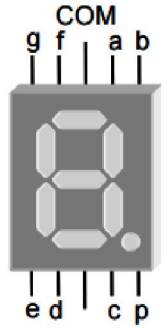
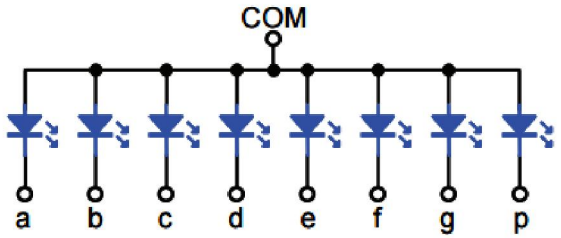
MCSL2016

歡呼吧大家

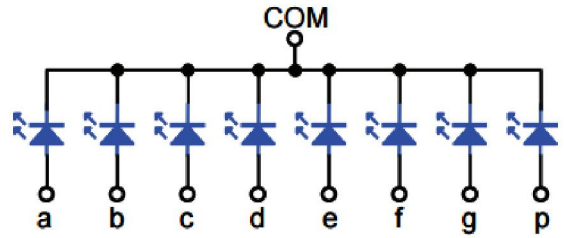
最後一個Assembly作業的Lab5

7-Seg LED

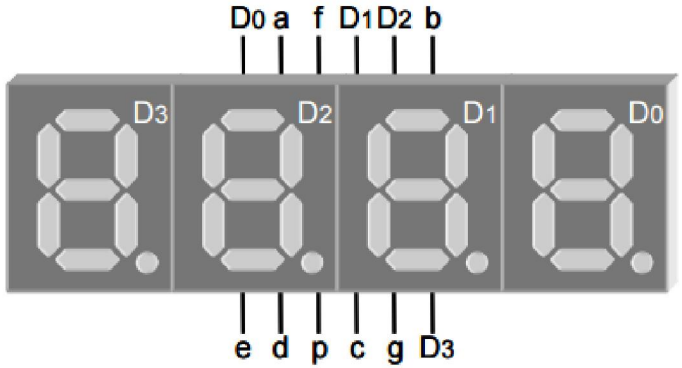


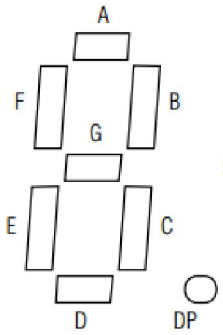


(a)共陽極結構



(b)共陰極結構





