承康科技有限公司

MAGNETIC INTEGRATED TECHNOLOGY CO., LTD.

MA93應用手冊

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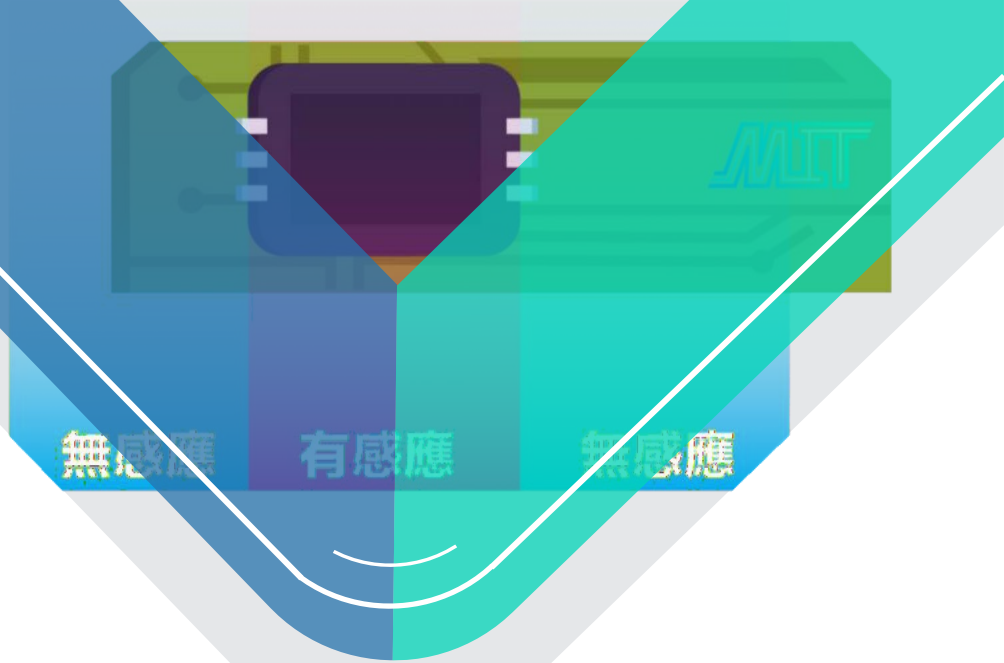

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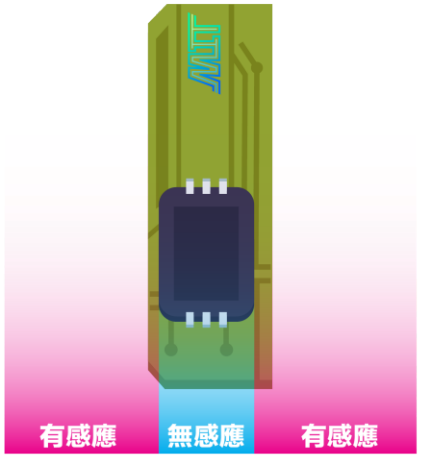
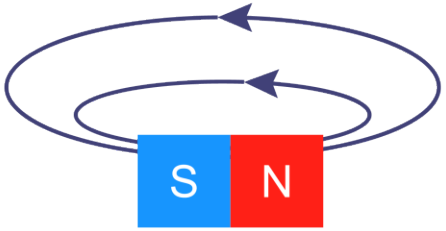
AMR感應方向說明-1

