

## Lens Driver for Digital Camera

### PRODUCT DESCRIPTION

The MS35009 is a motor driver chip for digital camera lens system. It can meet complicated and low-noise lens driver system due to microstep feature. It integrates microstep drive function control module and greatly reduces CPU power dissipation. In addition, the MS35009 integrates DC motor and voice coil motor and can meet differential lens systems.

### FEATURES

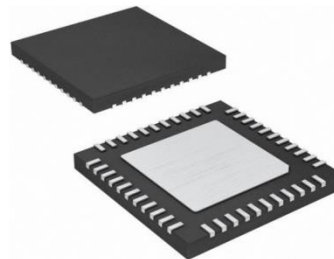
- 7 Channels H-bridge Drivers, Maximum Current  $\pm 0.8A$
- SPI (Serial Peripheral Interface)
- Load Voltage Range 2.7~5.5V
- QFN44 package

### APPLICATIONS

- Digital Camera

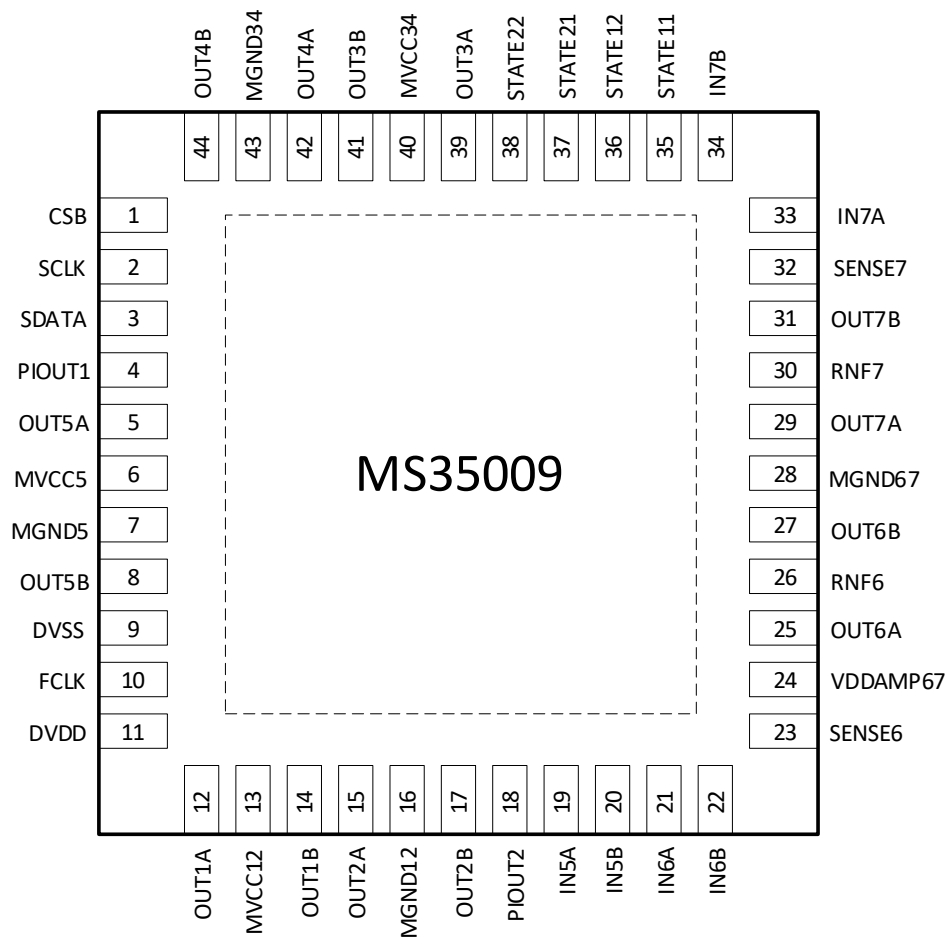
### PRODUCT SPECIFICATION

Part Number	Package	Marking
MS35009	QFN44	MS35009



QFN44

## PIN CONFIGURATION

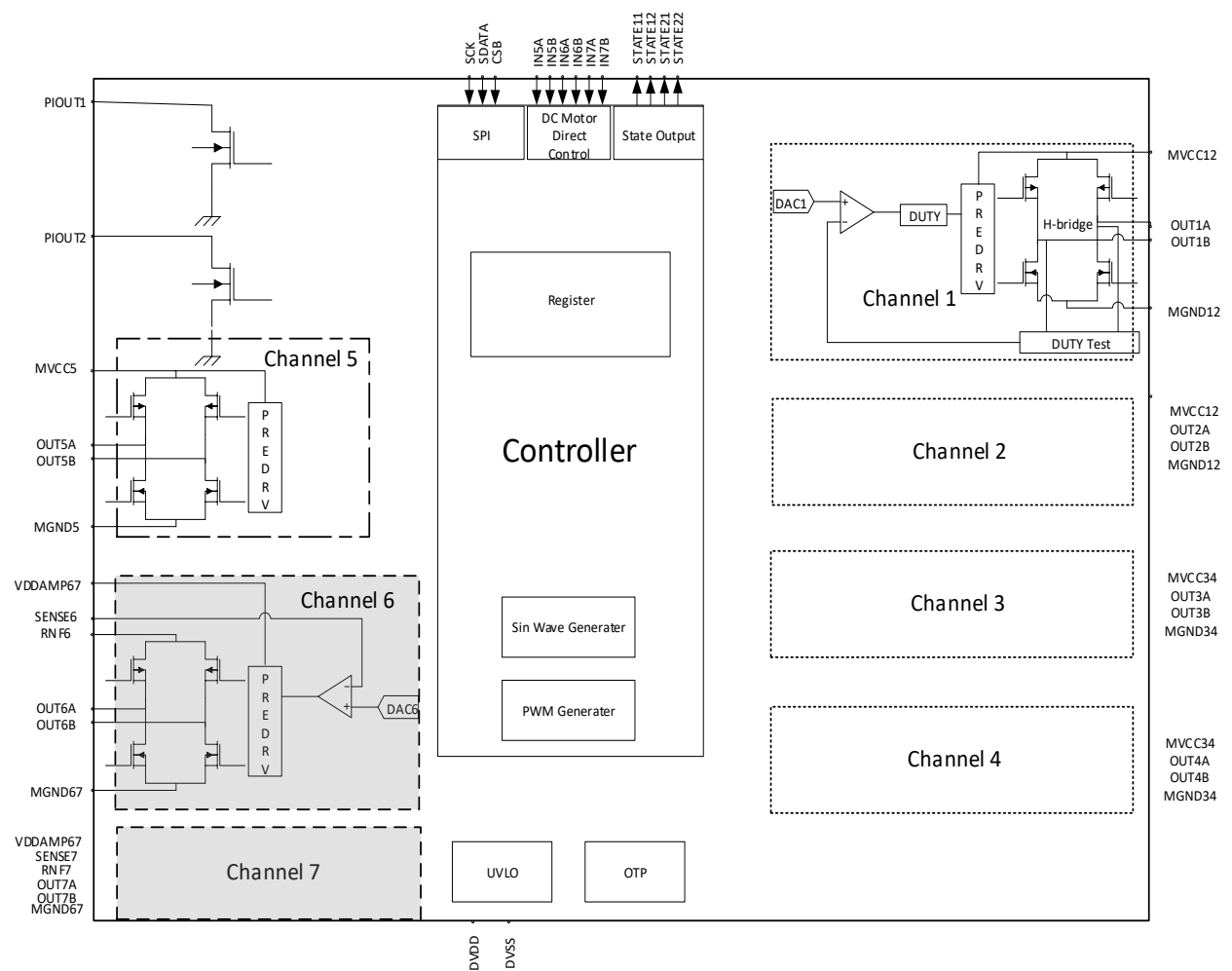


## PIN DESCRIPTION

Pin	Name	Type	Description
1	CSB	I	SPI Chip Select Input
2	SCLK	I	SP Clock Input
3	SDATA	I	SP Data Input
4	PIOUT1	O	PI Open-drain Output 1
5	OUT5A	O	Channel 5 Output
6	MVCC5	-	Channel 5 Power Supply
7	MGND5	-	Channel 5 Ground
8	OUT5B	O	Channel 5 Output
9	DVSS	-	Digital Ground
10	FCLK	I	Clock Reference
11	DVDD	-	3.3V Digital Power Supply
12	OUT1A	O	Channel 1 Output
