



AiP1629 (4-line) 4-line Serial Interface/Common Cathode 16Seg 8Grid LED Controller/Driver with 8*4 Keyboard Scan Ports

Product Specification

Specification Revision History:

Version	Date	Description
2021-11-A1	2021-11	New
2023-03-B1	2023-03	Update template



Contents

1、General Description.....	1
2、Pin Configurations And Pin Description.....	2
2.1、Pin Configurations.....	2
2.2、Pin Description.....	2
3、Electrical Parameter	3
3.1、Absolute Maximum Ratings.....	3
3.2、Recommended Operating Range.....	3
3.3、Electrical Characteristics.....	3
3.3.1、DC Characteristics.....	3
3.3.2、AC Characteristics 1.....	4
3.3.3、AC Characteristics 2.....	4
4、Function Description.....	5
4.1、Display Mode And RAM Address	5
4.2、Key Scanning And Key Scanning Data Registers.....	5
4.2.1、Combination Keys	6
4.3、Commands Description	7
4.3.1、Data Command Settings	7
4.3.2、Address Command Settings.....	8
4.3.3、Display Control.....	8
4.4、Serial Data Transfer Format.....	8
4.4.1、Data Receiving (Writing).....	9
4.4.2、Data Reading (Reading)	9
4.5、Transmission Of Serial Data In Application	9
4.5.1、Address Addition Mode.....	9
4.5.2、Fixed Address Mode.....	10
4.5.3、Reading Key Timing.....	10
4.6、Initialization Flow Chart	11
5、Typical Application Circuit And Application Note.....	12
5.1、Drive Common Cathode Digital Tube	13
5.2、Drive Common Anode Digital Tube	13
6、Package Information.....	14



6.1、QFP44	14
6.2、LQFP44.....	15
7、Statements And Notes	16
7.1、The name and content of Hazardous substances or Elements in the product.....	16
7.2、Notion.....	16

i-core



1、General Description

AiP1629 (4-line) is a 4-line serial interface/common cathode 16seg 8grid LED controller/driver with 8*4 keyboard scan ports. It has keyboard scan ports, MCU digital ports, data latches, LED drivers and other circuits. It is widely used in a variety of LED panels.

Features:

- built-in display RAM
- display modes(16 segment*8 grid)
- key scanning (8×4 bit)
- software adjustable display brightness
- 4-line serial interface(CLK, STB, DIN, DOUT)
- built-in RC oscillator
- mode of packaging: QFP44/LQFP44

Applications:

A variety of LED panels, for example, microwave ovens, induction cookers, water heaters and other home appliances.

Ordering Information:

Tube packing specifications:

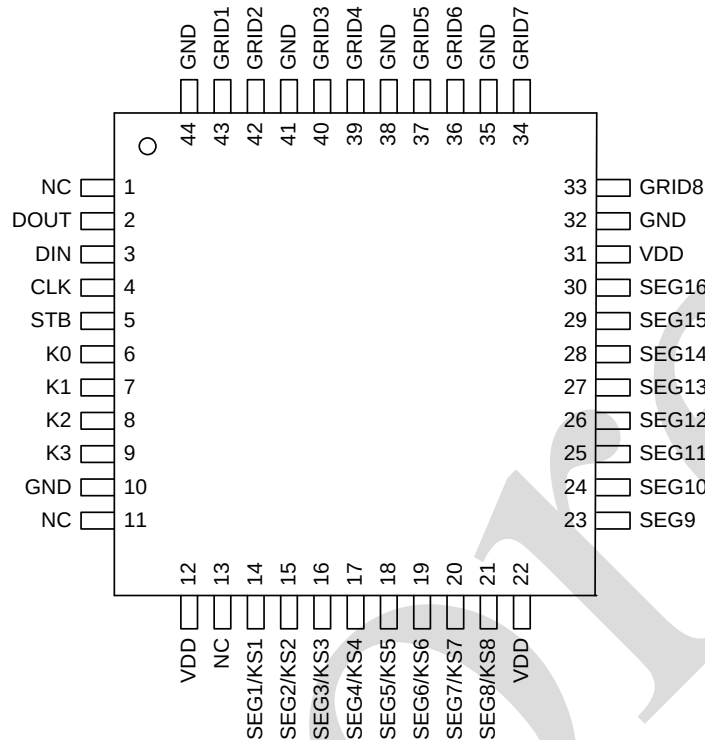
Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP1629-4NB44.TB	QFP44	AiP1629-4	160 PCS/plate	10 plate/box	1600 PCS/box	Dimensions of plastic enclosure: 10.0mm×10.0mm Pin spacing: 0.8mm
AiP1629-4LB44.TB	LQFP44	AiP1629-4	160 PCS/plate	10 plate/box	1600 PCS/box	Dimensions of plastic enclosure: 10mm×10mm Pin spacing: 0.8mm

