

## Three Half-H-Bridge Driver

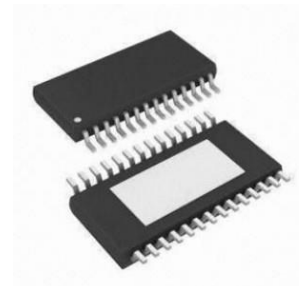
### PRODUCT DESCRIPTION

The MS8313 provides three independently controllable half-H-bridge drivers. It can be used to drive solenoids or other loads, mainly to drive a three-phase brushless DC motor. Each output driver channel includes N-channel power MOSFET configured by half-bridge. The MS8313 allows independent external current detection by connecting PGNDx to a SENSE resistance.

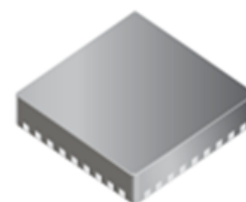
The MS8313 integrates a general comparator, which can be used as current limit circuit or other function circuit.

The MS8313 provides 2.5A peak current or 1.75A maximum continuous output current on each channel of half-bridge.

The chip has the functions of overcurrent protection, short-circuit protection, undervoltage protection and overtemperature protection.



eTSSOP28



QFN36

### FEATURES

- Three Half-H-Bridge Drivers
- Drive Three-Phase Brushless DC Motor
- Independent Half-Bridge Control
- Used for Low-side Current Detection Pin
- Low On-resistance of Power MOS
- Maximum Peak Current: 2.5A @24V, 25°C
- Built-in Comparator
- Built-in 3.3V,10mA Low Voltage Drop Regulator (LDO)
- Power Supply: 8V-36V
- Small Package with Thermal Pad

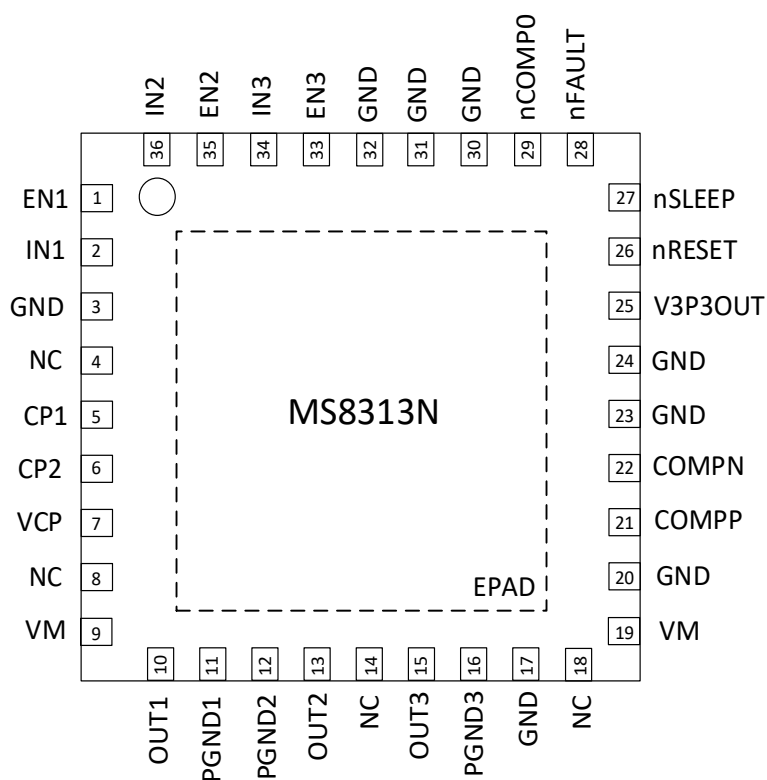
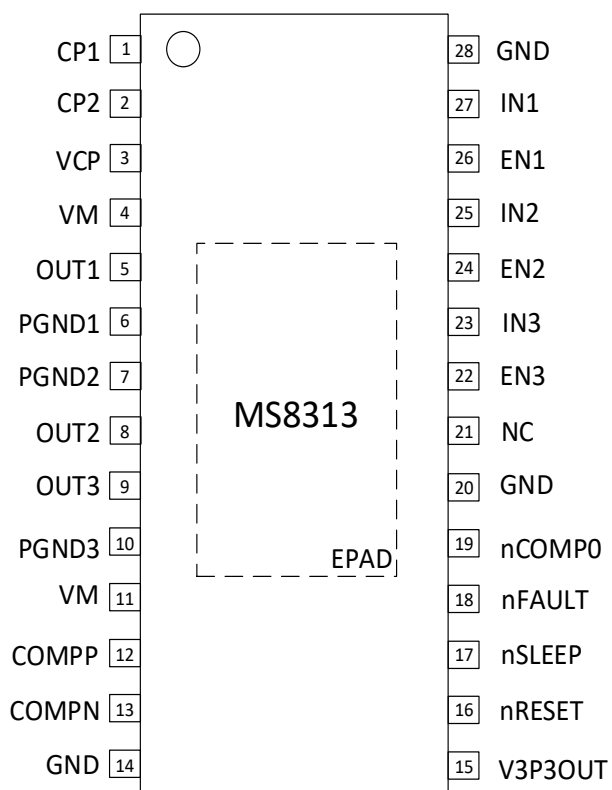
### APPLICATIONS

