FAIRCHILD SEMICONDUCTOR®

September 2006

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}=20KΩ
- 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 thresh-old 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

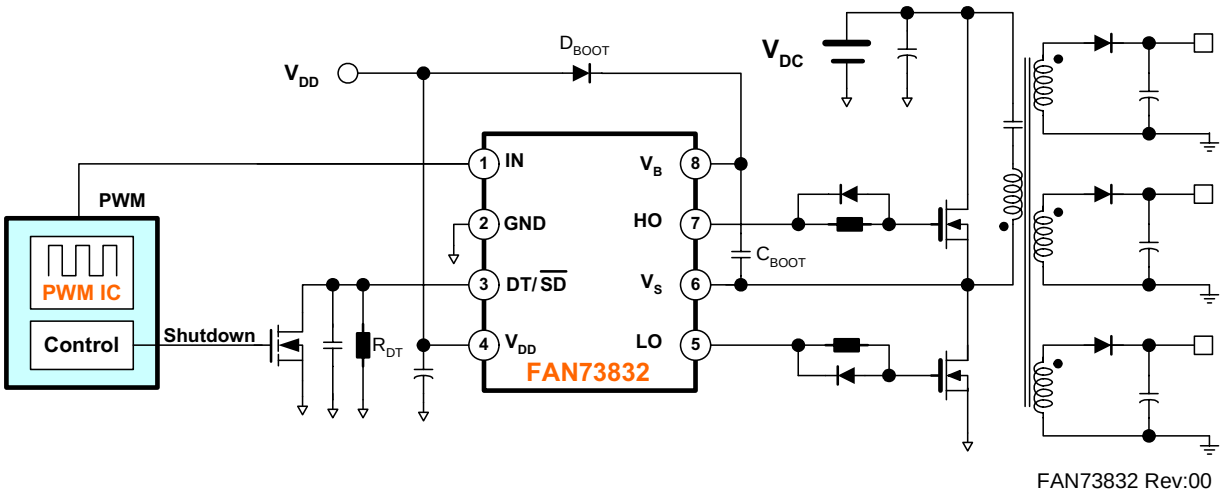


Figure 1. Application Circuit for Half-Bridge Switching Power Supply

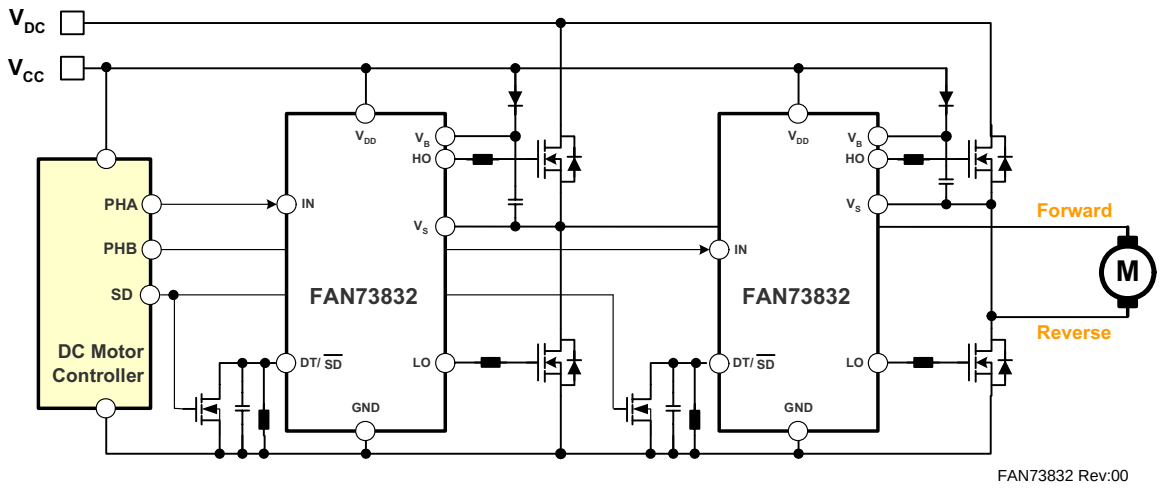


Figure 2. Application Circuit for Full-Bridge DC Motor Driver

Internal Block Diagram

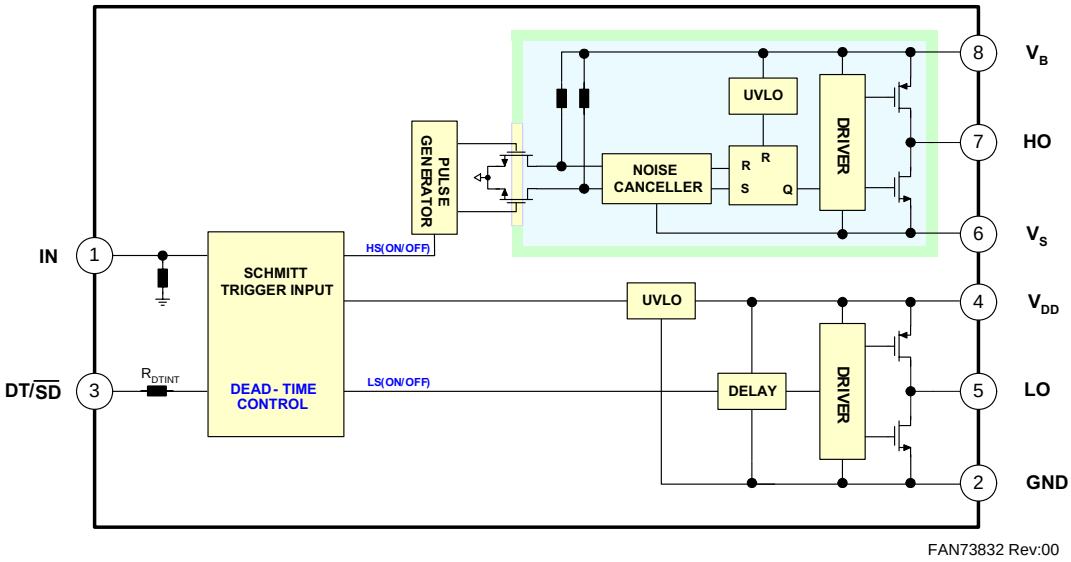


Figure 3. Functional Block Diagram of FAN73832

Pin Assignments

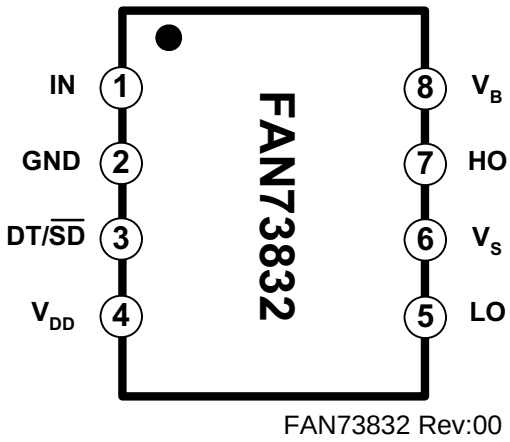


Figure 4. Pin Configuration (Top View)

Pin Definitions

Pin #	Name	Description
1	IN	Logic Input
2	GND	Ground
3	DT/$\overline{SD}$	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°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	°C/W
		8-DIP		100	
T_J	Junction temperature			150	°C
T_{STG}	Storage temperature			150	°C

Notes:

2. Mounted on 76.2 x 114.3 x 1.6mm PCB (FR-4 glass epoxy material).
3. 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
4. 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	°C

Electrical Characteristics

V_{BIAS} (V_{DD}, V_{BS})=15.0V, R_{DT}=20KΩ,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}=20KΩ 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}=20KΩ		580	730	nsec
t_{OFF}	Turn-off propagation delay	V_S=0V, R_{DT}=20KΩ		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} =20KΩ	300	400	500	
		R_{DT} = 200KΩ	1.20	1.68	2.30	
DMT	Dead-time matching	R_{DT} = 20KΩ		0	60	
		R_{DT} =200KΩ		0	150	

Note:

