ROBOTER
Bausatz-Shop

TM1638 8 Taster mit 8-stelligem Display und 8 LEDs

Anschlussbelegung
und
Technische Daten

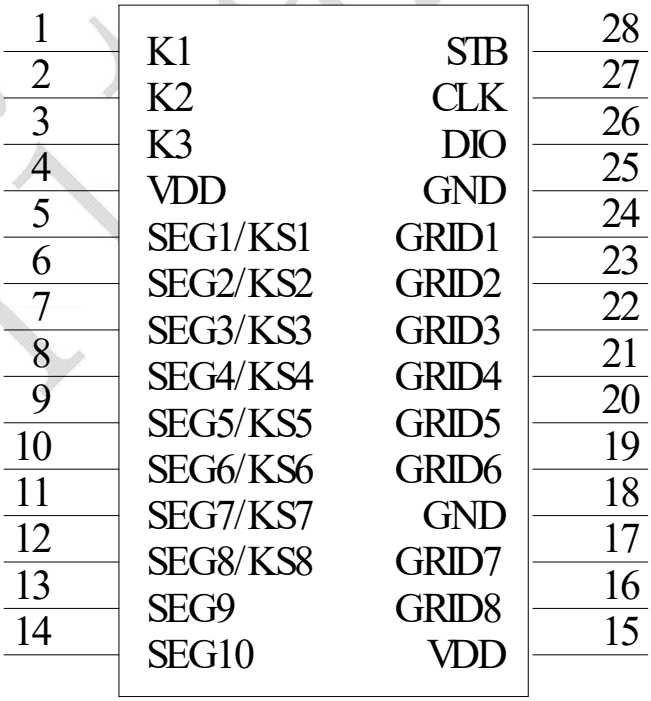
1. An overview

TM1638 is an LED Controller driven on a 1/16 to 14/16 duty factor. 10 segment output lines, 8 grid output lines, 8 segment/key scan output lines, one display memory, control circuit, key scan circuit are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer. Serial data is fed to TM1638 via a three-line serial interface. Housed in a SOP28 package, TM1638 pin assignments and application circuit are optimized for easy PCB Layout and cost saving advantages.

2. FEATURES

- CMOS Technology
- Display Mode 10 segments × 8-bit
- Key Scanning (8 × 3bit)
- 8-Step Dimming Circuitry
- Serial interface (CLK, STB, DIO)
- Oscillatory Manners: RC Oscillation（450KHz±5%）
- Built-in power-on reset circuit
- Available in SOP28 package

3. The pin definitions:



4. The pin function:

Symbol	PIN Name	Description
DIO	Data I/O	This pin outputs serial data at the falling edge of the shift clock. This pin inputs serial data at the rising edge of the shift clock (starting from the lower bit) (N-Channel, open-drain)
STB	Chip Select	Serial Interface Strobe Pin The data input after the STB has fallen is processed as a command. When t his pin is "HIGH", CLK is ignored.
CLK	Clock input	This pin reads serial data at the rising edge and outputs data at the falling edge.
K1 ~ K3	Key scan data input	The data sent to these pins are latched at the end of the display cycle
SEG1/KS1 ~ SEG8/KS8	Output (above)	Segment output (also used as key source) (P-Channel, open drain)
SEG9 ~ SEG10	Output (above)	Segment output (P-Channel, open drain)
GRID1 ~ GRID8	Output (above)	Grid Output Pins (N-Channel, open drain)
VDD	Power Supply	5V ± 10%
GND	Ground Pin	

Note: DIO port is N-channel open drain output. When read data with MCU it require an external 1K-10K pull-up resistor (10K is recomended).

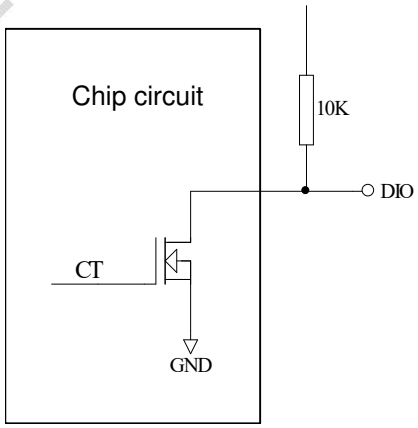


Figure (1)

5. Display memory address:

Data transmitted from an external device to TM1628 via the serial interface are stored in the Display RAM and are assigned addresses from 00H-0FH. The RAM addresses of TM1638 are given below in 16 bits unit.
LED display data write time, in accordance with the address from the show from low to high, the data byte from low to high operation.

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8	SEG9	SEG10	X	X	X	X	X	X	
xxHL (low nibble)				xxHU (high nibble)				xxHL (low nibble)				xxHU (high nibble)				
B0	B1	B2	B3	B4	B5	B6	B7	B0	B1	B2	B3	B4	B5	B6	B7	
00HL				00HU				01HL				01HU				GRID1
02HL				02HU				03HL				03HU				GRID2
04HL				04HU				05HL				05HU				GRID3
06HL				06HU				07HL				07HU				GRID4
08HL				08HU				09HL				09HU				GRID5
0AHL				0AHU				0BHL				0BHU				GRID6
0CHL				0CHU				0DHL				0DHU				GRID7
0EHL				0EHU				0FHL				0FHU				GRID8

Figure (2)

LED display when writing data follow from low address to high address, from low to high byte operation, In the use of no use to the SEG output BIT in the corresponding address bit write 0

6. Key scan and key scan data register:

Key scan matrix of 8 × 3bit, as shown in Figure (3) as follows:

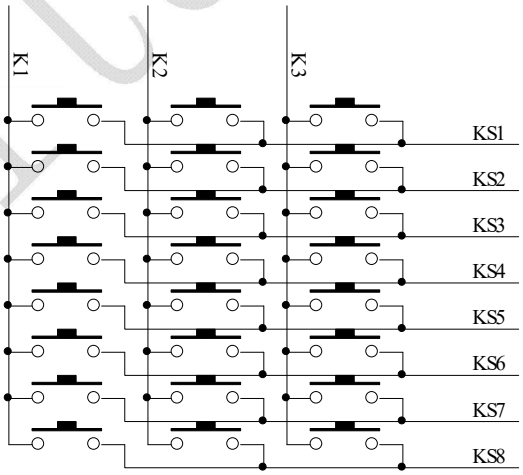


Figure (3)

Key scan data storage address is as follows, starting reading key command to start reading the key data BYTE1-BYTE4 bytes, reading it started from the low output; chip pins K and KS corresponding button is pressed, the corresponding BIT bit is 1 within the byte.

