AM2908 H-Bridge Brushed DC Motor Driver

● **Features and Benefits**

- Operating Voltage Range : 10 to 50V
- Low $R_{DS(ON)}$: HS +LS = 45mΩ
- 4.5A Continuous Current, 8A Peak Current
- Low Standby Current < 1uA
- Overcurrent Protection
- Thermal Shutdown Protection
- Undervoltage Lockout
- Fault Indicator Pin
- Charge Pump Circuit
- SOP16 Package for small PCB layout
- Halogen-Free Green Product & RoHS Compliant Package

● **Application**

- Massage Chair
- Robotic Vacuum
- Window Cleaning Robot
- Electric Curtain
- Electric Linear Actuator
- Cobot
- Pump(Water / Air)
- Power Tool

● **Description**

AM2908 is a brushed DC motor driver IC, provides outside PWM pulse to control motor speed, and it drivers current capability up to 4.5A continuous and 8A peak.

The device provides well protections for motor and device itself including internal functions for overcurrent, over temperature and UVLO protection.

● **Ordering Information**

Orderable Part Number	Package	Marking
AM2908	SOP16	AM2908

● **Absolute Maximum Ratings (T$_A$=25℃)**

Parameter	Symbol	Limits	Unit
Power Supply Voltage	PVCC/VCC	60	V
Signal Input IN_A and IN_B Voltage	V$_{IN\_X}$	6	V
Output Voltage	V$_{OUT}$	60	V
Peak Current	I$_{OUT}$	8.0	A
Operate Temperature Range	T$_{OPRr}$	-40～+85	℃
Storage Temperature Range	T$_{STG}$	-40～+150	℃

● **ESD Rating**

		Value	Unit
V$_{ESD}$ Electrostatic discharge	Human-body model (HBM) [1]	±5000	V
	Machine model (MM) [1]	±400	V

[1] The test method refers to JEDEC EIA/JESD22-A114-B.

● **Recommended Operating Conditions (T$_A$ =25℃)**

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

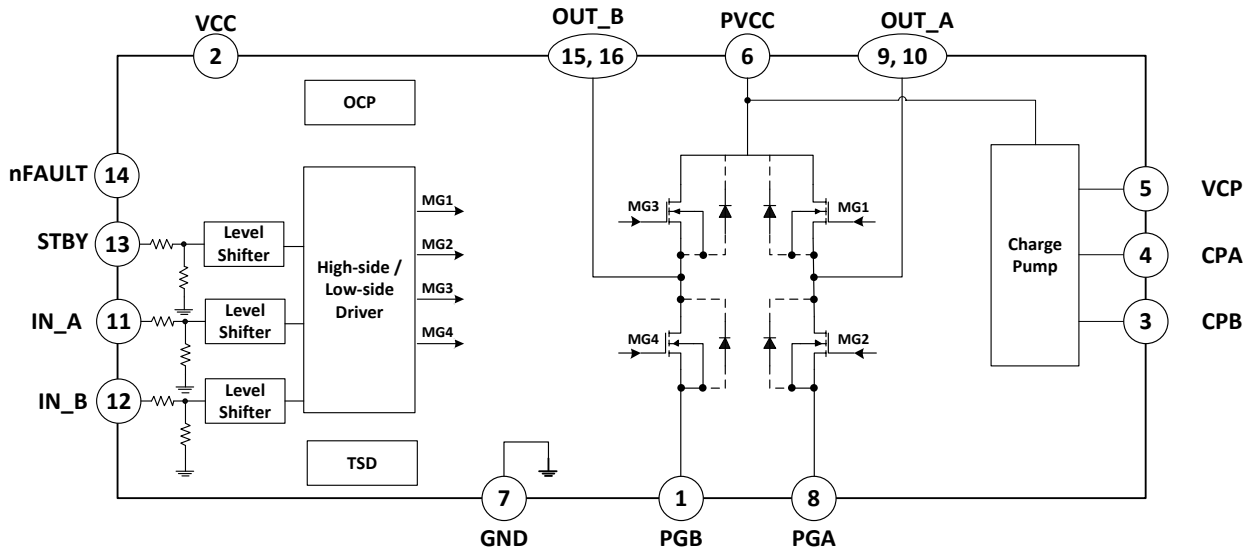| Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	PVCC	10		50	V
IC Operating Voltage	VCC	10		50	V
Signal Input IN_A and IN_B Voltage	V$_{IN\_X}$	-0.3		5.5	V
Continuous Current	I$_{OUT}$	0		4.5(Note*)	A
Externally Applied PWM Frequency	F$_{IN\_X}$	0.02		100	KHz

Note*: Power dissipation and thermal limits must be observed.