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



2、Pin Configurations And Pin Description

2.1、Pin Configurations



2.2、Pin Description

Pin No.	Pin Name	I/O	Description
1, 11, 13	NC	-	floating
2	DOUT	O	data output (N-Channel, open drain)
3	DIN	I	data input
4	CLK	I	clock input
5	STB	I	Serial Interface Strobe Pin.
6, 7, 8, 9	K0~K3	I	key data input (internal pull-down resistor)
10, 32, 35, 38, 41, 44	GND	-	ground
12, 22, 31	VDD	-	power supply
14	SEG1/KS1	O	Segment/key scan output (P-Channel, open drain)
15	SEG2/KS2	O	
16	SEG3/KS3	O	
17	SEG4/KS4	O	
18	SEG5/KS5	O	
19	SEG6/KS6	O	
20	SEG7/KS7	O	
21	SEG8/KS8	O	
23, 24, 25, 26, 27, 28, 29, 30	SEG9~SEG16	O	Segment output (P-Channel, open drain)
43, 42, 40, 39, 37, 36, 34	GRID1~GRID8	O	Grid output (N-Channel, open drain)



3、Electrical Parameter

3.1、Absolute Maximum Ratings

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

Characteristic	Symbol	Conditions	Value	Unit
supply voltage	VDD	-	-0.5 to +7.0	V
input voltage	V_I	-	-0.5 to VDD+0.5	V
HIGH-level drive output current (SEG)	I_{O1}	-	-50	mA
LOW-level drive output current (GRID)	I_{O2}	-	+150	mA
ambient temperature	T_{amb}	-	-40 to +85	$^{\circ}\text{C}$
storage temperature	T_{stg}	-	-65 to +150	$^{\circ}\text{C}$
soldering temperature	T_L	10s	260	$^{\circ}\text{C}$

3.2、Recommended Operating Range

Parameter	Symbol	Min.	Typ.	Max.	Unit
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~SEG16, $V_O=VDD-2V$	-20	-25	-40	mA
	I_{OH2}	SEG1~SEG16, $V_O=VDD-3V$	-20	-30	-50	mA
LOW-level output current	I_{OL1}	GRID1~GRID8, $V_O=0.3V$	80	100	-	mA
	I_{DO}	$V_O=0.4V$, DOUT	4	8	-	mA
segment HIGH-level output current tolerance	I_{TOLSG}	$V_O=VDD-3V$, SEG1~SEG16	-	-	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	$V_I=VDD/GND$, STB, CLK, DIN	-	-	± 1	μA
supply current	I_{DD}	No load, $V_I=VDD$	120	150	180	μA
input pull-down resistance	R_L	K0~K3	-	3	-	k Ω



3.3.2、AC Characteristics 1

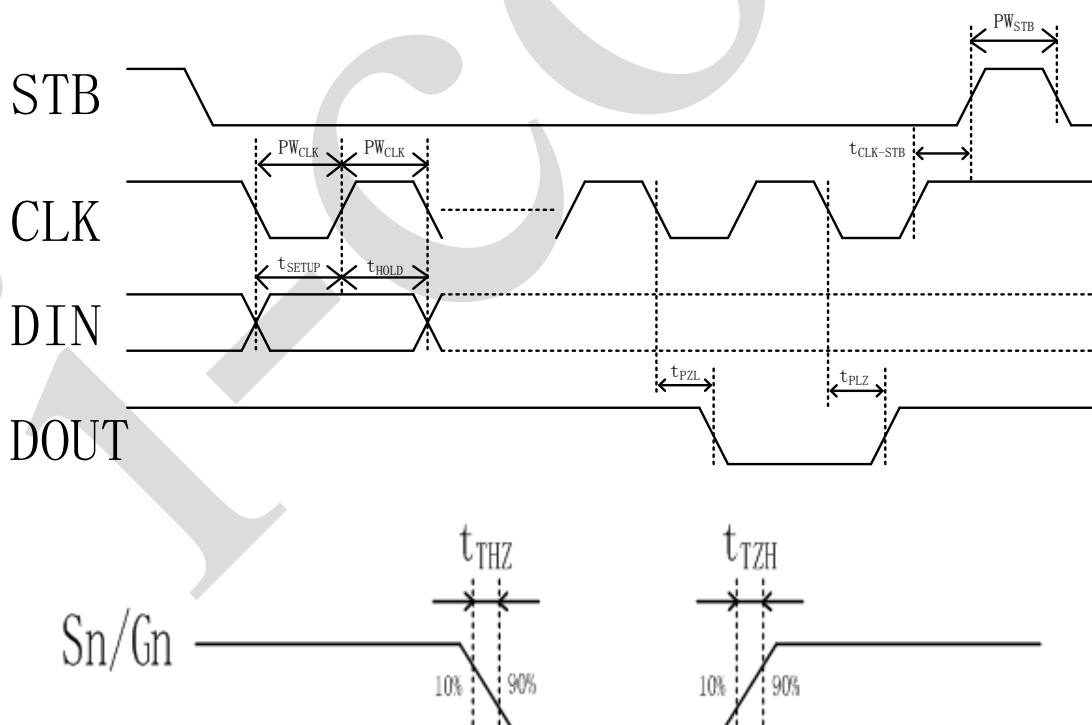
(VDD=4.5 to 5.5V, GND=0V, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
oscillation frequency	f_{OSC}	-	-	400	-	kHz
propagation delay	t_{PLZ}	CLK→DOUT, $C_L=15pF$, $R_L=10k\Omega$	-	-	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=50%	1	-	-	MHz

