NEXT Lab

Semiconductor Development Group

NXA7001

DMOS Full-Bridge Motor Diver

General Description

The device can drive DC motor, the NXA7001 is capable of peak output currents to ±2.8A and operating voltages to 36V.

PHASE and ENABLE input terminals are provided for use in controlling the speed and direction of a dc motor with externally applied PWM control signals. A low-power sleep mode is provided which shuts down internal circuitry to achieve very low quiescent current. This Sleep mode can be set using a dedicated SLEEP pin.

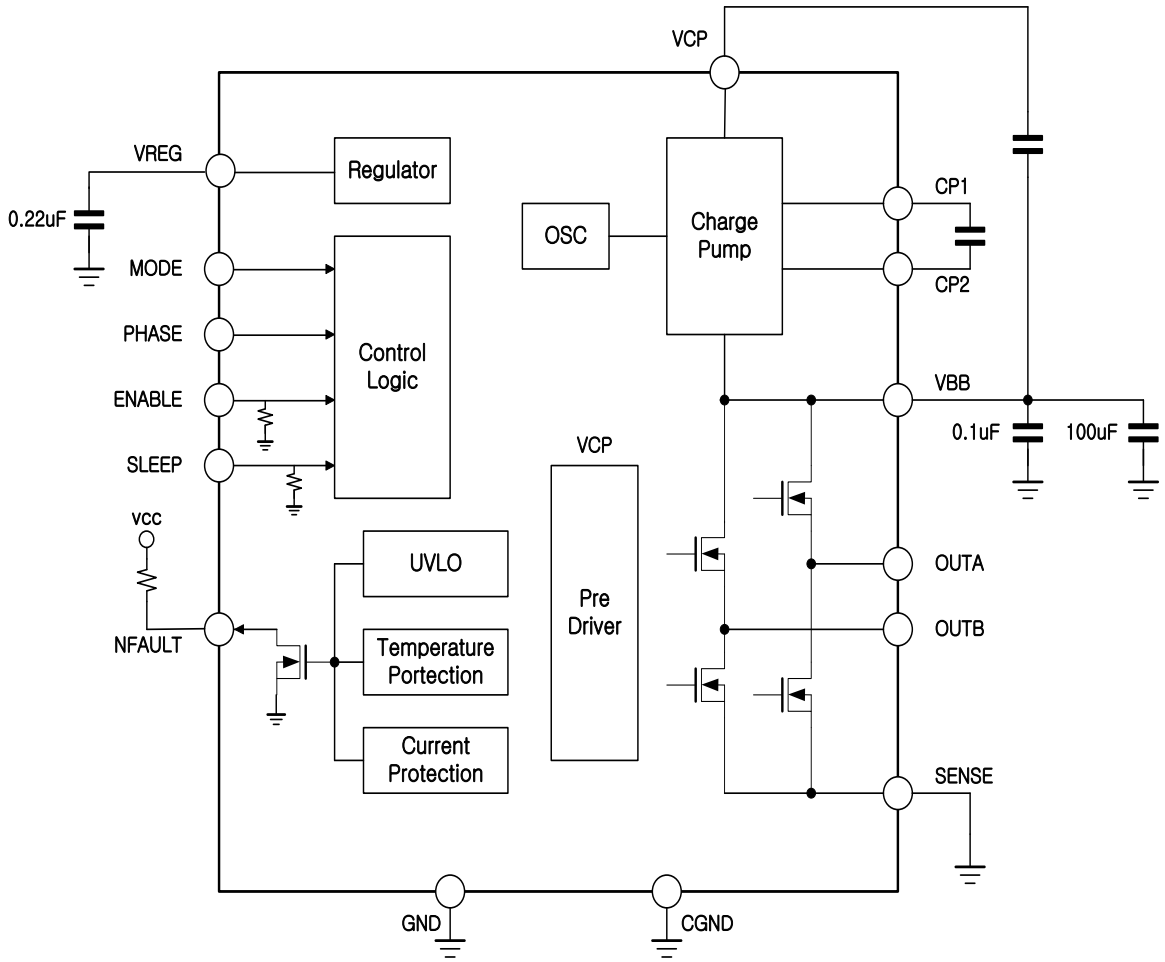
Internal protection functions are provided for under voltage lockout, over-current protection, short to ground/short-to-supply protection, and over-temperature protection.

The NXA7001 is packaged in a 16 pin TSSOP package with exposed PAD.

