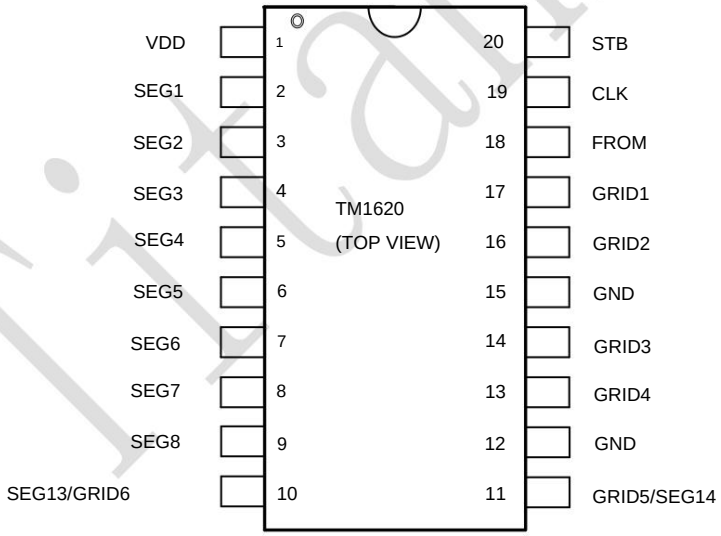
I. Overview

TM1620 is a dedicated IC for LED (Light Emitting Diode Display) drive control, which integrates MCU digital interface and data latch.
circuit, LED driver, etc. This product has reliable quality, good stability and strong anti-interference ability. Mainly suitable for home appliances (intelligent heat
Water heaters, microwave ovens, washing machines, air conditioners, induction cookers), set-top boxes, electronic scales, smart meters and other digital tubes or LED display devices.

2. Features Description • Adopt
CMOS technology • Display
mode (8 segments × 6 bits ~ 10 segments × 4 bits) • Brightness adjustment
circuit (8-level duty cycle adjustable) • Serial interface (CLK, STB, DIN) •
Oscillation mode: built-in RC oscillator• built-in power-on reset circuit• built-
in data latch circuit• built-in optimized circuit for LED reverse bias leakage
caused dark and bright problems• strong anti-interference ability• package
type: SOP20

3. Pin definition:



Four, pin function definition:

symbol	pin name pin number		illustrate
FROM	data input	18	Input serial data on the rising edge of the clock, starting from the low start.
CLK	clock input	19	Read serial data on rising edge, output on falling edge data.
STB	Chip select input	20	Initialize serial interface on 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 to SEG8 output (segment)		2~9 segment output, P tube open-drain output	
GRID1 to GRID4 output (bit)		16ÿ17 13ÿ14	Bit output, N tube open-drain output
SEG13 / DRID6 ÿ SEG14/GRID5	Output (segment/bit) 10~11 segments/bit multiplexed output, only select segment or bit output		
VDD	logic power	1 Connect to the power supply	
GND	Logic ground 12 and 15 are connected to system ground		

5. Instruction description: The

instruction is 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 serves as a command. After decoding, the highest two bits of B7 and B6 are taken to distinguish different instructions.

B7	B6	
0	0	Command Display Mode Command Settings
0	1	Data command settings
1	0	Display control command settings
1	1	Address command setting

If STB is set high during command or data transfer, serial communication is initialized and the command or data being transferred is invalid (previously transferred the instruction or data remains valid).

(1) Display mode command setting: This

command is used to set the number of selected segments and bits (4ÿ6 bits, 8ÿ10 segments). When this command is executed, the display is forcibly turned off. showing When the display mode remains unchanged, the data in the display 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, fill in 0				0	0	4 bits 10 segments
0	0					0	1	5 digits 9 segments
0	0					1	0	6 bits 8 segments

(2) Data command setting: This

command is used to set data writing and reading. Bits B1 and B0 are not allowed to set 01 or 11.

