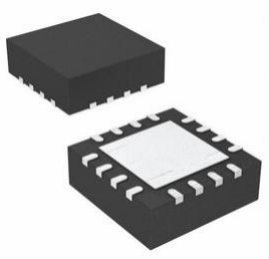
Three Phase Sensorless Sinusoidal BLDC Driver

PRODUCT DESCRIPTION

The MS37549 and MS37545 are three phase sensorless DC pre-drivers, adopting sinusoidal drive method. And the chip is characterized by low noise and small vibration.

Motor speed can be controlled by speed control pin. And power supply can be down to 4V to adjust the speed.

The MS37549 and the MS37545 are in QFN16 package with exposed thermal pad.



QFN16

FEATURES

- 180° Sinusoidal Drive with Low Noise
- External PNMOS
- High-Frequency Control Algorithm
- Sensorless Control
- Analog Speed Control Input (MS37545)
- PWM Speed Control Input (MS37549)
- Sleep Mode
- FG Speed Feedback Output
- Lock Detection Function
- Overcurrent Protection
- Soft Start

APPLICATIONS

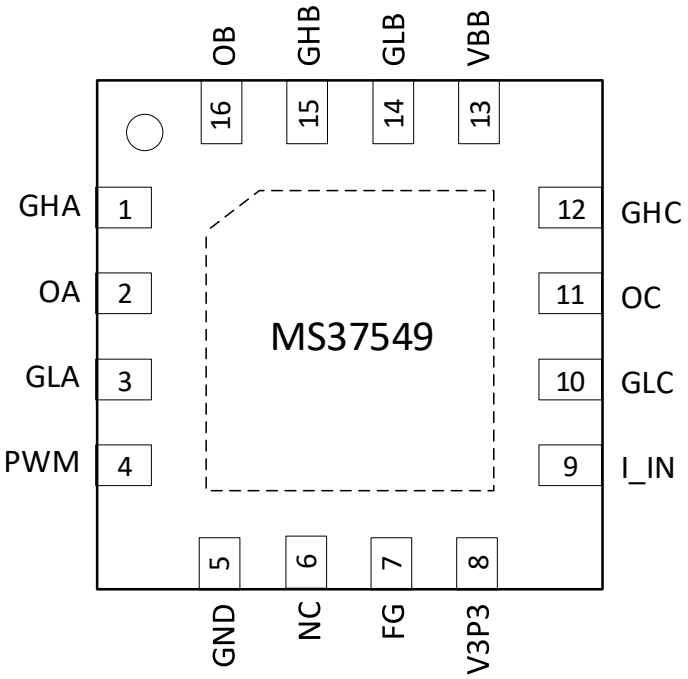
- Fan
- Consumption Type Product

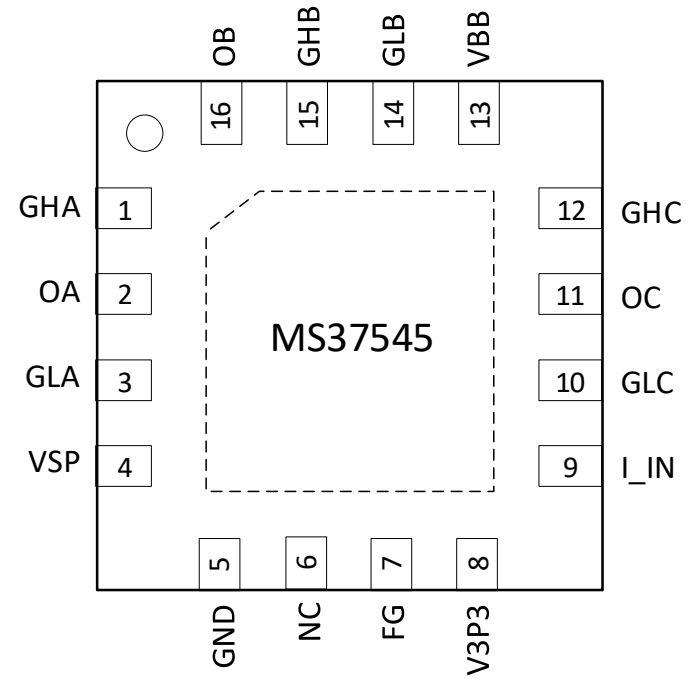
PRODUCT SPECIFICATION

Part Number	Package	Marking
MS37549	QFN16	MS37549
*MS37545	QFN16	MS37545

*The package is not available temporarily. If necessary, please contact Hangzhou Ruimeng Sales Department Center.