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

Typical Characteristics

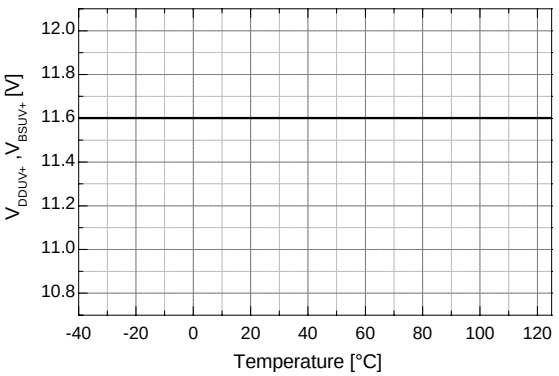


Figure 5. V_{DD}/V_{DD} UVLO (+) vs. Temperature

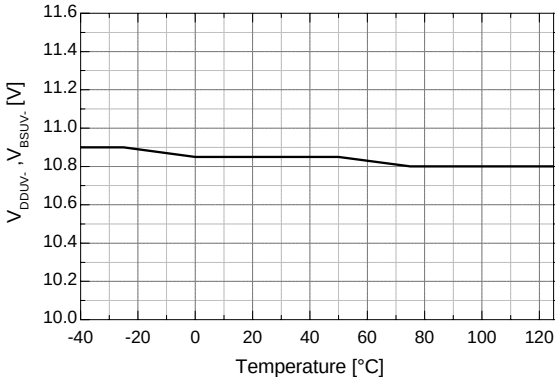


Figure 6. V_{DD}/V_{BS} UVLO (-) vs. Temperature

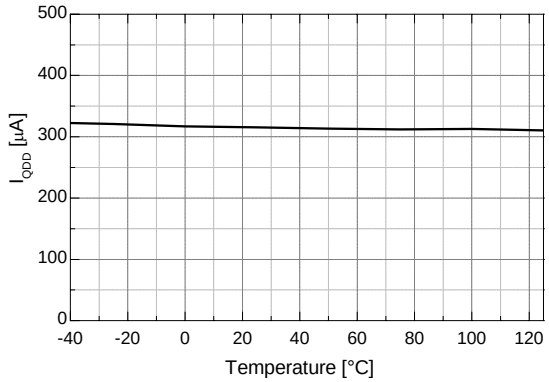


Figure 7. V_{DD} Quiescent Current vs. Temperature

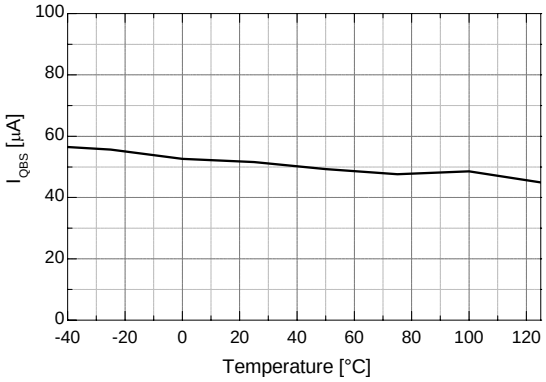


Figure 8. V_{BS} Quiescent Current vs. Temperature

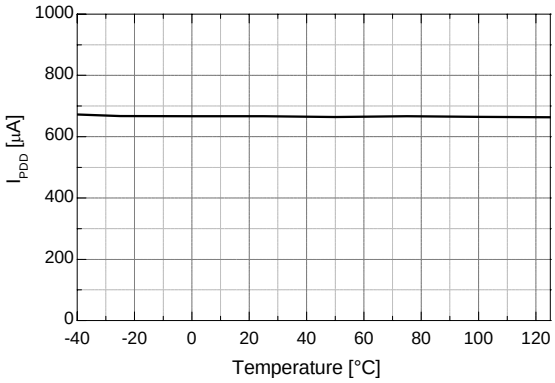


Figure 9. V_{DD} Operating Current vs. Temperature

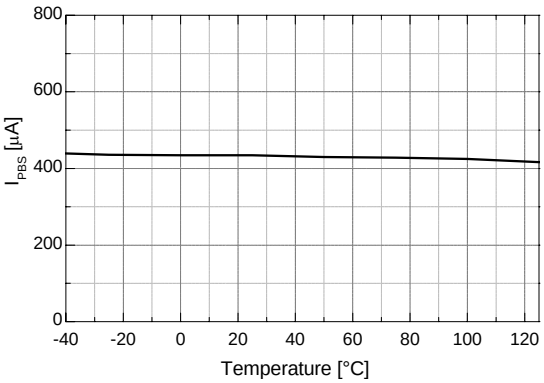


Figure 10. V_{BS} Operating Current vs. Temperature

Typical Characteristics (Continued)

