

# 智能功率模块：500V /2A 三相全桥驱动 NSMB02S50M1

## 1. 特点

- 内置 6 个 500V/2A 的快恢复功率 MOS (Typ.  $R_{ds,on} = 3\Omega @25^\circ C$ )
- 内置高压栅极驱动电路 (HVIC)
- 内置欠压保护
- 内置自举二极管
- 内置温度检测功能
- 内置栅极驱动电路的电压范围从 10V 到 20V
- 3 个独立的负电流端用于需要电流检测的应用
- 兼容 3.3V 和 5V 的 MCU 接口, 高电平有效
- 优化并采用了低电磁干扰设计
- 绝缘等级 1500Vrms/min

## 2. 典型应用

- 室内/户外空调
- 冰箱压缩机
- 排风扇
- 风扇
- 空气净化器
- 洗碗机水泵

## 3. 芯片概述

### 3.1 特点

NSMB02S50M1 是高度集成、高可靠性的三相无刷直流电机驱动电路, 主要应用于风扇类的小功率电机驱动。该模块内置了 6 个快恢复功率 MOS 管和 3 个半桥高压栅极驱动电路。

NSMB02S50M1 内部集成了欠压保护功能, 提供了优异的保护和失效保护操作。由于每一相都有一个独立的负直流端, 其电流可以分别单独检测。

NSMB02S50M1 采用了高绝缘、易导热和低电磁干扰的

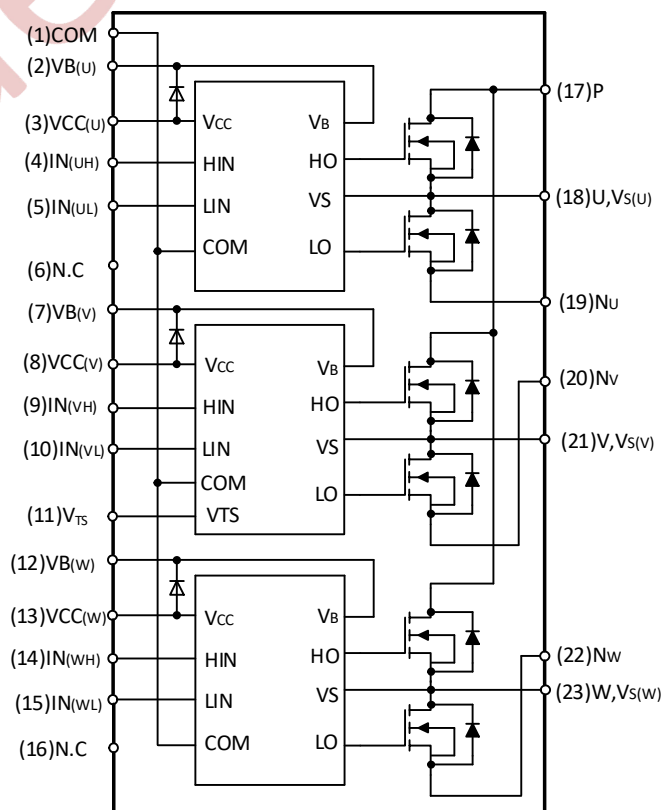
设计, 提供了非常紧凑的封装体, 使用非常方便, 尤其适合内置于电机的应用和要求紧凑安装的情况。

### 3.2 芯片信息




Part Number	Package	Body size
NSMB02S50M1	SOP23	29mm x 12mm

Functional Block Diagram



## 4 Ordering Guide

Part Number	LOGO	Package	Package	SPQ
NSMB02S50M1	 NSMB02S50M1 XXXXXX	SOP23	Tape & Reel	500

## 5 Revision history

Version	Content	Time
V1.0	Create	2022.10.10

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## 6 Function Pin Description