PIN CONFIGURATION

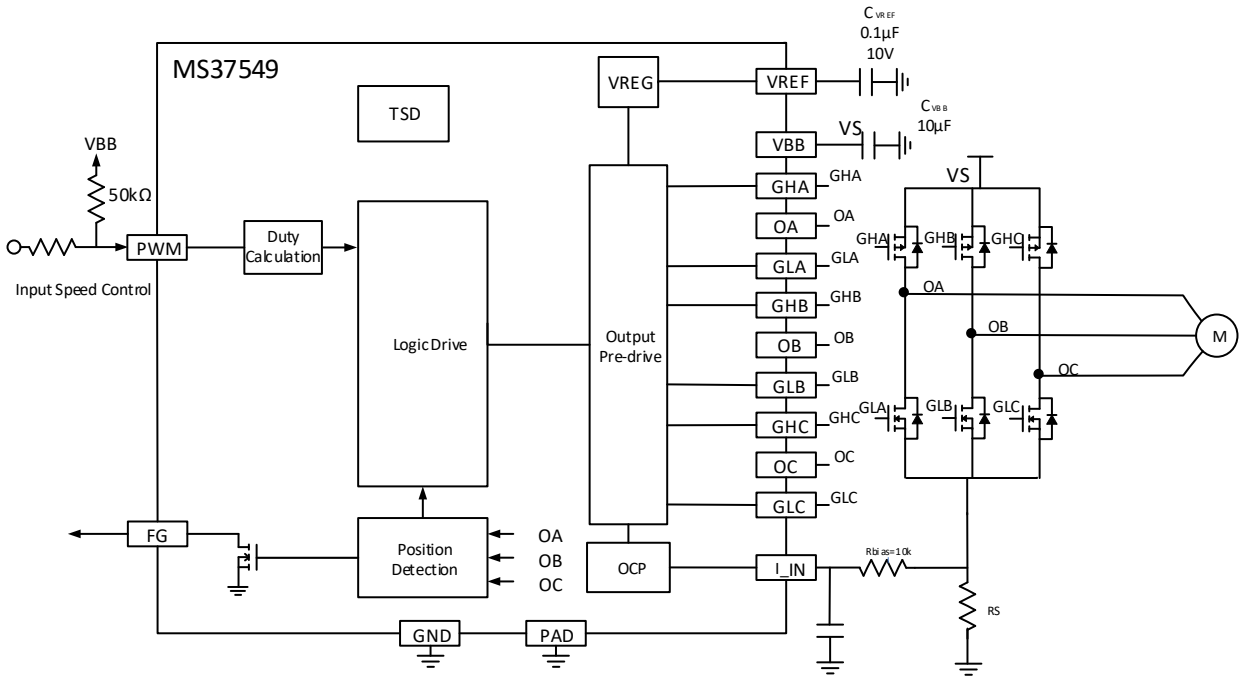




PIN DESCRIPTION

Pin	Name	Type	Description
1	GHA	O	High-side Gate Drive of Half Bridge A
2	OA	I	Output(A) of External Motor
3	GLA	O	Low-side Gate Drive of Half Bridge A
4	PWM	I	Speed Control Input (MS37549)
	VSP	I	Speed Control Input (MS37545)
5	GND	-	Ground
6	NC	-	Not Connect
7	FG	O	Speed Feedback Signal, Open-drain Output
8	V3P3	O	3.3V Output
9	I_IN	I	Current Detect Input
10	GLC	O	Low-side Gate Drive of Half Bridge C
11	OC	I	Output(C) of External Motor
12	GHC	O	High-side Gate Drive of Half Bridge C
13	VBB	-	Power Supply
14	GLB	O	Low-side Gate Drive of Half Bridge B
15	GHB	O	High-side Gate Drive of Half Bridge B
16	OB	I	Output(B) of External Motor

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{BB}	30	V
Input Logic Voltage	V_{IN}	-0.3 ~ 6	V
FG Logic Output	V_{FG}	30	V
FG Logic Output Current	I_{FG}	10	mA
Operating Ambient Temperature	T_A	-40 ~ 125	°C
Storage Temperature	T_{STG}	-65 ~ 150	°C

