

# FAN7371

## High-Current High-Side Gate Drive IC

### Features

- Floating Channel for Bootstrap Operation to +600V
- 4A/4A Sourcing/Sinking Current Driving Capability
- Common-Mode dv/dt Noise Canceling Circuit
- 3.3V and 5V Input Logic Compatible
- Output In-phase with Input Signal
- Under-Voltage Lockout for  $V_{BS}$
- 25V Shunt Regulator on  $V_{DD}$  and  $V_{BS}$
- 8-Lead Small Outline Package (SOP)

### Applications

- High-Speed Gate Driver
- Sustain Switch Driver in PDP Application
- Energy-Recovery Circuit Switch Driver in PDP Application
- High-Power Buck Converter
- Motor Drive Inverter

### Description

The FAN7371 is a monolithic high-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 current driving capability and minimum cross-conduction.

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

The UVLO circuit prevents malfunction when  $V_{BS}$  is lower than the specified threshold voltage.

The high-current and low-output voltage drop feature makes this device suitable for sustain switch driver and energy recovery switch driver in the Plasma Display Panel application, motor drive inverter, switching power supply, and high-power DC-DC converter applications.

8-SOP



### Ordering Information

Part Number	Package	Operating Temperature Range	Eco Status	Packing Method
FAN7371M <sup>(1)</sup>	8-SOP	-40°C ~ 125°C	RoHS	Tube
FAN7371MX <sup>(1)</sup>				Tape & Reel

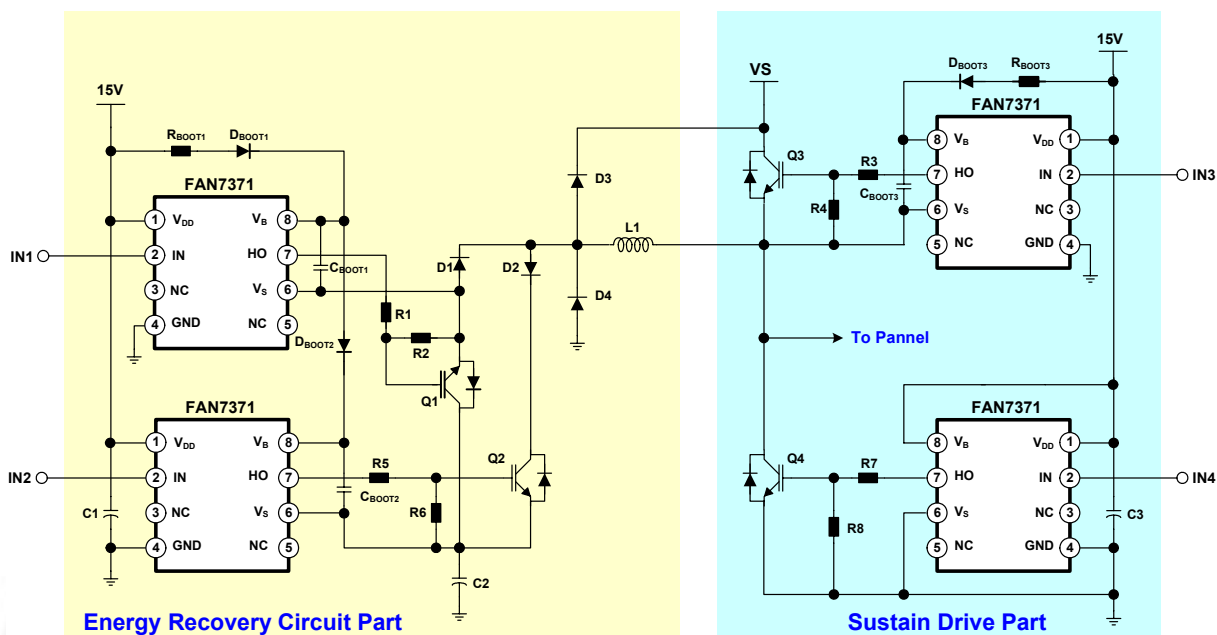
#### Note:

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



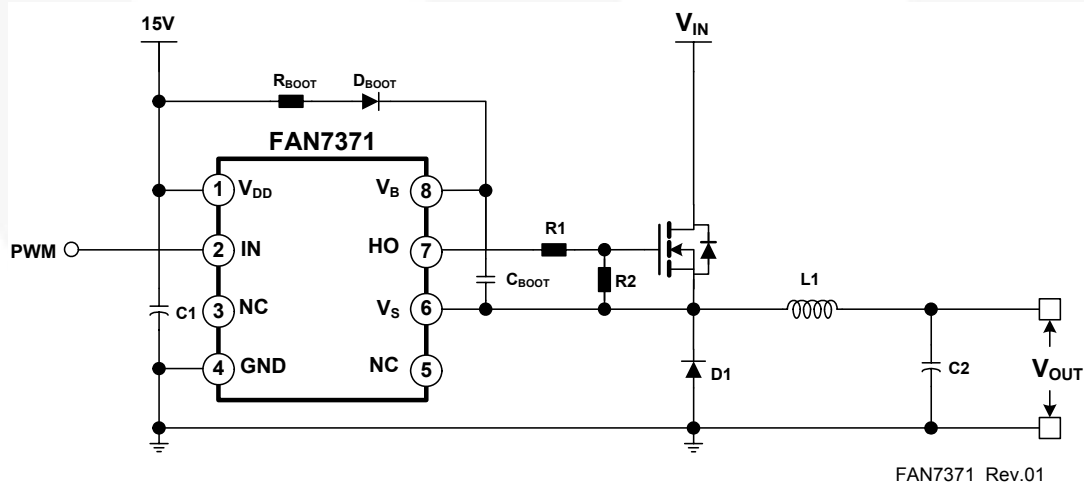
For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

## Typical Application Diagrams



FAN7371 Rev.03

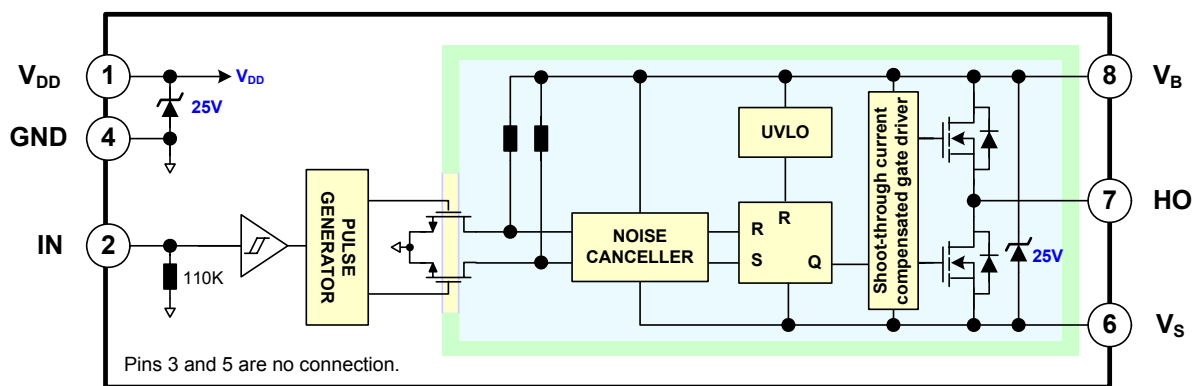
Figure 1. Floated Bidirectional Switch and Half-Bridge Driver: PDP application



FAN7371 Rev.01

Figure 2. Step-Down (Buck) DC-DC Converter Application

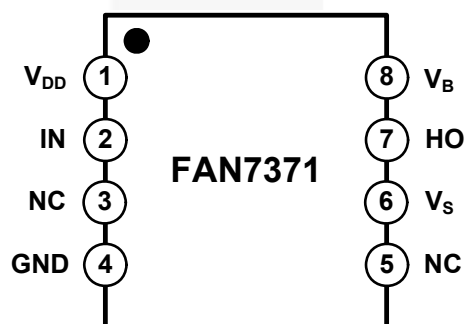
## Internal Block Diagram



FAN7371 Rev.04

Figure 3. Functional Block Diagram

## Pin Configuration



FAN7371 Rev.01

Figure 4. Pin Configuration (Top View)

