Three Channels Power Driver AM1217S

The AM1217S is a three-channel driver for DC motors and it integrates the Motor and Logic supply Pins. The AM1217S provides a high integrated motor-driver solution for Helicopters. The output driver block consists of two open-drain N-MOS; one H-bridge to drive motor winding.

The AM1217S operates on a device power-supply voltage from 3.0 V to 6.5 V. CH_A can supply up to 0.8A of output continuous current and 2.0 A of output maximum current ; CH_B and CH_C can supply up to 3.0A of output continuous current and 4.0 A of output maximum current.

The AM1217S has internal shutdown function for Over-temperature protection (TSDp = 150 ° C) , Over-temperature protection recover (TSDr = 125° C) , Power reverse-connect protection to prevent the IC damage in any wrong using ,the CH_B/CH_C have the shutdown function for Over-current protection(I_{OCP} = 4.5 A) ◦

Its package material is Pb-Free and Halogen-Free (Green) for the purpose of environmental protection and for the sustainable development of the Earth.

Applications

RC Helicopter

Features

1) Surface mount package (SOP-16)
2) Lower supply current
3) Lower VCC standby current
4) Lower MOSFETs On-resistance
5) Over-temperature protection
6) Over-temperature protection recover
7) Over-current protection (CH_B&C)

Ordering Information

Orderable Part Number	Package	Marking
AM1217S	SOP-16	AM1217S

Absolute Maximum Ratings (T_A=25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	VCC	7.0	V
CH_A Output continuous current	Iocont	0.8	A
CH_A Output maximum current	Iomax	2.0	A
CH_B/C Output continuous current	Iocont	3.0	A
CH_B/C Output maximum current	Iomax	4.0	A
Operate temperature range	T_{opr}	-40～+125	℃
Storage temperature range	T_{stg}	-40～+150	℃

Recommended operating conditions (TA =25℃)

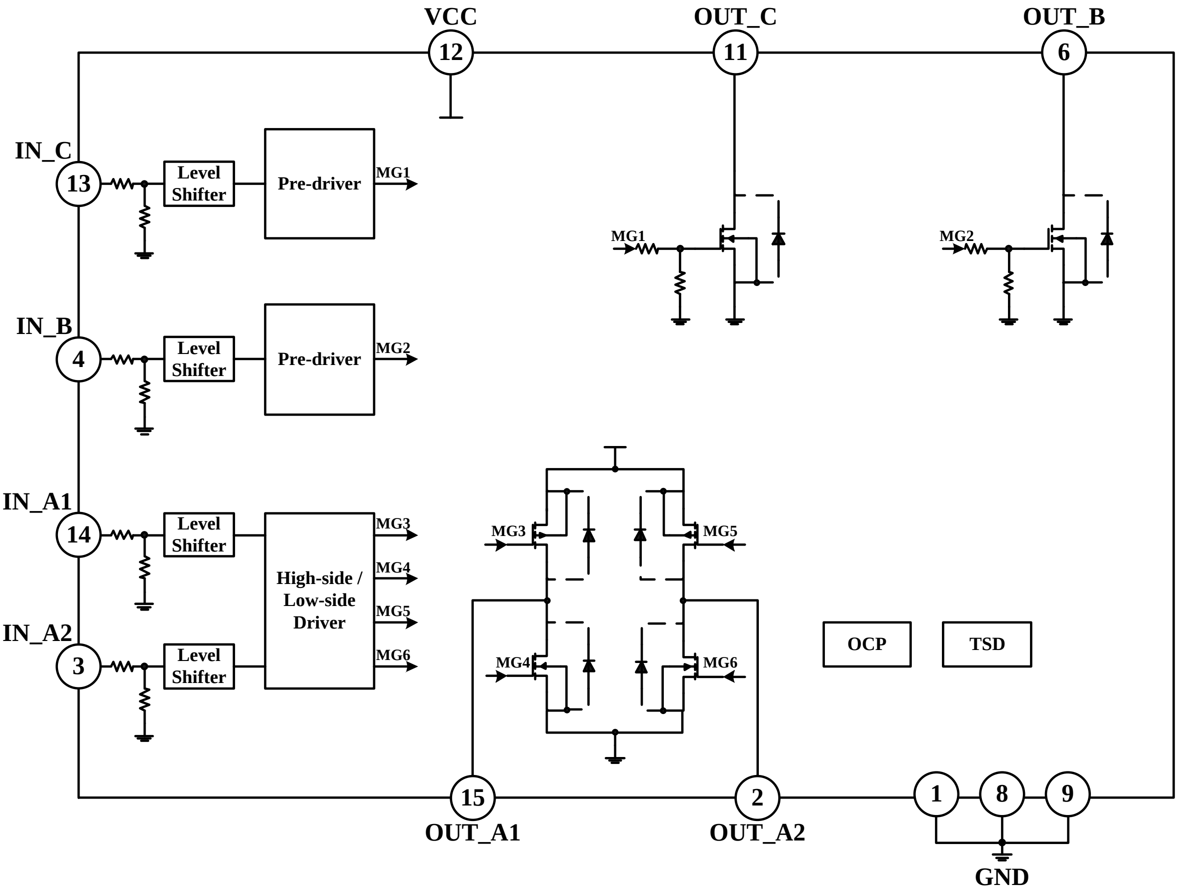
(Set the power supply voltage taking allowable dissipation into considering)