MSB LSB

B7 B6 B5 B4 B3 B2 B1 B0							Features	illustrate
0	1	irrelevant items, Fill in 0			0	0	Data mode setting	write data to display register
0	1			0			address increment mode set up	Automatic address increment
0	1			1				fixed address
0	1		0				Test Mode Settings (internal use)	normal mode
0	1		1					test mode

(3) Display control command setting: This

command is used to set the display switch and display brightness adjustment. A total of 8 levels of brightness can be selected for adjustment.

MSB LSB

B7 B6 B5 B4 B3 B2 B1 B0 Function								illustrate
1	0	irrelevant items, Fill in 0		0	0	0	Extinction quantity 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

command is used to set the address of the display register. The maximum valid address is 12 bits (00H-0BH). When powered on, the address defaults to 00H.

MSB LSB

B7 B6 B5 B4 B3 B2 B1 B0 Display address							
1	1		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	irrelevant items,	0	1	0	1	05H
1	1	Fill in 0	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 transmitted from the external device to TM1620 through the serial interface. The maximum effective address is from 00H-0BH in a total of 12-byte units.

They correspond to the SEG and GRID pins of the chip respectively, and the specific allocation is shown in Figure (2):

When writing LED display data, according to the display address from low to high, the data bytes operate from low to high.

–	–	–	–	–	–	–	–	X	X	X	X	–	–	X X	
xxHL (lower four digits)				xxHU (high four digits)				xxHL (lower four digits)				xxHU (high)			
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)

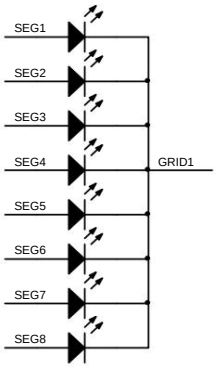
ÿNote: The value stored in the chip display register may be random and uncertain at the moment of power-on. At this time, the customer directly sends the screen opening command,

There may be garbled characters displayed. Therefore, our company recommends that customers perform a power-on clearing operation on the display register, that is, after power-on, the 12-bit display memory address is sent to the

(00H-0BH) all write data 0x00.

Seven, display: drive

common cathode digital tube:



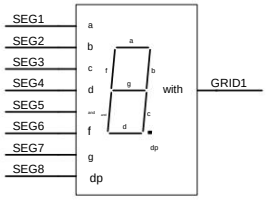


Figure (7)

Figure 7 shows the connection diagram of the common cathode nixie tube. If the nixie tube is to display "0", it is only necessary to open the address from the low position to the 00H (GRID1) address.

Just start writing 0x3F data, at this time 00H corresponds to the data of each SEG1-SEG8 as shown in the table below.

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	

Eight, serial data transmission format:

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

Data reception (write data)

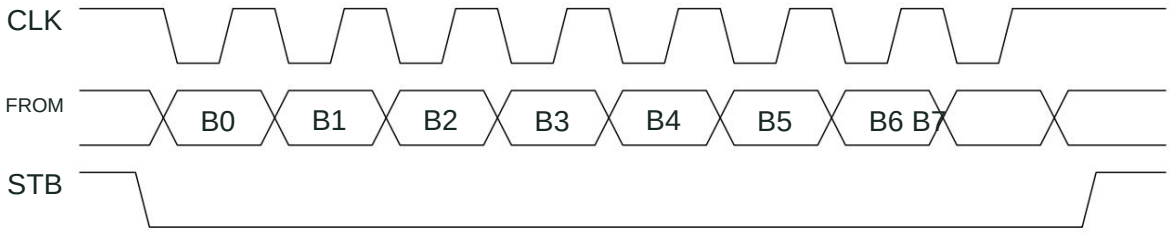


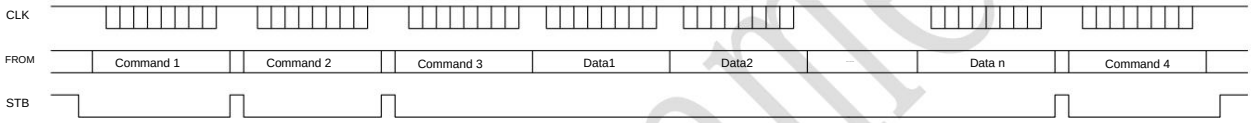
Figure 5)

