



# EIA Workshop II

November 6, 2010

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## **Logic Gates (邏輯門)**

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# Developing a Project

## 項目開發

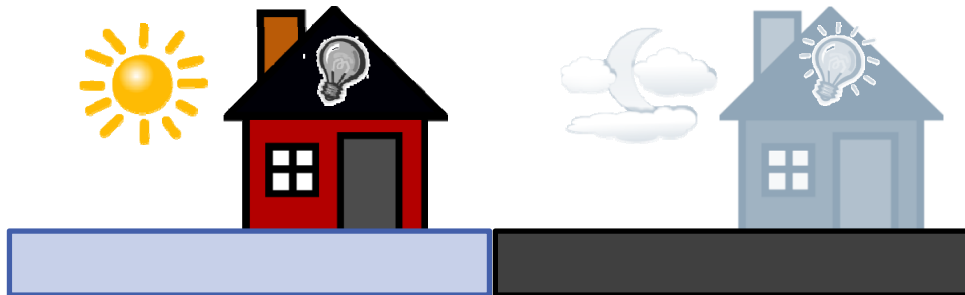
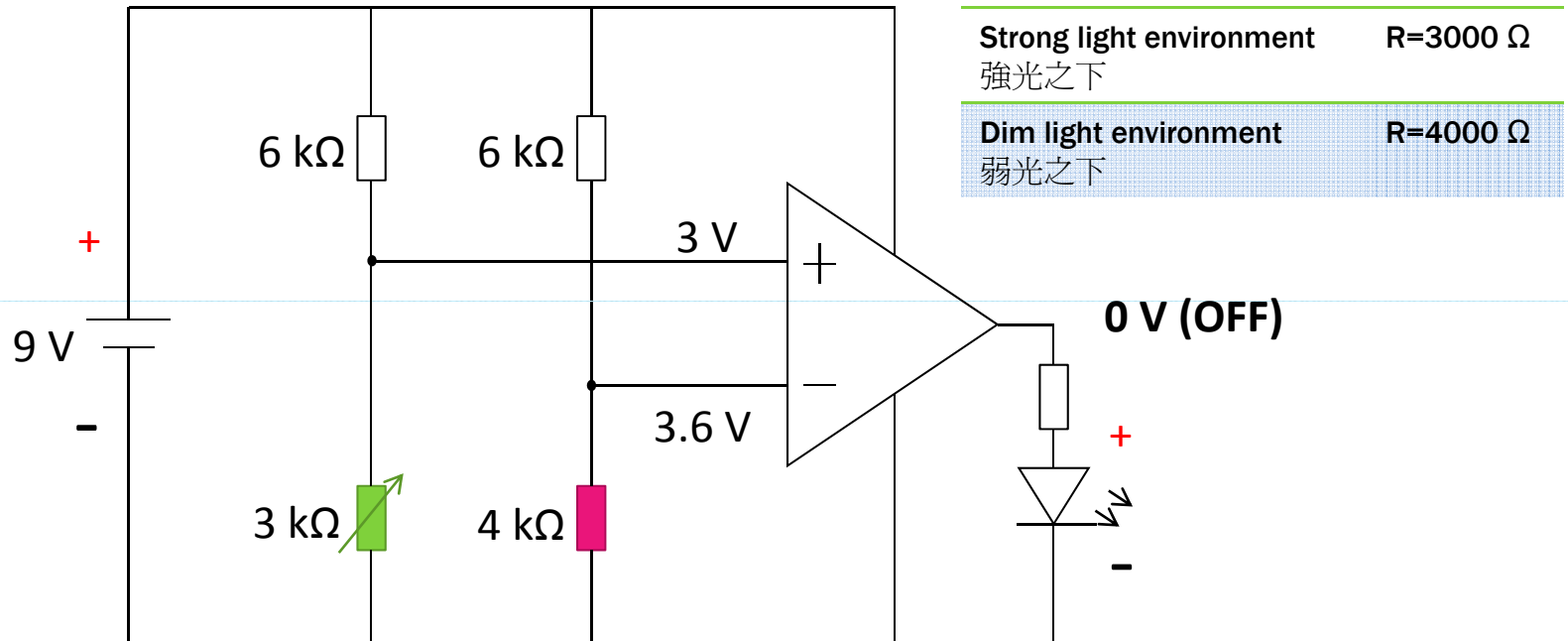
Detection  
(Sensor)  
探測  
(感應器)

Process  
(Logic Gates)  
處理  
(邏輯門)

Action  
(KMK/Others)  
行動  
(KMK/其他)

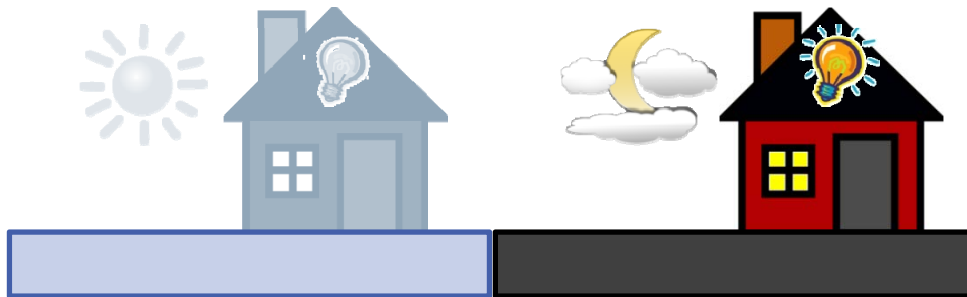
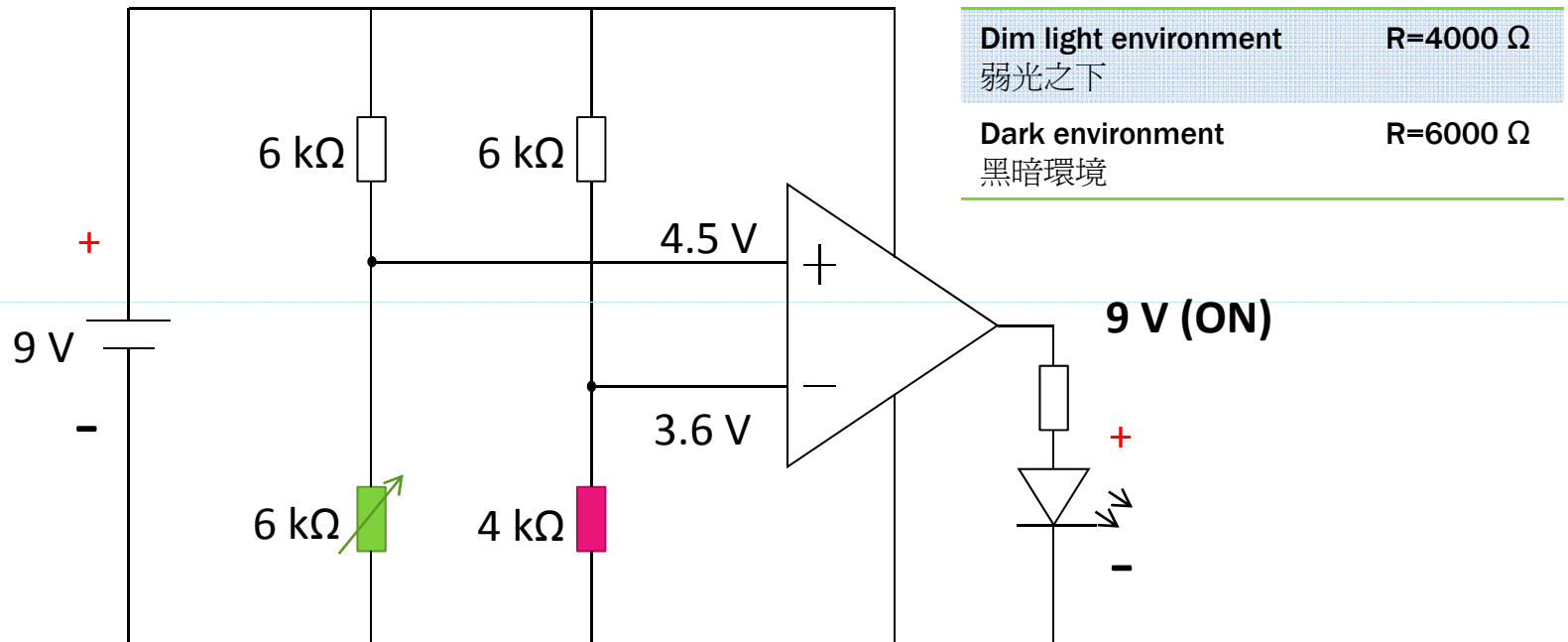
# Review: Detection