Parameter	Symbol	Min	Typ	Max	Unit
Operating supply voltage range	VCC	3.0		6.5	V
Input signal voltage	V_{IN}	-0.3		Vcc+0.3	V
CH_A output current	I_{OUT}	0		0.8	A
CH_B/C output current	I_{OUT}	0		3.0	A
Externally applied PWM frequency	f_{PWM}	0.02		65	KHz

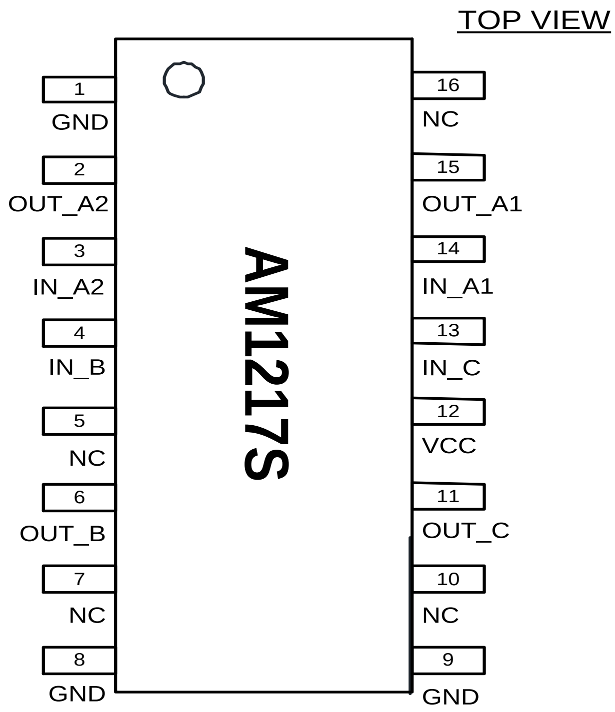
Electrical Characteristics (Unless otherwise specified, Ta = 25℃,V_{CC}=5V)