ELECTRICAL CHARACTERISTICS

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

Power Dissipation

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage	V_{BB}		4		24	V
Supply Current	I_{BB}	Normal Operation,V_{IN}=3V		8	11	mA
Operating Current in Sleep Mode	I_{STB}			<1		μA

Digital Input

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Current	I_{IN}	V_{IN}=3V(R_{IN}=100kΩ Pull-down)		33		μA
Low-Level Input Voltage	V_{IL}				0.8	V
High-Level Input Voltage	V_{IH}		2			V
Logic Input Hysteresis	V_{IHYS}		200	300	600	mV
Input Pull-down Resistance	R_{IN}		50	100	200	kΩ

MS37549 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}		7	7.5	8	%
PWM Input Frequency	f_{PWM}		0.1		100	kHz

MS37545 Speed Control (VSP Pin)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
VSP On-Threshold	V_{ON}			0.95		V
VSP On-Time	t_{ON}	C_{VREF}=1μF	100			μs
VSP Off-Threshold	V_{THOFF}			280		mV
VSP Accuracy	E_{RRVSP}			±6		LSB
VSP Maximum Level	$V_{SP(MAX)}$			3.1		V

Output Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
High-side Gate Drive Voltage	V_{GH}			5		V
Low-side Gate Drive Voltage	V_{GL}			5.8		V
High-side Pull-up Current	I_{GH_PU}			50		mA
Low-side Pull-up Current	I_{GL_PU}			30		mA
High-side Pull-down Current	I_{GH_PD}			50		mA
Low-side Pull-down Current	I_{GH_PD}			30		mA

Protection Circuit

Parameter	Symbol	Condition	Min	Typ	Max	Unit
VBB Undervoltage Lockout (UVLO)	V_{BBUVLO}	V_{BB} Rise		3.7		V
VBB UVLO Hysteresis	$V_{BBUVHYS}$			200		mV
Lock Protection Time	t_{OFF}			8		s
Lock Detection Time	t_{DETECT}			1		s
I_IN Pin Pull Current	$I_{BIAS\_I\_IN}$			50		μA
Internal Current Limiting Reference Voltage	V_{OLP}			1		V
Internal OverCurrent Reference Voltage	V_{OCP}			1.5		V
Thermal Shutdown Temperature (TSD)	T_{TSD}	Temperature Rise		165		°C
Thermal Shutdown Hysteresis	T_{TSDHYS}			20		°C

FUNCTION DESCRIPTIONS

The MS37545 and MS37549 can be applied to fan for the applications, which need low noise, small vibration and high frequency.

Sleep Mode

The sleep mode of MS37549 is controlled by PWM pin. When the PWM input pin is lower than PWM Off-Threshold for more than 36ms, the chip will enter sleep mode. At this time, the power consumption is less than 1μA. When PWM input goes high, the chip will restart immediately.

The sleep mode of MS37545 is controlled by VSP pin.When the VSP input pin is lower than VSP Off-Threshold for more than 36ms, the chip will enter sleep mode. At this time,the dissipation is less than 1μA. When VSP input goes high, the chip will restart immediately.

Speed Control

The fan speed is adjusted through three ways: voltage mode (control power supply), PWM duty cycle input control (MS37549) or analog input control (MS37545). The chip voltage in voltage mode can be decreased to 4V, to meet some specific applications.

MS37545-VSP Pin Analog Input Control

An internal ADC converts input voltage to a value required by speed control (Figure 1). When input voltage is less than V_{THOFF}, the motor outputs are disabled. However when starting, input must reach V_{THON} for t_{ON}. The t_{ON} delay time ensures normal startup of internal power reference and analog model. After the delay, VSP can control operation between V_{THOFF} and full-amplitude (7.5% - 100%). If 100% speed is needed, just directly connect a 50kΩ resistor between VSP pin and power supply.