3.3.3、AC Characteristics 2

(VDD=4.5 to 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	t_{SETUP}	-	100	-	-	ns
hold time	t_{HOLD}	-	100	-	-	ns
CLK→STB time	$t_{CLK-STB}$	CLK↑→STB↑	1	-	-	us
wait time	t_{WAIT}	CLK↑→CLK↓	1	-	-	us





4、Function Description

4.1、Display Mode And RAM Address

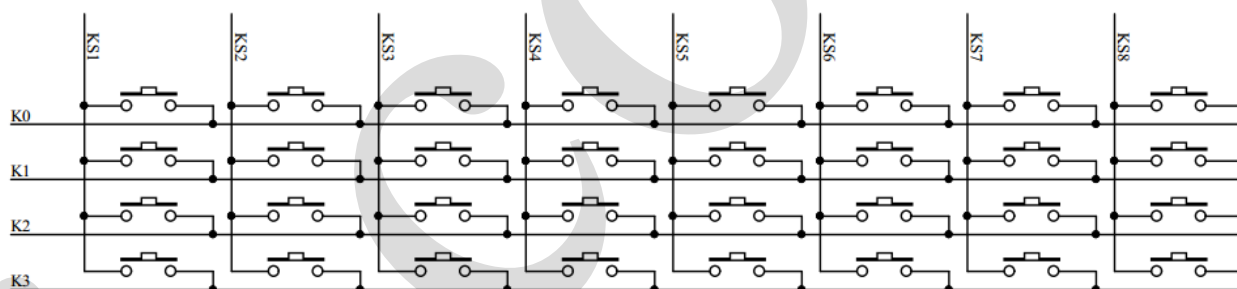
Data transmitted from an external device to AiP1629 (4-line) via the serial interface are stored in the Display register. The allocation of the register addresses is as follows:

SEG16	SEG15	SEG14	SEG13	SEG12	SEG11	SEG10	SEG9	SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1		
xxHU(high 4 bit)				xxHL(low 4 bit)				xxHU(high 4 bit)				xxHL(low 4 bit)					
B7	B6	B5	B4	B3	B2	B1	B0	B7	B6	B5	B4	B3	B2	B1	B0		
01HU				01HL				00HU				00HL				GRID1	
03HU				03HL				02HU				02HL				GRID2	
05HU				05HL				04HU				04HL				GRID3	
07HU				07HL				06HU				06HL				GRID4	
09HU				09HL				08HU				08HL				GRID5	
0BHU				0BHL				0AHU				0AHL				GRID6	
0DHU				0DHL				0CHU				0CHL				GRID7	
0FHU				0FHL				0EHU				0EHL				GRID8	

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

4.2、Key Scanning And Key Scanning Data Registers

Key scanning matrix is 8×4 bit, as follows:



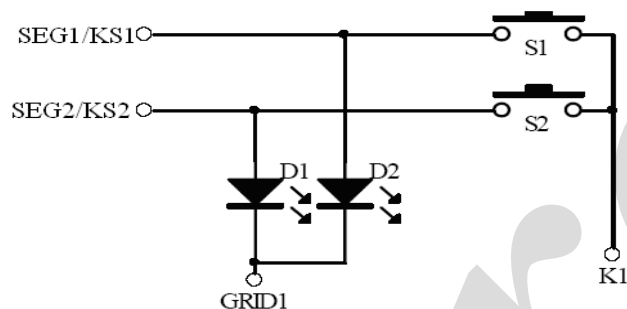
The Key scanning data storage address is as follows. After issuing the key reading command, read the key data BYTE1~BYTE4 and output the data from low-level. When the key corresponding to the pins K and KS is pressed, the BIT bit in the corresponding byte is 1.