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Supply current	I_{CC}		25		uA	Input signal IN_AX=H, IN_/B/C= L, No load on OUT_A/B/C
Standby current	I_{STB}		5	10	uA	Input signal IN_AX/B/C=L, No load on OUT_A/B/C
PWM input						
Input H level voltage	V_{PWMH}	2.5		V_{CC}	V	
Input L level voltage	V_{PWML}	0		0.7	V	
Input H level current	I_{PWMH}		30		μA	V_{CC} = 5 V , V_{IN} = 3 V
Input frequency	F_{PWM}	0.02		65	KHz	
Input pulldown resistance	R_{IPD}		100		KΩ	
Output						
On-resistance of CH_A	$R_{ds(on)}$		0.72		Ω	I_{Load}= 200mA Upper and Lower total
On-resistance of CH_B	$R_{ds(on)}$		0.12		Ω	I_{Load} = 600mA, Lower total
On-resistance of CH_C	$R_{ds(on)}$		0.12		Ω	I_{Load} = 600mA, Lower total
Output Protection						
Thermal shutdown protection	TSD_p		150		℃	
Thermal shutdown release	TSD_r		125		℃	

Block Diagram



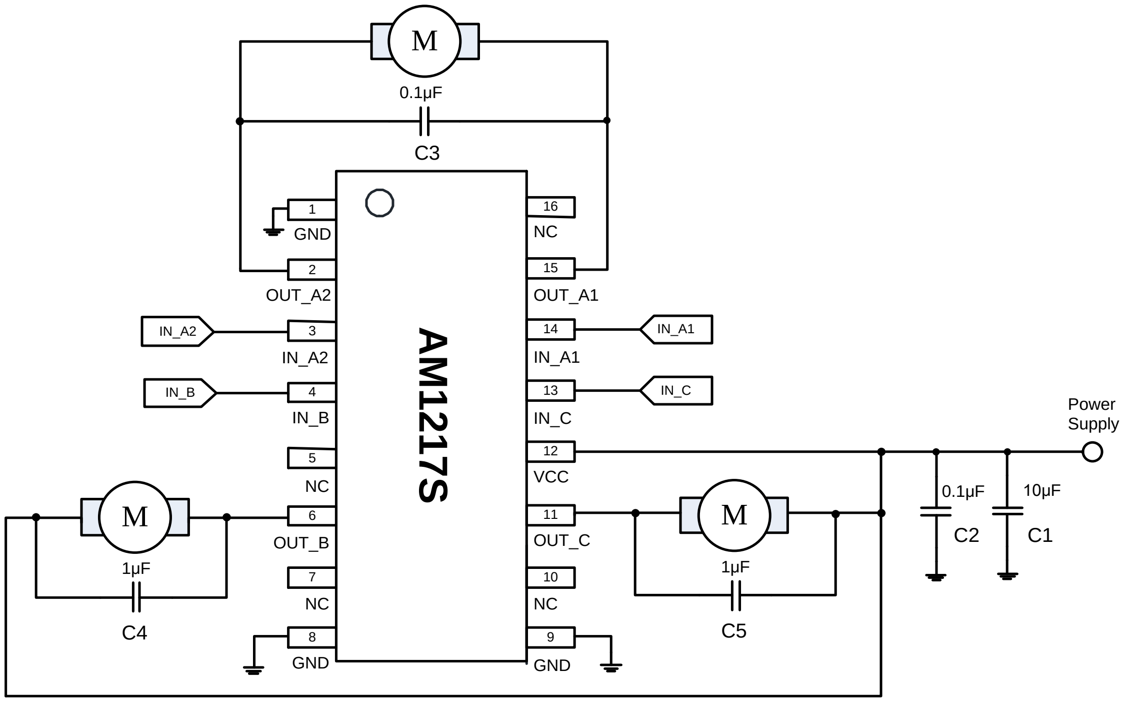
- **Pin configuration**



- **Pin Description**

PIN No	Pin Name	I/O	Description
1	GND	-	Ground
2	OUT_A2	O	Output negative terminal of CH_A
3	IN_A2	I	Input reverse signal for CH_A
4	IN_B	I	Input of CH_B
5	NC	-	No connector
6	OUT_B	O	Output negative terminal of CH_B
7	NC	-	No connector
8	GND	-	Ground
9	GND	-	Ground
10	NC	-	No connector
11	OUT_C	O	Output positive terminal of CH_C
12	VCC	-	Power input
13	IN_C	I	Input of CH_C
14	IN_A1	I	Input forward signal for CH_A
15	OUT_A1	O	Output positive terminal of CH_A
16	NC	-	No connector

