



AiP31066L

40 SEG / 16 COM Driver & Controller for Dot Matrix LCD (English-Japanese/ English-Russian/English-European)

Product Specification

Specification Revision History:

Version	Date	Description
2012-03-A1	2012-03	New
2023-06-B1	2023-06	Modify the content
2023-12-B2	2023-12	Modify the content



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1、General Description

AiP31066L is a dot matrix LCD driver & controller LSI which is fabricated by low power CMOS technology.

Features

- Character type dot matrix LCD driver & controller.
- Internal driver:16 common and 40 segment signal output.
- Easy interface with 4-bit or 8-bit MPU.
- Display character pattern:5×8 dots format (192 kinds) & 5×11 dots format (64 kinds).
- The Special character pattern is directly programmable by the Character Generator RAM.
- A customer character pattern is programmable by mask option.
- Programmable Driving Method by the same character font mask option:Display Waveform B-type
- It can drive a maximum at 80 characters by using the AiP31065 or AiP31063 externally.
- Various instruction functions.
- Built-in automatic power on reset.
- Internal Memory
 - Character Generator ROM (CGROM):10,880 bits (192 characters×5×8 dots) & (64 characters×5×11 dots)
 - Character Generator RAM (CGRAM):64×8 bits (8 characters×5×8 dots)or (4 characters×5×11 dots)
 - Display Data RAM (DDRAM):80×8 bits (80 characters max.)
- Low power operation
 - Power supply voltage range (VDD):2.7 to 5.5V
 - LCD driving voltage range (VDD-V5):3.0 to 7.0V
- CMOS process
- Programmable duty cycle:1/8,1/11,1/16
- Character Patterns:

Type of Character Patterns	
AiP31066LC	Character patterns of English & Japanese
AiP31066L-002	Character patterns of English & Russian
AiP31066L-003	Character patterns of English & Europe
AiP31066L-004	Character patterns of English & Persian

- Chip size: 2805×2555 (um×um).
- The IC substrate should be connected to VDD or float in the PCB layout artwork.
- 80 QFP, 80 LQFP or bare chip available (PAD Diagram is described in NO.7)

**Ordering Information:****Tube packing specifications:**

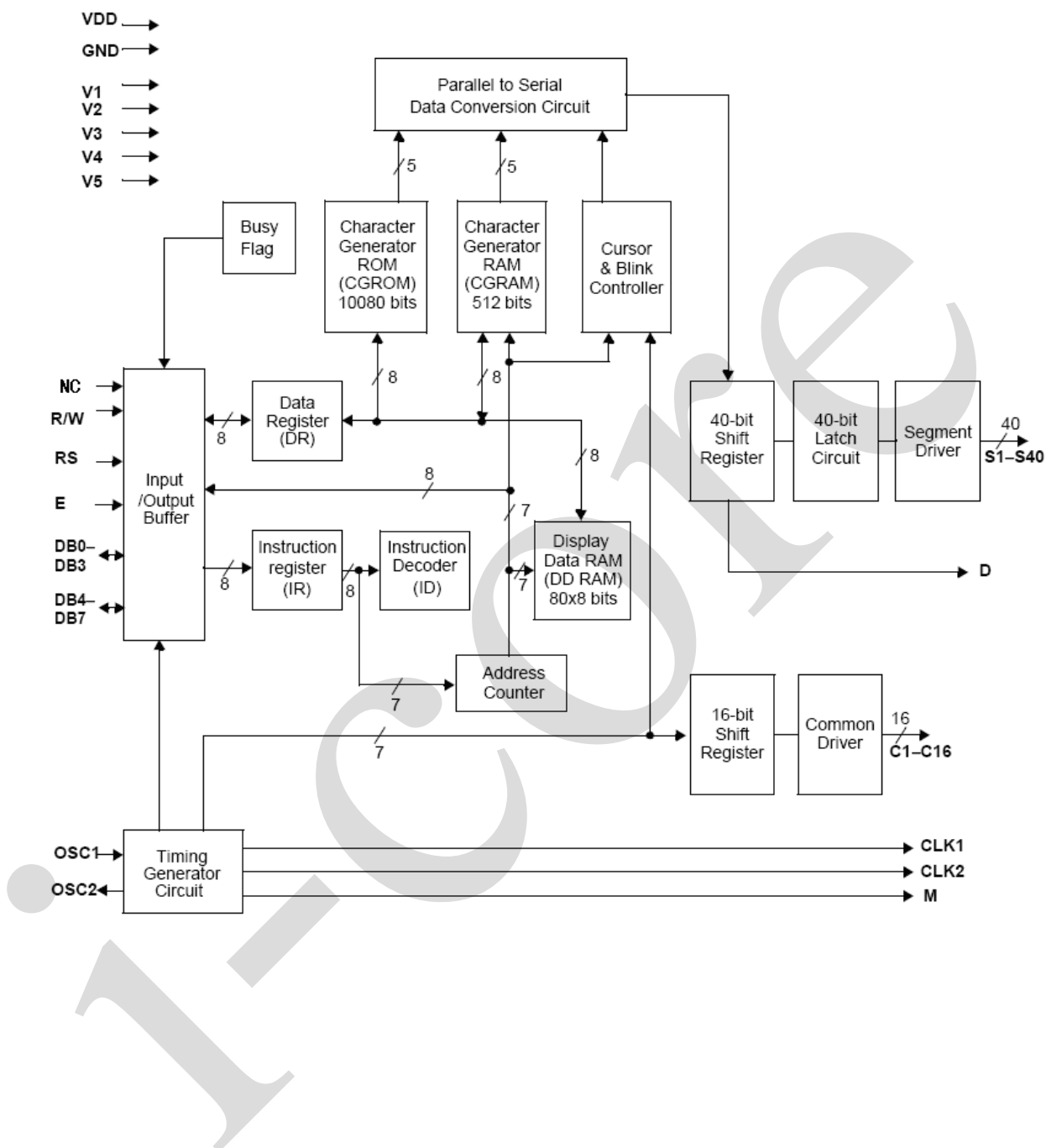
Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP31066LLB80.TB	LQFP80	AiP31066L	160 PCS/plate	10 plate/box	1600 PCS/box	Dimensions of plastic enclosure: 10mm×10mm Pin spacing: 0.4mm