B0	B1	B2	B3	B4	B5	B6	B7	
K3	K2	K1	X	K3	K2	K1	X	
KS1				KS2				BYTE1
KS3				KS4				BYTE2
KS5				KS6				BYTE3
KS7				KS8				BYTE4

Figure (4)

▲ **Note:** 1.TM1638 can read up to 4 bytes, more is not allowed to read.
2.The data byte can only be read sequentially from BYTE1-BYTE4. For example: hardware KS8 and K2 corresponding button is pressed, then you want to read this key data, you must need to read the first 4 bytes of the first 5BIT bit, can read data; When K1 and KS8, K2 and KS8, K3 and KS8 three keys pressed simultaneously, the read data at this time BYTE4 B4, B5, B6 bits are 1

7. Instruction:

Command to set the display mode and the LED status of the drive.
In the DIO input after the STB falling edge of the rst byte as a command.
After decoding, to take up B7, B6 two bits to
Distinguish between dierent instructions.

B7	B6	Instruction
0	1	Data Command set
1	0	Display control Command set
1	1	Address Command set

If the instructions or data transmission STB is set high, the serial communication is initialized, and the instruction or data being transmitted invalid (instruction or data prior to transmission remain valid).

7.1 Data Command Set

The command to set the data write and read, B1 and B0 bits are not allowed to set 01 or 11

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Explain
0	1	Unrelated items, fill in 0				0	0	Set up Data read and write mode	Write data to the display register
0	1					1	0		Read the key scan data
0	1				0			Set up Address increasing mode	Automatic address increased
0	1				1				Fixed address
0	1			0				Test mode (Internal use)	Normal mode
0	1			1					Test mode

7.2 Address Command Set

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Show Address
1	1	Unrelated items, fill in 0		0	0	0	0	00H
1	1			0	0	0	1	01H
1	1			0	0	1	0	02H
1	1			0	0	1	1	03H
1	1			0	1	0	0	04H
1	1			0	1	0	1	05H
1	1			0	1	1	0	06H
1	1			0	1	1	1	07H
1	1			1	0	0	0	08H
1	1			1	0	0	1	09H
1	1			1	0	1	0	0AH
1	1			1	0	1	1	0BH
1	1			1	1	0	0	0CH
1	1			1	1	0	1	0DH
1	1			1	1	1	0	0EH
1	1			1	1	1	1	0FH

Address Setting Commands are used to set the address of the display memory. The address is considered valid if it has a value of 00H to 0FH. If the address is set to 10H or higher, the data is ignored until a valid address is set. When power is turned ON, the address is set at 00H. Please refer to the diagram above.

7.3 Display Control Command Set

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Explain
1	0	Unrelated items, fill in 0			0	0	0	Set the number of extinction	Set the pulse width to 1/16
1	0				0	0	1		Set the pulse width to 2/16
1	0				0	1	0		Set the pulse width to 4/16
1	0				0	1	1		Set the pulse width to 10/16
1	0				1	0	0		Set the pulse width to 11/16
1	0				1	0	1		Set the pulse width to 12/16
1	0				1	1	0		Set the pulse width to 13/16
1	0				1	1	1		Set the pulse width to 14/16
1	0			0				Display switch	Display off
1	0			1					Display on

8. Serial data transfer formats:

Read and receive a BIT at the rising edge of the clock operation.

8.1 Reception (Data / Command Write)

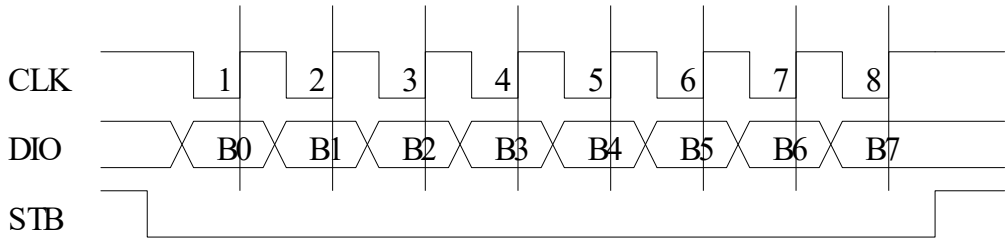


Figure (5)

8.2 Transmission (Data / Read)

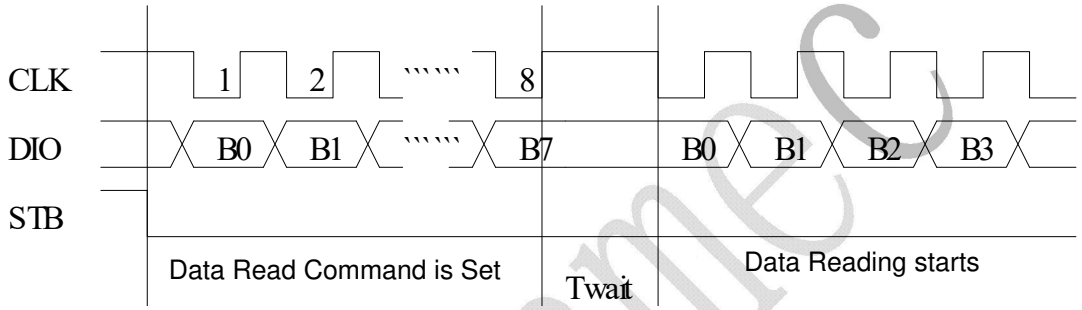


Figure (6)

Note: It must be noted that when the data is read, the waiting time(t) wait between the rising of the eighth clock that has set the command and the falling of the first clock that has read the data is greater or equal to 1μ s.

9. Display and Buttons:

(1) Display:

1. Common cathode LED:

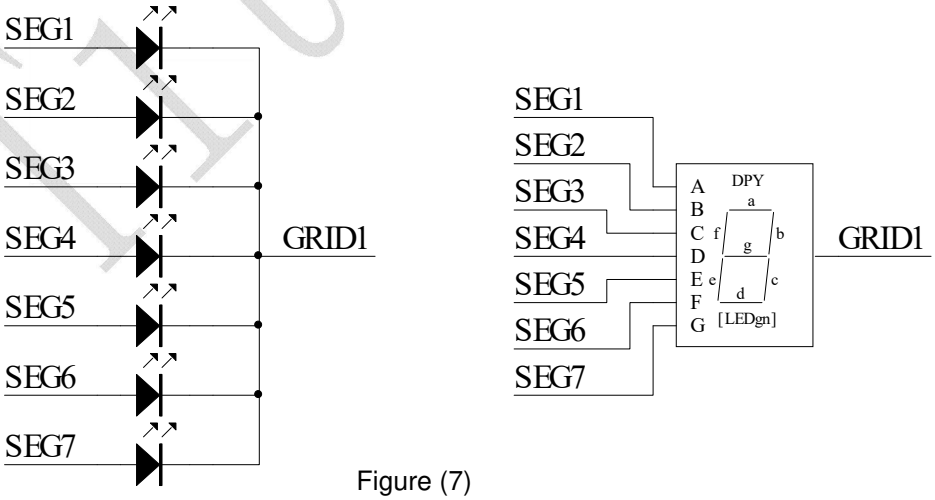


Figure (7)

Figure 7 shows the common cathode LED connection diagram, if the digital display to "0", Then you need to GRID1 low when so SEG1, SEG2, SEG3, SEG4, SEG5, SEG6 is high, SEG7 low, See Figure (2) shows the address table, just inside the 00H address unit write data 3FH You can make digital tube displays "0."

SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	
0	0	1	1	1	1	1	1	00H
B7	B6	B5	B4	B3	B2	B1	B0	

2. Common anode LED:

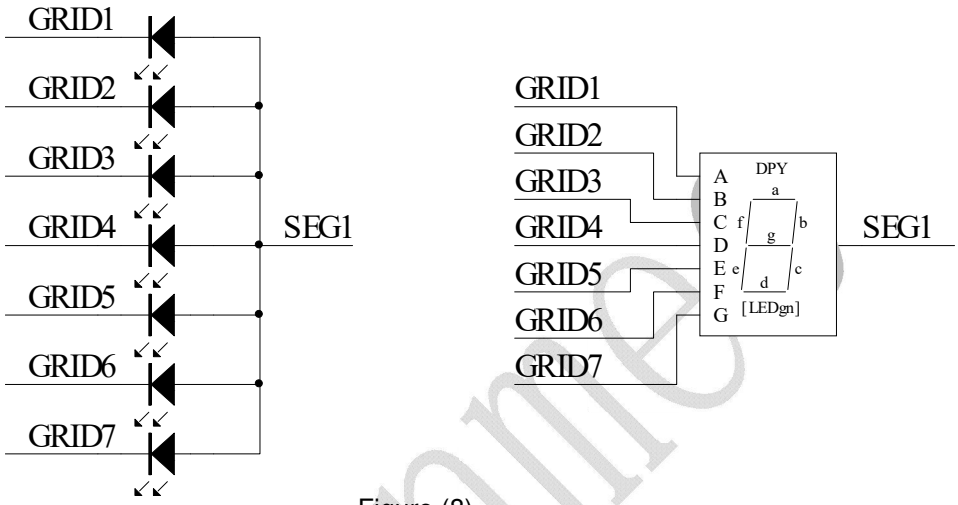


Figure (8)

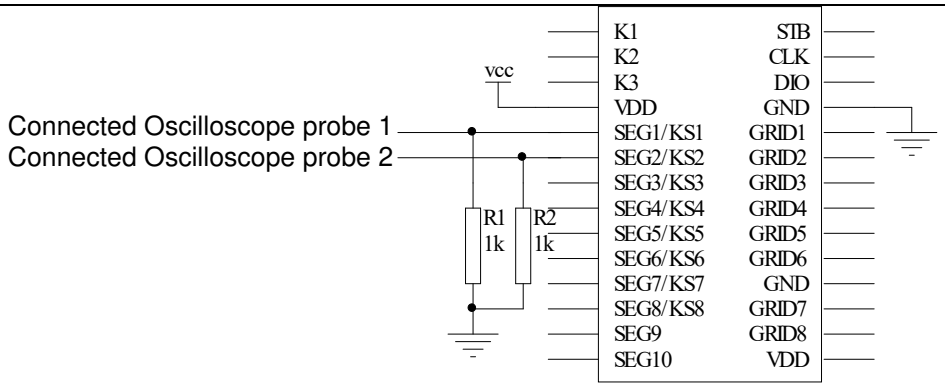
Figure 8 shows the LED common anode connection diagram, if the digital display to "0", then you need to GRID1, GRID2, GRID3, GRID4, GRID5, GRID6 time to SEG1 low to high, low, when in GRID7 so SEG1 low. To address unit 00H, 02H, 04H, 06H, 08H, 0AH which were written data 01H, all the rest of the address unit write data 00H.

SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	
0	0	0	0	0	0	0	1	00H
0	0	0	0	0	0	0	1	02H
0	0	0	0	0	0	0	1	04H
0	0	0	0	0	0	0	1	06H
0	0	0	0	0	0	0	1	08H
0	0	0	0	0	0	0	1	0AH
0	0	0	0	0	0	0	0	0CH
B7	B6	B5	B4	B3	B2	B1	B0	

Note:SEG1-10 are P-Channel open drain output, GRID1-8 are N-Channel open drain output, SEG1-10 can only access the LED anode , GRID can only access the LED cathode, can not reverse.

(2) Keyboard scan:

You can follow the Figure (9) observed with an oscilloscope and SEG2/KS2 SEG1/KS1 the output waveform, SEGN / KSN is shown in Figure (10).



Waveform when IC scans the keyboard SEGN / KSN :

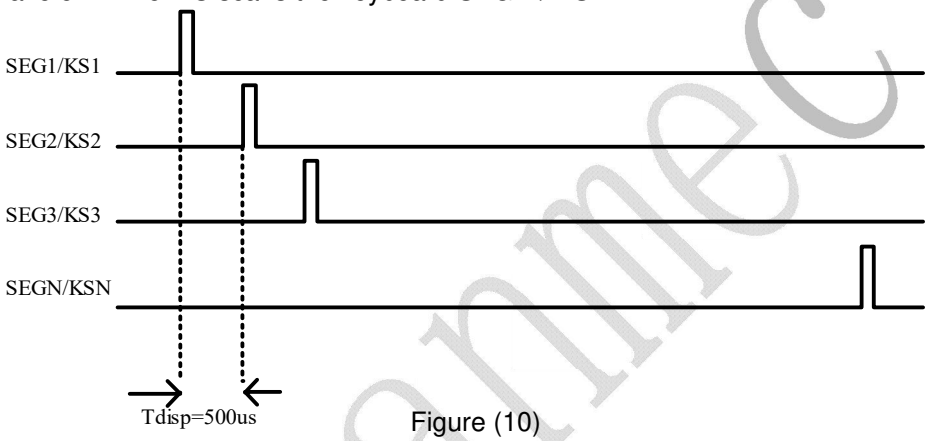


Figure (10)

Tsp and the oscillation frequency of the IC work, improve our TM1638 after several oscillation frequency is not exactly the same. 500uS only a reference to the actual measurement shall prevail.

. General use diagram (11), to meet key design requirements.