● **Electrical Characteristics (Unless otherwise specified, T_A = 25℃,PVCC=VCC=24V)**

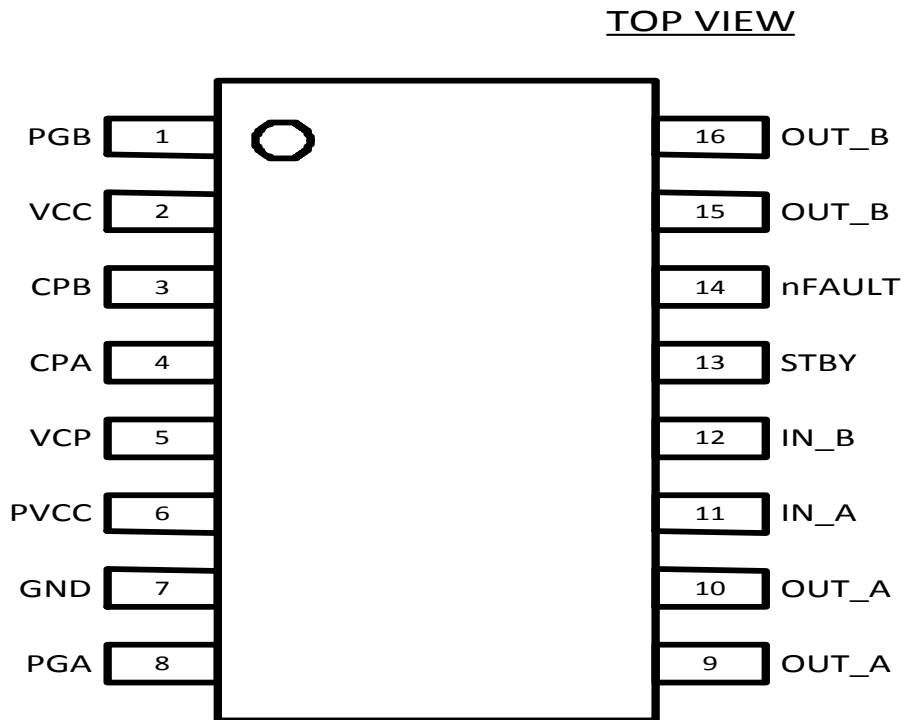| Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Power Supply						
Supply Current	I_{CC}		7		mA	STBY=1, No load on OUT
Standby Current	I_{STB}		1		uA	STBY=0, No Load on OUT
Charge Pump Frequency	F_{CP}		200		KHz	
IN_X Inputs						
Input H level Voltage	V_{IN_XH}	2.0		5.5	V	
Input L level Voltage	V_{IN_XL}	0		0.7	V	
Input Pull Down Resistance	R_{IN_X}		100		KΩ	
Input Frequency	F_{IN_X}	0.02		100	KHz	
H-Bridge FETs						
On-resistance	$R_{ds(ON)}$		45	55	mΩ	I_O = 1.0A Upper and Lower total
Protection Circuit						
Supply Undervoltage Lockout (UVLO)	V_{UVLO}		9.4		V	VCC Rising
			8.7		V	VCC Falling
Supply UVLO Hysteresis	$V_{UVLO - HYS}$		700		mV	
Overcurrent Deglitch Time	T_{DEG}		2.0		us	
Overcurrent Retry Time	T_{OCP}		5.3		ms	
Thermal Shutdown Protection	TSD_P		175		℃	*1
Thermal Shutdown Release	TSD_R		120		℃	*1
nFAULT Open Drain Output						
Output Low Voltage	V_{OL}			0.5	V	I_O=5mA
Output High Leakage Current	I_{OH}			1	uA	V_O=3.3V

*1: It is design target, not to be measured at production test.

