TM1616 Datasheet – V1.1

Source: http://www.titanmec.com/index.php/en/project/download/id/512.html
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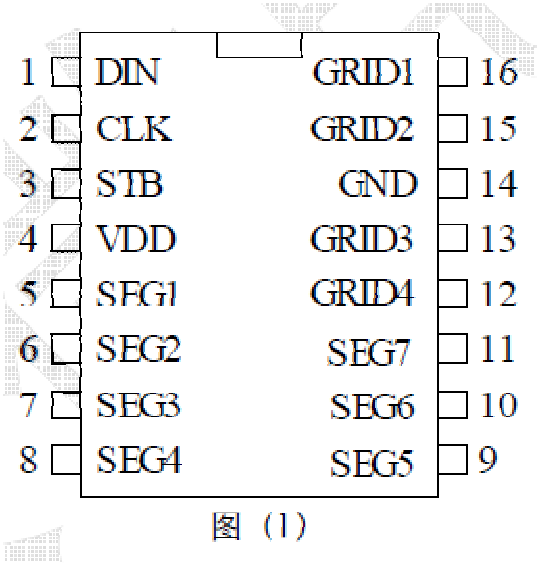
Feature description

TM1616 is a dedicated circuit for LED (Light Emitting Diode Display) drive control, which integrates MCU digital interface, data latch, Circuits such as LED high voltage drive. This product has excellent performance and reliable quality. Mainly used in VCR, VCD, DVD and home theater and other products. Display driver. Packaged in SOP16 and DIP16.

Feature Description

· Adopt power CMOS process
· Display mode (7 segments × 4 digits)
· Brightness adjustment circuit (8-level adjustable duty cycle)
· Serial interface (CLK, STB, DIN)
· Oscillation mode: built-in RC oscillation (450KHz+5%)
· Built-in power-on reset circuit
· Package form: SOP16, DIP16

Pin Definition



图（1）

Pin function

Symbol	Pin Name	Description
DIN	Data Input Serial	data is input on the rising edge of the clock, starting from low
STB	Chip Select	Initialize the serial interface on a rising or falling edge, then wait for a command to be received. STB is The first byte after the low is used as the instruction.

		When processing the instruction, the current other processing is termination. CLK is ignored when STB is high
CLK	Clock input	Read serial data on rising edge, output data on falling edge
SEG1~SEG7	output (segment)	S egment output (also used as key scan), p tube open-drain output
GRID1～GRID4	output (bit)	Bit output, N tube open-drain output
VDD	logic power supply	5V±10%
GND	Logic ground	Connect to system ground

In the dry season or in a dry environment, it is easy to generate a lot of static electricity, and electrostatic discharge may damage the integrated circuit. All appropriate integrated circuit precautions, if improperly handled and soldered, may cause ESD damage or performance degradation, and the chip cannot be properly work often.

Display register address and display mode

When writing LED display data, operate according to the display address from low to high, and from low to high of the data byte.
This register stores the data transferred from the external device to the TM1616 via the serial interface, and the addresses are assigned as follows:

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	X	
xxHL（低四位）				xxHU(高四位)				
B0	B1	B2	B3	B4	B5	B6	B7	
00HL				0CHU				GRID1
02HL				02HU				GRID2
04HL				04HU				GRID3
06HL				06HU				GRID4

xxHL (low four digits) xxHU (high four digits)

Instruction description

Commands are used to set the display mode and the state of the LED driver.
The first byte input by DIN after the falling edge of STB serves as an instruction. After decoding, take the highest two bits of B7 and B6 to distinguish different
the same instruction.

B7	B6	command
0	0	Display mode setting
0	1	Data command setting
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 (other than
The previously transmitted command or data remains valid).

1. Display mode settings

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Display Mode
0	0	Don't care, fill in 0				0	0	4 bits 7 segments

This command is used to set the number of selected segments and bits. Although TM1616 does not have segment multiplexing pins, it needs to write a mode command when writing programs;
When the command is executed, the display is forcibly turned off. To send the display control command to open the display, the data content originally displayed will not be changed, but when the same.
When the mode is set, the above situation does not occur. At power-up, the default setting mode is 7-bit 11-segment.

