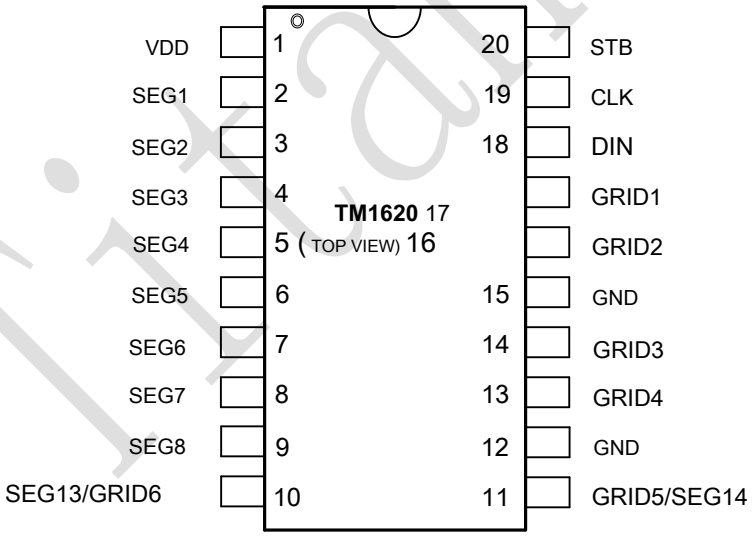
I. Overview

TM1620 is a special IC for LED (light emitting diode display) drive control, integrated with MCU digital interface and data latch Circuits such as the device, LED drive, etc. This product has reliable quality, good stability and strong anti-interference ability. Mainly suitable for home appliances (smart therm Water heaters, microwave ovens, washing machines, air conditioners, induction cookers), set-top boxes, electronic scales, smart meters and other digital tubes or LED display

2. Features

- **Using CMOS process**
- **Display mode (8 segments × 6 digits ~ 10 segments × 4 digits)**
- **Brightness adjustment circuit (8-level duty cycle adjustable)**
- **Serial interface (CLK, STB, DIN)**
- **Oscillation mode: built-in RC**
- **Built-in power-on reset circuit**
- **Built-in data latch circuit**
- **Light-up prevention circuit for LED reverse bias leakage caused dim**
- **Strong anti-interference**
- **Package form: SOP20**

3. Pin definition:



4. Pin function definition:

symbol	Pin name	Pin number	Description
DIN	data input	18	Input serial data on the rising edge of the clock, from the low bit Start.
CLK	Clock input	19	Read serial data on rising edge and output on falling edge data.
STB	Chip select input	20	Initialize the serial interface on the falling edge, then wait Receive instructions. The first byte after STB is low Is an instruction, when the instruction is processed, the current other processing Was terminated. When STB is high, CLK is ignored.
SGE1 ~ SEG8	Output (segment)	2 ~ 9	Segment output, P tube open drain output
GRID1 ~ GRID4	Output (bit)	16 ~ 17 13 ~ 14	Bit output, N tube open drain output
SEG13/DRID6 ~ SEG14/GRID5	Output (segment/position)	10 ~ 11	Segment/bit multiplexed output, only select segment or bit output
VDD	Logic power	1	Power supply
GND	Logically	12, 15	Systematically

5. Instructions:

Instructions are used to set the display mode and the status of the LED driver.

The first byte input by DIN after the falling edge of STB is used as a command. After decoding, take the highest B7 and B6 two bits to distinguish different commands.

B7	B6	instruction
0	0	Display mode command settings
0	1	Data command settings
1	0	Display control command settings
1	1	Address command settings

If STB is set to high level during command or data transmission, serial communication is initialized, and the command or data being transmitted is invalid (Previously sent The instructions or data remain valid).

(1) Display mode command settings:

This instruction is used to set the number of selected segments and bits (4~6 bits, 8~10 segments). When this command is executed, the display is forcibly closed. On display When the display mode is unchanged, the data in the video memory will not be changed, and the display control command controls the display switch.