13	MVCC12	-	Channel 12 Power Supply
14	OUT1B	O	Channel 1 Output
15	OUT2A	O	Channel 2 Output
16	MGND12	-	Channel 12 Ground
17	OUT2B	O	Channel 2 Output
18	PIOUT2	O	PI Open-drain Output 2
19	IN5A	I	Channel 5 External Input
20	IN5B	I	Channel 5 External Input
21	IN6A	I	Channel 6 External Input
22	IN6B	I	Channel 6 External Input
23	SENSE6	IO	Channel 6 Sense Pin
24	VDDAMP67	-	Channel 67 Control Power Supply
25	OUT6A	O	Channel 6 Output
26	RNF6	-	Channel 6 Power Supply
27	OUT6B	O	Channel 6 Output

Pin	Name	Type	Description
28	MGND67	-	Channel 67 Ground
29	OUT7A	O	Channel 7 Output
30	RNF7	-	Channel 7 Power Supply
31	OUT7B	O	Channel 7 Output
32	SENSE7	IO	Channel 7 Sense Pin
33	IN7A	I	Channel 7 External Input
34	IN7B	I	Channel 7 External Input
35	STATE11	O	State Output 11
36	STATE12	O	State Output 12
37	STATE21	O	State Output 21
38	STATE22	O	State Output 22
39	OUT3A	O	Channel 3 Output
40	MVCC34	-	Channel 34 Power Supply
41	OUT3B	O	Channel 3 Output
42	OUT4A	O	Channel 4 Output
43	MGND34	-	Channel 34 Ground
44	OUT4B	O	Channel 4 Output

## 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.  $T=25^{\circ}\text{C}$ , unless otherwise noted.

Parameter	Symbol	Ratings	Unit
Analog, Control Power Supply	DVDD	-0.3 ~ +4.5	V