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

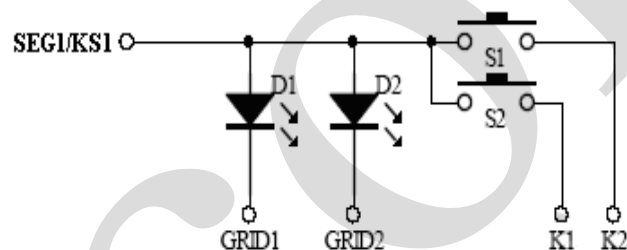


4.2.1、Combination Keys

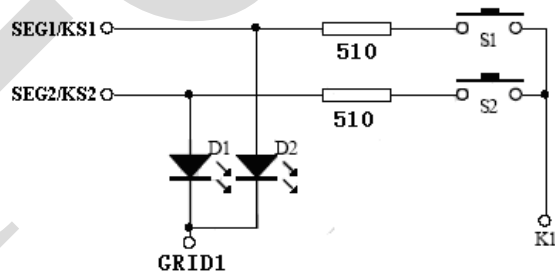
The key scan is done automatically by the AiP1629 (4-line) and is not controlled by the user. The user only needs to read the key value according to the timing. Two key cycles are required to complete a key scan, and SEG1/KS1-SEG10/KS10 are used for display and key scan multiplexing. As shown in the figure below, if D1 is off and D2 is on, you need to make SEG1 be “1” and SEG2 be “0”. If S1 and S2 are simultaneously pressed, it is equivalent to SEG1 and SEG2 being short-circuited, and both D1 and D2 are lit at this time, resulting in display abnormality. When you need to use the combination keys, pay attention to the following points:



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

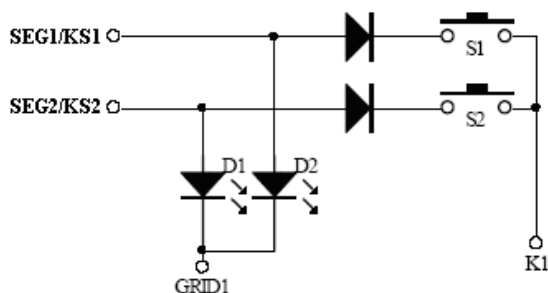


2. If the resistors are connected in series above SEG1~SEGN, the resistance of the resistor should be chosen to be 510Ω. If the value is too large, it will cause the key to fail. If the value is too small, it may not solve the problem of display interference, as shown in the following figure:





3. Connect the diodes above SEG1~SEGN as shown below:



4.3、Commands Description

Commands are used to set the display mode and the state of the LED driver.

The first byte entered by DIN after the falling edge of STB is used as an instruction. After decoding, the highest B7 and B6 bits are taken to distinguish different instructions.

B7	B6	Commands
0	1	data command settings
1	0	display control command settings
1	1	address command settings

If the STB is set to a high level at the time of instruction or data transmission, the 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 Command Settings

This instruction is used to set data write and read, B1 and B0 bits are not allowed to set 01 or 11.

MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
0	1	irrelevant terms, set 0		-	-	0	0	data read-write mode settings	write data to display register
0	1			-	-	1	0		read key scan data
0	1			-	0	-	-	address addition mode settings	automatic address increase
0	1			-	1	-	-		fixed address
0	1			0	-	-	-	test mode settings	common mode
0	1			1	-	-	-		test mode (internal use)



4.3.2、Address Command Settings

This instruction is used to set the address of the display register. If the address is set to 10H or higher, the data is ignored until the effective address is set. When power on,the address is set to 00H by default.

MSB				LSB				Display Address
B7	B6	B5	B4	B3	B2	B1	B0	
1	1	irrelevant terms, set 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

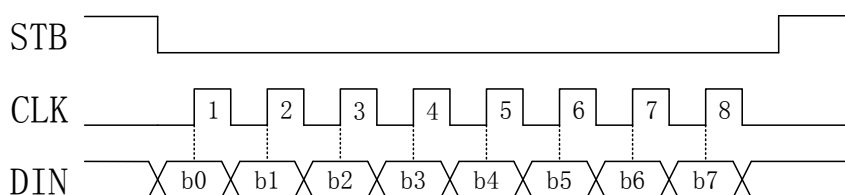
MSB				LSB				Function	Description
B7	B6	B5	B4	B3	B2	B1	B0		
1	0	irrelevant terms, set 0		-	0	0	0	extinction number settings	set the pulse width to 1/16
1	0			-	0	0	1		set the pulse width to 2/16
1	0			-	0	1	0		set the pulse width to 4/16
1	0			-	0	1	1		set the pulse width to 10/16
1	0			-	1	0	0		set 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 closed
1	0			1	-	-	-		display open