11. Serial data transmission during application:

(1) Address increment mode

Using the address auto-add 1 mode, setting the address is actually setting the starting address of the transmitted data stream. Start address command word sent

After the completion, "STB" does not need to be set high to transfer data, up to 14BYTE, and "STB" is set high after the data transfer is completed.



Command1: set display mode

Command2: Set data command

Command3: Set display address

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

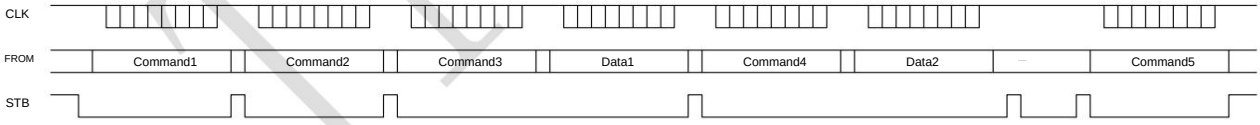
Command4: Display control commands

(2) Fixed address mode Using

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, followed by 1BYTE data transmission, and "STB" is set high after the data transmission is completed. Then reset the address where the second data needs to be stored,

After the data transmission of up to 12BYTE is completed, "STB" is set high.



Command1: set display mode

Command2: Set data command

Command3: Set display address 1

Data1: Transfer display data 1 to Command3 address

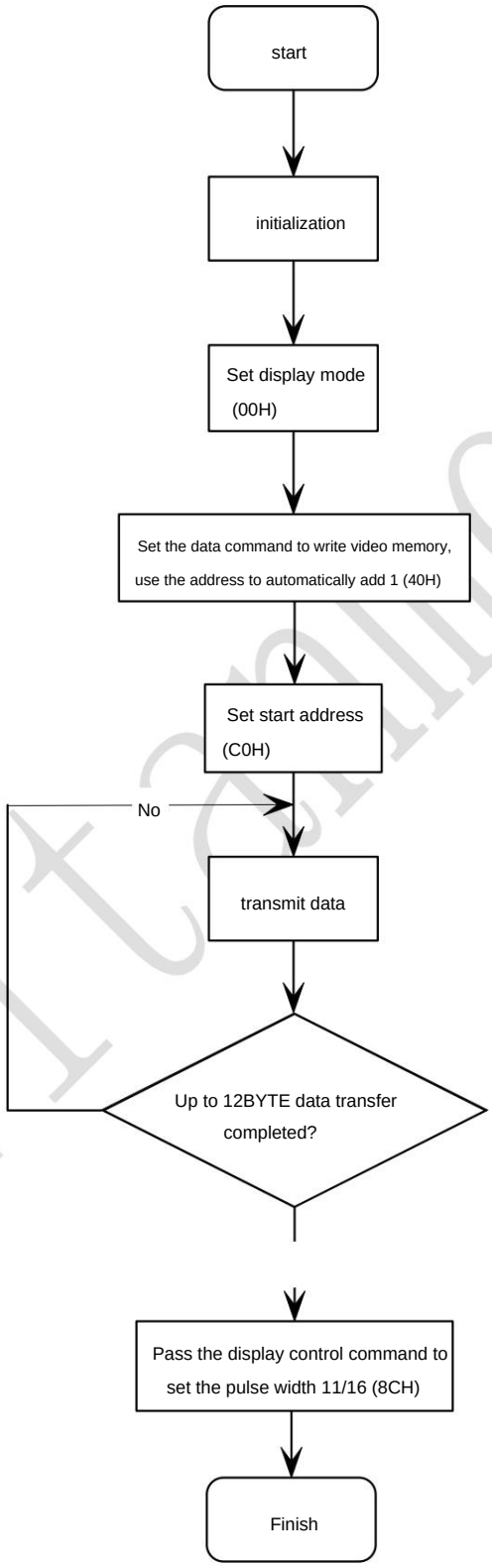
Command4: Set display address 2

Data2: Transmit display data 2 to Command4 address

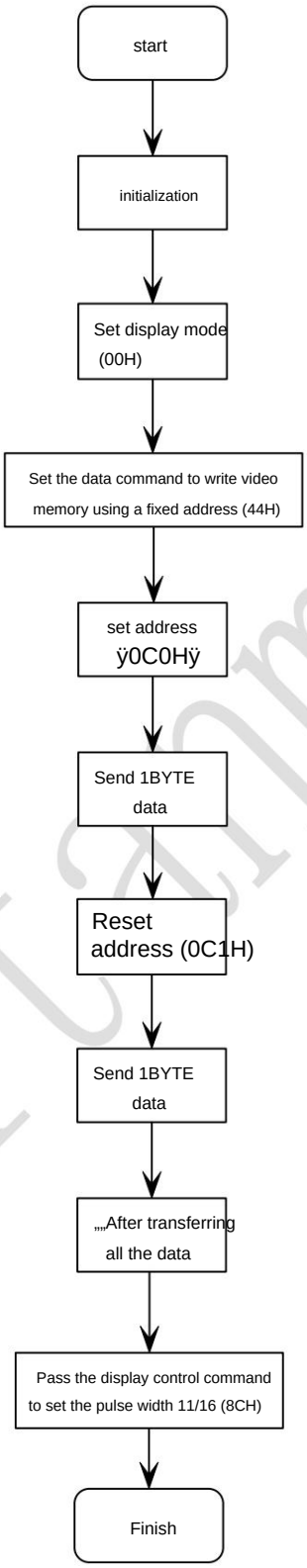
Command5: Display control commands

(4) Program design flow chart using automatic address increment and fixed address method:

The program design flow chart using automatic address plus one:



Flowchart of programming with fixed address:



12. Application circuit:

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

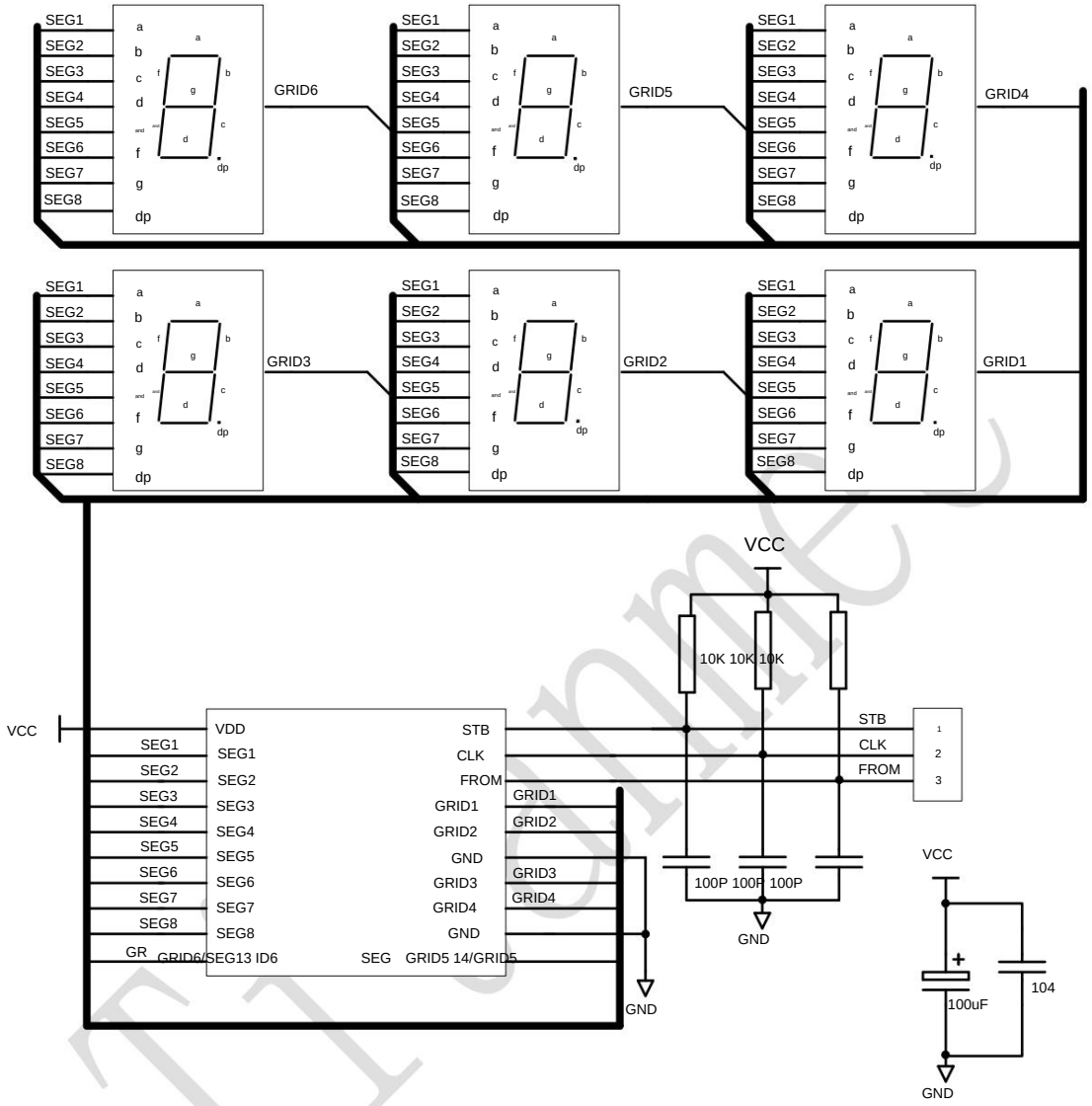


Figure (18)

ÿNote: 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. Connect to the DIN, CLK, STB communication ports and pull down three 100pF capacitors to reduce the interference to the communication ports.

3. Since the on-voltage step-down of the blue-light digital tube is about 3V, 5V should be selected for the power supply of TM1620.

13. Electrical

parameters: Limit parameters (Ta = 25ÿ, Vss = 0V)

parameter	symbol	scope	unit
Logic Supply Voltage	VDD	-0.5 ÿ+7.0	IN
Logic input voltage	VI1	-0.5 ÿ VDD + 0.5	IN
LED SEG driver output current	IO1	-50	mA
LED GRID drive output current	IO2	+200	mA
Power loss	PD	400	mW
Operating temperature	Topt	-40 ÿ +80	ÿ
Storage temperature	Tstg	-65 ÿ+150	ÿ

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

parameter	Symbol	Min	Typical	Max	Unit	Test Conditions
Logic Supply Voltage	VDD		5		IN	
High level input voltage	HIV	0.7 VDD		VDD	IN	
Low level input voltage	WILL	0		0.3 VDD	IN	

dedicated circuit for LED drive control (Ta = -20 to +80°C, VDD = 5V, VSS = 0V)

parameter	Symbol	Minimum	Typical	Maximum	Unit	Test Conditions
High level output current Ioh1		20	35	60	mA	SEG1ÿSEG8 Vo = VDD -3V
Low-level input current IOL		80	120		mA	GRID1 ÿ GRID6 Vo = 0.3V
Low-level output current Idout		3			mA	Vo = 0.4V,Dout
High level output current capacity Iot	Itolsg			5	%	Vo = VDD - 3V, SEG1ÿSEG8
High level input voltage VIH		0.7 VDD			IN	CLK, DIN, STB
Low-level input voltage VIL				0.3 VDD	IN	CLK, DIN, STB