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



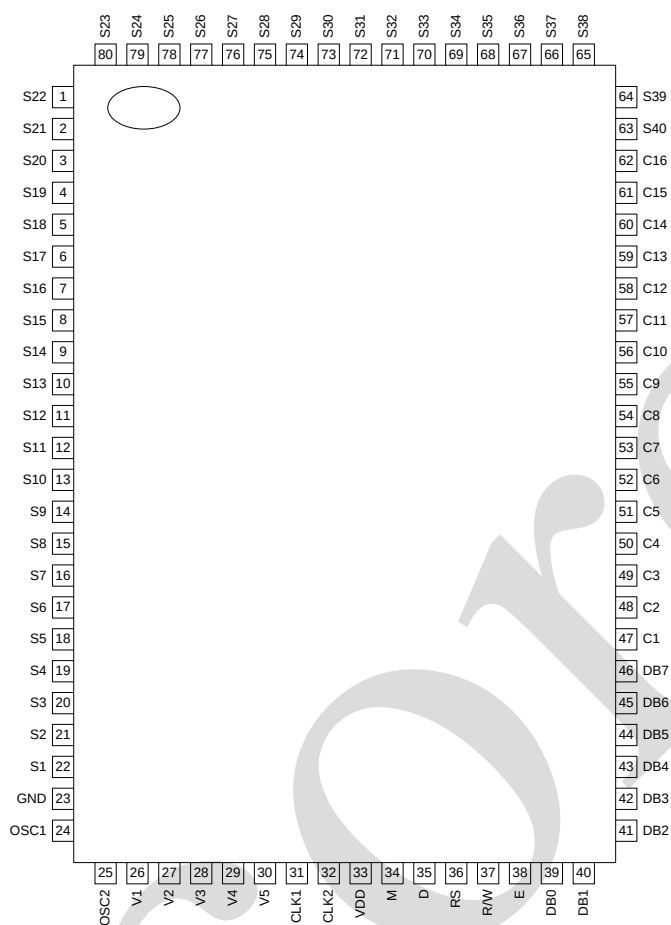
2、Block Diagram And Pin Description

2.1、Block Diagram

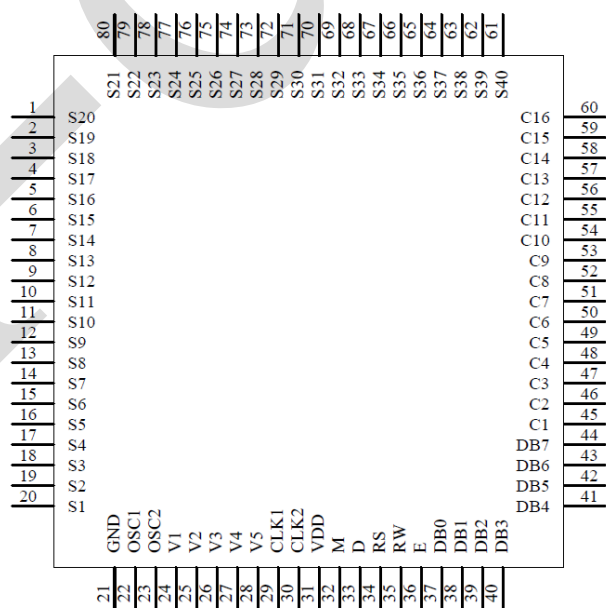




2.2、Pin Configurations



QFP80



LQFP80

**2.3、Pin Description****2.3.1、QFP80**

Pin No.	Pin Name		I/O	Description	Interface
33	VDD	Supply Voltage	P	Supply Voltage for logical circuit (+3V±10%,+5V±10%)	Power Supply
23	GND			Ground (0V)	
26~30	V1~V5			Bias voltage level for LCD driving	
1~22 63~80	S1~S40	Segment output	O	Segment signal output for LCD drive	LCD
47~62	C1~C16	Common output	O	Common signal output for LCD drive	LCD
24	OSC1	Oscillator	I	Oscillator. When using internal oscillator, connect external Rf resistor.	External resistor/oscillator (OSC1)
25	OSC2		O	If external clock is used, connect it to OSC1.	
31	CLK1	Extension driver Latch clock	O	Extension driver latch clock	Extension driver
32	CLK2	Extension driver Shift clock		Extension driver shift clock	
34	M	Alternated signal for LCD driver output		Outputs the alternating signal to convert LCD driver waveform to AC.	
35	D	Display data interface		Outputs extension driver data (the 41st dot's data)	
36	RS	Register select	I	Used as register selection input. When RS="High", Data register is selected. When RS="Low", Instruction register is selected.	MPU
37	R/W	Read/Write	I	Used as read/write selection input. When RW = "High", read operation. When RW = "Low", write operation.	
38	E	Read/Write enable	I	Used as read/write enable signal.	
39~42	DB0~DB3	Data bus 0-7	I/O	In 8-bit bus mode, used as low order bidirectional data bus. In 4-bit bus mode, open these pins.	
43~46	DB4~DB7		I/O	In 8-bit bus mode, used as high order bidirectional data bus. In 4-bit bus mode, used as both high and low order. DB7 used for Busy Flag output.	



2.3.2、LQFP80

Pin No.	Pin Name	I/O	Description	Interface
31	VDD	P	Supply Voltage for logical circuit (+3V±10%, +5V±10%)	Power Supply
21	GND	P	Ground (0V)	
24~28	V1~V5	P	Bias voltage level for LCD driving	
1~20 61~80	S1~S40	O	Segment signal output for LCD drive	LCD
45~60	C1~C16	O	Common signal output for LCD drive	LCD
22	OSC1	I	Oscillator. When using internal oscillator, connect external Rf resistor. If external clock is used, connect it to OSC1.	External resistor/oscillator (OSC1)
23	OSC2	O		
29	CLK1	O	Extension driver latch clock	Extension driver
30	CLK2		Extension driver shift clock	
32	M		Outputs the alternating signal to convert LCD driver waveform to AC.	
33	D		Outputs extension driver data (the 41st dot's data)	
36	E	I	Used as read/write enable signal.	MPU
35	R/W		Used as read/write selection input. When RW = "High", read operation. When RW = "Low", write operation.	
34	RS		Used as register selection input. When RS="High", Data register is selected. When RS="Low", Instruction register is selected.	
37~40	DB0~DB3	I/O	In 8-bit bus mode, used as low order bidirectional data bus. In 4-bit bus mode, open these pins.	
41~44	DB4~DB7	I/O	In 8-bit bus mode, used as high order bidirectional data bus. In 4-bit bus mode, used as both high and low order. DB7 used for Busy Flag output.	



3、Electrical Parameter

3.1、Absolute Maximum Ratings

($T_{amb}=25^{\circ}\text{C}$, All voltage referenced to GND, unless otherwise specified)

Characteristic	Symbol	Value	Unit
Power Supply Voltage(1)	VDD	-0.3~+7.0	V
Power Supply Voltage(2)	V _{LCD}	VDD-12.0~VDD+0.3	V
Input Voltage	V _{IN}	-0.3~VDD+0.3	V
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STG}	-55~+125	°C
Soldering Temperature	T _L	250	°C

Note: Voltage greater than above may damage the circuit. $VDD \geq V1 \geq V2 \geq V3 \geq V4 \geq V5$

3.2、Electrical Characteristics

3.2.1、DC Characteristics 1

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

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage	VDD	-	4.5	-	5.5	V
Supply Current	I _{DD}	Internal oscillation or external clock. (VDD=5.0V, f _{OSC} =250kHz)	-	0.55	0.8	mA
Input Voltage (1) (except OSC1)	V _{IH1}	-	2.5	-	VDD	V
	V _{IL1}	-	-0.3	-	0.6	
Input Voltage (2) (OSC1)	V _{IH2}	-	VDD-1.0	-	VDD	V
	V _{IL2}	-	-0.2	-	1.0	
Output Voltage (1) (DB0 to DB7)	V _{OH1}	I _{OH} =-0.205mA	2.4	-	-	V
	V _{OL1}	I _{OL} =1.2mA	-	-	0.4	
Output Voltage (2) (except DB0 to DB7)	V _{OH2}	I _O =-40mA	0.9VDD	-	-	V
	V _{OL2}	I _O =40mA	-	-	0.1VDD	
Input Leakage Current	I _{IKG}	V _{IN} = 0V to VDD	-1	-	1	uA
Input Low Current	I _{IL}	V _{IN} =0V, VDD=5V(PULL UP)	-50	-125	-250	
Internal Clock (external R _f)	f _{OSC1}	R _f =91kΩ±2%(VDD=5V)	190	270	350	kHz
External Clock	f _{OSC}	-	125	270	410	kHz
	duty		45	50	55	%
	t _R , t _F		-	-	0.2	ms
COM ON resistance	R _{COM}	I _O =±50uA, V _{LCD} =4.0V COM1-COM16	-	-	20	kΩ
SEG ON resistance	R _{SEG}	I _O = ±50uA, V _{LCD} =4.0V SEG1-SEG40	-	-	30	
LCD Driving Voltage	V _{LCD}	VDD-V5(1/5, 1/4 Bias)	3.0	-	7.0	V



3.2.2、DC Characteristics 2

(VDD=2.7V~4.5V, T_{amb}=-40~+85°C)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage	VDD	-	2.7	-	4.5	V
Supply Current	I _{DD}	Internal oscillation or external clock. (VDD=3.0V, f _{OSC} =250kHz)	-	0.2	0.4	mA
Input Voltage (1) (except OSC1)	V _{IH1}	-	0.7VDD	-	VDD	V
	V _{IL1}	-	-0.3	-	0.55	
Input Voltage (2) (OSC1)	V _{IH2}	-	0.7VDD	-	VDD	V
	V _{IL2}	-	-	-	0.2VDD	
Output Voltage (1) (DB0 to DB7)	V _{OH1}	I _{OH} =-0.1mA	0.75VDD	-	-	V
	V _{OL1}	I _{OL} =0.1mA	-	-	0.2VDD	
Output Voltage (2) (except DB0 to DB7)	V _{OH2}	I _O =-40mA	0.8VDD	-	-	V
	V _{OL2}	I _O =40mA	-	-	0.2VDD	
Input Leakage Current	I _{IKG}	V _{IN} =0V to VDD	-1	-	1	uA
Input Low Current	I _{IL}	V _{IN} =0V, VDD=3V(PULL UP)	-10	-50	-120	
Internal Clock (external R _f)	f _{OSC1}	R _f =75kΩ±2%(VDD=3V)	190	270	350	kHz
External Clock	f _{OSC2}	-	125	270	410	kHz
	duty		45	50	55	%
	t _R , t _F		-	-	0.2	ms
COM ON resistance	R _{COM}	I _O =±50uA, V _{LCD} =4.0V COM1-COM16	-	-	20	kΩ
SEG ON resistance	R _{SEG}	I _O =±50uA, V _{LCD} =4.0V SEG1-SEG40	-	-	30	
LCD Driving Voltage	V _{LCD}	VDD-V5 (1/5, 1/4 Bias)	3.0	-	7.0	V

