



AiP1929

4-Line Serial Interface, Common Cathode, 16 Seg×8 Grid LED Driver and Controller with Ghost Elimination and 8×4 Keyboard input Ports

Product Specification

Specification Revision History:

Version	Date	Description
2019-03-A1	2019-03	New
2019-07-A2	2019-07	Add ordering information
2021-12-A3	2021-12	Modify ordering information



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1、General Description

AiP1929 is a 4-line serial interface, common cathode, 16 seg×8 grid LED driver and controller with ghost elimination and 8×4 keyboard input ports. There are built-in keyboard scanning interface, MCU digital interface, data latch, LED driver circuits and so on. It is widely applied in all kinds of panel occasions.

Features:

- Built-in display RAM
- Display mode 16 seg×8 grid
- 8*4 scanning key matrix
- 4-line serial interface (CLK, STB, DIN, DOUT)
- Built-in RC oscillation
- Built-in ghost elimination function
- Packing form: LQFP44

Application Area:

LED display panel occasions, such as microwave oven, induction cooker, water heater and other household appliances.

Ordering Information:

Tube packing specifications:

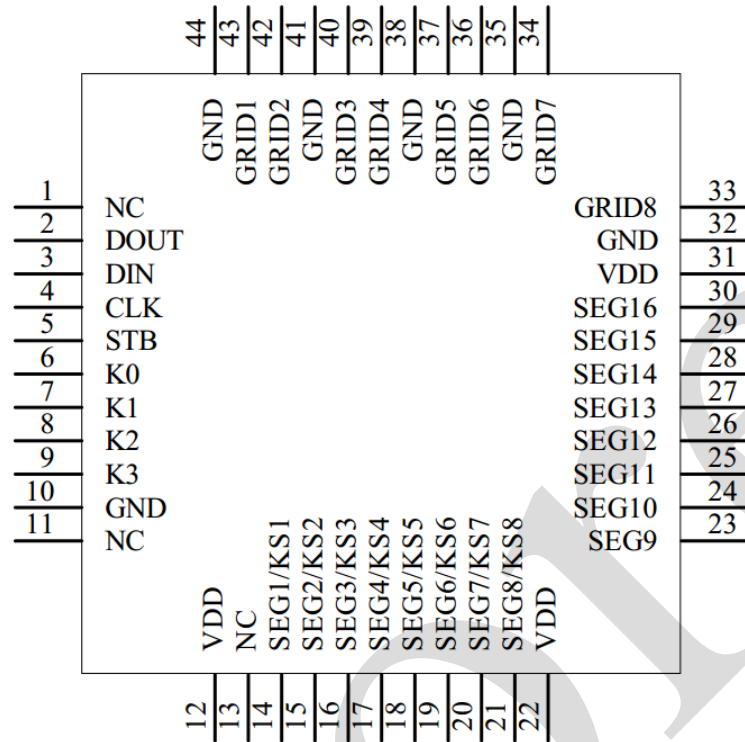
Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP1929LB44.TB	LQFP44	AiP1929	160 PCS/board	10 board/box	1600 PCS/box	Dimensions of plastic enclosure: 10.0mm×10.0mm Pin spacing: 0.8mm

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



2、Pin Description and Pin Description

2.1、Pin Configurations



2.2、Pin Description

Pin	Symbol	I/O	Description
1	NC	-	Floating
2	DOUT	O	Data output port, N-tube open-drain output
3	DIN	I	Data input port
4	CLK	I	Clock port
5	STB	I	Clip select port
6	K0	I	Key input port, built-in pull-down resistance
7	K1	I	Key input port, built-in pull-down resistance
8	K2	I	Key input port, built-in pull-down resistance
9	K3	I	Key input port, built-in pull-down resistance
10	GND	-	Ground
11	NC	-	Floating
12	VDD	-	Power supply
13	NC	-	Floating
14	SEG1/KS1	O	Segment output/key scanning output, P-tube open-drain output
15	SEG2/KS2	O	Segment output/key scanning output, P-tube open-drain output
16	SEG3/KS3	O	Segment output/key scanning output, P-tube open-drain output
17	SEG4/KS4	O	Segment output/key scanning output, P-tube open-drain output