## Pin Definitions

Pin #	Name	Description
1	V <sub>DD</sub>	Supply Voltage
2	IN	Logic Input for High-Side Gate Driver Output
3	NC	No Connection
4	GND	Ground
5	NC	No Connection
6	V <sub>S</sub>	High-Voltage 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	Characteristics	Min.	Max.	Unit
$V_S$	High-Side Floating Offset Voltage	$V_B - V_{SHUNT}$	$V_B + 0.3$	V
$V_B$	High-Side Floating Supply Voltage <sup>(2)</sup>	-0.3	625.0	V
$V_{HO}$	High-Side Floating Output Voltage	$V_S - 0.3$	$V_B + 0.3$	V
$V_{DD}$	Low-Side and Logic Supply Voltage <sup>(2)</sup>	-0.3	$V_{SHUNT}$	V
$V_{IN}$	Logic Input Voltage	-0.3	$V_{DD} + 0.3$	V
$dV_S/dt$	Allowable Offset Voltage Slew Rate		$\pm 50$	V/ns
$P_D$	Power Dissipation <sup>(3, 4, 5)</sup>		0.625	W
$\theta_{JA}$	Thermal Resistance		200	$^{\circ}\text{C}/\text{W}$
$T_J$	Junction Temperature	-55	+150	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature	-55	+150	$^{\circ}\text{C}$
$T_A$	Operating Ambient Temperature	-40	+125	$^{\circ}\text{C}$

### Notes:

- This IC contains a shunt regulator on  $V_{DD}$  and  $V_{BS}$  with a normal breakdown voltage of 25V. Please note that this supply pin should not be driven by a low-impedance voltage source greater than the  $V_{SHUNT}$  specified in the Electrical Characteristics section
- 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, and  
JESD51-3: Low effective thermal conductivity test board for leaded surface mount packages.
- Do not exceed power dissipation ( $P_D$ ) 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	Min.	Max.	Unit
$V_{BS}$	High-Side Floating Supply Voltage	$V_S + 10$	$V_S + 20$	V
$V_S$	High-Side Floating Supply Offset Voltage	$6 - V_{DD}$	600	V
$V_{HO}$	High-Side Output Voltage	$V_S$	$V_B$	V
$V_{IN}$	Logic Input Voltage	GND	$V_{DD}$	V
$V_{DD}$	Supply Voltage	10	20	V

## Electrical Characteristics

$V_{BIAS}(V_{DD}, V_{BS})=15.0V$ ,  $T_A = 25^\circ C$ , unless otherwise specified. The  $V_{IN}$  and  $I_{IN}$  parameters are referenced to GND. The  $V_O$  and  $I_O$  parameters are relative to  $V_S$  and are applicable to the respective output HO.

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<b>POWER SUPPLY SECTION</b>						
$I_{QDD}$	Quiescent $V_{DD}$ Supply Current	$V_{IN}=0V$ or $5V$		25	70	$\mu A$
$I_{PDD}$	Operating $V_{DD}$ Supply Current	$f_{IN}=20KHz$ , No Load		35	100	$\mu A$
<b>BOOTSTRAPPED SUPPLY SECTION</b>						
$V_{BSUV+}$	$V_{BS}$ Supply Under-Voltage Positive Going Threshold Voltage	$V_{BS}=\text{Sweep}$	8.2	9.2	10.2	V
$V_{BSUV-}$	$V_{BS}$ Supply Under-Voltage Negative Going Threshold Voltage	$V_{BS}=\text{Sweep}$	7.5	8.5	9.5	V
$V_{BSHYS}$	$V_{BS}$ Supply Under-Voltage Lockout Hysteresis Voltage	$V_{BS}=\text{Sweep}$		0.7		V
$I_{LK}$	Offset Supply Leakage Current	$V_B=V_S=600V$			10	$\mu A$
$I_{QBS}$	Quiescent $V_{BS}$ Supply Current	$V_{IN}=0V$ or $5V$		60	120	$\mu A$
$I_{PBS}$	Operating $V_{BS}$ Supply Current	$C_{LOAD}=1nF$ , $f_{IN}=20KHz$ , rms Value		1.0	2.8	mA
<b>SHUNT REGULATOR SECTION</b>						
$V_{SHUNT}$	$V_{DD}$ and $V_{BS}$ Shunt Regulator Clamping Voltage	$I_{SHUNT}=5mA$	24	25		V
<b>INPUT LOGIC SECTION</b>						
$V_{IH}$	Logic "1" Input Voltage		2.5			V
$V_{IL}$	Logic "0" Input Voltage				0.8	V
$I_{IN+}$	Logic Input High Bias Current	$V_{IN}=5V$		45	70	$\mu A$
$I_{IN-}$	Logic Input Low Bias Current	$V_{IN}=0V$			2	$\mu A$
$R_{IN}$	Input Pull-down Resistance		70	110		$K\Omega$
<b>GATE DRIVER OUTPUT SECTION</b>						
$V_{OH}$	High Level Output Voltage ( $V_{BIAS} - V_O$ )	No Load			1.2	V
$V_{OL}$	Low Level Output Voltage	No Load			30	mV
$I_{O+}$	Output High, Short-Circuit Pulsed Current <sup>(6)</sup>	$V_{HO}=0V$ , $V_{IN}=5V$ , $PW \leq 10\mu s$	3.0	4.0		A
$I_{O-}$	Output Low, Short-Circuit Pulsed Current <sup>(6)</sup>	$V_{HO}=15V$ , $V_{IN}=0V$ , $PW \leq 10\mu s$	3.0	4.0		A
$V_S$	Allowable Negative $V_S$ pin Voltage for IN Signal Propagation to HO			-9.8	-7.0	V