2. Data command settings

This command 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	Function	Description
0	1	irrelevant, fill in 0				0	0	Data read and write mode	set to write data to display register
0	1				0			Address increase mode setting	Automatic address increment
0	1				1				Fixed address
0	1			0				Test mode setting (in Ministry use)	normal mode
0	1			1					Test mode

3. Address command setting

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Video memory address
1	1	irrelevant, fill in 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

This command is used to set the address of the display register.

There are 14 memory addresses 00H-0DH inside TM1616, only 00H, 02H, 04H, 06H are actually used. If the address is used, it will automatically increase by 1
mode, other addresses can be written 0, the address is set to 0EH or higher, the data is ignored until the effective address is set. When powered on, the first address is set to 00H by default.

4. Display control

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
1	0	irrelevant, 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					Display On

Serial data transfer format

When STB is low, the chip operates on the rising edge of the clock when receiving a BIT.

1. Data receiving (writing data) timing diagram

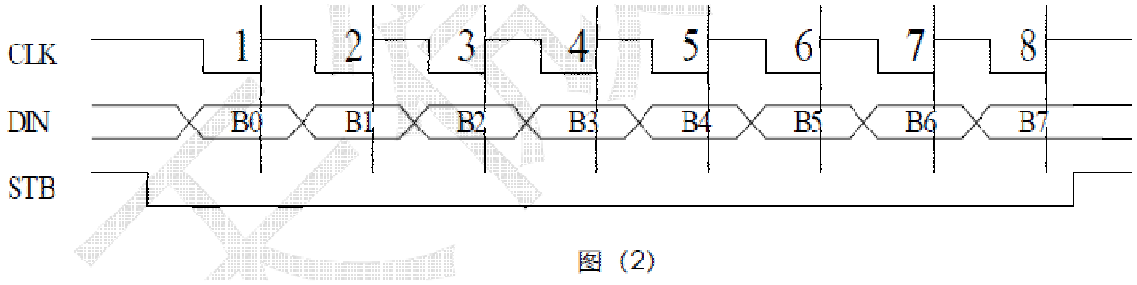


图 (2)

show

1. Display

Drive common cathode digital tube

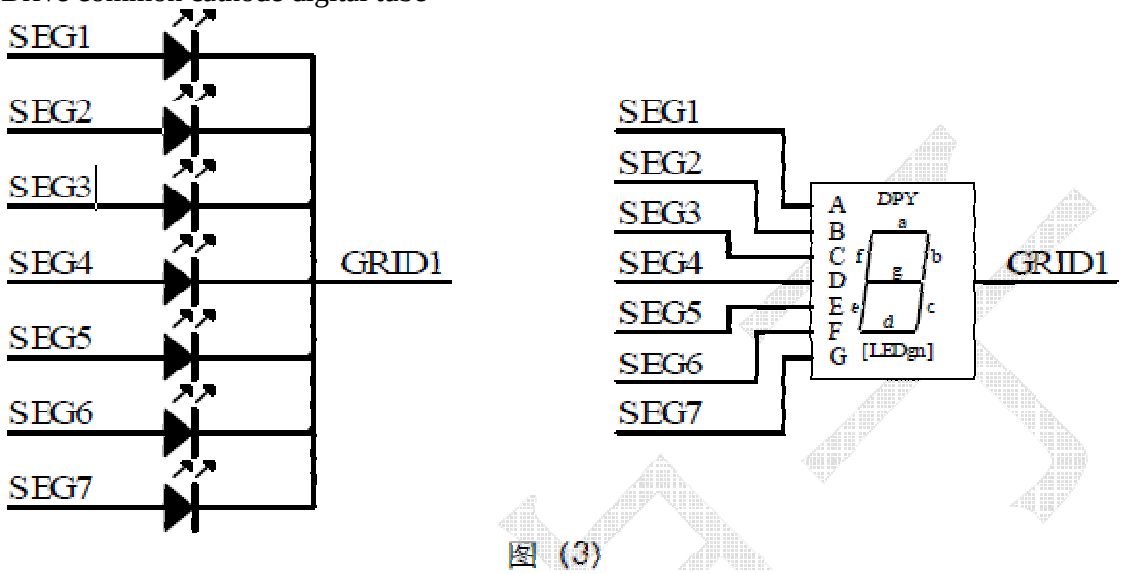


图 (3)