18	SEG5/KS5	O	Segment output/key scanning output, P-tube open-drain output
19	SEG6/KS6	O	Segment output/key scanning output, P-tube open-drain output
20	SEG7/KS7	O	Segment output/key scanning output, P-tube open-drain output
21	SEG8/KS8	O	Segment output/key scanning output, P-tube open-drain output
22	VDD	-	Power supply
23	SEG9	O	Segment output, P-tube open-drain output
24	SEG10	O	Segment output, P-tube open-drain output
25	SEG11	O	Segment output, P-tube open-drain output
26	SEG12	O	Segment output, P-tube open-drain output
27	SEG13	O	Segment output, P-tube open-drain output
28	SEG14	O	Segment output, P-tube open-drain output
29	SEG15	O	Segment output, P-tube open-drain output
30	SEG16	O	Segment output, P-tube open-drain output
31	VDD	-	Power supply
32	GND	-	Ground
33	GRID8	O	Bit output, N-tube open-drain output
34	GRID7	O	Bit output, N-tube open-drain output
35	GND	-	Ground
36	GRID6	O	Bit output, N-tube open-drain output
37	GRID5	O	Bit output, N-tube open-drain output
38	GND	-	Ground
39	GRID4	O	Bit output, N-tube open-drain output
40	GRID3	O	Bit output, N-tube open-drain output
41	GND	-	Ground
42	GRID2	O	Bit output, N-tube open-drain output
43	GRID1	O	Bit output, N-tube open-drain output
44	GND	-	Ground

3、Electrical Parameter

3.1、Absolute Maximum Ratings

($T_{amb}=25^{\circ}\text{C}$, GND=0V, unless otherwise specified)

Characteristic	Symbol	Conditions	Value	Unit
Power Supply Voltage	VDD	-	-0.5~+7.0	V
Logic Input Voltage	VIN	-	-0.5~VDD+0.5	V
Output High-Level Drive (SEG)	I_{O1}	-	-50	mA
Output Low-Level Drive (GRID)	I_{O2}	-	+150	mA
Operating Temperature	T_{amb}	-	-40~+85	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-	-65~+150	$^{\circ}\text{C}$
Soldering Temperature	T_L	10s	260	$^{\circ}\text{C}$



3.2、Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Logic Power 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
Output High-Level Drive	I _{OH1}	SEG1~SEG16, V _O =VDD-2V	-20	-25	-40	mA
	I _{OH2}	SEG1~SEG16, V _O =VDD-3V	-20	-30	-50	mA
Output Low-Level Drive	I _{OL1}	GRID1~GRID8, V _O =0.3V	80	100	-	mA
	I _{DO}	V _O =0.4V, DOUT	4	8	-	mA
High-Level Output Current Tolerance	I _{TOLSG}	V _O =VDD-3V, SEG1~SEG16	-	-	5	%
Input High-Level Voltage	V _{IH}	CLK, DIN, STB	0.7VDD	-	-	V
Input Low-Level 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/GND, STB, CLK, DIN	-	-	±1	uA
Quiescent Current	I _{DD}	No load, VIN=VDD	120	150	180	uA
Input Pull-Down Resistance	R _L	K0~K3	-	3	-	kΩ