Motor Control Power Supply 1	MVCCA MVCCB	-0.3 ~ +7.0	V
Input Voltage	$V_{\text{IN}}$	-0.3 ~ DVDD+0.3	V
H-bridge Current <sup>1</sup>	$I_{\text{M1}(1234)}$	$\pm 0.5$	A/ch
H-bridge Current <sup>2</sup>	$I_{\text{M1}(567)}$	$\pm 0.8$	A/ch
DC Motor Drive	$I_{\text{M1}(E)}$	$\pm 0.5$	A/ch
Operating Temperature	$T_{\text{A}}$	-40 ~ +85	$^{\circ}\text{C}$
Storage Temperature	$T_{\text{STG}}$	-55 ~ +125	$^{\circ}\text{C}$
ESD(HBM)	$V_{\text{ESD}}$	$>\pm 2\text{k}$	V

Note:

1. Maximum operating duration current for channel 1, 2, 3, 4.
2. Maximum operating duration current for channel 5, 6, 7.

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Range			Unit
		Min	Typ	Max	
Power Supply <sup>1</sup>	DVDD	2.7	3	3.6	V
	MVCC	2.7	5	5.5	V
Reference Frequency <sup>2</sup>	$f_{\text{CLK}}$	1		27.5	MHz

Note:

1. Each power needs to be supplied in use. Otherwise, undervoltage protection is triggered and the chip stops operating.
2. Use differential  $f_{\text{CLK}}$  inputs, note the setting of clock register to make  $f_{\text{MAIN}}$  near 24MHz.

## ELECTRICAL CHARACTERISTICS

MVCC=5V, DVDD=3.3V, DVSS=MGND=0. Unless other noted,  $T_A=25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ .

### Current Consumption

Parameter	Symbol	Condition	Min	Typ	Max	Unit
DVDD Current When Standby	$I_{SSD}$	CDM_res=0		0.45	1.5	mA
MVCC Current When Standby	$I_{SSVM}$	CDM_res=0		50	100	$\mu\text{A}$
DVDD Current When Active	$I_{CC2}$	$I_{DDD}$		6	10	mA

### Digital Input and Output

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Low-level Input Voltage	$V_{IL}$		DVSS		$0.3 \times \text{DVDD}$	V
High-level Input Voltage	$V_{IH}$		$0.7 \times \text{DVDD}$		DVDD	V
Low-level Input Current	$I_{IL}$	$V_{IL}=\text{DVSS}$	0		10	$\mu\text{A}$
High-level Input Current	$I_{IH}$	$V_{IL}=\text{DVDD}$	0		10	$\mu\text{A}$
Low-level Output Voltage	$V_{OL}$	Sink current $I_O=1\text{mA}$	DVSS		$0.2 \times \text{DVDD}$	V
High-level Output Voltage	$V_{OH}$	Source current $I_O=-1\text{mA}$	$0.8 \times \text{DVDD}$		DVDD	V

### Voltage-Type Output Driver (Channel 1,2,3,4)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On-Resistance	$R_{ON}$	$I_{OUT}=\pm 100\text{mA}$ , Up+Down		1.5	2	$\Omega$
Off Leakage Current	$I_{OZ}$		-10		10	$\mu\text{A}$
Differential Voltage Accuracy between Different Outputs	$V_{DIFF}$	Differential voltage register setting 010-1011	-5		+5	%

### Voltage -Type Output Driver (Channel 5)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On-Resistance	$R_{ON}$	$I_{OUT}=\pm 100\text{mA}$ , Up+Down		1.1	1.5	$\Omega$
Off Leakage Current	$I_{OZ}$		-10		10	$\mu\text{A}$

### Current-Type Output Driver (Channel 6,7)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On-Resistance	$R_{ON}$	$I_{OUT}=\pm 100\text{mA}$ , Up+Down		1.1	1.5	$\Omega$
Off Leakage Current	$I_{OZ}$		-10		10	$\mu\text{A}$
Output Current	$I_O$	DAC Setting 1000-0000, $R_F=1\Omega$	180	200	210	mA

**PI Output**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
PI Output Voltage	$V_{PIO}$	Sink current $I_{IH}=30mA$		0.16	0.50	V

**Over Temperature Protection**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Over Temperature Protection	$T_{TSD}$			157		°C
Over Temperature Protection Hysteresis	$\Delta T_{TSD}$			32		°C

**Power Supply Monitor Circuit**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
DVDD Reset	$V_{RSTON}$			2.0		V
DVDD Reset Hysteresis	$V_{RSTHYS}$			0.1		V



## FUNCTION DESCRIPTION

### 1. System Module

#### Stepper Motor Driver (Channel 1 to 4)

The MS35009 has built-in microstep PWM driving mode and It can drive two stepper motors at most.

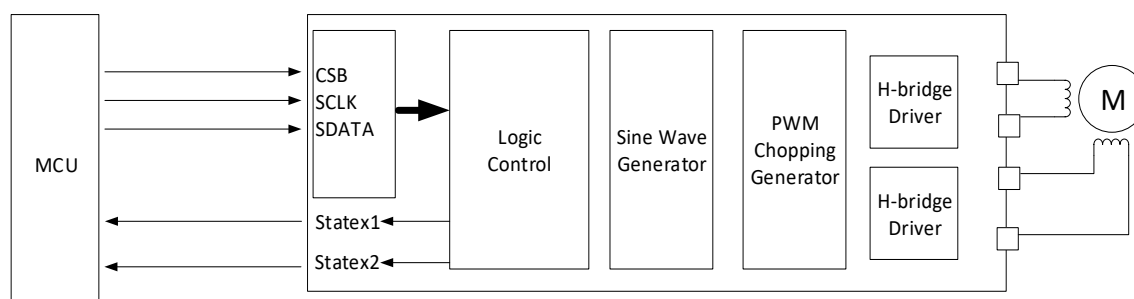
Built-in the voltage feedback circuit of D-class type.

Channel 3 and channel 4 can be used as DC motor or voice coil motor drivers.

Select the appropriate microstep mode of 1024, 1/2 phase or 2 phase mode with setting corresponding registers. In addition, system has command buffer. When motor is operating current command, following commands can be set and motor can operate continuously.

The operating status indication ACT and the rotation position information MO, can be read out from STATExx pin.