- HVAC Motor
- Consumer Products
- Office Automation Device
- Factory Automation
- Robot

### PRODUCT SPECIFICATION

Part Number	Package	Marking
MS8313	eTSSOP28	MS8313
MS8313N	QFN36	MS8313N

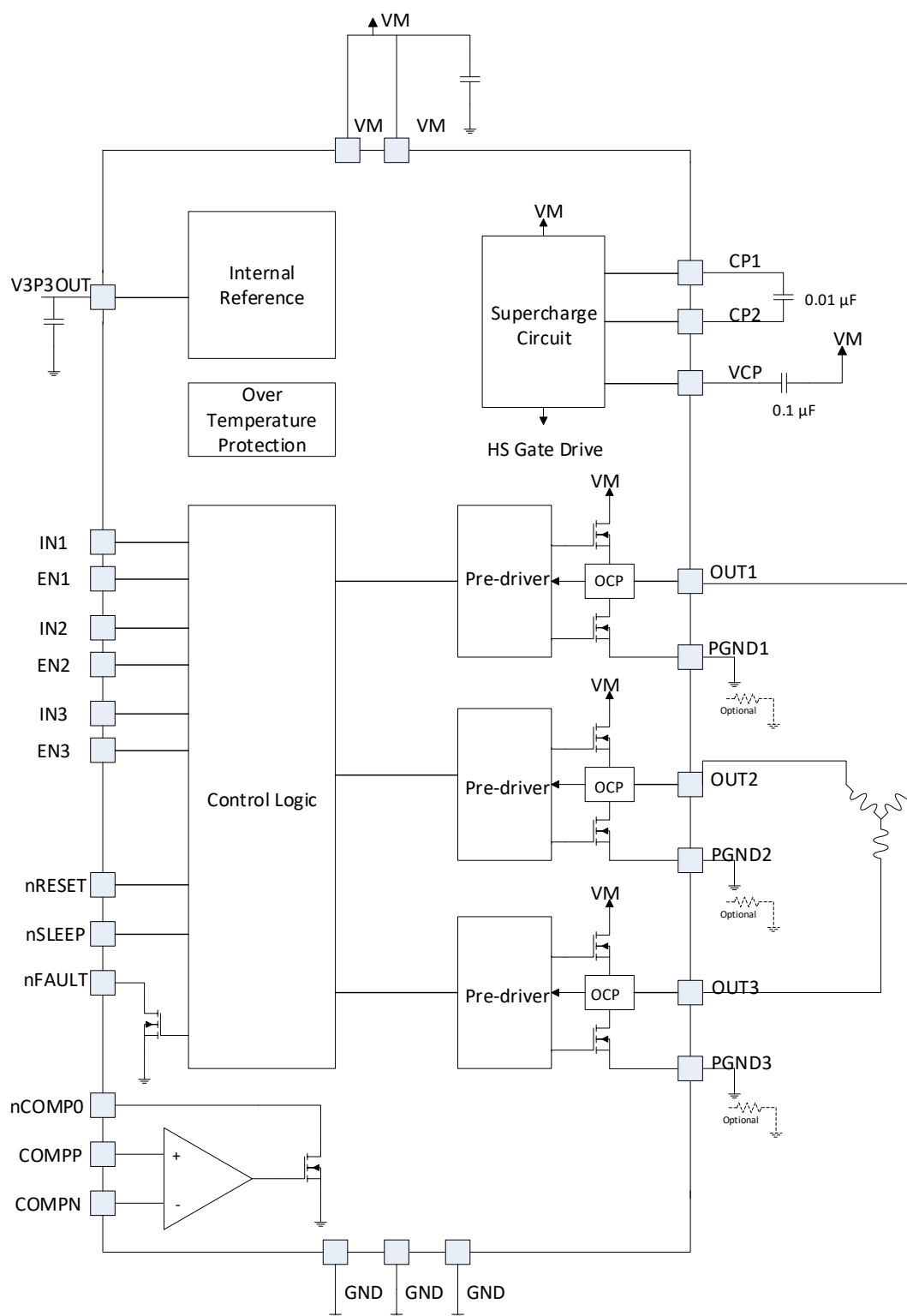
## PIN CONFIGURATION



## PIN DESCRIPTION

Pin		Name	Type	Description
MS8313	MS8313N			
1	5	CP1	IO	Charge Pump External Capacitance
2	6	CP2	IO	Charge Pump External Capacitance
3	7	VCP	IO	High-side Gate Drive Voltage
4, 11	9,19	VM	-	Power Supply
5	10	OUT1	O	Half Bridge OUT1
6	11	PGND1	-	Lower-side FET Source of Half Bridge OUT1
7	12	PGND2	-	Lower-side FET Source of Half Bridge OUT2
8	13	OUT2	O	Half Bridge OUT2
9	15	OUT3	O	Half Bridge OUT3
10	16	PGND3	-	Lower-side FET Source of Half Bridge OUT3
12	21	COMPP	I	Positive Input of Built-in Comparator
13	22	COMP_N	I	Negative Input of Built-in Comparator
14, 20, 28	3, 17, 20, 23, 24, 30, 31, 32	GND	-	Ground
