One Channel H-Bridge Power Driver AM2009

Features and Benefits

- Wide supply voltage range up to 10V
- Maximum continuous current output up to 2.0A
- Built-in low offset OP, optimized for current sense function
- Low $R_{DS(ON)}$ for high efficient H-bridge output.
- DFN 3X3 package for small size PCB layout
- Over current protection
- Over temperature protection
- Low standby current
- Low quiescent current

Application

- Robotics (R/C servo, Sweeping robot)
- Small Appliances (Reduce PCB surface area and perimeter)
- Any relevant DC motor applications.

Description

The AM2009 is one channel H-Bridge driver with a built in low offset OP. It provides integrated motor-driver solution for high current power motion control applications. The output driver block consists of N-channel and P-channel power MOSFETs configured as H-Bridge to drive DC motor.

The AM2009 maximum operating voltage is 10V. It can supply up to 2.0A of output continuous current and 3.5A of output peak current. There are internal shutdown function for over-temperature protection and over-current protection (I_{OCP} = 3.5 A).

Package material is Halogen-Free Green Product & RoHS compliant for the purpose of environmental protection and for sustainable development of the Earth.

Ordering Information

Orderable Part Number	Package	Marking
AM2009	DFN 3X3	AM2009

● Absolute Maximum Ratings (T_A=25℃)

Parameter	Symbol	Limits	Unit
Power Supply voltage	PVCC/VCC	14	V
Output continuous current	Iocont	2.0 (NOTE*)	A
Output peak current	Iomax	3.5	A
Operate temperature range	T_{opr}	-20～+85	℃
Storage temperature range	T_{stg}	-40～+150	℃

Note *: Based on 30x30 mm^2 FR4 PCB (1 oz.) at double side PCB

● Recommended operating conditions (T_A =25℃)

(Set the power supply voltage taking allowable dissipation into considering)

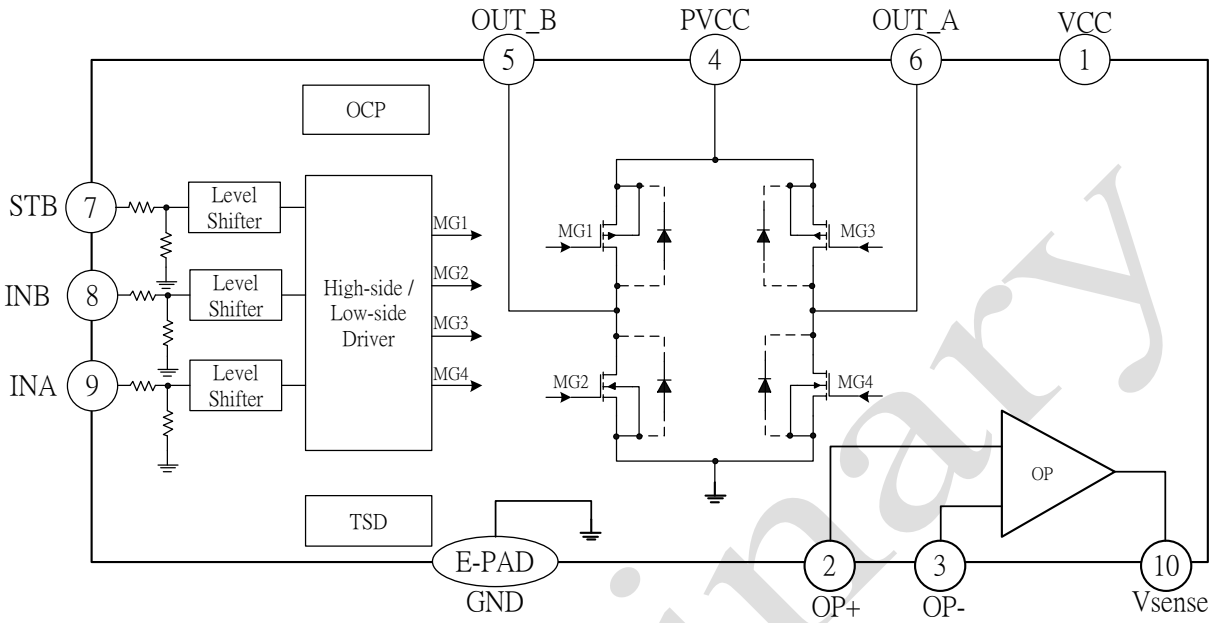
Parameter	Symbol	Min	Typ	Max	Unit
Power Supply voltage for H-Bridge	PVCC	2.8(Note**)		10	V
IC internal circuit and Pre-driver operating voltage	VCC	2.8(Note**)		10	V
Signal input IN_A and IN_B voltage	V_{IN_x}	-0.3		Vcc+0.3	V
H-bridge output continuous current	I_{OUT}	0		2.0(Note*)	A
Externally applied PWM frequency	F_{IN_x}	0.02		65	KHz

