AiP1616
3-Line Serial Interface,Common Cathode ,7Seg *4Grid LED Driver and Controller

Product Specification

Specification Revision History:

Version	Date	Description
2010-01-A1	2010-01	New
2012-01-A2	2012-01	Add the specification number and issue history
2019-04-A3	2019-04	Update template
2019-07-A4	2019-07	Add order information
2021-12-A5	2021-12	Modify order information
2022-05-A6	2022-05	Modify the static circuit threshold in DC parameters

Contents

1、General Description

AiP1616 is a common cathode 7-segment, 4-grid LED drive control circuit with three-line serial communication interface, RC oscillator, with 8-step dimming circuitry, widely used in various LED panel occasions.

Features:

- Display modes :7 segment, 4 grid
- Built-in display RAM
- 8-step dimming circuitry
- Three-line serial interface(CLK, STB, DIO)
- Built-in RC oscillator
- Package: DIP16/SOP16

Ordering Information:

Tube packing specifications:

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP1616EP DA16.TB	DIP16	AiP1616EP	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing: 2.54mm
AiP1616EO SA16.TB	SOP16	AiP1616EO	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm

Reel packing specifications:

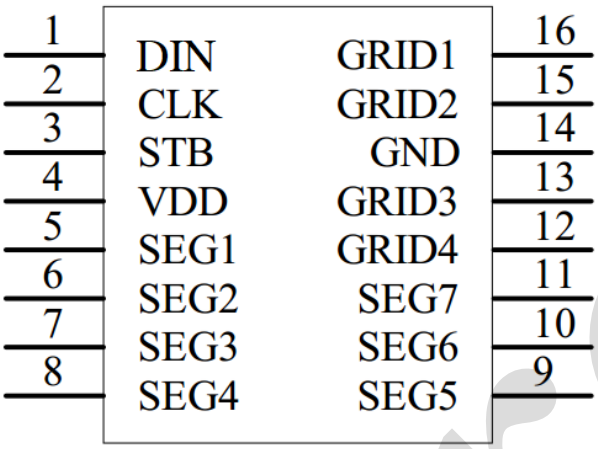
Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP1616EO SA16.TR	SOP16	AiP1616EO	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing: 1.27mm

Note 1: “XX” refers to variable content, meaning year and package batch serial number.

Note 2: If the physical information is inconsistent with the ordering information, please refer to the actual product.

2、Block Diagram And Pin Description

2.1、Block Diagram



2.2、Pin Description

Pin No.	Pin Name	I/O	Description
1	DIN	I	Data input Pin
2	CLK	I	Clock input Pin
3	STB	I	Serial Interface Strobe Pin
4	VDD	—	Power Supply
5	SEG1	O	Segment Output Pins(p-channel, open drain)
6	SEG2	O	Segment Output Pins(p-channel, open drain)
7	SEG3	O	Segment Output Pins(p-channel, open drain)
8	SEG4	O	Segment Output Pins(p-channel, open drain)
9	SEG5	O	Segment Output Pins(p-channel, open drain)
10	SEG6	O	Segment Output Pins(p-channel, open drain)
11	SEG7	O	Segment Output Pins(p-channel, open drain)
12	GRID4	O	Grid Output Pins(N-channel, open drain)
13	GRID3	O	Grid Output Pins(N-channel, open drain)
14	GND	—	Ground Pin
15	GRID2	O	Grid Output Pins(N-channel, open drain)
16	GRID1	O	Grid Output Pins(N-channel, open drain)

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(T_{amb}=25℃, GND=0V, unless otherwise specified)

Characteristic	Symbol	Conditions		Value	Unit
Supply Voltage	VDD	-		-0.5~+7.0	V
Input Voltage	VIN	-		-0.5~VDD+0.5	V
Drive Output Current	I_{O1}	SEG		-50	mA
	I_{O2}	GRID		+150	mA
Ambient Temperature	T_{amb}	-		-40~+85	℃
Torage Temperature	T_{stg}	-		-65~+150	℃
Soldering Temperature	T_L	10s	DIP	245	℃
			SOP	260	℃