● **Block Diagram**

● **Pin configuration**

TOP VIEW

PGB	1	
VCC	2	
CPB	3	
CPA	4	
VCP	5	
PVCC	6	
GND	7	
PGA	8	

16	OUT_B	
15	OUT_B	
14	nFAULT	
13	STBY	
12	IN_B	
11	IN_A	
10	OUT_A	
9	OUT_A	

● **Pin Descriptions**

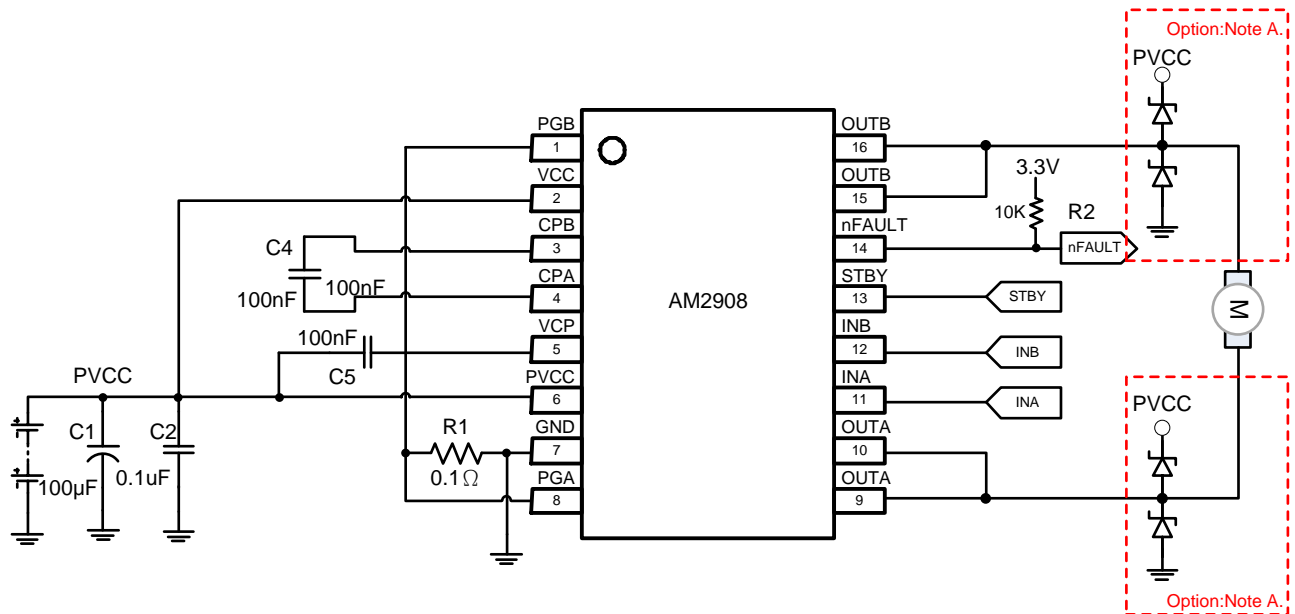| Pin No	Name	I/O	Description
1	PGB	-	Power Ground B
2	VCC	-	Power Supply
3	CPB		Pump fly capacitor. Connect a 100nF capacitor between there pins
4	CPA	-	
5	VCP	-	Charge pump output. Connect a 100nF capacitor to PVCC
6	PVCC	-	Power Supply
7	GND	-	Ground Pin
8	PGA	-	Power Ground A
9, 10	OUT_A	O	Output Terminal A
11	IN_A	I	Logic Input A
12	IN_B	I	Logic Input B
13	STBY	I	Standby Mode setting input
14	nFAULT	O	Low-level indicates UVLO, TSD or OCP fault. Connect to a pull-up resistor.
15, 16	OUT_B	O	Output Terminal B

● **Input Logic Descriptions**

Function Truth Table: STBY=1

IN_A	IN_B	OUT_A	OUT_B	模式
L	L	Hi-Z[2]	Hi-Z[2]	Stop
L	H	L	H	Reverse
H	L	H	L	Forward
H	H	L	L	Brake

Note:

1. When STBY =0, IC is standby mode.
2. "High-Z" is the status that High-side MOSFETs and Low-side MOSFETs of H-Bridge are switched to "OFF".

● **Application circuit**

● **Circuit Descriptions**

The function descriptions of capaacitors on the application circuit:

1. C1、C2: Power supply PVCC/VCC pin capacitors:

   The capacitors can reduce the power spike when the motor is in motion. And prevent the IC from damaging by the PVCC/VCC peak voltage. They can stabilize the power supply voltage and reduce its ripples.