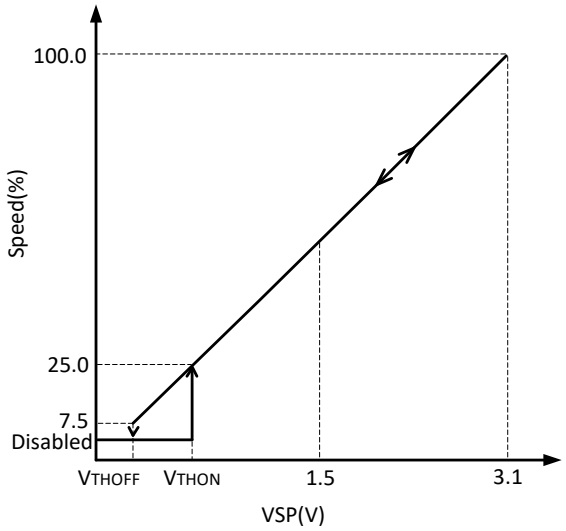


Figure 1. MS37545 Analog Speed Input Characteristic

MS37549-PWM Pin Duty Cycle Input Control

An internal PWM duty cycle measurement mode translates PWM input to required value (9-bit data) to control fan speed. When PWM duty cycle reaches about 10%, the motor drive will start working (Figure 2). PWM input terminal integrates filter to filter some interference signals, which may result in opening or closing chip.

PWM pin integrates a pull-down resistor (100kΩ). And if input pin isn't good connection, the chip will disable output drive directly. If 100% speed is needed, just directly connect a 50kΩ resistor between PWM pin and power supply.

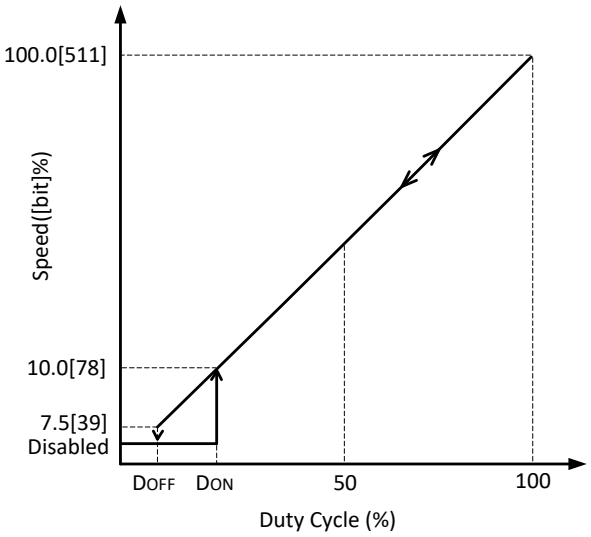


Figure 2. MS37549 PWM Speed Input Characteristic

Power Supply Mode

The motor speed can be controlled by power supply voltage as well. Through the way, just need to connect a 50kΩ resistor between VBB pin and VSP pin (MS37545) or PWM pin (MS37549). The motor driver will be controlled by VBB Undervoltage Lockout. And it is enabled or disabled when power supply is above or under threshold.

Lock Protection

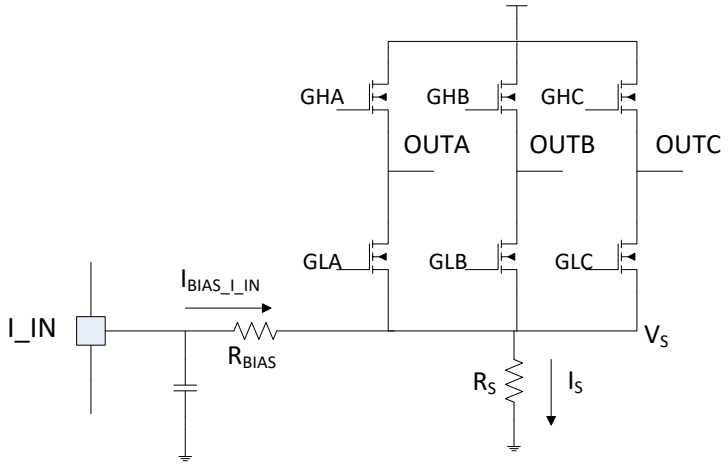
The chip detects current speed and judges whether it's in lock state. If a lock state is detected, the chip will disable drive for t_{OFF}, and try to restart motor after the time.

FG

FG output is open-drain, used to indicate current speed condition. FG changes one period accordingly every time the motor rotates in a circle.

Current Detection and Protection

I_IN pin outputs 50μA current, R_{bias} is used for generating a DC reference to prevent negative voltage.



The relationship between V_{I_IN} and I_S is shown in equation below:

$$V_{I\_IN}=I_{BIAS\_I\_IN}\times R_{BIAS}+I_S\times R_S$$

Recommend to add 0.5V DC offset on I_IN. And R_{BIAS} can be 10kΩ.