Note* : Based on 30x30mm^2 FR4 PCB (1 oz.) at double side PCB

Electrical Characteristics (Unless otherwise specified, TA = 25℃,PVCC=VCC=6V)

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Power Supplies						
Supply current	I_{CC}		1		mA	STB=1, INA=0, INB=0, No load on OUT
Standby current	I_{stb2}		1		uA	STB=0, INA=0, INB=0, No load on OUT
IN_x Inputs						
Input H level voltage	V_{IN_xH}	2.0		Vcc	V	
Input L level voltage	V_{IN_xL}	0		0.7	V	
Input pull down resistance	R_{IN_X}		200		KΩ	
Input frequency	F_{IN_x}	0.02		65	KHz	
H-bridge FETs						
On-resistance	$R_{ds(on)}$		0.3		Ω	I_O = 0.6A Upper and Lower total
Current Sense Function						
Current sense voltage	V_{sense}	0.95	1	1.05	V	R_{SENSE}=20mΩ, I_{LOAD}=1A
Gain ratio	G_{ISENSE}	48	50	52	V/V	
Input offset voltage	V_{OO}	-1		1	mV	
Protection circuit						
Overcurrent deglitch time	T_{DEG}		1		us	
Overcurrent retry time	T_{OCP}		1		ms	
Thermal shutdown protection	TSD_p		175		℃	
Thermal shutdown release	TSD_r		120		℃	