   The C1 capacitor can compensate power supply when motor starts running.

   The capacitor value (μF) determines the stability of the PVCC/VCC during motor is in motion. If the large voltage power or a heavier loading motor is used, then a larger capacitor would be needed.

   On the PCB configuration, the C1、C2 must be placed as close as possible to VCC/PVCC pin (PIN2/PIN6).

2. In order to use PWM current control, a low-value resistor is placed between the PGA/PGB pin and ground for current sensing purposes. The ground-trace should be as short as possible. For low-value sense resistors, the ground-trace voltage drops in the PCB could be significant, and should be taken into account.

   When selecting a value for sense resistor, be sure not to exceed the maximun voltage of ±500 mV at maximum load. During over-current events, this rating may be exceeded for short durations.
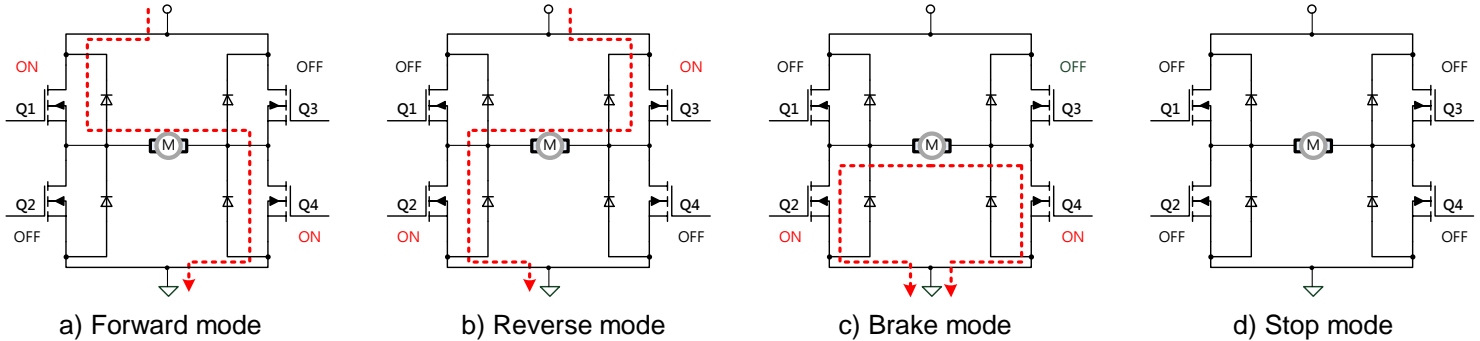
   The resistance of the sense resistor must be rated for high enough power.

*Note :

   A.   The schottky diodes placed between output and PGND could decrease useless power dissipation and lower temperature. It is optional according to requirements of the actual application.

● **Operating Mode Descriptions**

   a) Forward mode: When IN_A=H, IN_B=L, then OUT_A=H, OUT_B=L

   b) Reverse mode: When IN_A=L, IN_B=H, then OUT_A=L, OUT_B=H

   c) Brake mode: When IN_A=IN_B=H, then OUT_A=OUT_B=L

   d) Stop mode: 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) Thermal shutdown protection (TSD)

   If the IC junction temperature exceeds 175℃ (Typ.), the internal thermal shutdown protection will be triggered, and all FETs in the H-Bridge are disabled so that it will ensure the safety of customers' products. If the IC junction temperature falls to 120℃(Typ.), the IC resumes automatically.

   2) Overcurrent protection:

   When the IC conducts a large current, 8A (Typ), the internal overcurrent protection function will be triggered. The device enters protection mode and disabled all FETs in the H-Bridge to avoid damaging IC and system . After approximately 5.3ms, the H-Bridge is re-enabled automatically.