## 複習: 探測



# Review: Detection

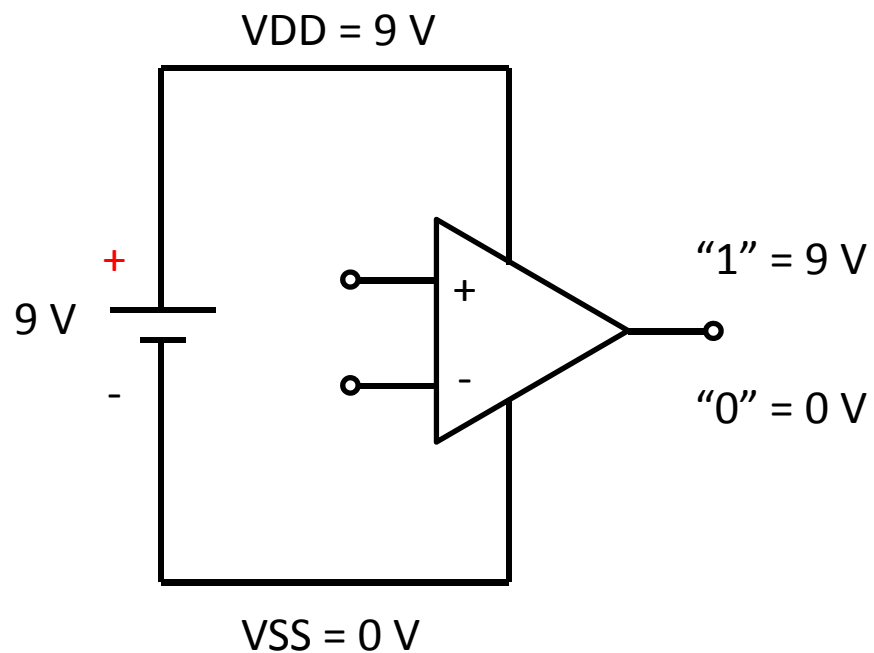
## 複習: 探測



# Digital Logic

## 數字邏輯

State 狀態	Digital Representation 數位表示法	Voltage 電壓
ON	"1"	VDD
OFF	"0"	VSS



# Logic Gates

## 邏輯門

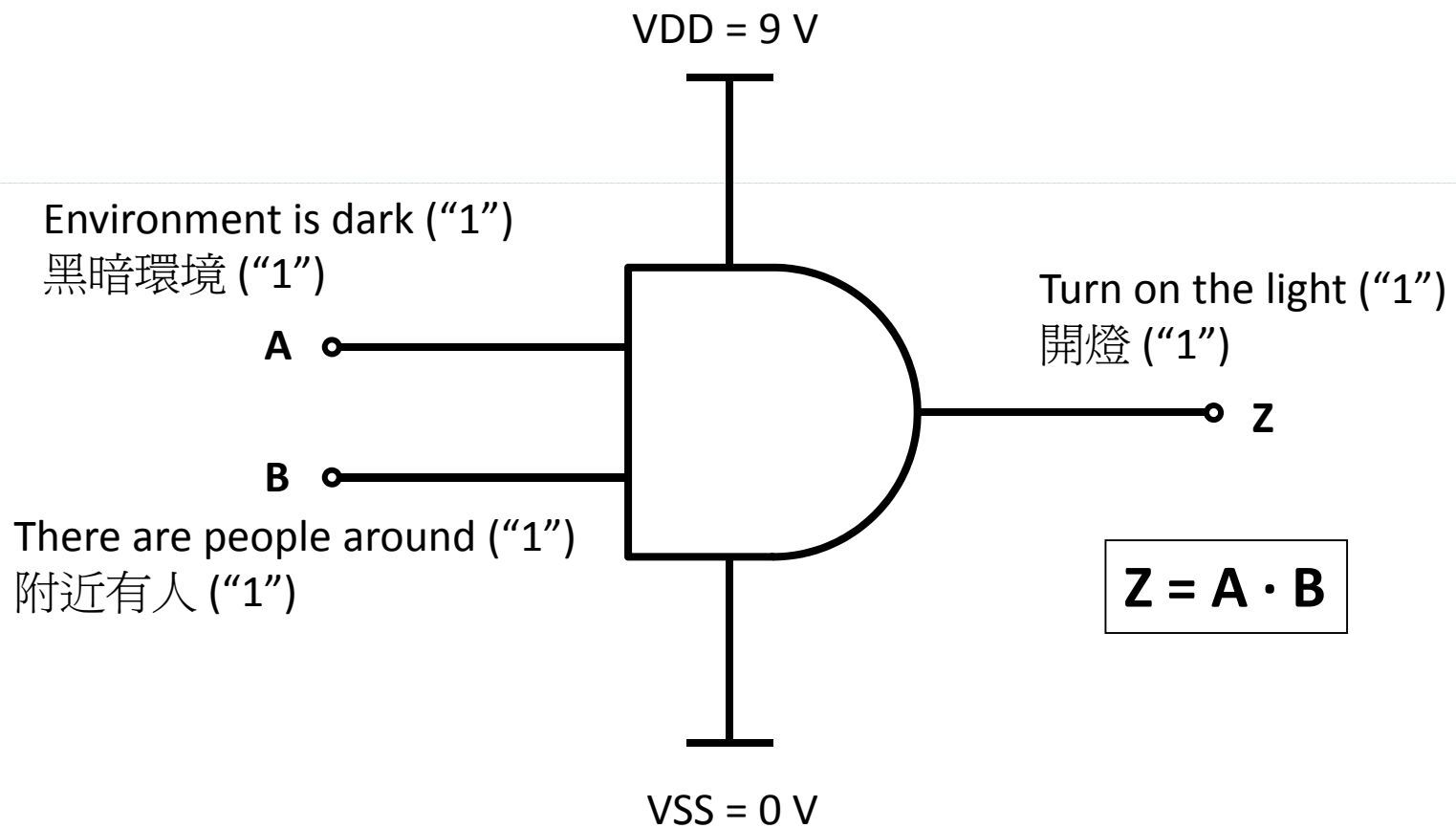
- AND Gate (與門)
- OR Gate (或門)

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- NOT Gate (非門)
- XOR Gate (異或門)
- NAND Gate (與非門)
- NOR Gate (或非門)

# AND Gate

## 與門



# AND Gate

## 與門

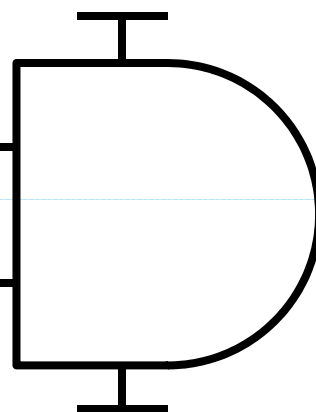
Environment is bright ("0")

強光環境 ("0")



There are people around ("1")

附近有人 ("1")



Turn off the light ("0")

關燈 ("0")



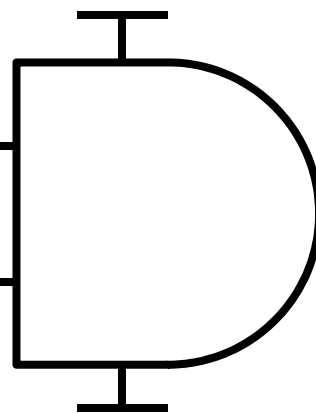
Environment is dark ("1")

黑暗環境 ("1")



There is no one around ("0")