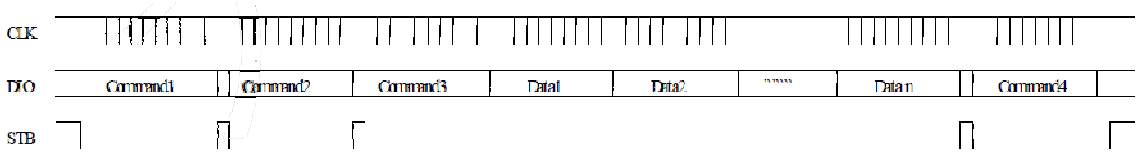
Figure 3 shows the connection diagram of the common cathode nixie tube. If you want the nixie tube to display "0", then you need to make the GRID1 low when GRID1 is low SEG1, SEG2, SEG3, SEG4, SEG5, SEG6 are high, SEG7 is low,
View the memory address table, just write data 3FH in the 00H address unit to make the digital tube display "0".

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

Transmission of serial data during application

1. Address increment mode

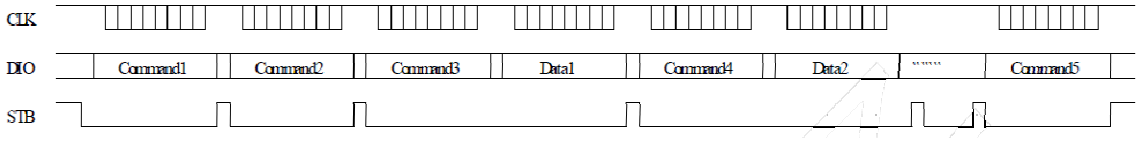
Using the address auto-add 1 mode, setting the address is actually setting the starting address where the transmitted data stream is stored. Start address command word sent
After the data is transmitted, "STB" does not need to be set high and then the data is transmitted. After the data is transmitted, the "STB" is set high. There are 14 memory addresses 00H-0DH inside. Only 00H, 02H, 04H, 06H are actually used.
If the address is automatically incremented by 1, other addresses can be written to 0. The address is set to 0EH or higher. data is ignored.



Command1: set display mode
Command2: Set data command
Command3: Set display address
Data1～Datan: Transfer display data to Command3 address and the following addresses
Command4: Display control commands

2. Fixed address mode

Using the fixed address mode, setting the address is actually setting the address where the data to be transmitted is stored. After the address is sent, "STB" does not need
To set high, followed by transmission of 1BYTE data, and "STB" is set high after the data transmission is completed. Then reset the address where the second data needs to be stored, Then transmit 1BYTE data, and set "STB" high after the data is transmitted, and so on.