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Display mode
0	0	Irrelevant items, fill in 0				0	0	4 digits 10 segments
0	0					0	1	5 digits 9 segments
0	0					1	0	6 bits 8 segments

(2) Data command setting:

This instruction is used to set 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	Features	Description
0	1	Irrelevant items, Fill 0				0	0	Data mode setting	Write data to display register
0	1				0			Address increase mode	Automatic address increase
0	1				1			Set up	Fixed address
0	1			0				Test mode setting	Normal mode
0	1			1				(internal use)	Test mode

(3) Display control command settings:

This command is used to set the display switch and display brightness adjustment. There are 8 levels of brightness to choose from for adjustment.

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Features	Description
1	0	Irrelevant items, Fill 0			0	0	0	Extinction number setting	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 settings	Display off
1	0		1					Show on

(4) Address command setting:

This instruction is used to set the address of the display register. The most effective address is 12 bits (00H-0BH). When power on, the address is set to 00H by default.

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Show address
1	1	Irrelevant items, Fill 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

6. Display register address:

This register stores the data received from the external device to the TM1620 through the serial interface, the most effective address is from 00H-0BH, a total of 12 byte units, Correspond to the SEG and GRID pins of the chip respectively, and the specific allocation is shown in Figure (2):

write led When displaying data, follow the display address from low to high, and data byte from low to high.

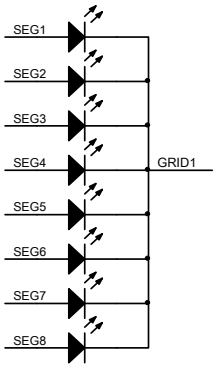
SEG1	**SEG2**	**SEG3**	**SEG4**	**SEG5**	**SEG6**	**SEG7**	**SEG8**	**X**	**X**	**X**	**X**	**SEG13**	**SEG14**	**X**	**X**	
xxHL (lower four digits)				xxHU (high four)				xxHL (lower four digits)				xxHU (high position)				
B0	B1	B2	B3	B4	B5	B6	B7	B0	B1	B2	B3	B4	B5	B6	B7	
00HL				00HU				01HL				01HU				**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**

figure 2)

▲**Attention** : The value stored in the chip display register at the moment of power-on may be random and uncertain. At this time, the customer directly sends the screen-opening command. Garbled characters may appear. Therefore, our company recommends that customers perform a power-on reset operation on the display register, that is, to the 12-bit video memory address after power-on (00H-0BH) all write data 0x00.

Seven, display:

Drive common cathode digital tube:



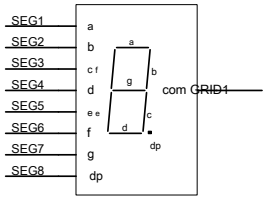


Figure (7)

Figure 7 shows the connection diagram of the common cathode digital tube. If the digital tube displays "0", you only need to switch to 00H (GRID1) address from the low position.

Just write 0x3F data. At this time, 00H corresponds to the data of each SEG1-SEG8 in the following table.

SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	
0	0	1	1	1	1	1	1	GRID1(00H)
B7	B6	B5	B4	B3	B2	B1	B0	

8. Serial data transmission format:

Both reading and receiving a BIT operate on the rising edge of the clock.

Data receiving (write data)