附近無人 ("0")



Turn off the light ("0")

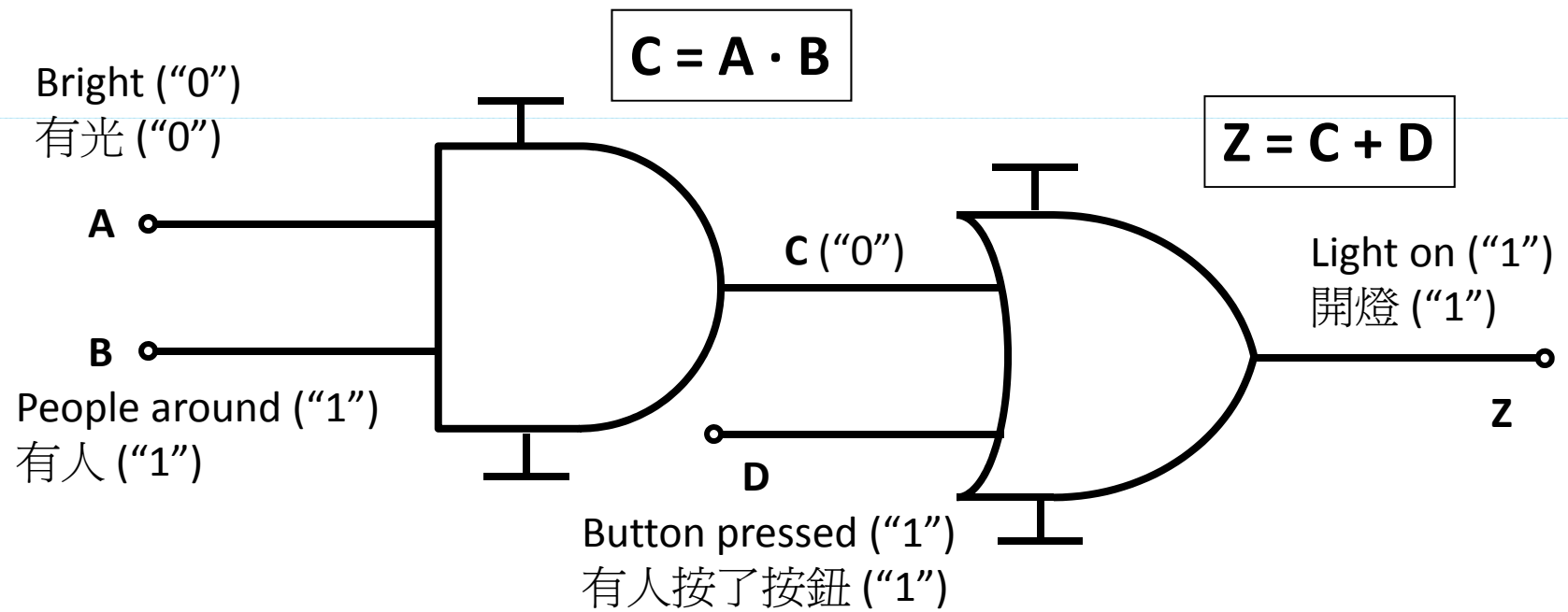
關燈 ("0")





# OR Gate

## 或門



# Truth Table

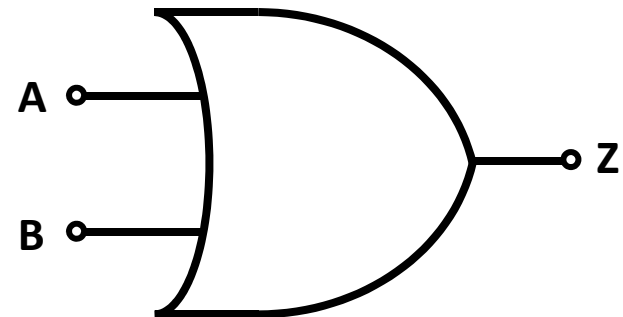
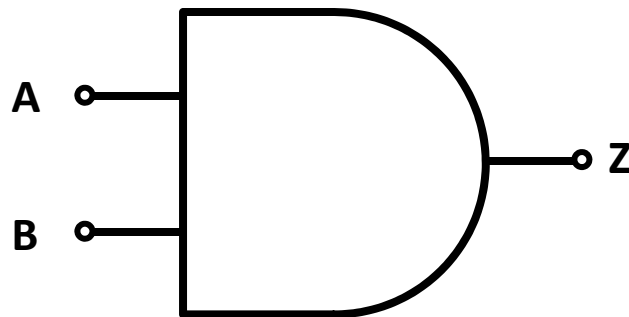
## 真值表

**AND Gate 與門**

A	B	Z
0	0	0
0	1	0
1	0	0
1	1	1

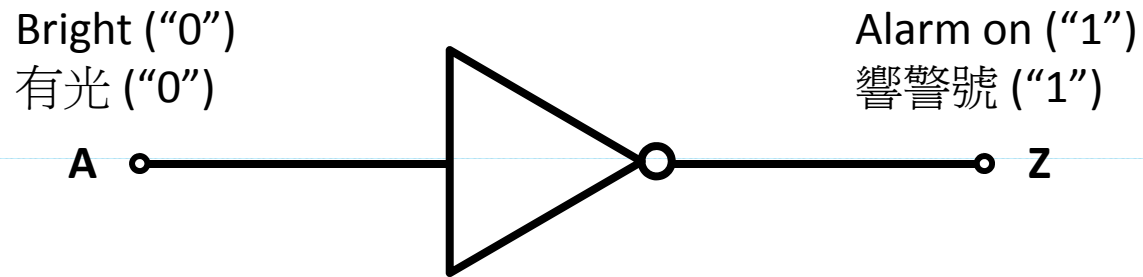
**OR Gate 或門**

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1



# NOT Gate

## 非門



### NOT Gate 非門

A	Z
0	1
1	0

$$Z = \bar{A}$$

# XOR (Exclusive-OR) Gate

## 異或門

Bright on left sensor ("0")  
左邊有光 ("0")

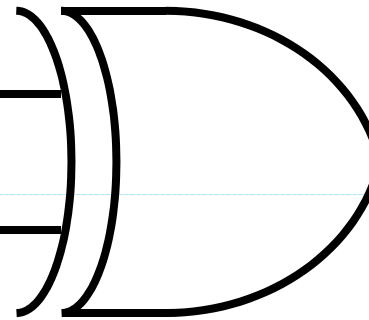
A

B

Bright on right sensor ("0")  
右邊有光 ("0")

Go straight ("0")  
向前直走 ("0")