The control diagram is as below:

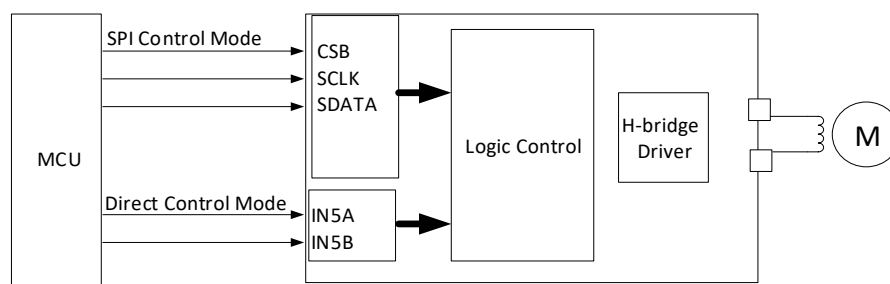


#### DC Motor Driver (Channel 5)

DC motor driver is a voltage-type PWM chopping control.

The motor driver can set registers by SPI. And due to external direct control pin, the motor driver can also be controlled by external pin. Or it is controlled by mixed control.

The control diagram is as below:



#### Current-Type DC Driver (Channel 6,7)

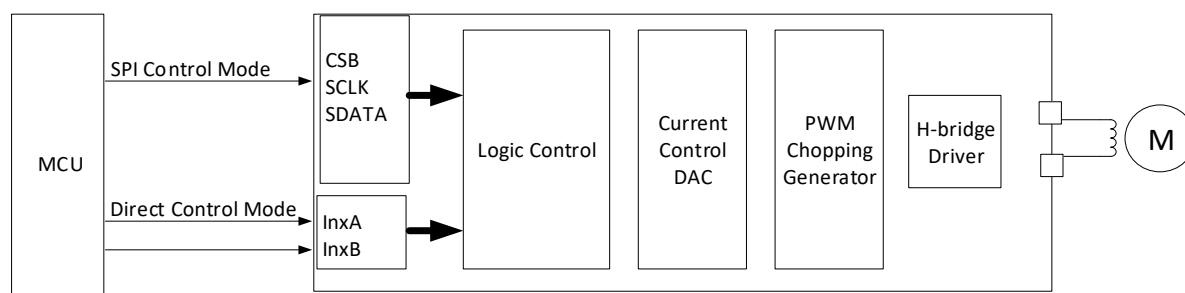
Channel 6,7 are current-type output driver with constant current mode

The output current of motor is decided by the voltage of RNF pin and the RNF resistance. Built-in high-precision comparator to make current stable.

If parasitism resistance exist on REF pin, it will affect current accuracy for special attention.

The current-type driver sets registers by SPI and is also controlled by external input pin.

The control diagram is as below:



## 2. SPI Interface

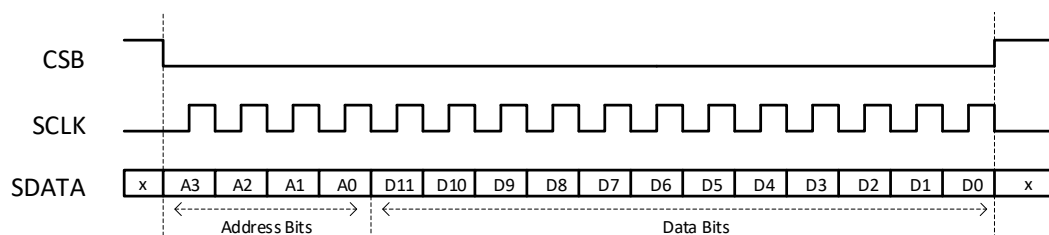
### 3-wire SPI interface

Control command consists of 16bit serial data and enter from CSB, SCLK and SDATA pins. The four MSBs are address bits and other 12bits are data bits.

Each bit input from SDATA pin is read on the rising edge of SCLK.

When CSB is low-level, data write is valid. But loading timing of differential registers is different.

