Three-phase Sensorless Sinusoidal BLDC Driver

PRODUCT DESCRIPTION

The MS39549 and the MS39545 are three-phase sensorless DC motor drivers with low noise and vibration, which adopt sinusoidal drive mode.

Motor speed can be controlled by VSP/PWM pin. And the voltage can be as low as 4V to adapt or adjust the motor speed.

The MS39549 and the MS39545 are available in SOP8/PP packages with thermal pad.

SOP8/PP

FEATURES

- 180° Sinusoidal Drive
- Efficient Sensorless Control
- Analog Speed Control Input (MS39545)
- PWM Speed Control Input (MS39549)
- Wide Power Supply Range: 4V-16V
- FG Speed Feedback Output
- Locked-rotor Detection
- Overcurrent Protection, Short-circuit Protection
- Soft Start

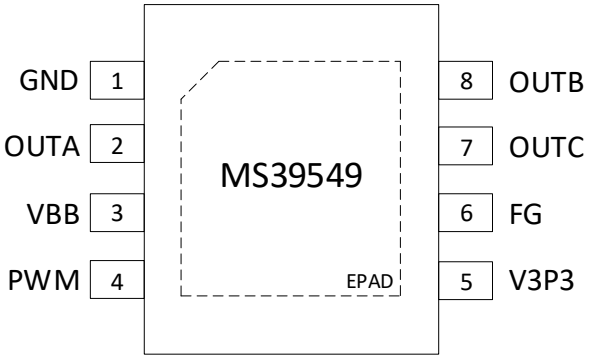
APPLICATIONS

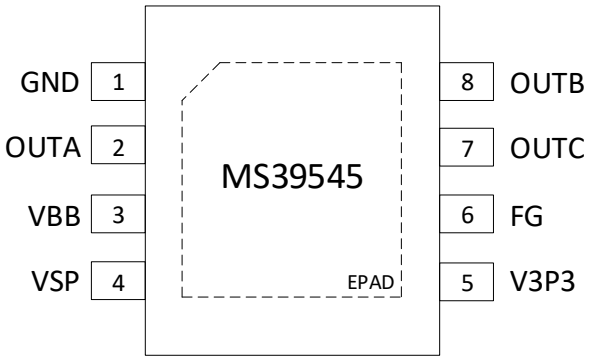
- Fan
- Consumer Products

PRODUCT SPECIFICATIONS

Part Number	Package	Marking
MS39549	SOP8/PP	MS39549
MS39545	SOP8/PP	MS39545

PIN CONFIGURATION

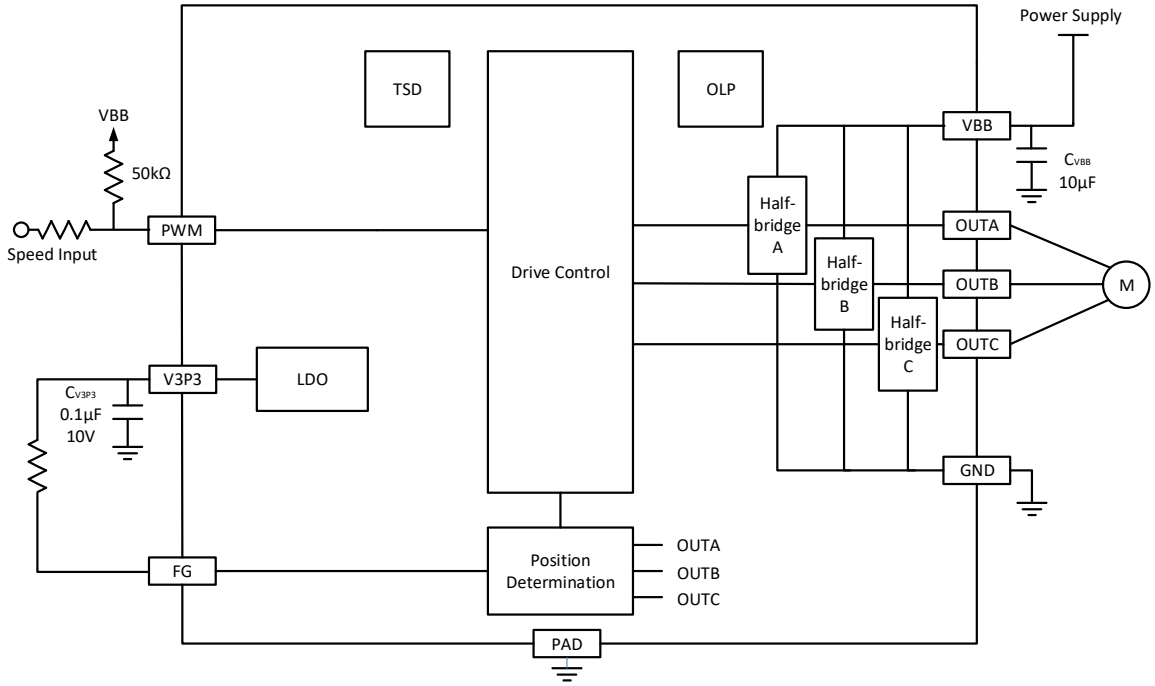




PIN DESCRIPTIONS

Pin	Name	Type	Description
1	GND	-	Ground
2	OUTA	O	Three-phase Output (A)
3	VBB	-	Power Supply
4	VSP	I	Speed Control Input (MS39545)
	PWM	I	Speed Control Input (MS39549)
5	V3P3	O	3.3V Supply Output
6	FG	O	Speed Output Signal
7	OUTC	O	Three-phase Output (C)
8	OUTB	O	Three-phase Output (B)
-	EPAD	-	Thermal Pad

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{BB}	20	V
Input Logic Voltage	V_{IN}	-0.3 ~ 6	V
FG Voltage-endurance	V_{FG}	20	V
FG Current	I_{FG}	10	mA
Output Current	I_{OUT}	1.6	A
Operating Temperature	T_A	-40 ~ 125	°C
Storage Temperature	T_{STG}	-65 ~ 150	°C

ELECTRICAL CHARACTERISTICS

Note: Unless otherwise noted, T_A = 25°C ±2°C, V_{BB}=12V.

Power Dissipation

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage	V_{BB}		4		16	V
Supply Current	I_{BB}	Normal Operation, V_{IN}=3V, PWM Output		7	10	mA
