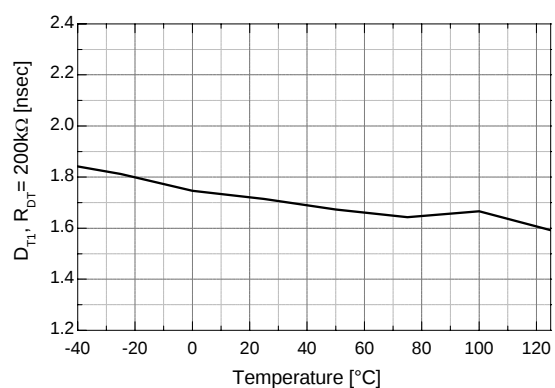


Figure 19. Dead Time ($R_{DT}=200k\Omega$) vs. Temperature

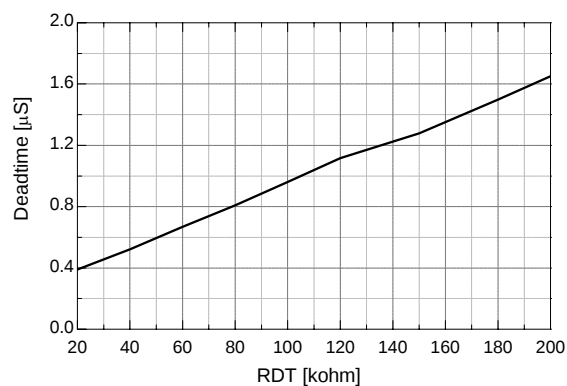


Figure 20. R_{DT} vs. Dead Time

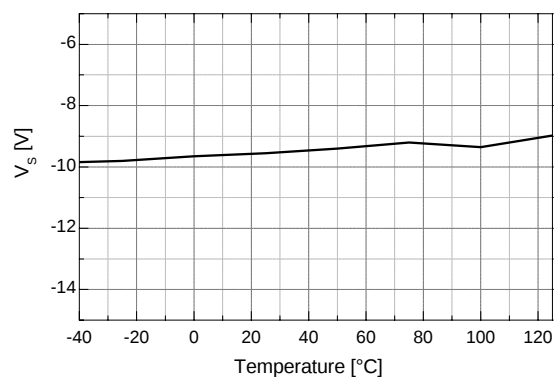
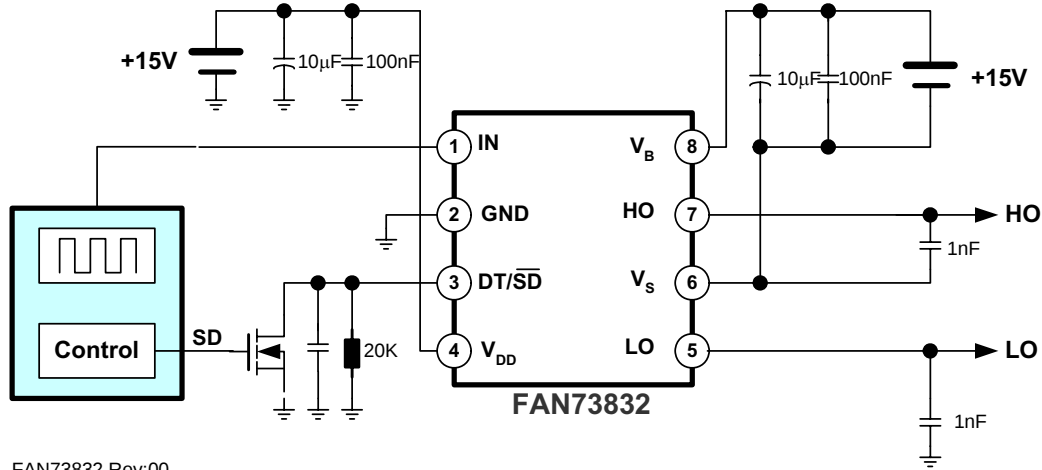