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

3. Program design flow chart

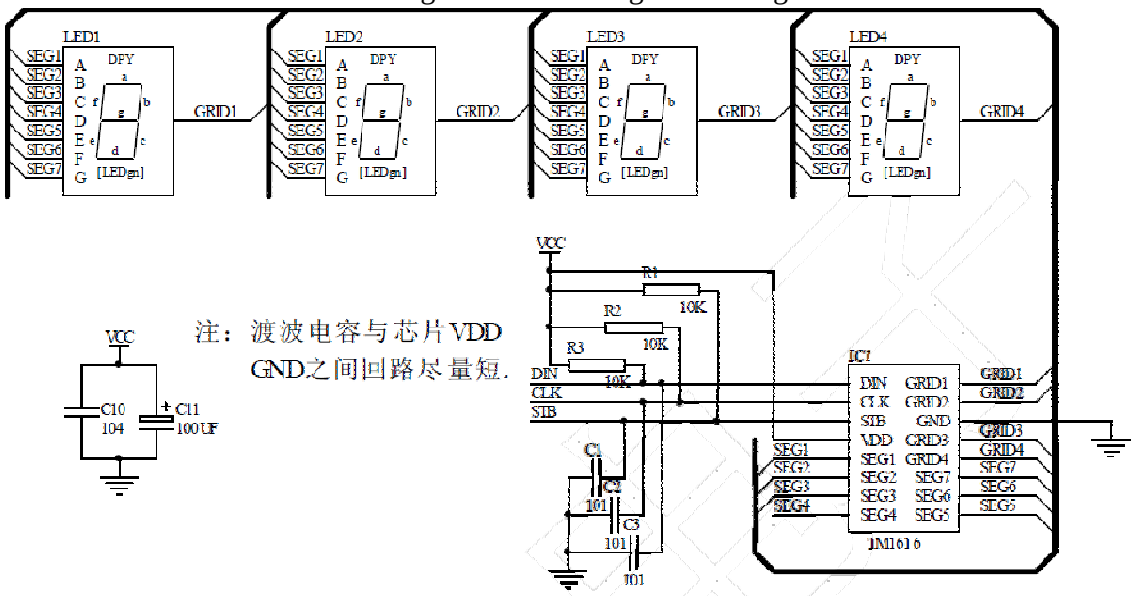
The flow chart of program design using automatic address increment by 1
start
initialization
set display mode
Set the data to write to the video memory
command, using address auto
Plus 1 mode (40H)
set start address
(0C0H)
transmit data
14 bytes of data
Finished sending?
pass display control command
setting, maximum brightness (8FH)
Finish

Flowchart of programming with fixed address

start
initialization
set display mode
Set the data to write to the video memory
command, using a fixed address
Mode (44H)
set a memory location
site
Pass the display control command settings, the most
High brightness (8FH)
Finish
transfer one byte
according to
reset the display
store address
transfer one byte
according to
After sending all data

application circuit

TM1616 drive common cathode digital screen wiring circuit diagram



Note: wave capacitor and chip VDD
The loop between GND should be as short as possible.

▲Note: 1. The filter capacitor between VDD and GND should be placed as close as possible to the TM1616 chip on the PCB board to enhance the filtering effect.
2. Three 100P capacitors connected to the DIN, CLK, STB communication ports can 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 TM1616.

Electrical parameters

1. Limit parameters (Ta = 25℃, Vss = 0 V)

Parameter Symbol Range Unit
Logic power supply voltage VDD -0.5 to +7.0 V
Logic input voltage VI1 -0.5 to VDD + 0.5 V
LED SEG drive output current IO1 -50 mA
LED GRID drive output current IO2 +200 mA
Power loss PD 400 mW
Working temperature Topt -40 ～ +80 ℃
Storage temperature Tstg -65 ～+150 ℃

2. Normal working range (Ta = -20 ~ +70℃, Vss = 0 V)

PARAMETER SYMBOL MIN TYP MAX 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 –

3. Electrical characteristics (Ta = -20 ~ +70℃, VDD = 4.5 ~ 5.5 V, Vss = 0 V)

PARAMETER SYMBOL MIN TYP MAX UNIT TEST CONDITIONS
SEG pin high level output power
flow
Ioh1 20 25 40 mA Vo = vdd-2V
Ioh2 20 30 50 mA Vo = vdd-3V
GRID pin low level input
current
IOL1 -80 -140 - mA Vo=0.3V
Low level output current Idout 4 - - mA VO = 0.4V, dout
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