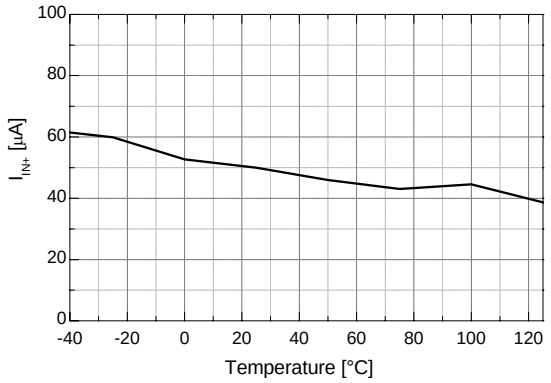


Figure 11. Logic Input Current vs. Temperature

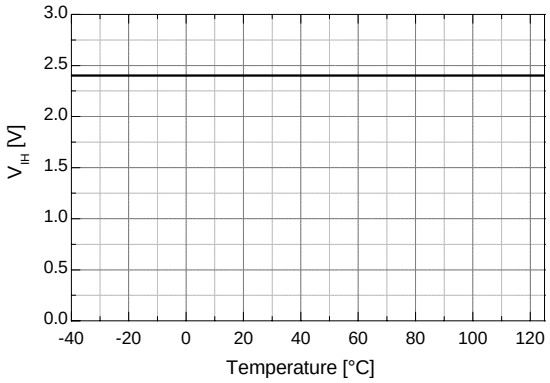


Figure 12. Logic Input High Voltage vs. Temperature

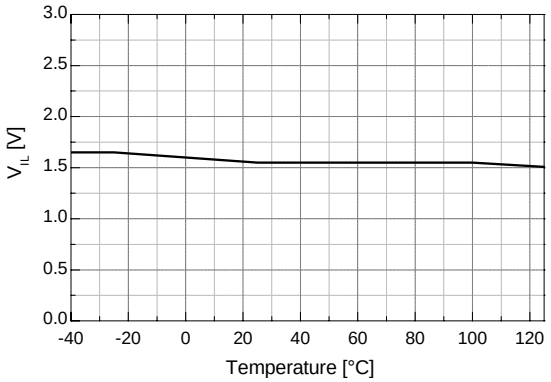


Figure 13. Logic Input Low Voltage vs. Temperature

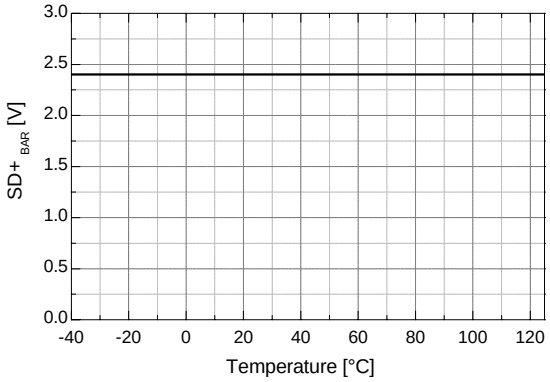


Figure 14. $\overline{SD}$ Positive Threshold vs. Temperature

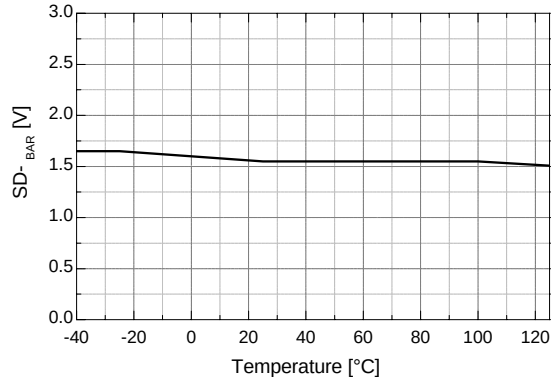


Figure 15. $\overline{SD}$ Negative Threshold vs. Temperature

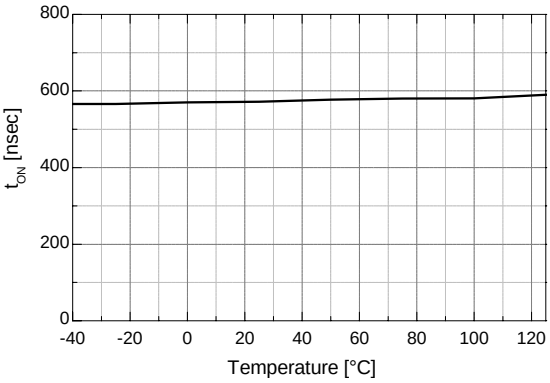


Figure 16. Turn-on Delay Time vs. Temperature

Typical Characteristics (Continued)