- **Block Diagram:**



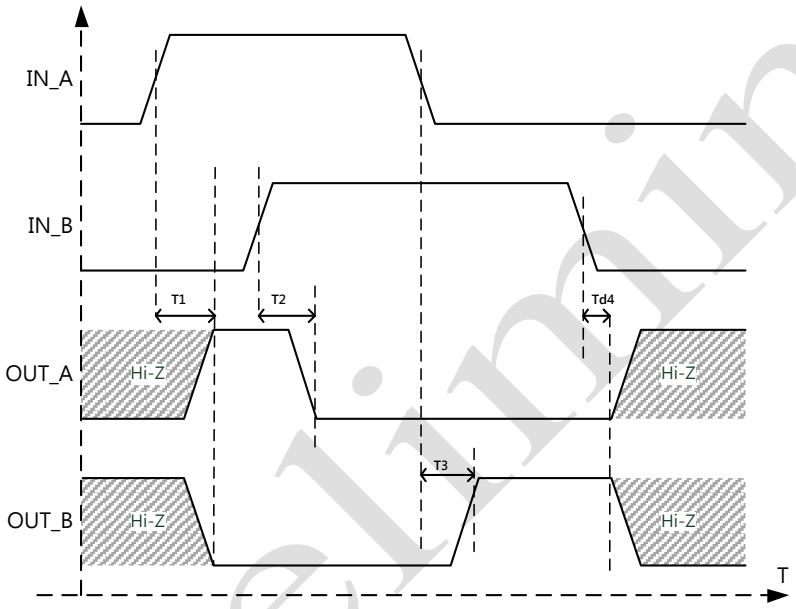
- **Input Logic Descriptions**

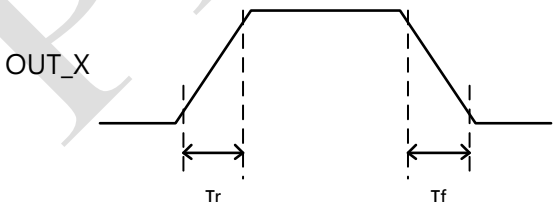
Function truth table

STB	INA	INB	OUT_A	OUT_B	模式
1	L	L	Hi-Z	Hi-Z	Stop
1	L	H	L	H	Reverse
1	H	L	H	L	Forward
1	H	H	L	L	Brake
0	X	X	HI-Z	HI-Z	Standby

● Timing Requirements

Time Parameter	Symbol	Typical	Unit	Conditions
Output enable time	T_1	200	ns	T_A = 25℃, VCC=PVCC=6 V , R_{load}=20 Ω
Forward to Brake mode time	T_2	200	ns	
Brake to Reverse mode time	T_3	200	ns	
Output disable time	T_4	200	ns	
Output rise time	T_r	100	ns	
Output fall time	T_f	100	ns	

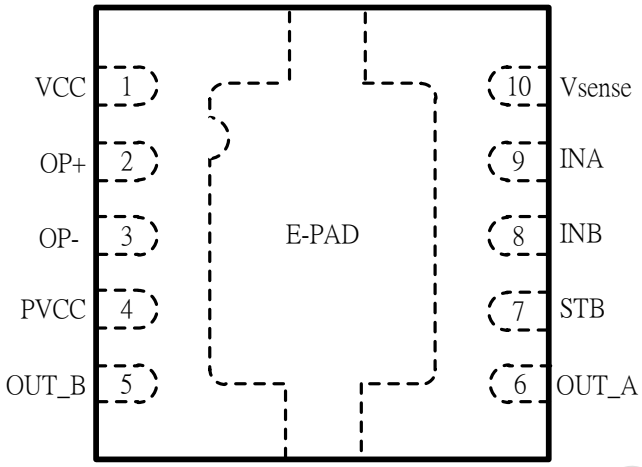




T_r : Output voltage rising from 10% to 90%.

T_f : Output voltage falling from 90%to 10%.