3.2、Recommended Operating Range

Parameter	Symbol	Min.	Typ.	Max.	Unit
Logic Supply Voltage	VDD	3	5	5.5	V
High-level Input Voltage	V_{IH}	0.7VDD	-	VDD	V
Low-level Input Voltage	V_{IL}	0	-	0.2VDD	V

3.3、Electrical Characteristics

3.3.1、DC Characteristics

(VDD=5V, GND=0V, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
High-level Output Current	I_{OH1}	SEG1～SEG7，V_O=VDD-2V	-20	-25	-40	mA
	I_{OH2}	SEG1～SEG7，V_O=VDD-3V	-20	-30	-50	mA
Low-level Output Current	I_{OL1}	GRID1～GRID4，V_O=0.3V	80	100	—	mA
Segment High-level Output Current Tolerance	I_{TOLSG}	V_O=VDD-3V，SEG1～SEG7	—	—	5	%
High-level Input Voltage	V_{IH}	CLK、DIN、STB	0.7VDD	—	—	V
Low-level Input Voltage	V_{IL}	CLK、DIN、STB	—	—	0.2VDD	V
Hysteresis Voltage	V_H	CLK、DIN、STB	—	0.35	—	V
Input Leakage Current	I_I	VIN=VDD，STB、CLK、DIN	—	—	±1	μA
		VIN=GND，CLK、STB	—	—	±1	μA
		VIN=GND，DIN	100	200	400	μA
Supply Current	I_{DD}	No load, V_{IN}=VDD	110	150	230	μA
Pull-up Resistor	R_{IP}	DIN	—	24	—	KΩ

3.2.2、AC Characteristics 1

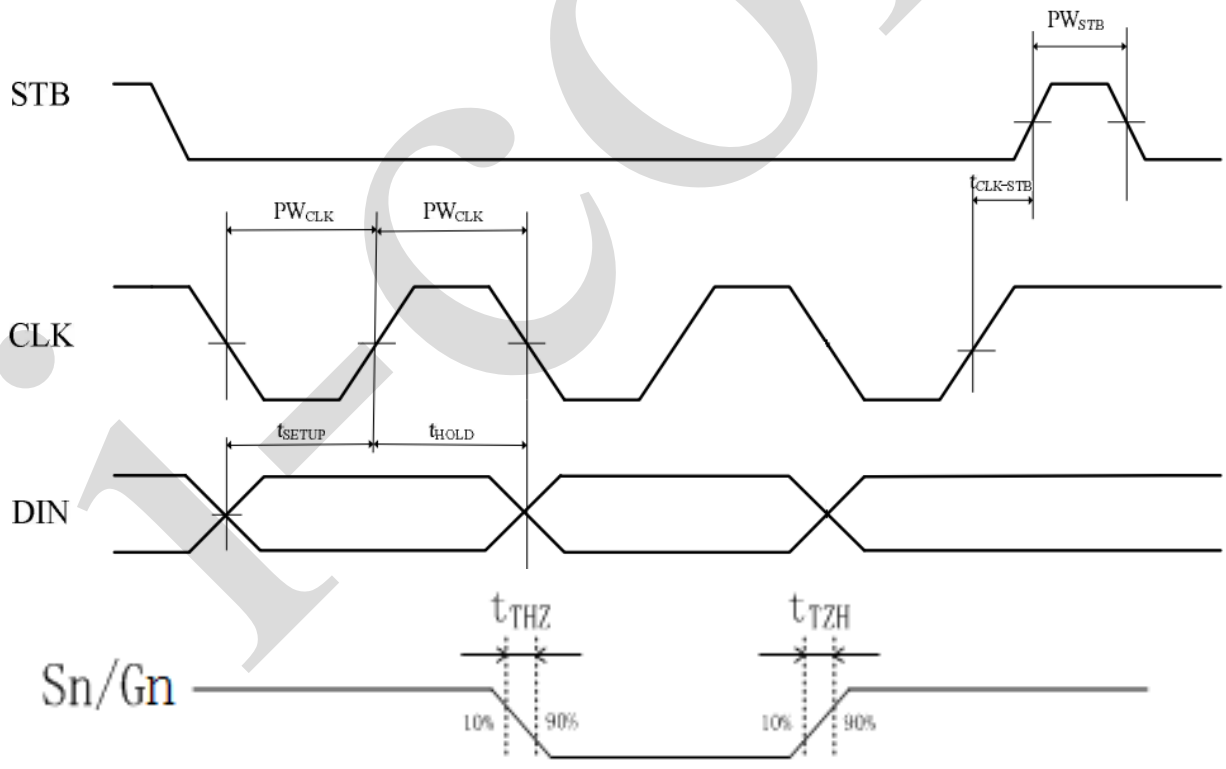
(VDD=4.5~5.5V, GND=0V, unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Oscillation Frequency	f_{OSC}	-		-	400	-	KHz
Rise Time	t_{TZH1}	C_L=300pF	SEG1～SEG7	-	-	2	us
	t_{TZH2}		GRID1～GRID4	-	-	0.5	us
Fall Time	t_{THZ}	C_L=300pF，SEGn、GRIDn		-	-	120	us
Maximum Clock Frequency	f_{max}	Duty=50%		1	-	-	MHz