LCD Driving Voltage

Power	Duty	1/8, 1/11 Duty	1/16 Duty
	Bias	1/4 Bias	1/5 Bias
VDD		VDD	VDD
V1		VDD-V _{LCD} /4	VDD-V _{LCD} /5
V2		VDD-V _{LCD} /2	VDD-2V _{LCD} /5
V3		VDD-V _{LCD} /2	VDD-3V _{LCD} /5
V4		VDD-3V _{LCD} /4	VDD-4V _{LCD} /5
V5		VDD-V _{LCD}	VDD-V _{LCD}



3.2.3、AC Characteristics 1

(VDD=4.5V~5.5V, T_{amb}=-40~+85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Figure 1)	E Cycle Time	t _c	500	-	-	ns
	E Rise/Fall Time	t _R ,t _F	-	-	20	
	E Pulse Width (High,Low)	t _w	230	-	-	
	R/W and RS Setup Time	t _{su1}	40	-	-	
	R/W and RS Hold Time	t _{H1}	10	-	-	
	Data Setup Time	t _{su2}	80	-	-	
	Data Hold Time	t _{H2}	10	-	-	
Read Mode (Refer to Figure 2)	E Cycle Time	t _c	500	-	-	ns
	E Rise/Fall Time	t _R ,t _F	-	-	20	
	E Pulse Width (High, Low)	t _w	230	-	-	
	R/W and RS Setup Time	t _{su}	40	-	-	
	R/W and RS Hold Time	t _H	10	-	-	
	Data Output Delay Time	t _D	-	-	120	
	Data Hold Time	t _{DH}	5	-	-	

3.2.4、AC Characteristics 2

(VDD=2.7V~4.5V, T_{amb}=-40~+85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode (Refer to Figure 1)	E Cycle Time	t _{CWH}	1000	-	-	ns
	E Rise/Fall Time	t _R ,t _F	-	-	25	
	E Pulse Width (High,Low)	t _w	450	-	-	
	R/W and RS Setup Time	t _{su1}	60	-	-	
	R/W and RS Hold Time	t _{H1}	20	-	-	
	Data Setup Time	t _{su2}	195	-	-	
	Data Hold Time	t _{H2}	10	-	-	
Read Mode (Refer to Figure 2)	E Cycle Time	t _c	1000	-	-	ns
	E Rise/Fall Time	t _R ,t _F	-	-	25	
	E Pulse Width (High,Low)	t _w	450	-	-	
	R/W and RS Setup Time	t _{su}	60	-	-	
	R/W and RS Hold Time	t _H	20	-	-	
	Data Output Delay Time	t _D	-	-	360	
	Data Hold Time	t _{DH}	5	-	-	



3.2.5、AC Characteristics 3

(VDD=2.7V~4.5V, T_{amb}=-40~+85°C)

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Interface Mode with Extension Driver (Refer to Figure 3)	Clock Pulse Width (High, Low)	t _c	800	-	-	ns
	Clock Rise/Fall Time	t _R , t _F	-	-	25	
	Clock Setup Time	T ₌	500	-	-	
	Data Setup Time	t _{su2}	300	-	-	
	Data Hold Time	t _{DH}	300	-	-	
	M Delay Time	t _{DM}	-1000	-	1000	