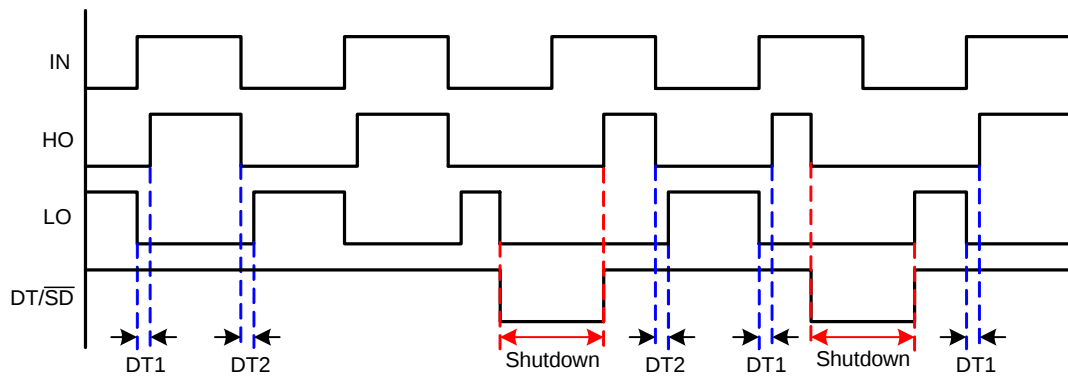
Figure 21. Allowable Negative V_S Voltage for Signal Propagation to High Side vs. Temperature

Switching Time Definitions



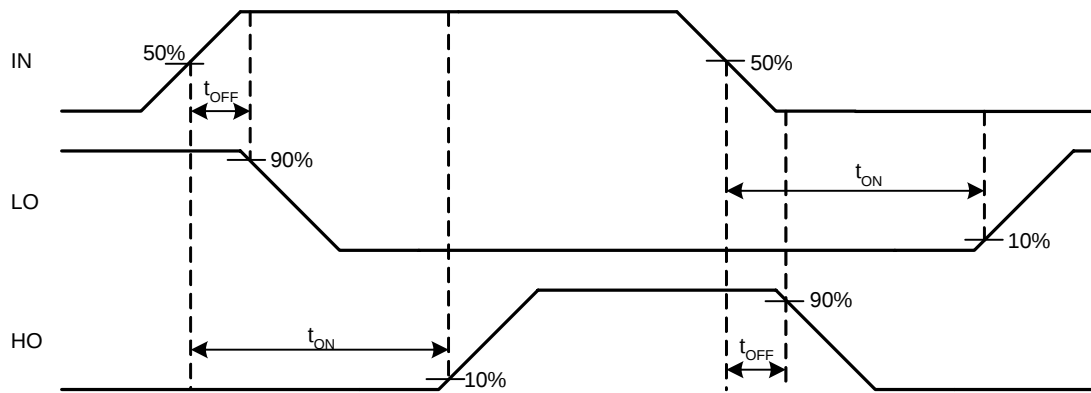
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Figure 22. Switching Time Test Circuit



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Figure 23. Input / Output Waveforms



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Figure 24. Switching Time Waveform Definitions