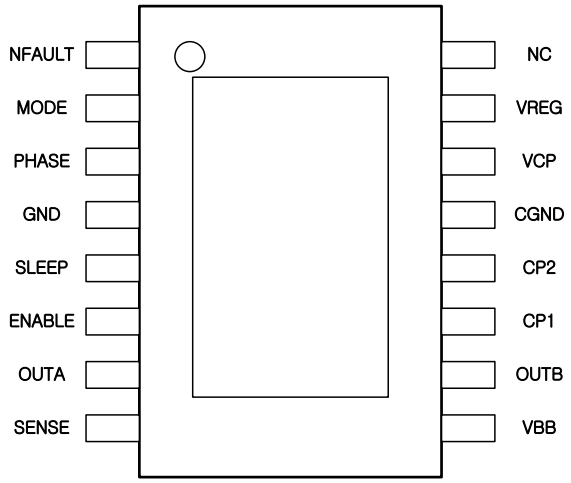
Feature

- Low $R_{DS(on)}$ outputs
- Low-Power Sleep Mode
- 8-36V Operating Supply Voltage
- Over-current protection
- Short-to-ground protection(STG)
- Short-to-supply protection(STS)
- Under-voltage lockout(VBB,VCP,VREG)
- Over-temperature protection

Block Diagram



Terminal assignment



Pin description

Pin Name	Pin No.	I/O	Description
NFAULT	1	O	Fault output, open drain
MODE	2	I	Logic input,
PHASE	3	I	Logic input
GND	4	G	ground
SLEEP	5	I	Sleep Mode control input
ENABLE	6	I	Logic input
OUTA	7	O	Full bridge output A
SENSE	8	G	Power return, (connect directly to GND)
VBB	9	P	Supply voltage
OUTB	10	O	Full bridge output B
CP1	11	I/O	Charge pump flying capacitor terminal
CP2	12	I/O	Charge pump flying capacitor terminal
CGND	13	G	Charge pump ground (connect to GND)
VCP	14	I/O	Charge pump output
VREG	15	I/O	Regulator output
NC	16	-	No connection

Maximum Absolute ratings

over operation free-air temperature range, T_A=25℃ (unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply voltage	VBB	-0.3~40	V
Digital Input voltage	V_I	-0.3~5.5	V
Operating free-air temperature range	T_A	-40~85	℃
Operating junction temperature range	T_J	-40~150	℃
Storage temperature range	T_{stg}	-65~85	℃