		Normal Operation, V_{IN}=3V, Zero Output		7.7	10	mA

Digital Input (The MS39549 PWM Pin or The MS39545 VSP Pin)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Current	I_{IN}	V_{IN}=3V (R_{IN}=100kΩ Pull-down)		33		μA
Low-level Input	V_{IL}				0.8	V
High-level Input	V_{IH}		2			V
Logic Input Hysteresis	V_{IHYS}		100	200	500	mV
Input Pull-down Resistor	R_{IN}		50	100	200	kΩ

The MS39549 Speed Control (PWM Pin)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
PWM On Threshold	D_{ON}		9.5	10	10.5	%
PWM Off Threshold	D_{OFF}		6.5	7	7.5	%
PWM Input Range	f_{PWM}		0.1	-	100	kHz

The MS39545 Speed Control (VSP Pin)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
VSP Enabling Voltage	V_{ON}			0.9		V
VSP Enabling Time	t_{ON}	C_{V3P3}=1μF	100			μs
VSP Off Threshold	V_{THOFF}			300		mV
VSP Accuracy	E_{RRVSP}			±6		LSB
VSP Maximum-value	$V_{SP(MAX)}$			3.1		V

Output Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Drive $R_{DS(on)}$(H+L)	$R_{DS(on)}$	I_{OUT}=500mA		800		mΩ
Output Voltage on V3P3	V_{3P3}		3.2	3.3	3.4	V
Output Saturation Voltage on FG	$V_{FG(sat)}$	I_{FG}=5mA			0.3	V
FG Output Leakage Current	$I_{FG(LKG)}$	V_{FG}=12V			1	μA
Output Chopping Frequency	f_{OUTPWM}		28	30	32	kHz

Protection Circuit

Parameter	Symbol	Condition	Min	Typ	Max	Unit
VBB Undervoltage Protection	V_{BBUVLO}	V_{BB} Rising		3.7		V
Undervoltage Protection Hysteresis	$V_{BBUVHYS}$			200		mV
Locked-rotor Protection Time	t_{OFF}		7	8	9	s
Locked-rotor Detection Time	t_{DETECT}			1		s
Current-limiting	I_{OCL}			1.6		A
Thermal Shutdown Protection	T_{TSD}	Temperature Rising		165		°C
Thermal Shutdown Protection Hysteresis	T_{TSDHYS}			20		°C

FUNCTION DESCRIPTIONS

The MS39545 and the MS39549 are applied to fans, targeted at applications that require low noise, low vibration and high frequency.