- **Application**



- **Circuit Descriptions**

The functional description of capacitors on the application circuits:

I. C1, C2: V_{CC} input capacitor:

1) The capacitor can reduce the power spike from the motor, to avoid the IC being directly damaged by the peak voltage. It also can stabilize the Vcc voltage and decay its ripples.
2) The capacitor can offer motor the compensated power in motor start running.
3) The capacitor value depends on the value of the VCC and motor loading. In general, a 10μF capacitor is enough in low voltage power (VCC). If the large voltage power or a heavy loading motor is used, a larger capacitor should be chosen.
4) On the PCB configuration, the C1&C2 must be mounted as close as possible to VCC (PIN12).

II. C3, C4, C5: The across-motor capacitor:

1) The C3 capacitors can reduce the power spike of motor in start running. A 0.1μF capacitor is recommended.
2) The C4&C5 capacitors can reduce the power spike of motor in start running. A 1μF capacitor is recommended

- **Input Logic Description**

Function truth table of CH_A

IN_A1	IN_A2	OUT_A1	OUT_A2	Mode
L	L	L	L	Stop/ Brake
L	H	L	H	Reverse
H	L	H	L	Forward
H	H	L	L	Stop

Function truth table of CH_B/CH_C

IN_B/IN_C	OUT_B/OUT_C	Mode
L	H	Open
H	L	Active

※Low standby current function when IN_A1 = IN_A2 = IN_B = IN_C = Low level

Operating Mode Descriptions

1) H-Bridge basic operation mode

a) Forward mode

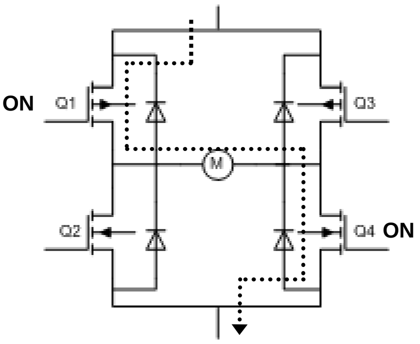
Definition：When IN_A1=H，IN_ A2=L，then OUT_A1=H，OUT_A2=L

b) Reverse mode

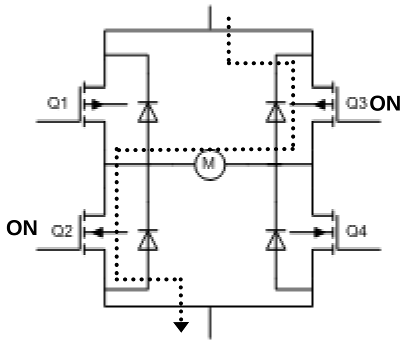
Definition：When IN_A1=L，IN_ A2=H，then OUT_A1=L，OUT_ A2=H

c) Stop/Break mode

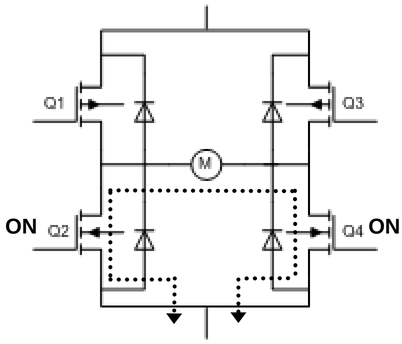
Definition：When IN_A1=IN_ A2=L or H，then OUT_A1=OUT_ A2=L