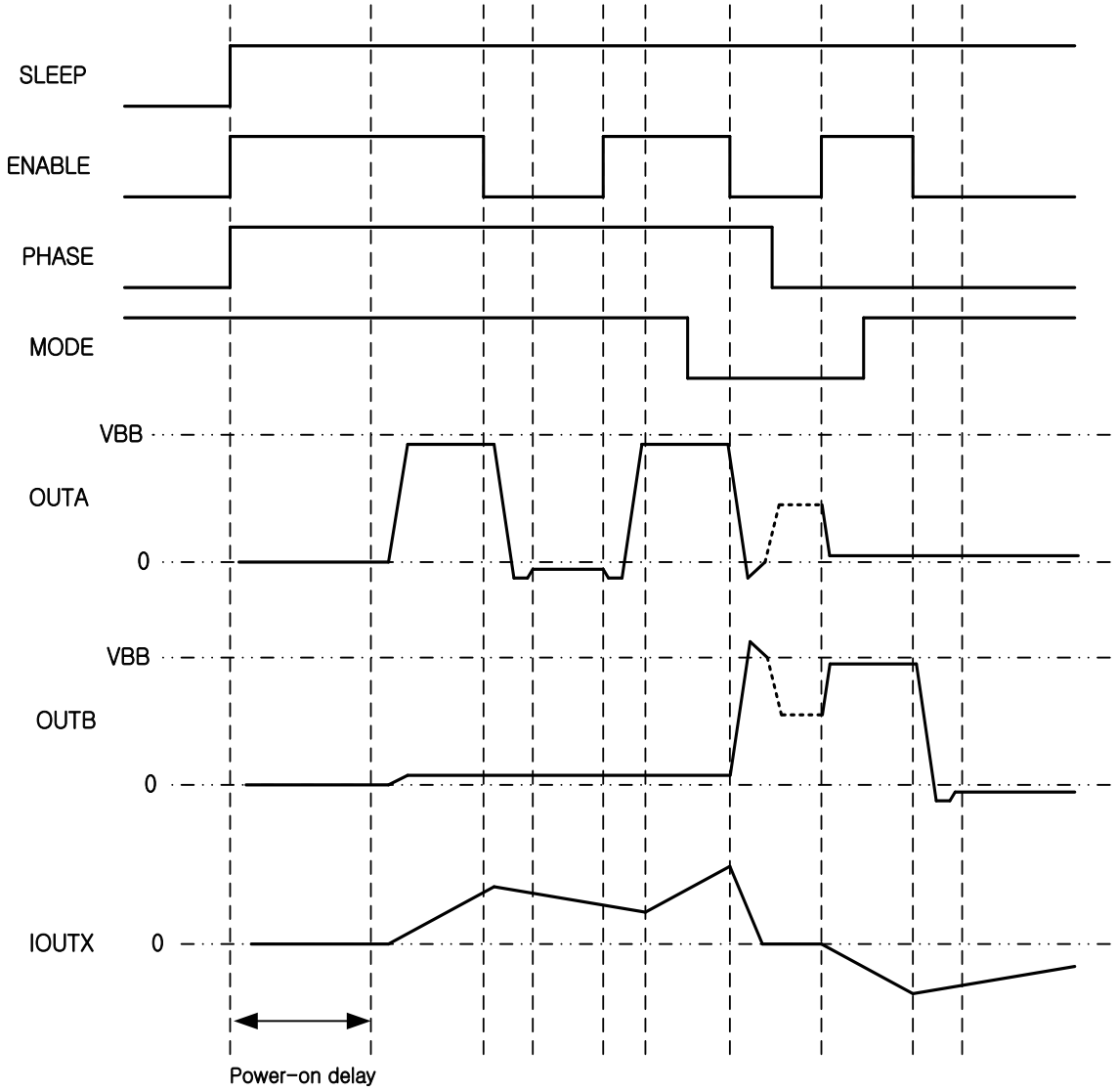
Electrical Characteristics

Ta=25.0℃, VBB=8 to 36V (Unless otherwise noted)

Characteristics	Symbol	Condition	Value			Unit
			min	typ	max	
Operating Voltage	VBB		8		36	V
Motor Supply Current	I_{VBB}	f_{PWM} < 50kHz		6		mA
		Charge Pump on, Outputs disabled		3		mA
		Sleep mode			1	uA
PHASE,ENABLE,MODE Input Voltage	V_{IH}		2.0			V
	V_{IL}				0.8	
SLEEP Input Voltage	V_{IH}		2.7			V
	V_{IL}				0.8	
PHASE,MODE Input Current	I_{IH}	V_{IN}=2.0V			1	uA
	I_{IL}	V_{IN}=0.8V			1	
ENABLE Input Current	I_{IH}	V_{IN}=2.0V		40		uA
	I_{IL}	V_{IN}=0.8V		16		
SLEEP Input Current	I_{IH}	V_{IN}=2.7V		27		uA
	I_{IL}	V_{IN}=0.8V		<1		
NFAULT Output Voltage	V_{OL}	Isink=1.0mA			0.4	V
Output On Resistance	R_{DSon}	Source driver, Iout=-2.8A,Tj=25℃		0.35		Ω
		Source driver, Iout=-2.8A,Tj=125℃		0.53		
		Sink driver, Iout=2.8A,Tj=25℃		0.3		
		Sink driver, Iout=2.8A,Tj=125℃		0.45		

