

I. Overview

TM 1616 is a kind of LED (light-emitting diode display) drive control dedicated IC. The internal integrated circuits include MCU digital interface, data latch, and LED drive etc. The product is featured by reliable quality, stable performance and strong anti-jamming capacity. It is mainly used in VCR, VCD, DVD, home theater and other products display driver.

II. Features Descriptions

- Apply CMOS technological process
- Display mode (7 segment × 4 bit)
- Brightness regulating circuit (adjustable duty ratio of Class 8)
- Serial interface (CLK, STB, DIN)
- Oscillation way: built-in RC oscillation (450KHz+5%)
- Built-in optimized circuit for dimming caused by LED reverse bias leakage
- Built-in power-on reset circuit
- Package mode: SOP20 and DIP16

III. Pin Definition:

1	DIN	GRID1	16
2	CLK	GRID2	15
3	STB	GND	14
4	VDD	GRID3	13
5	SEG1	GRID4	12
6	SEG2	SEG7	11
7	SEG3	SEG6	10
8	SEG4	SEG5	9

IV. Pin function Definition:

Symbol	Pin Name	Pin No.	Descriptions
DIN	Digital input	1	Input serial data at rising edge of clock with beginning from low bit. uilt-in 13.3 K Ω pull-up resistor
CLK	Clock input	2	Read serial data at rising edge and export data from falling edge. uilt-in 13.3 K Ω pull-up resistor
STB	Chip select input	3	Initialize serial interface at falling edge and wait for receiving instruction. STB takes the first byte after the instruction is low; other processes shall be stopped when processing the instruction. CLK shall be ignored when STB is high. uilt-in 13.3K Ω pull-up resistor
SGE1 - SEG7	Output (segment)	5-11	Segment output, PMOS open-drain output. output with a 4K Ω pull-down resistor
GRID1 - GRID4	Output (bit)	16、15、13、12	Bit output, NMOS open-drain output. output with a 2.7K Ω pull-up resistor
VDD	Logic power	4	5V \pm 10%
GND	Logic earth	14	Connect to earth pole of the system



In the dry season or dry use environment, it is easy to generate a lot of static electricity, and static electricity discharge may damage the integrated circuit. Titan Microelectronics recommends to take all appropriate preventive measures for integrated circuit, improper operation and welding may cause ESD damage or performance degradation so that chip can not work normally.

V. Display register address and display mode

When writing LED display data, operate from display address low to high, and from data byte low to high. This register stores data sent from external devices to TM1616 via the serial interface, and the address assignment is as follows:

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	X		
xxHL (four low bits)				xxHU (four high bits)					
B0	B1	B2	B3	B4	B5	B6	B7		
00HL				00HU				GRID1	
02HL				02HU				GRID2	
04HL				04HU				GRID3	
06HL				06HU				GRID4	

VI. Instruction Description:

The instruction is used for setting the display mode and the status of LED driver.

The first byte inputted by DIN behind the STB falling edge is the instrument. With decoding, we take the maximum B7 and B6 bits to distinguish different instructions.

B7	B6	Instruction
0	0	Display Mode Command Setting
0	1	Data Command Setting
1	0	Display Control Command Setting
1	1	Address Command Setting

If STB is set at high level in instruction or data transmission, the serial communication is initialized and the instruction or data under transmission is invalid (the instruction or data transmitted before are still in effect).

(1) Display mode command setting:

This instruction is used for setting the number of selected segment and bit (4 - 7 bits). The display is forced to shut down when the instrument is executed. To send a display control command to open the display, the data content previously displayed is not changed, but this does not happen when the same mode is set.

MSB				LSB				Display mode
B7	B6	B5	B4	B3	B2	B1	B0	
0	0	Irrelevant item, filled with 0				0	0	4 bit × 7segment

(2) Data command Setting:

The instrument is used for setting the writing and reading for data. The B1 and B0 shall not be set as 01 or 11.

MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
0	1	Irrelevant item, filled with 0				0	0	Data mode setting	Write data to display register
0	1				0			Address increment mode setting	Auto increment
0	1				1				Fixed address
0	1			0				Test mode setting (For inner use)	Normal mode
0	1			1					Test mode

(3) Address command setting:

The instrument is used for setting the address of display register. TM1616 has 14 memory addresses (00H-0DH), but only 00H, 02H, 04H, 06H are actually used. If you use the address auto + 1 mode, the other addresses can be written 0, the address is set to 0EH or higher, and the data is ignored until the valid address is set. The default address is set as 00H when powering on.

B7	B6	B5	B4	B3	B2	B1	B0	register address
1	1	Irrelevant item, filled with 0		0	0	0	0	00H
1	1			0	0	1	0	02H
1	1			0	1	0	0	04H
1	1			0	1	1	0	06H

(4) Display control command setting:

MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
1	0	Irrelevant item, filled with 0			0	0	0	Extinction Number Setting	Set pulse width to 1/16
1	0				0	0	1		Set pulse width to 2/16
1	0				0	1	0		Set pulse width to 4/16
1	0				0	1	1		Set pulse width to 10/16
1	0				1	0	0		Set pulse width to 11/16
1	0				1	0	1		Set pulse width to 12/16
1	0				1	1	0		Set pulse width to 13/16
1	0				1	1	1		Set pulse width to 14/16
1	0			0				Display Switch Setting	Display closed
1	0			1					Display opened

VII. Display:

Drive common cathode nixie tube:



Figure above is the connection diagram for common cathode nixie tube. Input 0x3F to 00H address (GRID1) from lower bit to enable this nixie tube to show “0”. The data of SEG1-SEG8 corresponding to 00H are shown in the following table at the same time.

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	

VIII. Transmission format of serial data:

Reading and receiving 1 Bit are all operated at the rising edge of the clock.

Data receiving (writing data)

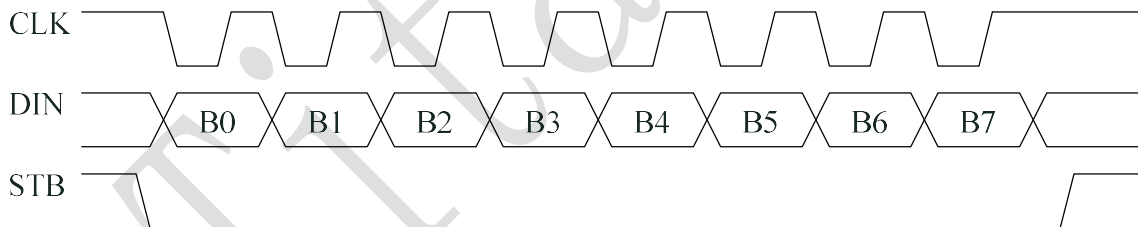
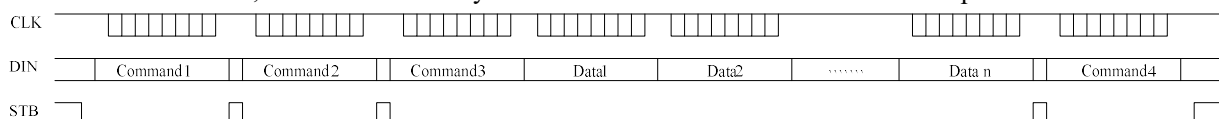


Figure (5)

IX. Transmission of serial data in application:

(1) Address increment mode

Using the auto increment mode to set address is to set the initial storage address for transmitted data flow actually. “STB” does not need to be increased to transmit data after finishing sending of command words for initial address, it is 14 BYTE at most, and can “STB” only be increased after data transmission is completed.