4.4、Serial Data Transfer Format

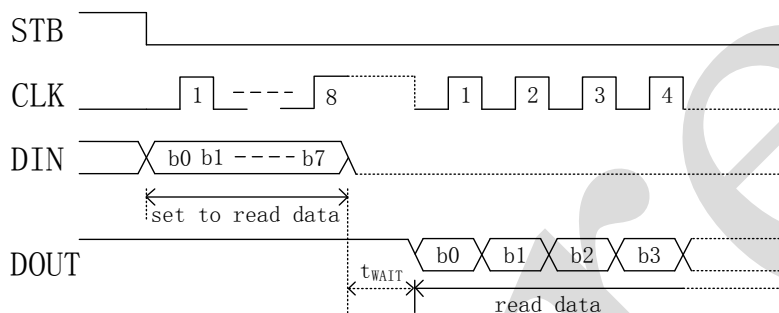
Reading and receiving a BIT are performed at the rising edge of the clock.



4.4.1、Data Receiving (Writing)



4.4.2、Data Reading (Reading)



Note: When reading data, there is a waiting time t_{WAIT} (minimum 1us) between setting instructions from the 8th rising edge of serial clock CLK to the falling edge of CLK.

4.5、Transmission Of Serial Data In Application

4.5.1、Address Addition Mode



Command1: setting data command

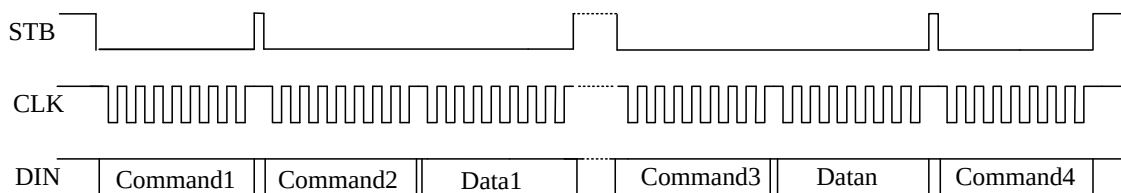
Command2: setting display address

Data1~Datan: transfer display data

Command3: display control command



4.5.2、Fixed Address Mode



Command1: setting data command

Command2: setting display Address 1

Data1: transfer display data to Command2 Address