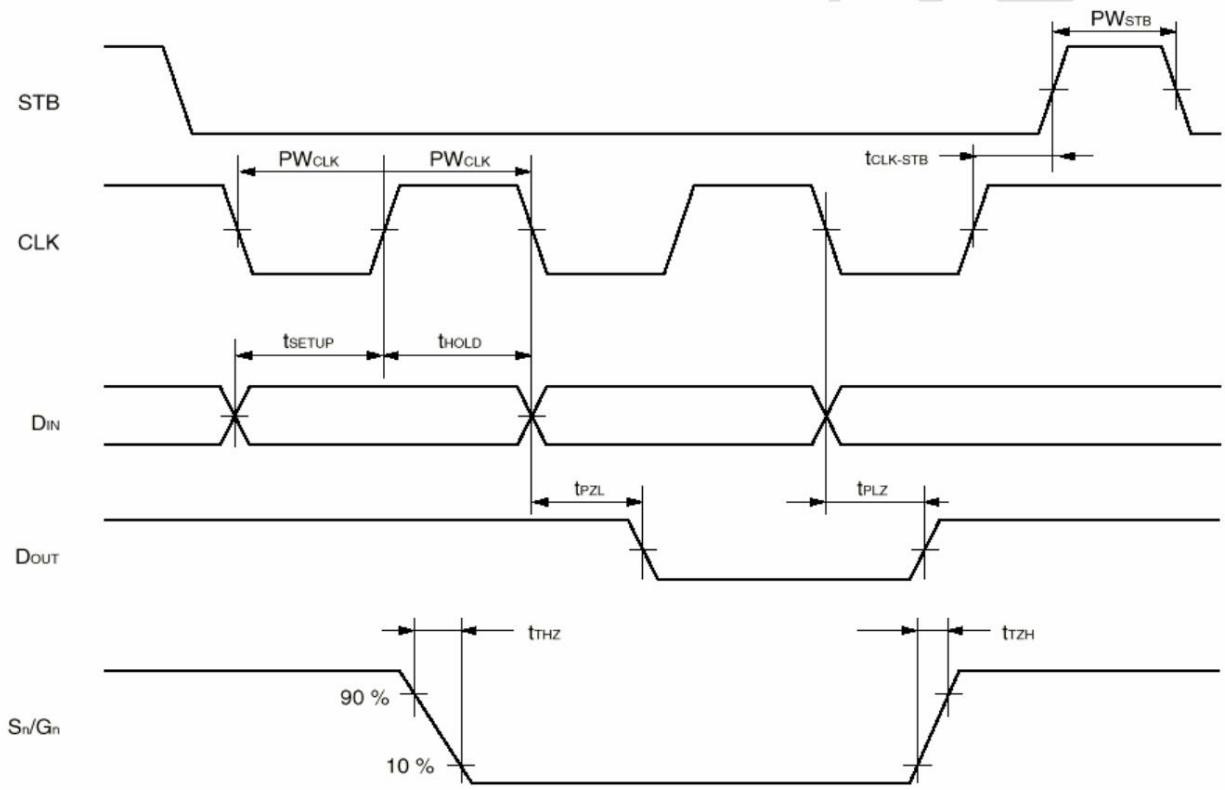
Switching characteristics (Ta = -20 ~ +80ÿ, VDD = 5V)

parameter	Symbol	Minimum	Typical	Maximum	Unit	Test Conditions	
transmission delay time	tPLZ			300	ns	CLK ÿ DIN CL = 15pF, RL = 10K ÿ	
	tPZL			100	ns		
Rise Time	tTZH 1			2	ÿ s	CL = 300p F	SEG1ÿSEG8
	tTZH 2			0.5	ÿ s		GRID1 ÿ GRID4 SEG13/GRID6ÿ SEG14/GRID5
fall time	tTHZ			1.5	ÿ s	CL = 300pF,SEGn,GRIDn	
Maximum input clock frequency Rate	Fmax			1	MHz	50% duty cycle	
input capacitance	THERE			15	pF		