(1) Forward mode



(2) Reverse mode



(3) Stop/Break mode

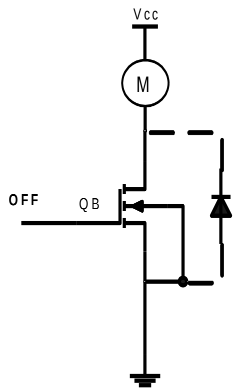
2) CH_B/C basic operation mode

a) Stop mode

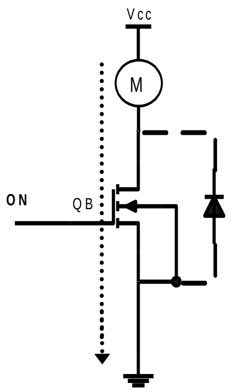
Definition : When IN_B/C = L，then OUT_B/C = H

b) Start mode

Definition : When IN_B/C = H，then OUT_B/C = L



(1)Stop mode



(2) Start mode

Protection Descriptions

1) Over-temperature protection

If the IC junction temperature exceeds 150°C (Typ), the internal over-temperature protection circuits will be triggered and all the FETs in H-bridge are disabled to ensure the safety of customers' products. If it falls to 125°C(Typ), the IC resumes automatically.

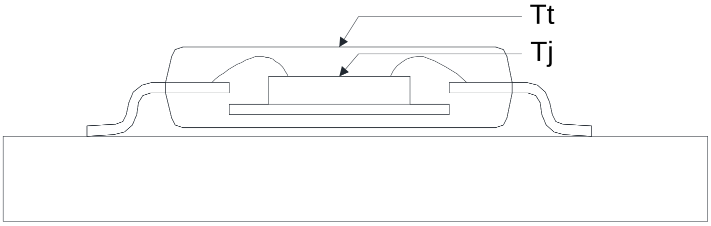
2) Over-current protection (OCP)

While the CH_B/C passes through a large current, 4.5A (Typ), the internal OCP circuits will be triggered and entry a protection mode of auto-recover to avoid damage in IC and EE system of device.

- **Thermal Information**

θja	junction-to-ambient thermal resistance	87.41℃/W
Ψjt	junction-to-top characterization parameter	4.15℃/W

- **Θja** is obtained in a simulation on a JEDEC-standard 1s0p board as specified inJESD-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:



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

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

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

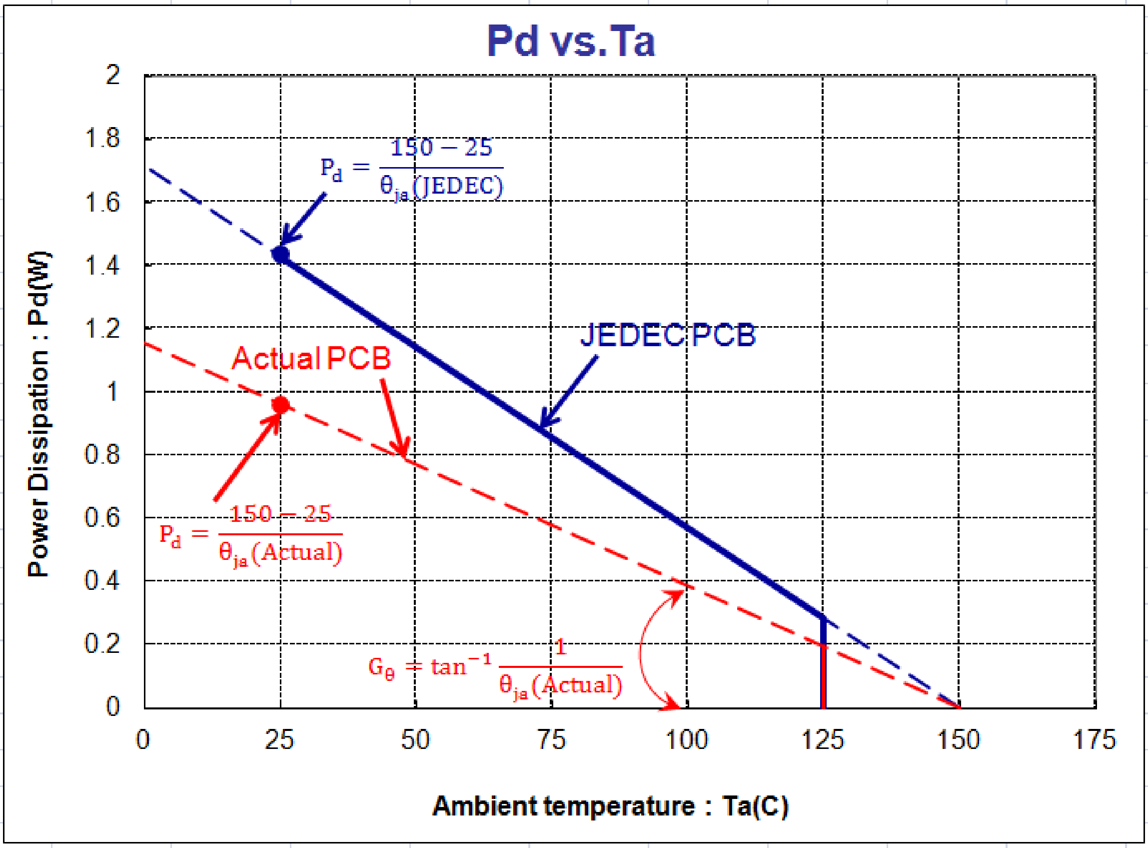
Step 4 : Estimate **Tj** value by

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

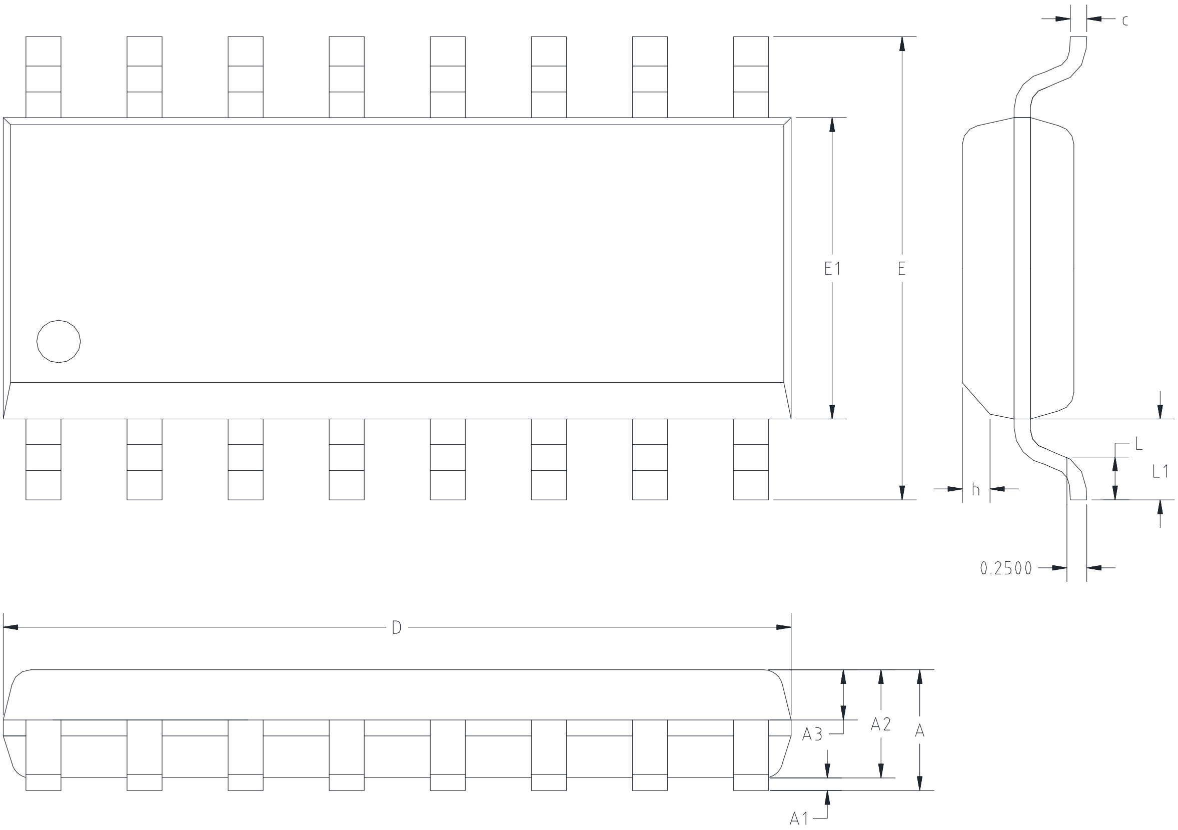
Step 5: Calculated Θja value of actual PCB by the known **Tj**