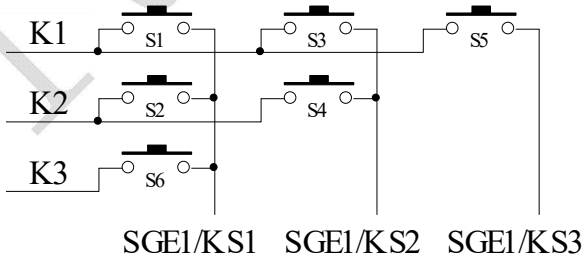


Figure (11)

When S1 is pressed, the first byte B0 read "1." If multiple keys are pressed, it will read more than one "1", When the S2, S3 is pressed, the first byte in the B1, B3 read "1."

Note: The use of composite key considerations:
SEG1/KS1-SEG10/KS10 display and key scanning is re-used. In Figure (12) as an example, display the desired light D1, D2 off,need to SEG1 to "1", SEG2 "0" state, if S1, S2 are pressed simultaneously, the equivalent of SEG1, SEG2 is short, then D1, D2 are illuminated.

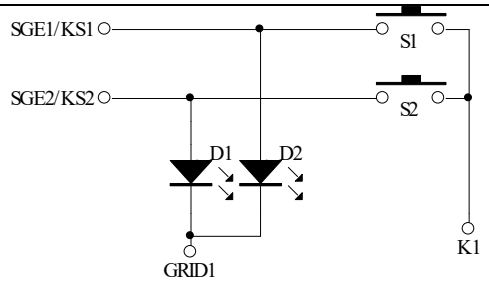


Figure (12)

Solution:

1. the hardware, you can press the keys will need to set the K-line in a different figure above (13), the

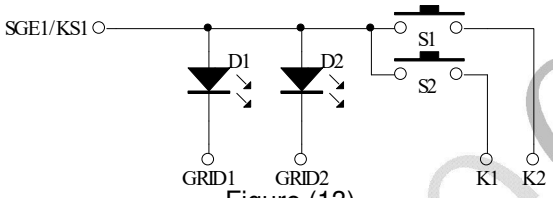


Figure (13)

2. in SEG1-SEG N series resistance shown in the above (14), the resistance of 510 ohms resistance should be chosen, resulting in too large Key failure, is too small to show interference may not solve the problem.

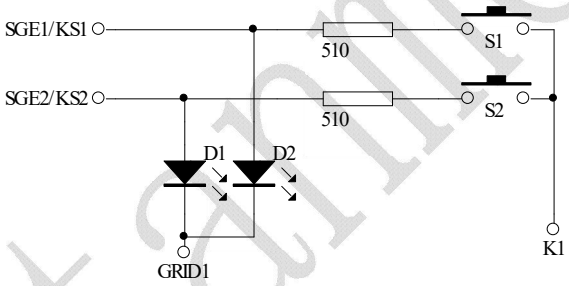


Figure (14)

3. or series diode as shown in Figure (15) below.

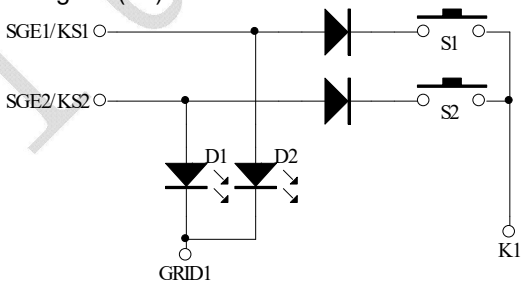
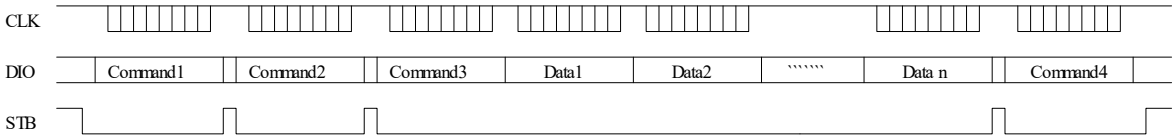


Figure (15)

10. Application of the serial data transmission:

10.1 Address increasing mode

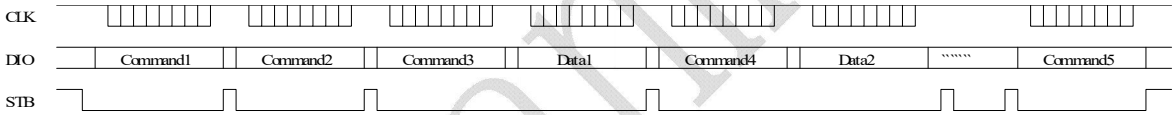
Use address auto-increment mode, set the address is actually transmitted data stream to set the starting address stored. Start address command word has been sent, "STB" do not set high data transmission followed up 16BYTE, data transfer is completed before the "STB" is set high.



Command1: Display Mode Setting command
Command2: Data Setting Command
Command3: Set the display address
Data1 ~ n: Transfer Display Data (up to 16 bytes)
Command4: Display Control Command

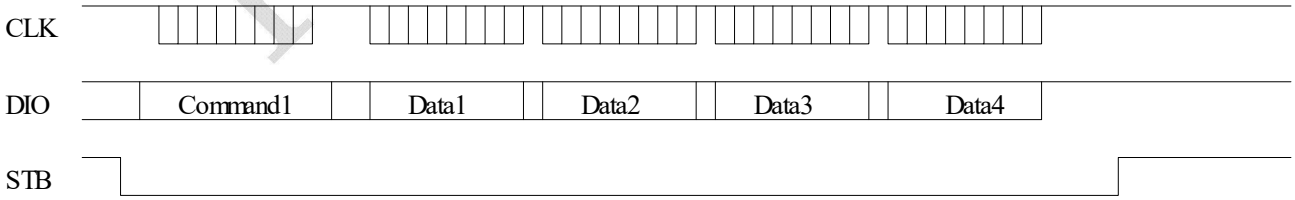
10.2 Fixed Address Mode

Use a fixed address mode, set the address is actually a set of its need to send the address of 1BYTE data storage. Address to send completed, "STB" do not set high, followed by transfer 1BYTE data, data transfer is completed before the "STB" is set high. And then re-set the first two address data needs to be stored up to 16BYTE data transfer is completed, "STB" is set high.