Command1: Set display mode

Command2: Set data command

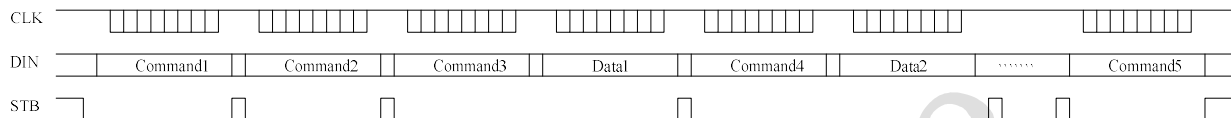
Command3: Set display address

Data1- n: Transmit display data to address in Command 3 and the latter addresses (12 bytes at most).

Command4: Display control command

(2) Fixed address Mode

Using the fixed address mode of to set address is to set the storage address of 1BYTE data for transmission actually. "STB" does not need to be increased to transmit 1BYTE data after finishing address sending, can "STB" only be increased after finishing data transmission. Reset the storage address for second data. "STB" can be increased after finishing data transmission for 12 BYTE at most.



Command1: Set display mode

Command2: Set data command

Command3: Set display address1

Data1: Transmit display digital1 to Command3 address

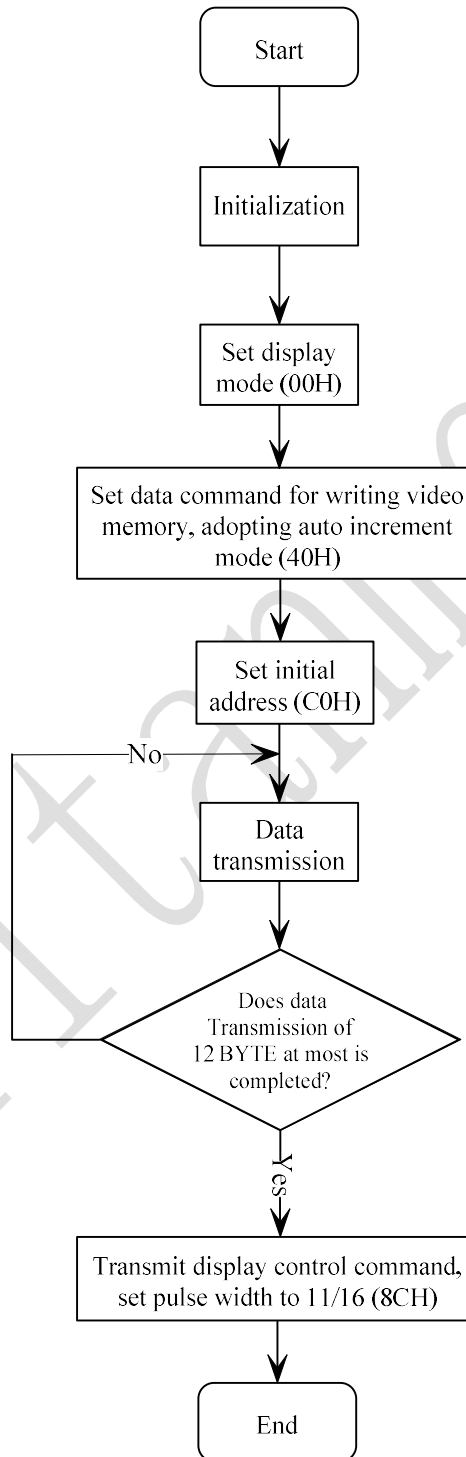
Command4: Set display address2