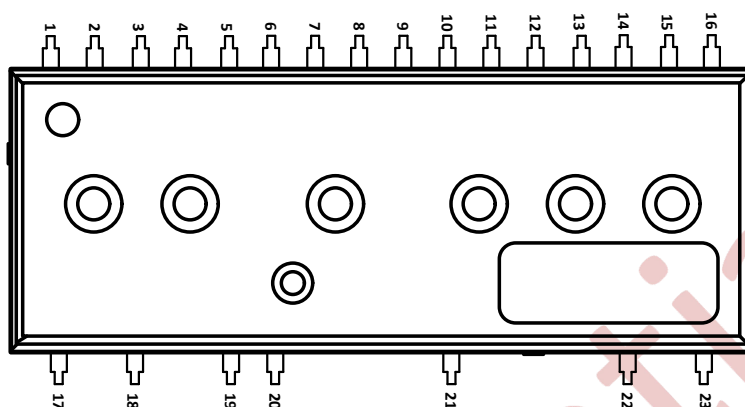


Figure6-1 23-Pin Top view

Table6-1 Lead Definitions

Number	Symbol	Description
1	COM	IC Common Supply Ground
2	$V_{B(U)}$	Bias Voltage for U-Phase High-Side MOSFET Driving
3	$V_{CC(U)}$	Bias Voltage for U-Phase IC and Low-Side MOSFET Driving
4	$IN_{(UH)}$	Signal Input for U-Phase High-Side
5	$IN_{(UL)}$	Signal Input for U-Phase Low-Side
6	N.C	No Connection
7	$V_{B(V)}$	Bias Voltage for V-Phase High Side MOSFET Driving
8	$V_{CC(V)}$	Bias Voltage for V-Phase IC and Low Side MOSFET Driving
9	$IN_{(VH)}$	Signal Input for V-Phase High-Side
10	$IN_{(VL)}$	Signal Input for V-Phase Low-Side
11	$V_{TS}$	Output for HVIC Temperature Sensing
12	$V_{B(W)}$	Bias Voltage for W-Phase High-Side MOSFET Driving
13	$V_{CC(W)}$	Bias Voltage for W-Phase IC and Low-Side MOSFET Driving
14	$IN_{(WH)}$	Signal Input for W-Phase High-Side
15	$IN_{(WL)}$	Signal Input for W-Phase Low-Side
16	N.C	No Connection
17	P	Positive DC-Link Input
18	$U, V_{S(U)}$	Output for U-Phase & Bias Voltage Ground for High-Side MOSFET Driving
19	$N_U$	Negative DC-Link Input for U-Phase
20	$N_V$	Negative DC-Link Input for V-Phase
21	$V, V_{S(V)}$	Output for V-Phase & Bias Voltage Ground for High-Side MOSFET Driving
22	$N_W$	Negative DC-Link Input for W-Phase
23	$W, V_{S(W)}$	Output for W Phase & Bias Voltage Ground for High-Side MOSFET Driving

## 7 Product specifications

### 7.1 Absolute Maximum Ratings

Exceeding the limit maximum rating may cause permanent damage to the device. All voltage parameters are rated with reference to COM and an ambient temperature of 25°C.

#### Inverter Part (each MOSFET unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
$V_{DSS}$	Drain-Source Voltage of Each MOSFET		500	V
$I_D$	Each MOSFET Drain Current, Continuous	$T_C = 25^\circ\text{C}$	2.0	A
$I_{DP}$	Each MOSFET Pulse Current, Peak	$T_C = 25^\circ\text{C}$ , Less than 100us	6.0	A
$I_{DRMS}$	Each MOSFET Current, Rms	$T_C = 80^\circ\text{C}$ , $F_{PWM} < 20\text{KHz}$	1.5	$A_{rms}$
$P_D$	Maximum Power Dissipation	$T_C = 25^\circ\text{C}$ For each MOSFET	14	W

#### Control Part (each HVIC unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
$V_{CC}$	Control Supply Voltage	Applied between $V_{CC}$ and COM	20	V
$V_{BS}$	High-side Bias Voltage	Applied between $V_B$ and $V_S$	20	V
$V_{IN}$	Input Signal Voltage	Applied between $V_{IN}$ and COM	$-0.3 \sim V_{CC} + 0.3$	V

#### Bootstrap Diode Part (each bootstrap diode unless otherwise specified)

Symbol	Definition	Conditions	Rating	Units
$V_{RRMB}$	Maximum Repetitive Reverse Voltage		500	V
$I_{FB}$	Forward Current	$T_C = 25^\circ\text{C}$	0.25	A
$I_{FPB}$	Forward Peak Current, Peak	$T_C = 25^\circ\text{C}$ , Under 1ms Pulse Width	0.5	A

#### Total System

Symbol	Definition	Conditions	Rating	Units
$T_J$	Operating Junction Temperature		$-40 \sim 150$	$^\circ\text{C}$
$T_{STG}$	Storage Temperature		$-40 \sim 150$	$^\circ\text{C}$
$V_{ISO}$	Isolation Voltage	60Hz, Sinusoidal, 1 minute, Connect Pins to Heat-Sink Plate	1500	Vrms

#### Thermal Resistance

Symbol	Definition	Conditions	Rating	Units
$R_{\theta JC}$	Junction to Case Thermal resistance	Each MOSFET under Inverter Operating Condition	7.1	$^\circ\text{C}/\text{W}$

Note1: To insure safe operation of the IPM, the average junction temperature should be limited to  $T_J \leq 150^\circ\text{C}$  ( $@T_C \leq 100^\circ\text{C}$ ).