4、Testing Circuit

4.1、AC Testing Circuit

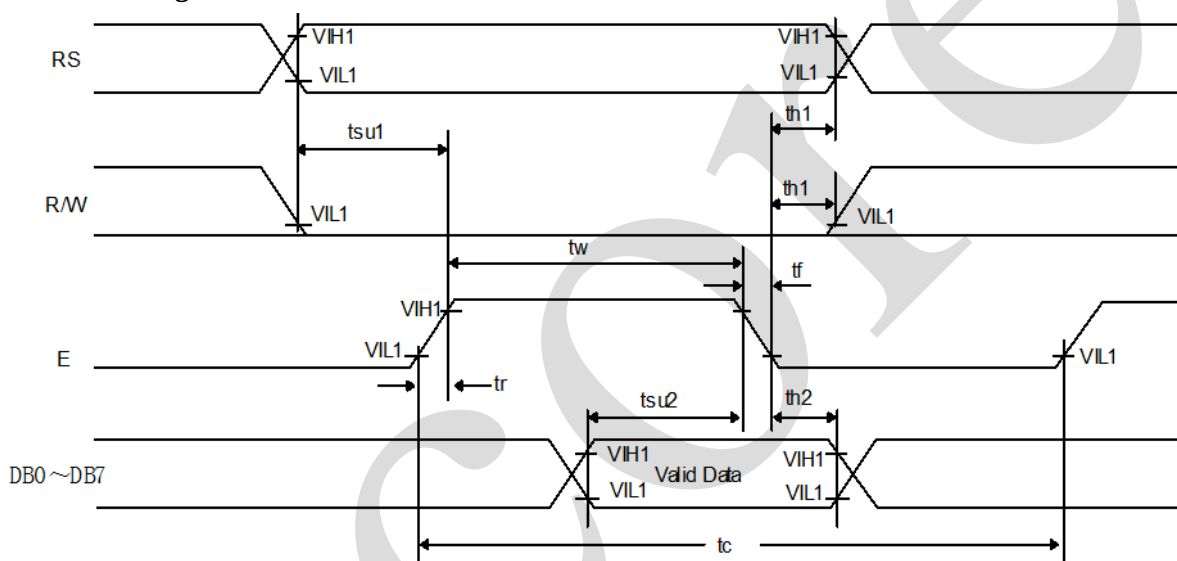


Figure 1. Write Mode Timing Diagram

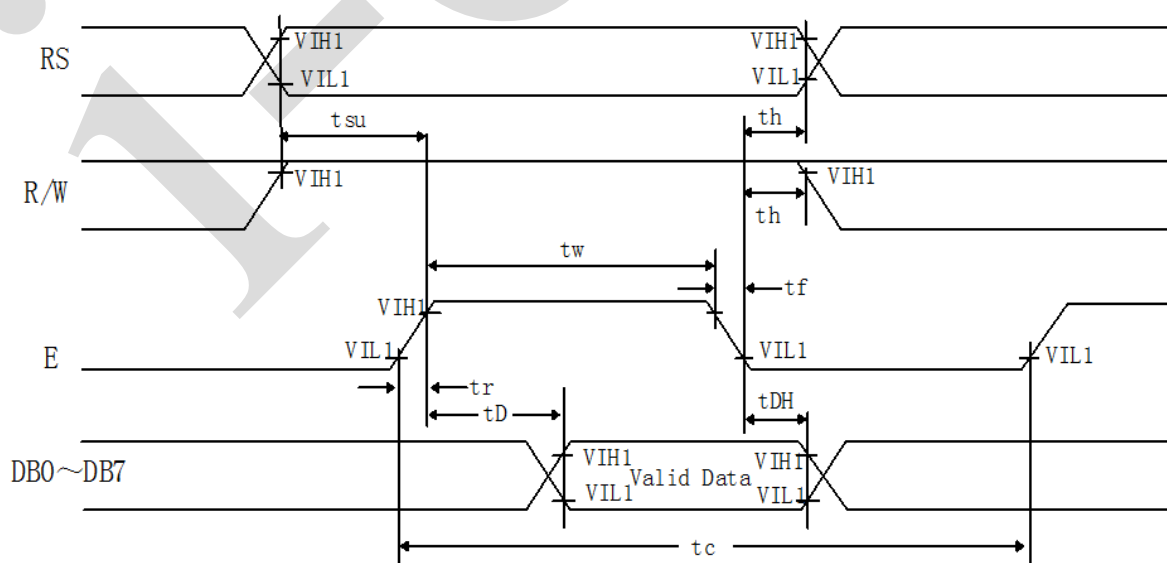


Figure 2 . Read Mode Timing Diagram

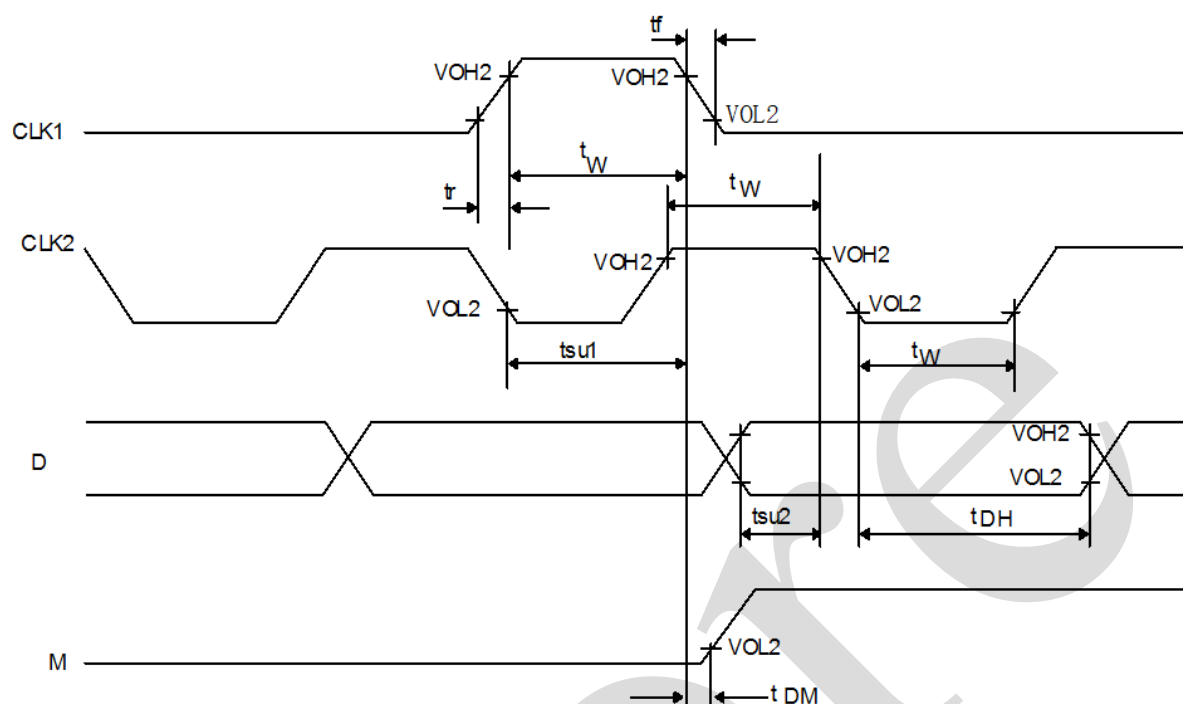


Figure 3 . Interface Mode With Extension Driver Timing Diagram

5、Function Description

5.1、System Interface

This chip has both kinds of interface type with MPU: 4-bit bus and 8-bit bus.

4-bit bus and 8-bit bus are selected by the DL bit in the instruction register. During read or write operation, two 8-bit registers are used. One is the data register (DR), and the other is the instruction register (IR).

The data register (DR) is used as a temporary data storage place for being written into or read from DDRAM/CGRAM. The target RAM is selected by RAM address setting instruction. Each internal operation, reading from or writing into RAM, is done automatically. Thus, after MPU reads DR data, the data in the next DDRAM/CGRAM address is transferred into DR automatically. Also, after MPU writes data to DR, the data in DR is transferred into DDRAM/CGRAM automatically.

The Instruction register (IR) is used only to store instruction codes transferred from MPU. MPU cannot use it to read instruction data. To select a register, you can use RS input pin in 4-bit/8-bit bus mode.

Various kinds of Operations according to RS and R/W bits:

RS	R/W	Operation
L	L	Instruction Write operation (MPU writes Instruction code into IR)
L	H	Read Busy flag(DB7) and address counter (DB0 to DB6)
H	L	Data Write operation (MPU writes data into DR)
H	H	Data Read operation (MPU reads data from DR)



● Busy Flag (BF)

BF="High", indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted. BF can be read through DB7 port when RS="Low" and R/W="High" (Read Instruction Operation). Before executing the next instruction, be sure that BF is not "High".

● Address Counter (AC)

The address Counter (AC) stores DDRAM/CGRAM addresses, transferred from IR. After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1. When RS="Low" and R/W="High", AC can be read through ports DB0 to DB6.

● Display Data RAM (DDRAM)

DDRAM stores display data of maximum 80×8 bits (80 characters). DDRAM address is set in the address counter (AC) as a hexadecimal number (Refer to Fig-4.)

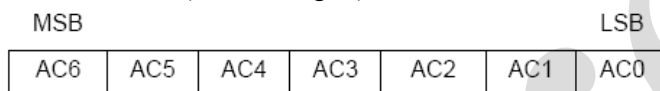


Figure 4 . DDRAM Address

1) 1-line display

In case of 1-line display, the address range of DDRAM is 00H-4FH.

An extension driver will be used. Fig-5 shows the example with 40 segment extension driver added.

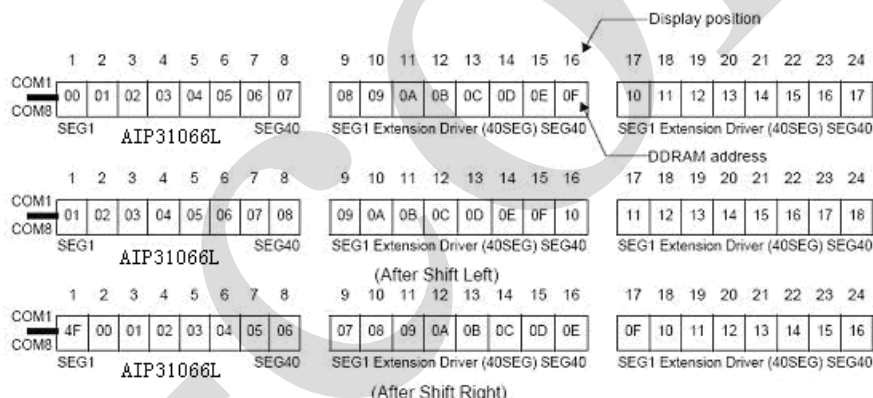


Figure 5 . 1-line × 24 char. display with 40 SEG. extension driver



2) 2-line display

In case of 2-line display, the address range of DDRAM is 00H-27H and 40H-67H.

An extension driver will be used. Fig-6 shows the example with 40 segment extension driver added.

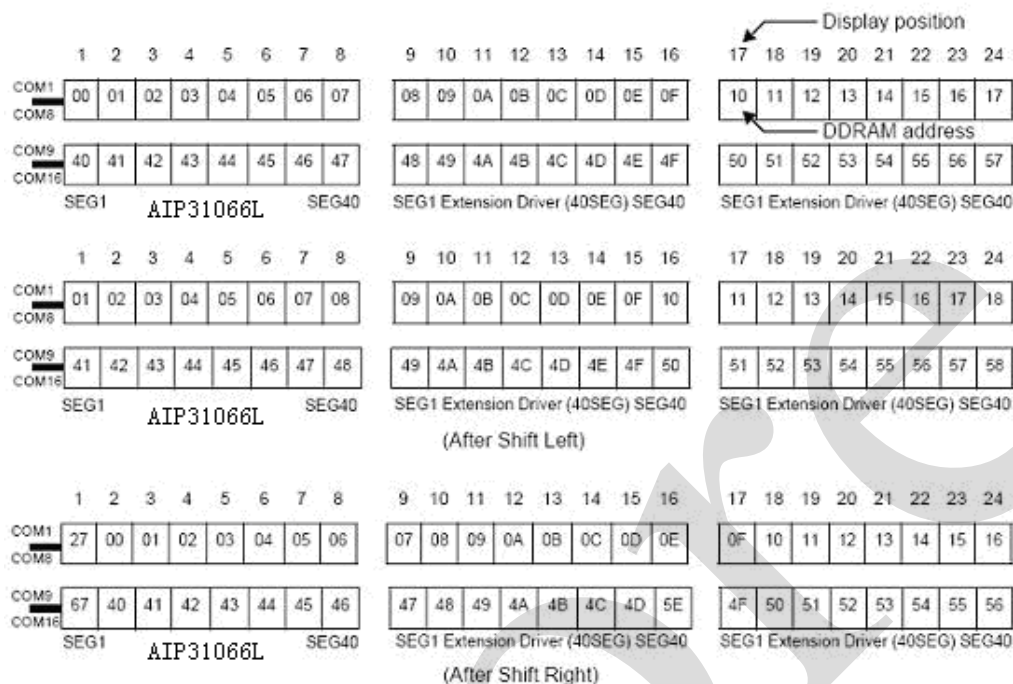


Figure 6 . 2-line×24 char. display with 40 SEG. extension driver

- **CGROM(Character Generator ROM)**

CGROM has a 5×8 dots 192 characters pattern and a 5×11 dots 64 characters pattern.