Data2: Transmit display digital 2 to Command4 address

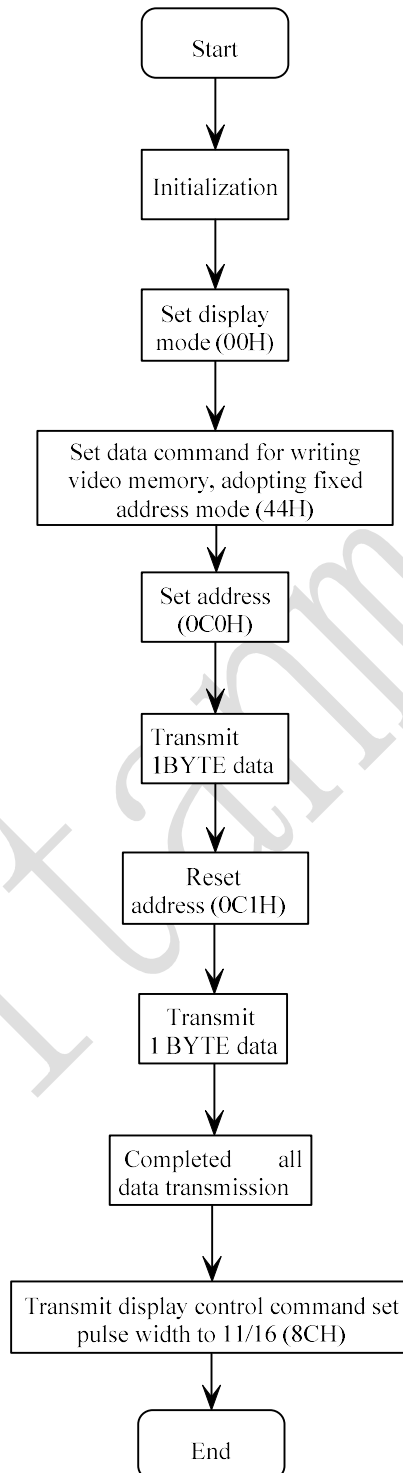
Command5: Display control command

(4) Flow diagram of programming design adopting auto increment mode and fixed address mode:

Flow diagram of programming design adopting auto increment mode:

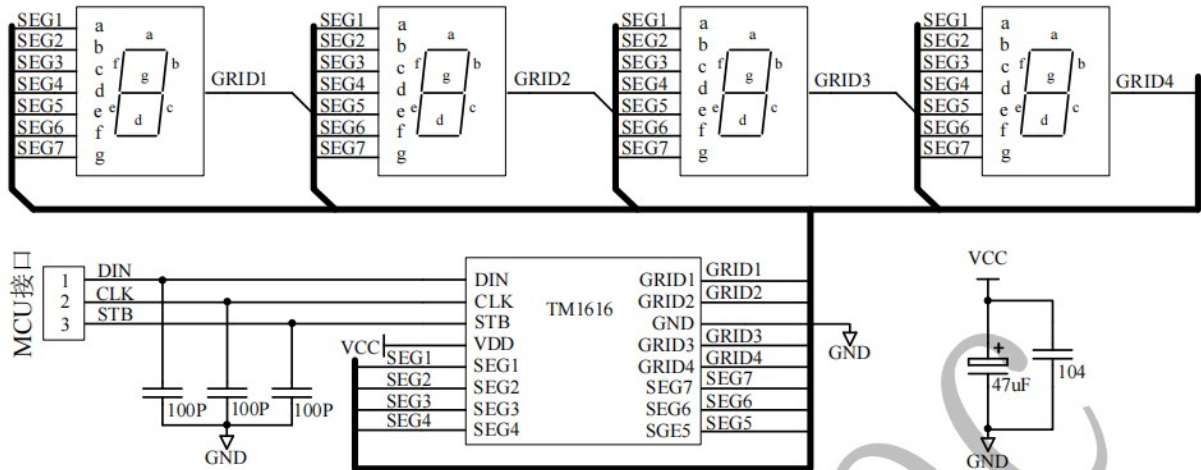


(5) Programming flow diagram adopting fixed address mode:



X. Application circuit:

Hardware circuit diagram of TM1616 drive common cathode digital screen:



▲ Notes:

1. The filter capacitor between VDD and GND at wiring on PCB board should be placed near TM1616 chip as much as possible to strengthen filtering effect.
2. Pull down three 100pF capacitors on communication ports of DIN, CLK and STB can reduce the interference to the communication port.
3. As the drop voltage for blue-light nixie tube is about 3V, the power supply for TM1620 should be 5V.

