One Channel H-Bridge DrMOS AM2908

Features and Benefits

- Lowest $R_{DS(ON)}$ =45mΩ
- 60V Absolute Maximum Voltage
- 4.5A Maximum Continuous Current.
- Lowest $R_{DS(ON)}$ and Small Package
- 10~50V Operating Voltage Range
- Overcurrent Protection
- Thermal Shutdown Protection
- Undervoltage Lockout
- Fault Indicator Pin
- Low Standby Current
- Charge Pump Circuit

Application

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

Description

The AM2908 output driver block consists of N-channel power MOSFETs configured as H-Bridge to driver DC motor.

The AM2908 maximum operating voltage is 50V. It can supply up to 4.5A of continuous current and 8.0A of peak current. There are internal shutdown function, UVLO, thermal shutdown protection and overcurrent protection (I_{OCP} = 8 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
AM2908	SOP16	AM2908

● Absolute Maximum Ratings (T_A=25℃)

Parameter	Symbol	Limits	Unit
Power Supply Voltage	PVCC/VCC	60	V
Output Continuous Current	IO_{CONT}	4.5 (NOTE*)	A
Output Peak Current	IO_{peak}	8.0	A
Operate Temperature Range	T_{opr}	-20～+85	℃
Storage Temperature Range	T_{stg}	-40～+150	℃

Note *: 1. Based on 30 x 30 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)

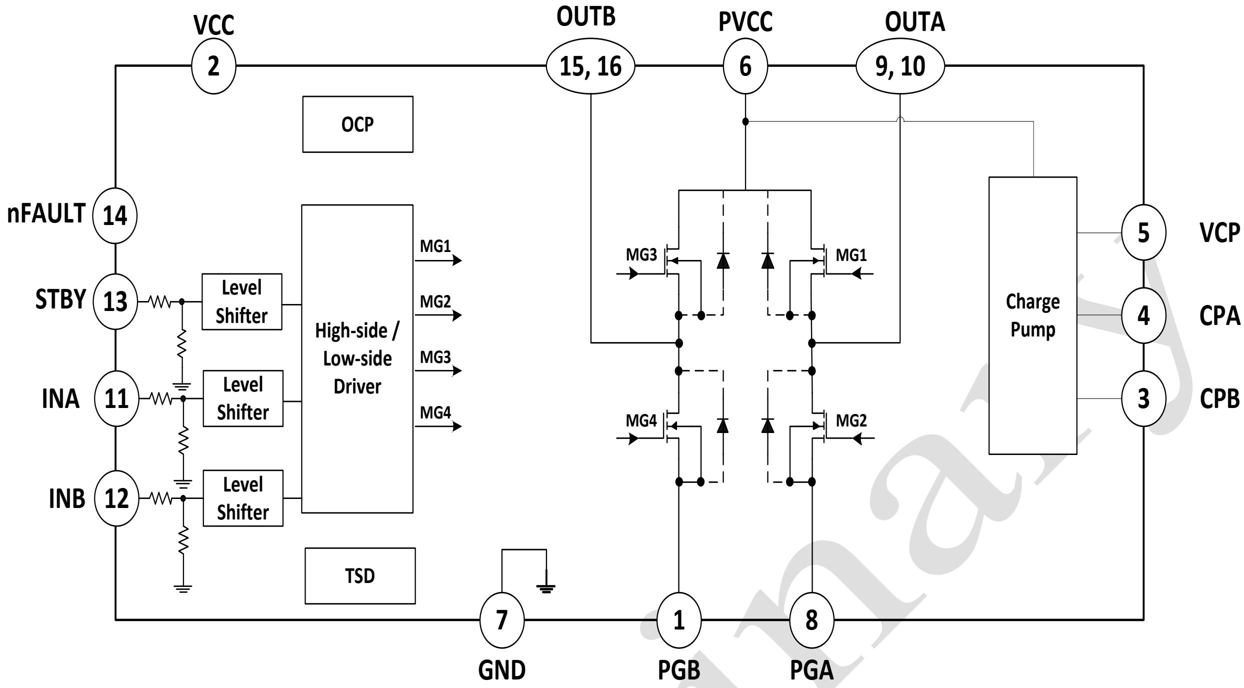
Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	PVCC	10		50	V
IC Operating Voltage	VCC	10		50	V
Signal Input IN_A and IN_B Voltage	V_{IN_X}	-0.3		5.5	V
H-Bridge Output Continuous Current	I_{OUT}	0		4.5(Note*)	A
Externally Applied PWM Frequency	F_{IN_X}	0.02		100	KHz