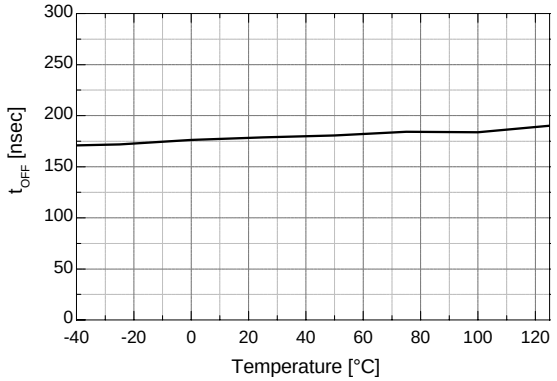


Figure 17. Turn-off Delay Time vs. Temperature

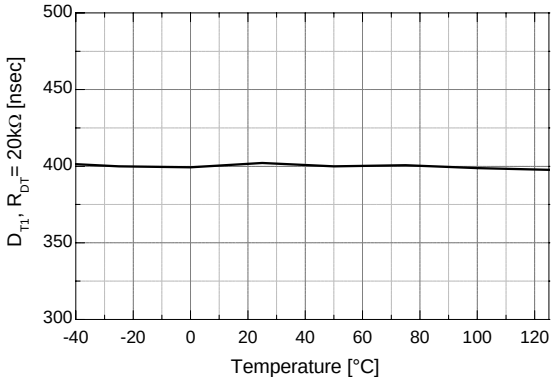


Figure 18. Dead Time (R_{DT}=20kΩ) vs. Temperature

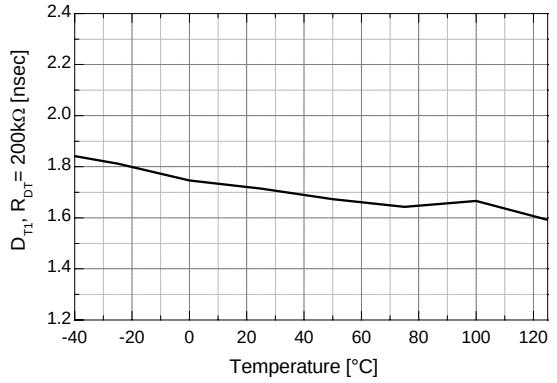


Figure 19. Dead Time (R_{DT}=200kΩ) vs. Temperature

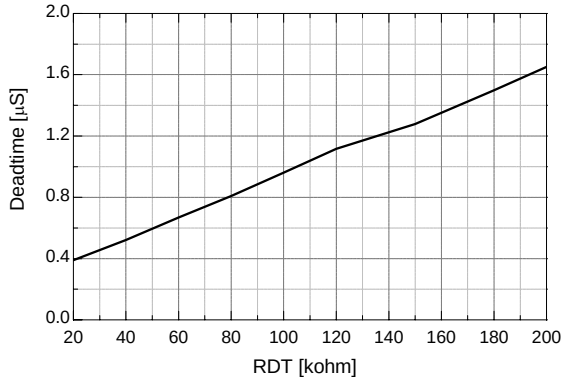


Figure 20. R_{DT} vs. Dead Time

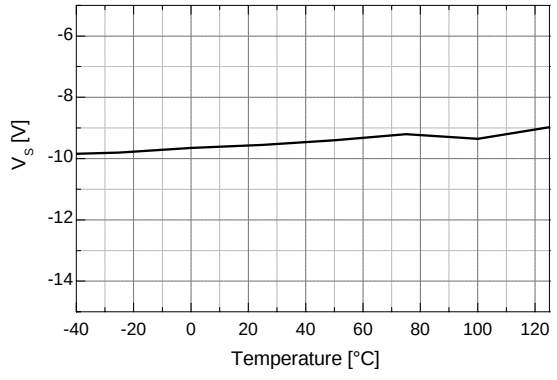


Figure 21. Allowable Negative V_S Voltage for Signal Propagation to High Side vs. Temperature

