

## Buffered H-Bridge Driver with Integrate MOSFET

### DESCRIPTION

The Si9988 is an integrated, buffered H-bridge with TTL compatible inputs and the capability of delivering a continuous 0.65 A at  $V_{DD} = 5\text{ V}$  (room temperature) at switching rates up to 200 kHz. Internal logic prevents the upper and lower outputs of either half-bridge from being turned on simultaneously. Both outputs may be forced low (for motor braking) by pulling  $\overline{EN}$  to logic high.

The Si9988 is available in both standard and lead (Pb)-free, 8-pin TSSOP packages, specified to operate over a voltage range of 3.8 V to 13.2 V, and the industrial temperature range of -40 °C to 85 °C (D suffix).

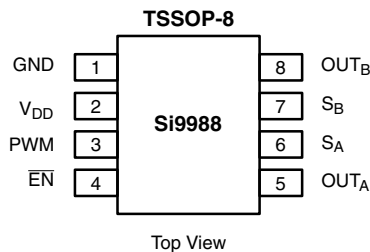
### FEATURES

- 0.65 A H-bridge
- 200 kHz switching rate
- Shoot-through limited
- TTL compatible inputs
- 3.8 V to 13.2 V operating range
- Surface mount packaging
- Total  $R_{DS(on)}$  for N- and P-channel: 1.8  $\Omega$  at  $V_{DD} = 4.5\text{ V}$  and  $T_A = 85\text{ }^\circ\text{C}$

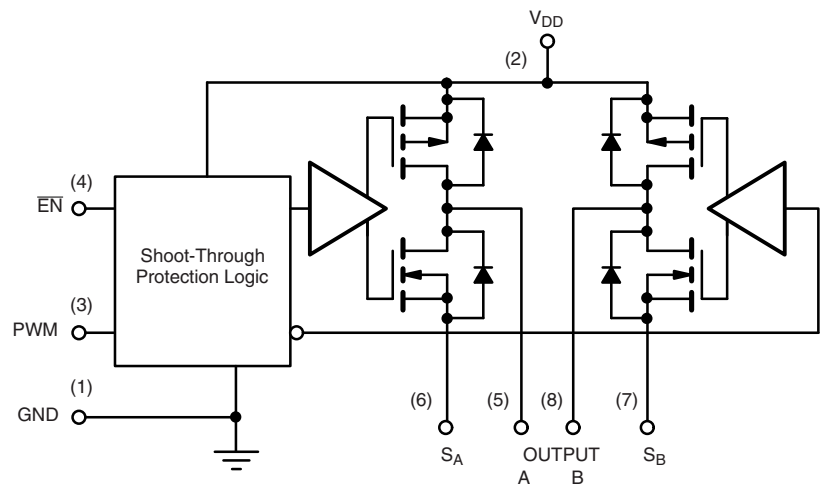
### APPLICATIONS

- VCM driver
- Brushed motor driver
- Stepper motor driver
- Power converter
- Optical disk drives
- Power supplies
- High performance servo

### FUNCTIONAL BLOCK DIAGRAM, PIN CONFIGURATION AND TRUTH TABLE



TRUTH TABLE			
EN	PWM	OUT <sub>A</sub>	OUT <sub>B</sub>
0	0	0	1
0	1	1	0
1	0	0	0
1	1	0	0



ORDERING INFORMATION			
Part Number	Marking	Temperature Range	Package
Si9988DQ-T1	988	-40 °C to 85 °C	Tape and reel
Si9988DQ-T1-E3			

ABSOLUTE MAXIMUM RATINGS <sup>a</sup>			
Parameter	Limit	Unit	
V <sub>DD</sub>	15	V	
Voltage on any Pin with Respect to Ground	- 0.3 to V <sub>DD</sub> + 0.3		
Voltage on Pins 5, 8 with Respect to Ground	- 1 to V <sub>DD</sub> + 1		
Voltage on Pins 6, 7	- 0.3 to GND + 1		
Peak Output Current	1	A	
Storage Temperature	- 65 to 150	°C	
Junction Temperature (T <sub>J</sub> )	150		
Continuous I <sub>out</sub> Current (T <sub>J</sub> = 135 °C, V <sub>DD</sub> = 5 V)	T <sub>A</sub> = 25 °C	0.67	A
	T <sub>A</sub> = 85 °C	0.47	
Power Dissipation <sup>b</sup>	0.83	W	
θ <sub>JA</sub>	120	°C/W	
Operating Temperature Range	- 40 to 85	°C	

