



AiP1638

3-line Serial Interface/Common Cathode 10Seg 8Grid LED Controller/Driver with 8*3 Keyboard Scan Ports

Product Specification

Specification Revision History:

Version	Data	Description
2015-03-A1	2015-03	New
2019-04-A2	2019-04	Replace the new template
2019-08-A3	2019-08	Add Ordering Information
2021-12-A4	2021-12	Modify Ordering Information
2024-11-B1	2024-11	Update the template; modify the content



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1、General Description

AiP1638 is an LED Controller driven on a 1/8 duty factor. 10 segment output lines, 8 grid output lines, one display memory, control circuit, key scan circuit are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer. Serial data is fed to AiP1638 via a three-line serial interface. Housed in a 28 pins SOP package, AiP1638 pin assignments and application circuit are optimized for easy PCB Layout and cost saving advantages.

Features:

- CMOS technology
- Low power consumption
- Display modes(10 segment*8 grid)
- Key scanning(3*8 matrix)
- 8-step dimming circuitry
- Serial interface for clock, data input, data output, strobe pins
- Built-in RC oscillator
- Mode of packaging: SOP28

Ordering Information:

Tube packing specifications:

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP1638SA28.TB	SOP28	AiP1638	25 PCS/tube	80 tube/box	2000 PCS/box	Dimensions of plastic enclosure: 17.9mm×7.5mm Pin spacing: 1.27mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP1638SA28.TR	SOP28	AiP1638	1250 PCS/reel	1250 PCS/box	Dimensions of plastic enclosure: 17.9mm×7.5mm Pin spacing: 1.27mm

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



2、Block Diagram And Pin Description

2.1、Pin Configurations

1	K1	STB	28
2	K2	CLK	27
3	K3	DIO	26
4	VDD	GND	25
5	SEG1/KS1	GR1	24
6	SEG2/KS2	GR2	23
7	SEG3/KS3	GR3	22
8	SEG4/KS4	GR4	21
9	SEG5/KS5	GR5	20
10	SEG6/KS6	GR6	19
11	SEG7/KS7	GND	18
12	SEG8/KS8	GR7	17
13	SEG9	GR8	16
14	SEG10	VDD	15

2.2、Pin Description

Pin No.	Pin Name	Description
1	K1	Key Data input Pins The data sent to these pins are latched at the end of the display cycle.(Internal Pull-Low Resistor)
2	K2	Key Data input Pins The data sent to these pins are latched at the end of the display cycle.(Internal Pull-Low Resistor)
3	K3	Key Data input Pins The data sent to these pins are latched at the end of the display cycle.(Internal Pull-Low Resistor)
4	VDD	Power Supply
5	SEG1/KS1	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
6	SEG2/KS2	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
7	SEG3/KS3	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
8	SEG4/KS4	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
9	SEG5/KS5	Segment Output Pins(p-channel, open drain) Also acts as the Key Source



10	SEG6/KS6	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
11	SEG7/KS7	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
12	SEG8/KS8	Segment Output Pins(p-channel, open drain) Also acts as the Key Source
13	SEG9	Segment Output Pins
14	SEG10	Segment Output Pins
15	VDD	Power Supply
16	GR8	Grid Output Pins
17	GR7	Grid Output Pins
18	GND	Ground Pin
19	GR6	Grid Output Pins
20	GR5	Grid Output Pins
21	GR4	Grid Output Pins
22	GR3	Grid Output Pins
23	GR2	Grid Output Pins
24	GR1	Grid Output Pins
25	GND	Ground Pin
26	DIO	Data input Pin This pin inputs serial data at the rising edge of the shift clock (starting from the lower bit) Data Output pin(N-Channel, Open-Drain)
27	CLK	Clock input Pin .This pin reads serial data at the rising edge and outputs data at the falling edge.
28	STB	Serial Interface Strobe Pin The data input after the STB has fallen is processed as a command. When this pin is “HIGH”, CLK is ignored.