Command1: Display Mode Setting command
Command2: Data Setting Command
Command3: Set the display address 1
Data1: display data transmitted within 1 to Command3 address
Command4: Set the display address 2
Data2: display data transmitted within 2 to Command4 address
Command5: Display Control Commands

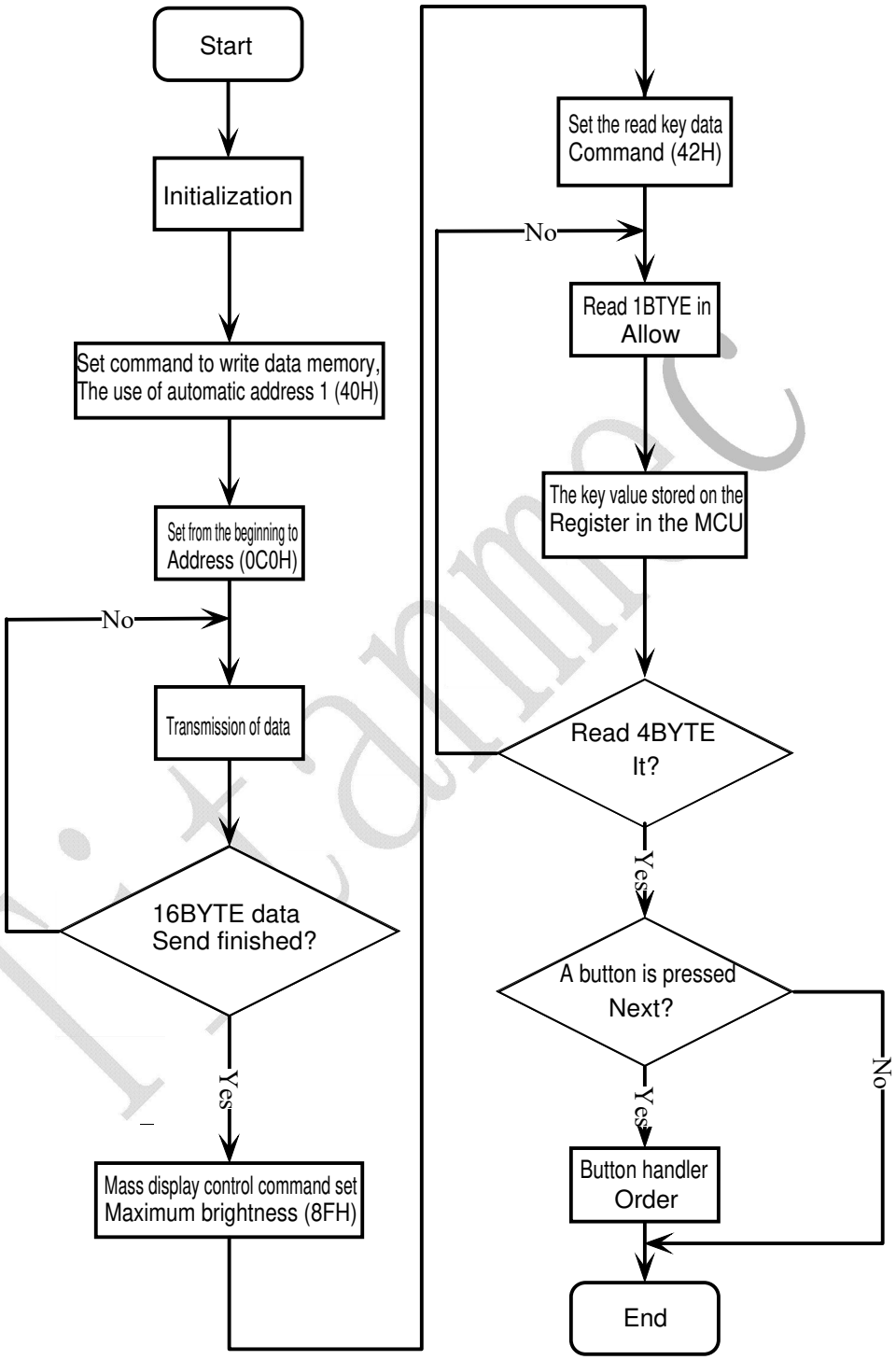
10.3 Read Timing button



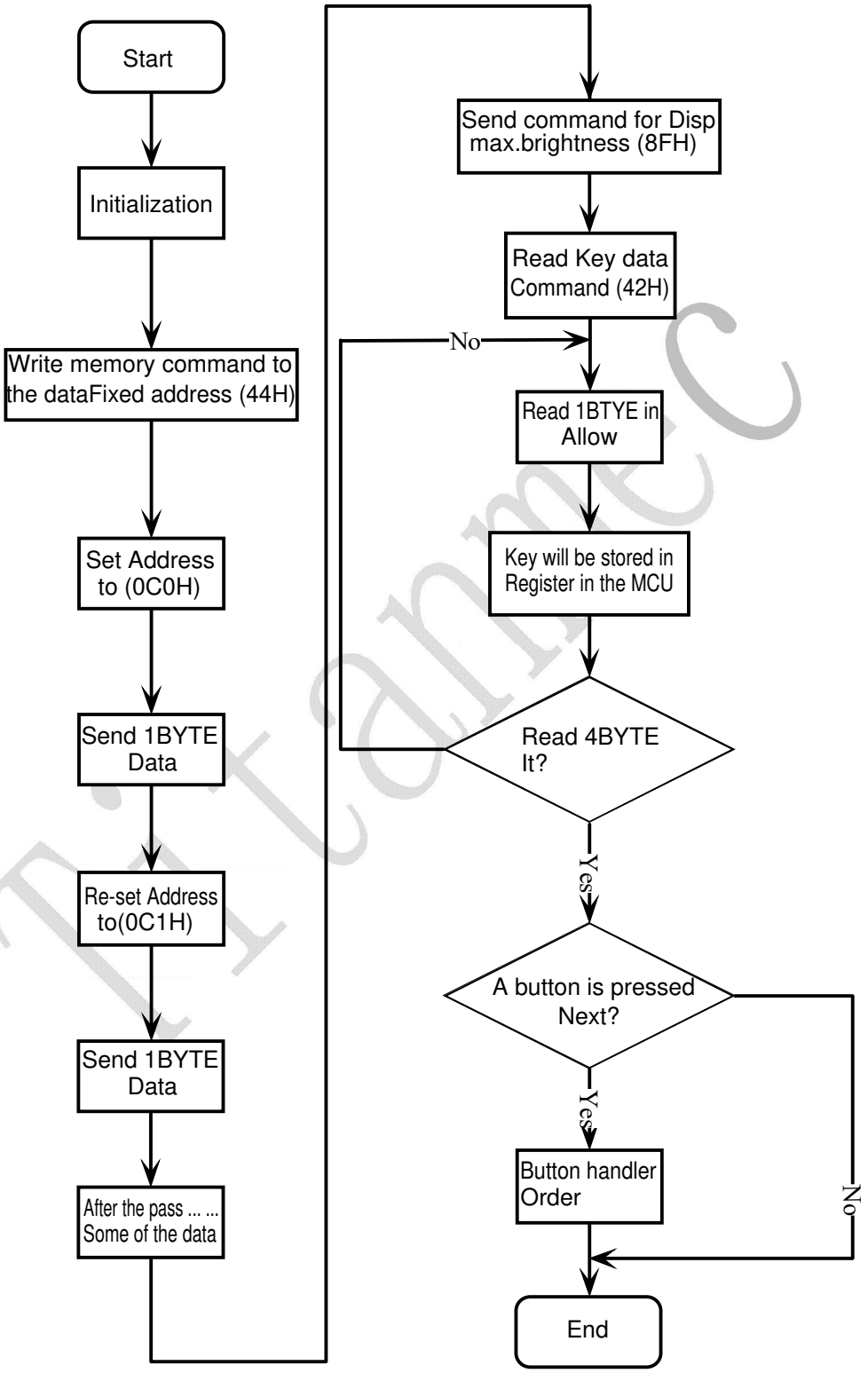
Command1: Set the display mode
Data1 ~ 4: read the key data