### 7.2 Recommended Operating Conditions

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
$V_{PN}$	Supply Voltage	Applied between P and N	-	300	400	V
$V_{CC}$	Control Supply Voltage	Applied between $V_{CC}$ and COM	10		18.5	V
$V_{BS}$	High-Side Bias Voltage	Applied between $V_B$ and $V_S$	10		18.5	V
$V_{IN(ON)}$	Input ON Threshold Voltage	Applied between $V_{IN}$ and COM	3.0	-	$V_{CC}$	V
$V_{IN(OFF)}$	Input OFF Threshold Voltage		0	-	0.6	V
$t_{dead}$	Blanking Time for Preventing Arm-Short	$V_{CC} = V_{BS} = 13.5 \sim 16.5 \text{ V}$ , $T_J < 150^\circ\text{C}$	1.0	-	-	us
$f_{PWM}$	PWM Switching Frequency	$T_J < 150^\circ\text{C}$	-	15	-	KHz

### 7.3 Electrical Characteristics

Valid for temperature range at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

**Inverter Part**(each MOSFET unless otherwise specified)

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
$BV_{DSS}$	Drain - Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	545	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0\text{ V}, V_{DS} = 500\text{ V}$	-	-	1	$\mu\text{A}$
$R_{DS(on)}$	Static Drain-Source Turn-On Resistance	$V_{CC} = V_{BS} = 15\text{ V}, V_{IN} = 5\text{ V}, I_D = 1.5\text{ A}$	-	3	3.8	$\Omega$
$V_{SD}$	Drain - Source Diode Forward Voltage	$V_{CC} = V_{BS} = 15\text{ V}, I_D = -2.0\text{ A}$	-	-	1.4	V
$t_{ON}$	Switching Times	$V_{PN} = 300\text{ V}, V_{CC} = V_{BS} = 15\text{ V}, I_D = 0.5\text{ A}$ $I_N = 0\text{ V} \leftrightarrow 5\text{ V}$ , Inductive Load $L = 3\text{ mH}$ High- and Low-Side MOSFET Switching	-	920	-	ns
$t_{OFF}$			-	520	-	ns
$t_{rr}$			-	210	-	ns
$E_{ON}$			-	40	-	$\mu\text{J}$
$E_{OFF}$			-	10	-	$\mu\text{J}$
RBSOA	Reverse Bias Safe Operating Area	$V_{PN} = 400\text{ V}, V_{CC} = V_{BS} = 15\text{ V}, I_D = I_{DP}$ , $V_{DS} = B_{V_{DSS}}, T_J = 150^\circ\text{C}$ High- and Low-Side MOSFET Switching	Full Square			

**Control Part**(each HVIC unless otherwise specified)

Symbol	Parameter	Condition		MIN.	TYP.	MAX.	Units
$I_{QCC}$	Quiescent VCC Supply Current	$V_{CC} = 15\text{ V}$ $V_{IN} = 0\text{ V}$	Applied between VCC and COM	-	100	220	$\mu\text{A}$
$I_{QBS}$	Quiescent VB Supply Current	$V_{BS} = 15\text{ V}$ $V_{IN} = 0\text{ V}$	Applied between $V_{B(U)} - U$ , $V_{B(V)} - V, V_{B(W)} - W$	-	50	100	$\mu\text{A}$
$V_{CCD}$	Low-side UVLO threshold	VCC Under-Voltage Protection Detection Level		-	7.7	-	V
$V_{CCR}$		VCC Under-Voltage Protection Reset Level		-	8.7	-	V
$V_{BSD}$	High-side UVLO threshold	VBS Under-Voltage Protection Detection Level		-	7.3	-	V
$V_{BSR}$		VBS Under-Voltage Protection Reset Level		-	8.2	-	V
$V_{TS}$	HVIC Temperature Sensing Voltage Output	$V_{CC} = 15\text{ V}, T_{HVIC} = 25^\circ\text{C}$		320	650	900	mV
$V_{IH}$	ON Threshold Voltage	Logic HIGH Level	Applied between $V_{IN}$ and COM	-	-	2.5	V
$V_{IL}$	OFF Threshold Voltage	Logic LOW Level		0.8	-	-	V