Switching Time Definitions

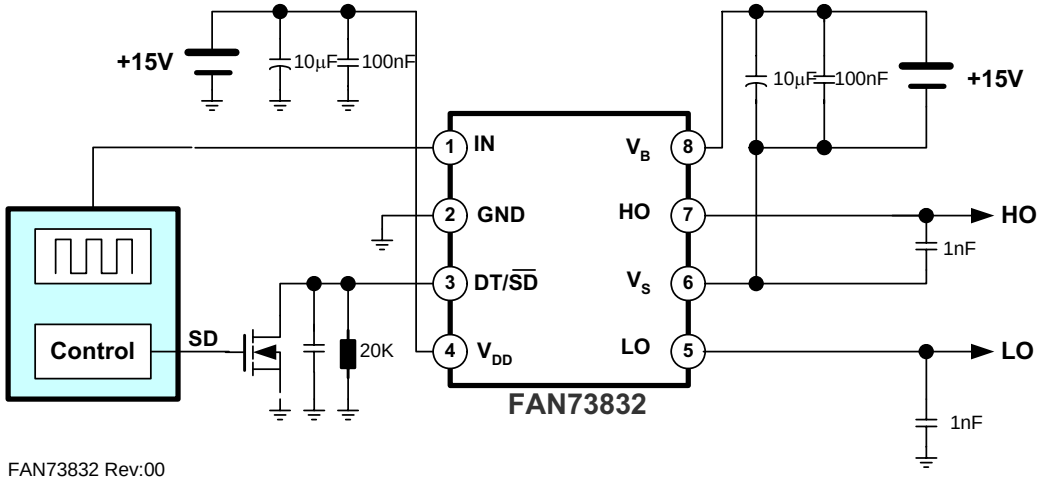


Figure 22. Switching Time Test Circuit

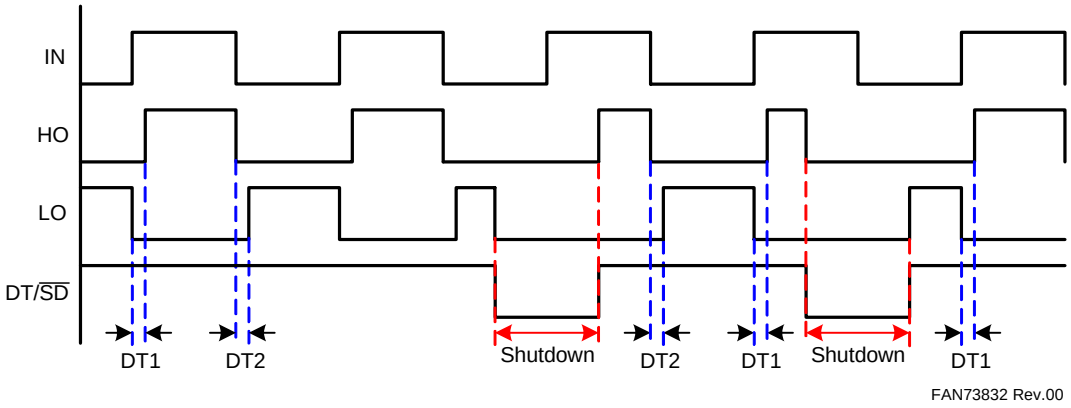


Figure 23. Input / Output Waveforms

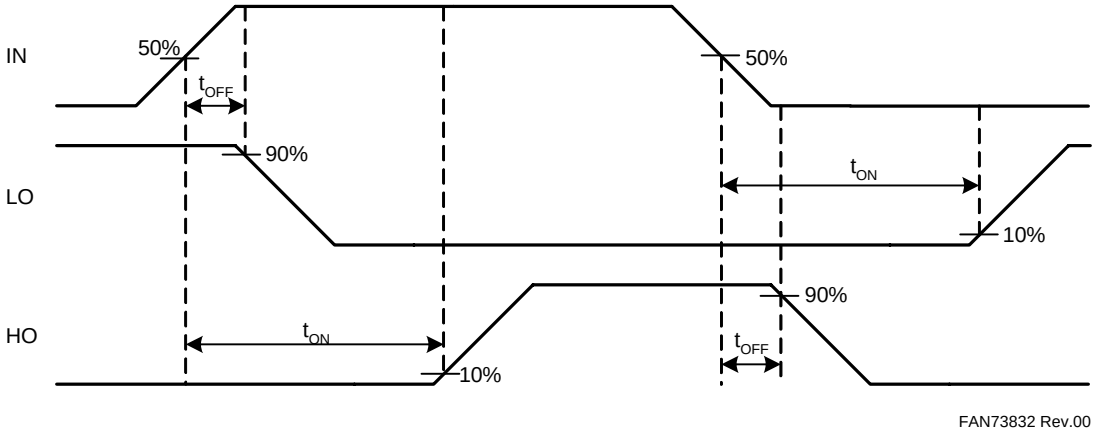


Figure 24. Switching Time Waveform Definitions

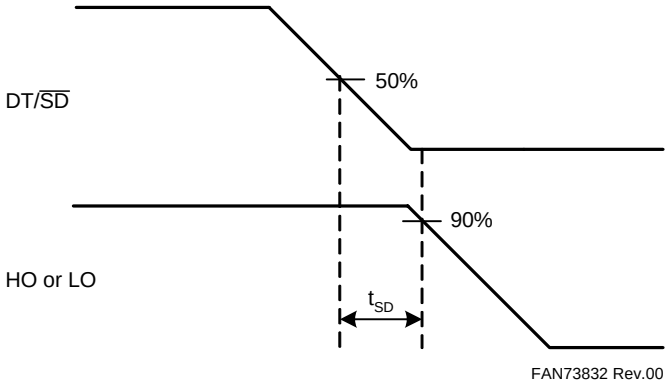


Figure 25. Shutdown Waveform Definition