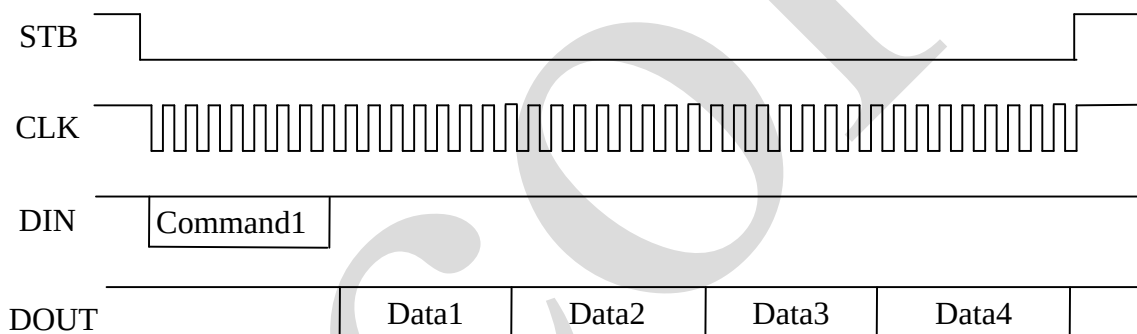
⋮

Command3: setting display address N

Datan: transfer display data to Command3 address

Command4: display control command

4.5.3、Reading Key Timing

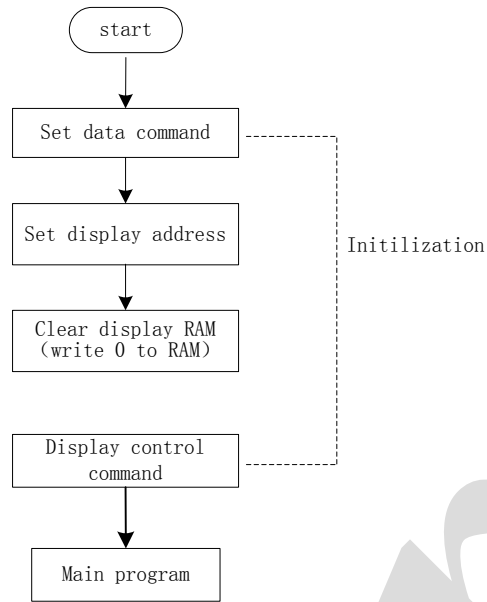


Command1: setting reading key data command

Data1~4: read key data



4.6、Initialization Flow Chart

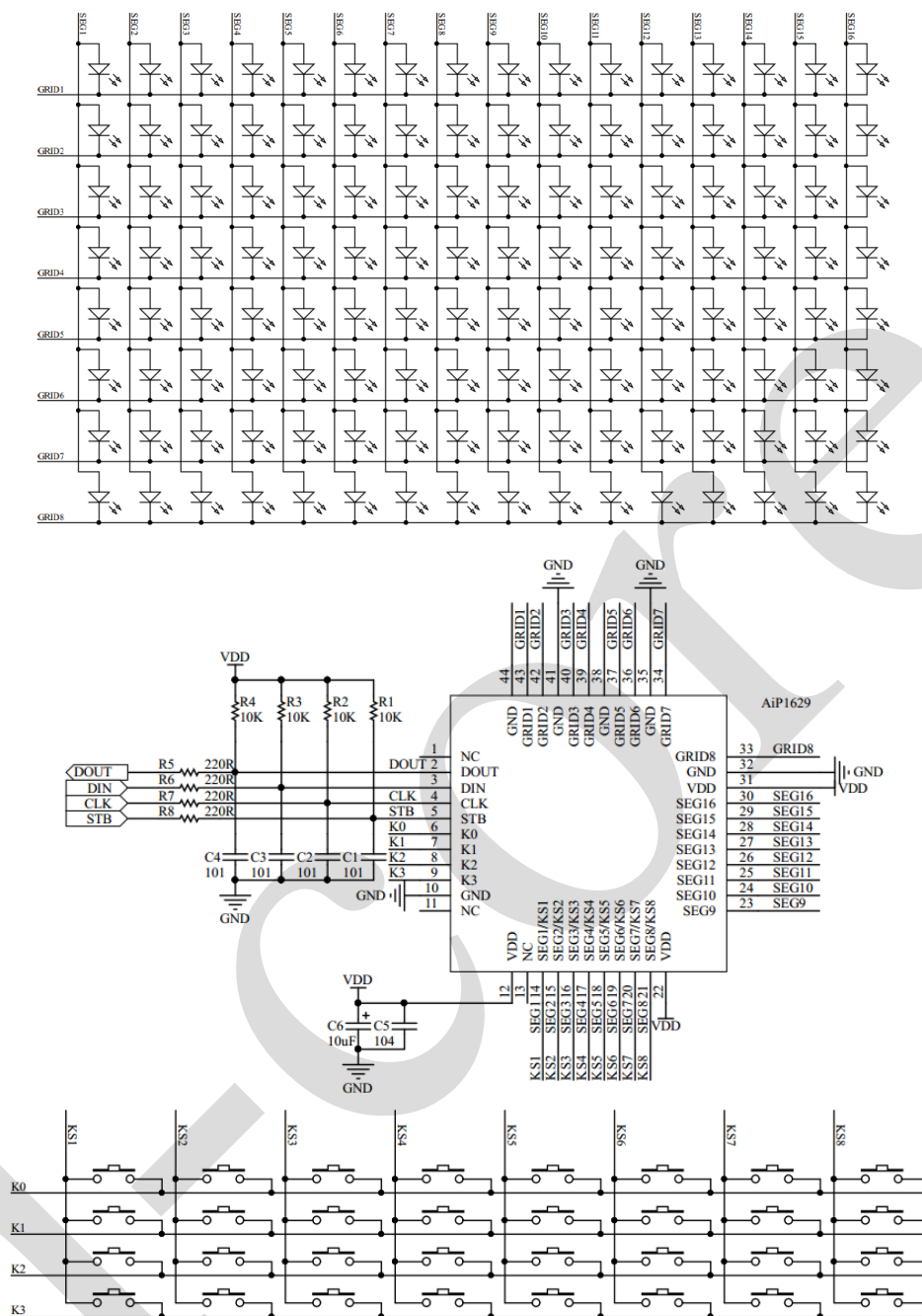


Note:

1. The data command is used to select whether to write display data for the RAM area (divided into two types: fixed address and address self-addition) or read key values.
2. When the IC is powered on, the content of RAM is not fixed. In order to prevent the display from appearing randomly when the display is turned on first. It is recommended to clear the RAM and then turn on the display.