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

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

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Power Supplies						
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	$V_{UVLO\text{ - }HYS}$		700		mV	
Overcurrent Deglitch Time	T_{DEG}		2.0		us	
Overcurrent Retry Time	T_{OCP}		5.3		ms	
Thermal Shutdown Protection	TSD_P		175		℃	
Thermal Shutdown Release	TSD_R		120		℃	
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

Block Diagram



Input Logic Descriptions

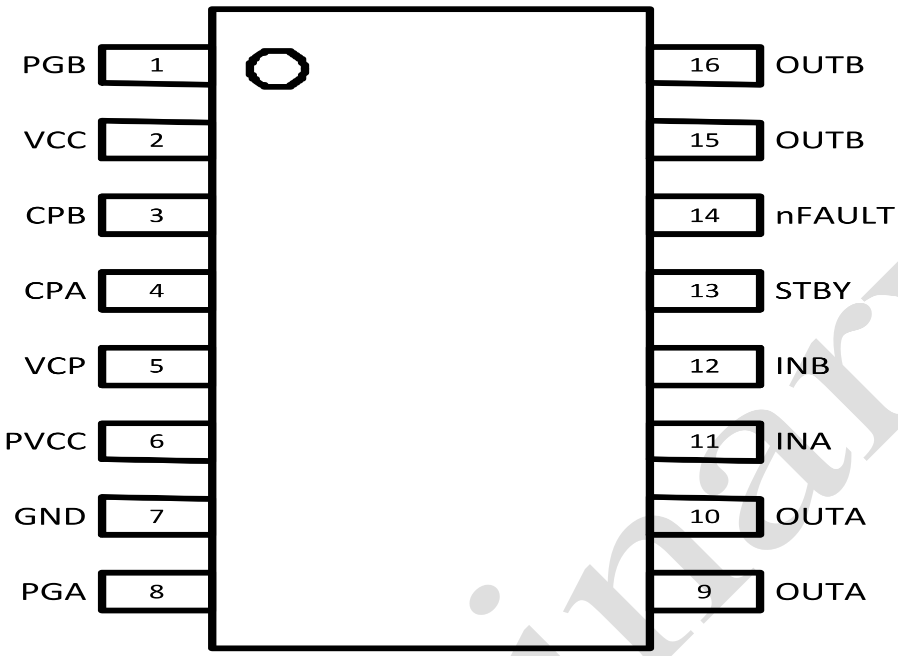
Function Truth Table: STBY=1

INA	INB	OUTA	OUTB	模式
L	L	Hi-Z	Hi-Z	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.