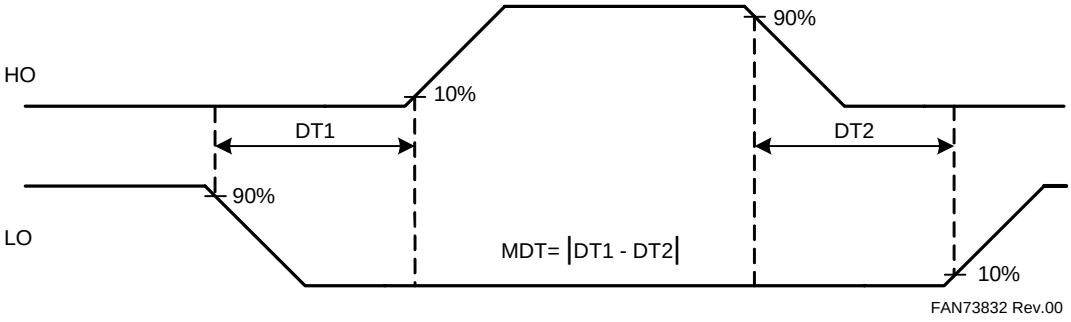


Figure 26. Dead-Time Control Waveform Definition

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 20kΩ to 200kΩ 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 20KΩ 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}) indepently.

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.