15	25	V3P3OUT	O	Built-in 3.3V LDO Output
16	26	nRESET	I	Reset Input
17	27	nSLEEP	I	Sleep Input
18	28	nFAULT	OD	Fault Indication Pin, Open Drain Output
19	29	nCOMP0	OD	Comparator Output, Open Drain Output
21	4, 8, 18, 14	NC	-	Not Connection
22	33	EN3	I	Channel 3 Enable
23	34	IN3	I	Channel 3 Data In
24	35	EN2	I	Channel 2 Enable
25	36	IN2	I	Channel 2 Data In
26	1	EN1	I	Channel 1 Enable
27	2	IN1	I	Channel 1 Data In
-	-	EPAD	-	Thermal Pad, Recommend to connect with ground

## 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	Range	Unit
Power Supply	$V_M$	-0.3 ~ 40	V
Digital Port Voltage Range	$V_{DIN}$	-0.5 ~ 7	V
Comparator Input Voltage Range	$V_{CIN}$	-0.5 ~ 7	V
Pin Voltage (PGND1, PGND2, PGND3)	$V_{PGND}$	$\pm 600$	mV
Maximum Continuous Output Current	$I_{con}$	1.75	A
Operating Temperature	$T_A$	-40 ~ 125	°C
Storage Temperature	$T_{STG}$	-65 ~ 150	°C