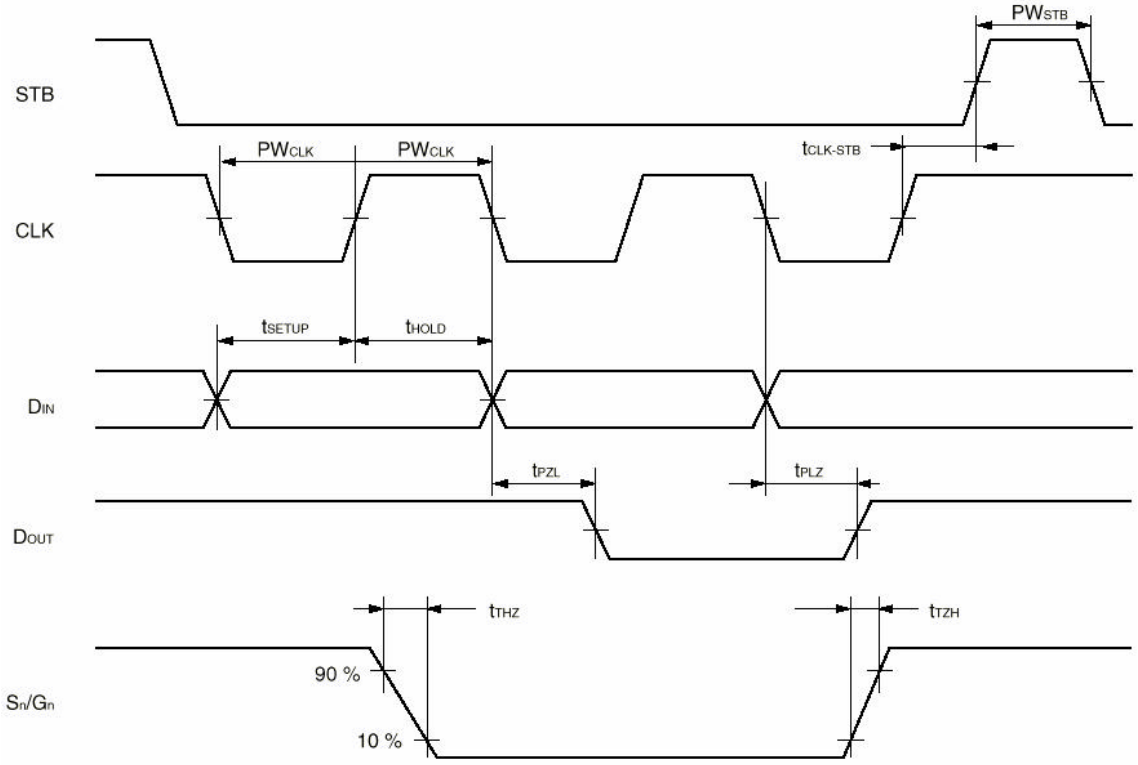
4. Switching characteristics (Ta = -20 ~ +70℃, VDD = 4.5 ~ 5.5 V)

PARAMETER SYMBOL MIN TYP MAX UNIT TEST CONDITIONS
Oscillation frequency fosc - 500 - KHz R = 16.5 KΩ
transmission delay time
tPLZ - - 300 ns CLK → DIN
tPZL - - 100 ns CL = 15pF, RL = 10KΩ
Rise Time
TTZH 1 - - 2 μs
CL =
300p F
Seg1～Seg11
TTZH
2
- - 0.5 μs
Grid1～Grid4
Seg12/Grid7～
Seg14/Grid5
Fall Time TTHZ - - 120 μs
CL = 300pF, Segn,
Gridn
Maximum clock frequency Fmax 1 - - MHz Duty cycle 50%
Input capacitance CI - - 15 pF –

5. Timing characteristics (Ta = -20 ~ +70℃, 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↑
Wait time tWAIT 1 - - μs CLK↑→CLK↓