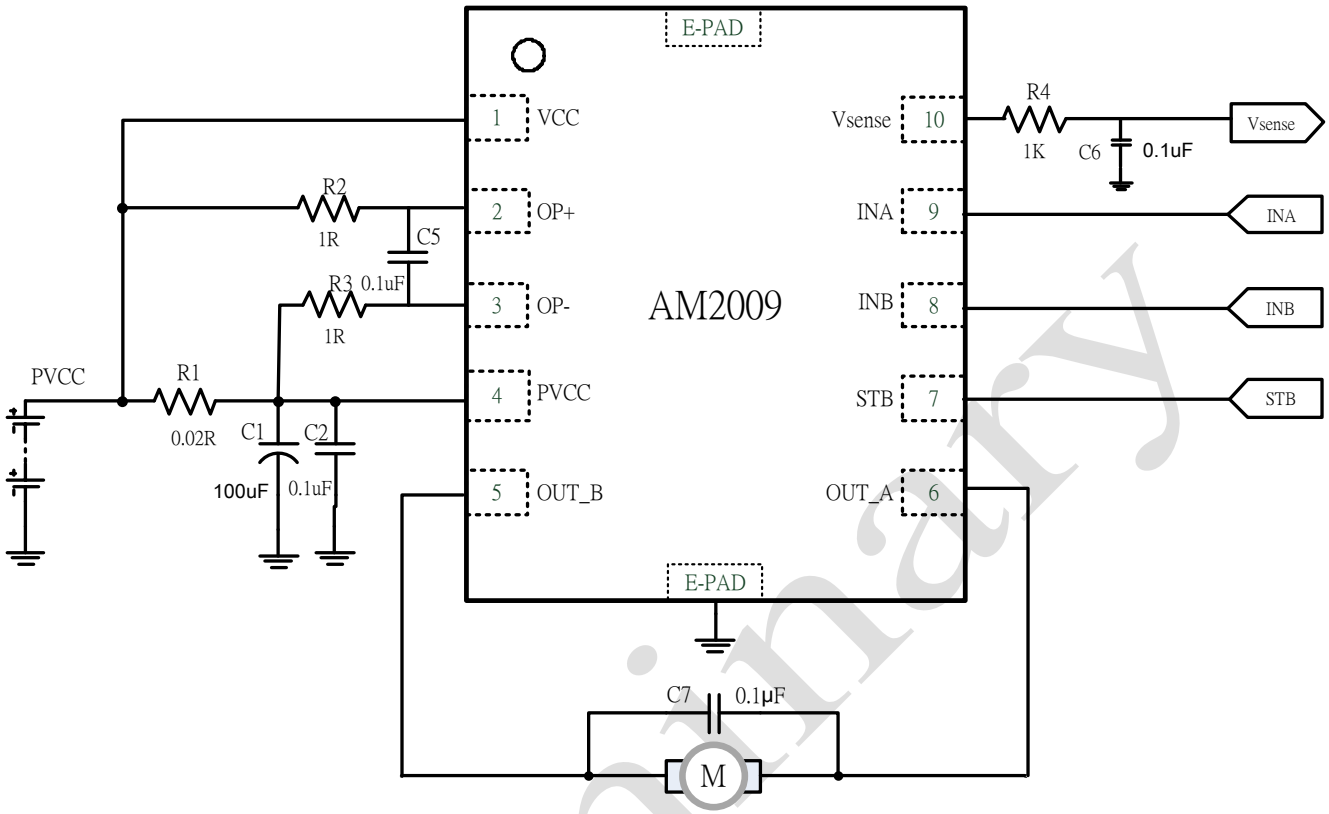
- **Pin configuration DFN 3X3**



- **Pin Descriptions**

PIN No.	Pin Name	I/O	Description
1	VCC	-	Internal circuit and Pre-driver Power Supply
2	OP+	I	Current sense Amplifier positive input
3	OP-	I	Current sense Amplifier negative input
4	PVCC	-	Power Supply for H-Bridge
5	OUT_B	O	Output B
6	OUT_A	O	Output A
7	STB	I	Standby Mode setting input
8	INB	I	Terminal B Input
9	INA	I	Terminal A Input
10	Vsense	O	Current sense Voltage
E-PAD	GND	-	Ground Pin

Application circuit:



Circuit Descriptions

1. C1、C2、: Power supply PVCC pin capacitor:
   a) The capacitor can reduce the power spike when the motor is in motion. To avoid the IC directly damaged by the PVCC peak voltage. It also can stabilize the power supply voltage and reduce its ripples.
   b) The C1 capacitor can compensate power spike when motor starts running.
   c) On the PCB configuration, the C1、C2 should be placed as close to the VCC(PIN1) and PVCC(PIN4) pin as possible with a thick trace or ground plane connection to the device GND pin.

2. C7: The across-output capacitor
   a) The capacitors can reduce the power spike of motor when operating. Therefore, a 0.1μF capacitor is recommended. .
   b) On the PCB configuration, the C7 must be mounted as close as possible to OUT_A&B (PIN 5 & PIN 6).
   c) The C7 capacitor must be added to the general application.