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 to +7.0	V
Input Voltage	V _{IN}	-	-0.5 to VDD+0.5	V
Drive output current	I _{O1}	GRID	+150	mA
	I _{O2}	SEG	-50	mA
Ambient Temperature	T _{amb}	-	-40~+85	℃
Storage Temperature	T _{stg}	-	-65~+150	℃
Soldering Temperature	T _L	10s	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

(T_{amb}=-40°C~+85°C, VDD=5V, GND=0V.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
High-level output current	I _{OH1}	SEG1~SEG10, V _O =VDD-2V	-20	-25	-40	mA
	I _{OH2}	SEG1~SEG10, V _O =VDD-3V	-20	-30	-50	mA
Low-level output current	I _{OL1}	GR1~GR8, V _O =0.3V	80	100	-	mA
Low-level output current	I _{DIO}	V _O =0.4V, DIO	4	8	-	mA
Segment High-level output current tolerance	I _{TOLSG}	V _O =VDD-3V, SEG1~SEG10	-	-	5	%
High-level input voltage	V _{IH}	CLK, DIO, STB	0.7VDD	-	-	V
Low-level input voltage	V _{IL}	CLK, DIO, STB	-	-	0.2VDD	V
Hysteresis Voltage	V _H	CLK, DIO, STB	-	0.35	-	V
Input current	I _I	V _I =VDD/GND	-	-	±1	uA
Static current	I _{DD}	No load, V _{IN} =VDD	120	150	180	uA
Pull-down Resistor	R _L	K1~K3	-	3	-	kΩ

3.3.2、Switching Characteristics

(T_{amb}=-40°C~+85°C, VDD=4.5V~5.5V.)

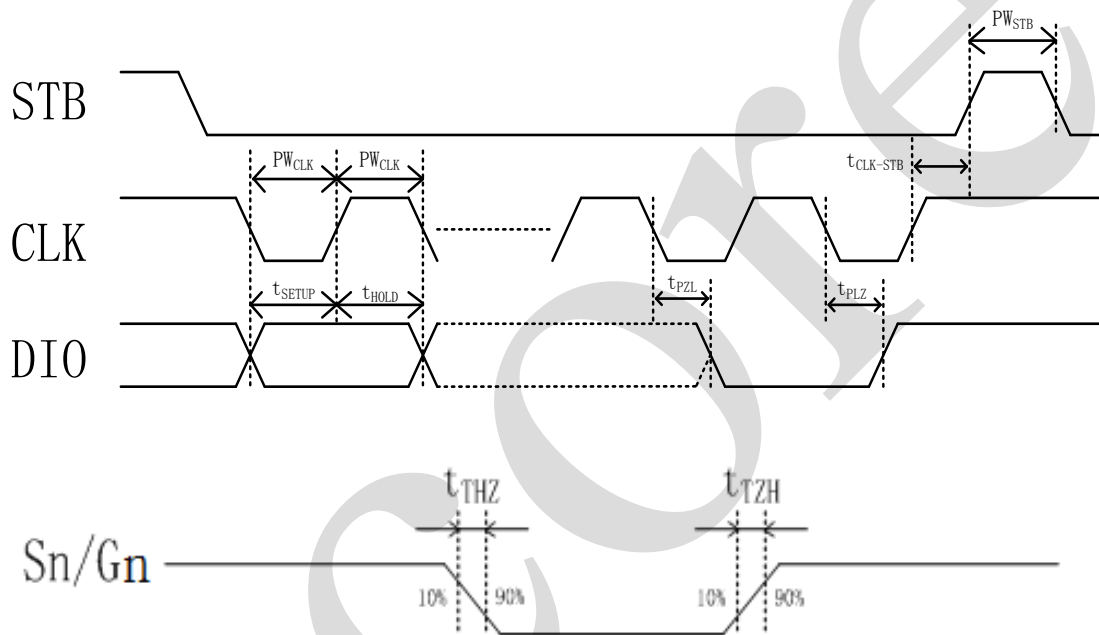
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Oscillation frequency	f _{OSC}	-	-	400	-	kHz
Propagation delay	t _{PLZ}	CLK→DIO	-	-	300	ns
	t _{PZL}	C _L =15pF, R _L =10kΩ	-	-	100	ns
Rise Time	t _{TZH1}	C _L =300pF	SEG1 ~SEG10		2	us
	t _{TZH2}		GR1~GR8		0.5	us
Fall Time	t _{THZ}	C _L =300pF, SEGn, GRn		-	120	us
Maximum clock frequency	f _{max}	Duty=50%		1	-	MHz



3.3.3、Timing Characteristics

($T_{amb} = -40^{\circ}\text{C} \sim +85^{\circ}\text{C}$, $V_{DD} = 4.5\text{V} \sim 5.5\text{V}$.)

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	$t_{CLK-STB}$	$CLK \uparrow \rightarrow STB \uparrow$	1	-	-	us
Wait time	t_{wait}	$CLK \uparrow \rightarrow CLK \downarrow$	1	-	-	us



4、Function Description

4.1、Display Mode And RAM Address

Data transmitted from an external device to AiP1638 via the serial interface are stored in the Display RAM and are assigned addresses. The RAM addresses of AiP1638 are given below in 8 bits unit.

SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8	SEG9	SEG10	X	X	X	X	X	X
xxHL(低四位)				xxHU(高四位)				xxHL(低四位)				xxHU(高四位)			
B0	B1	B2	B3	B4	B5	B6	B7	B0	B1	B2	B3	B4	B5	B6	B7
00HL				00HU				01HL				01HU			
02HL				02HU				03HL				03HU			
04HL				04HU				05HL				05HU			
06HL				06HU				07HL				07HU			
08HL				08HU				09HL				09HU			

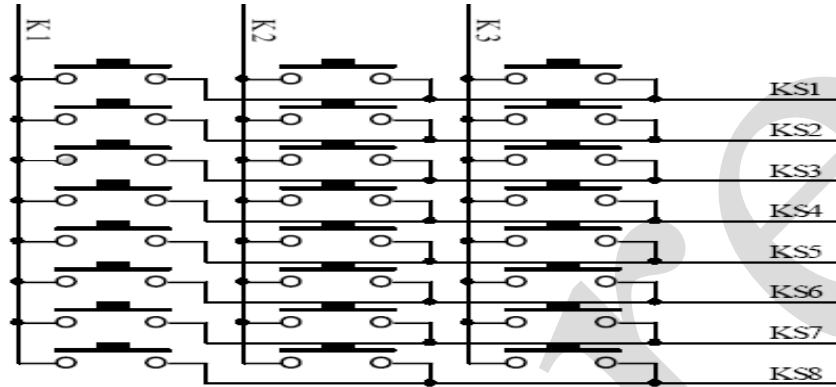


0AHL	0AHU	0BHL	0BHU	GR6
0CHL	0CHU	0DHL	0DHU	GR7
0EHL	0EHU	0FHL	0FHU	GR8

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

4.2、Key Matrix & Key Input DATA Storage RAM

Key Matrix consists of 8×3 array as shown below:



Each data entered by each key is stored as follows and read by a READ Command, starting from the last significant bit. When the most significant bit of the data (b0) has been read, the least significant bit of the next data (b7) is read, b7 do not care.

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

4.3、Commands Description

A command is the first byte (b0 to b7) inputted to AiP1638 via the DIO Pin after STB Pin has changed from HIGH to LOW State. If for some reason the STB Pin is set to HIGH while data or commands are being transmitted, the serial communication is initialized, and the data/commands being transmitted are considered invalid.

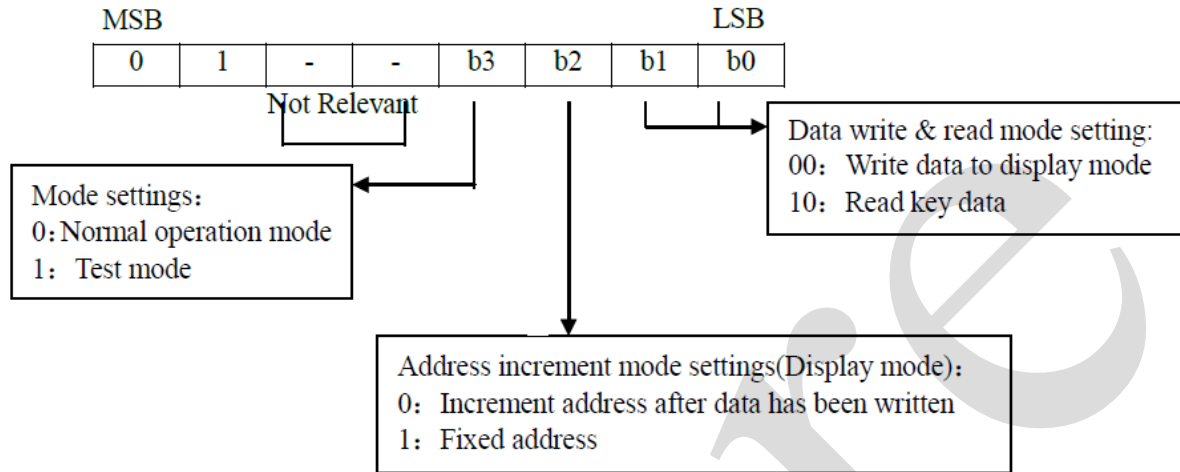
B7	B6	Commands
0	1	Data setting commands
1	0	Display control commands
1	1	Address setting commands



4.3.1、Data Setting Commands

The Data Setting Commands executes the Data Write or Data Read Modes for AiP1638. The data Setting Command, the bits 5 and 6 (b4, b5) are ignored, bit 7 (b6) is given the value of 1 while bit 8 (b7) is given the value of 0. Please refer to the diagram below.