The MS39549-PWM Input Mode

The MS39549 can control the fan speed by PWM duty cycle. When PWM reaches 10%, motor drive will start working. A 50kΩ resistor can be connected between PWM and power supply to achieve 100% speed.

The MS39545-VSP Analog Input Control

The MS39545 can control motor speed by VSP analog input voltage. A 50kΩ resistor can be connected between VSP and power supply to achieve 100% speed.

Soft Start

The chip integrates soft start function, which provides two schemes for consumers:

Quickly start for 1s to reach the maximum current-limiting point.

Slowly start for 4s to reach the maximum current-limiting point.

FG

The open-drain output is applied on the FG to feedback the present speed. FG changing corresponds to a revolution of the motor.

Protection Module

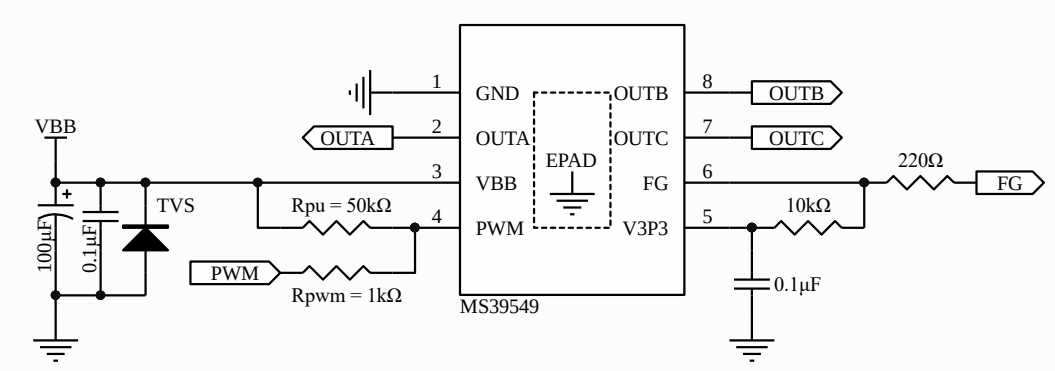
The chip integrates comprehensive protection mode: locked-rotor detection with restart, overcurrent protection, output short-circuit protection, supply undervoltage protection and thermal shutdown.

The chip is featured with locked-rotor protection function. If a locked-rotor state is detected, the chip will disable driver for about 8s, and attempt to restart the motor after that time.

The chip is featured with current-limiting protection function. If the current is detected to exceed I_{OCL}, the chip will disable the remaining PWM cycle output.

TYPICAL APPLICATION DIAGRAM

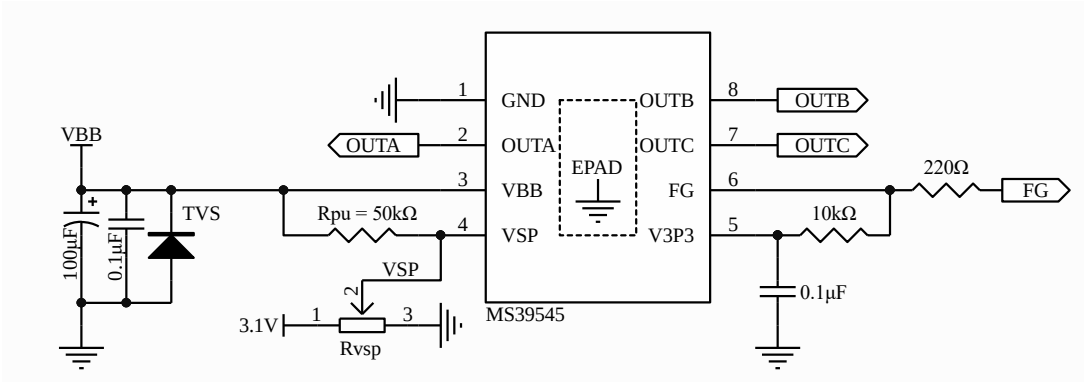
The MS39549 Application Diagram



Note: It is recommended that the reverse cutoff voltage V_{rwm} of TVS is about 2V higher than VBB.