## Notes:

a. Device mounted with all leads soldered or welded to PC board.

b. Derate 8.3 mW/°C above 25 °C.

c. T<sub>J</sub> = T<sub>A</sub> + (P<sub>D</sub>)(θ<sub>JA</sub>), P<sub>D</sub> = power dissipation.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RANGE		
Parameter	Limit	Unit
V <sub>DD</sub>	3.8 to 13.2	V
Maximum Junction Temperature (T <sub>J</sub> )	135	°C

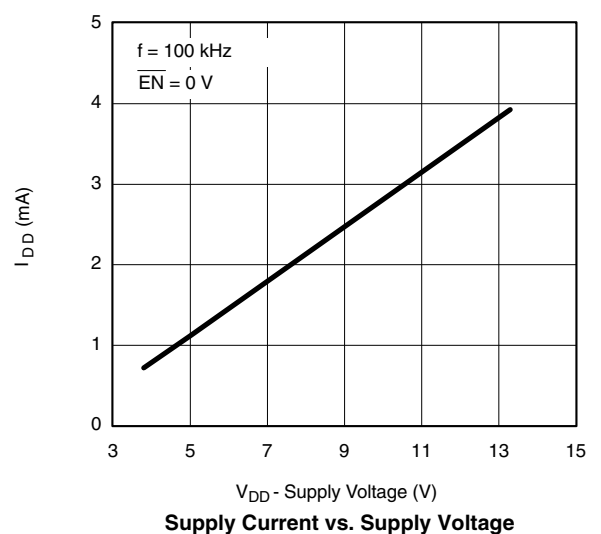
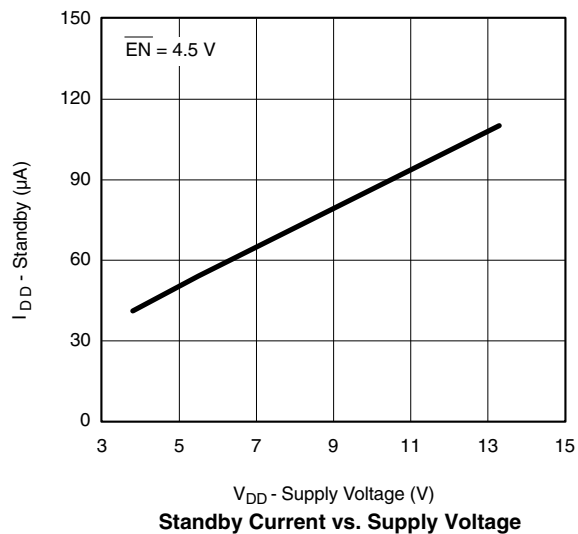
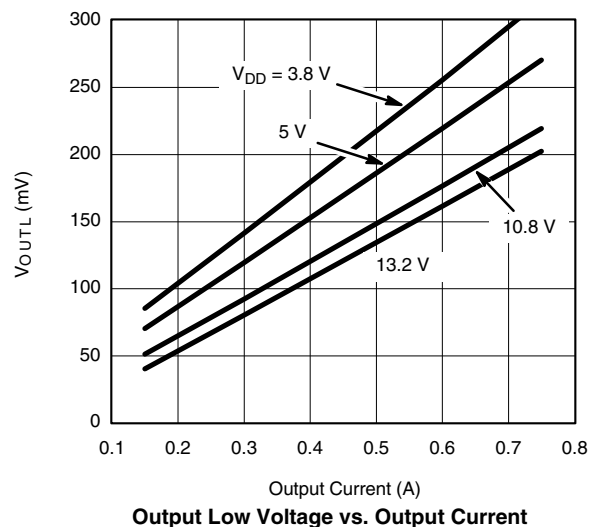
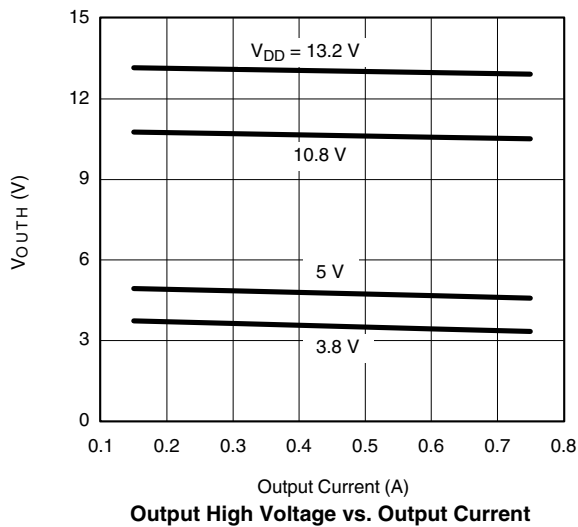
SPECIFICATIONS							
Parameter	Symbol	Test Conditions Unless Otherwise Specified V <sub>DD</sub> = 3.8 to 13.2 V S <sub>A</sub> at GND, S <sub>B</sub> at GND	Limits D Suffix, - 40 °C to 85 °C			Unit	
			Min <sup>a</sup>	Typ <sup>b</sup>	Max <sup>a</sup>		
<b>Input (EN̄, PWM)</b>							
Input Voltage High	V <sub>INH</sub>		2			V	
Input Voltage Low	V <sub>INL</sub>				1		
Input Current with Input Voltage High	I <sub>INH</sub>	V <sub>IN</sub> = 13.2 V			1	μA	
Input Current with Input Voltage Low	I <sub>INL</sub>	V <sub>IN</sub> = 0 V	- 1				
<b>Output</b>							
Output Voltage High <sup>c</sup>	V <sub>OUTH</sub>	I <sub>OUT</sub> = - 300 mA	V <sub>DD</sub> = 10.8 V	10.55	10.70	V	