方向1

IC窄邊(側邊)對著磁環

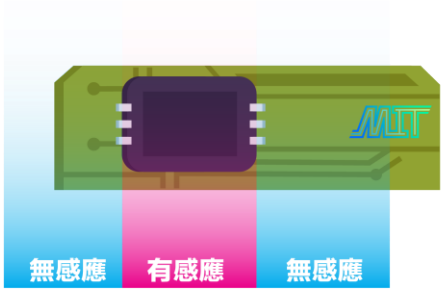


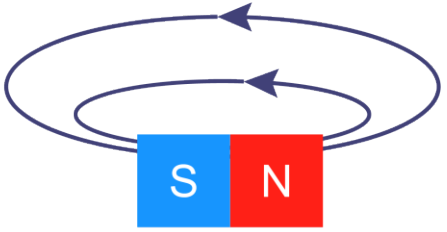


不正確感應方向

方向2

IC (側邊)對著磁環





正確感應方向

AMR感應方向說明-2

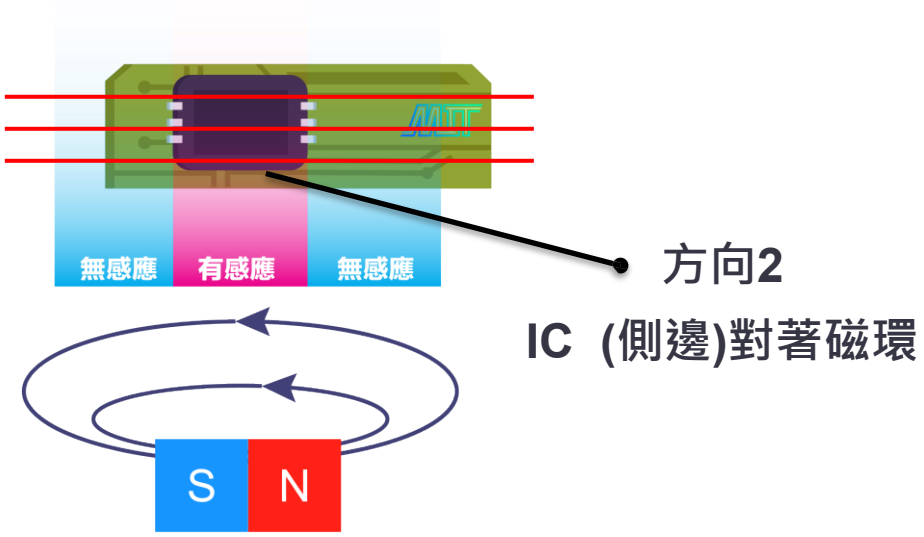
Question summary：

Q1. 為什麼在方向2的使用狀況下，不管多近多遠都只有在磁鐵正上方有一次感應?

Q2. 為什麼在前頁所述方向1的使用狀況下，會有兩次感應，且在磁鐵正上方沒有感應?

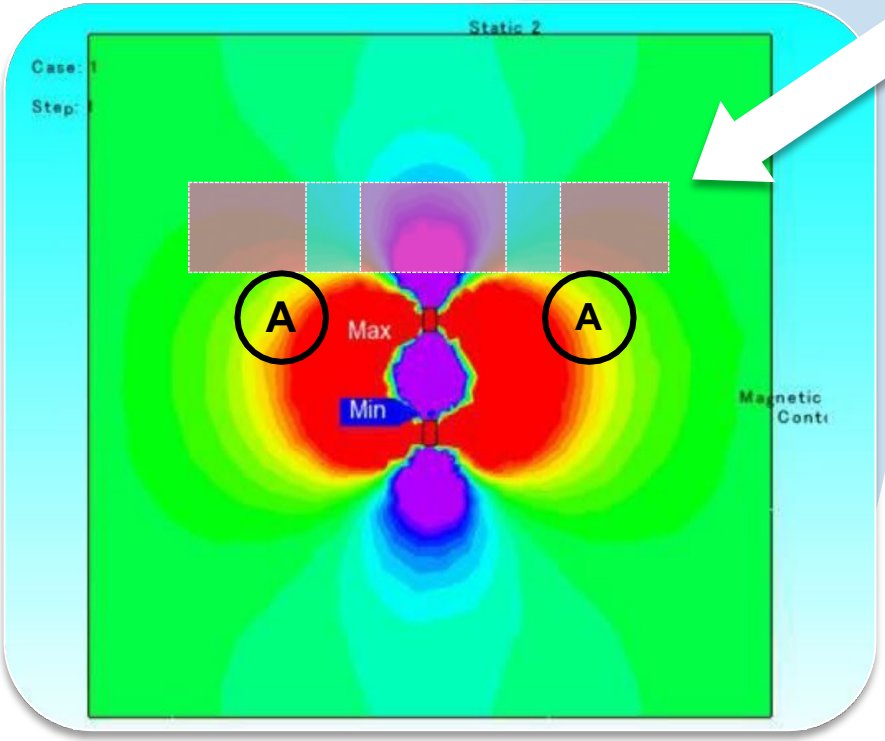
Ans：

MA93(AMR)產品只能感應水平方向的磁場，如下紅線所畫，**這是一個1D的磁開關**，**並不是2D的磁開關**，只有如下列紅色水平的磁力線方向才能正確做動MA93