**Control Part**(each bootstrap diode unless otherwise specified)

Symbol	Parameter	Condition	MIN.	TYP.	MAX.	Units
VF	BSD Forward voltage	$I_F = 0.1\text{ A}, T_C = 25^\circ\text{C}$	-	2.8	-	V
$t_{rrB}$	Reverse Recovery Time	$I_F = 0.1\text{ A}, T_C = 25^\circ\text{C}$	-	80	-	ns
R	BSD Current Limiting Resistor		-	18	-	ohm

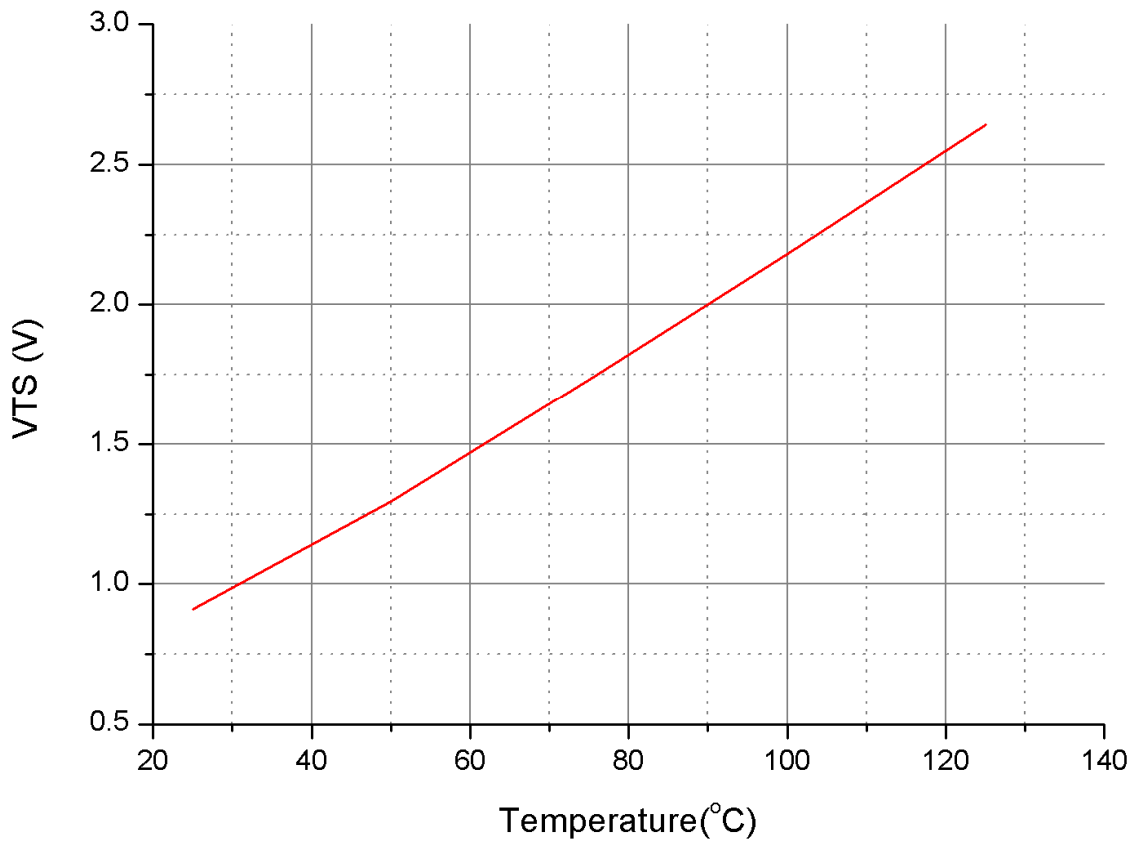


Figure7-1 Temperature Profile of V<sub>TS</sub>(Typical)