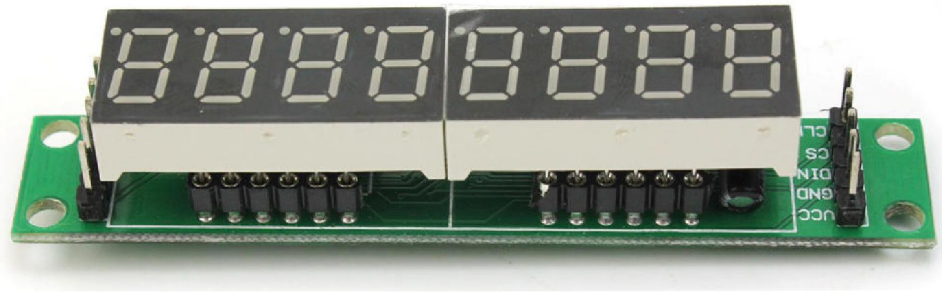
STANDARD 7-SEGMENT LED

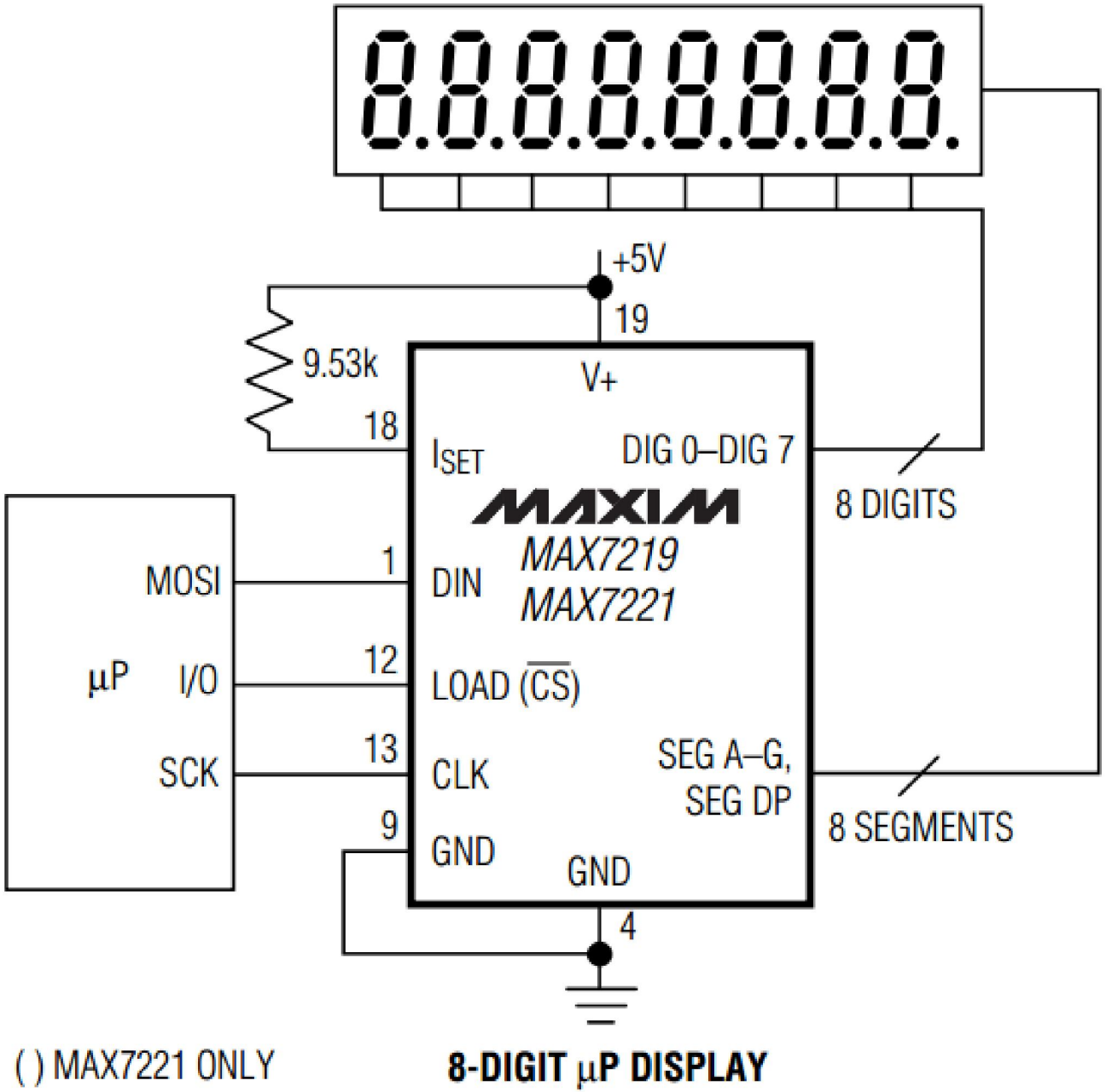
If we connect stm32 I/O pin on 7-Seg LED directly

- We use eight 7-Seg LED ➔ We will need 16 GPIO pin!
- We have to scan eight 7-Seg LED to show different number on it!