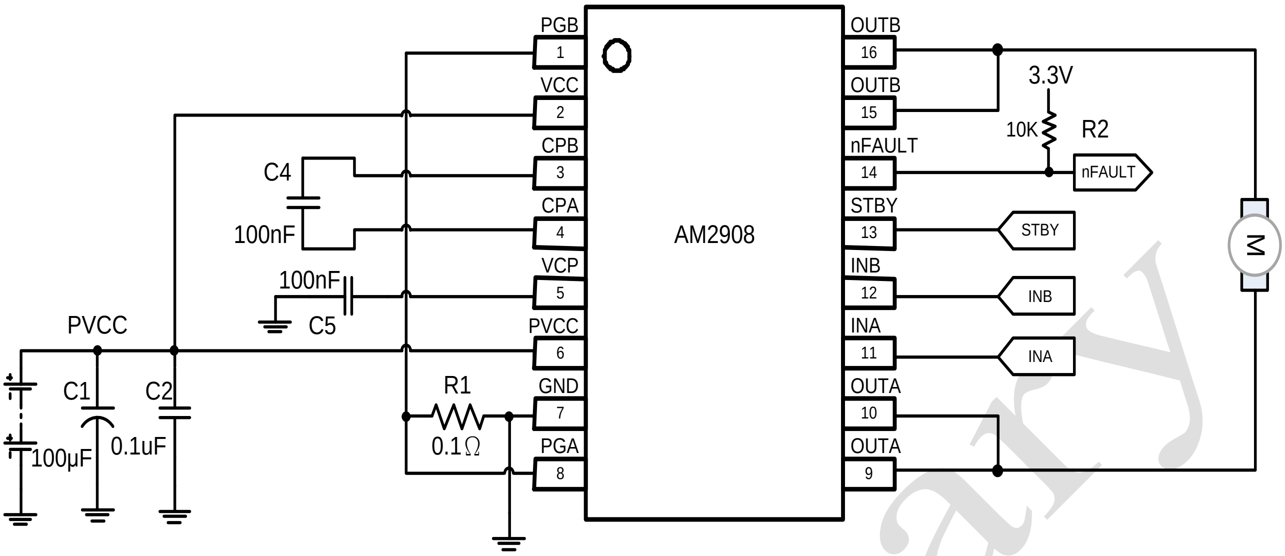
- **Pin configuration**



- **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 ceramic capacitor between there pins
4	CPA	-	
5	VCP	-	Charge pump output. Connect a 100nF capacitor to GND
6	PVCC	-	Power Supply for H-Bridge
7	GND	-	Ground Pin
8	PGA	-	Power Ground A
9, 10	OUTA	O	Output A
11	INA	I	Input terminal A
12	INB	I	Input terminal 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	OUTB	O	Output B

- **Application circuit**



- **Circuit Descriptions**

1. C1、C2: Power supply PVCC/VCC 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/VCC peak voltage. It also can stabilize the power supply voltage and reduce its ripples.
   b) The C1 capacitor can compensate power when motor starts running.
   c) The capacitor value (µF) determines the stability of the PVCC/VCC during motor in motion. In general, 100µF capacitor is enough in low voltage power (PVCC)；0.1µF capacitor is enough in low voltage power (VCC). If the large voltage power or a heavy loading motor is used, then a larger capacitor would be needed.
   d) On the PCB configuration, the C1、C2 must be mounted as close as possible to VCC/PVCC pin (PIN2/PIN6).

2. In order to use PWM current control, a 100mΩ sense resistor is placed between the PGA/PGB pin and ground for current sensing purposes. The ground-trace should be as short as possible. For 100mΩ sense resistors, the ground-trace voltage drops in the PCB can be significant, and should be taken into account.
   The sense resistor setting 100mΩ at maximum load. During overcurrent events, this rating may be exceeded for short durations.

Operating Mode Descriptions

1) H-Bridge basic operating mode：

a) Forward mode

Definition：When INA=H，INB=L，then OUTA=H，OUTB=L

b) Reverse mode

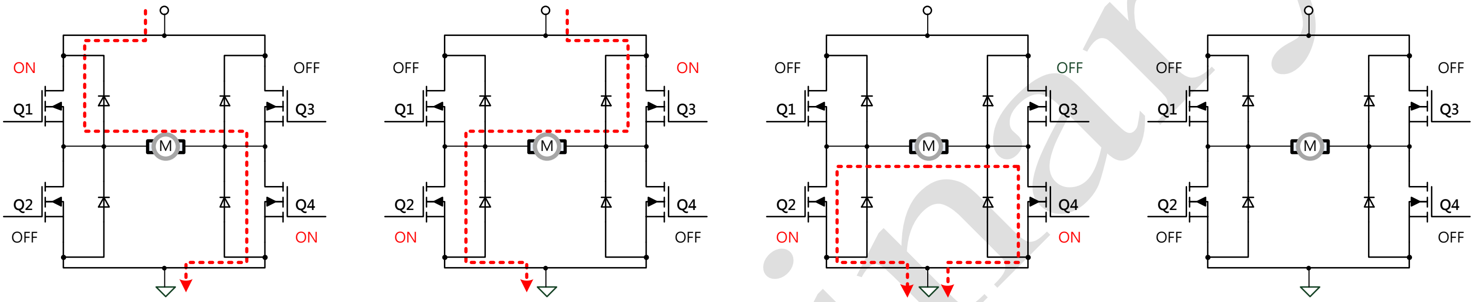
Definition：When INA=L，INB=H，then OUTA=L，OUTB=H

c) Brake mode

Definition：When INA=INB= H，then OUTA=OUTB=L

d) Stop mode

Definition：When INA=INB= L，then OUTA=OUTB=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 overtemperature 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℃ (Typ.), the IC resumes automatically.