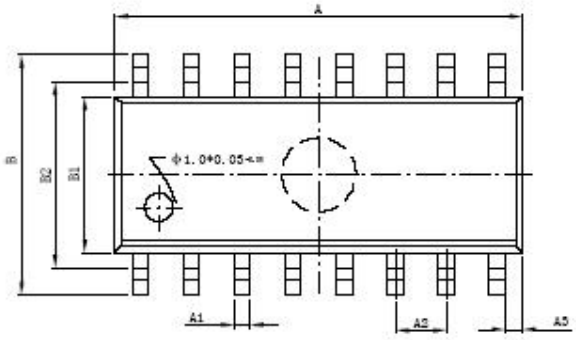
Timing Waveform

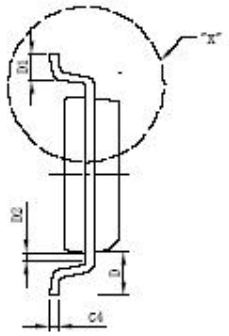


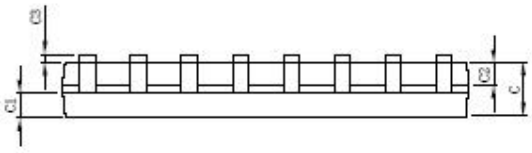
IC Package Diagram

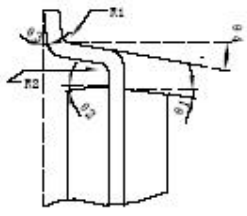
1. SOP16

尺寸 / 标注	最 小（mm）	最 大（mm）	尺寸 / 标注	最 小（mm）	最 大（mm）
A	9.9	10.10	C4	0.2TYP	
A1	0.356	0.456	D	1.05TYP	
A2	1.27TYP		D1	0.40	0.70
A3	0.35TYP		D2	0.22	0.42
B	5.84	6.24	R1	0.15TYP	
B1	3.84	4.04	R2	0.15TYP	
B2	5.0TYP		θ1	8° TYP	
C	1.35	1.55	θ2	8° TYP	
C1	0.61	0.71	θ3	4° TYP	
C2	0.54	0.64	θ4	15° TYP	
C3	0.10	0.30			



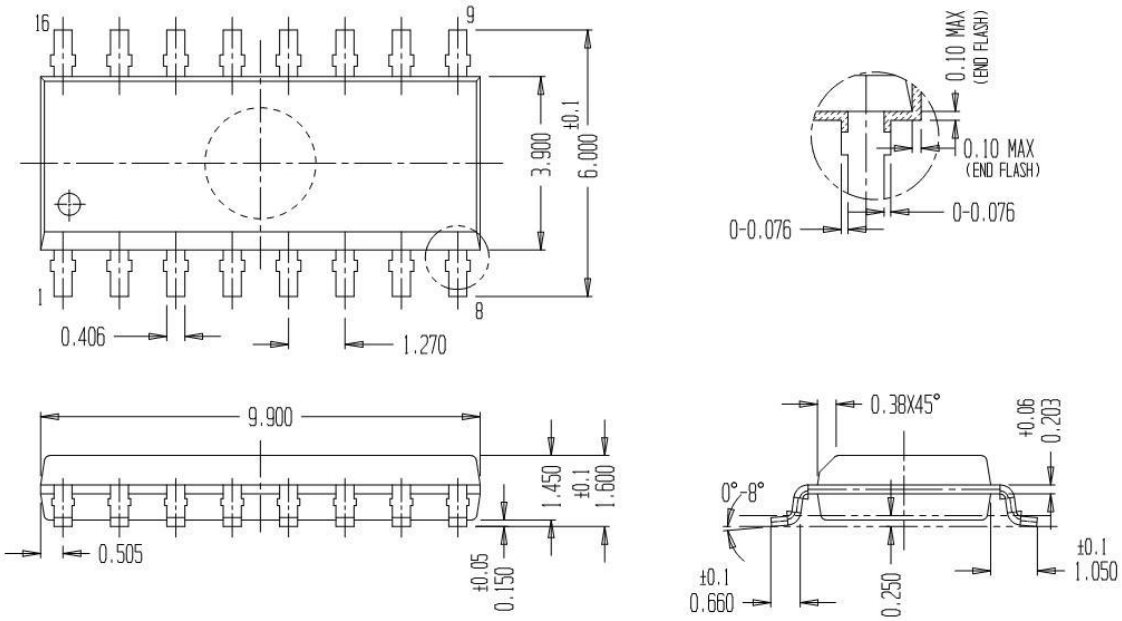






DETAIL "X"

2、 DIP16



revise history

Version Release Date Revision Brief
V1.0 2010-05-25 Initial release
Ver1.1 2012-08-07 1. Modify the typesetting format
2. Add DIP16 package