## ELECTRICAL CHARACTERISTICS

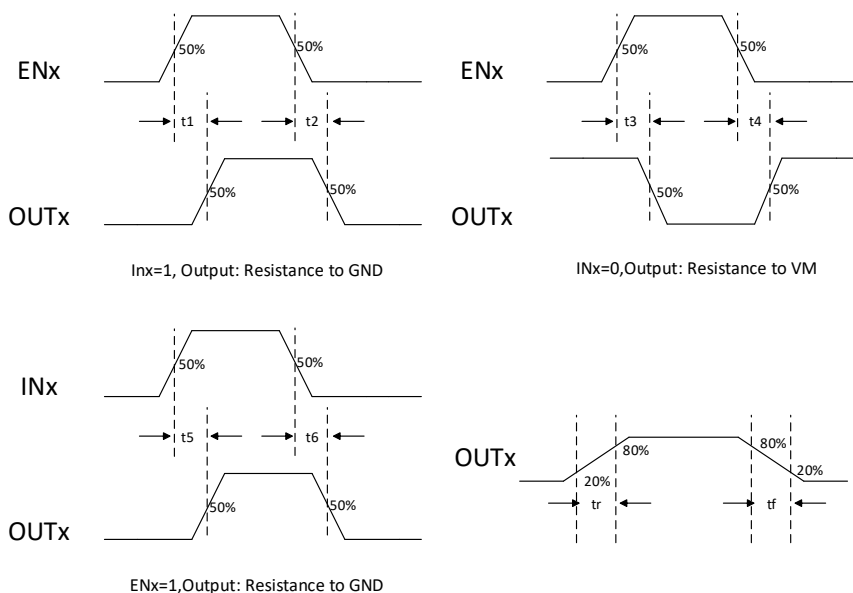
### Electrical Parameters

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Supply	$V_M$		6.5		36	V
PGNDx Pin Voltage	$V_{PGNDX}$		-500		500	mV
Built-in LDO Driving Current	$I_{LDO}$		0		10	mA
Built-in LDO Output Voltage	$V_{3P3}$	$I_{OUT}=0$ to 10mA	3.1		3.52	V
Operating Supply Current	$I_{VM}$	$V_M=24V$ , $f_{PWM}<50kHz$		1	5	mA
Sleep Mode Current	$I_{VMQ}$	$V_M=24V$		500	800	$\mu A$
Undervoltage Protection Voltage	$V_{UVLO}$			6.3	8	V
<b>Logic Input</b>						
High-level Logic Input Voltage	$V_{IH}$		2.2		5.25	V
Low-level Logic Input Voltage	$V_{IL}$			0.6	0.7	V
Hysteresis Window	$V_{HYS}$		50		600	mV
Logic Input Low Current	$I_{IL}$	$V_{IN}=0$	-5		5	$\mu A$
Logic Input High Current	$I_{IH}$	$V_{IN}=3.3V$			100	$\mu A$
Pull-down Resistance	$R_{PD}$			80		k $\Omega$
<b>nFAULT and nCOMP0 Output (Open Drain Output)</b>						
Output Low Voltage	$V_{OL}$	$I_O=5mA$			500	mV
Output High Current	$I_{OH}$	$V_O=3.3V$			1	$\mu A$
<b>Comparator</b>						
Common-mode Voltage Range	$V_{CM}$		0		5	V
Input Offset Voltage	$V_{IO}$		-7		7	mV
Input Current	$I_{IB}$		-300		300	nA
Response Time	$t_R$				2	$\mu s$
<b>H-bridge Output FET</b>						
High-side FET On-resistance	$R_{dson}$	$V_M=24V$ , $I_O=1A$ , $T_J=25^\circ C$		0.24		$\Omega$
		$V_M=24V$ , $I_O=1A$ , $T_J=85^\circ C$		0.29	0.39	$\Omega$
Low-side FET On-resistance	$R_{dson}$	$V_M=24V$ , $I_O=1A$ , $T_J=25^\circ C$		0.24		$\Omega$
		$V_M=24V$ , $I_O=1A$ , $T_J=85^\circ C$		0.29	0.39	$\Omega$
Off-state Leakage Current	$I_{OFF}$		-2		2	$\mu A$
Dead Time	$t_{DEAD}$			100		ns
<b>Protection Circuit</b>						
Overcurrent Protection	$I_{OCP}$		3			A
Overcurrent protection Detection Time	$t_{OCP}$			6		$\mu s$
Thermal Shutdown	$T_{TSD}$		150	160	180	$^\circ C$