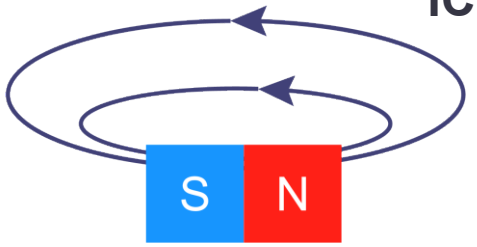
AMR感應方向說明-3

在下圖的磁力線的圖示中(方向3)，**在標注圓圈A處**，是存在微弱的磁力分量的，這是導致有晶片會有感應，並且靈敏度越高，會觸發感應的機率會越大這就是為什麼更高靈敏度的磁開關更為容易觸發



方向3

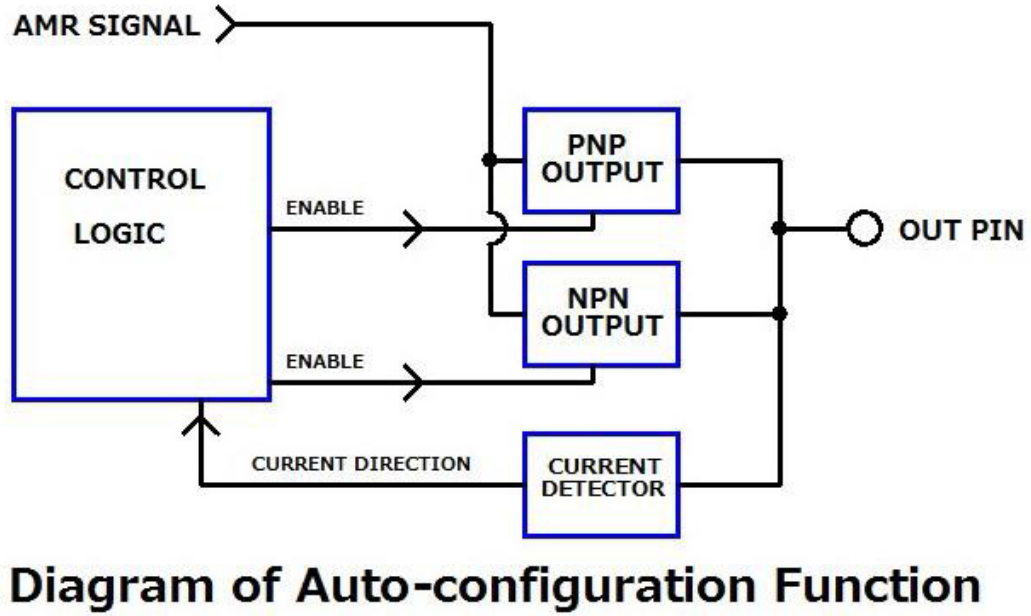
IC marking (正面)對著磁環



MA93不正常閃爍可能原因

- MA93感磁方向問題,左圖顯示為IC marking面對磁環的邊角磁力線
- MA93 Bop and Brp 臨界值問題

NPN PNP自動判斷原理說明



Block Diagram of Auto-configuration Function

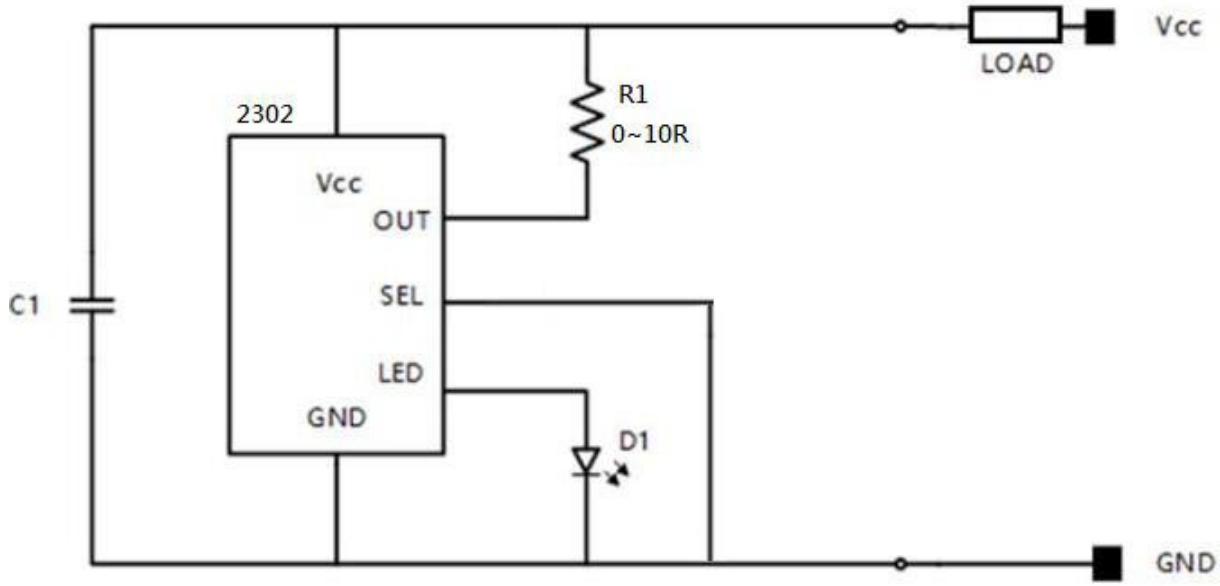
承康科技磁感IC自動判斷示意圖

- 在IC內部設計有一個自動偵測路線來判斷IC out pin(輸出腳)在上電瞬間時電流是流入還是流出，藉此推動一個Latch Device(栓取器)來選擇並鎖定NPN或PNP來作為輸出級，藉此功能可實現NPN/PNP在三線式電路設計上達到共用一套線路BOM即可完成二種不同輸出模式的功能

MA93散熱相關說明-1

TYPICAL APPLICATION CIRCUIT

SYMBOL	RECOMMEND
R1	10Ω or 0Ω, depends on different load conditions, refer to application notes
C1	0.1μF