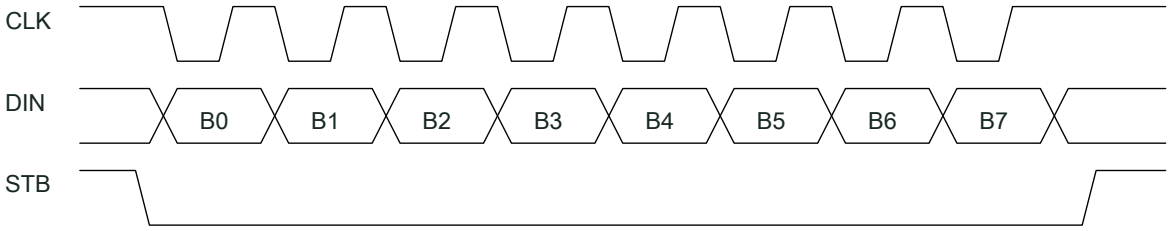


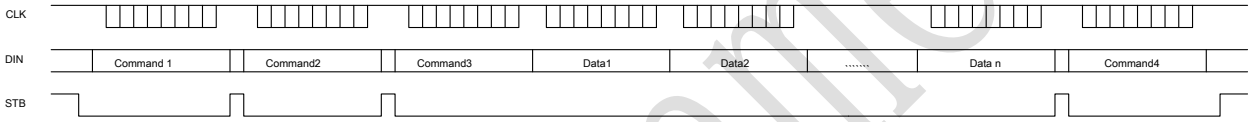
Figure 5)

11. Serial data transmission during application :

(1) Address increase mode

Using the automatic address plus 1 mode, the setting address is actually the starting address where the data stream to be transmitted is stored. The start address command word is sent

After that, "STB" does not need to be set high and then the data is transmitted, up to 14 BYTE, and "STB" is set high after the data transmission is completed.



Command1: Set the display mode

Command2: Set data command

Command3: Set the display address

Data1 ~ n: Transmit display data to Command3 address and the following address (maximum 12bytes)

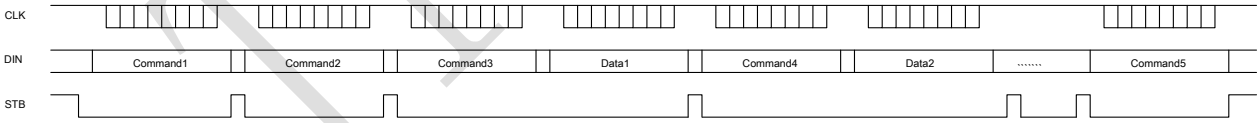
Command4: Display control commands

(2) Fixed address mode

Using the fixed address mode, setting the address is actually setting the address where the 1BYTE data to be transmitted is stored. Address sent" , STB"

There is no need to set high, immediately after transmitting 1BYTE data, the "STB" is set high after the data transmission is completed. Then reset the address where the second data needs to be stored,

After the transmission of up to 12 bytes of data is complete, "STB" is set high.