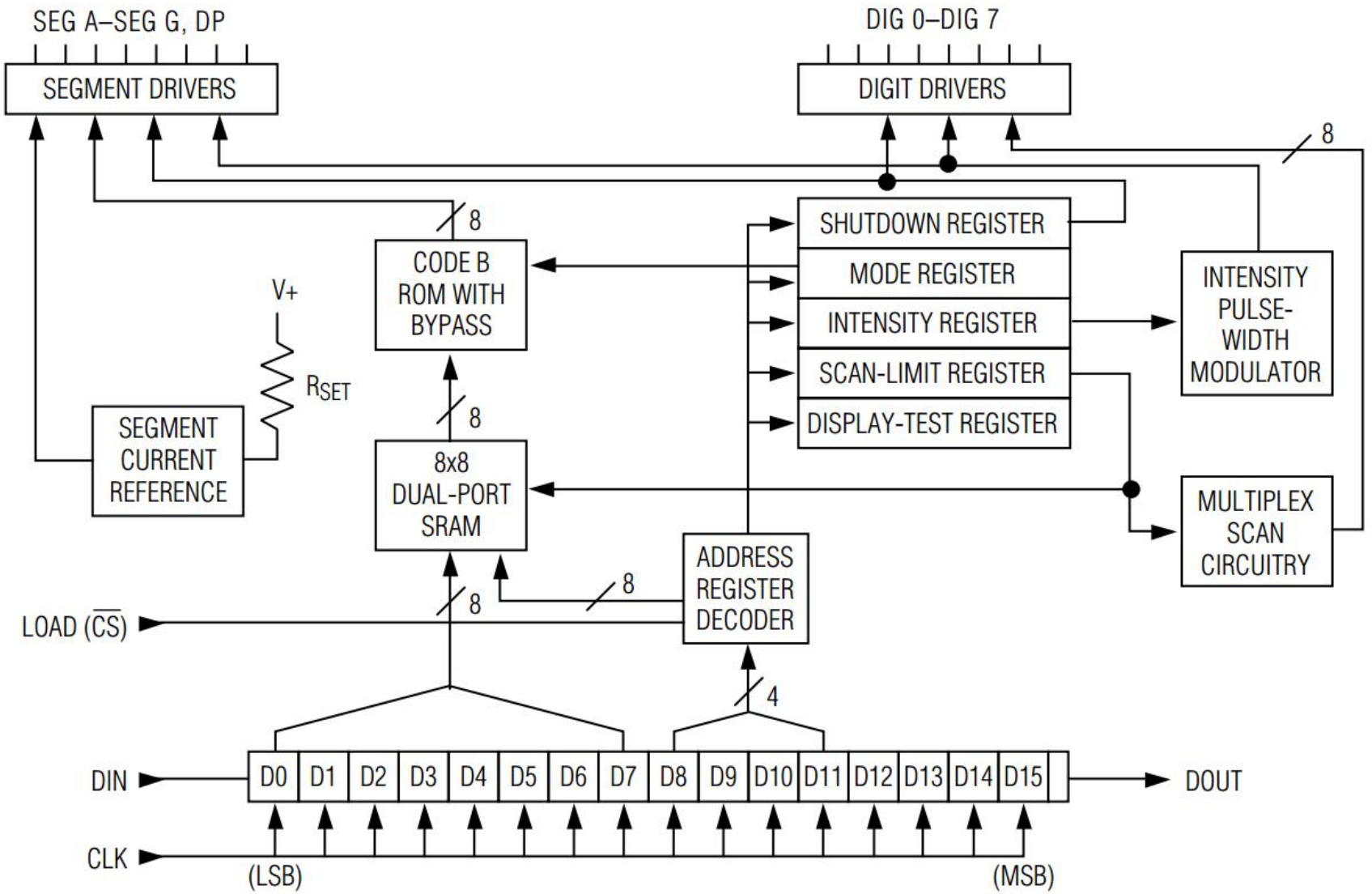
➔We use Max7219 to simplify our work!!

Max7219




+5V
19
9.53k
V+
18
ISET
DIG 0–DIG 7
8 DIGITS
MAXIM
MAX7219
MAX7221
MOSI
1
DIN
µP
I/O
12
LOAD (CS)
SCK
13
CLK
SEG A–G,
SEG DP
8 SEGMENTS
9
GND
GND
4
( ) MAX7221 ONLY
8-DIGIT µP DISPLAY

Max7219


SEG A–SEG G, DP
DIG 0–DIG 7
SEGMENT DRIVERS
DIGIT DRIVERS
8
SHUTDOWN REGISTER
MODE REGISTER
INTENSITY REGISTER
SCAN-LIMIT REGISTER
DISPLAY-TEST REGISTER
CODE B ROM WITH BYPASS
INTENSITY PULSE-WIDTH MODULATOR
V+
RSET
SEGMENT CURRENT REFERENCE
8x8 DUAL-PORT SRAM
MULTIPLEX SCAN CIRCUITRY
ADDRESS REGISTER DECODER
LOAD (CS)
4
DIN
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15
DOUT
CLK
(LSB)
(MSB)

Max7219

- DIN: Serial-Data Input. Data is loaded into the internal 16-bit shift register on CLK's rising edge.
- CS: Load-Data Input. The last 16 bits of serial data are latched on LOAD(CS)'s rising edge.
- CLK: Serial-Clock Input. 10MHz maximum rate. On CLK's rising edge, data is shifted into the internal shift register.