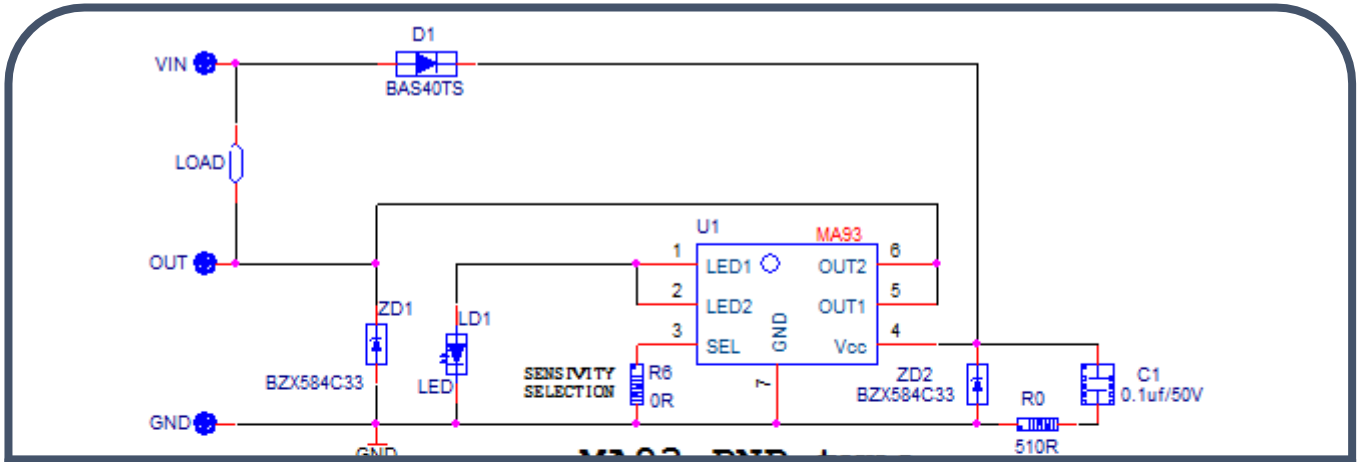


2-Wire Typical Circuit

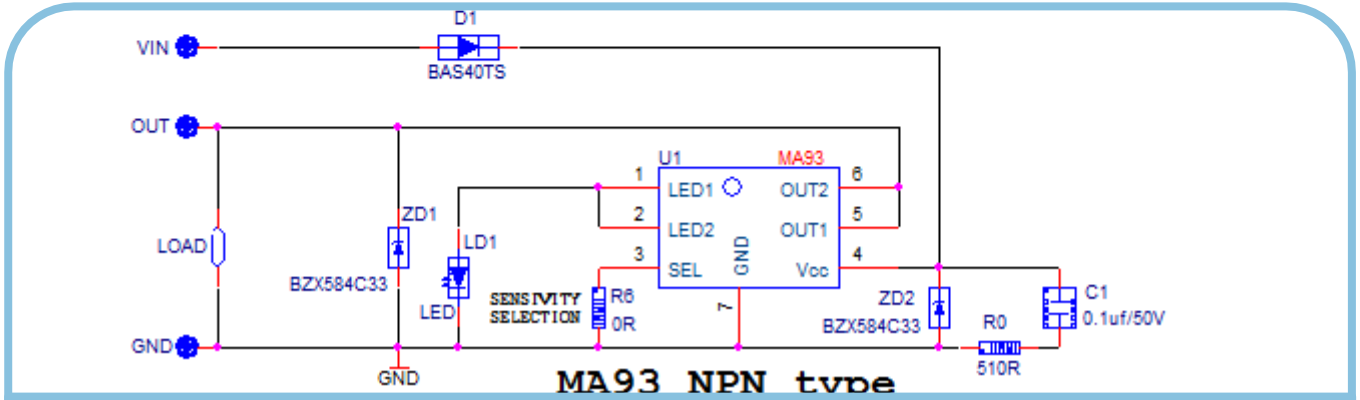
MA93散熱相關說明-2

3-Wire Typical Circuit

For both pull-up and pull-down load in 3-wire applications a constant current will be provided to LD1



3-wire with pull-up load

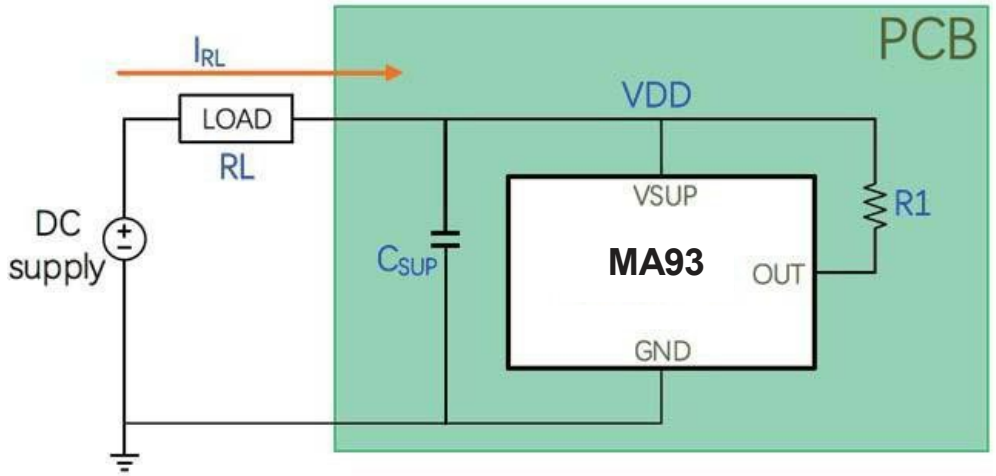


3-wire with pull-down load

MA93散熱相關說明-3

R1 selection guide in 2-wire applications

The 2-wire cylinder application circuit employing the MA93 is demonstrated in following recommend circuit. A decoupling capacitor C_{SUP} and resistor R1. In 2-wire application, the PCB is connected to a load element with the load resistance RL and load current IRL.