10.4 Programming Flow Chart

The use of automatic address programming flow chart 1:

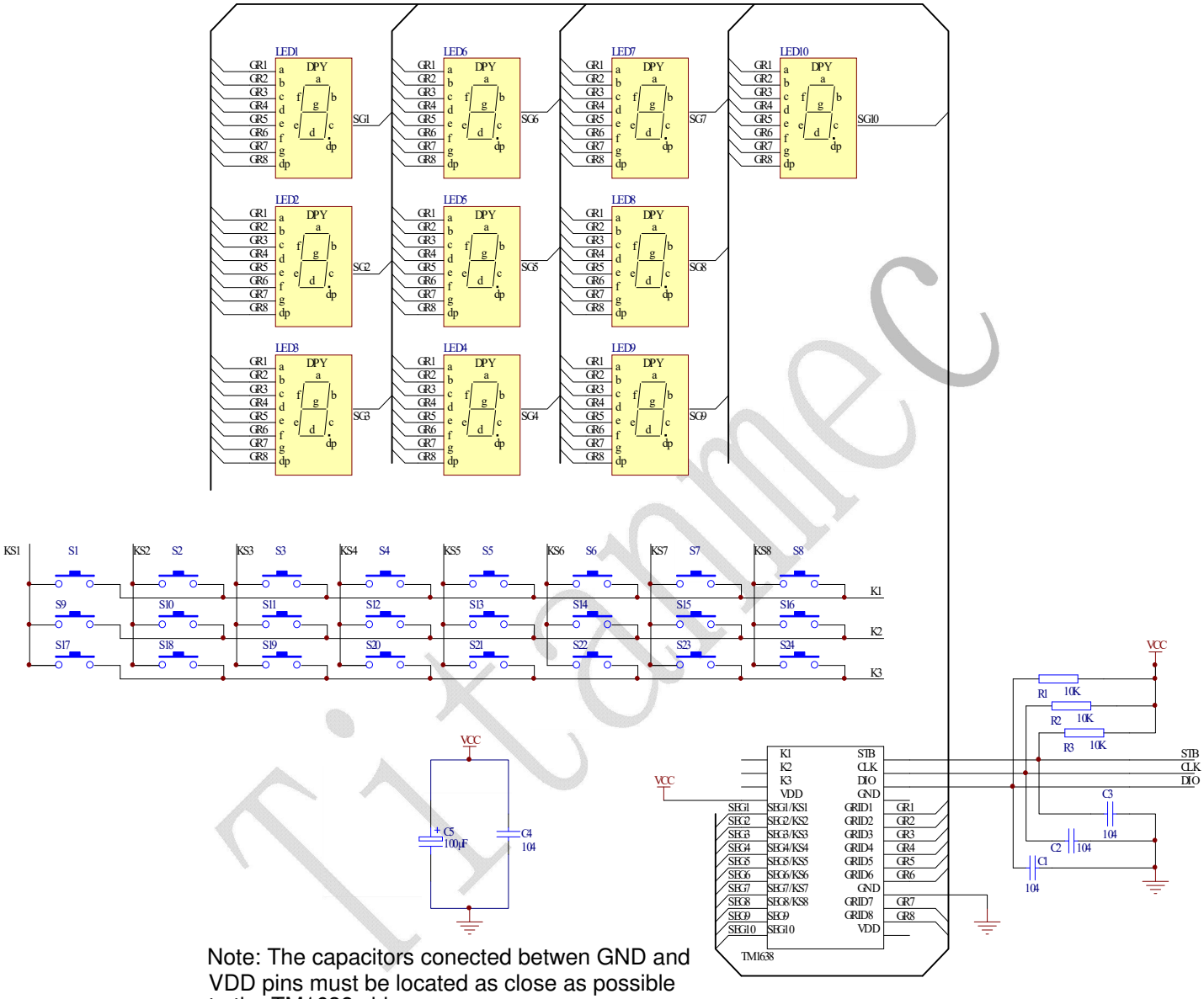


Fixed address programming flow chart:



11. Application circuit:

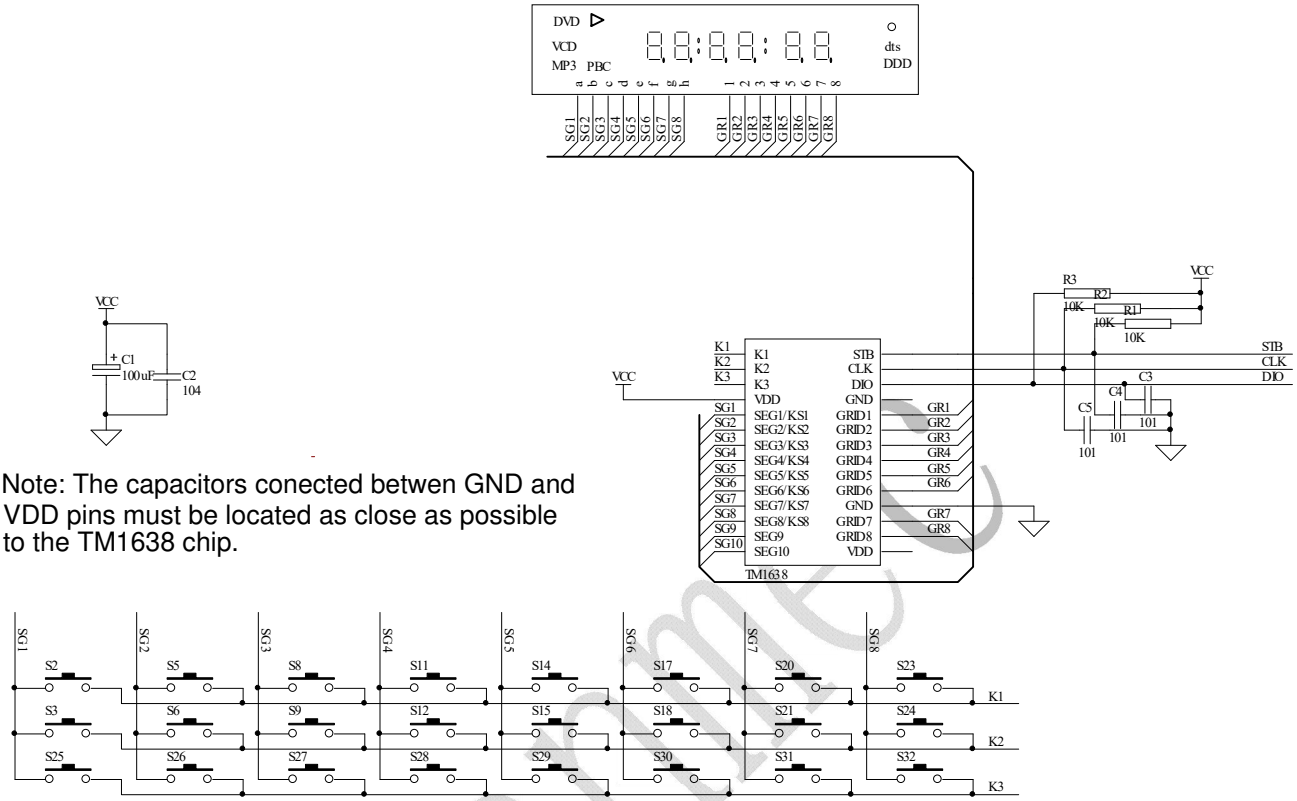
11.1 TM1638 with common anode LED displays, as shown in Figure (16):



Note: The capacitors conected betwen GND and VDD pins must be located as close as possible to the TM1638 chip.

Figure (16)

11.2 TM1638 with common cathode LED display, as shown in Figure (17):



Note: The capacitors conected betwen GND and VDD pins must be located as close as possible to the TM1638 chip.

Figure (17)

Note: 1. VDD, GND filter capacitor between the PCB board layout should be placed as close to the TM1638 chip, enhanced filtering effect.

2. The three 100pF capacitors connected to the DIO, CLK, STB communication port can reduce the interference of the communication port.

3. Due to Blu-ray turn-on voltage of digital blood pressure is about 3V, so TM1638 power supply should be used in 5V.

12. Electrical characteristics:

Absolute maximum ratings (Ta=25C, Vss=0V)

Parameter	Symbol	Ratings	Unit
Logic supply voltage	Vdd	-0.5 ~ +7.0	V
Logic input voltage	VI1	-0.5 ~ VDD + 0.5	V
LED Seg drive output current	IO1	-50	mA
LED Grid drive output current	IO2	+200	mA
Power dissipation	PD	400	mW
Operating temperature	Topt	-40 ~ +80	C
Storage temperature	Tstg	-65 ~ +150	C

Recommended operating range (Ta = -20 ~ +70 C, Vss = 0 V)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Power supply voltage	Vdd		5		V	
High level input voltage	ViH	0.7 Vdd	-	Vdd	V	
Low level input voltage	ViL	0	-	0.3 Vdd	V	

Electrical Characteristics (Ta = -20 ~ +70 C, VDD = 4.5 ~ 5.5 V, Vss = 0 V

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
High-Level Output Current	Ioh1	-20	-25	-40	mA	Seg1~Seg11 , Vo = vdd-2V
	Ioh2	-20	-30	-50	mA	Seg1~Seg11 , Vo = vdd-3V
Low-Level Output Current	IOL1	80	140	-	mA	Grid1~Grid6 Vo=0.3V

Low-level output current	Idout	4	-	-	mA	Vo=0.4V, dout
Segment High-Level Output Current Tolerance	Itolsg	-	-	5	%	VO = VDD – 3V, Seg1 ~ Seg11
Output pull-down resistor	RL		10		kΩ	K1 ~ K3
Input Current	Ii	-	-	± 1	μA	VI = VDD / VSS
High-Level Input Voltage	VIH	0.7 VDD	-		V	CLK, DIN, STB
Low-Level Input Voltage	VIL	-	-	0.3 VDD	V	CLK, DIN, STB
Hysteresis voltage	VH	-	0.35	-	V	CLK, DIN, STB
Dynamic current consumption	IDDdyn	-	-	5	mA	no load, display off