### Switch Characteristics

 $V_M=24V$ ,  $R_L=20\Omega$ ,  $T_A=25^\circ C$ 

Symbol	Description	Min	Max	Unit
t1	Delay Time from ENx High to OUTx High, INx=1	130	330	ns
t2	Delay Time from ENx Low to OUTx Low, INx=1	275	475	ns
t3	Delay time from ENx High to OUTx Low, INx=0	100	300	ns
t4	Delay time from ENx Low to OUTx High, INx=0	200	400	ns
t5	Delay time from INx High to OUTx High, ENx=1	300	500	ns
t6	Delay time from INx Low to OUTx Low, ENx=1	275	475	ns
tr	Output Rise Time	30	150	ns
tf	Output Fall Time	30	150	ns



## FUNCTION DESCRIPTION

### Output Stage

The MS8313 includes three half-H-bridge drivers. In addition, the source stages of each half-bridge low-side FETs are independent ports (PGND1, PGND2, PGND3). The current detection function can be realized by grounding the resistance through these ports. If the detection resistor is connected in application, must ensure that the PGNDx port voltage does not exceed  $\pm 500\text{mv}$ .

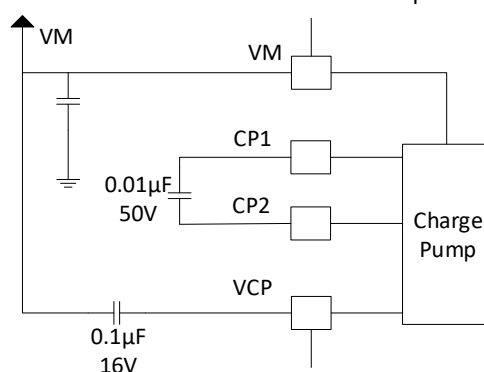
## Channel Control Timing

The state of output OUTx is controlled by input signal of INx, and ENx input signal controls the channel OUTx to close or open. The timing sequence is as follows:

INx	ENx	OUTx
X	0	Z
0	1	L
1	1	H

## Charge Pump

Because the output stages use N-channel FETs, the gate-drive voltage should be higher than  $V_M$  to make the FETs fully open. The MS8313 integrates charge pump circuit to generate high voltage. During normal operation, the charge pump circuit needs to be connected with two capacitors, as shown in the figure below:



When entering sleep mode, the charge pump is turned off.

### Built-in Comparator

The MS8313 integrates a comparator, which can be used for current limit or other functions.

## nRESET Control Function

When nRESET pin is low, the chip is reset. At the same time, all output channels will be closed, and the input signal will not affect the output. There is a power-on reset circuit internally, so there is no need to drive nRESET pin at power-on reset.

### **nSLEEP Control Function**

When the nSLEEP pin is low, the chip enters the low-power-dissipation sleep mode. In this state, the output will be turned off (high-impedance state), the charge pump will also be turned off, and all internal logic reset (including fault signals). In this mode, output will not be affected by input signal until nSLEEP signal becomes high. When entering working mode from sleep mode, it takes about 1ms, and the output drive reaches the working state. It should be noted that in the sleep mode, the internal 3.3V LDO will remain operation.

### **Protection Circuit**

The MS8313 has the functions of undervoltage protection, overcurrent protection and overtemperature protection.

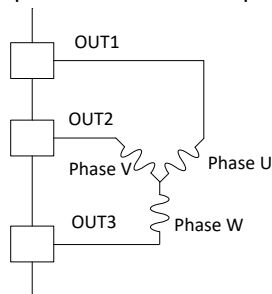
The overcurrent protection of the MS8313 includes two processes: fast response and slow response. In a very short time, if the overcurrent protection threshold of fast response is exceeded, the chip will adopt analog mode to protect the chip from excessive spike current. If the duration time of this spike exceeds the set time (about 6μs), the chip will close the corresponding channel and output a low signal on nFAULT. The channel can only be opened by resetting or power on again.

When the chip temperature exceeds the set threshold, the overtemperature protection circuit will work. At this time, all channels will be closed, and nFAULT outputs a low-level signal. When the temperature drops back to safe temperature, the chip will return to normal operation state.

When power supply drops below the threshold of undervoltage protection, the chip will close all channels, reset the internal logic circuit, and output a low-level signal on nFAULT. When the voltage rises above the threshold, the chip will return to normal operation state.