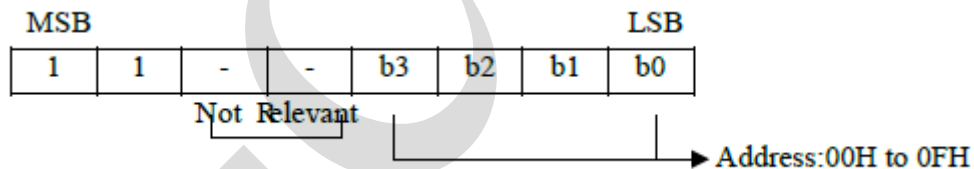
When power is turned on, bit 4 to bit 1 (b3 to b0) are given the value of 0.



4.3.2、Address Setting Commands

Address Setting Commands are used to set the address of the display memory. The address is considered valid if it has a value of 00H to 0DH. If the address is set to 0EH or higher, the data is ignored until a valid address is set. When power is turned ON, the address is set at 00H.

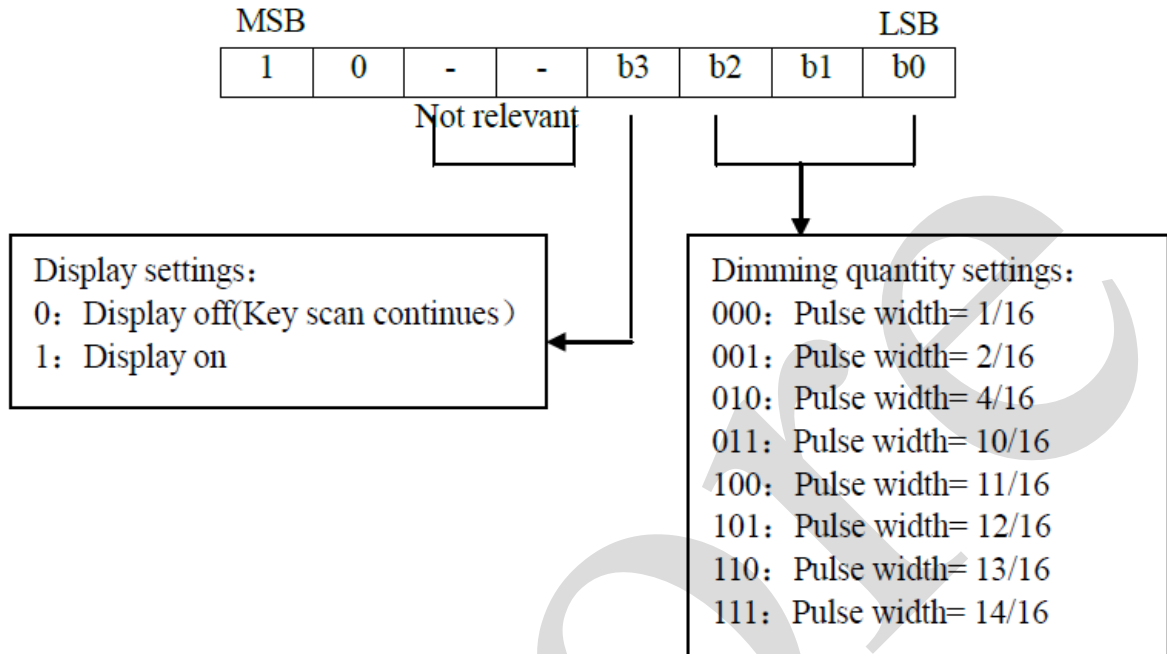
Please refer to the diagram below:





4.3.3、Display Control Commands

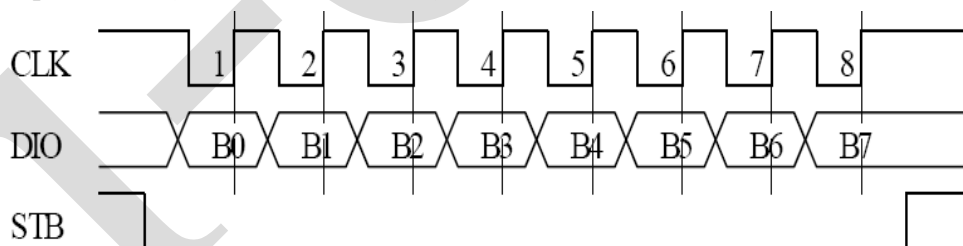
The Display Control Commands are used to turn ON or OFF a display. It also used to set the pulse width. Please refer to the diagram below. When the power is turned ON, a 1/16 pulse width is selected and the displayed is turned OFF (the key scanning is started).