CGROM has 192 character patterns of 5×8 dots, and 64 character patterns of 5×11 dots.

- **CGRAM(Character Generator RAM)**

CGRAM has up to 5×8 dots 8 characters or 5×11 dots 4 characters. By writing font data to CGRAM, user defined characters can be used (Refer to Table 1)

- **Timing Generation Circuit**

Timing generation circuit generates clock signals for the internal operations.

- **LCD Driver Circuit**

LCD Driver circuit has 16 common and 40 segment signals for LCD driving. Data from CGRAM/CGROM is transferred to a 40-bit segment latch serially, and then is stored to 40-bit shift latch. When each common is selected by 16-bit common register, segment data is also output through segment driver from a 40-bit segment latch. In case of 1-line display mode, COM1 to COM8 have 1/8 duty or COM1 to COM11 have 1/11 duty, and in 2-line mode, COM1 to COM16 have a 1/16 duty ratio.

- **Cursor/Blink Control Circuit**

It controls the cursor/blink ON/OFF at cursor position.

**Table 1. Relationship between Character Code (DDRAM) and Character Pattern (CGRAM)**

Character Code (DDRAM data)								CGRAM address						CGRAM Data										Pattern number
D7	D6	D5	D4	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0			
0	0	0	0	×	0	0	0	0	0	0	0	0	0	×	×	×	0	1	1	1	0	pattern1		
											0	0	1				0	0						
											0	1	0				0	0						
											0	1	1				0	0						
											1	0	0				0	0						
											1	0	1				0	0						
											1	1	0				0	0						
											1	1	1				0	0						
0	0	0	0	×	0	0	1	0	0	1	0	0	0	×	×	×	0	1	1	1	0	pattern2		
											0	0	1				1	0	1					
											0	1	0				1	0	0					
											0	1	1				1	0	0					
											1	0	0				1	0	0					
											1	0	1				1	0	0					
											1	1	0				0	1	0					
											1	1	1				0	0	0					
* * * *								* * * *						* * * *										
0	0	0	0	×	1	1	1	1	1	1	0	0	0	×	×	×	1	1	1	1	1	pattern8		
											0	0	1				1	0	0					
											0	1	0				1	0	0					
											0	1	1				1	1	0					
											1	0	0				1	0	0					
											1	0	1				1	0	1					
											1	1	0				1	1	0					
											1	1	1				0	0	0					

Character Code (DDRAM data)									CGRAM address							CGRAM Data										Pattern number
D7	D6	D5	D4	D3	D2	D1	D0		A5	A4	A3	A2	A1	A0		P7	P6	P5	P4	P3	P2	P1	P0			
0	0	0	0	×	0	0	×		0	0	0	0	0	0		×	×	×	0	0	1	0	0	pattern1		
								0			0	0	1	0	0				1	0	0					
								0			0	1	0	1	1				1	1	1					
								0			0	1	1	1	0				1	0	1					
								0			1	0	0	1	0				1	0	1					
								0			1	0	1	1	1				1	1	1					
								0			1	1	0	0	0				1	0	0					
								0			1	1	1	0	0				1	0	0					



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VER: 2023-12-B2



5.2、Instruction Description

To overcome the speed difference between the internal clock of AiP31066L and the MPU clock, AiP31066L performs internal operations by storing control information to IR or DR. The internal operation is determined according to the signal from MPU, composed of read/write and data bus (Refer to Table 3).

Instructions can be divided largely into four groups:

- 1) AiP31066L function set instructions (set display methods, set data length, etc.)
- 2) address set instructions to internal RAM
- 3) data transfer instructions with internal RAM
- 4) others

The address of the internal RAM is automatically increased or decreased by 1.

Note: During internal operation, Busy Flag (DB7) is read “High”.

Busy Flag check must be preceded by the next instruction.

When an MPU program with checking the Busy Flag (DB7) is made, it must be necessary 1/2 fosc for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to “Low”.

1) Clear Display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing “20H” (space code) to all DDRAM address, and set DDRAM address to “00H” into AC (address counter). Return cursor to the original status, namely, bring the cursor to the left edge on the first line of the display. Make the entry mode increment (I/D=“High”).

2) Return Home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

*“-”: don't care

Return Home is cursor return home instruction. Set DDRAM address to “00H” into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

3) Entry Mode Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D: Increment / decrement of DDRAM address (cursor or blink)

When I/D=“High”, cursor/blink moves to right and DDRAM address is increased by 1.

When I/D=“Low”, cursor/blink moves to left and DDRAM address is decreased by 1.

* CGRAM operates the same way as DDRAM, when reading from or writing to CGRAM.

SH: Shift of entire display

When DDRAM read (CGRAM read/write) operation or SH=“Low”, shifting of entire display is not



performed. If SH="High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D="High":shift left, I/D = "Low":shift right).

4) Display ON/OFF Control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D: Display ON/OFF control bit

When D="High", entire display is turned on.

When D="Low", display is turned off, but display data remains in DDRAM.

C: Cursor ON/OFF control bit

When C="High", cursor is turned on.

When C="Low", cursor is disappeared in current display, but I/D register preserves its data.

B: Cursor Blink ON/OFF control bit

When B="High", cursor blink is on, which performs alternately between all the "High" data and display characters at the cursor position.

When B="Low", blink is off.

5) Cursor or Display Shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

Shifting of right/left cursor position or display without writing or reading of display data. This instruction is used to correct or search display data.(Refer to Table 2) During 2-line mode display, cursor moves to the 2nd line after the 40th digit of the 1st line.

Note that display shift is performed simultaneously in all the lines. When displayed data is shifted repeatedly, each line is shifted individually. When display shift is performed, the contents of the address counter are not changed.

Table 2. Shift Patterns According to S/C and R/L Bits

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC is increased by 1
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6) Function Set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	-	-

DL:Interface data length control bit

When DL="High",it means 8-bit bus mode with MPU.

When DL="Low",it means 4-bit bus mode with MPU. Hence, DL is a signal to select 8-bit or 4-bit bus mode.



When 4-bit bus mode, it needs to transfer 4-bit data twice.

N: Display line number control bit

When N="Low", 1-line display mode is set.

When N="High", 2-line display mode is set.

F: Display font type control bit

When F="Low", 5×8 dots format display mode is set.

When F="High", 5×11 dots format display mode.

7) Set CGRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC. This instruction makes CGRAM data available from MPU.

8) Set DDRAM Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC. This instruction makes DDRAM data available from MPU.

When 1-line display mode (N=Low), DDRAM address is from "00H" to "4FH". In 2-line display mode (N=High), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9) Read Busy Flag & Address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether AiP31066L is in internal operation or not.

If the resultant BF is "High", internal operation is in progress and should wait until BF is to be Low, which by then the next instruction can be performed. In this instruction you can also read the value of the address counter.

10) Write data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM. The selection of RAM from DDRAM, and CGRAM, is set by the previous address set instruction (DRAM address set, CGRAM address set). RAM set instruction can also determine the AC direction to RAM. After write operation, the address is automatically increased/decreased by 1, according to the entry mode.



11) Read data from RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM. The selection of RAM is set by the previous address set instruction. If the address set instruction of RAM is not performed before this instruction, the data that has been read first is invalid, as the direction of AC is not Yet determined. If RAM data is read several times without RAM address instructions set before read operation, the correct RAM data can be obtained from the second. But the first data would be incorrect, as there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction, it also transfers RAM data to output data register.

After read operation, address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

NOTE: In case of RAM write operation, AC is increased/decreased by 1 as in read operation.

At this time, AC indicates the next address position, but only the previous data can be read by the read instruction.



Table 3. Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc= 270 kHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.53 ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	39 μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μs
Function Set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F:5×11dots/5×8 dots)	39 μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μs

* --: dont care

Note: When an MPU program with checking the Busy Flag(DB7) is made, it must be necessary $1/2f_{osc}$ is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag (DB7) goes to "Low".



5.3、Interface With MPU

1) Interface with 8-bit MPU

When interfacing data length are 8-bit, transfer is performed at a time through 8 ports, from DB0 to DB7. Example of timing sequence is shown below.