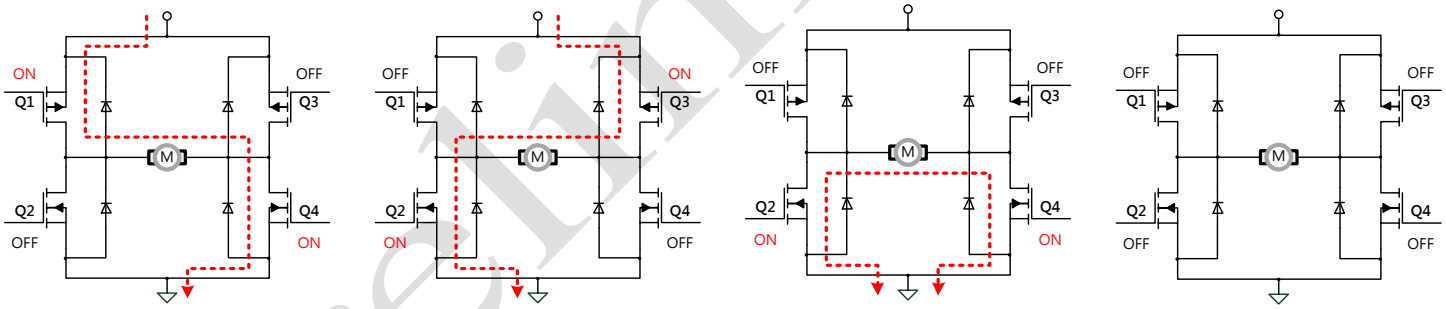
3. R1: The shunt resistor of R1 is for current monitor.
   a) The input pins, OP+ and OP-, must be connected as close as possible to the shunt resistor of R1 to minimize any resistance in series with the shunt resistor of R1

4. C5/R2/R3: The input filtering circuit consists of C5/R2/R3.
   a) The capacitors C5 can bypass the power spike of motor when operating. Therefore, a 0.1μF capacitor is recommended.
   b) The resistor R2& R3 creates an additional filter in the measurement so the value of R2& R3 resistor muse be kept to 10Ω (or less if possible) to reduce impact to accuracy. Therefore, 1Ω resistor is recommended.
5. R4/C6: The output filter circuit consists of R4/C6.
   a) R4/C6 consists of low pass filter for stabilize the Vsense output voltage and its ripples.

● Operating Mode Descriptions

H-Bridge basic operating mode：

a) Forward mode
   Definition：When IN_A=H，IN_B=L，then OUT_A=H，OUT_B=L
b) Reverse mode
   Definition：When IN_A=L，IN_B=H，then OUT_A=L，OUT_B=H
c) Brake mode
   Definition：When IN_A=IN_B= H，then OUT_A=OUT_B=L
d) Stop mode
   Definition：When IN_A=IN_B= L，then OUT_A=OUT_B=Hi-Z