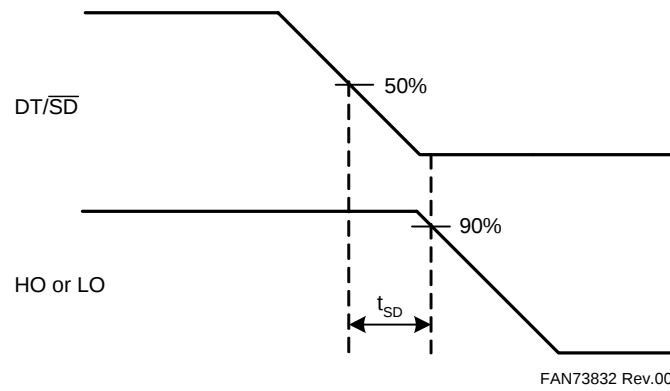


Figure 25. Shutdown Waveform Definition

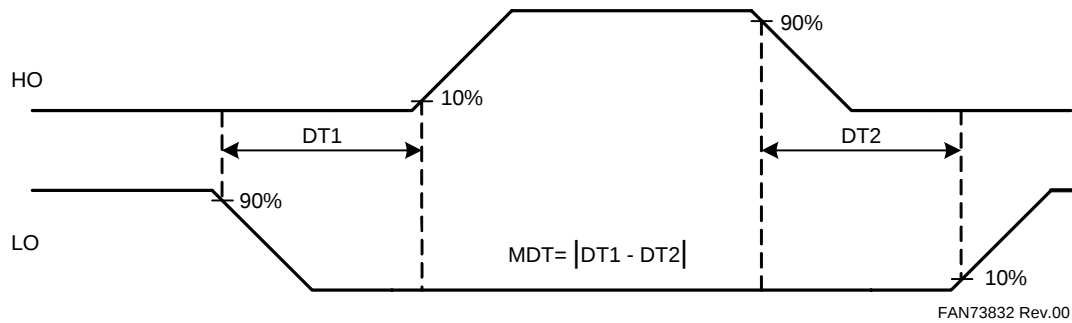


Figure 26. Dead-Time Control Waveform Definition

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}) independently.

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.