Z

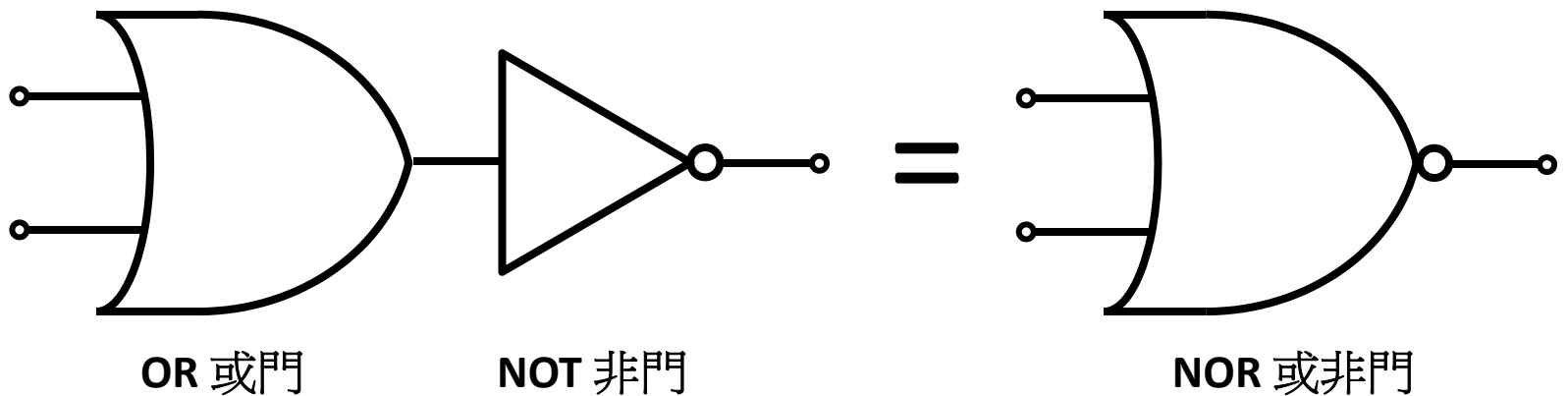
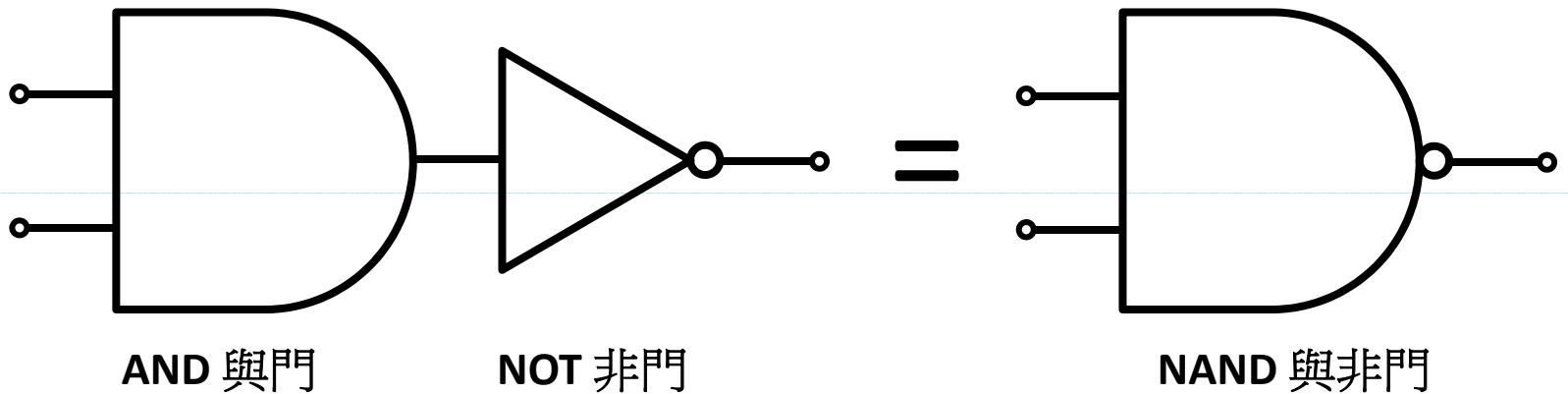


## XOR Gate 異或門

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	0

# Commonly Available Gates

## 其他常用閘門

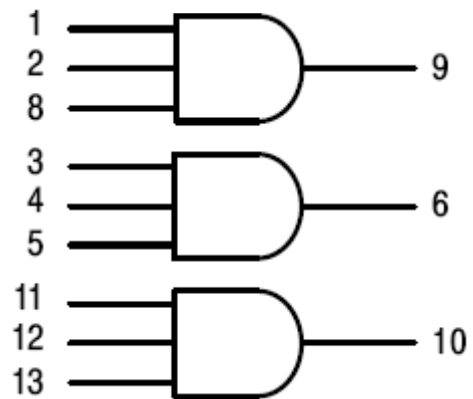


# Multiple Inputs

## 多個輸入

### AND Gate 與門

**MC14073B**  
Triple 3-Input AND Gate



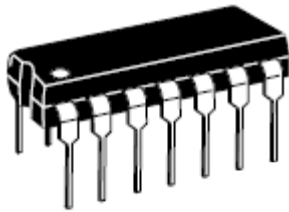
1	2	8	9
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Reference 參考:

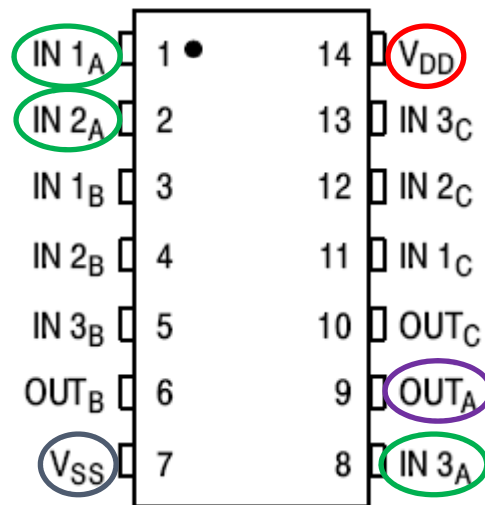
<http://www.onsemi.com/PowerSolutions/product.do?id=MC14073B>

# Commercial Products

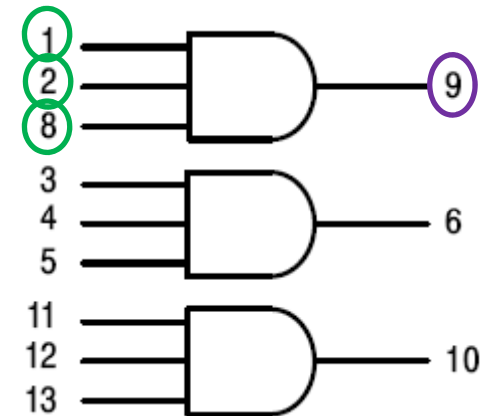
## 商業產品



**MC14073B**  
**Triple 3-Input AND Gate**



**MC14073B**  
**Triple 3-Input AND Gate**

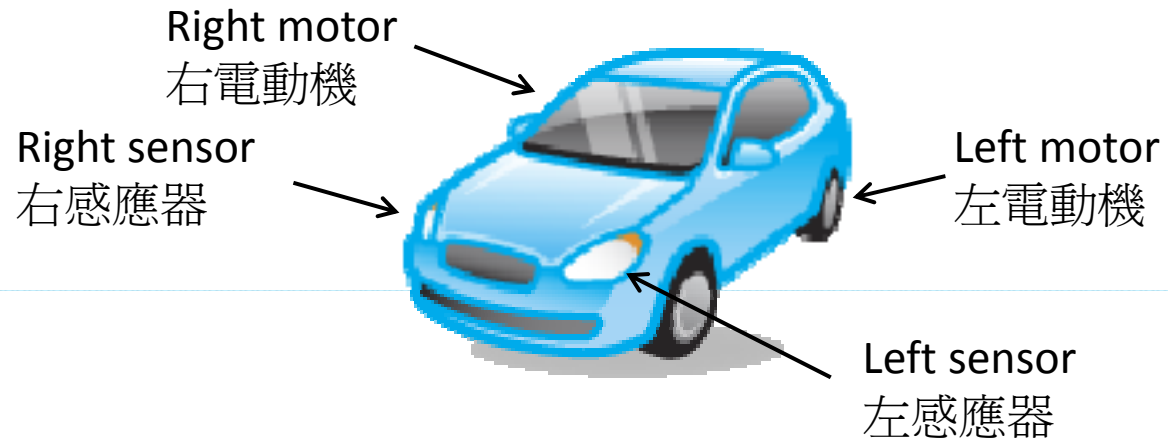


Reference 參考:

<http://www.onsemi.com/PowerSolutions/product.do?id=MC14073B>

# Example – Photophilic Car

## 實例 – 向光行走的車



### Detected signals 探測到的信號

Bright 光 (“0”)  
Dark 暗 (“1”)