   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.
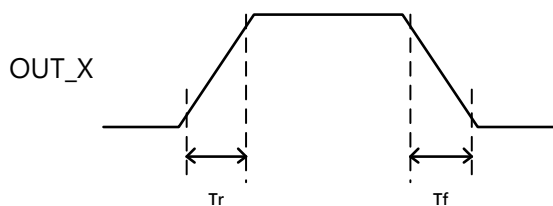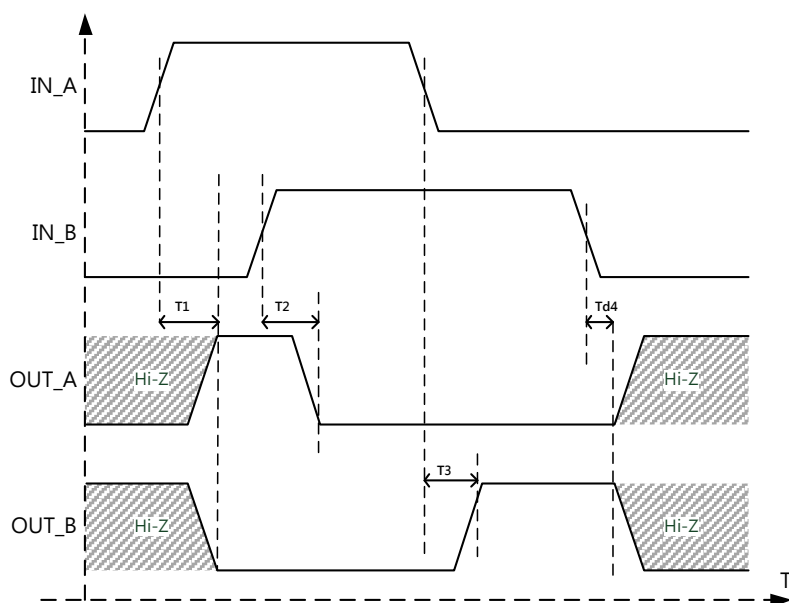
   3) nFAULT table

<div align="center">Protection Functionality</div>

	Condition	H-Bridge Becomes	nFAULT Becomes	Recovery
Overcurrent (OCP)	$I_{OUT} > I_{OCP}$(8A)	Disable	Low	T_{OCP} (5.3ms)
Thermal shutdown(TSD)	$T_J > 175℃$	Disable	Low	Tj < 120℃
Undervoltage (UVLO)	VCC < 8.7V	Disable	Low	VCC > 9.4V

● **Propagation Delay Time**

Time Parameter	Symbol	Typical	Unit	Conditions
Output enable time	T_1	1300	ns	$T_A = 25℃$, VCC=PVCC=24 V, R_{load}=50 Ω
Forward to Brake mode time	T_2	350	ns	
Brake to Reverse mode time	T_3	1300	ns	
Output disable time	T_4	300	ns	
Output rise time	T_r	700	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%.

● **Thermal Information**

θja	junction-to-ambient thermal resistance	76.7℃/W
Ψjt	junction-to-top characterization parameter	8.2℃/W

Condition :

      a.   FR4 PCB 25 x 25 mm^2

      b.   1S1P-2 layers

      c.   with 1 oz copper

● **Power Dissipation**

● **How to predict Tj in the environment of the actual PCB**

Step 1: Use the simulated Ψjt value listed above.

Step 2: Measure Tt value by using ~40 gauge thermocouple or thermo gun.

      Tt : Temp. at top center of the package

Step 3: calculate power dissipation

$$P \cong \left(VCC - \left| V_{O\_Hi} - V_{O\_Li} \right| \right) \times I_{OUT} + VCC \times Icc$$