5、Typical Application Circuit And Application Note

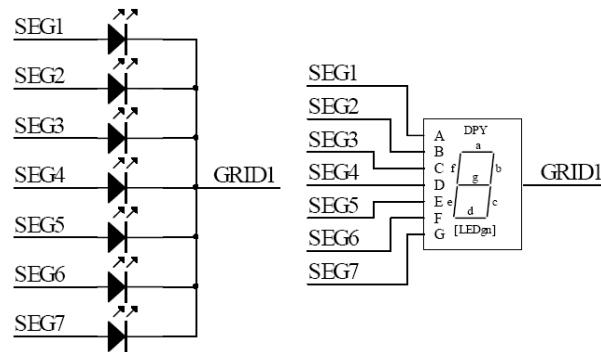


Note:

1. The circuit between filter capacitor and VDD, GND is as short as possible to enhance the filter effect.
2. In order to improve the anti-interference ability of the circuit, the communication port is recommended to be connected according to the above figure. The specific parameter values can be adjusted according to actual needs.



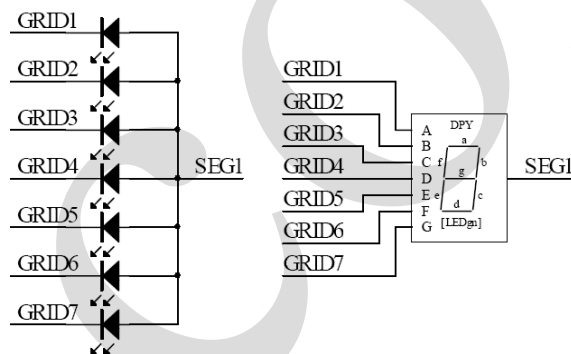
5.1、 Drive Common Cathode Digital Tube



If the digital tube displays “0”, then you need to make SEG1, SEG2, SEG3, SEG4, SEG5, SEG6 high and SEG7 low when GRID1 is low. Just write the data 3FH in the 00H address to make the digital tube display “0”. The connection diagram of the common cathode digital tube shows below:

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 Digital Tube



If the digital tube shows “0”, then you need to make SEG1 high when GRID1, GRID2, GRID3, GRID4, GRID5 and GRID6 are low, and SEG1 low when GRID7 is low. Write data 01H to address units 00H, 02H, 04H, 06H, 08H, 0AH, respectively, the rest of the address units all write data 00H. The connection diagram of the common anode digital tube shows below:

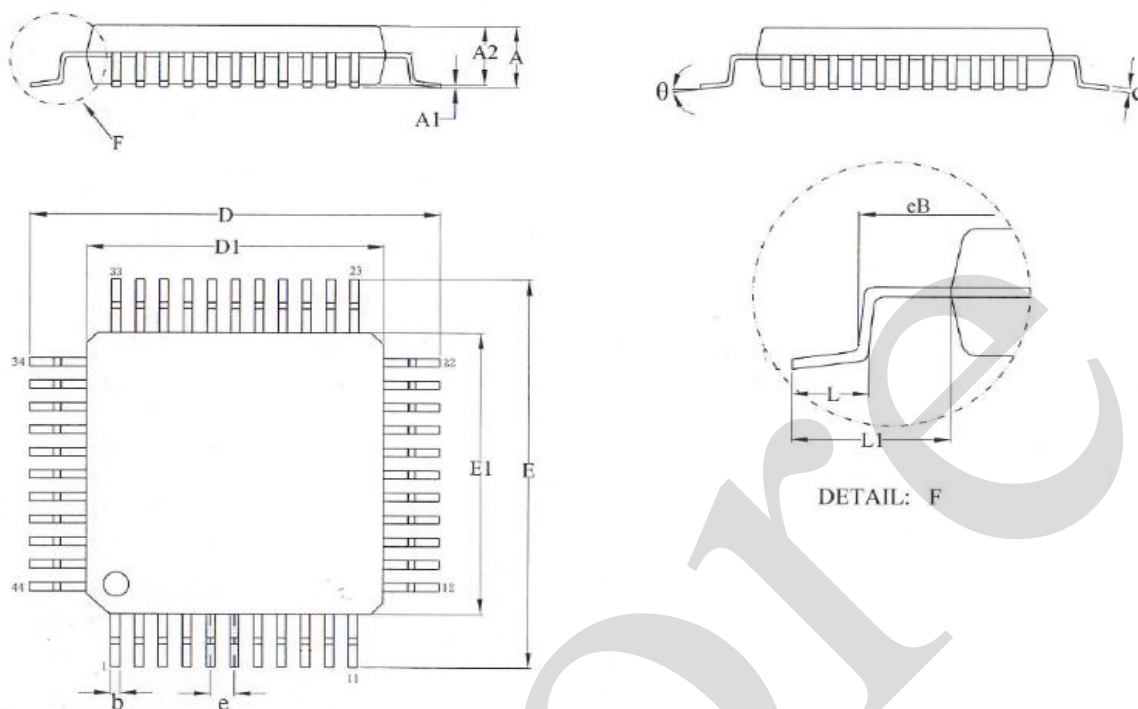
SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	Address
B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	0	0	1	00H
0	0	0	0	0	0	0	1	02H
0	0	0	0	0	0	0	1	04H
0	0	0	0	0	0	0	1	06H
0	0	0	0	0	0	0	1	08H
0	0	0	0	0	0	0	1	0AH
0	0	0	0	0	0	0	0	0CH

Note: SEGn is the P channel open drain output, GRIDn is the N channel open drain output. When using, SEGn can only connect the anode of LED, GRIDn can only connect the cathode of LED, no reverse connection.