Recommended 2-wire cylinder application circuit
(for simplity the LED pad and SEL pad are not shown)

MA93散熱相關說明-4

R1 is added to relieve the IC overheating issue when IRL is high, after adding R1, the total PCB power will be distributed between R1 and the IC. In 2-wire application, if R1.IRL<3V, the VDD will be clamped by the IC at around 3V, so the power consumption is given by:

$$PPCB \approx VDD \times IRL = 3V \times IRL \quad (1)$$

$$PR1 = I2RL*R1 \quad (2)$$

$$PIC \approx PPCB \times PR1 = 3V \times IRL - I2RL \times R1 \quad (3)$$

Following table is the power distribution for typical I_{RL} value, @ R1=10Ω

I_{RL} (mA)	P_{PCB} (mW)	P_{R1} (mW) @ R1=10Ω	P_{IC} (mW) @ R1=10Ω
2	6	0.04	5.96
20	60	4	56
50	150	25	125
100	300	100	200
200	600	400	200

Following table is the power distribution for typical R1 value, @ I_{RL} =50mA

I_{RL} (mA)	P_{PCB} (mW)	P_{R1} (mW) @ R1=10Ω	P_{IC} (mW) @ R1=10Ω
0	150	0	150
5	150	12.5	137.5
10	150	25	125
20	150	50	100
50	150	125	25

All these data can be derived through the equation (1)~(3) For IRL in the range of 2mA~200mA, we recommend R1=10Ω

MA93散熱相關說明-5

In addition, we recommend reading through the following important notes:

1. R1 s power limit should be checked, especially for small-package SMT resistors. Customer should calculate their PR1 through equation (2) to make sure it does not exceed R1 s power limit. In cases when the IC heating issue is not severe (e.g., when I_{RL} is very low), R1 can be simply 0Ω
2. MA93 has internal over temperature protection mechanism to prevent it from over-heating and thermal damage. The following equation can be used to estimate the IC s temperature rise:

$$T_J = T_A + R_{\Theta JA} \times P_{IC} \quad (4)$$

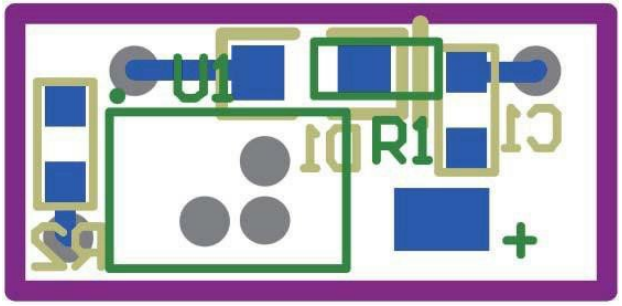
Where T_J is IC s internal junction temperature, T_A is environment temperature, $R_{\theta JA}$ is thermal resistance. If T_J exceed 130°C, the IC will enter over-temperature protection mode where the output driver is turned off momentarily.

3. Thermal resistance $R_{\theta JA}$ depends strongly on the PCB layout. $R_{\theta JA}$ should be minimized the reduce the IC's internal temperature rise and prevent it from entering over-temperature mode. The next section provides some design guidelines for PCB layout. It is estimated that $R_{\theta JA}$ =430°C/W can be achieved the layout presented int eh following section.
4. It is also possible to pick a higher R1 value to reduce the IC's power consumption P_{IC}. But it should be noted that choosing a different R1 only changes the distribution of the total PCB power P_{PCB}, it does not reduce P_{PCB}.
5. R1 greater than 3V/I_{RL} is not recommended.