Command1: Set the display mode

Command2: Set data command

Command3: Set display address 1

Data1: Transmit display data 1 to the Command3 address

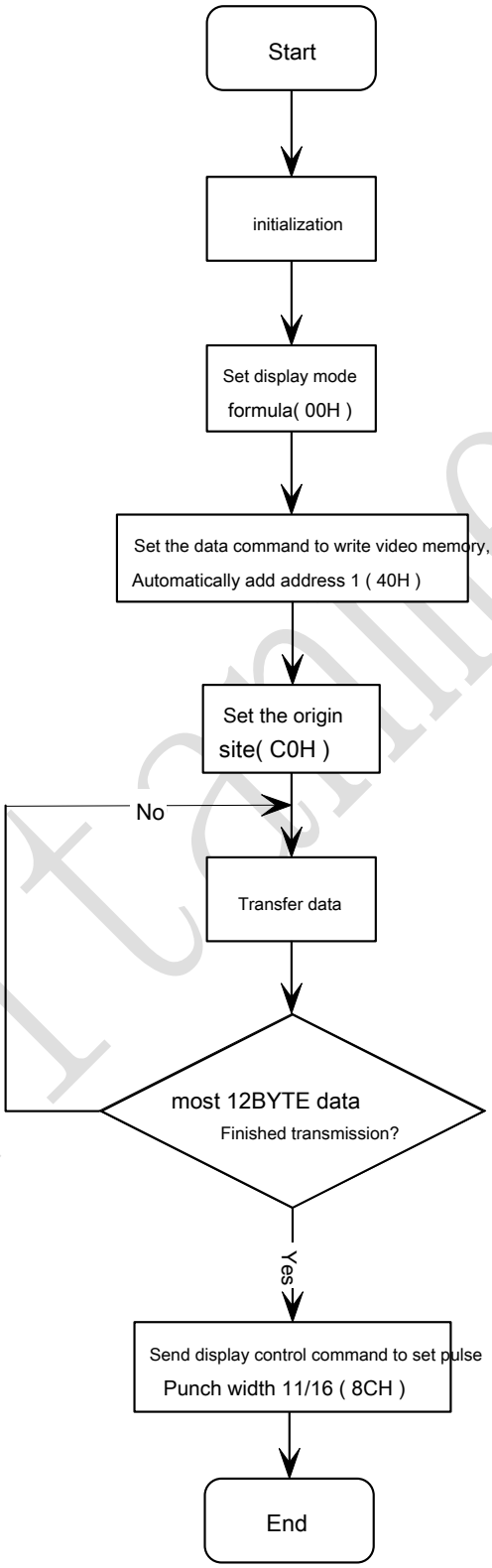
Command4: Set display address 2

Data2: Transmit display data 2 to the Command4 address

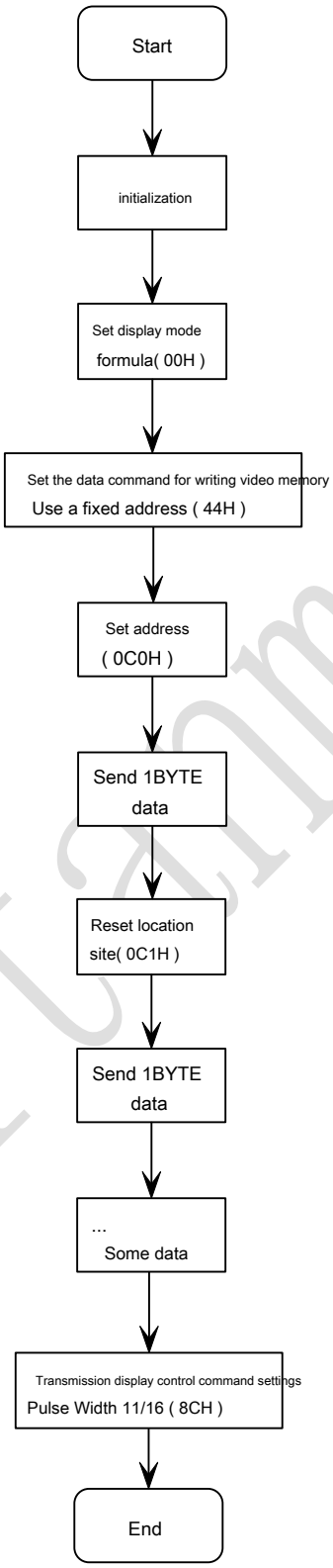
Command5: Display control commands

(4) The program design flow chart adopting the address automatic increment and fixed address method:

Program design flow chart with automatic address plus one :



Program design flow chart with fixed address :



12. Application circuit:

TM1620 drive common cathode digital screen hardware circuit diagram (18)

