

Three-phase Sensorless Sinusoidal BLDC Driver

PRODUCT DESCRIPTION

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



SOP8/PP

FEATURES

- 180° Sinusoidal Drive
- Efficient Sensorless Control
- Analog Speed Control Input (MS39545-A)
- PWM Speed Control Input (MS39549-A)
- Wide Power Supply Range: 4V-24V
- FG Speed Feedback Output
- Locked-rotor Detection
- Overcurrent Protection, Short-circuit Protection
- Soft Start

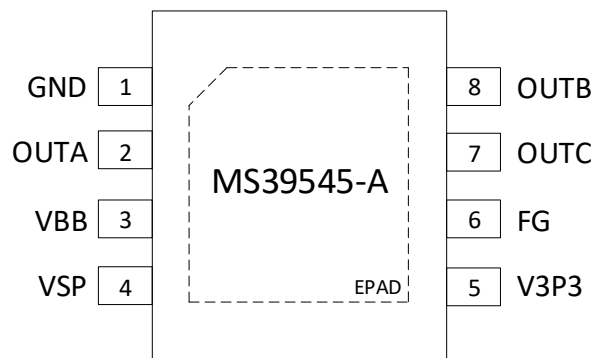
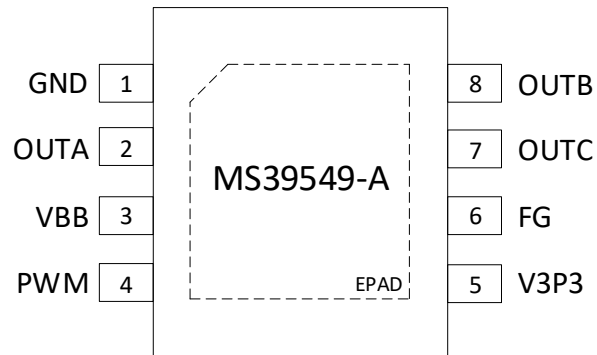
APPLICATIONS

- Fan
- Consumer Products

PRODUCT SPECIFICATIONS

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

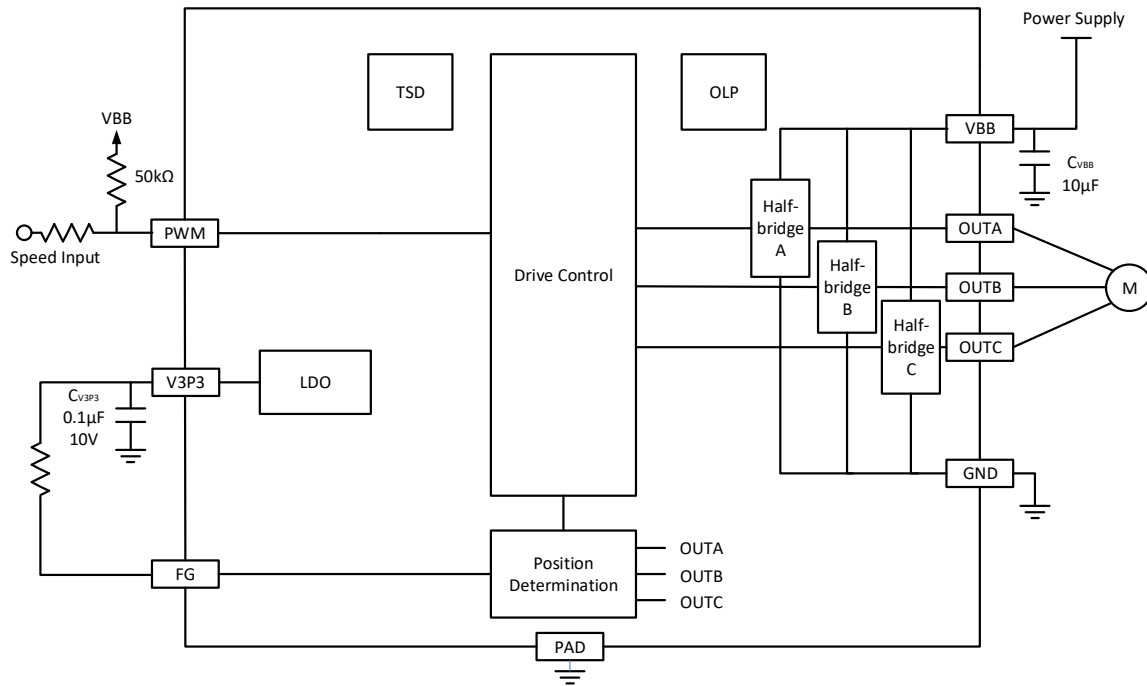
PIN CONFIGURATION



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-A)
	PWM	I	Speed Control Input (MS39549-A)
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}	26	V
Input Logic Voltage	V_{IN}	-0.3 ~ 6	V
FG Voltage-endurance	V_{FG}	26	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, $T_A = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, $V_{BB}=12\text{V}$.

Power Dissipation

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage	V_{BB}		4		24	V
Supply Current	I_{BB}	Normal Operation, $V_{IN}=3\text{V}$, PWM Output		7	10	mA
		Normal Operation, $V_{IN}=3\text{V}$, Zero Output		7.7	10	mA

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Current	I_{IN}	$V_{IN}=3\text{V}$ ($R_{IN}=100\text{k}\Omega$ 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	$\text{k}\Omega$

The MS39549-A 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-A Speed Control (VSP Pin)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
VSP Enabling Voltage	V_{ON}			0.9		V
VSP Enabling Time	t_{ON}	$C_{V3P3}=1\mu\text{F}$	150			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}		17	19	21	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}		11.5	13	14.5	s
Locked-rotor Detection Time	t_{DETECT}			1.5		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-A and the MS39549-A are applied to fans, targeted at applications that require low noise, low vibration and high frequency.