			V <sub>DD</sub> = 4.5 V	4.20	4.35		
			V <sub>DD</sub> = 3.8 V	3.40	3.62		
Output Voltage Low <sup>c</sup>	V <sub>OUTL</sub>	I <sub>OUT</sub> = 300 mA	V <sub>DD</sub> = 10.8 V		0.09	0.20	
			V <sub>DD</sub> = 4.5 V		0.12	0.25	
			V <sub>DD</sub> = 3.8 V		0.14	0.30	
Output V Clamp High	V <sub>CLH</sub>	EN̄ = PWM ≥ 2 V	I <sub>OUT</sub> = 100 mA		V <sub>DD</sub> + 0.7	V <sub>DD</sub> + 1.0	V
Output V Clamp Low	V <sub>CLL</sub>		I <sub>OUT</sub> = - 100 mA	- 1.0	- 0.7		
<b>Supply</b>							
V <sub>DD</sub> Supply Current	I <sub>DD</sub>	EN̄ = 0 V, PWM = 100 kHz, V <sub>DD</sub> = 5 V		1.0	1.5	mA	
		EN̄ = 4.5 V, PWM = 100 kHz, V <sub>DD</sub> = 5.5 V		60	140	μA	
		EN̄ = PWM = 4.5 V, V <sub>DD</sub> = 5.5 V		55	110		

<b>SPECIFICATIONS</b>						
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_{DD} = 3.8\text{ V to }13.2\text{ V}$ $S_A$ at GND, $S_B$ at GND	Limits D Suffix, -40 °C to 85 °C			Unit
			Min <sup>a</sup>	Typ <sup>b</sup>	Max <sup>a</sup>	
<b>Dynamic</b>						
Propagation Delay - $OUT_A^d$	$T_{PLH}$	$V_{DD} = 5\text{ V}, \overline{EN} = 0\text{ V}$		300		nS
	$T_{PHL}$			115		
Propagation Delay - $OUT_B^d$	$T_{PLH}$			75		
	$T_{PHL}$			330		
Break-Before-Make <sup>d</sup>	$BBM_{PLH}$			225		
	$BBM_{PHL}$			215		