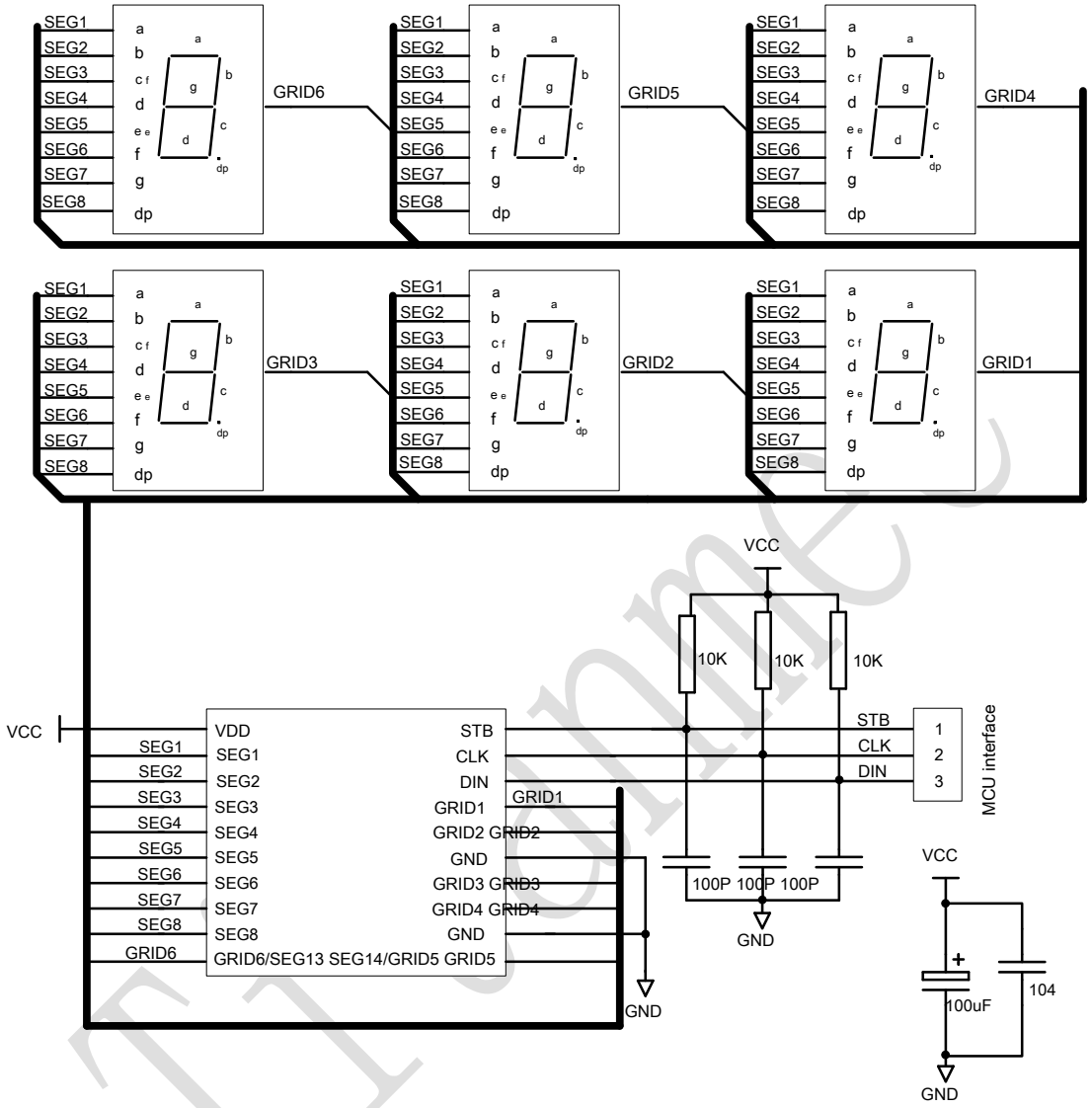


Figure (18)

▲**Attention** :1. The filter capacitor between VDD and GND should be placed as close as possible to the TM1620 chip on the PCB board to enhance the filtering effect.

2. Connecting three 100pF capacitors on the DIN, CLK, and STB communication ports can reduce the interference to the communication ports.

3. Since the turn-on voltage of the blue digital tube is about 3V, the TM1620 power supply should be 5V.

13. Electrical parameters:

Limit parameters (Ta = 25℃, Vss = 0V)

parameter	symbol	range	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 driver output current	IO2	+ 200	mA
Power loss	PD	400	mW
Operating temperature	Topt	-40 ~ +80	°C
Storage temperature	Tstg	-65 ~ +150	°C