XI. Electric Parameters
Limit Parameters (Ta = 25°C, Vss = 0V)

Parameter	Symbol	Range	Unit
Logic power supply voltage.	VDD	-0.5 - +7.0	V
Logic input voltage	VI1	-0.5 - VDD + 0.5	V
LED SEG driving output current	IO1	-50	mA
LED GRID driving output current	IO2	+200	mA
Power loss	PD	400	mW
Working temperature	Topt	-40 - +85	°C
Storage temperature	Tstg	-65 - +150	°C

Normal operating range (Vss = 0V)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Test condition
Logic power supply voltage.	VDD	3	5	6	V	-
High level input voltage	VIH	0.7 VDD	-	VDD	V	-
Low level input voltage	VIL	0	-	0.3 VDD	V	-

Electric Features (VDD = 5V, Vss=0)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Test condition
High level output current	Ioh1	20	35	60	mA	SEG1 - SEG8 Vo = VDD -3V
Low level input current	IOL	80	120	-	mA	GRID1 - GRID6 Vo=0.3V
High level output current tolerance	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

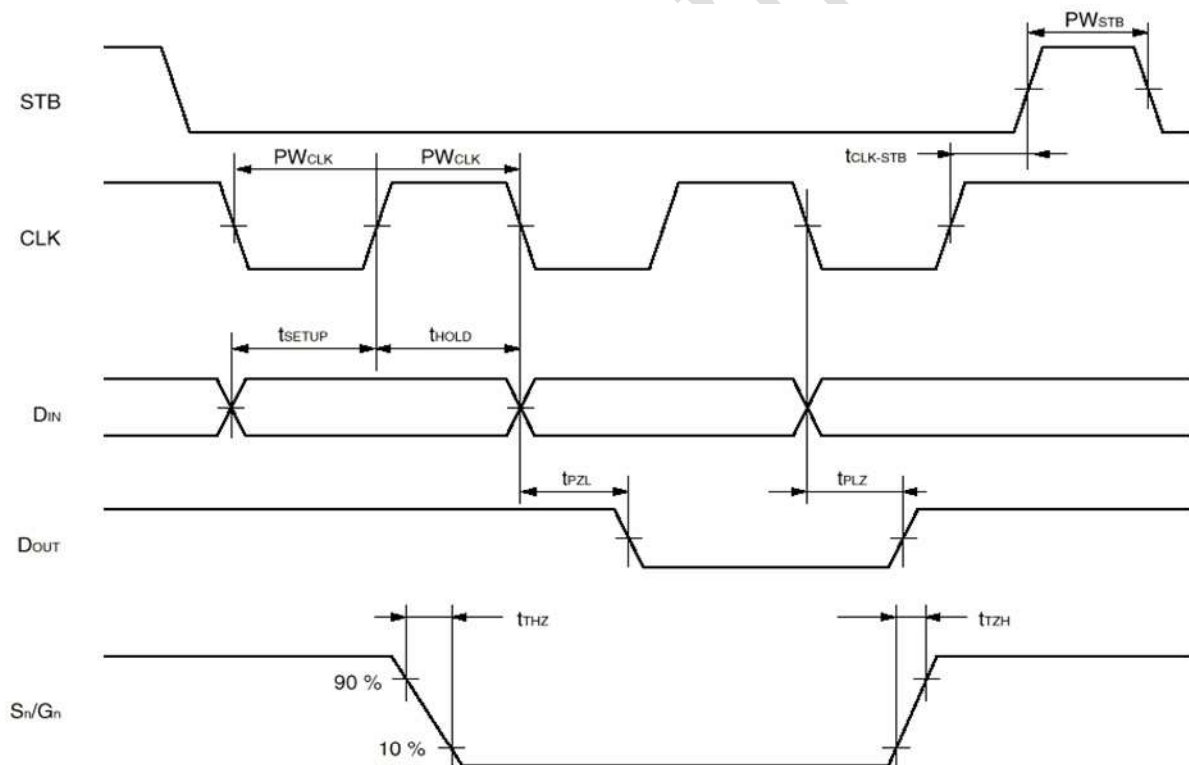
Switch features (VDD = 5V)