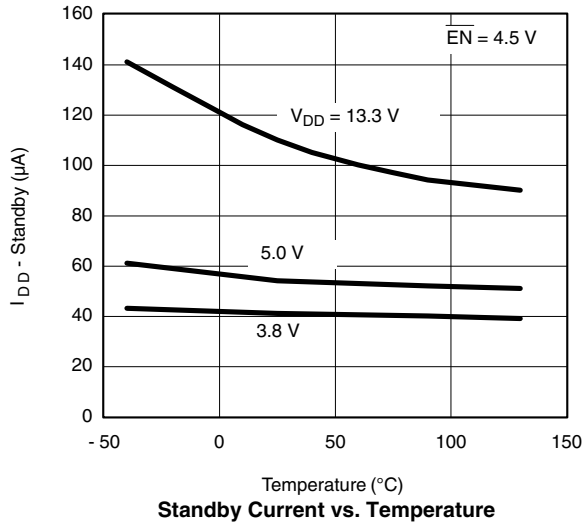
**Notes:**

- a. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing, measured  $T_A = 25\text{ °C}$ .
- c. Min and Max value measured at  $T_J = 135\text{ °C}$ .
- d. PLH = PWM low to high, PHL = PWM high to low.

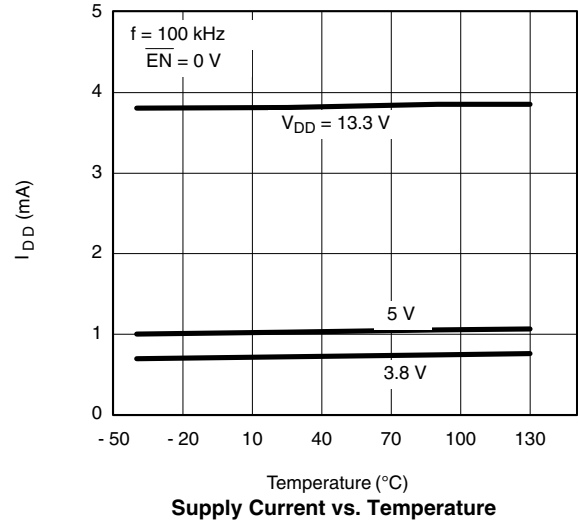
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



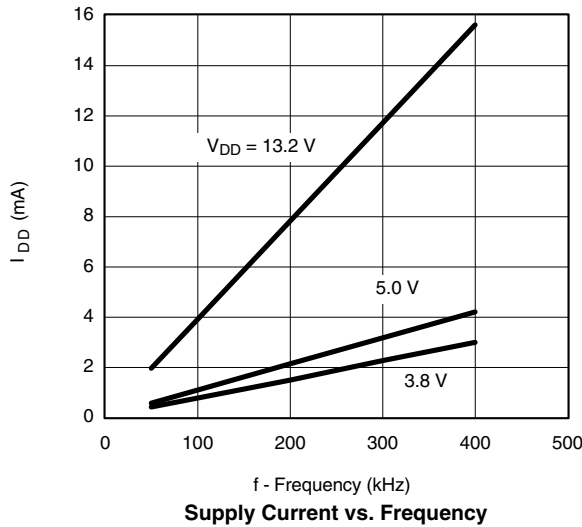
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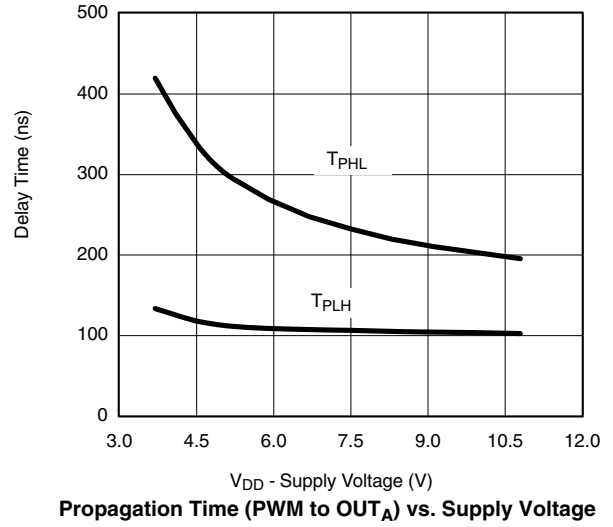
Standby Current vs. Temperature