3.3.2、AC Characteristics 1

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

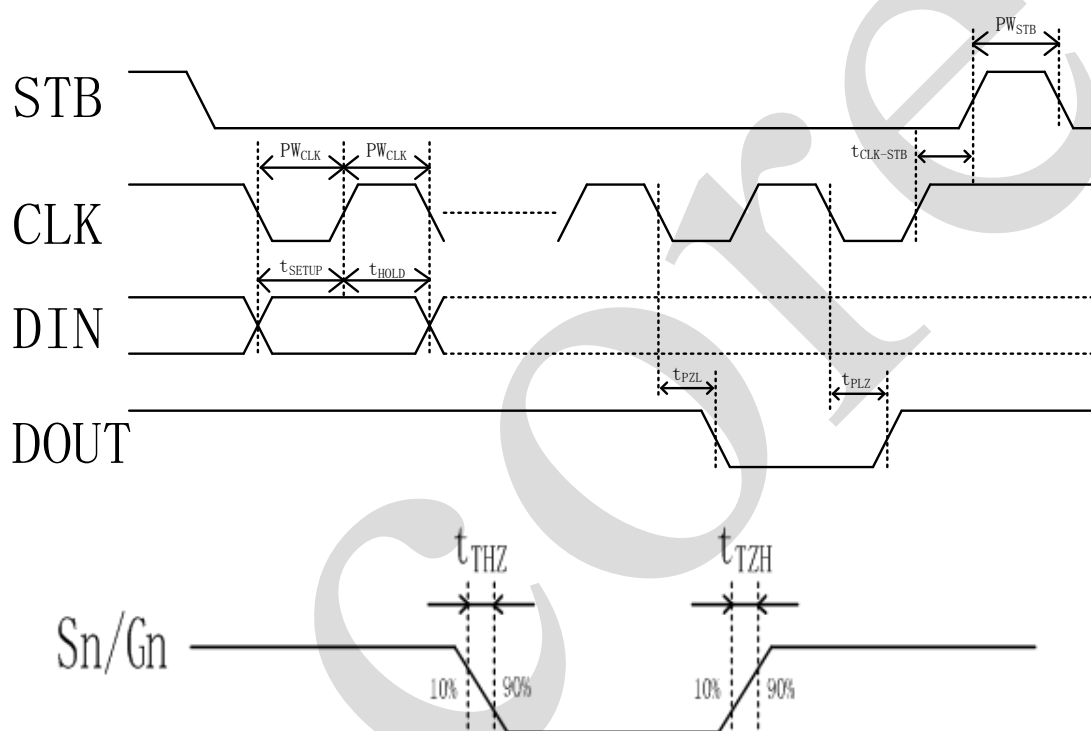
Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Oscillation frequency	f _{OSC}	-		-	400	-	kHz
Transmission Delay Time	t _{PLZ}	CLK→DOUT, C _L =15pF, R _L =10kΩ		-	-	300	ns
	t _{PZL}			-	-	100	ns
Rise Time	t _{TZH1}	C _L =300pF	SEG1~SEG16	-	-	2	us
	t _{TZH}		GRID1~GRID8	-	-	0.5	us
Fall Time	t _{THZ}	C _L =300pF, SEGn, GRIDn		-	-	120	us
Maximum Clock Frequency	f _{max}	Duty Cycle 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
Gate Width	PW_{STB}	-	1	-	-	us
Data Setup Time	t_{SETUP}	-	100	-	-	ns
Data Retention Time	t_{HOLD}	-	100	-	-	ns
Clk→stb Time	$t_{CLK-STB}$	$CLK\uparrow \rightarrow STB\uparrow$	1	-	-	us
Waiting Time	t_{WAIT}	$CLK\uparrow \rightarrow CLK\downarrow$	1	-	-	us





4、Function Description

4.1、Display Register Address

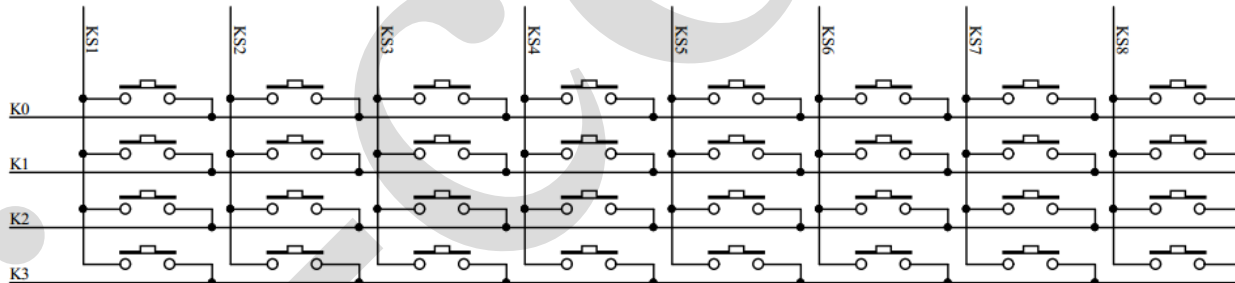
The register stores the data transmitted from the external device to AiP1929 via a serial interface, and the address is assigned as follows:

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8	SEG9	SEG10	SEG11	SEG12	SEG13	SEG14	SEG15	SEG16	
xxHL (Low Four)				xxHU (High Four)				xxHL (Low Four)				xxHU (High Four)				
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
0CHL				0CHU				0DHL				0DHU				GRID7
0EHL				0EHU				0FHL				0FHU				GRID8

Note: After power on, write data to RAM first, and then turn on the display.