### Note:

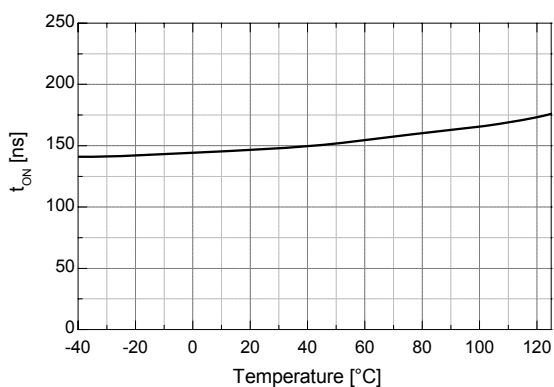
6 These parameters guaranteed by design.

## Dynamic Electrical Characteristics

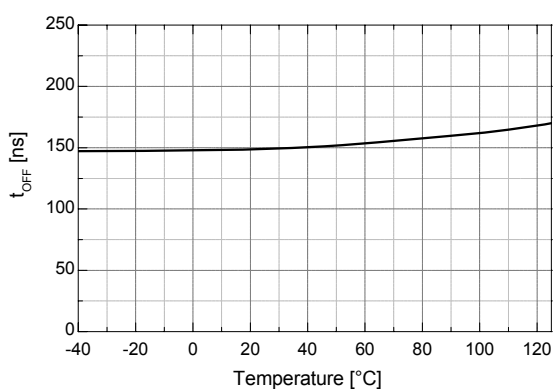
$V_{DD}=V_{BS}=15V$ ,  $GND=0V$ ,  $C_{LOAD}=1000pF$ ,  $T_A=25^\circ C$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$t_{on}$	Turn-on Propagation Delay Time	$V_S=0V$		150	210	ns
$t_{off}$	Turn-off Propagation Delay Time	$V_S=0V$		150	210	ns
$t_r$	Turn-on Rise Time			25	50	ns
$t_f$	Turn-off Fall Time			15	40	ns

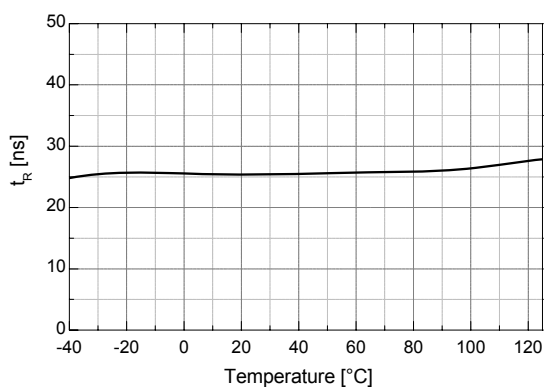
## Typical Characteristics



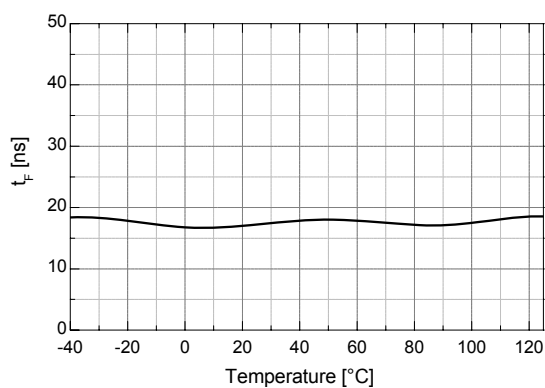
**Figure 5. Turn-on Propagation Delay vs. Temperature**