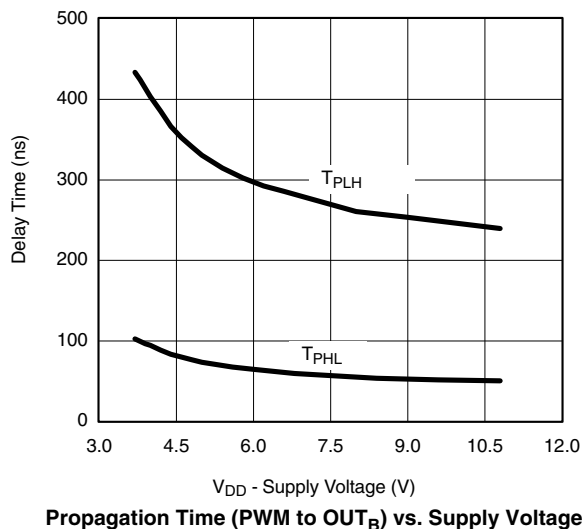
Supply Current vs. Temperature



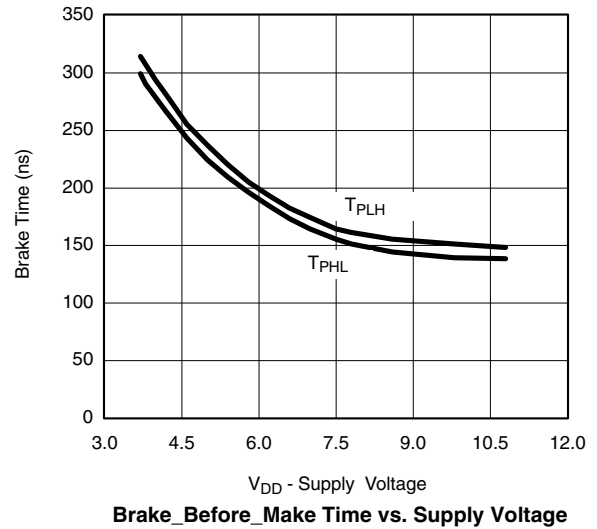
Supply Current vs. Frequency



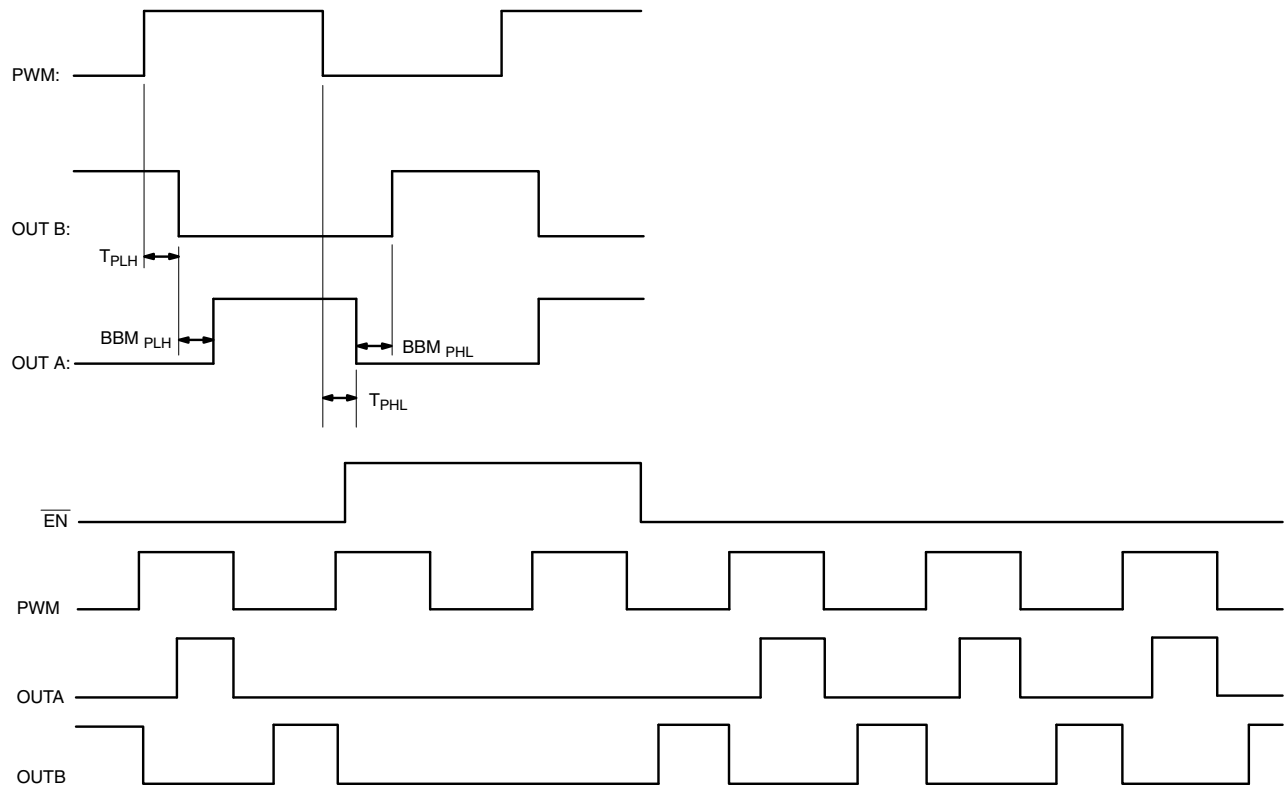
Propagation Time (PWM to OUT<sub>A</sub>) vs. Supply Voltage



Propagation Time (PWM to OUT<sub>B</sub>) vs. Supply Voltage



Brake\_Before\_Make Time vs. Supply Voltage

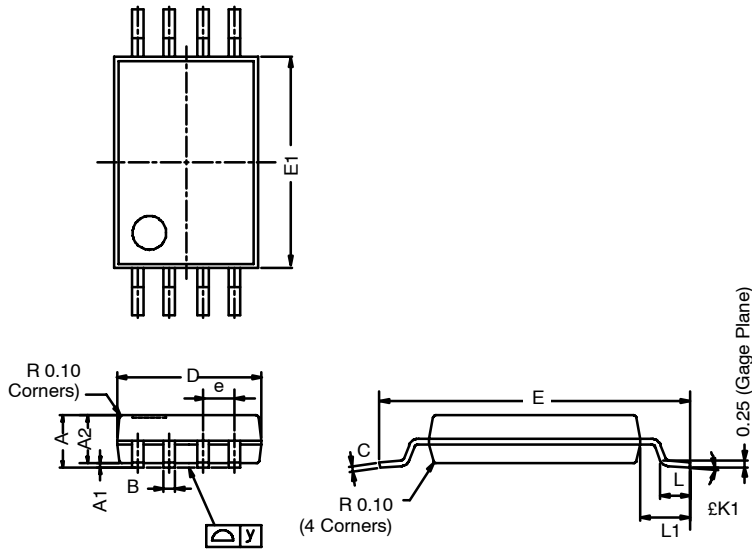
**TIMING WAVEFORMS**

**Figure 1.**

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**TSSOP: 8-LEAD (POWER IC ONLY)**

JEDEC Part Number: MO-153



Dim	MILLIMETERS		
	Min	Nom	Max
A	-	-	1.20
A <sub>1</sub>	0.05	0.10	0.15
A <sub>2</sub>	0.80	1.00	1.05
B	0.19	0.28	0.30
C	-	0.127	-
D	2.90	3.00	3.10
E	6.20	6.40	6.60
E <sub>1</sub>	4.30	4.40	4.50
e	-	0.65	-
L	0.45	0.60	0.75
L <sub>1</sub>	0.90	1.00	1.10
Y	-	-	0.10
£K1	0°	3°	6°

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DWG: 5908



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