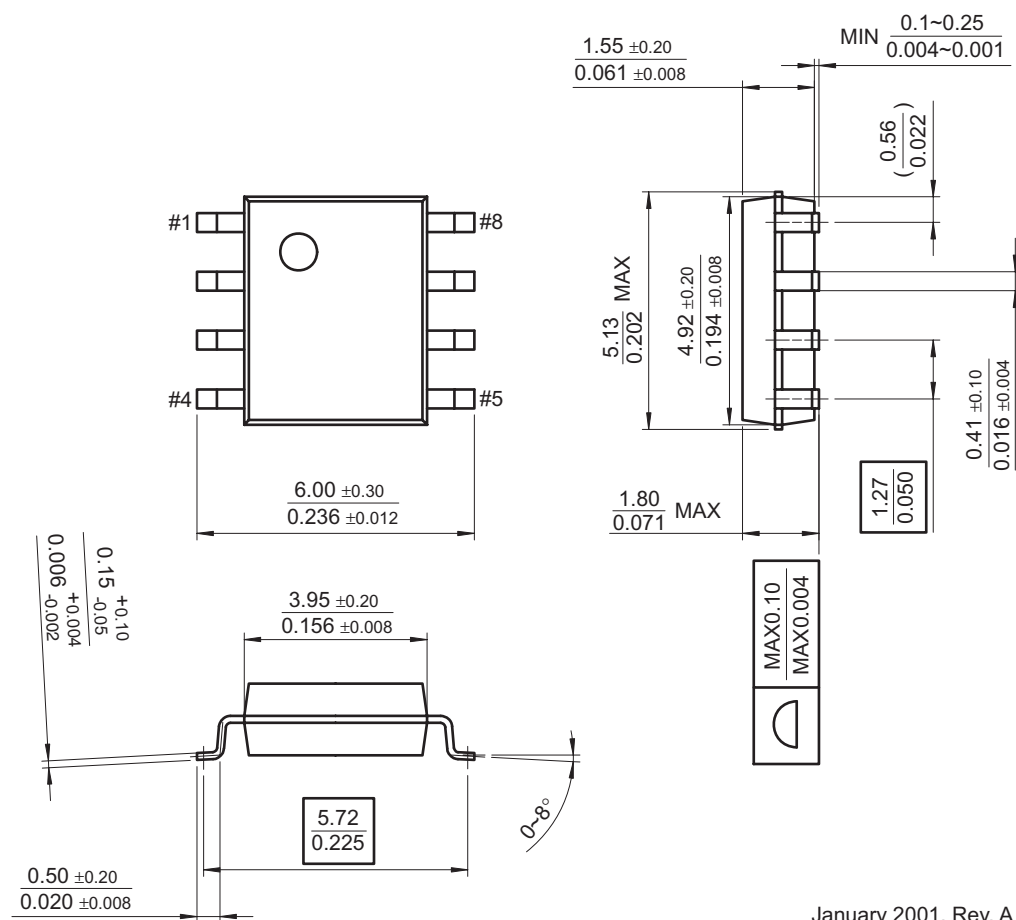
3.3 Ground Plane

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

Mechanical Dimensions

8-SOP

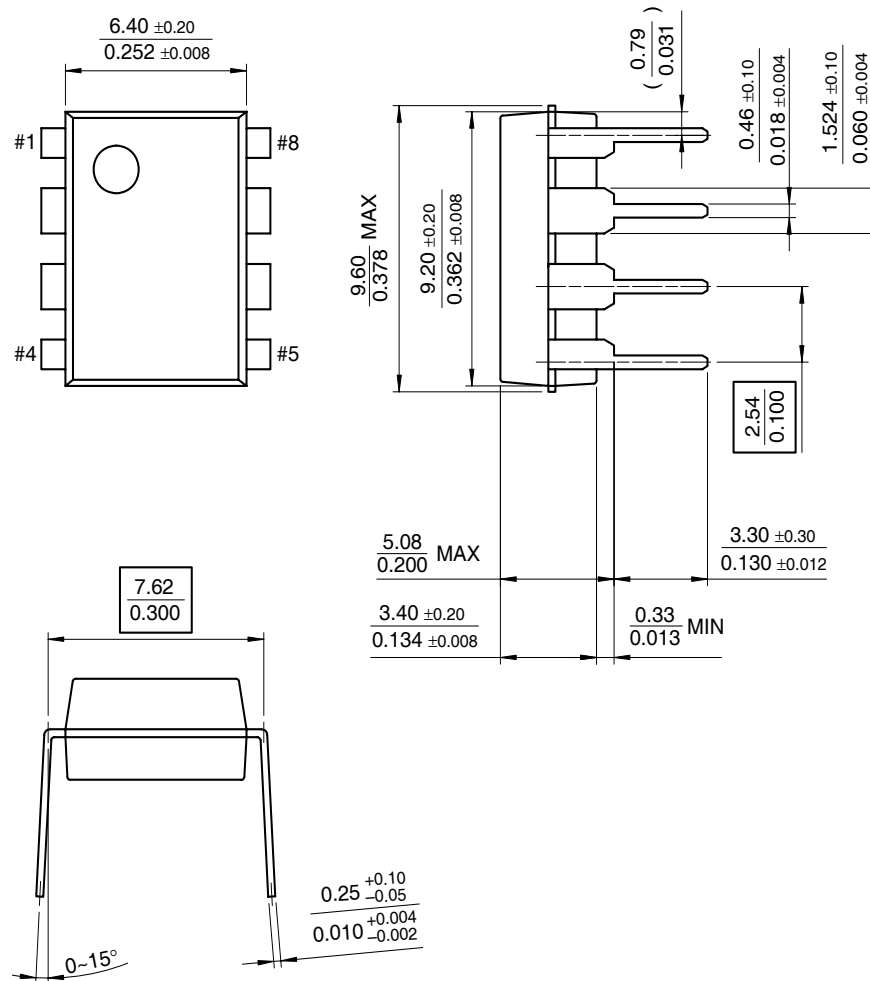
Dimensions are in millimeters (inches) unless otherwise noted.



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Mechanical Dimensions (Continued)**8-DIP**

Dimensions are in millimeters (inches) unless otherwise noted.



September 1999, Rev B
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