### Action signals 行動用的信號

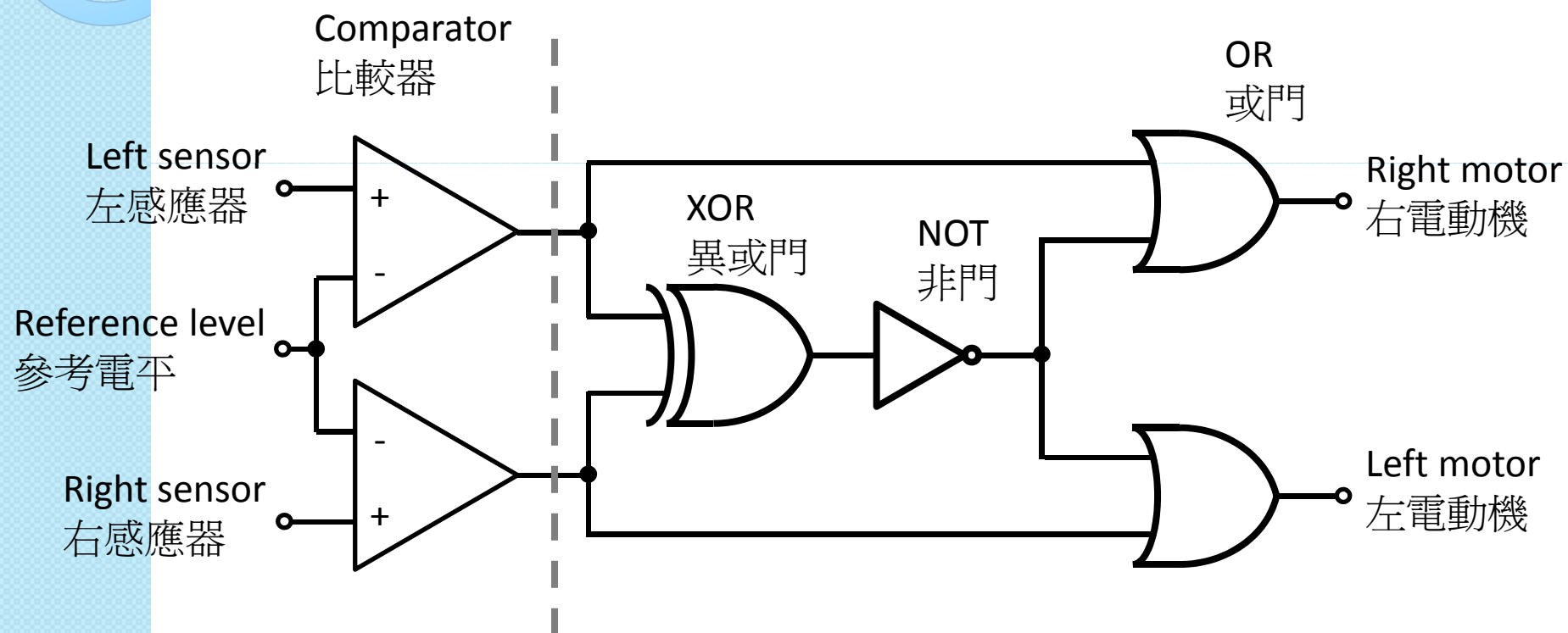
Motor on 開啓電動機 (“1”)  
Motor off 關掉電動機 (“0”)





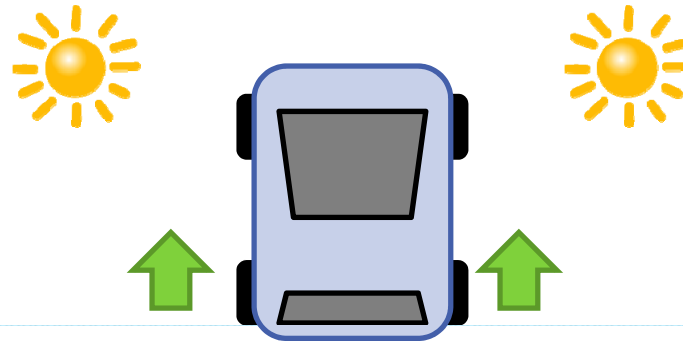
# Example – Logic Circuit

## 實例 – 邏輯線路



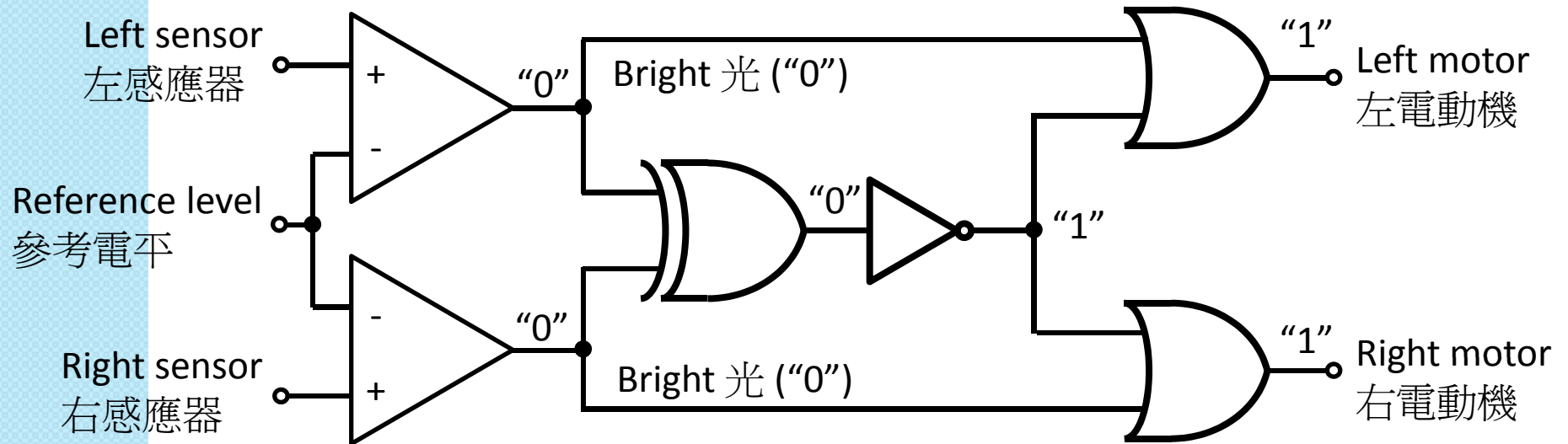
# Example – Logic Circuit

## 實例 – 邏輯線路



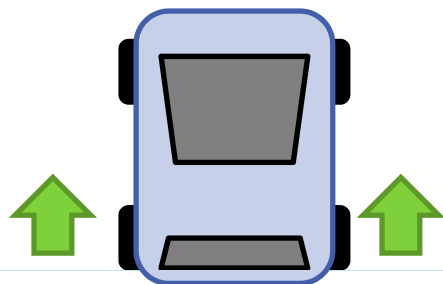
**Scenario 1: Bright on both sides → Go straight**