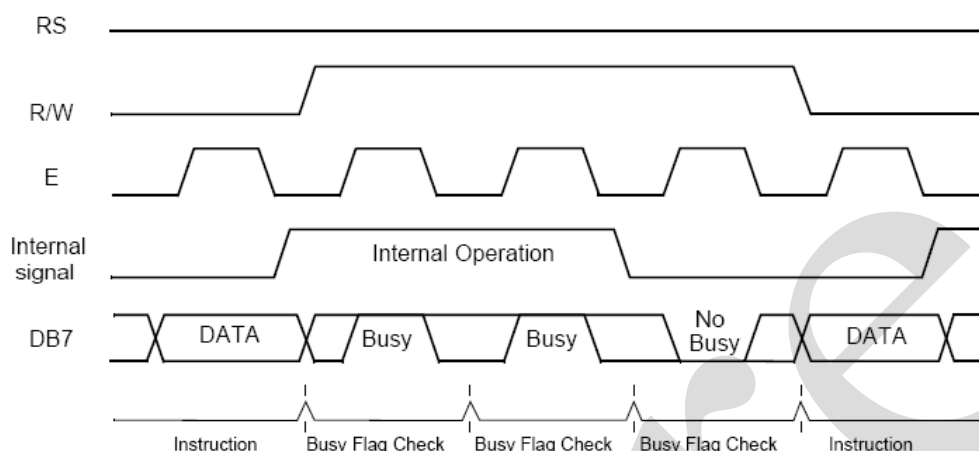


Figure 7 . Example of 8-bit Bus Mode Timing Diagram

2) Interface with 4-bit MPU

When interfacing data length are 4-bit, only 4 ports, from DB4 to DB7, are used as data bus.

At First, the higher 4-bit (in case of 8-bit bus mode, the contents of DB4-DB7), and then the lower 4-bit (in case of 8-bit bus mode, the contents of DB0-DB3) are transferred. So transfer is performed twice. Busy Flag outputs “High” after the second transfer is ended.

Example of timing sequence is shown below.

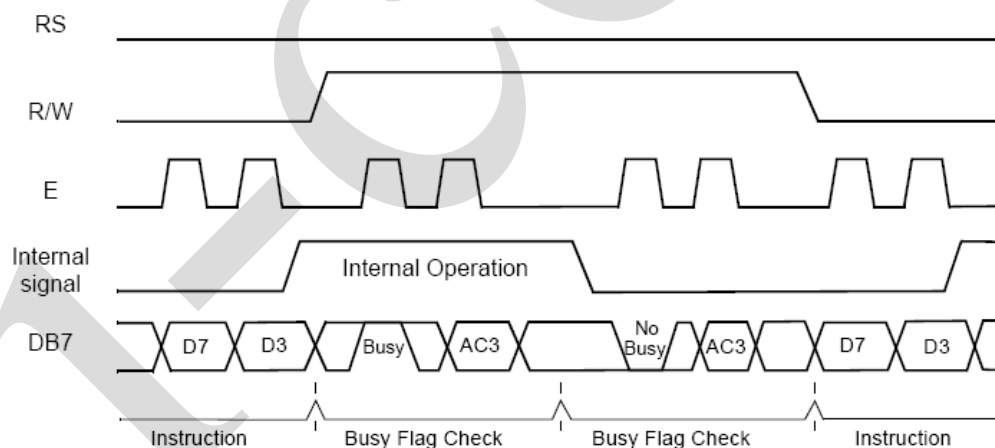


Figure 8 . Example of 4-bit Bus Mode Timing Diagram

5.4、Initializing

When the power is turned on, AiP31066L is initialized automatically by power on reset circuit.

During the initialization, the following instructions are executed, and BF (Busy Flag) is kept “High” (busy state) to the end of initialization.

(1) Display Clear instruction: Write “20H” to all DDRAM

(2) Set Functions instruction:



DL="High":8-bit bus mode

N="Low":1-line display mode

F="Low":5×8 font type

(3) Control Display ON/OFF instruction:

D="Low":Display OFF

C="Low":Cursor OFF

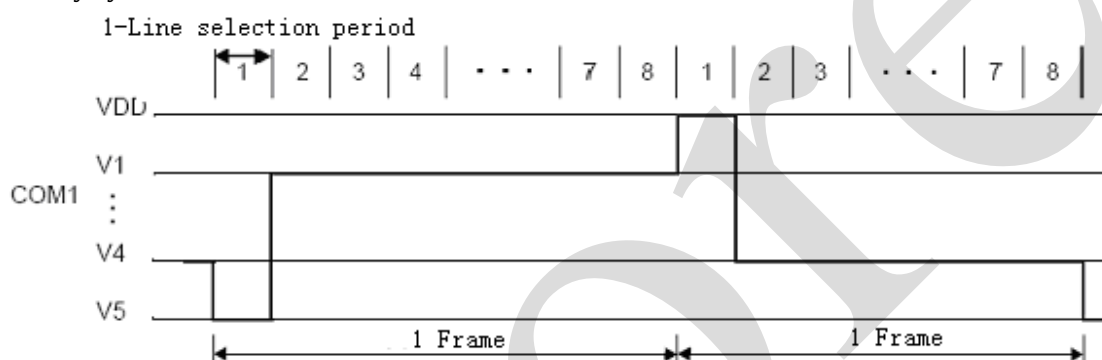
B="Low":Blink OFF

(4) Set Entry Mode instruction: I/D="High":Increment by 1

SH="Low":No entire display shift

5.5、Frame Frequency

1) 1/8 duty cycle

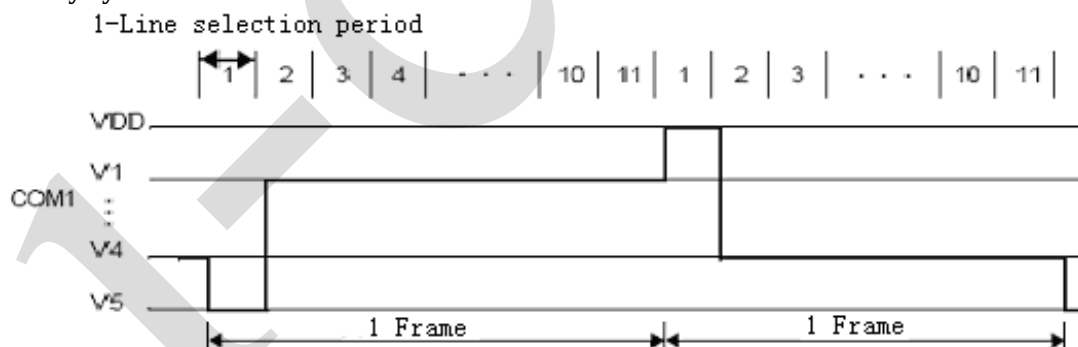


1-Line selection period = 400 clocks

1 Frame=400×8×3.7us=11850us=11.9ms (1 clock=3.7us, fosc=270kHz)

Frame frequency=1/11.9ms=84.4Hz

2) 1/11 duty cycle



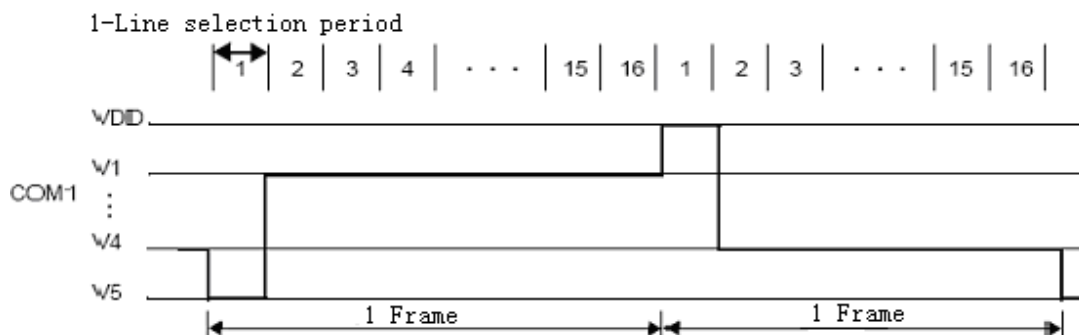
1-Line selection period = 400 clocks

1 Frame=400×11×3.7us=16300us=16.3ms (1 clock=3.7us, fosc=270kHz)

Frame frequency=1/16.3ms=61.4Hz



3) 1/16 duty cycle



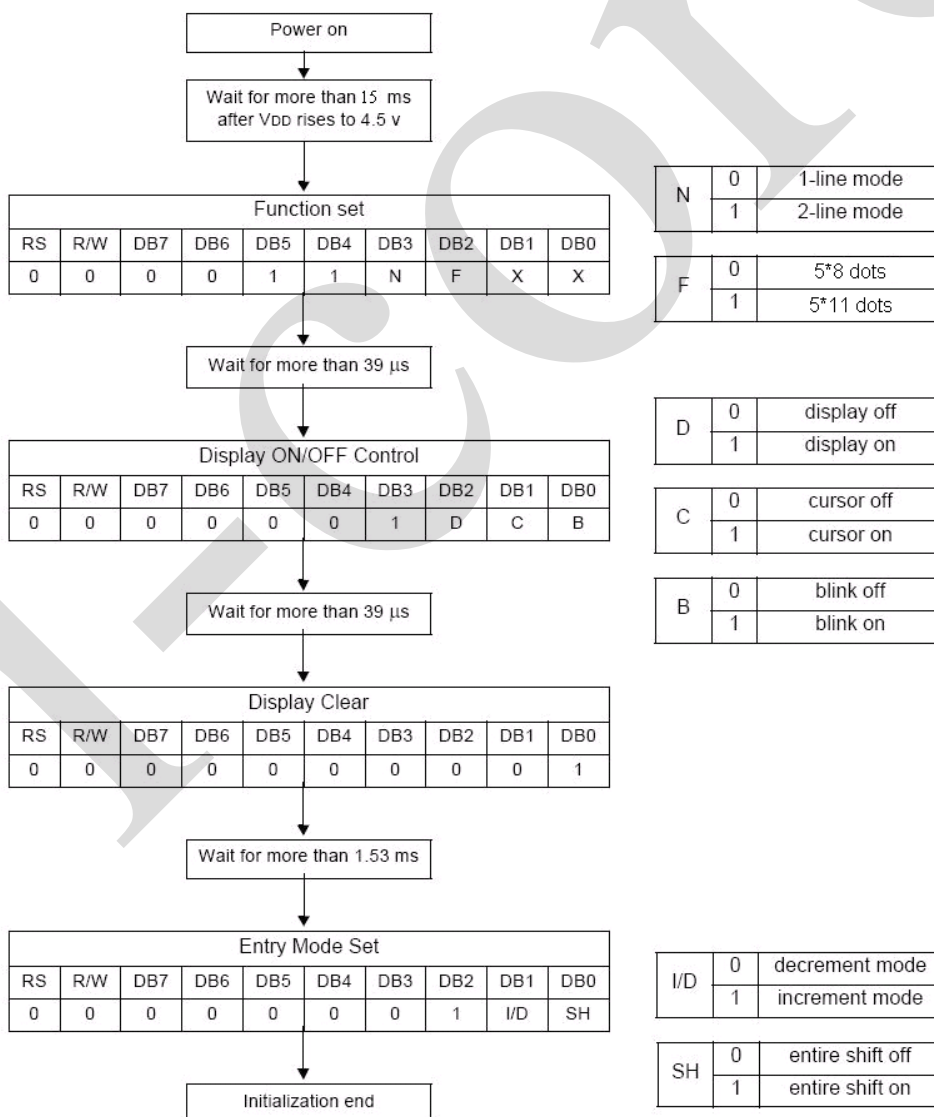
1-Line selection period = 200 clocks

1 Frame = $200 \times 16 \times 3.7 \mu s = 11850 \mu s = 11.9 \text{ ms}$ (1 clock = $3.7 \mu s$, $f_{\text{OSC}} = 270 \text{ kHz}$)

Frame frequency = $1/11.9 \text{ ms} = 84.3 \text{ Hz}$

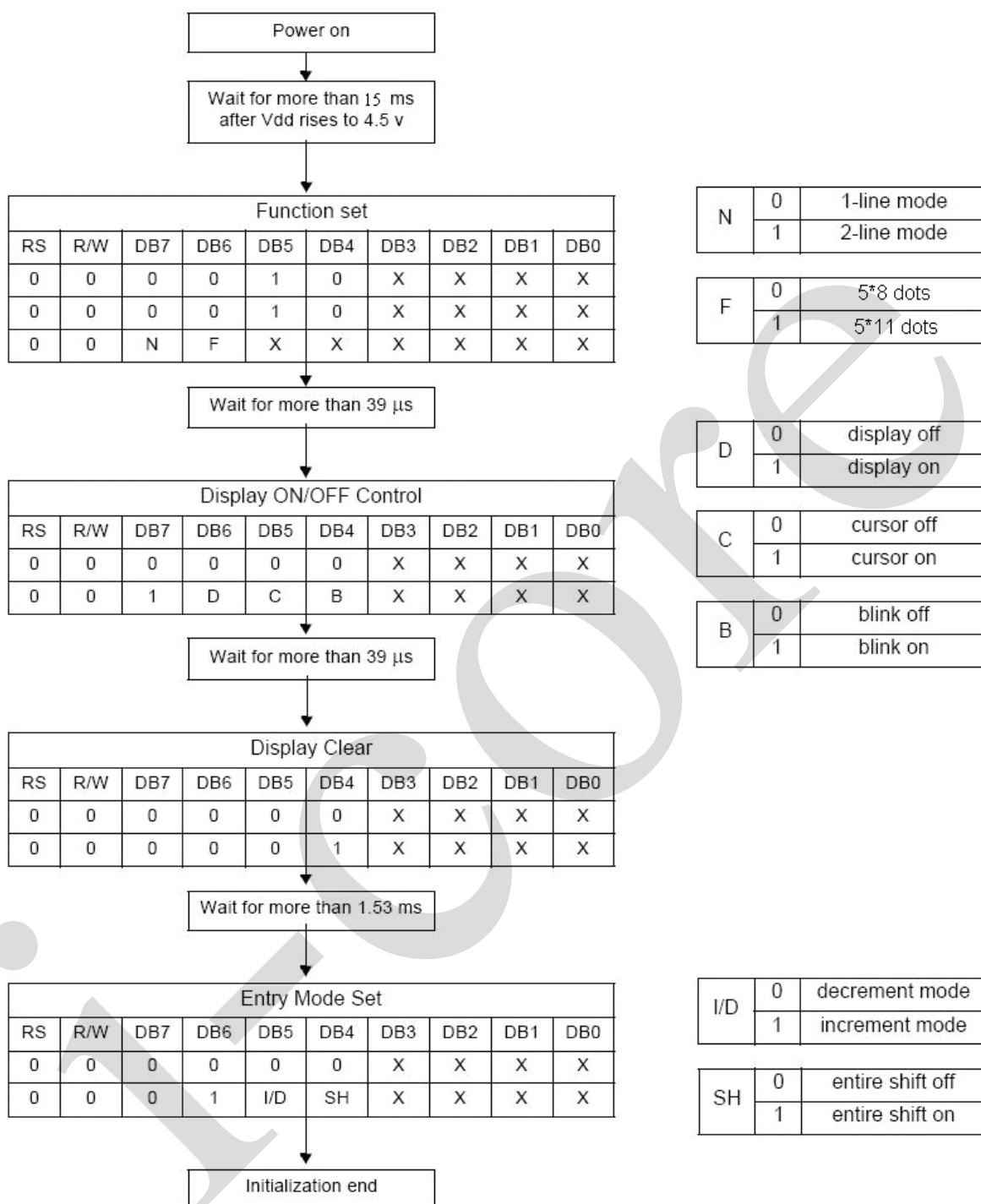
5.6、Initializing By Instruction

1) 8-bit interface mode (Condition: $f_{\text{OSC}} = 270 \text{ kHz}$)





2) 4-bit interface mode (Condition: $f_{OSC}=270kHz$)