Current Limiting function is set as follow. When detecting V_{I_IN} exceeds internal current limiting reference voltage (V_{OLP}), PMOS of this side would be off in remaining PWM period until next period start. V_{OLP} is set as 1V during normal operation.

When detecting V_{I_IN} exceeds internal overcurrent reference voltage (V_{OCP}), the chip would disable output directly. V_{OCP} is set as 1.5V during normal operation.

Soft Start

The soft start function needs to combined with current limiting protection. The reference voltage of current limiting protection can choose fast ramp and slow rape.

Fast Ramp, the reference voltage rises from 0.5V to 1V within 1s after startup.

Slow Ramp, the reference voltage rises from 0.5V to 1V within 4s after startup.

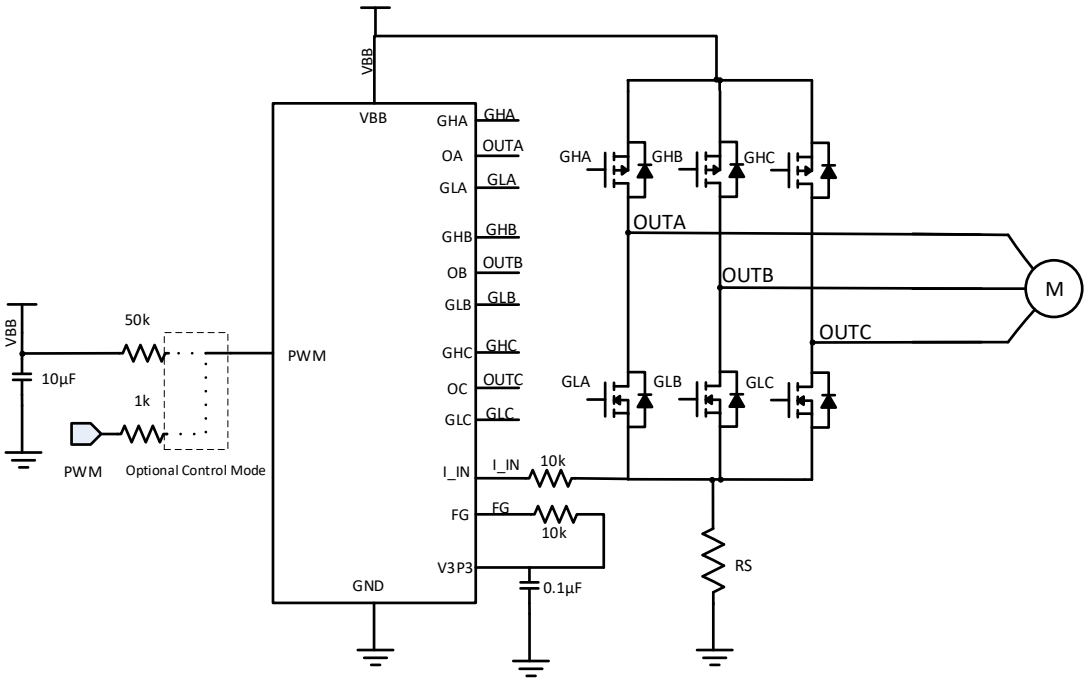
Combined with internal current limiting protection, only require to adjust R_S and R_{BIAS}, accordingly achieve an appropriate soft start process.