**情況一: 左右兩邊都有光 → 向前走**



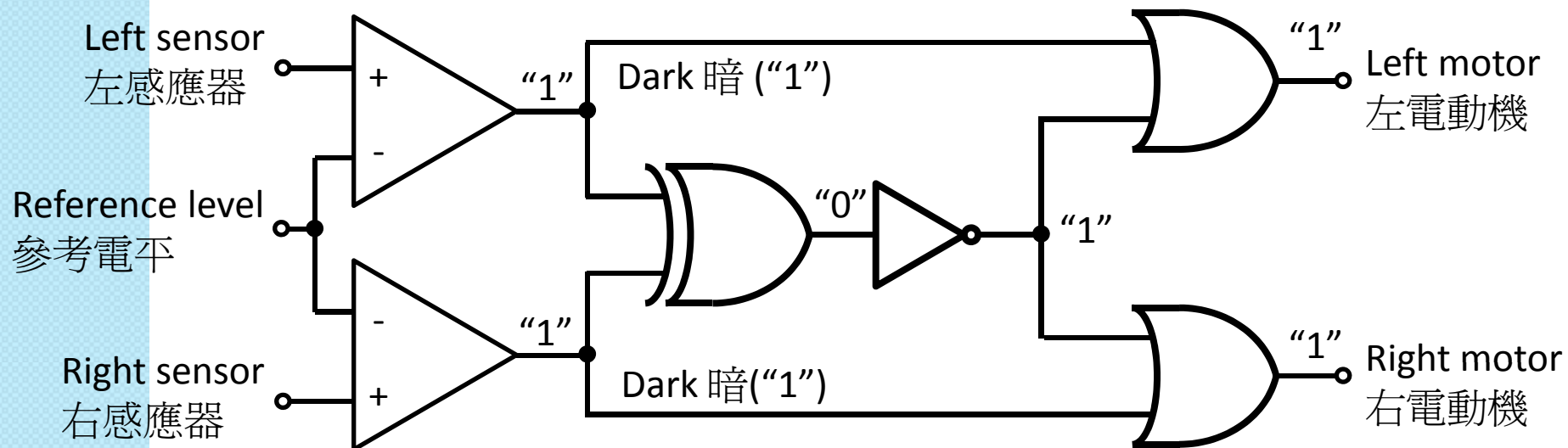
# Example – Logic Circuit

## 實例 – 邏輯線路



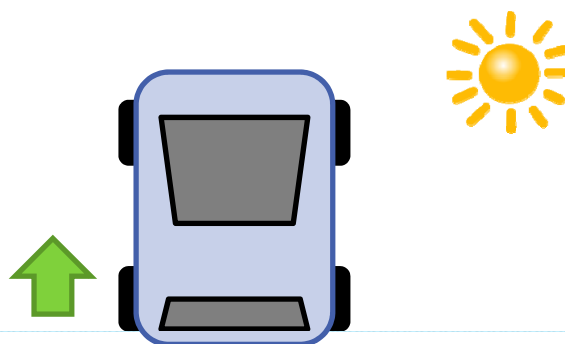
Scenario 2: Dark on both sides → Go straight

情況二: 左右兩邊都沒有光 → 向前走



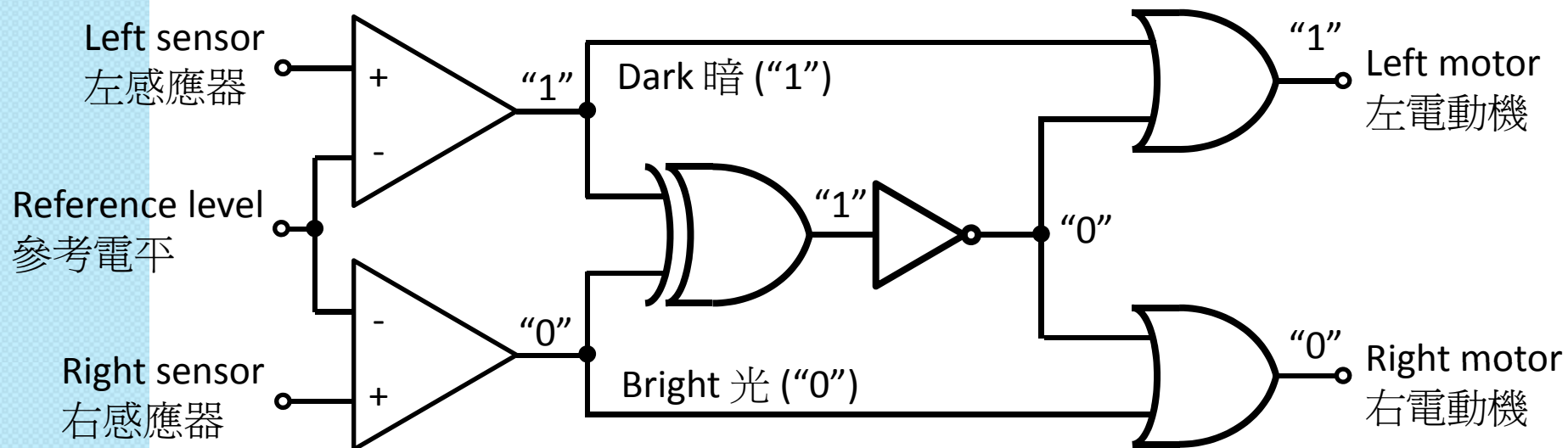
# Example – Logic Circuit

## 實例 – 邏輯線路



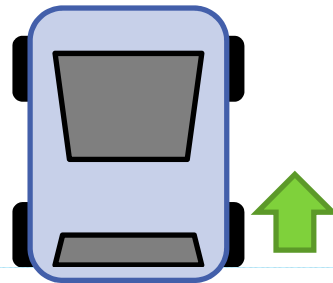
Scenario 3: Bright on right side → Go right