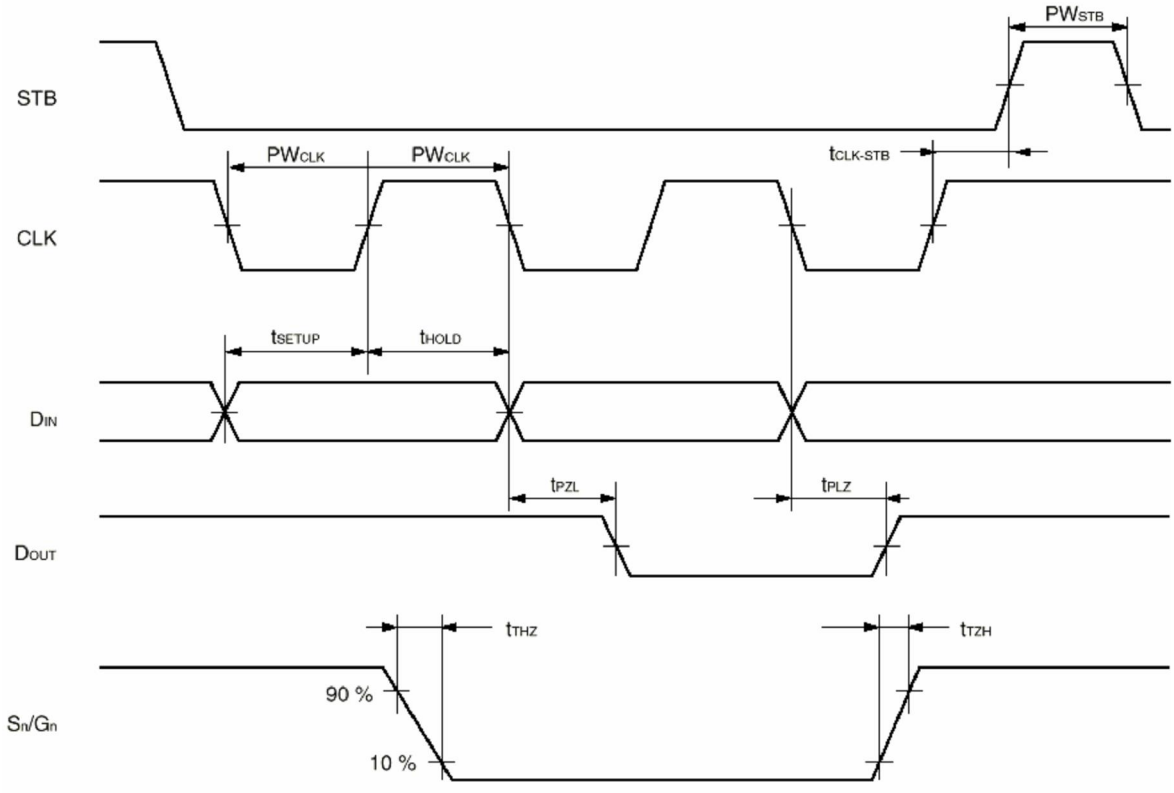
Switching Characteristics (Ta = -20 ~ +70 C, VDD = 4.5 ~ 5.5 V)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions	
Oscillation frequency	Fosc	-	500	-	KHz	R = 16.5 K	
Transmission Delay Time	tPLZ	-	-	300	ns	CLK → DOUT	
	tPZL	-	-	100	ns	CL = 15pF, RL = 10K Ω	
Rise Time	TTZH1	-	-	2	μs	CL = 300pF	Seg1 ~ Seg11
	TTZH2	-	-	0.5	μs		Grid1 ~ Grid4 Seg12/Grid7 ~ Seg14/Grid5
Fall Time	TTHZ	-	-	120	μs	CL = 300pF, Segn, Gridn	
Maximum clock frequency	Fmax	1	-	-	MHz	50% duty cycle	
Input capacitance	CI	-	-	15	pF		

Timing Characteristics (Ta = -20 ~ +70 C, VDD = 4.5 ~ 5.5 V)

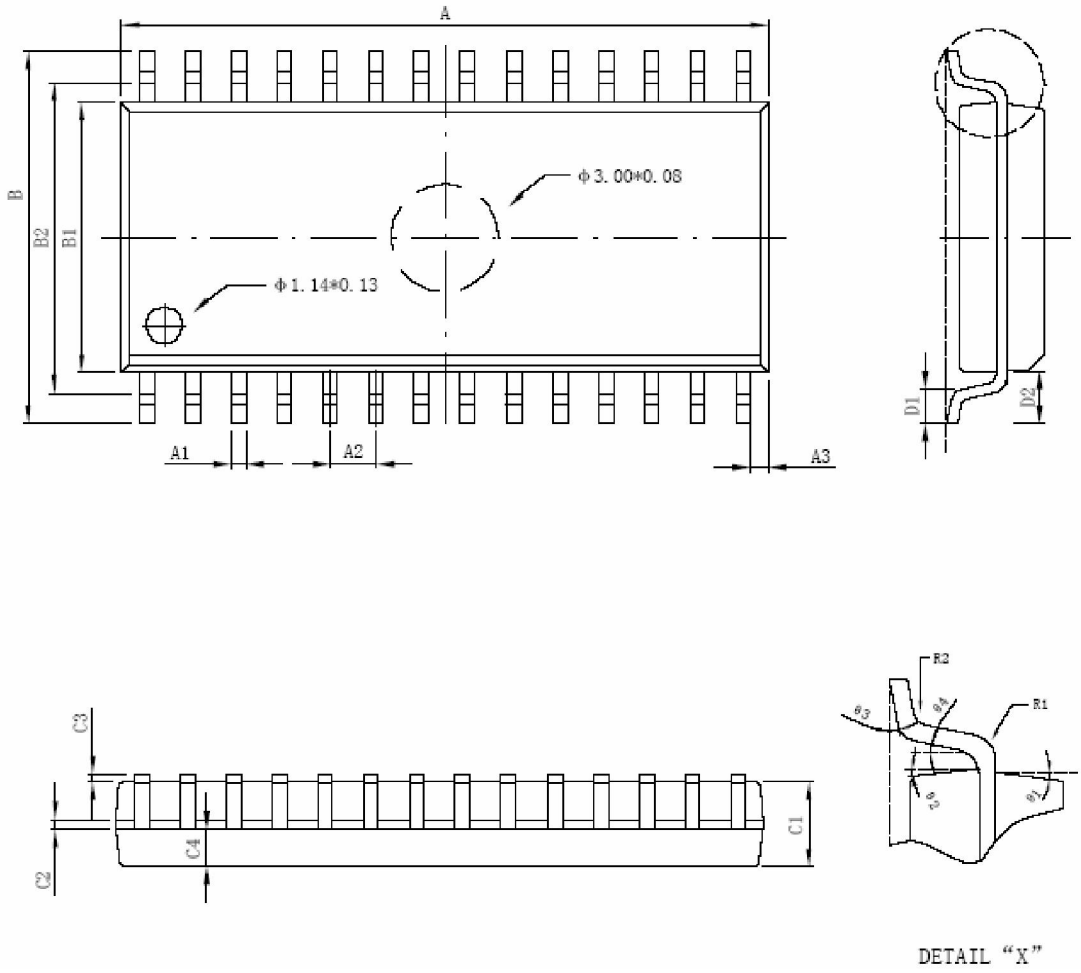
Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Clock pulse width	PWCLK	400			ns	
Strobe pulse width	PWSTB	1			µs	
Data setup time	tSETUP	100			ns	
Data hold time	tHOLD	100			ns	
CLK ->STB time	tCLK-STB	1			µs	CLK↑ →STB↑
Waiting time	tWAIT	1			µs	CLK↑ →CLK↓

Timing Waveform:



13. Package size

尺寸 / 标注	最 小（mm）	最 大（mm）	尺寸 / 标注	最 小（mm）	最 大（mm）
A	17.83	18.03	C4	1.043TYP	
A1	0.4064TYP		D1	0.70	0.90
A2	1.27TYP		D2	1.395TYP	
A3	0.51TYP		R1	0.508TYP	
B	9.90	10.50	R2	0.508TYP	
B1	7.42	7.62	θ1	7° TYP	
B2	8.9TYP		θ2	5° TYP	
C1	2.24	2.44	θ3	4° TYP	
C2	0.204	0.33	θ4	10° TYP	
C3	0.10	0.25			



- All specs and applications shown above subject to change without prior notice.

This application document was last updated :2011 -4-9