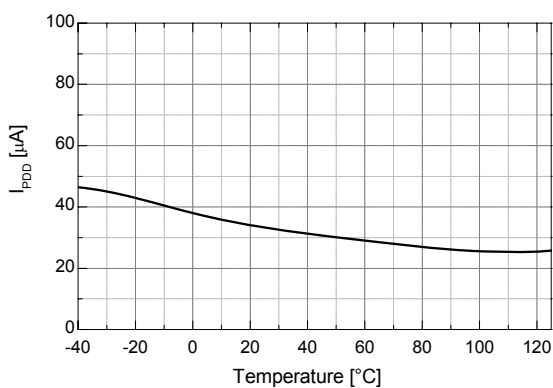
**Figure 6. Turn-off Propagation Delay vs. Temperature**



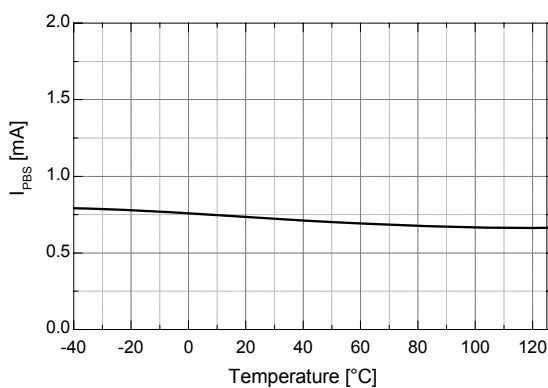
**Figure 7. Turn-on Rise Time vs. Temperature**