情況三: 右邊有光 → 向右走



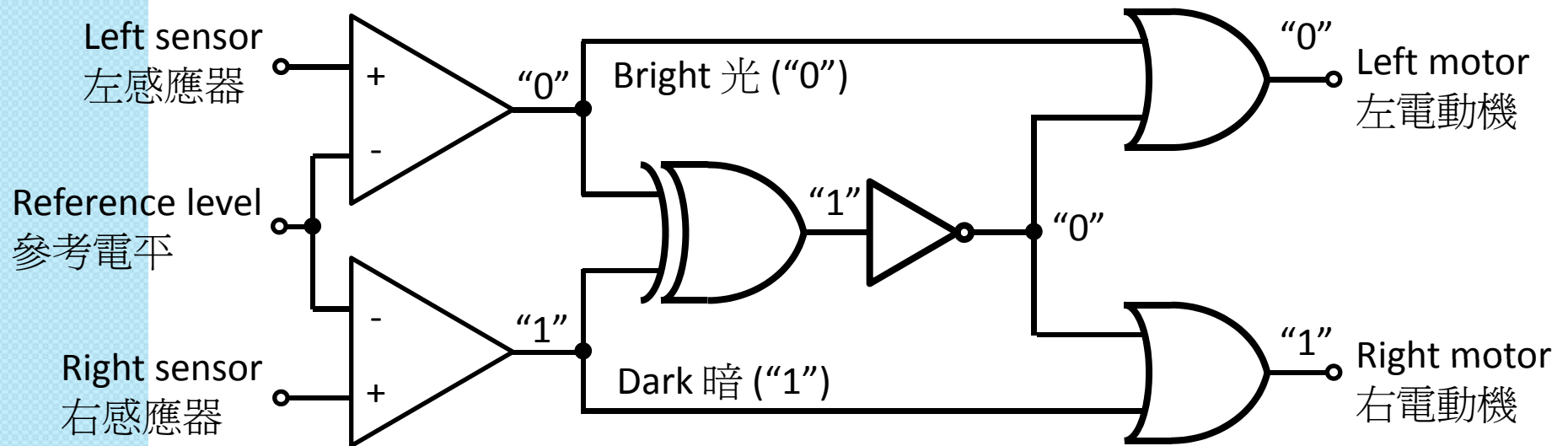
# Example – Logic Circuit

## 實例 – 邏輯線路



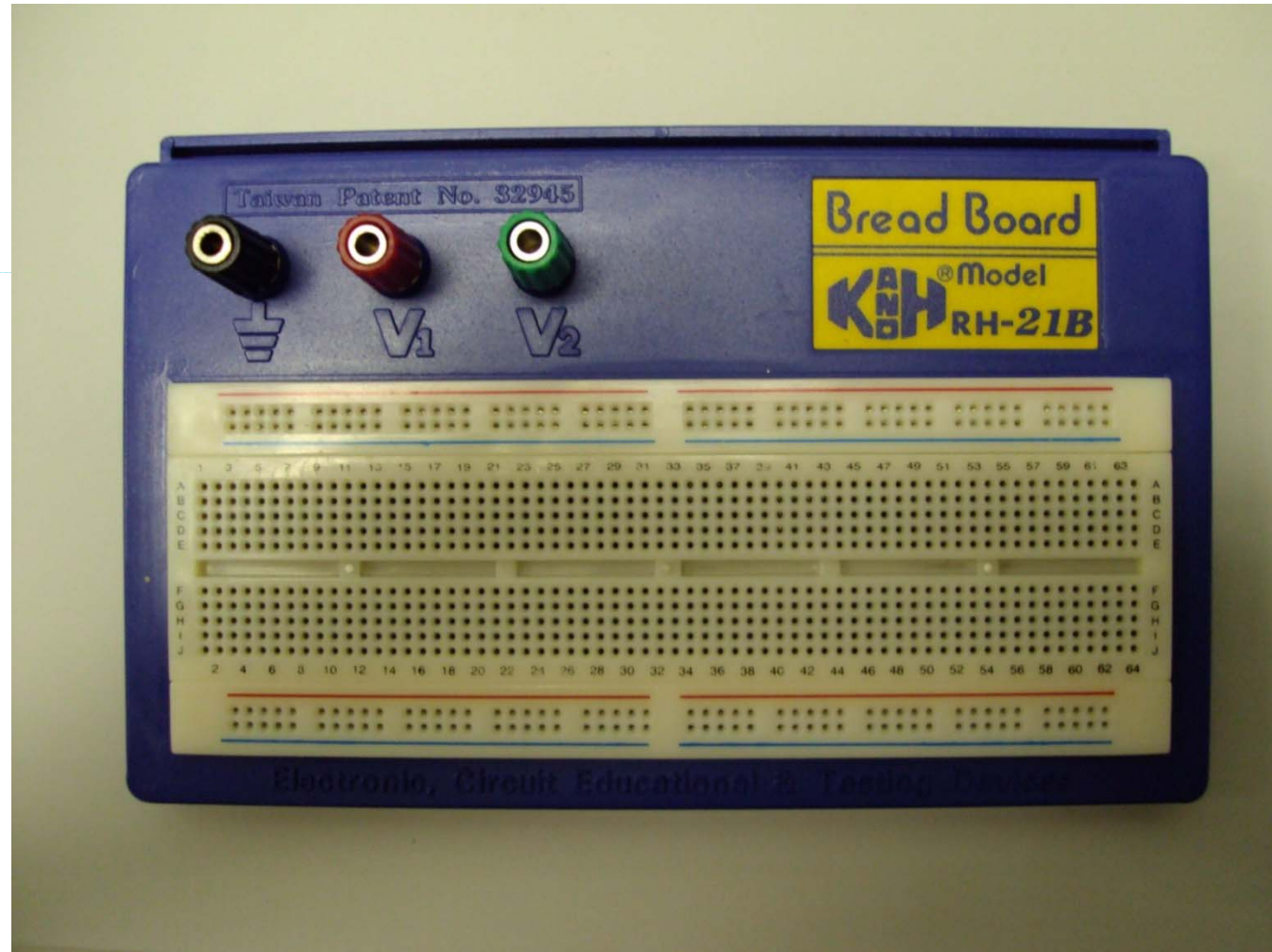
Scenario 4: Bright on left side → Go left

情況四: 左邊有光 → 向左走



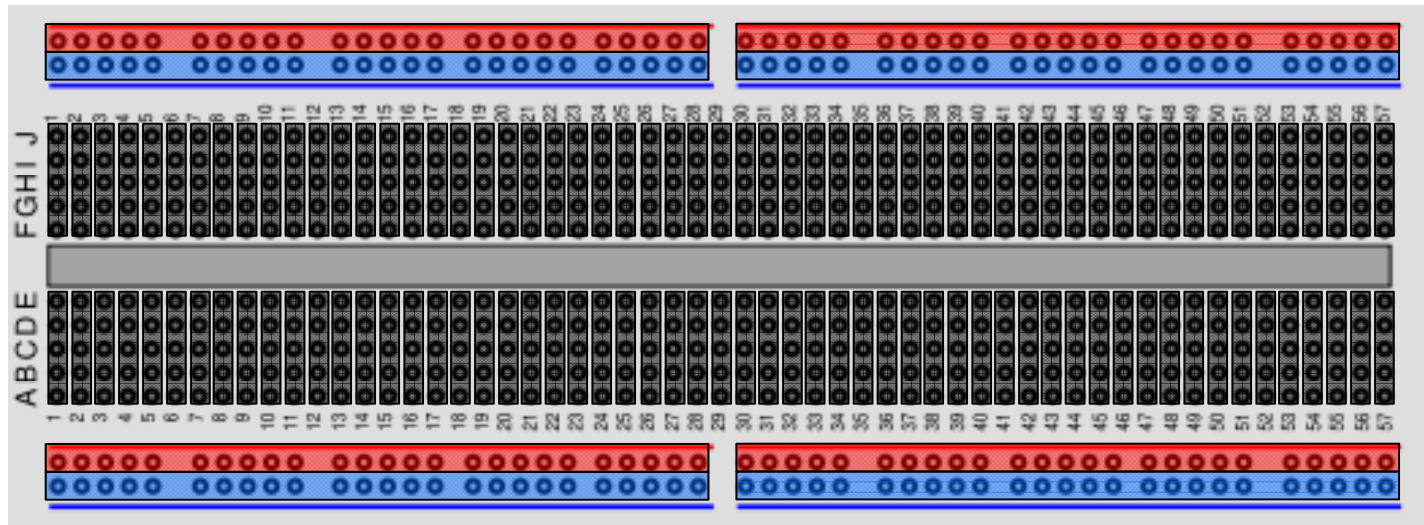
# Bread Board

麵包板



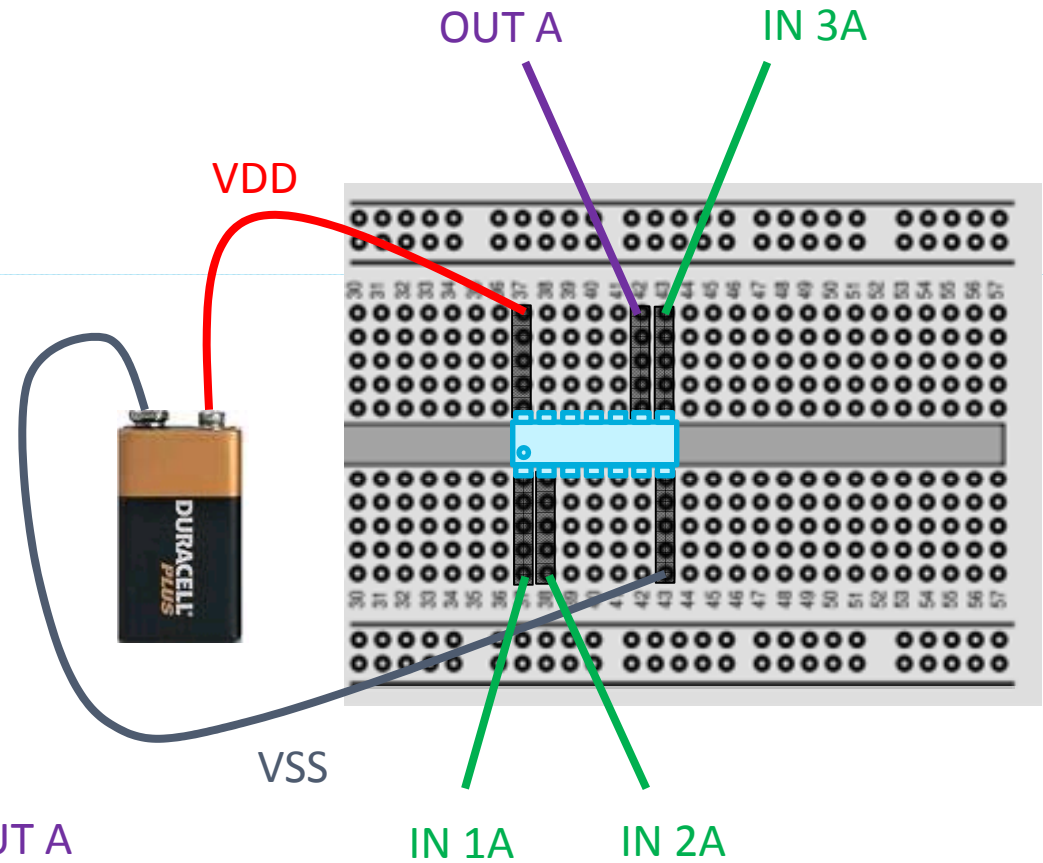
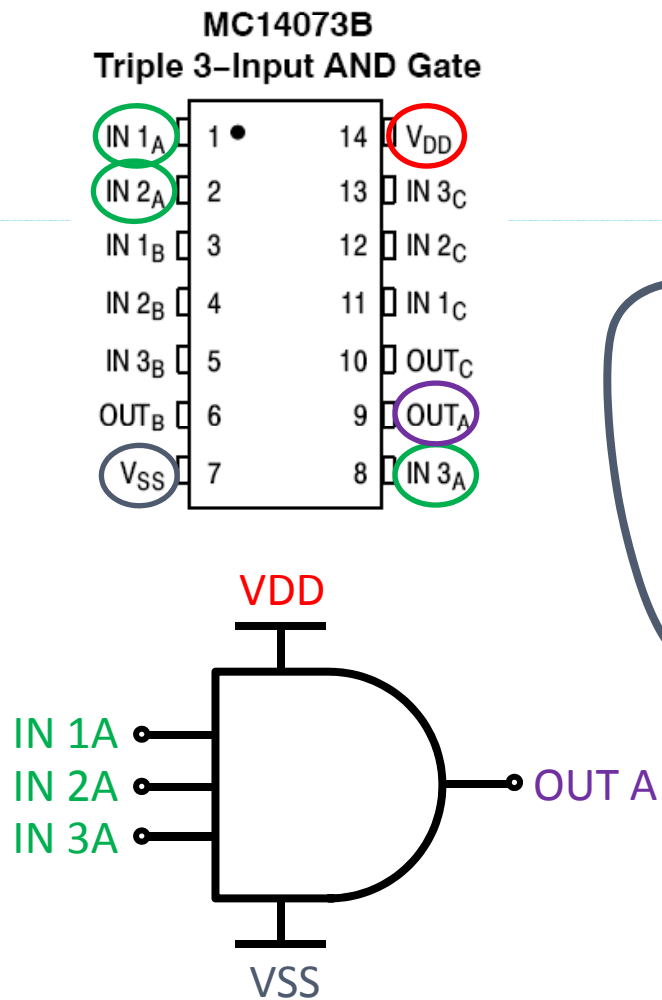
# Bread Board