a) Forward mode b) Reverse mode c) Brake mode d) Stop mode

● Protection Mechanisms Descriptions

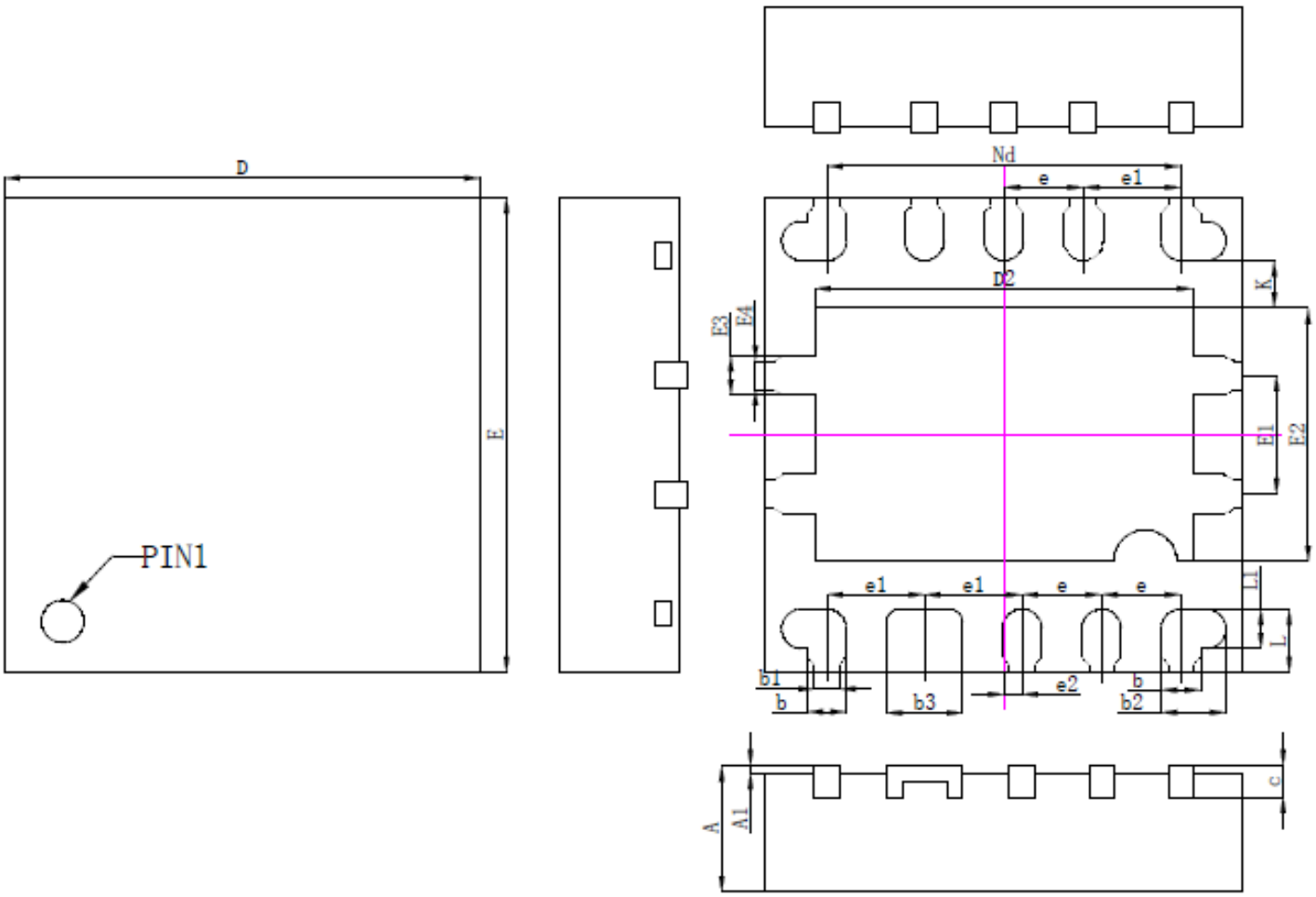
1) Over-temperature protection
   If the IC junction temperature exceeds 175° C (Typ.), the internal over-temperature protection function will be triggered, all FETs in the H-bridge are disabled, that will ensure the safety of customers' products. If the IC junction temperature falls to 120° C(Typ.), the IC resumes automatically.

2) Over-current protection (OCP)

While the IC conducts a large current, 3.5A (Typ), the H-bridge are disabled. After approximately 1ms, the bridge is re-enabled automaticly.