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

- **Maximum Power Dissipation (de-rating curve) under JEDEC PCB & actual PCB**

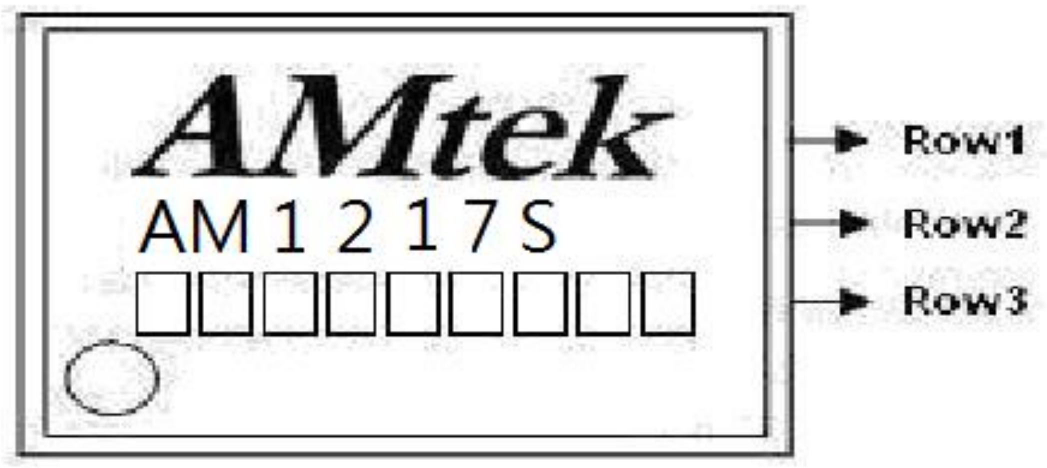


- **Packaging outline --- SOP16** **Unit: mm**



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**

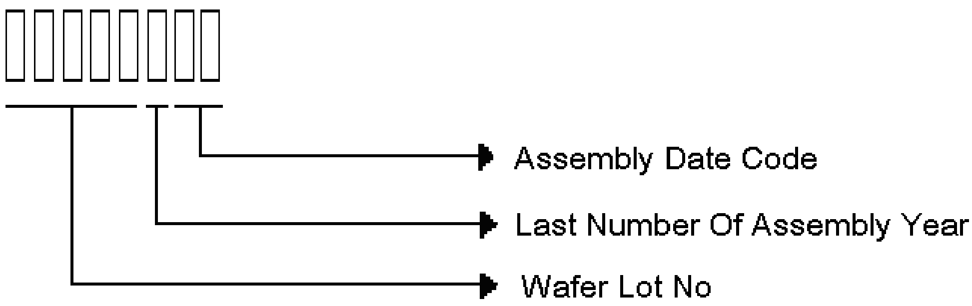


NOTE:

Row1 ： Logo

Row2 ： Device

Row3 ： Wafer Lot No、Assembly Year、Assembly Date Code



Example : Wafer Lot No is CH + last number of assembly year is 2 (C=2) + produce at the week 51

Then mark 〝88888C51〞

Assembly Year Code：

(Year_A=0,B=1,C=2,D=3,E=4,F=5,G=6,H=7,I=8,J=9, e.g. : 2012=C)