The MS39549-A-PWM Input Mode

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

The MS39545-A-VSP Analog Input Control

The MS39545-A can control motor speed by VSP analog input voltage. A 50k Ω 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 1.55s to reach the maximum current-limiting point.

Slowly start for 6.2s 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

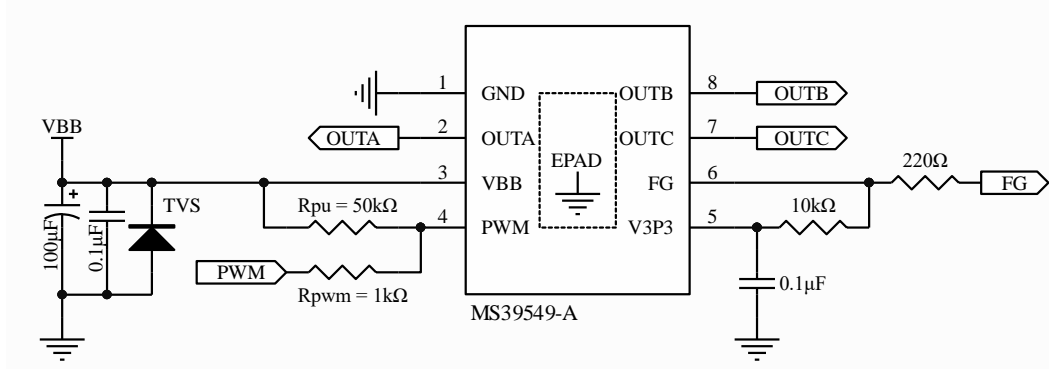
The chip integrates comprehensive protection modes: locked-rotor detection with restart, overcurrent protection, output short-circuit protection, supply undervoltage protection and thermal shutdown.

The chip is featured with locked-rotor protection function. If a locked-rotor state is detected, the chip will disable driver for about 13s, 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

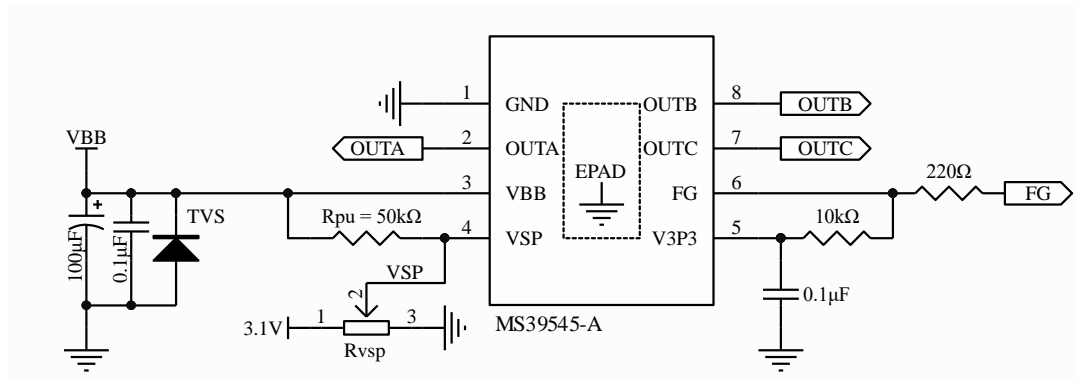
The MS39549-A Application Diagram



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 needs to adjust speed by external PWM signal, R_{pu} is not required.

The MS39545-A Application Diagram



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

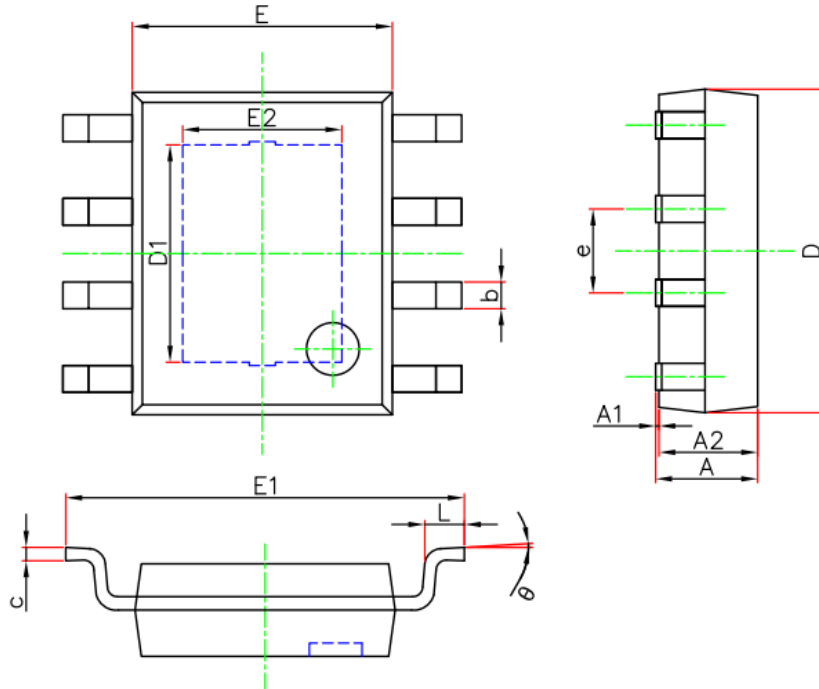
If the system is needed to run at the fastest speed, R_{vsp} is not required. If the system needs to adjust speed by external VSP signal, R_{pu} is not required.

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-A	SOP8/PP	4000	1	4000	8	32000
MS39545-A	SOP8/PP	4000	1	4000	8	32000

STATEMENT

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**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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