4.2、Key Scan and Key Scan Data Register

The key scan matrix is 8*4, as shown in the figure below:



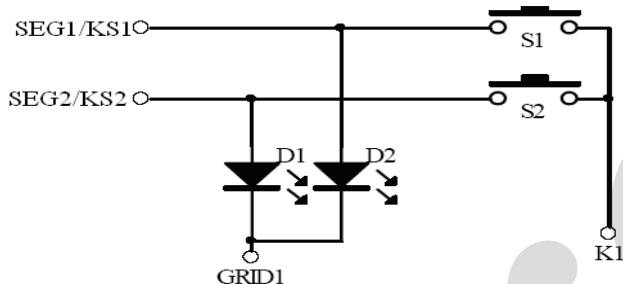
The key scan data storage data is as follows. After running the read key command, read the key data BYTE1-BYTE4 bytes. The read data is output from the low bit, and B6 and B7 bits are invalid bits and fixedly output 0. When the key corresponding to the K and KS pins of the chip is pressed, the Bit in the corresponding byte is 1.

B0	B1	B2	B3	B4	B5	B6	B7	
K3	K2	K1	K0	K3	K2	K1	K0	
KS1				KS2				BYTE1
KS3				KS4				BYTE2
KS5				KS6				BYTE3
KS7				KS8				BYTE4

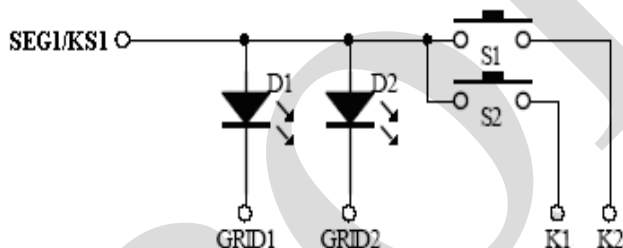


4.2.1、Combination Key

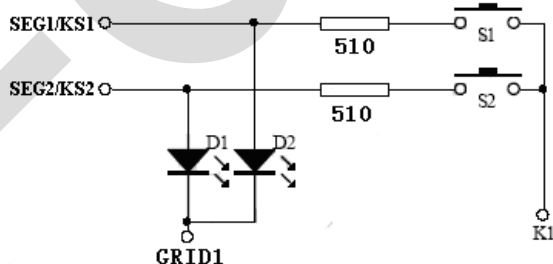
Key scanning is automatically completed by AiP1929, which is not controlled by the user, and the user only needs to read the key value according to the timing. It takes 2 display cycles to complete a key scan, and SEG1/KS1-SEG10/KS10 are multiplex of display and key scan. As shown in the following figure, if D1 is off and D2 is on, set SEG1 to 1 and SEG2 to 0. If S1 and S2 are pressed at the same time, SEG1 and SEG2 are short-circuited. In this case, both D1 and D2 are lit, resulting in abnormal display. When you need to use a combination of keys, there are a few things to pay attention to:



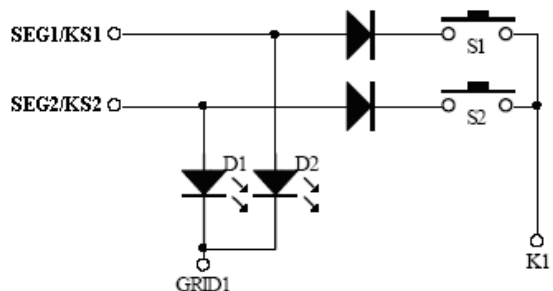
1. On the hardware, the keys that need to be pressed at the same time can be set on different K-lines, as shown in the figure below.



2. Install the resistance in series on SEG1-SEGN. The resistance value of the resistance should be selected at 510 ohms. If the value is too large, it will cause the key to lose efficiency; if the value is too small, it may fail to solve the problem of display interference, as shown in the figure below:



3. Install the diodes in series on SEG1-SEGN, as shown in the figure below.





4.3、Instruction Introduction

Each time the STB port changes from high to low, the first byte sent into the circuit from the DIO port is used as an introduction input, and the second byte is used as a data input. The higher two digits in an instruction are used to distinguish between different instructions.

B7	B6	Instruction
0	1	Data command setting
1	0	Display control command setting
1	1	Address command setting

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

4.3.1、Data Setting

This instruction is used to set data reading and writing. B1 and B0 cannot be set to 01 and 11.

MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
0	1	Irrelevant term, write 0		-	-	0	0	Read-write mode setting	Write data to the display register
0	1			-	-	1	0		Read the key value
0	1			-	0	-	-	Address mode setting	Address auto-adding mode
0	1			-	1	-	-		Fixed address mode
0	1			0	-	-	-	Test mode setting	Normal mode
0	1			1	-	-	-		Test mode (internal use)

4.3.2、Address setting

This instruction is used to set the address of the display register. If the address is set higher than 0FH, the data is ignored until the effective address is set. During powering on, the default address is 00H.

MSB				LSB				Display Address
B7	B6	B5	B4	B3	B2	B1	B0	
1	1	Irrelevant term, 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
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



1	1		1	1	0	0	0CH
1	1		1	1	0	1	0DH
1	1		1	1	1	0	0EH
1	1		1	1	1	1	0FH

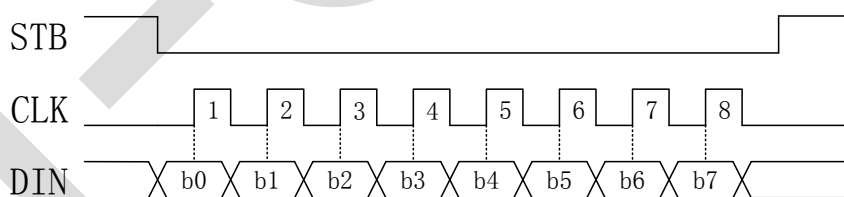
4.3.3、Display Control

MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
1	0	Irrelevant term, write 0		-	0	0	0	Display brightness 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 setting	Display off
1	0			1	-	-	-		Display on

4.4、Serial Data Transmission Format

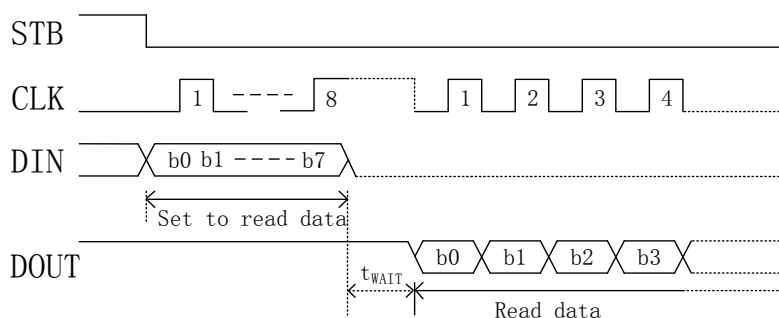
Both reading and receiving 1 bit operate on the rising edge of the clock.

4.4.1、Write Data





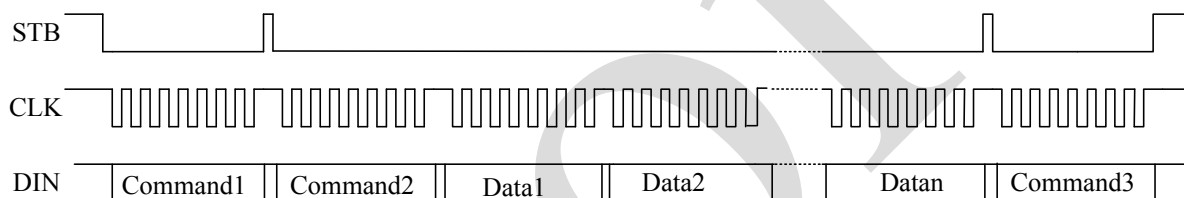
4.4.2、Read Data



Note: When reading data, a waiting period t_{WAIT} (min. 1us) is required between setting the instruction at the beginning of the 8th rising edge of the serial clock CLK and reading the data at the falling edge of CLK.