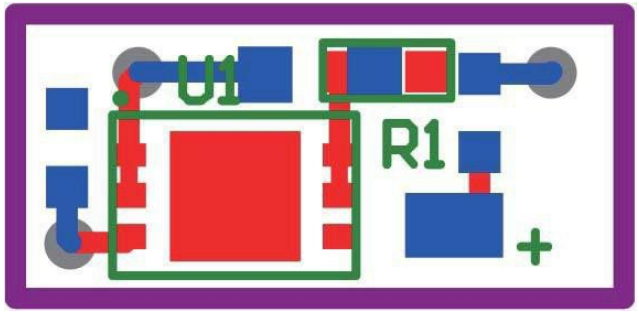
MA93散熱相關說明-6

RECOMMEND PCB Layout guidelines

1. For the purpose of better heat dissipation, apply mass copper clad on the PCB back side, also apply copper clad on the front side if the PCB area allows.
2. The routing line of Vcc, OUT and GND pad should be greater than 10mil because they are large current pads.If PCB area allows, increase these lines width to 20mil or even use copper clads to route these lines.
3. The SEL and LED are small current pads, so PCB trace connected to those 2 signals can have the minimum width.
4. At least 2 vias are required on the GND copper clad. More vias help to conduct the heat more efficiently
5. Add teardrops around PCB pads to increase reliability and to avoid high voltage tips.
6. If possible, apply 2-ounce copper on the PCB for better head dissipation.