3.3.3、AC Characteristics 2

(VDD=4.5~5.5V, GND=0V, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Clock Pulse Width	PW_{CLK}	-	400	-	-	ns
STB Pulse Width	PW_{STB}	-	1	-	-	us
Set-up Time For Data	t_{SETUP}	-	100	-	-	ns
Hold Time For Data	t_{HOLD}	-	100	-	-	ns
Propagation Delay CLK to STB	$t_{CLK-STB}$	CLK↑→STB↑	1	-	-	us



4、Function Description

4.1、Display Mode And RAM Address

Data transmitted from an external device to AiP1616 via the serial interface are stored in the Display RAM and are assigned addresses. The RAM addresses of AiP1616 are given below in 8 bits unit.

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	X	X	X	X	X	X	X	X	X	
xxHL(low 4 bit)				xxHU(high 4 bit)				xxHL(low 4 bit)				xxHU(high 4 bit)				
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

Note: When power up, first transfer data to RAM, and then setup display on.

4.2、Commands Description

Each time the STB port changes from HIGH to LOW, the first byte sent into the circuit from the DIO port is used as a command input, and the second byte is used as data input. The upper two bits in the command are used to distinguish different commands.

B7	B6	Commands
0	0	Display mode setting commands
0	1	Data setting commands
1	0	Display control commands
1	1	Address setting commands

If STB is set to HIGH during command or data transmission, serial communication is initialized and the command or data being transmitted is invalid (the command or data previously remains valid).

4.2.1、Display Mode Setting Commands

The Display Mode Setting Commands are used to set the number of selected drive segments and grids. When the command is executed, the display is forced to close. To redisplay, the display ON/OFF command “ON” must be executed, the above situation does not occur.

MSB **LSB**

B7	B6	B5	B4	B3	B2	B1	B0	Display Mode
0	0	Not relevant, write 0				0	0	7segments，4grids

4.2.2、Data Setting Commands

The Data Setting Commands executes the Data Write or Data Read Modes for AiP1616, B1, B0 cannot set 01 or 11 or 10.

MSB **LSB**

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
0	1	Not relevant, write 0		-	-	0	0	Data write & read mode setting	Write data to display mode
0	1			-	0	-	-	Address mode settings	Auto increase
0	1			-	1	-	-		Fixed address
0	1			0	-	-	-	TEST mode	Normal mode
0	1			1	-	-	-		Test mode (internal use)

4.2.3、Address Setting Commands

Address Setting Commands are used to set the address of the display register. If the address is set higher than 07H, the data is ignored until a valid address is set. When power is turned ON, the address is set at 00H.

MSB **LSB**

B7	B6	B5	B4	B3	B2	B1	B0	Address
1	1	Not relevant, write 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

4.2.4、Display Control Commands

The Display Control Commands are used to set the display switch and display brightness adjustment. This circuit has 8 levels of brightness for adjustment.