4.5、Transmission of Serial Data in Application

4.5.1、Address Increment Mode Communication Timing



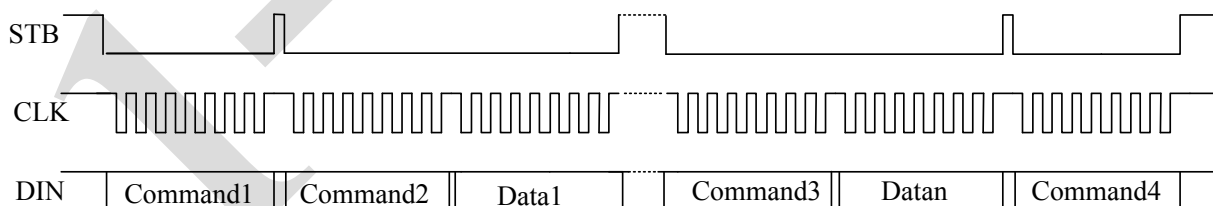
Command1: Set data instruction

Command2: Set display address

Data1~Datan: Transmit display data

Command3: Display control instruction

4.5.2、Fixed Address Mode Communication Timing



Command1: Set data instruction

Command2: Set display address 1

Data1: Display data written into Command2 address

⋮

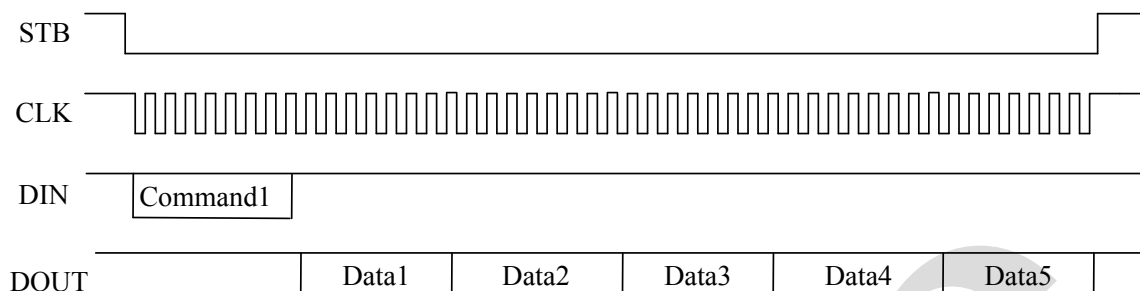
Command3: Set display address N

Datan: Display data written into Command3 address



Command4: Display control instruction

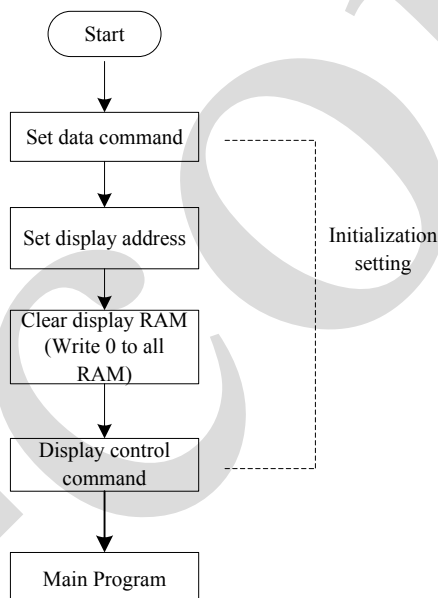
4.5.3、Read Key Value Timing



Command1: Set read key instruction

Data1~4: Key value data that is read

4.6、Initialization Flowchart

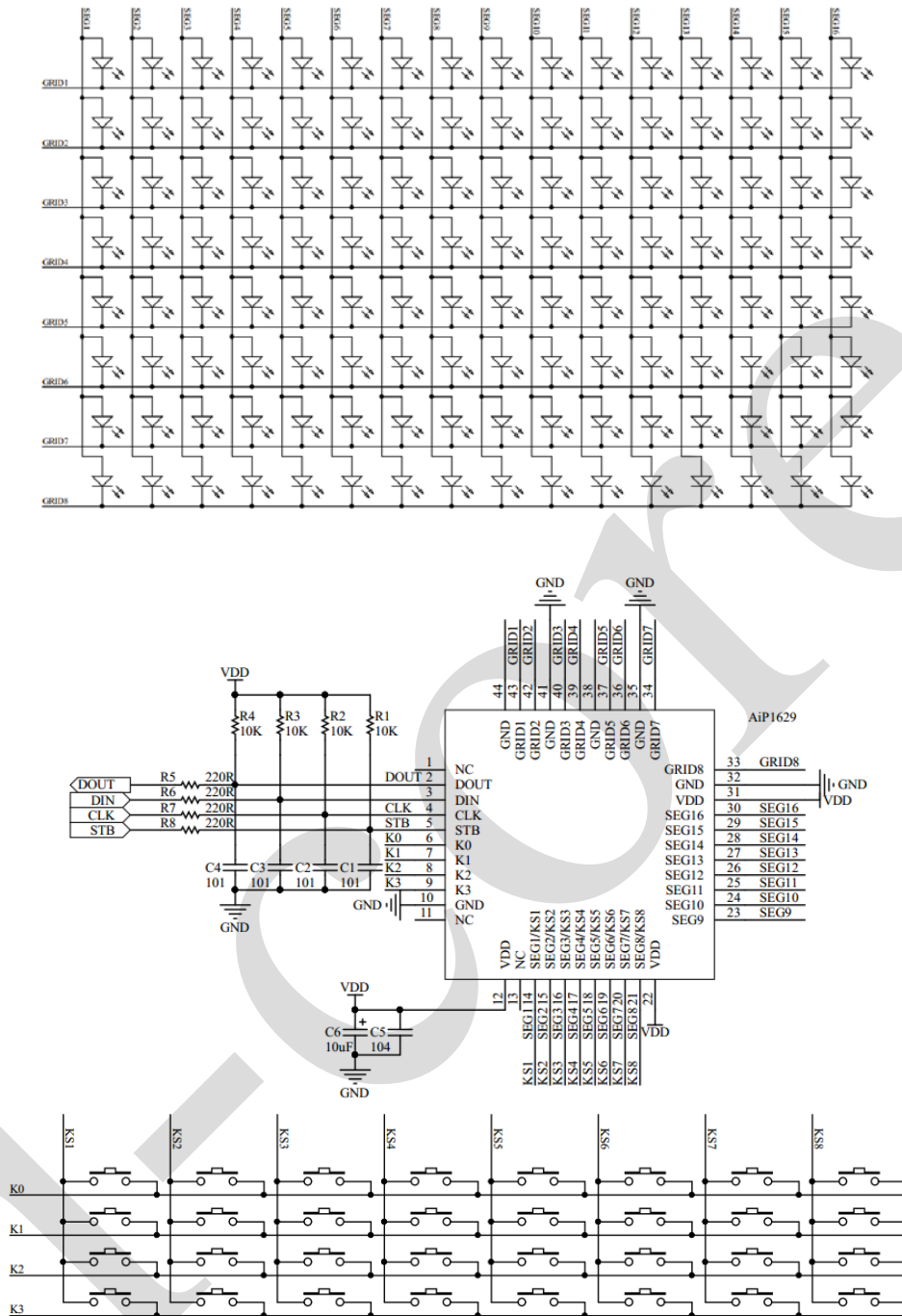