6、Package Information

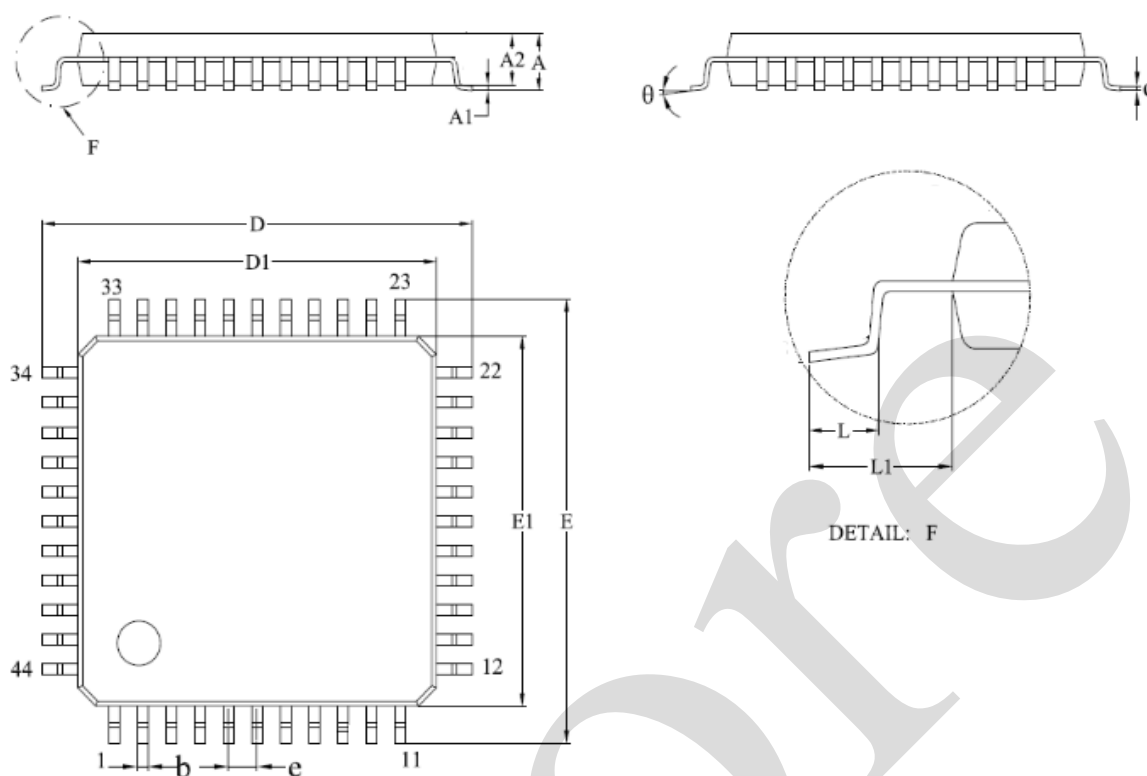
6.1、QFP44



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	2.35
A1	0.05	0.15
A2	2.05	2.15
b	0.28	0.36
c	0.15	0.19
D	13.00	13.40
D1	9.90	10.10
E	13.00	13.40
E1	9.90	10.10
eB	11.59	11.89
e	0.80	
L	0.78	0.98
L1	1.60	
θ	0 °	7 °



6.2、LQFP44



Symbol	Dimensions (mm)	
	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.

The information in this chapter is provided for reference only and i-Core disclaims any express or implied warranties, including but not limited to applicability, special application or non-infringement of third party rights.

This product is not suitable for critical equipment such as life-saving, life-sustaining or safety equipment. It is also not suitable for applications that may result in personal injury, death, or serious property or environmental damage due to product malfunction or failure. I-Core will not be liable for any damages incurred by the customers at their own risk for such applications.

The customer is responsible for conducting all necessary tests i-Core's application to avoid failure in the application or the application of the customer's third party users. I-Core does not accept any liability.

The Company reserves the right to change or improve the information published in this chapter at any time. The information in this chapter are subject to change without notice. We recommend the customer to consult our sales staff before purchasing.

Please obtain related materials form i-Core's regular channels and we are not responsible for its content if it is provided by sources other than our company.

In case of any conflict between the Chinese and English version, the version is subject to the Chinese one.