Table 1. Serial-Data Format (16 Bits)

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
X	X	X	X	ADDRESS				MSB	DATA						LSB

說人話

- DIN: 吃一串16 bit input，一次一個bit慢慢吃
  - 下一頁開始講這16 bit的具體內容
- CS: DIN全部餵完之後把CS設成1，告訴他你餵完了
- CLK: 01010101… 當CLK從0變1時會吃DIN一個bit

DIN吃的東西—總表

Table 2. Register Address Map

REGISTER	ADDRESS					HEX CODE
	D15–D12	D11	D10	D9	D8	
No-Op	X	0	0	0	0	0xX0
Digit 0	X	0	0	0	1	0xX1
Digit 1	X	0	0	1	0	0xX2
Digit 2	X	0	0	1	1	0xX3
Digit 3	X	0	1	0	0	0xX4
Digit 4	X	0	1	0	1	0xX5
Digit 5	X	0	1	1	0	0xX6
Digit 6	X	0	1	1	1	0xX7
Digit 7	X	1	0	0	0	0xX8
Decode Mode	X	1	0	0	1	0xX9
Intensity	X	1	0	1	0	0xXA
Scan Limit	X	1	0	1	1	0xXB
Shutdown	X	1	1	0	0	0xXC
Display Test	X	1	1	1	1	0xXF

DIN吃的東西—Shutdown Register

Table 3. Shutdown Register Format (Address (Hex) = 0xXC)

MODE	ADDRESS CODE (HEX)	REGISTER DATA							
		D7	D6	D5	D4	D3	D2	D1	D0
Shutdown Mode	0xXC	X	X	X	X	X	X	X	0
Normal Operation	0xXC	X	X	X	X	X	X	X	1

When the MAX7219 is in shutdown mode, the scan oscillator is halted, all segment current sources are pulled to ground, and all digit drivers are pulled to V+, thereby blanking the display. Data in the digit and control registers remains unaltered.

DIN吃的東西—Decode-Mode Register

Table 4. Decode-Mode Register Examples (Address (Hex) = 0xX9)

DECODE MODE	REGISTER DATA								HEX CODE
	D7	D6	D5	D4	D3	D2	D1	D0	
No decode for digits 7–0	0	0	0	0	0	0	0	0	0x00
Code B decode for digit 0 No decode for digits 7–1	0	0	0	0	0	0	0	1	0x01
Code B decode for digits 3–0 No decode for digits 7–4	0	0	0	0	1	1	1	1	0x0F
Code B decode for digits 7–0	1	1	1	1	1	1	1	1	0xFF