Note:

1. The data instruction is used to choose whether to write the display data to the RAM area (which is divided into fixed address and address auto-adding) or to read the key value.
2. IC displays unfixed RAM content when powering on, in order to prevent chaotic displays when the users turn on the display first, it is recommended to clear the RAM before turning on the display.



5、Typical Application Circuit

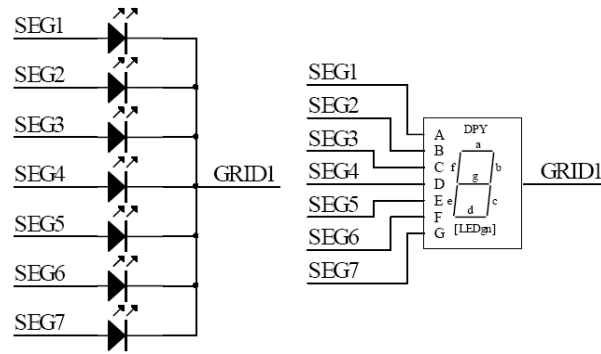


Note:

1. The filtering capacitor between VDD and GND should be close to AiP1929 to enhance the filtering effect.
2. In order to improve the anti-interference ability of the circuit, it is recommended to connect the communication port according to the figure above, and the specific parameter values can be adjusted according to the actual needs.