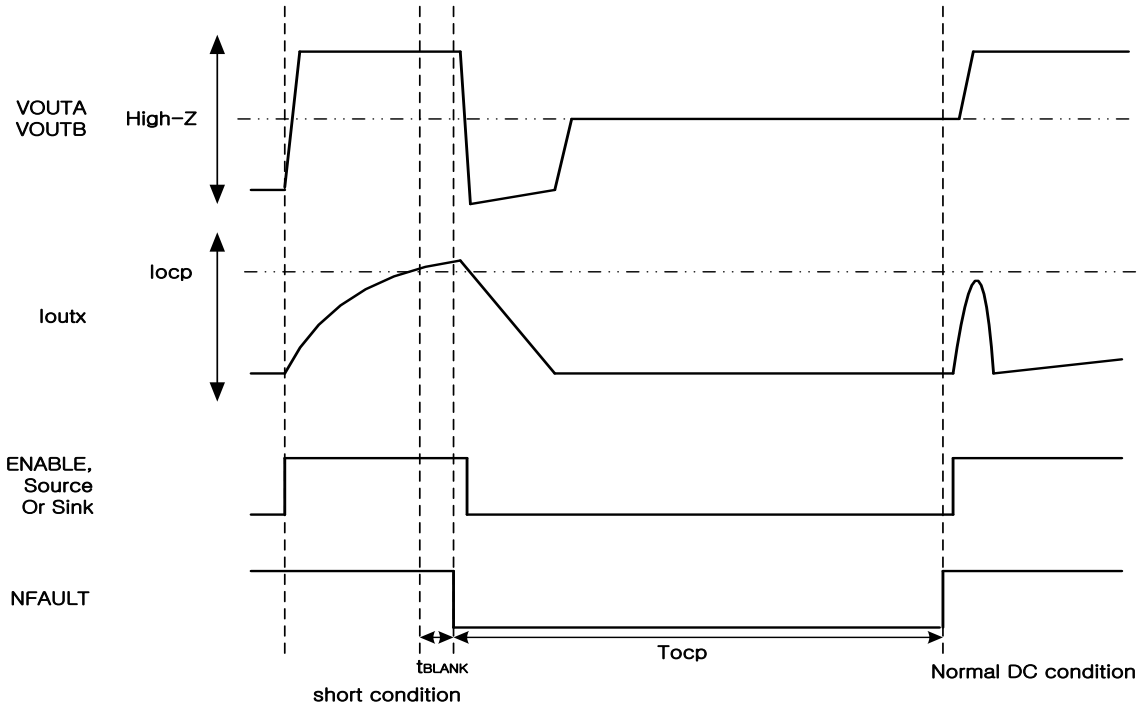
Characteristics	Symbol	Condition	Value			Unit
			min	typ	max	
Body Diode Forward Voltage	Vf	Source diode, If=-2.8A			1.4	V
		Sink diode, If=2.8A			1.4	
Propagation Delay Time	Tpd	PWM, change to source or sink ON		600		ns
		PWM, change to source or sink OFF		100		
Crossover Delay Time	Tcod			500		ns
Protection circuits						
UVLO	Vuvlo	VBB rising		6.5		V
UVLO Hysteresis	Vuvhys			250		mV
Over current Level	Vocp		3			A
Over current retry Period	Tocp			1.2		ms
Thermal Warning Temperature	Tjw	Temperature rising		160		℃
Thermal Warning Hysteresis	Tjwhys			15		℃
Thermal shutdown Temperature	Tjs	Temperature rising		175		℃
Thermal shutdow Hysteresis	Tjshys			15		℃

Timing Diagram: PWM control



PIN						FUNCTION
SLEEP	ENABLE	MODE	PHASE	OUTA	OUTB	
0	X	X	X	Z	Z	Sleep Mode
1	1	X	0	L	H	Reverse
1	1	X	1	H	L	Forward
1	0	1	X	L	L	Brake
1	0	0	0	Z	Z	Decay
1	0	0	1	Z	Z	Decay

Timing Diagram: Over-current Protection



Application Note

Device Operation

The NXA7001 is designed to operate one dc motor. The Currents in the output full-bridges, all N-channel DMOS, are regulated with fixed off-time pulse width modulated control circuitry.

VREG

This voltage is used to drive the low-side DMOS gates. VREG pin should be decoupled with a 0.22uF capacitor to ground.

Charge Pump Flying Capacitor and VCP Capacitor

The NXA7001 feature use charge pump. The charge pump flying capacitor serves to transfer charge during the generation of the VCP supply voltage. The VCP is used to drive High side DMOS gates. A 0.1uF capacitors should be connected between CP1 and CP2, VCP and VBB.

Protection

In the event of fault due to temperature, or low voltage on VBB or VREG or VCP, over current protection, the outputs of the device are disabled until the fault condition is removed.

If the die temperature increases past the thermal warning threshold the NFAULT pin will be driven low. If the die temperature increases past the thermal shutdown threshold, all DMOS in the OUTPUT will be disabled.

Over-current Protection (OCP)

The current flowing through the high-side and low-side drivers is monitored to ensure that the motor lead is not shorted to supply or ground. If a short is detected, all output DMOS will be disabled, NFAULT is driven low and a 1.2ms Fault timer is started. After this period the device is then allowed to follow the input commands and another turn-on is attempted. If there is still a fault condition, the cycle repeats. If after Tocp expires it is determined the short condition is not present, normal operation resumes and NFAULT is released.

SENSE Pin

A low value resistor and be placed between the SENSE pin and ground for current sensing purposes. To minimize ground -trace IR drops in sensing the output current level. This trace should be as short as possible. When selecting a value for the sense resistor be sure not to exceed the maximum voltage on the SENSE pin of ±500mV.

Power Dissipation

Power dissipation in the NXA7001 is dominated by the power dissipated in the output Rdson. Output current path is through High-side DMOS driver, Motor winding, and Low-side DMOS driver, Power dissipation is I^2R loses in one high side and low side DMOS driver. As shown in the following equation;

$$P_D = I^2(R_{HSON} + R_{LSON})$$