Step 4: Estimate Tj value
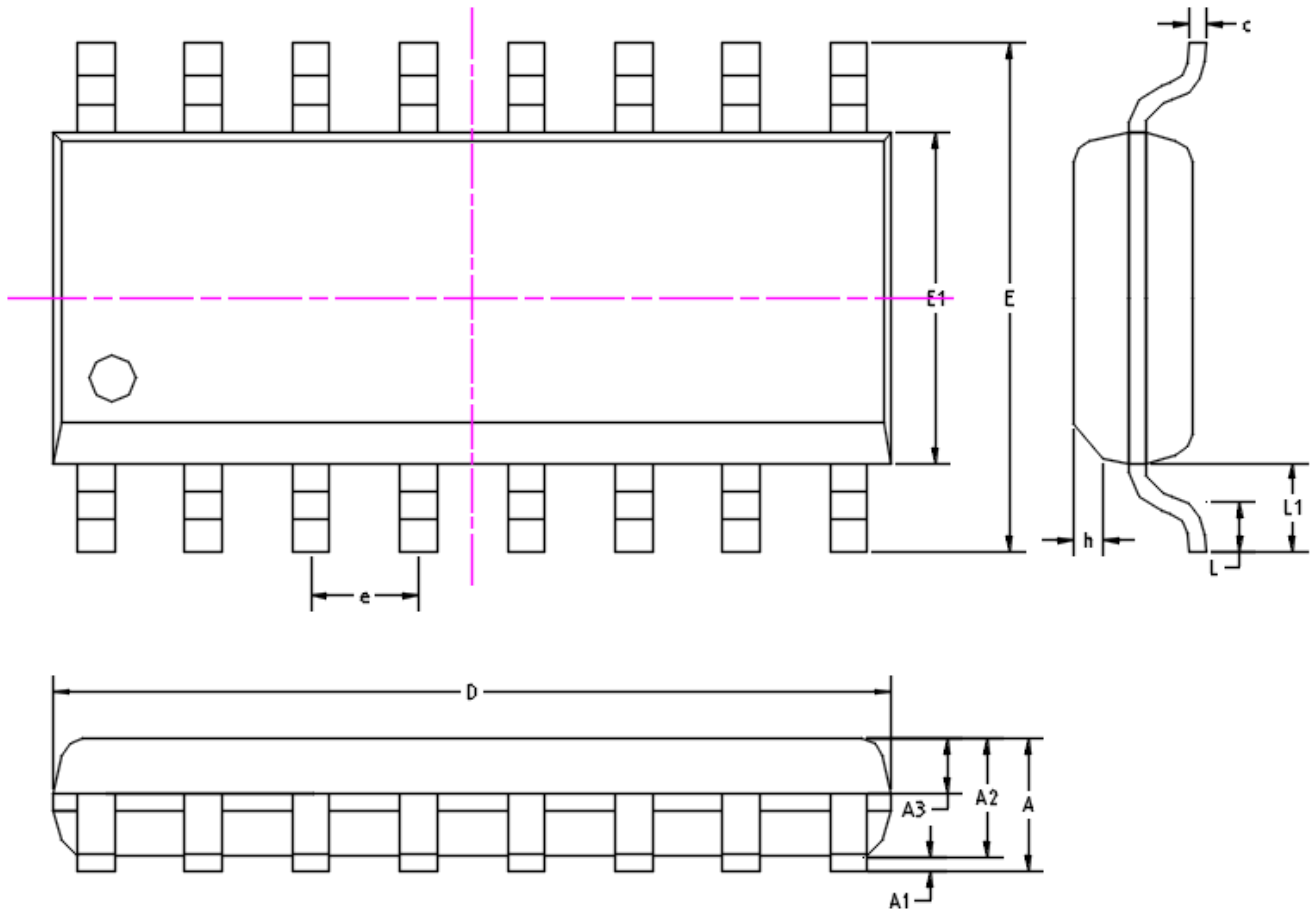
$$Tj = Tt + \Psi jt \times P$$

Step 5: Calculate Θja value of actual PCB

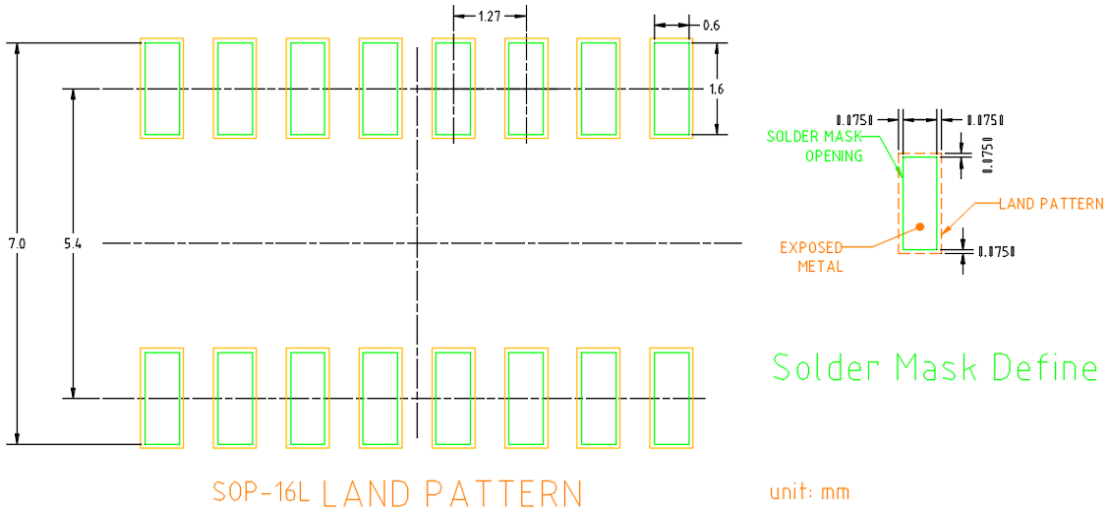$$\theta ja = \frac{(Tj - Ta)}{P} = \frac{Tt + \Psi jt \times P - Ta}{P} = \frac{Tt - Ta}{P} + \Psi jt$$