Normal working range (Ta = -20 ~ +80℃, Vss = 0V)

parameter	symbol	The smallest	typical	maximum	unit	Test Conditions
Logic 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 ~ +80℃, VDD = 5V, V_{SS} = 0V)

parameter	symbol	The smallest	typical	maximum	unit	Test Conditions
High level output current	Ioh1	20	35	60	mA	SEG1 ~ SEG8 Vo = VDD -3V
Low-level input current	I_{OL}	80	120	-	mA	GRID1 ~ GRID6 Vo=0.3V
Low-level output current	Idout	3	-	-	mA	Vo = 0.4V,Dout
High level output current capacity A lot	Itolsg	-	-	5	%	Vo = VDD – 3V, SEG1 ~ SEG8
High level input voltage	VIH	0.7 VDD	-		V	CLK, DIN, STB
Low-level input voltage	VIL	-	-	0.3 VDD	V	CLK, DIN, STB

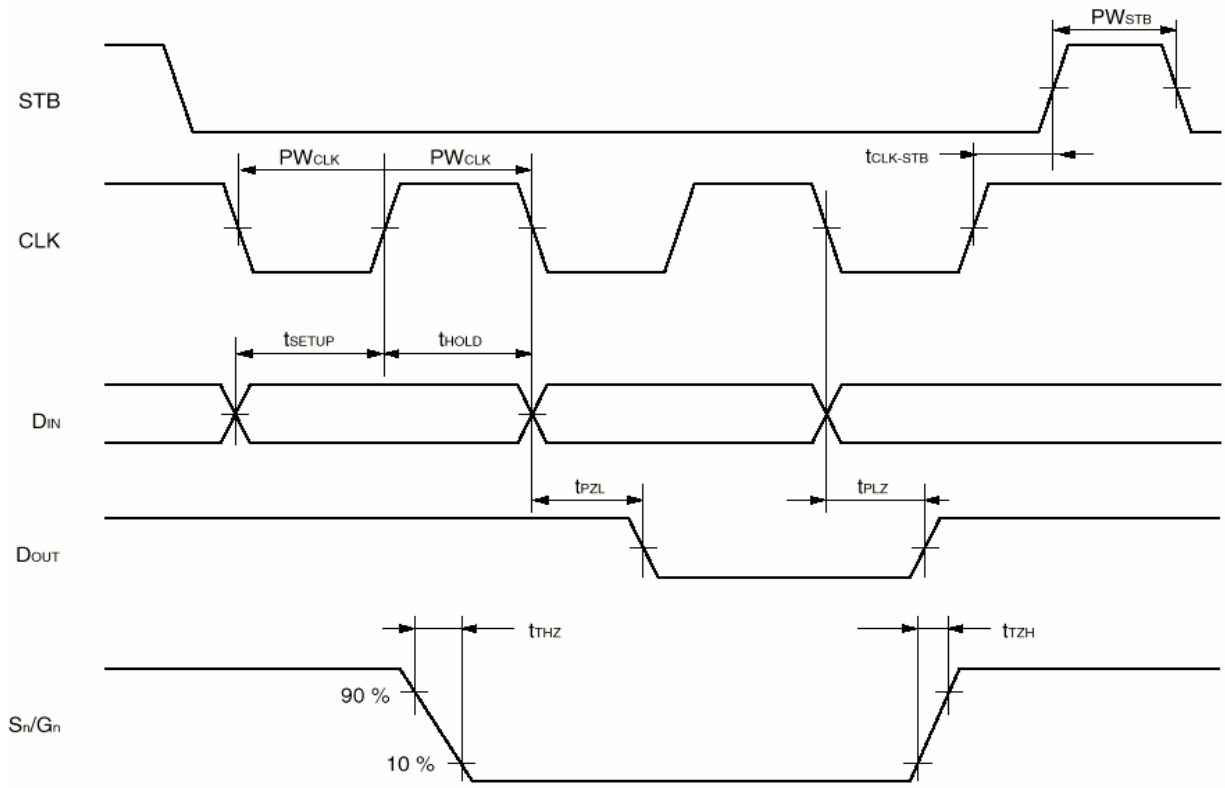
Switching characteristics (Ta = -20 ~ +80℃, VDD = 5V)