4.4、Serial Communication Format

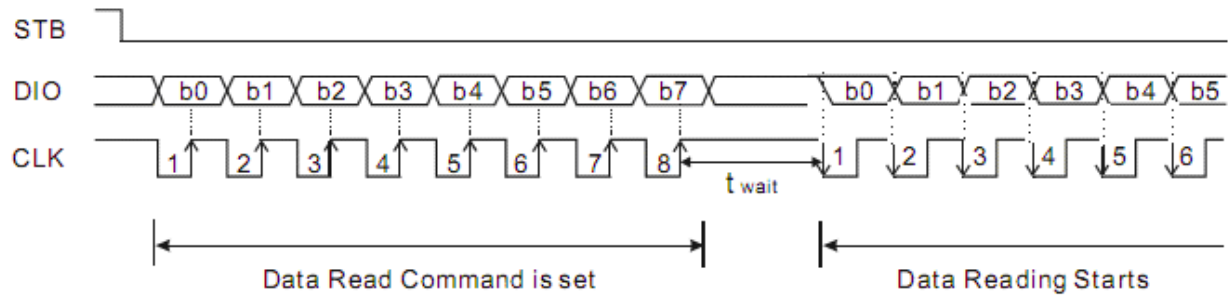
The following diagram shows the AiP1638 serial communication format. The DIO Pin is an N-channel, open-drain output pin, therefore, it is highly recommended that an external pull-up resistor (1kΩ to 10kΩ) must be connected to DIO.

4.4.1、Reception Data (COMMAND WRITE)





4.4.2、Transmission (DATA READ)



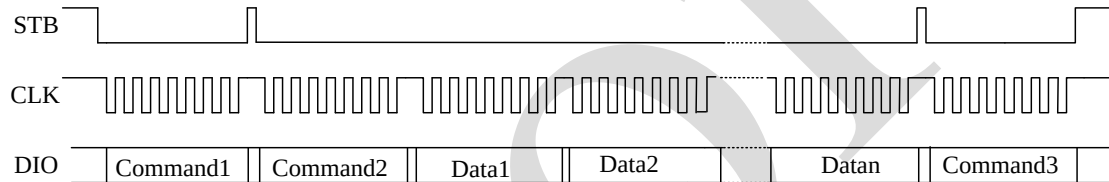
Where: t_{wait} (waiting time) $\geq 1\mu s$

It must be noted that when the data is read, the waiting time (t_{wait}) between the rising of the eighth clock that has set the command and the falling of the first clock that has read the data is greater or equal to $1\mu s$.

4.5、The Serial Data Transfer In The Applications

4.5.1、Address Increasing Mode

Display memory is updated by incrementing addresses. Please refer to the following diagram.



Where:

Command 1: Data setting command.

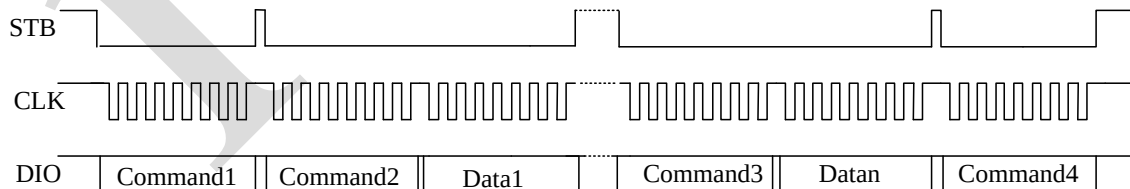
Command 2: Address setting command.

Data 1 to n: Transfer display data (16 bytes max.).

Command 3: Display control command.

4.5.2、Fixing Address

The following diagram shows the waveforms when updating specific addresses.