DIN吃的東西—Decode-Mode Register

Table 5. Code B Font

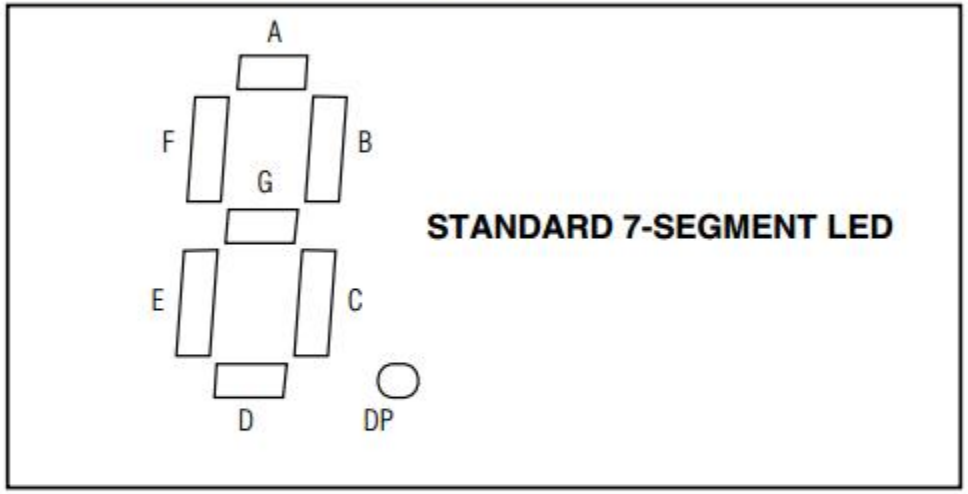
7-SEGMENT CHARACTER	REGISTER DATA						ON SEGMENTS = 1							
	D7*	D6–D4	D3	D2	D1	D0	DP*	A	B	C	D	E	F	G
0		X	0	0	0	0		1	1	1	1	1	1	0
1		X	0	0	0	1		0	1	1	0	0	0	0
2		X	0	0	1	0		1	1	0	1	1	0	1
3		X	0	0	1	1		1	1	1	1	0	0	1
4		X	0	1	0	0		0	1	1	0	0	1	1
5		X	0	1	0	1		1	0	1	1	0	1	1
6		X	0	1	1	0		1	0	1	1	1	1	1
7		X	0	1	1	1		1	1	1	0	0	0	0
8		X	1	0	0	0		1	1	1	1	1	1	1
9		X	1	0	0	1		1	1	1	1	0	1	1
—		X	1	0	1	0		0	0	0	0	0	0	1
E		X	1	0	1	1		1	0	0	1	1	1	1
H		X	1	1	0	0		0	1	1	0	1	1	1
L		X	1	1	0	1		0	0	0	1	1	1	0
P		X	1	1	1	0		1	1	0	0	1	1	1
blank		X	1	1	1	1		0	0	0	0	0	0	0

*The decimal point is set by bit D7 = 1

When the code B decode mode is used, the decoder looks only at the lower nibble of the data in the digit registers (D3–D0), disregarding bits D4–D6. D7, which sets the decimal point (SEG DP), is independent of the decoder and is positive logic (D7 = 1 turns the decimal point on)

DIN吃的東西—Decode-Mode Register

Table 6. No-Decode Mode Data Bits and Corresponding Segment Lines



	REGISTER DATA							
	D7	D6	D5	D4	D3	D2	D1	D0
Corresponding Segment Line	DP	A	B	C	D	E	F	G

When no-decode is selected, data bits D7–D0 correspond to the segment lines of the MAX7219/MAX7221.

DIN吃的東西—Intensity Register

Table 7. Intensity Register Format (Address (Hex) = 0xXA)

DUTY CYCLE		D7	D6	D5	D4	D3	D2	D1	D0	HEX CODE
MAX7219	MAX7221									
1/32 (min on)	1/16 (min on)	X	X	X	X	0	0	0	0	0xX0
3/32	2/16	X	X	X	X	0	0	0	1	0xX1
5/32	3/16	X	X	X	X	0	0	1	0	0xX2
7/32	4/16	X	X	X	X	0	0	1	1	0xX3
9/32	5/16	X	X	X	X	0	1	0	0	0xX4
11/32	6/16	X	X	X	X	0	1	0	1	0xX5
13/32	7/16	X	X	X	X	0	1	1	0	0xX6
15/32	8/16	X	X	X	X	0	1	1	1	0xX7
17/32	9/16	X	X	X	X	1	0	0	0	0xX8
19/32	10/16	X	X	X	X	1	0	0	1	0xX9
21/32	11/16	X	X	X	X	1	0	1	0	0xXA
23/32	12/16	X	X	X	X	1	0	1	1	0xXB
25/32	13/16	X	X	X	X	1	1	0	0	0xXC
27/32	14/16	X	X	X	X	1	1	0	1	0xXD
29/32	15/16	X	X	X	X	1	1	1	0	0xXE
31/32	15/16 (max on)	X	X	X	X	1	1	1	1	0xXF

DIN吃的東西—Scan-Limit Register

Table 8. Scan-Limit Register Format (Address (Hex) = 0xXB)

SCAN LIMIT	REGISTER DATA								HEX CODE
	D7	D6	D5	D4	D3	D2	D1	D0	
Display digit 0 only*	X	X	X	X	X	0	0	0	0xX0
Display digits 0 & 1*	X	X	X	X	X	0	0	1	0xX1
Display digits 0 1 2*	X	X	X	X	X	0	1	0	0xX2
Display digits 0 1 2 3	X	X	X	X	X	0	1	1	0xX3
Display digits 0 1 2 3 4	X	X	X	X	X	1	0	0	0xX4
Display digits 0 1 2 3 4 5	X	X	X	X	X	1	0	1	0xX5
Display digits 0 1 2 3 4 5 6	X	X	X	X	X	1	1	0	0xX6
Display digits 0 1 2 3 4 5 6 7	X	X	X	X	X	1	1	1	0xX7

*See *Scan-Limit Register* section for application.