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Test condition	
Transmission delay time	tPLZ	-	-	300	ns	CLK → DIN	
	tPZL	-	-	100	ns	CL = 15pF, RL = 10K Ω	
Raising time	tTZH 1	-	-	2	μs	CL = 300pF	SEG1 - SEG8
	tTZH 2	-	-	0.5	μs		GRID1 - GRID4 SEG13/GRID6 - SEG14/GRID5
Falling time	tTHZ	-	-	1.5	μs	CL = 300pF, SEGn, GRIDn	
Maximum input clock frequency	Fmax	-	-	1	MHz	Duty cycle 50%	
Input capacitance	CI	-	-	15	pF	-	

Timing sequence features (VDD = 5V)

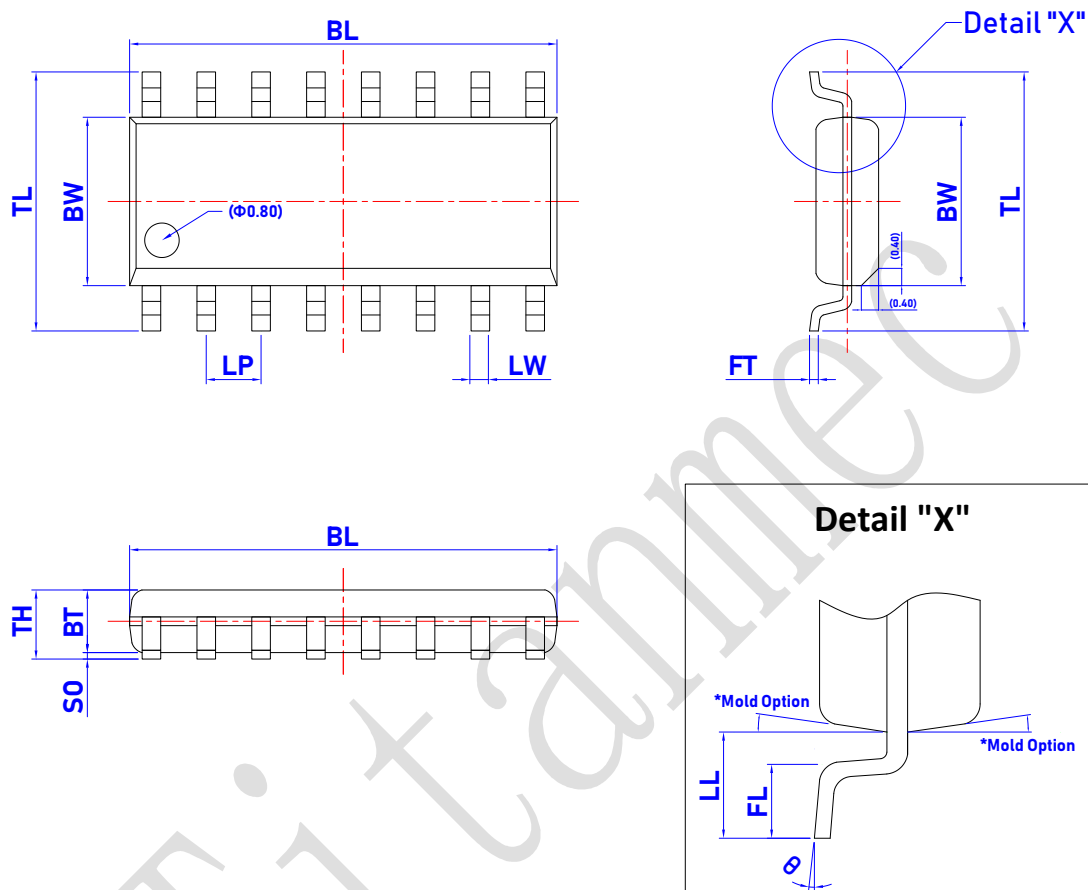
Parameter	Symbol	Minimum	Typical	Maximum	Unit	Test condition
Clock-pulse width	PW _{CLK}	500	-	-	ns	-
Gate width	PW _{STB}	1	-	-	μs	-
Data set up time	t _{SETUP}	100	-	-	ns	-
Data hold time	t _{HOLD}	100	-	-	ns	-
CLK → STB Time	t _{CLK-STB}	1	-	-	μs	CLK↑→STB↑