If the system is needed to run at the fastest speed, R_{pwm} is not required. If the system is needed to adjust speed by external PWM signal, R_{pu} is not required.

The MS39545 Application Diagram



Note: It is recommended that the reverse cutoff voltage V_{rwm} of TVS is about 2V higher than VBB.

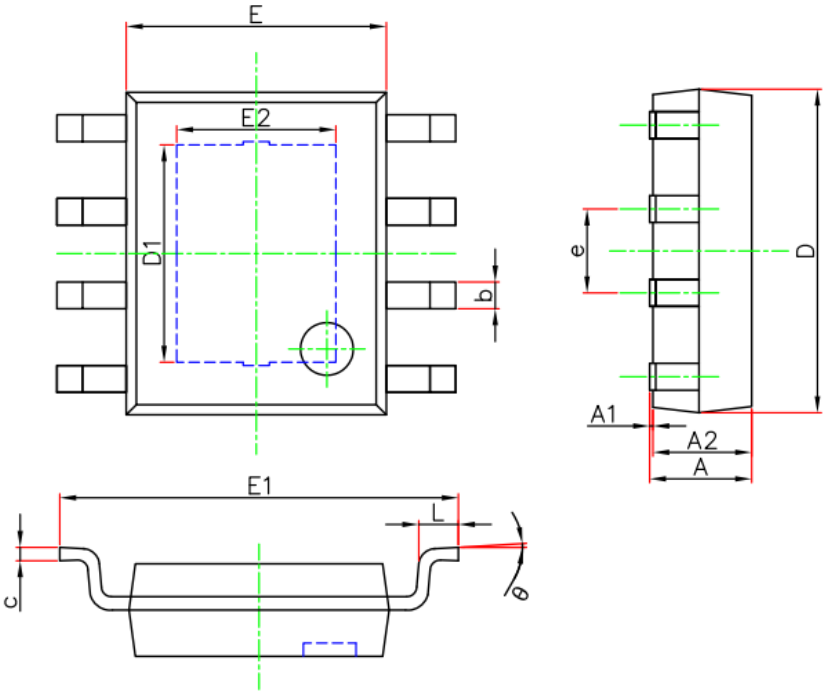
If the system is needed to run at the fastest speed, R_{vsp} is not required. If the system is needed to adjust speed by external VSP signal, R_{pu} is not required.

Layout Notes:

1. Adding thermal vias to the chip thermal pad and connecting it to the PCB ground.
2. Place C_{V3P3} and C_{VBB} as possible as close to the chip.

PACKAGE OUTLINE DIMENSIONS

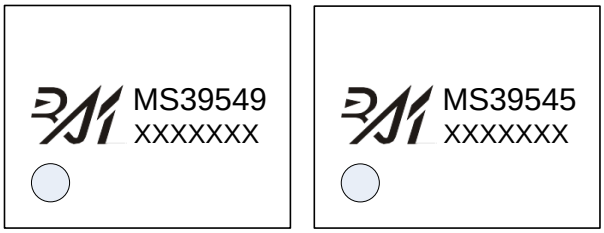
SOP8/PP (Bottom with Thermal Pad)



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.300	1.700	0.051	0.067
A1	0.000	0.100	0.000	0.004
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description



Product Name: MS39549, MS39545

Product Code: XXXXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging specifications

Device	Package	Piece/Reel	Reel/Box	Piece /Box	Box/Carton	Piece/Carton
MS39549	SOP8/PP	4000	1	4000	8	32000
MS39545	SOP8/PP	4000	1	4000	8	32000

STATEMENT

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- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1、The operator shall ground through the anti-static wristband.

2、The equipment shell must be grounded.

3、The tools used in the assembly process must be grounded.

4、Must use conductor packaging or anti-static materials packaging or transportation.

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