Where:

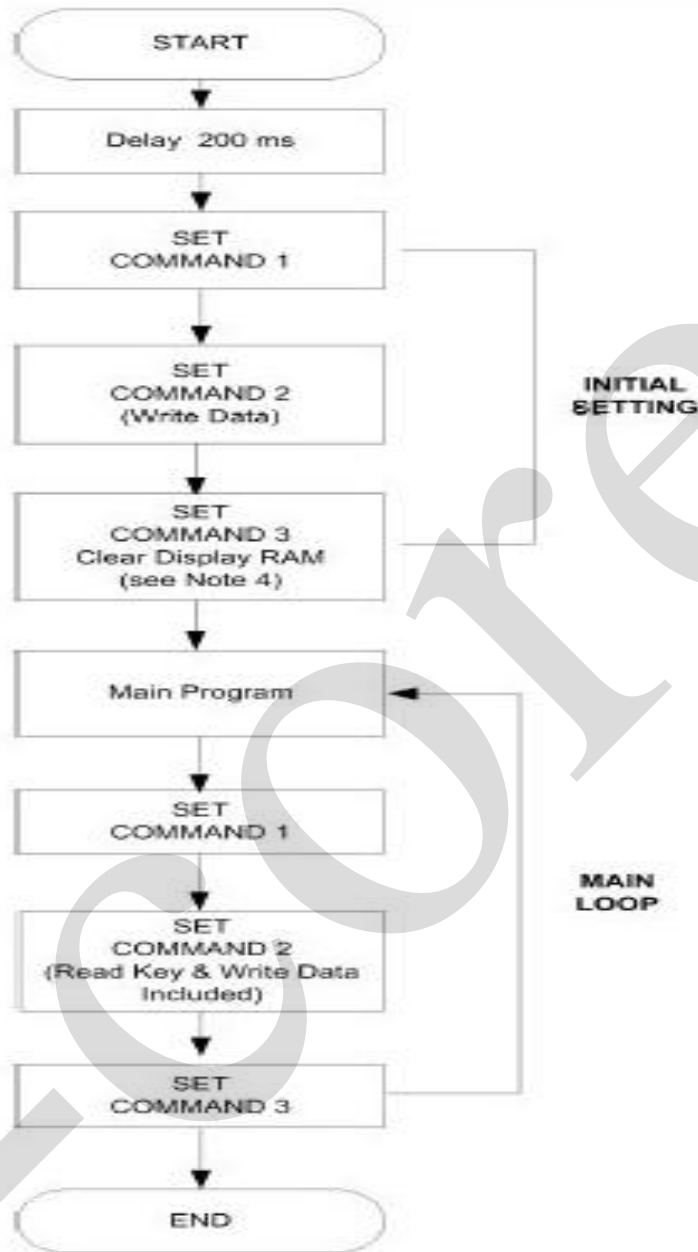
Command 2: Data setting command.

Command 3: Address setting command.

Data: display data.



4.6、Recommended Software Flowchart



Note:

[1] COMMAND1: Data setting commands.

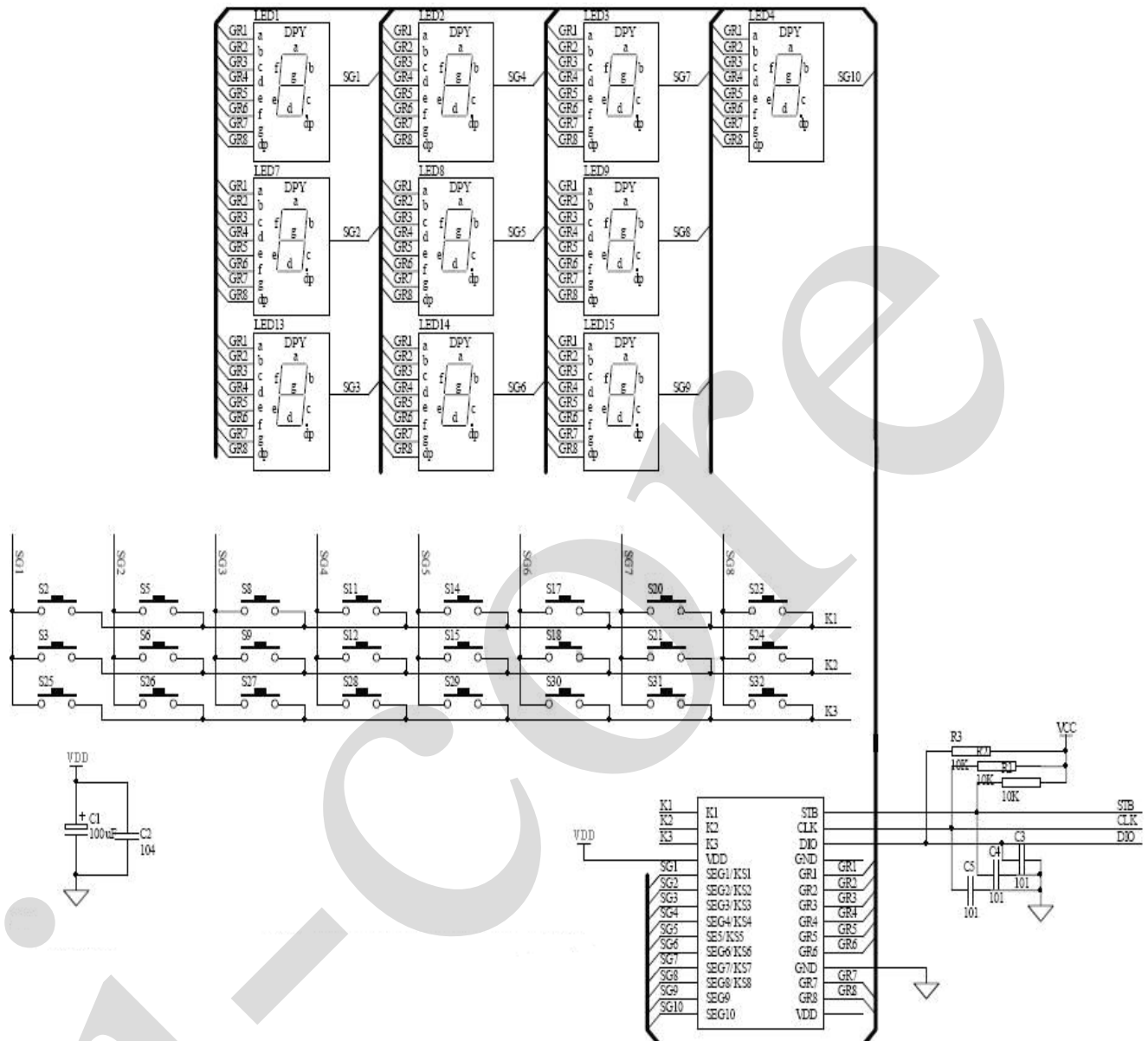
[2] COMMAND2: Address setting commands.