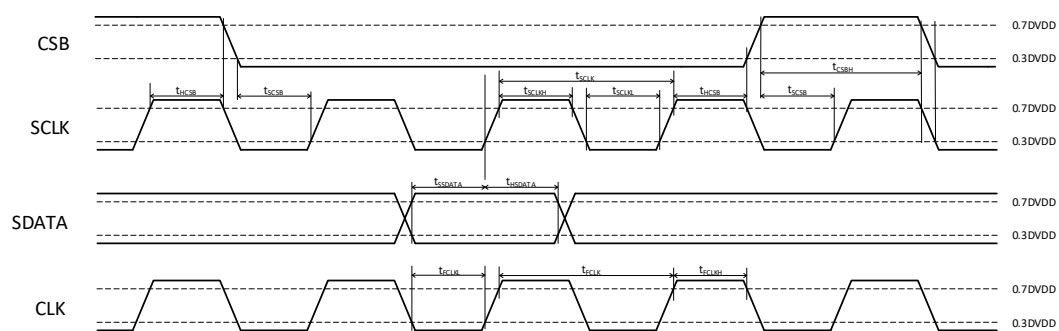
Different registers' loading time can be different. For more details please refer to note 6.



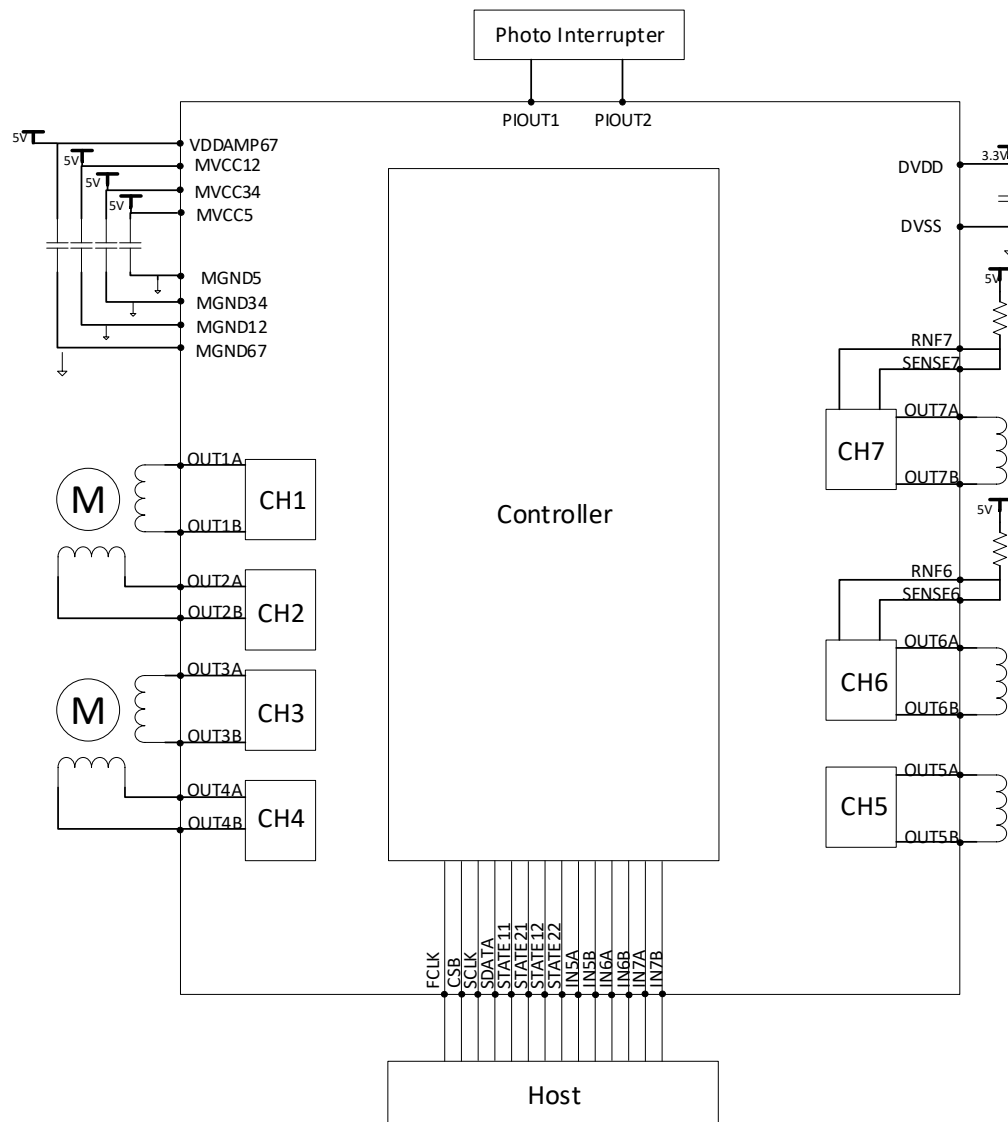
### Timing Table

Unless other noted,  $T_A=25^{\circ}\text{C}$ ,  $\text{DVDD} = 3.3\text{V}$ .