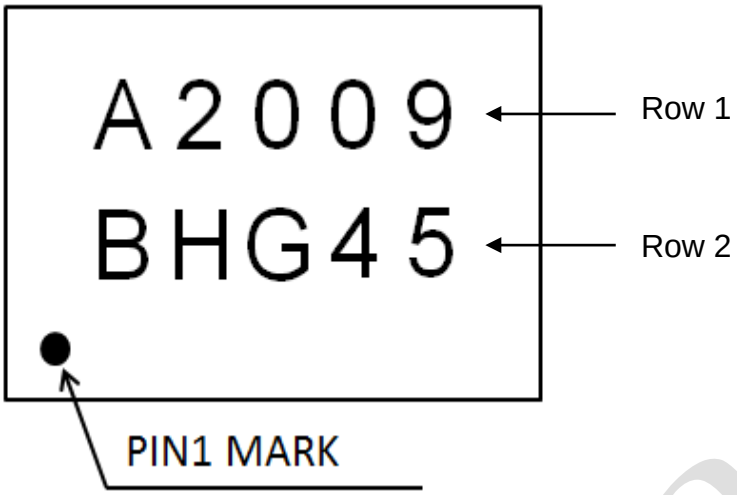
Overcurrent conditions on both high- and low-side devices, that is, a short to ground, supply, or across the motor winding all result in an overcurrent shutdown.

- **Packaging outline --- DFN 3X3-10L** **Unit : mm**



SYMBOL	MILLIMETERS		INCHES	
	Min.	Max.	Min.	Max.
A	0.70	0.80	0.028	0.031
A1	0.00	0.05	0.000	0.002
c	0.20 REF		0.008 REF	
b	0.20	0.30	0.008	0.012
b1	0.16 REF		0.006 REF	
b2	0.36	0.46	0.014	0.018
b3	0.43	0.53	0.017	0.021
D	3.00 BSC		0.118 BSC	
E	3.00 BSC		0.118 BSC	
D2	2.28	2.48	0.090	0.098
Nd	2.18	2.28	0.086	0.090
E1	0.70	0.80	0.028	0.031
E2	1.50	1.70	0.059	0.067
E3	0.20	0.30	0.008	0.012
E4	0.18 REF		0.007 REF	
L	0.35	0.45	0.014	0.018
e	0.50 BSC		0.020 BSC	
e1	0.615 BSC		0.024 BSC	
e2	0.115 BSC		0.005 BSC	
K	0.25	0.35	0.010	0.014
L	0.35	0.45	0.014	0.018
L1	0.25 REF		0.010 REF	

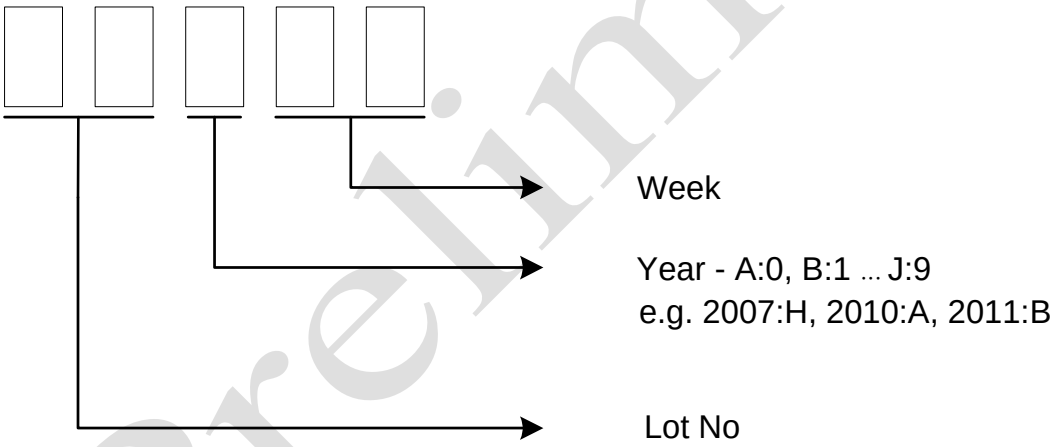
● Marking Identification:



NOTE:

Row1 ： A2009

Row2 ： Wafer Lot No use two codes + Assembly Year use one code + Assembly Week use two codes



Example: Wafer Lot No is BH + Year 2016 is G + Week 45 is 45，then mark〝BHG45〞

The last code of assembly year, explanation as below:：

(Year： A=0,B=1,C=2,D=3,E=4,F=5,G=6,H=7,I=8,J=9. For example: year 2016=G)