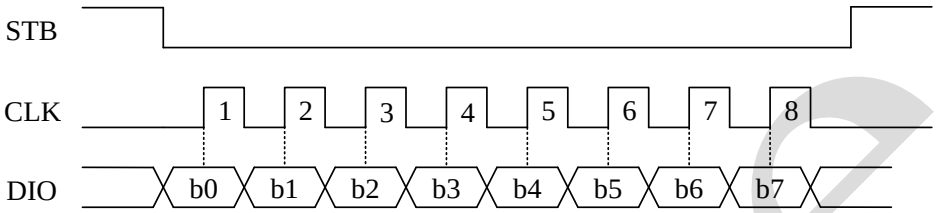
MSB **LSB**

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
1	0	Not relevant, write 0		-	0	0	0	Dimming quantity settings	Pulse width 1/16
1	0			-	0	0	1		Pulse width 2/16
1	0			-	0	1	0		Pulse width 4/16
1	0			-	0	1	1		Pulse width 10/16
1	0			-	1	0	0		Pulse width 11/16
1	0			-	1	0	1		Pulse width 12/16
1	0			-	1	1	0		Pulse width 13/16

1	0		-	1	1	1		Pulse width 14/16
1	0		0	-	-	-	Display off/on	Display off
1	0		1	-	-	-		Display on

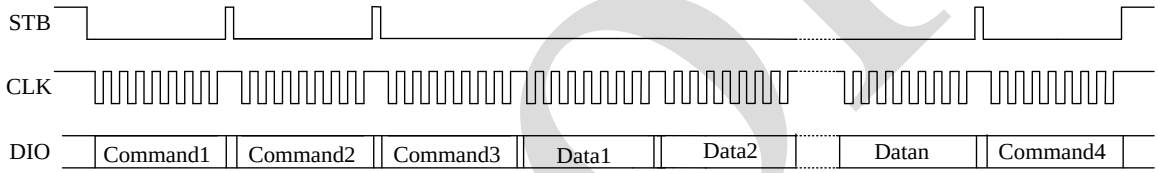
4.3、Serial Communication Format

Data is locked into the IC at rising edge of CLK



4.4、The Serial Data Transfer In The Applications

4.4.1、Address Increasing Mode



where:

Command 1: Display mode setting command

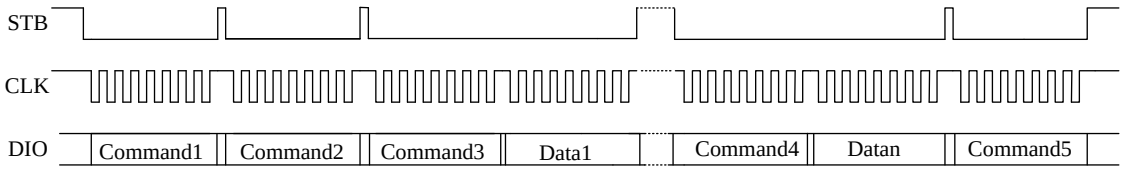
Command 2: Data setting command

Command 3: Display Address setting command

Data 1 to n: Transfer display data

Command 4: Display control command

4.4.2、Fixing Address



where:

Command 1: Display mode setting command

Command 2: Data setting command

Command 3: Display Address 1 setting command

Data 1: Display data written to the Command 3 Address

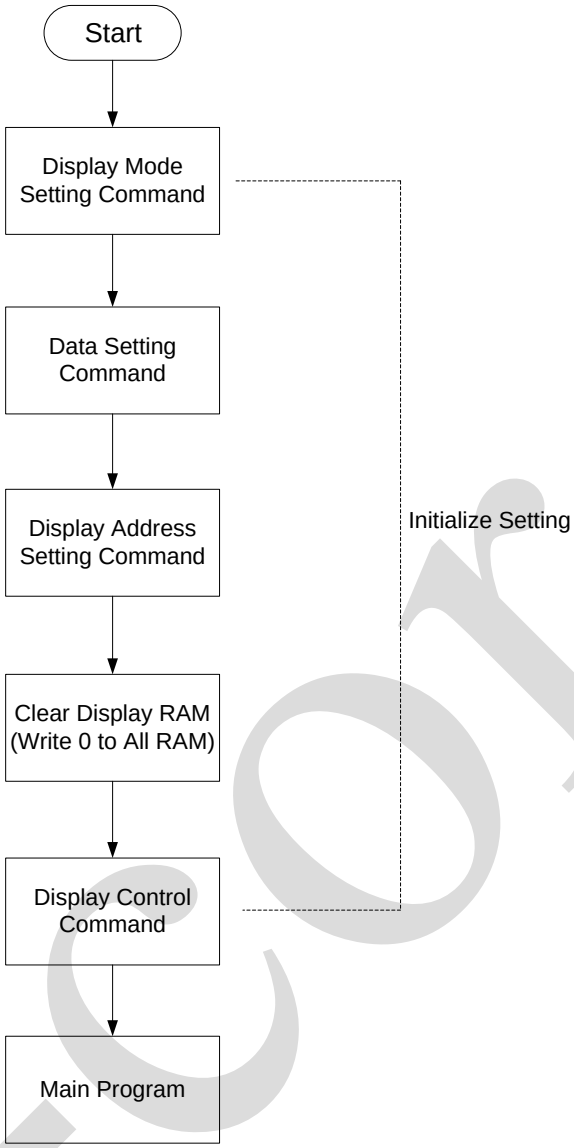
……

Command 4: Display Address N setting command

Data n: Display data written to the Command 4 Address

Command5: Display control command

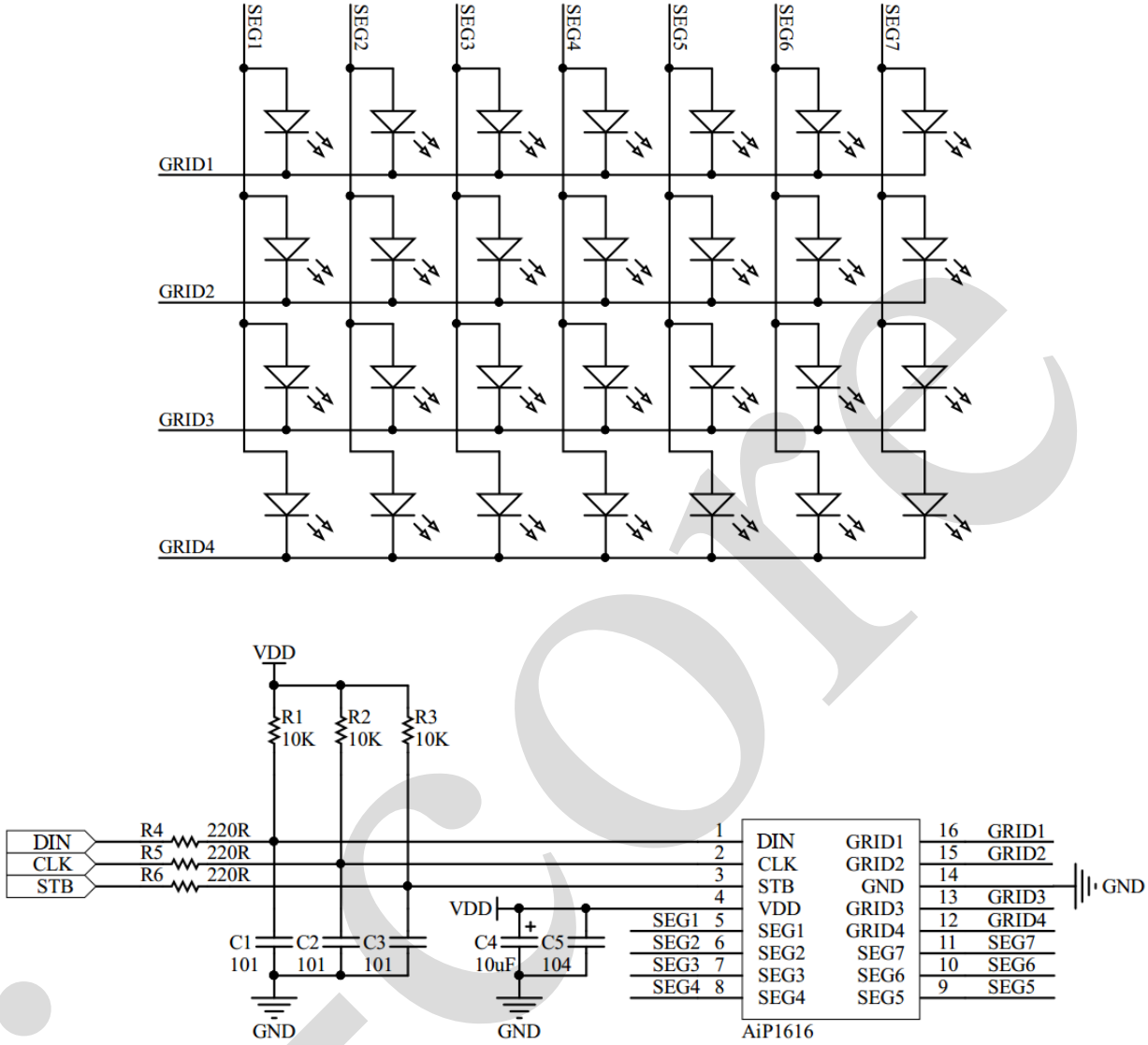
4.5、Initialization Flowchart



Note:

1. The display mode setting is used to select the number of segments to drive the display screen, which needs to be selected according to the actual hardware connection of the user, generally only set in the initialization part.
2. The content of the RAM displayed when the IC is powered on is not fixed, in order to prevent the user from turning on the display first. It is recommended to clear the RAM before turning on the display.

5、Typical Application Circuit And Application Note

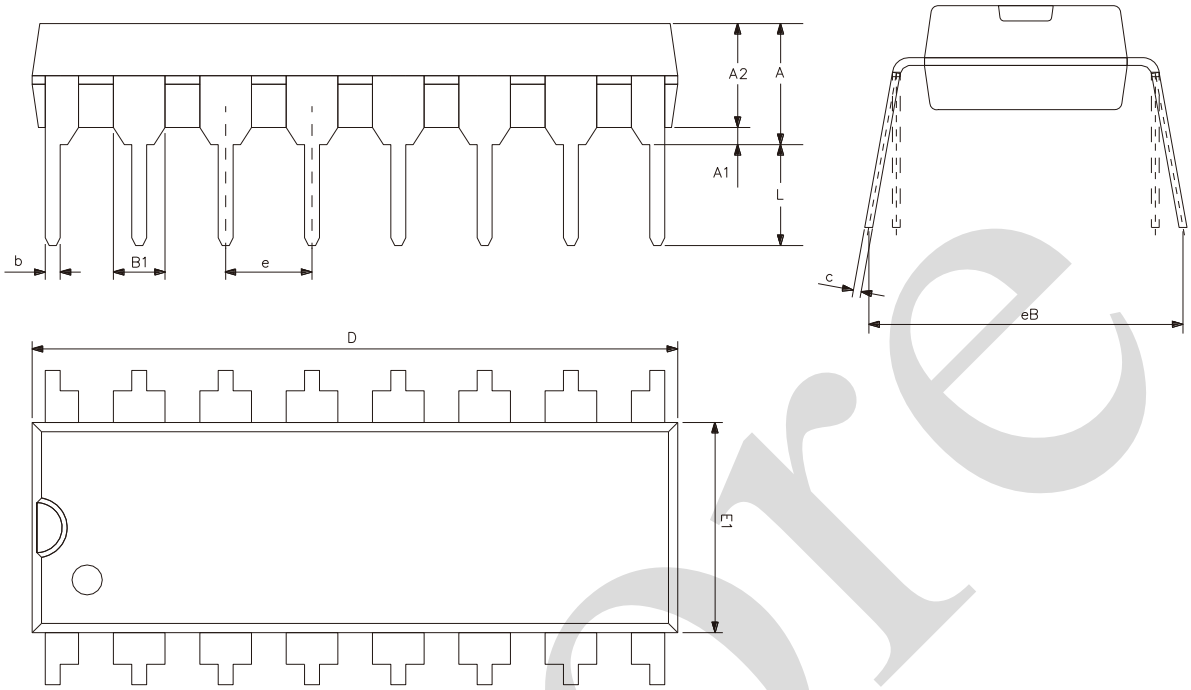


Note:

1. The filter capacitance between VDD and GND should be close to AiP1616 to enhance the filtering effect.
2. In order to improve the anti-interference ability of the circuit, the communication port is suggested to be connected according to the above diagram, and the specific parameters can be adjusted according to the actual needs.

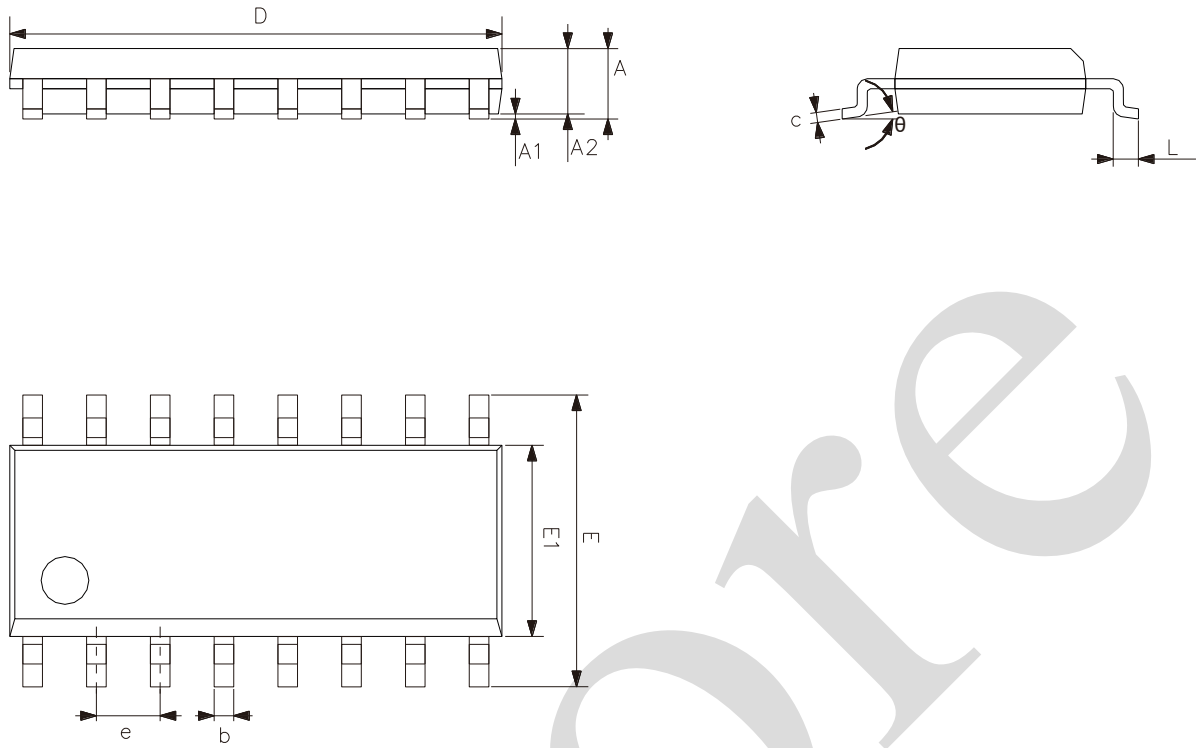
6、Package Information

6.1、DIP16



Symbol	Dimensions (mm)	
	Min.	Max.
A2	3.20	3.60
A1	0.51	—
A	3.60	5.33
L	3.00	—
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
c	0.20	0.36
eB	7.62	9.30

6.2、SOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
θ	0 °	8 °

7、Statements And Notes

7.1、The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○：Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×：Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

7.2、Notes

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