Parameter	Symbol	Specification
SCLK Input Cycle	$t_{\text{SCLK}}$	> 125ns
SCLK Low-level Time	$t_{\text{SCLKL}}$	> 50ns
SCLK High-level Time	$t_{\text{SCLKH}}$	> 50ns
SDATA Setup Time	$t_{\text{SSDATA}}$	> 50ns
SDATA Setup Time	$t_{\text{HSDATA}}$	> 50ns
CSB High-level Time	$t_{\text{SCLK}}$	> 380ns
SDATA Setup Time	$t_{\text{SCSB}}$	> 50ns
CSB Hold Time	$t_{\text{HCSB}}$	> 50ns
FCLK Input Cycle	$t_{\text{SCLK}}$	> 36ns
FCLK Low-level Time	$t_{\text{FCLKL}}$	> 18ns
FCLK High-level Time	$t_{\text{FCLKH}}$	> 18ns

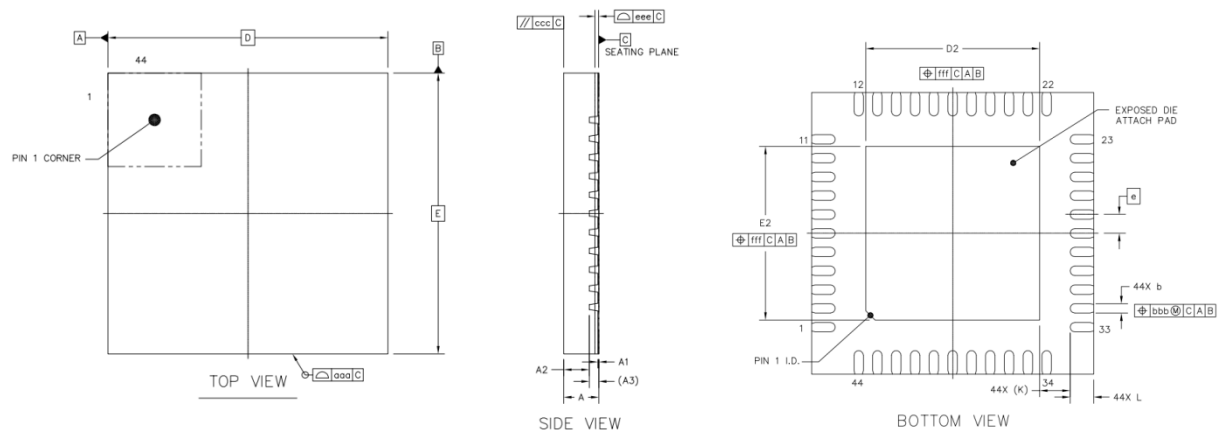


## APPLICATION DIAGRAM



# PACKAGE OUTLINE DIMENSIONS

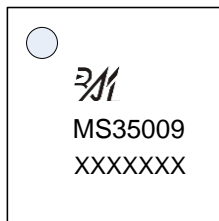
QFN44(0606X0.75-0.4)



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	0.7	0.75	0.8
A1	0	0.02	0.05
A2		0.55	
A3	0.203REF		
b	0.15	0.2	0.25
D	6 BSC		
E	6 BSC		
e	0.4 BSC		
D2	3.6	3.7	3.8
E2	3.6	3.7	3.8
L	0.4	0.5	0.6
K	0.65REF		
aaa	0.1		
ccc	0.1		
eee	0.08		
bbb	0.07		
fff	0.1		

## MARKING and PACKAGING SPECIFICATION

### 1. Marking Drawing Description



Product Name: MS35009

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
MS35009	QFN44	4000	1	4000	8	32000

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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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