Timing Characteristics (Ta = -20 ~ +80ÿ, VDD = 5V)

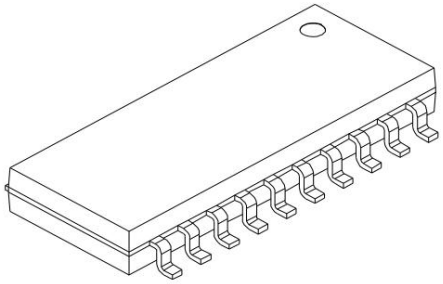
parameter	Symbol	Min	Typical	Max	Unit	Test Conditions
Clock pulse width PWCLK			500		ns	
Strobe width PWSTB			1		ÿ s	
Data setup time tSETUP			100		ns	
data retention time	tHOLD		100		ns	
CLK ÿ STB time tCLK-STB			1		ÿ s	CLKÿÿSTBÿ

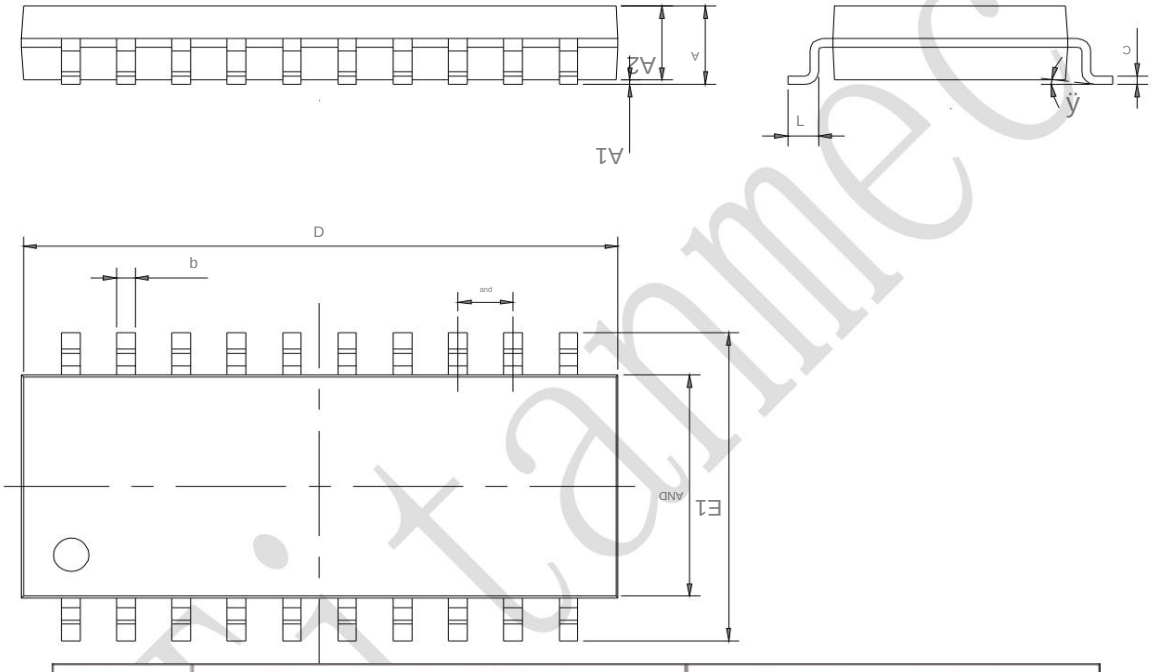
Timing waveform diagram:



14. Schematic diagram of IC package:

SOP20 Package Dimensions:





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 the company makes corrections without prior notice.)