The scan-limit register sets how many digits are displayed, from 1 to 8. The number of scanned digits affects the display brightness,

DIN吃的東西—Display Test Register

Table 10. Display-Test Register Format (Address (Hex) = 0xXF)

MODE	REGISTER DATA							
	D7	D6	D5	D4	D3	D2	D1	D0
Normal Operation	X	X	X	X	X	X	X	0
Display Test Mode	X	X	X	X	X	X	X	1

Note: The MAX7219/MAX7221 remain in display-test mode (all LEDs on) until the display-test register is reconfigured for normal operation.

The display-test register operates in two modes: normal and display test. Display-test mode turns all LEDs on by overriding, but not altering, all controls and digit registers (including the shutdown register).

DIN吃的東西—懶人包

MODE	高位8 bits	低位8 bits	功能
Decode	0xX9	0x00	NO Decode
		0xFF	Code B decode for digit 0~7
Scan Limit	0xXB	0xX0~0x07	最多顯示1~8位數
Display Test	0xXF	0xX0	關掉這個Test模式
		0xX1	讓所有LED亮起來，方便你跟助教說七段顯示器壞了

※大寫的X是放什麼都可以

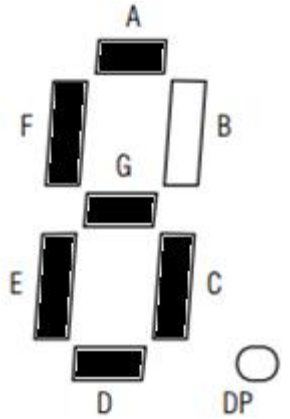
DIN吃的東西—懶人包

MODE	高位8 bits	低位8 bits	功能
Digit	0xX1~0x08	這個digit要顯示啥	指定某個digit要顯示的內容

此處應有例子

我想在某個digit顯示數字 6

	Code B decode for digit 0~7時	No decode時
低位8 bits	0xX6	0101 1111



Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	

Example

想餵的DIN：0xXF 0xX1（打開Display Test）

0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0

Example

想餵的DIN：0xXF 0xX1（打開Display Test）

0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0
0	1	0	00

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0
0	1	0	00
X	0	0	00

Example

想餵的DIN：0xXF 0xX1（打開Display Test）

0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0
0	1	0	00
X	0	0	00
0	1	0	000

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0
0	1	0	00
X	0	0	00
0	1	0	000
X	0	0	000

Example

想餵的DIN：0xXF 0xX1（打開Display Test）

0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
X	0	0	
0	1	0	0
X	0	0	0
0	1	0	00
X	0	0	00
0	1	0	000
X	0	0	000
0	1	0	0000

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
前略			
X	0	0	0000

Example

想餵的DIN：0xXF 0xX1（打開Display Test）

0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
前略			
X	0	0	0000
1	1	0	0000 1

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
前略			
X	0	0	0000
1	1	0	0000 1
好累喔 中略			

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
前略			
X	0	0	0000
1	1	0	0000 1
好累喔 中略			
1	1	0	0000 1111 0000 0001

Example

想餵的DIN：0xXF 0xX1（打開Display Test）
0000 1111 0000 0001

DIN	CLK	CS	目前為止吃到的DIN
前略			
X	0	0	0000
1	1	0	0000 1
好累喔 中略			
1	1	0	0000 1111 0000 0001
X	0	1	0000 1111 0000 0001

吃完了

Reference

- https://www.sparkfun.com/datasheets/Components/General/COM-09622-MAX7219-MAX7221.pdf

節約資源．愛惜公物

看著你的七段顯示器　還有Max7219

發誓你不會摔死它們

拜偷