Time sequence oscillogram :



XII. Schematic diagram of IC package:

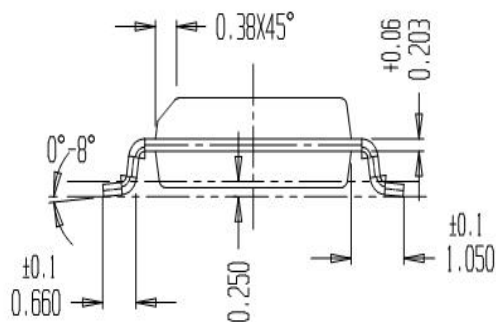
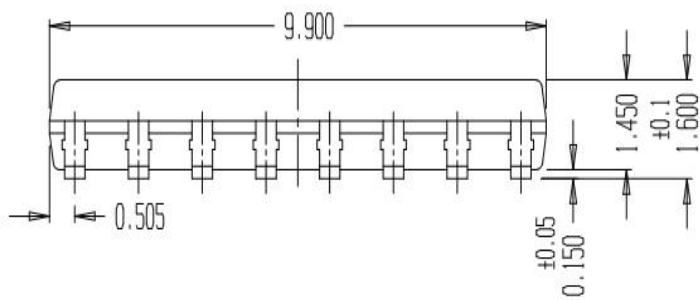
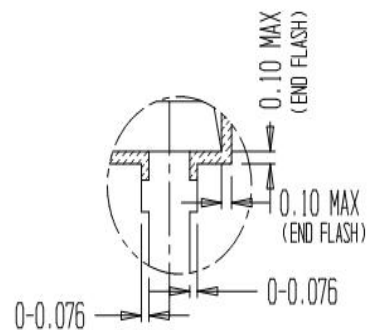
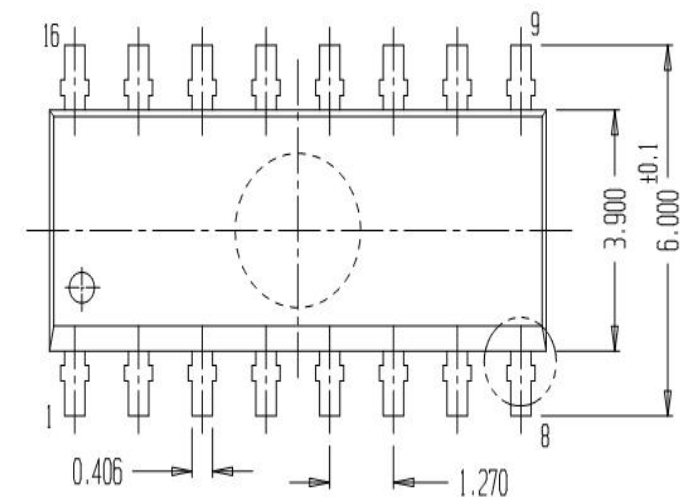
1、SOP16-150



Dimensions

Item	BL	BW	TL	LW	LP	FT	BT	SO	TH	LL	FL	θ
表示	总长	胶体宽度	跨度	脚宽	脚间距	脚厚	胶体厚度	站高	胶体高度	单边长	脚长	脚角度
Unit	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	°
Spec	10.00 (9.90) 9.80	4.00 (3.90) 3.80	6.20 (6.00) 5.80	0.430 TYP	1.270 TYP	0.250 (0.200) 0.150	1.55 (1.45) 1.25	0.200 (0.150) 0.060	1.650 Max.	1.25 (1.04) 0.80	0.80 (0.60) 0.45	8 (4) 0

2、DIP16



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