[3] COMMAND3: Display Control commands.

[4] When IC power is applied for the first time, the contents of the Display RAM are not defined; thus, it is strongly suggested that the contents of the Display RAM must be cleared during the initial setting.

5、 Typical Application Circuit And Application Note

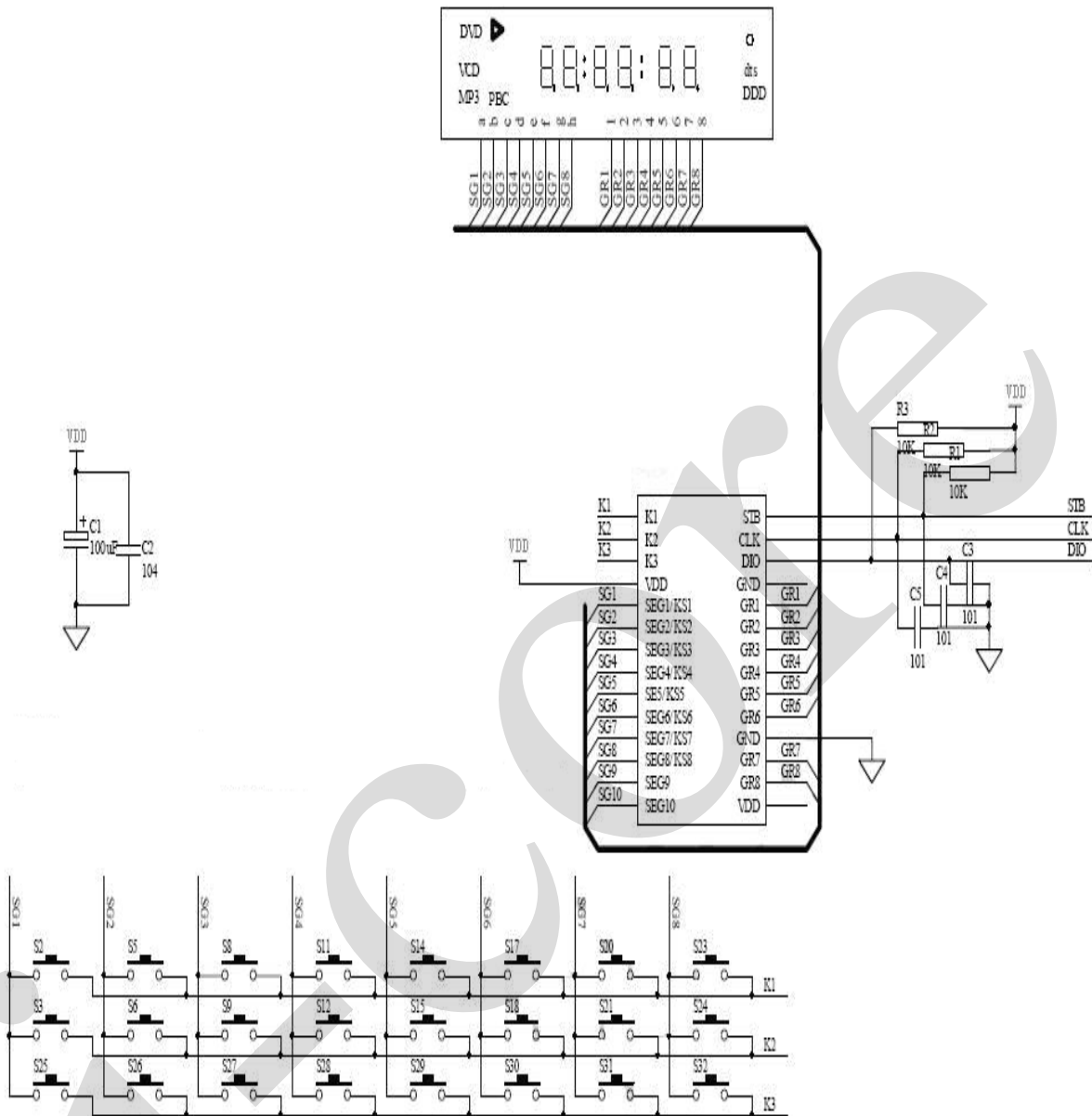
5.1、 Common Cathode Type LED Panel



Note: The external capacitor (0.1uF) that is connected between the GND and the VDD pins must be located as close to the AiP1638 chip as possible.



5.2、Common Anode Type LED Panel