**Figure 8. Turn-off Fall Time vs. Temperature**



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



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

## Typical Characteristics (Continued)

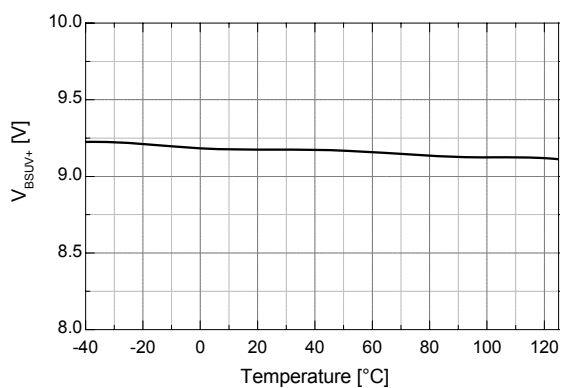


Figure 11.  $V_{BS}$  UVLO+ vs. Temperature

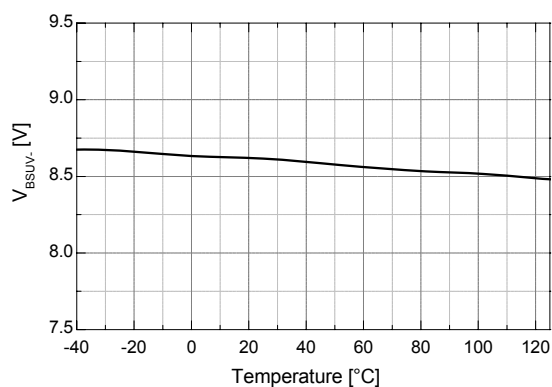


Figure 12.  $V_{BS}$  UVLO- vs. Temperature

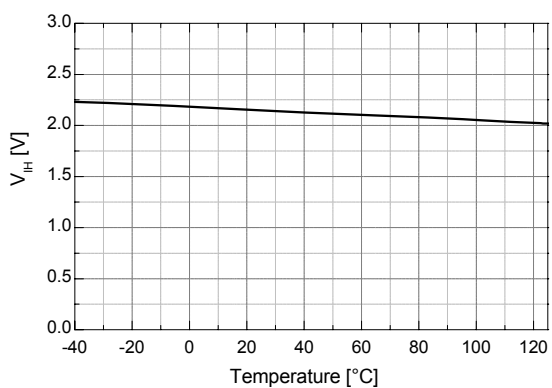


Figure 13. Logic High Input Voltage vs. Temperature

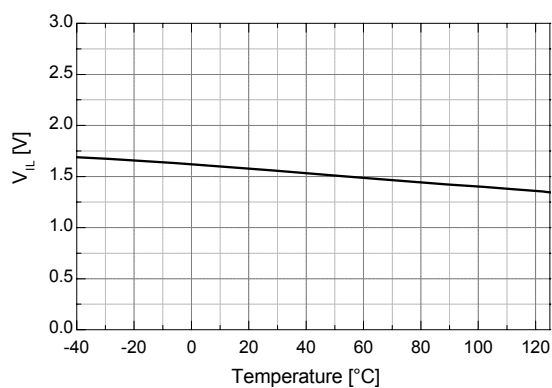


Figure 14. Logic Low Input Voltage vs. Temperature

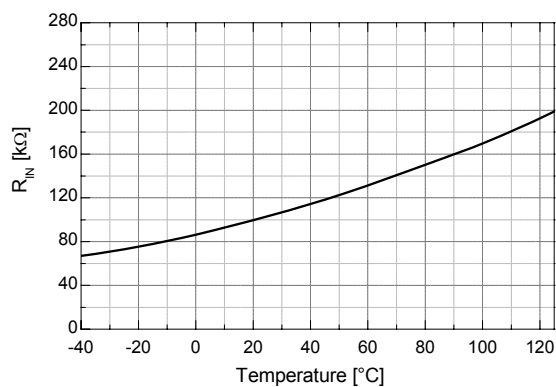


Figure 15. Input Pull-Down Resistance vs. Temperature.