## TYPICAL APPLICATION

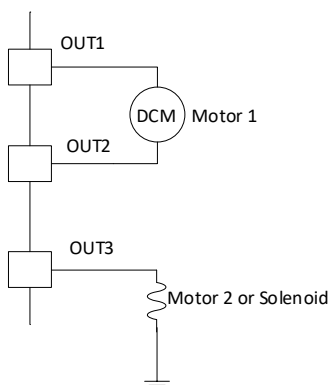
The typical application of the MS8313 is for driving three-phase brushless motor. In this application, the three outputs are connected to the three inputs of the motor respectively, as shown in the figure below:



The operation g timing sequence is as follows:

State	OUT1(Phase U)			OUT2(Phase V)			OUT3(Phase W)		
	IN1	EN1	OUT1	IN2	EN2	OUT2	IN3	EN3	OUT3
1	X	0	Z	1/PWM	1	H/PWM	0	1	L
2	1/PWM	1	H/PWM	X	0	Z	0	1	L
3	1/PWM	1	H/PWM	0	1	L	X	0	Z
4	X	0	Z	0	1	L	1/PWM	1	H/PWM
5	0	1	L	X	0	Z	1/PWM	1	H/PWM
6	0	1	L	1/PWM	1	H/PWM	X	0	Z

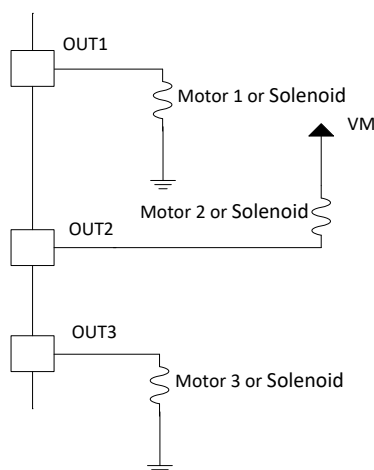
The MS8313 can also be used to drive DC motor and solenoid. The example is as follows:



Motor 1						
Function	IN1	EN1	OUT1	IN2	EN2	OUT2
Close or Coast	X	0	Z	X	X	X
Close or Coast	X	X	X	X	0	X
Forward Rotation	1/PWM	1	H	0	1	L
Reverse Rotation	0	1	L	1/PWM	1	H
Brake or Slow Decay	0	1	L	0	1	L
Brake or Slow Decay	1	1	H	1	1	H

Motor 2			
Function	IN3	EN3	OUT3
Open	1/PWM	1	H
Close or Slow Decay	0	1	L
Close or Coast	X	0	X

The MS8313 can also drive three motors or solenoids independently. The specific application is as follows:



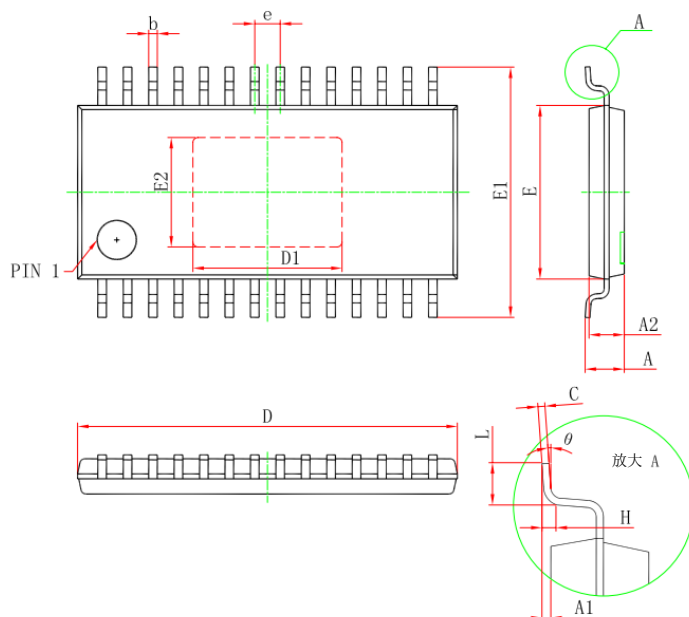
Motor 1 or Solenoid			
Function	IN1	EN1	OUT1
Open	1/PWM	1	H
Close or Slow Decay	0	1	L
Close or Coast	X	0	X