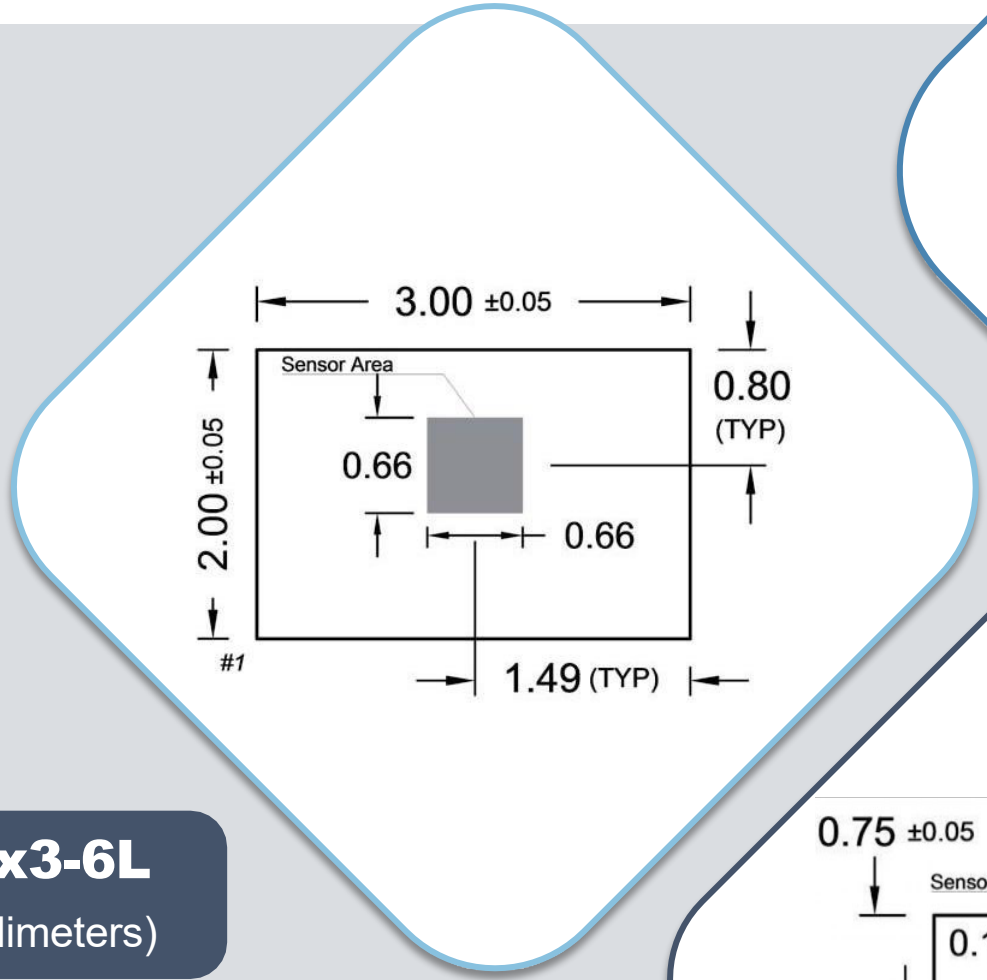
Front side

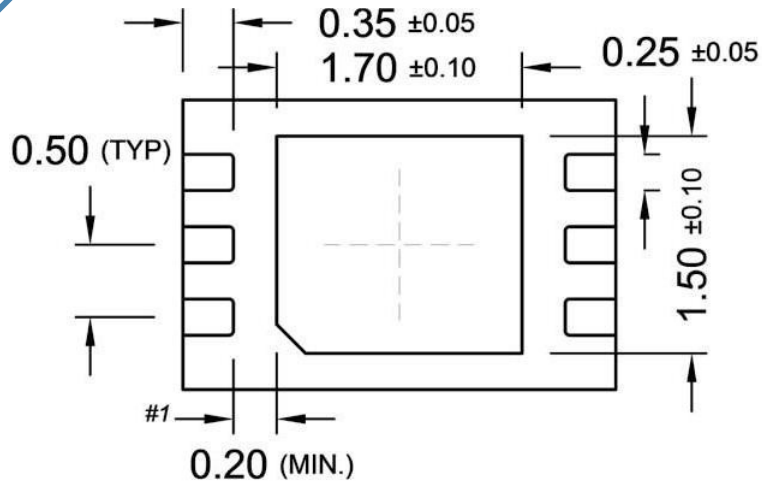


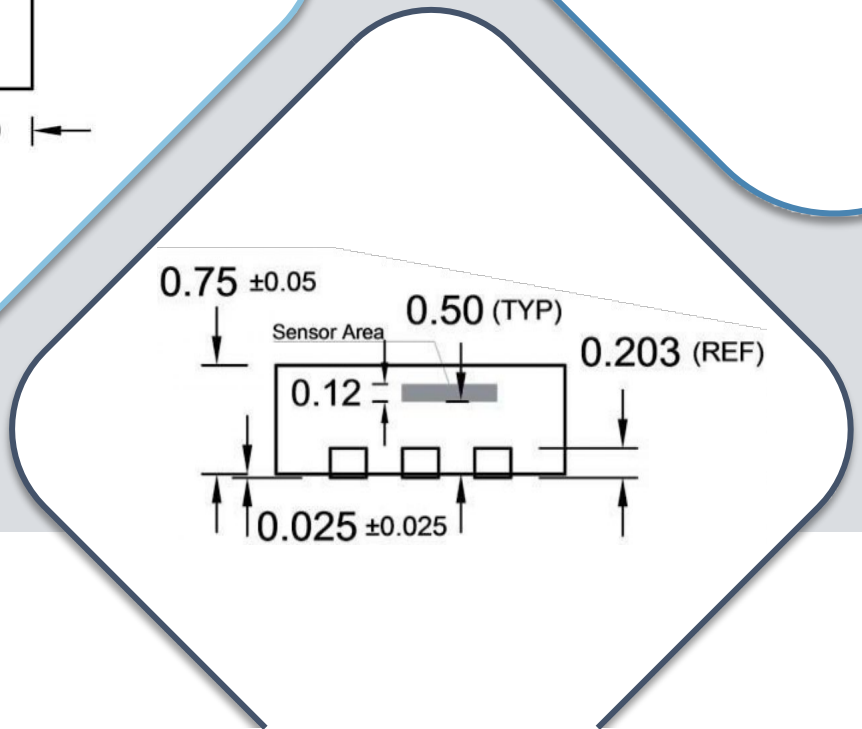
Back side

MA93散熱相關說明-7

PACKAGE OUTLINE DIMENSIONS







DFN2x3-6L

(Unit: Millimeters)

THANKS YOU

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