2) Overcurrent protection (OCP)

When the IC conducts a large current, 8.0A (Typ), the internal overcurrent protection function will be triggered, the H-bridge are disabled (Hiz state). After approximately 5.3ms, the 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.

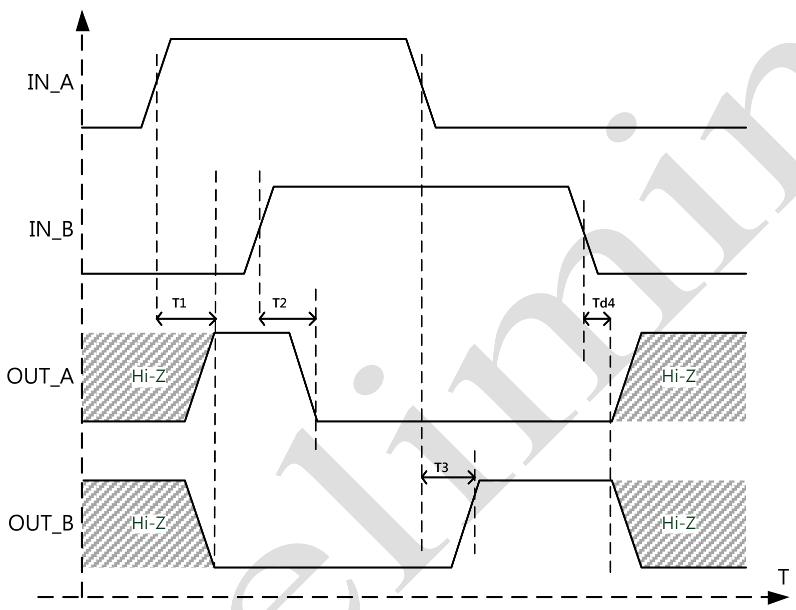
3) nFAULT table

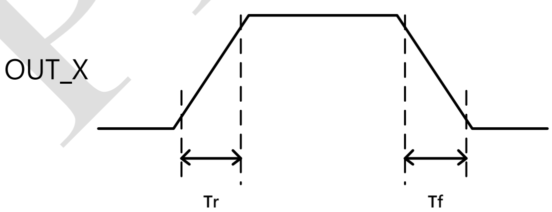
Protection Functionality

	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%.

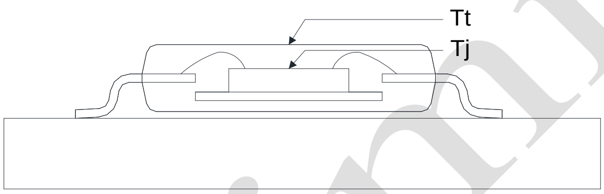
T_f : Output voltage falling from 90%to 10%.

Thermal Information (T.B.F)

Θja	junction-to-ambient thermal resistance	??℃/W
Ψjt	junction-to-top characterization parameter	??℃/W

- **Θja** is obtained in a simulation on a JEDEC-standard 2s2p board as specified in JESD-51.
- The **Θja** number listed above gives an estimate of how much temperature rise is expected if the device was mounted on a standard JEDEC board.
- When mounted on the actual PCB, the **Θja** value of JEDEC board is totally different than the **Θja** value of actual PCB.
- **Ψjt** is extracted from the simulation data to obtain **Θja** using a procedure described in JESD-51, which estimates the junction temperature of a device in an actual PCB.

- The thermal characterization parameter, **Ψjt**, is proportional to the temperature difference between the top of the package and the junction temperature. Hence, it is useful value for an engineer verifying device temperature in an actual PCB environment as described in JEDEC JESD-51-12.
- When Greek letters are not available, **Ψjt** is written Psi-jt.
- Definition:



DEFINITION : $\psi_{jt} = (T_j - T_t) / P_d$

Where :

Ψjt (Psi-jt) = Junction-to-Top(of the package) °C/W
Tj= Die Junction Temp. °C
Tt= Top of package Temp at center. °C
Pd= Power dissipation. Watts

- Practically, most of the device heat goes into the PCB, there is a very low heat flow through top of the package, So the temperature difference between **Tj** and **Tt** shall be small, that is any error caused by PCB variation is small.