parameter	symbol	The smallest	typical	maximum	unit	Test Conditions	
Transmission delay time	t_{PLZ}	-	-	300	ns	CLK → DIN CL = 15pF, RL = 10K Ω	
	t_{PZL}	-	-	100	ns		
Rise Time	t_{TZH1}	-	-	2	μ s	CL = 300p F	SEG1 ~ SEG8
	t_{TZH2}	-	-	0.5	μ s		GRID1 ~ GRID4 SEG13/GRID6 ~ SEG14/GRID5
Fall time	t_{THZ}	-	-	1.5	μ s	CL = 300pF, SEGn, GRIDn	
Maximum input clock frequency rate	Fmax	-	-	1	MHz	50% duty cycle	
Input capacitance	CI	-	-	15	pF	-	

Timing characteristics (Ta = -20 ~ +80℃, VDD = 5V)

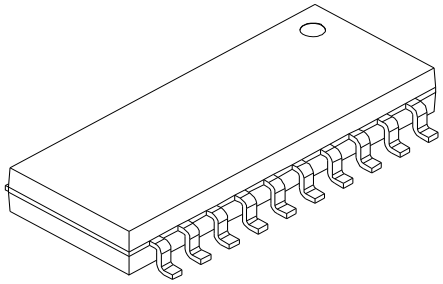
parameter	symbol	The smallest	Typical	maximum	unit	Test Conditions
Clock pulse width	PW_{CLK}	500	-	-	ns	-
Strobe pulse width	PW_{STB}	1	-	-	μs	-
Data establishment time	t_{SETUP}	100	-	-	ns	-
Data retention time	t_{HOLD}	100	-	-	ns	-
CLK →STB time	$t_{CLK-STB}$	1	-	-	μs	CLK↑→STB↑

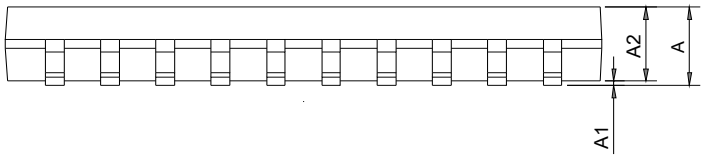
Timing waveform diagram:

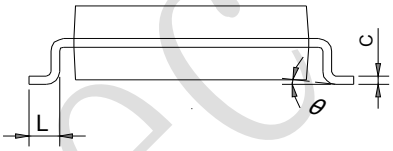


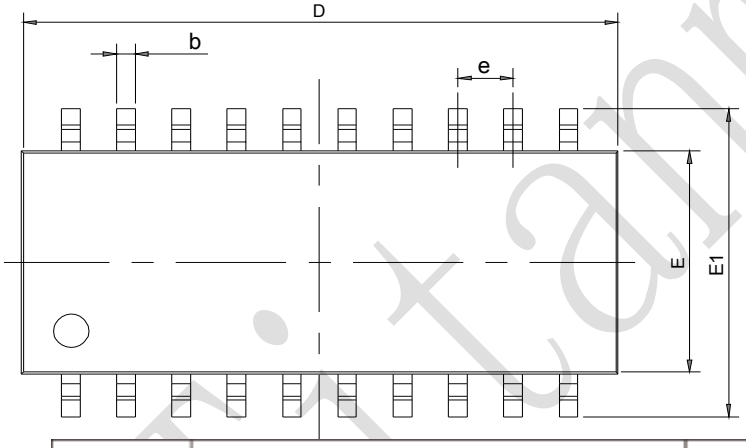
14. IC package diagram:

SOP20 package size:









Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	2.350	2.650	0.093	0.104
A1	0.100	0.300	0.004	0.012
A2	2.100	2.500	0.083	0.098
b	0.330	0.510	0.013	0.020
c	0.204	0.330	0.008	0.013
D	12.520	13.000	0.493	0.512
E	7.400	7.600	0.291	0.299
E1	10.210	10.610	0.402	0.418
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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

(The above circuit and specifications are for reference only. If our company makes amendments without notice.)