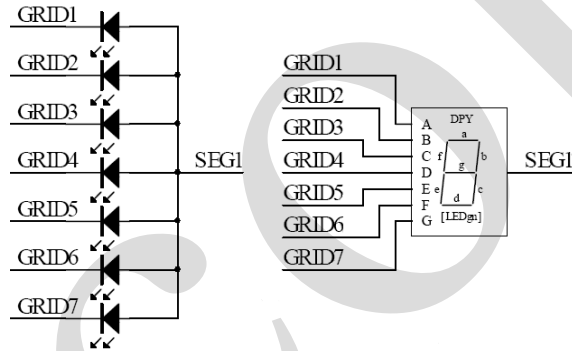
5.1、Drive Common Cathode Nixie Tube



As shown in the figure, to make the nixie tube display “0”, just write data 3FH in the 00H address unit when GRID1 is low, SEG1, SEG2, SEG3, SEG4, SEG5 and SEG6 are high, and SEG7 is low.

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

5.2、Drive Common Anode Nixie Tube



As shown in the figure, to make the nixie tube display “0”, SEG1 is high when GRID1, GRID2, GRID3, GRID4, GRID5, GRID6 are low, SEG1 is low when GRID7 is low.

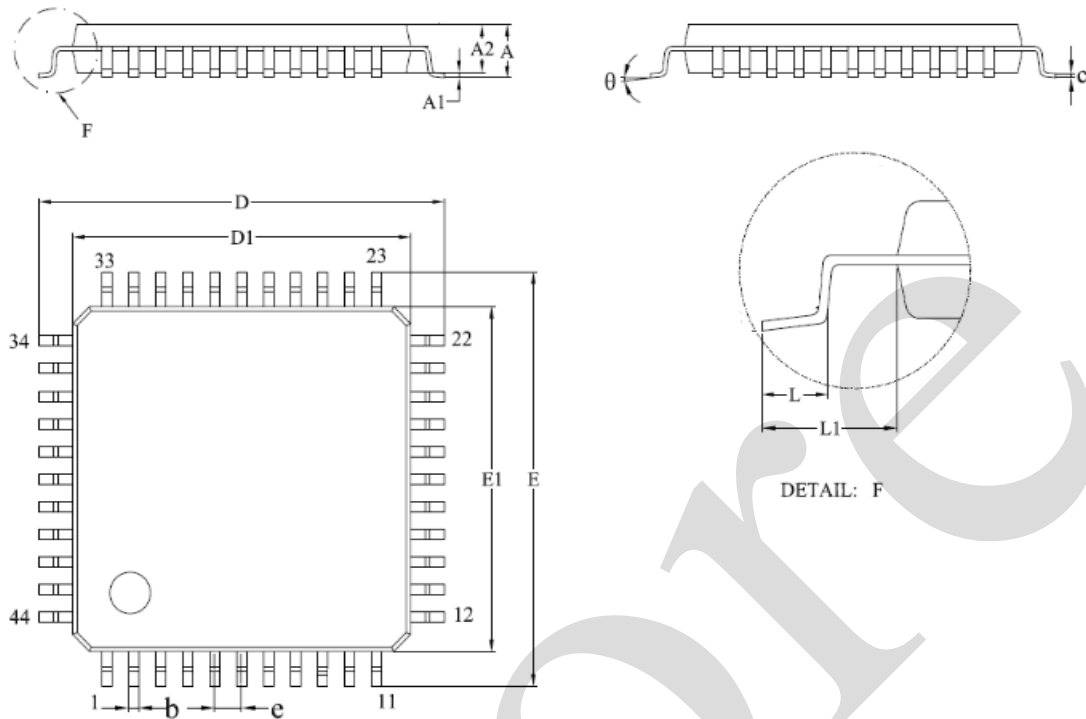
SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	Address
B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	0	0	1	00H
0	0	0	0	0	0	0	1	02H
0	0	0	0	0	0	0	1	04H
0	0	0	0	0	0	0	1	06H
0	0	0	0	0	0	0	1	08H
0	0	0	0	0	0	0	1	0AH
0	0	0	0	0	0	0	0	0CH

Note: SEGn is P-tube open-drain output and GRIDn is N-tube open-drain output. In use, SEGn can only be connected to the anode of LED while GRIDn can only be connected to the cathode of LED. It cannot be reversed.



6、Package Information

6.1、LQFP44



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	1.45	1.65
A1	0.05	0.20
A2	1.30	1.50
b	0.28	0.36
c	0.13	0.18
D	11.80	12.20
D1	9.90	10.10
E	11.80	12.20
E1	9.90	10.10
e	0.80	
L	0.42	0.75
L1	0.95	1.15
θ	0°	10°



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

We recommend you to read this chapter carefully before using this product.

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