- This constant represents that **Ψjt** is completely PCB independent and could be used to predict the **Tj** in the environment of the actual PCB if **Tt** is measured properly.

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

Step 1 : Used the simulated **Ψjt** value listed above.

Step 2 : Measure **Tt** value by using

- **Thermocouple Method**

  We recommend use of a small ~40 gauge(3.15mil diameter) thermocouple. The bead and thermocouples wires should touch the top of the package and be covered with a minimal amount of thermally conductive epoxy. The wires should be heat-insulated to prevent cooling of the bead due to heat loss into wires. This is important towards preventing “too cool” **Tt** measurements, which would lead to the calculated **Tj** also being too cool.

- **IR Spot Method**

  An IR Spot method should be utilized only when using a tool with a small enough spot area to acquire the true top center “hot spot”.

  Many so-called “small spot size” tools still have a measurement area of 0~100+mils at “zero” distance of the tool from the surface. This spot area is too big for many smaller packages and likely would result in cooler readings than the small thermocouple method. Consequently, to match between spot area and package surface size is important while measuring **Tt** with IR sport method.

Step 3 : calculating power dissipation by

$$P \cong (VCC - |Vo_{\_Hi} - Vo_{\_Lo}|) \times I_{out} + VCC \times Icc$$

Step 4 : Estimate **Tj** value by

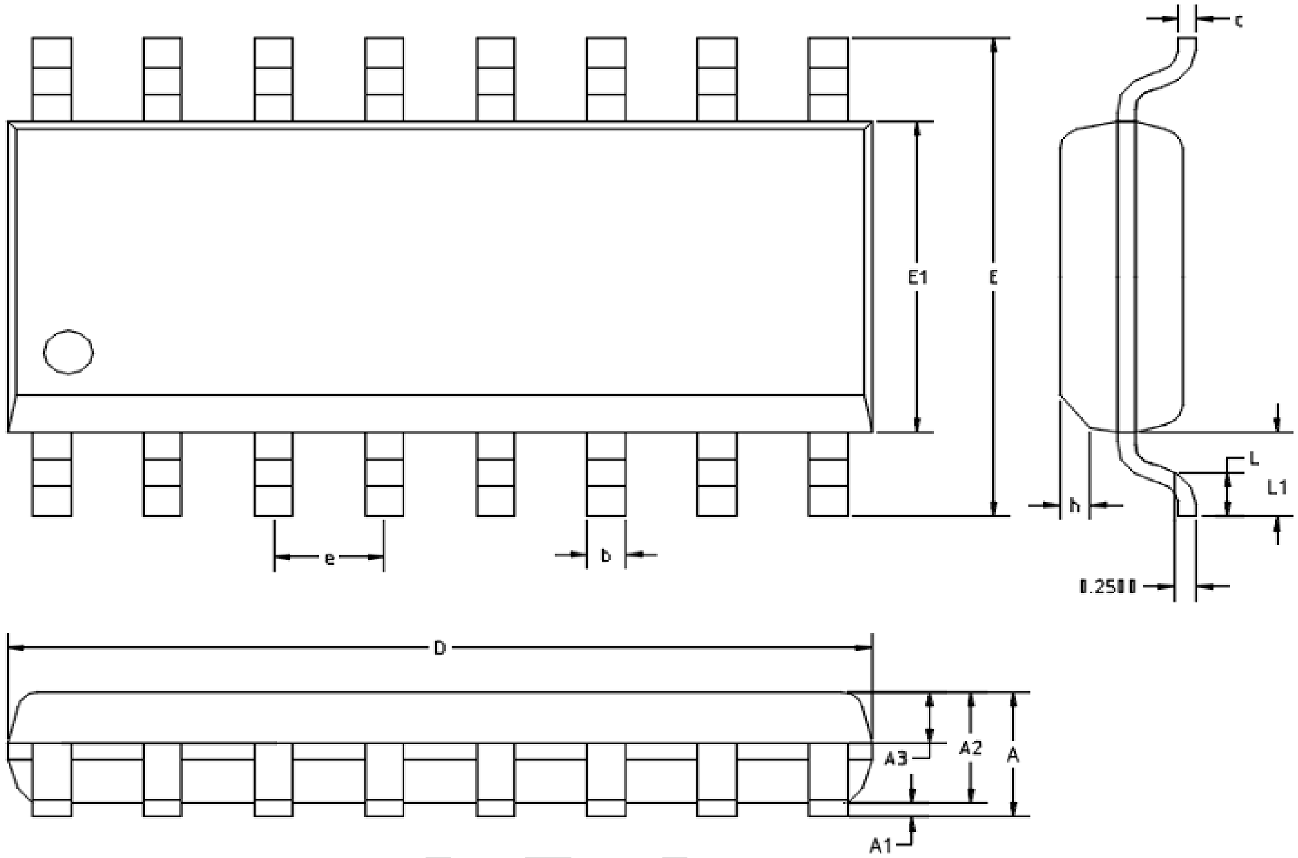
$$Tj = \Psi jt \times P + Tt$$

Step 5 : Calculated Θja value of actual PCB by the known **Tj**

$$\Theta ja(actual) = (Tj - Ta)/P$$

- **Maximum Power Dissipation (de-rating curve) under JEDEC PCB & actual PCB (T.B.F)**

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

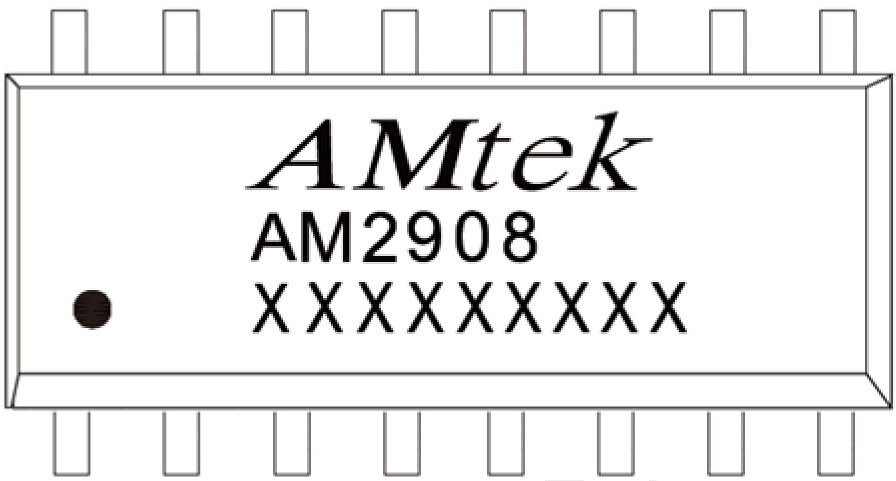


SYMBOL	MILLIMETERS		INCHES	
	Min.	Max.	Min.	Max.
A	--	1.75	--	0.069
A1	0.05	0.225	0.002	0.009
A2	1.30	1.50	0.051	0.059
A3	0.60	0.70	0.024	0.028
b	0.39	0.48	0.015	0.019
c	0.21	0.26	0.008	0.010
D	9.70	10.10	0.382	0.398
E	5.80	6.20	0.228	0.244
E1	3.70	4.10	0.146	0.161
e	1.27 TYP.		0.05 TYP.	
h	0.25	0.50	0.010	0.020
L	0.50	0.80	0.020	0.031
L1	1.05 TYP		0.041 TYP.	

- **Marking Identification**

Package Type : SOP16

Device : AM2908

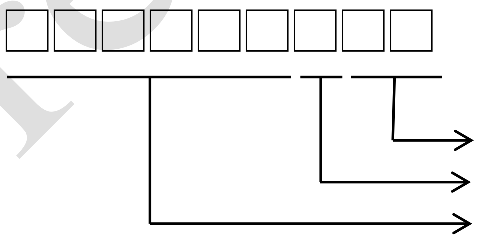


NOTE:

Row1：Logo

Row2：Device Name

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



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)