## 8 NSMB02S50M1 Description

### Typical application circuit

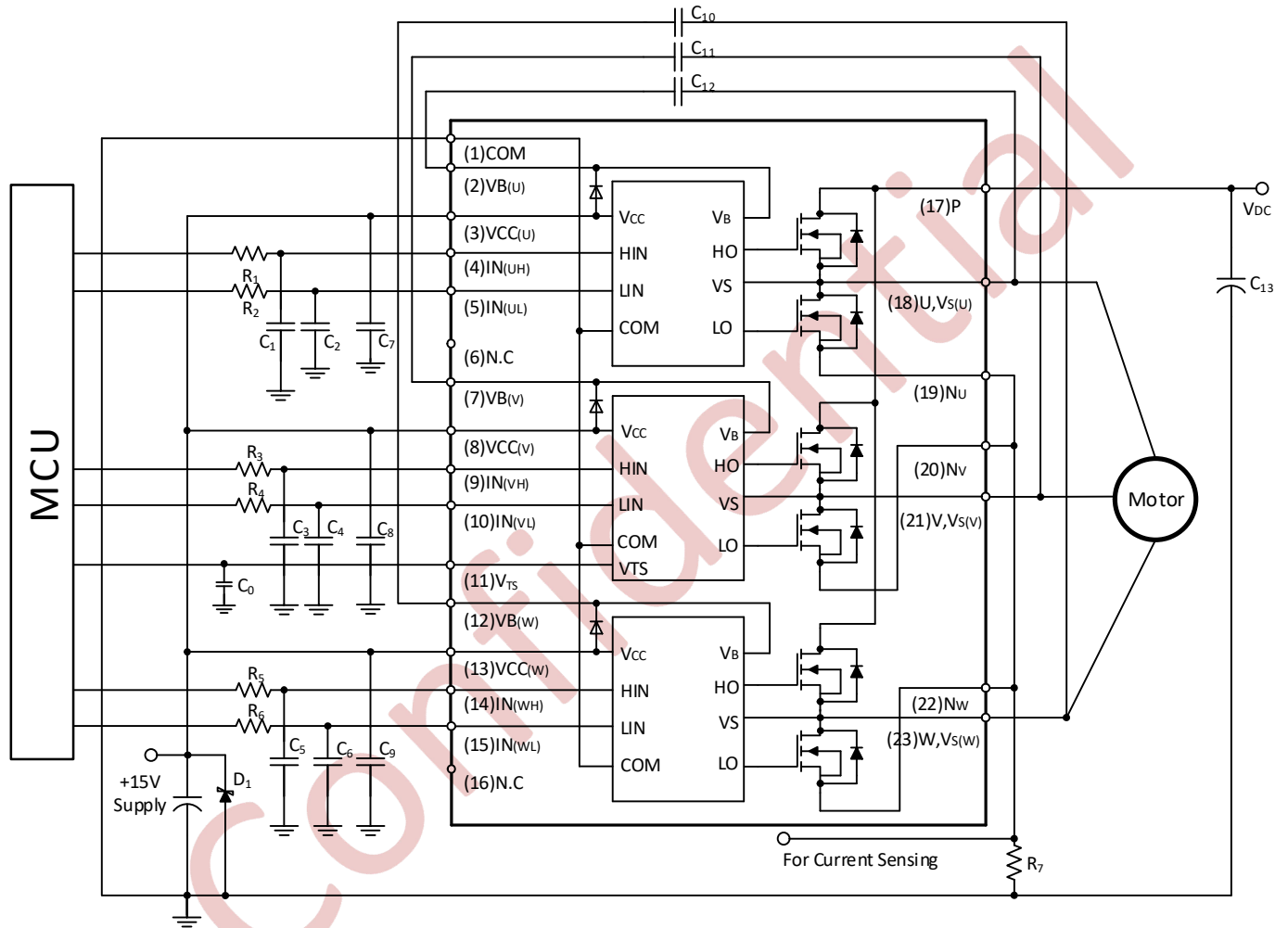


Figure8-1 Example of RC-coupling parameter 390 ohm and 1nF  
Recommended Application Circuit and MCU Interface with parameter

#### Notes:

1. RC-coupling ( $R_1 - R_6$  and  $C_0 - C_6$ ) at each input of IPM product and MCU are useful to prevent improper input signal caused by controller scheme and /or surge-noise.
2. All the filter capacitors should be connected close to IPM product, and they should have good characteristics for rejecting high-frequency ripple current.