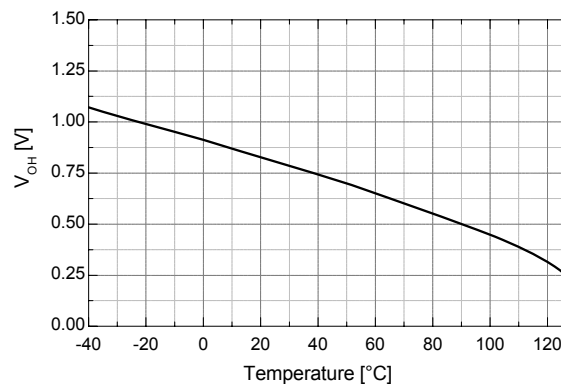


Figure 16. High-Level Output Voltage vs. Temperature

## Typical Characteristics (Continued)

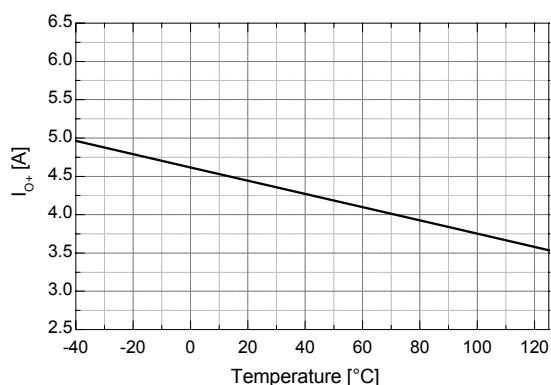


Figure 17. Output High, Short-Circuit Pulsed Current vs. Temperature

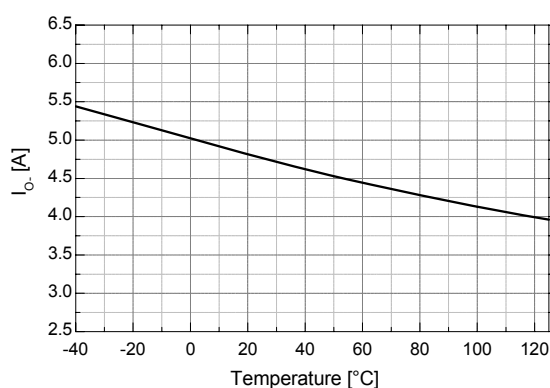


Figure 18. Output Low, Short-Circuit Pulsed Current vs. Temperature

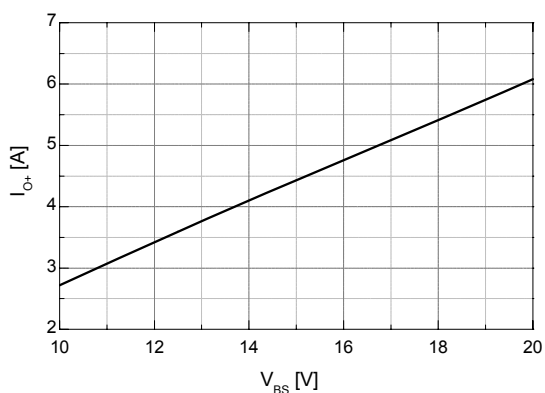


Figure 19. Output High, Short-Circuit Pulsed Current vs. Supply Voltage

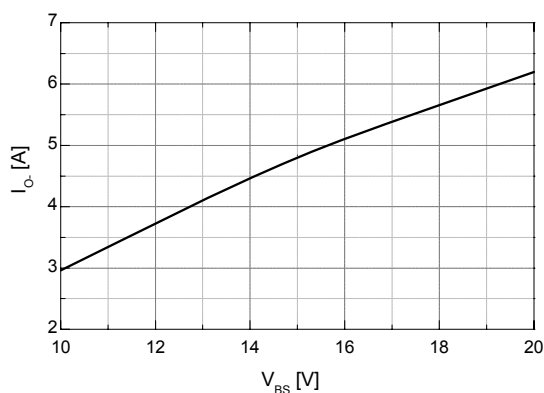


Figure 20. Output Low, Short-Circuit Pulsed Current vs. Supply Voltage

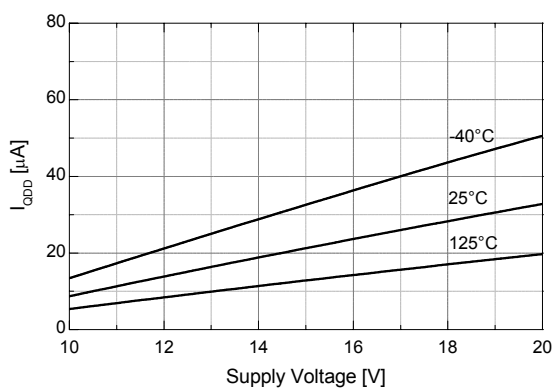


Figure 21. Quiescent  $V_{DD}$  Supply Current vs. Supply Voltage

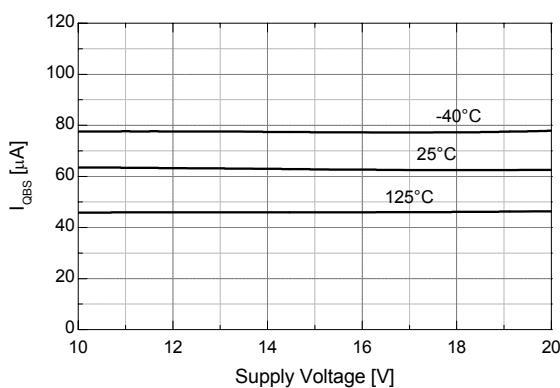


Figure 22. Quiescent  $V_{BS}$  Supply Current vs. Supply Voltage



## Switching Time Definitions

### Timing Diagram

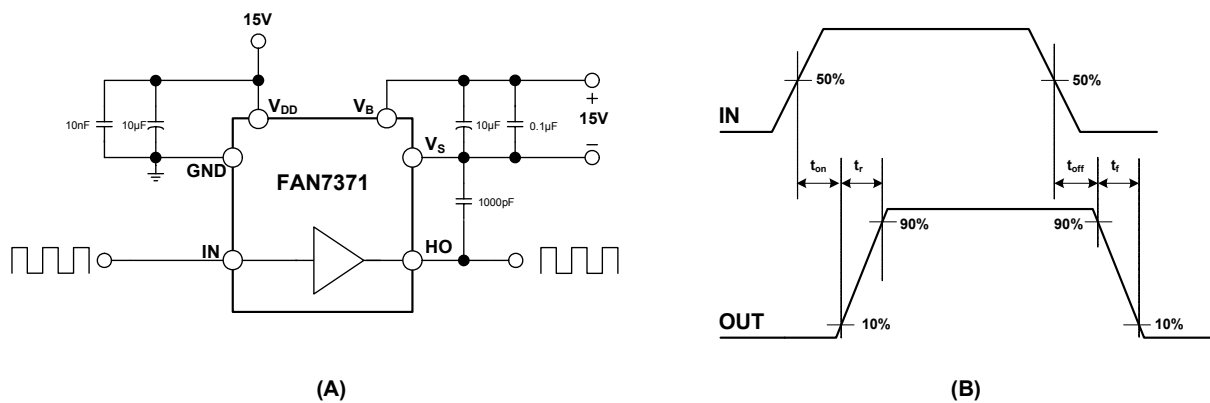


Figure 23. Switching Time Test Circuit and Waveform Definitions





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Preliminary	First Production	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.
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