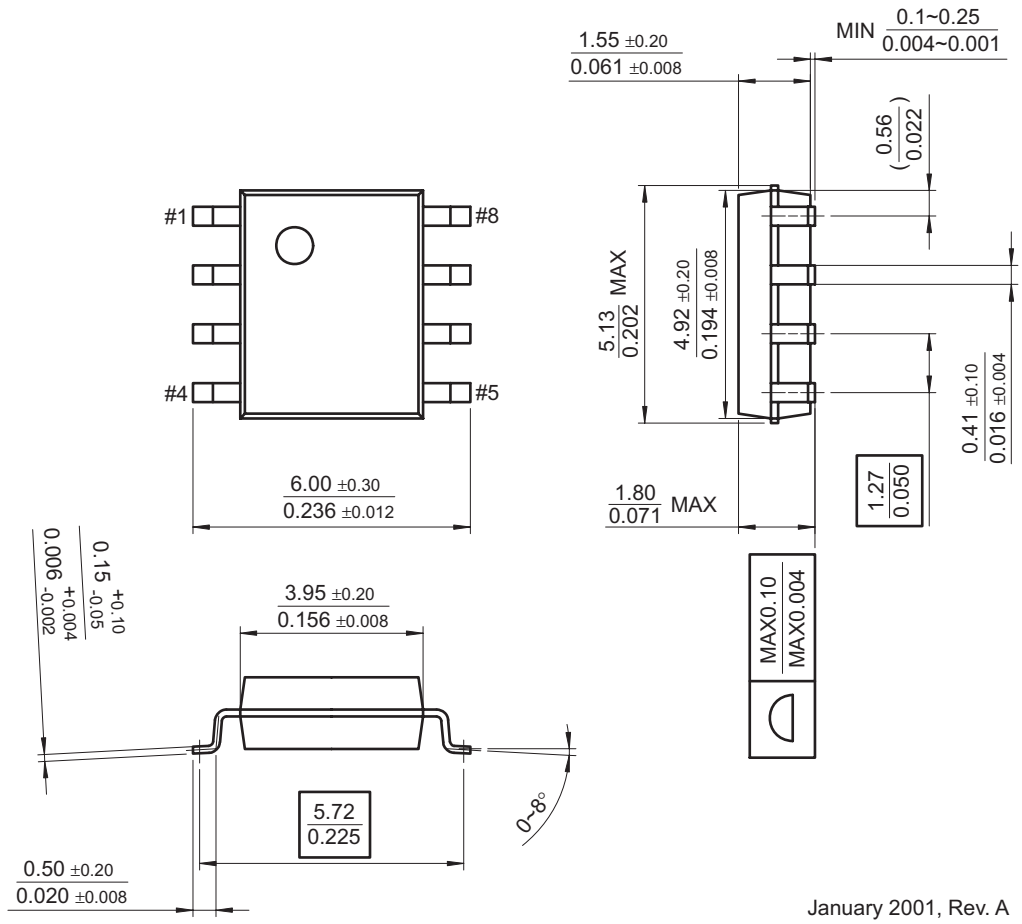
3.3 Ground Plane

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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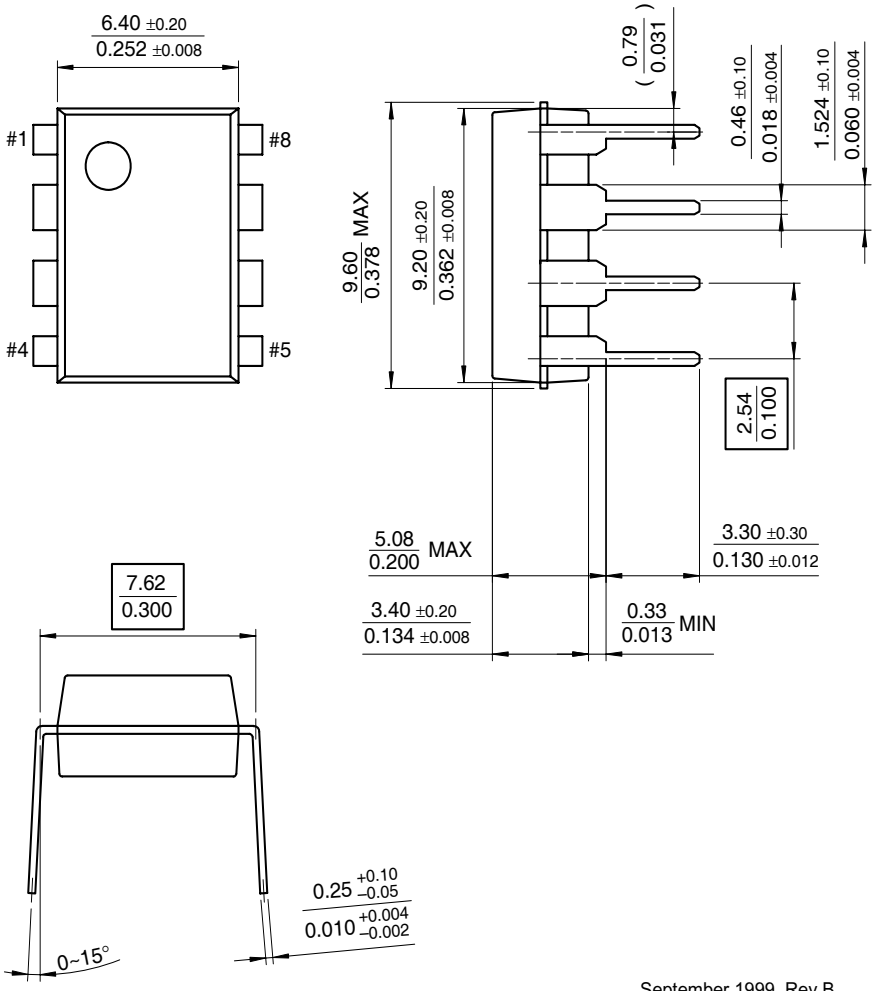
Mechanical Dimensions (Continued)

8-DIP

Dimensions are in millimeters (inches) unless otherwise noted.



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CROSSVOLT™	ImpliedDisconnect™	Power247™	SuperFET™	TruTranslation™
DOME™	IntelliMAX™	PowerEdge™	SuperSOT™-3	UHC™
EcoSPARK™	ISOPLANAR™	PowerSaver™	SuperSOT™-6	UltraFET®
E^2CMOS™	LittleFET™	PowerTrench®	SuperSOT™-8	UniFET™
EnSigna™	MICROCOUPLER™	QFET®	SyncFET™	VCX™
FACT™	MicroFET™	QS™	TCM™	Wire™
FACT Quiet Series™	MicroPak™	QT Optoelectronics™	TinyBoost™	
FAST®	MICROWIRE™	Quiet Series™		
FASTr™	MSX™	RapidConfigure™	Across the board. Around the world.™	
FPS™	MSXPro™	RapidConnect™	Programmable Active Droop™	
FRFET™	OCX™	ScalarPump™	The Power Franchise®	

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

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