Protection Mode

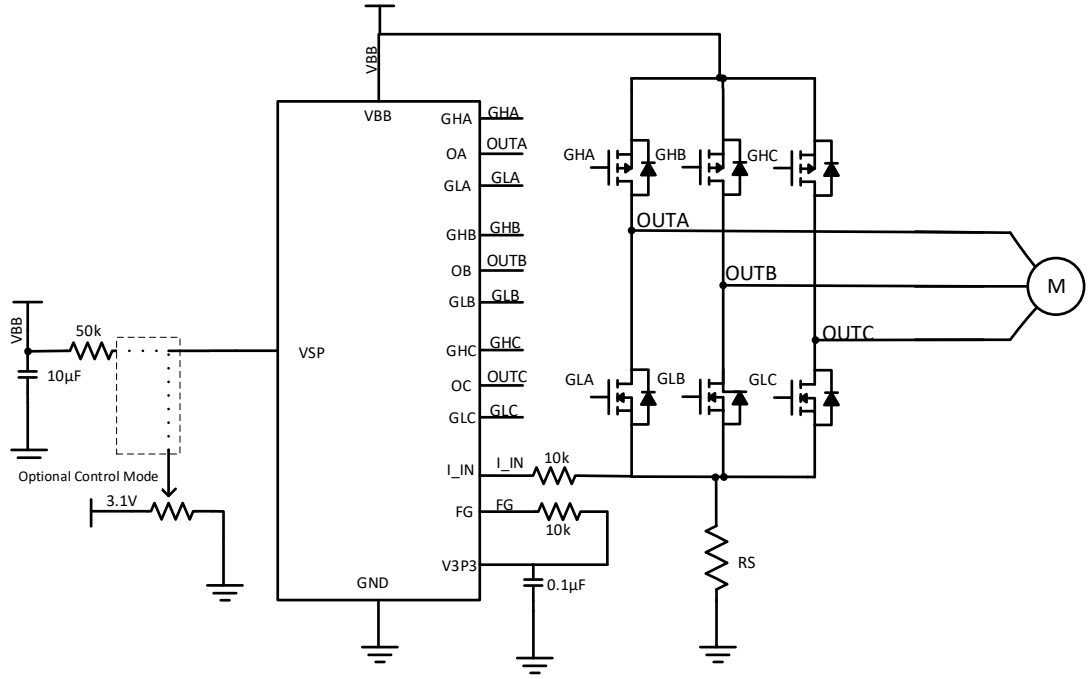
The chip has perfect protection mode: lock detection with restart, overcurrent protection, output short circuit protection, power supply undervoltage lockout and thermal shutdown.

TYPICAL APPLICATION DIAGRAM

MS37549

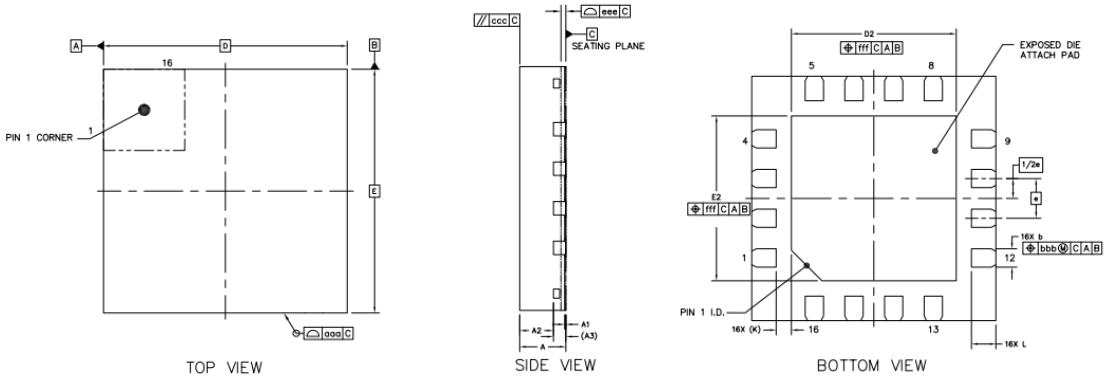


MS37545



PACKAGE OUTLINE DIMENSIONS

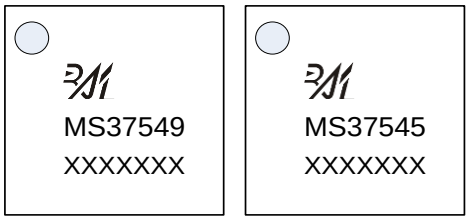
QFN16



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	0.7	0.75	0.8
A1	0.000	0.02	
A2		0.55	
A3		0.203REF	
b	0.25	0.3	0.35
D		4	
E		4	
e		0.65	
D2	2.6	2.7	2.8
E2	2.6	2.7	2.8
L	0.3	0.4	0.5
K		0.25REF	
aaa		0.1	
ccc		0.1	
eee		0.08	
bbb		0.1	
fff		0.1	

MARKING and PACKAGING SPECIFICATION

1. Marking Drawing Description



Product Name: MS37549, MS37545

Product Code: XXXXXXX

2. Marking Drawing Demand

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

3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece /Box	Box/Carton	Piece/Carton
MS37549	QFN16	4000	1	4000	8	32000
MS37545	QFN16	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.

+86-571-89966911

Rm701, No.9 Building, No. 1 WeiYe Road, Puyan Street, Binjiang District, Hangzhou, Zhejiang

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