● **Packaging outline --- SOP16**   **Unit : mm**

SYMBOL	MILLIMETERS		INCHES	
	Min.	Max.	Min.	Max.
A	--	1.75	--	0.069
A1	0.10	0.25	0.004	0.010
A2	1.35	1.55	0.053	0.061
A3	0.55	0.75	0.022	0.030
b	0.36	0.51	0.014	0.020
c	0.18	0.25	0.007	0.010
D	9.80	10.00	0.386	0.394
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 TYP.		0.05 TYP.	
h	0.30	0.50	0.012	0.020
L	0.60 TYP.		0.024 TYP.	
L1	1.05 TYP		0.041 TYP.	

● **Land Pattern And Solder Mask**

SOP-16L LAND PATTERN

Solder Mask Define
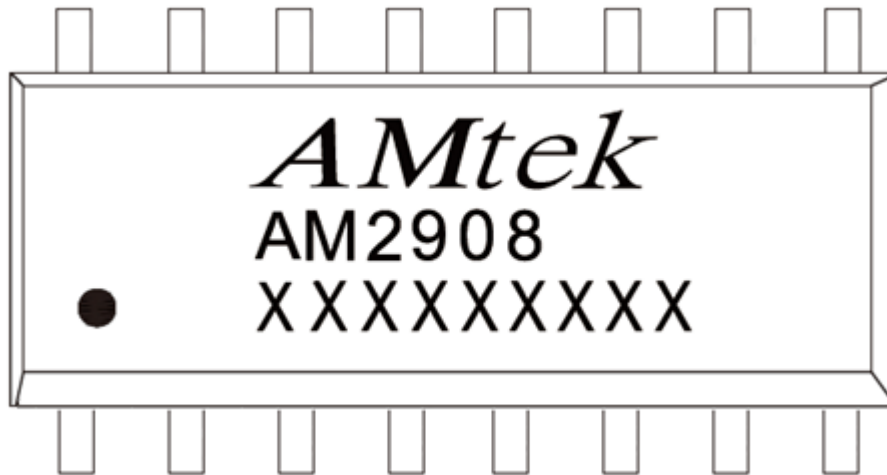
unit: mm

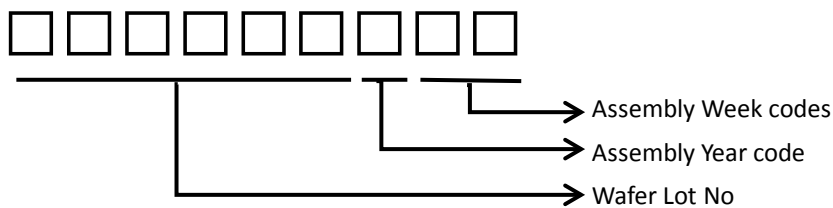● **Marking Identification**
Package Type: SOP16
Device：AM2908

NOTE:

Row1: Logo

Row2: Device Name

Row3: Wafer Lot No use six codes + Assembly Year use one code + Assembly Week use two codes

Assembly Week codes
Assembly Year code
Wafer Lot No

Example：Wafer lot no is RH8NH0 + Year 2020 is A + Week12 is 12，

we type〝RH8NH0A12″

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. Year 2020=A)

● **Revision History**

Date	Revision	Changes
25.Mar.2020	V0.1	New release
9.Jul.2020	V0.2	P6. Remove output terminal capacitor on applicition ciruit
2.Nov.2022	V0.3	P2. Add ESD rating P6. Revise VCP capacitor on applicition ciruit P9. Add thermal information and power dissipation P10. Update POD P11. Add Land Pattern and Solder Mask P13. Add Revision History Operating Temperature Range up to 125℃

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