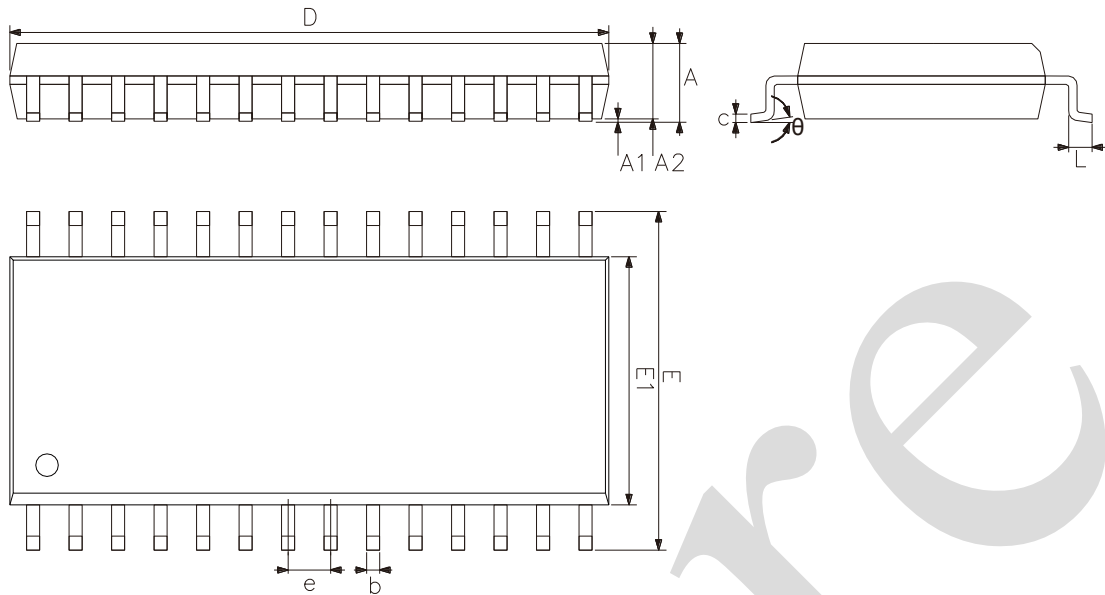


Note: The external capacitor (0.1uF) that is connected between the GND and the VDD pins must be located as close to the AiP1638 chip as possible.



6、Package Information

6.1、SOP28



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	2.15	2.75
A1	0.03	0.30
A2	2.05	2.44
b	0.35	0.51
c	0.20	0.36
D	17.70	18.30
E	10.00	10.65
E1	7.30	7.70
e	1.27	
L	0.40	1.27
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

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

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