## 麵包板



# Connection

## 連接信號





# Spec Sheet

## 規格表

### ELECTRICAL CHARACTERISTICS (Voltages Referenced to $V_{SS}$ )

Characteristic	Symbol	$V_{DD}$ Vdc	- 55°C		25°C			125°C		Unit	
			Min	Max	Min	Typ <sup>(2)</sup>	Max	Min	Max		
Output Voltage $V_{in} = V_{DD}$ or 0	"0" Level $V_{OL}$	5.0	-	0.05	-	0	0.05	-	0.05	Vdc	
		10	-	0.05	-	0	0.05	-	0.05		
		15	-	0.05	-	0	0.05	-	0.05		
$V_{in} = 0$ or $V_{DD}$	"1" Level $V_{OH}$	5.0	4.95	-	4.95	5.0	-	4.95	-	Vdc	
		10	9.95	-	9.95	10	-	9.95	-		
		15	14.95	-	14.95	15	-	14.95	-		
Input Voltage	"0" Level $V_{IL}$	( $V_O = 4.5$ or $0.5$ Vdc)	5.0	-	1.5	-	2.25	1.5	-	1.5	Vdc
		( $V_O = 9.0$ or $1.0$ Vdc)	10	-	3.0	-	4.50	3.0	-	3.0	
		( $V_O = 13.5$ or $1.5$ Vdc)	15	-	4.0	-	6.75	4.0	-	4.0	
	"1" Level $V_{IH}$	( $V_O = 0.5$ or $4.5$ Vdc)	5.0	3.5	-	3.5	2.75	-	3.5	-	Vdc
		( $V_O = 1.0$ or $9.0$ Vdc)	10	7.0	-	7.0	5.50	-	7.0	-	
		( $V_O = 1.5$ or $13.5$ Vdc)	15	11	-	11	8.25	-	11	-	

Reference 参考:

<http://www.onsemi.com/PowerSolutions/product.do?id=MC14073B>

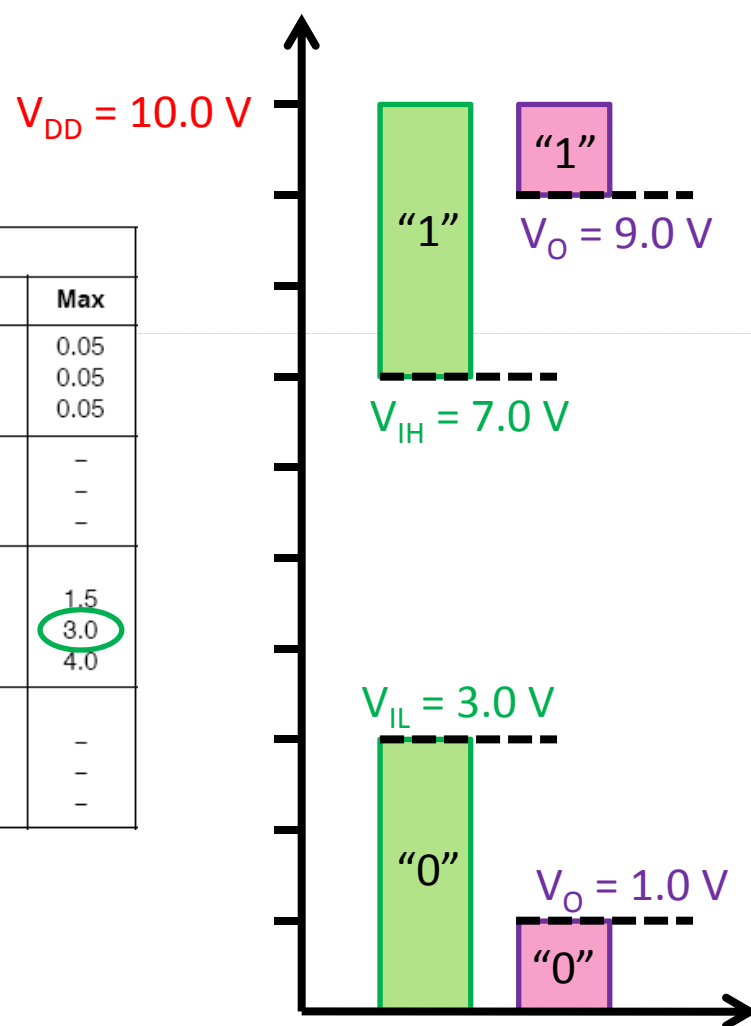
# Spec Sheet

## 規格表

Characteristic	Symbol	V <sub>DD</sub> Vdc	25°C			
			Min	Typ (2)	Max	
Output Voltage V <sub>in</sub> = V <sub>DD</sub> or 0	"0" Level V <sub>OL</sub>	5.0	-	0	0.05	
		10	-	0	0.05	
		15	-	0	0.05	
	"1" Level V <sub>in</sub> = 0 or V <sub>DD</sub>	V <sub>OH</sub>	5.0	4.95	5.0	-
			10	9.95	10	-
			15	14.95	15	-
Input Voltage	"0" Level V <sub>IL</sub>	5.0	-	2.25	1.5	
		10	-	4.50	3.0	
		15	-	6.75	4.0	
	"1" Level V <sub>IH</sub>	V <sub>IH</sub>	5.0	3.5	2.75	-
			10	7.0	5.50	-
			15	11	8.25	-

Reference 參考:

<http://www.onsemi.com/PowerSolutions/product.do?id=MC14073B>



# References

## 參考資料

- ON Semiconductor: MCI4074B  
Triple 3-Input AND Gate  
<http://www.onsemi.com/PowerSolutions/product.do?id=MCI4073B>
- Texas Instruments: CD4703B  
CMOS Triple 3-Input AND Gate  
<http://focus.ti.com/docs/prod/folders/print/cd4073b.html>
- 華輝在線: 電子零件 - Logic  
[http://www.weclonline.com/tchi/productcat3.asp?mc\\_code=08&sc\\_code=006&s2c\\_code=0001](http://www.weclonline.com/tchi/productcat3.asp?mc_code=08&sc_code=006&s2c_code=0001)



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