Motor 2 or Solenoid			
Function	IN2	EN2	OUT2
Open	1/PWM	1	H
Close or Slow Decay	0	1	L
Close or Coast	X	0	X

Motor 3 or Solenoid			
Function	IN3	EN3	OUT3
Open	1/PWM	1	H
Close or Slow Decay	0	1	L
Close or Coast	X	0	X

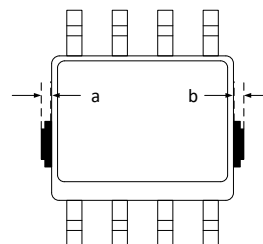
# PACKAGE OUTLINE DIMENSIONS

## eTSSOP28



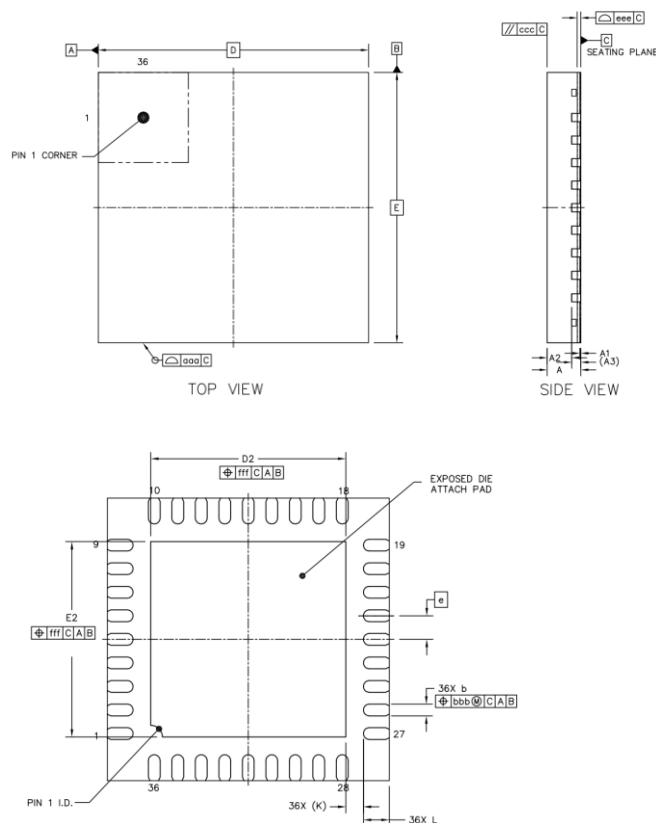
Note: In addition to the package size, a, b are allowed to have the maximum size of 0.15mm for waste glue simultaneously.

The diagram is as follows: taking SOP8 package as an example.



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
D	9.600	9.800	0.378	0.386
D1	3.710	3.910	0.146	0.154
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
E2	2.700	2.900	0.106	0.122
A		1.100		0.043
A2	0.800	1.000	0.031	0.039
A1	0.020	0.150	0.001	0.006
e	0.65(BSC)		0.026(BSC)	
L	0.500	0.700	0.02	0.028
H	0.25(TYP)		0.01(TYP)	
$\theta$	1°	7°	1°	7°

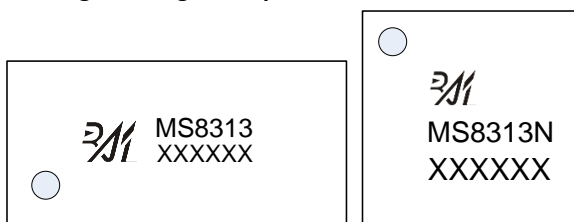
## QFN36



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	0.2	0.25	0.3
D	6BSC		
E	6BSC		
e	0.5BSC		
D2	4.05	4.15	4.25
E2	4.05	4.15	4.25
L	0.45	0.55	0.65
K	0.375REF		
aaa	0.1		
ccc	0.1		
eee	0.08		
bbb	0.1		
fff	0.1		

## MARKING and PACKAGING SPECIFICATIONS

### 1. Marking Drawing Description



Product Name: MS8313, MS8313N

Product Code: XXXXXX

### 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
MS8313	eTSSOP28	3000	1	3000	8	24000
MS8313N	QFN36	2000	1	2000	8	16000

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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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