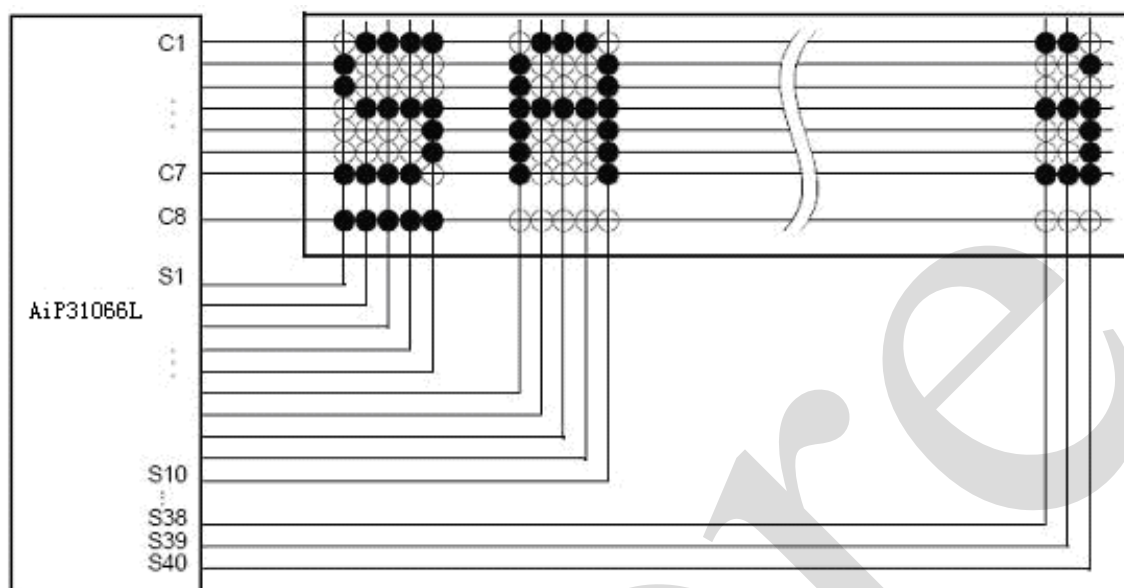




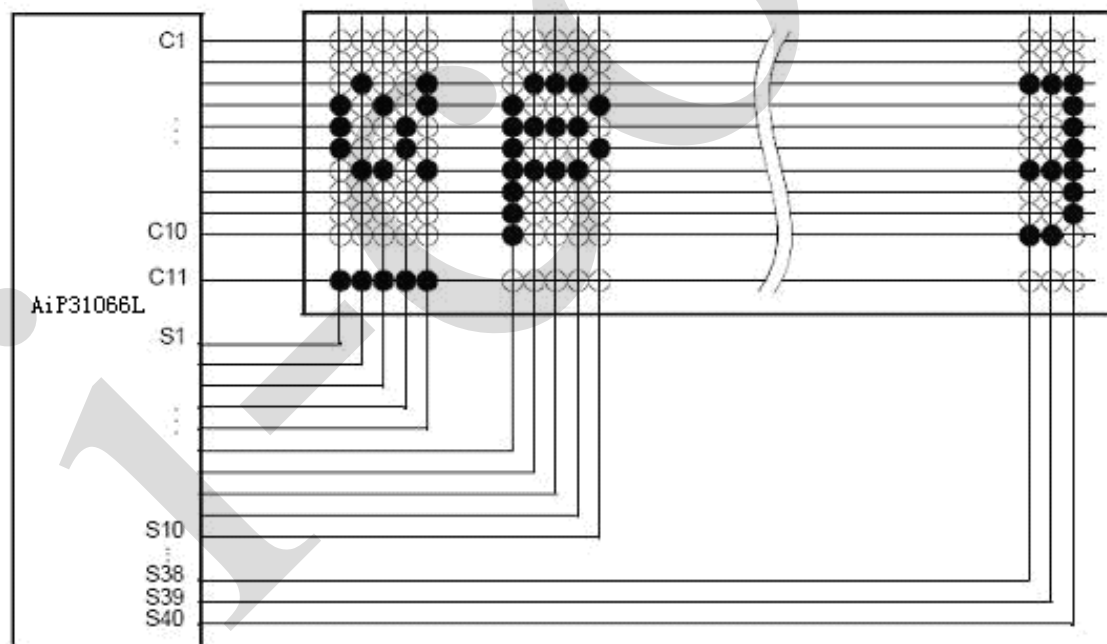
6、Typical Application Circuit And Application Note

6.1、Typical Application

1) LCD Panel:8 characters×1-line format (5×7 dots+1cursor line,1/4 bias,1/8 duty)

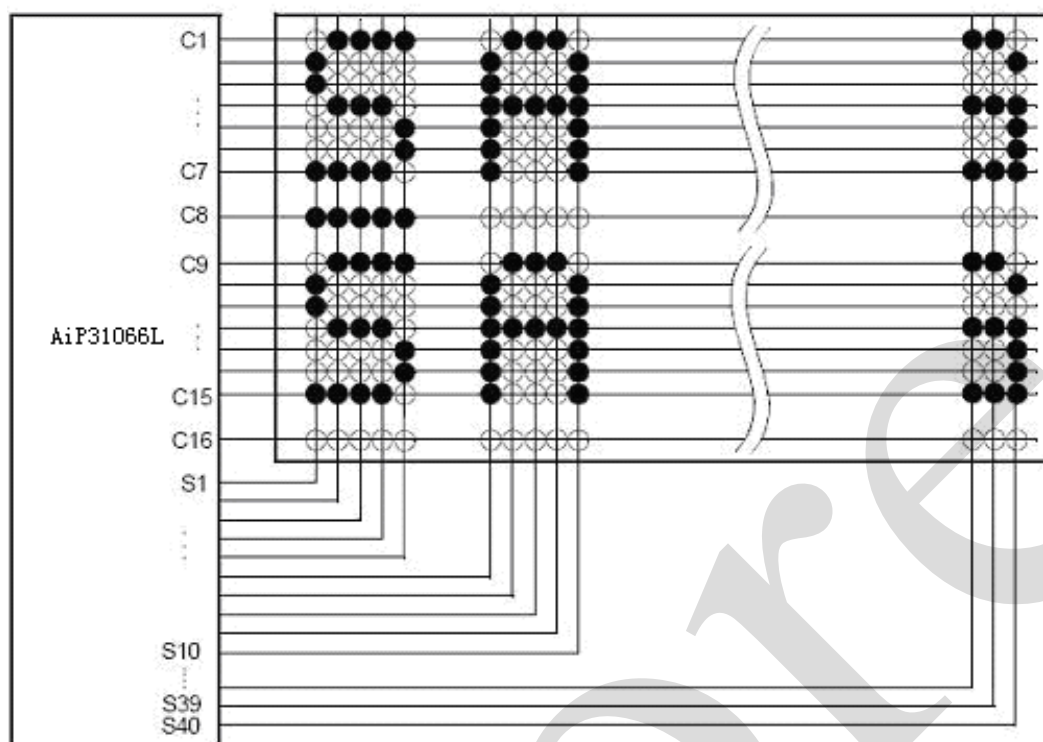


2) LCD Panel:8 characters×1-line format (5×10 dots+1 cursor line, 1/4 bias, 1/11 duty)

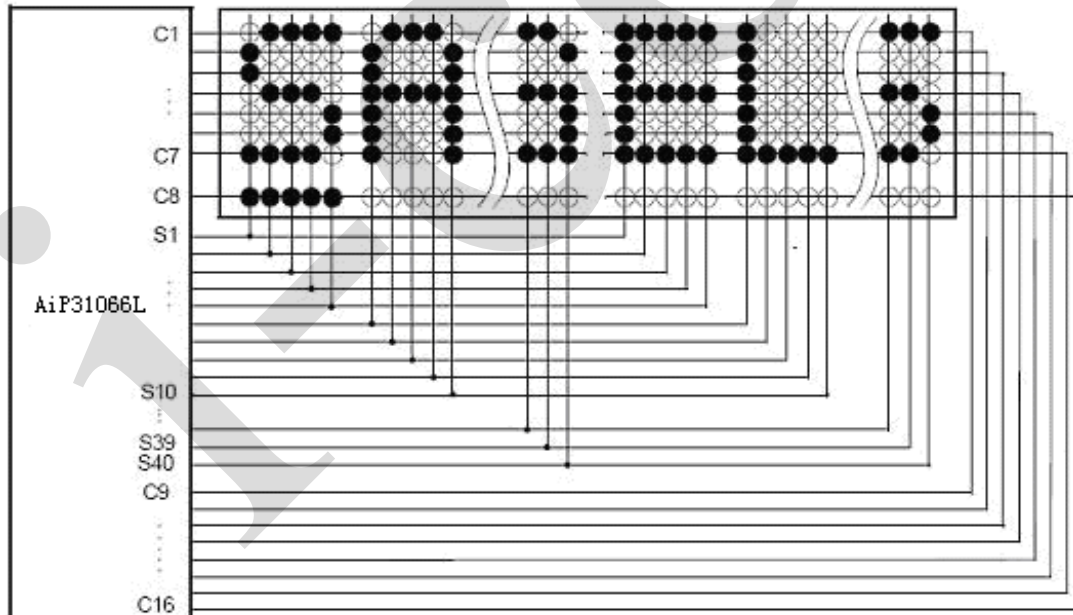




3) LCD Panel:8 characters×2 -line format (5×7 dots+line,1/5 bias,1/16 duty)

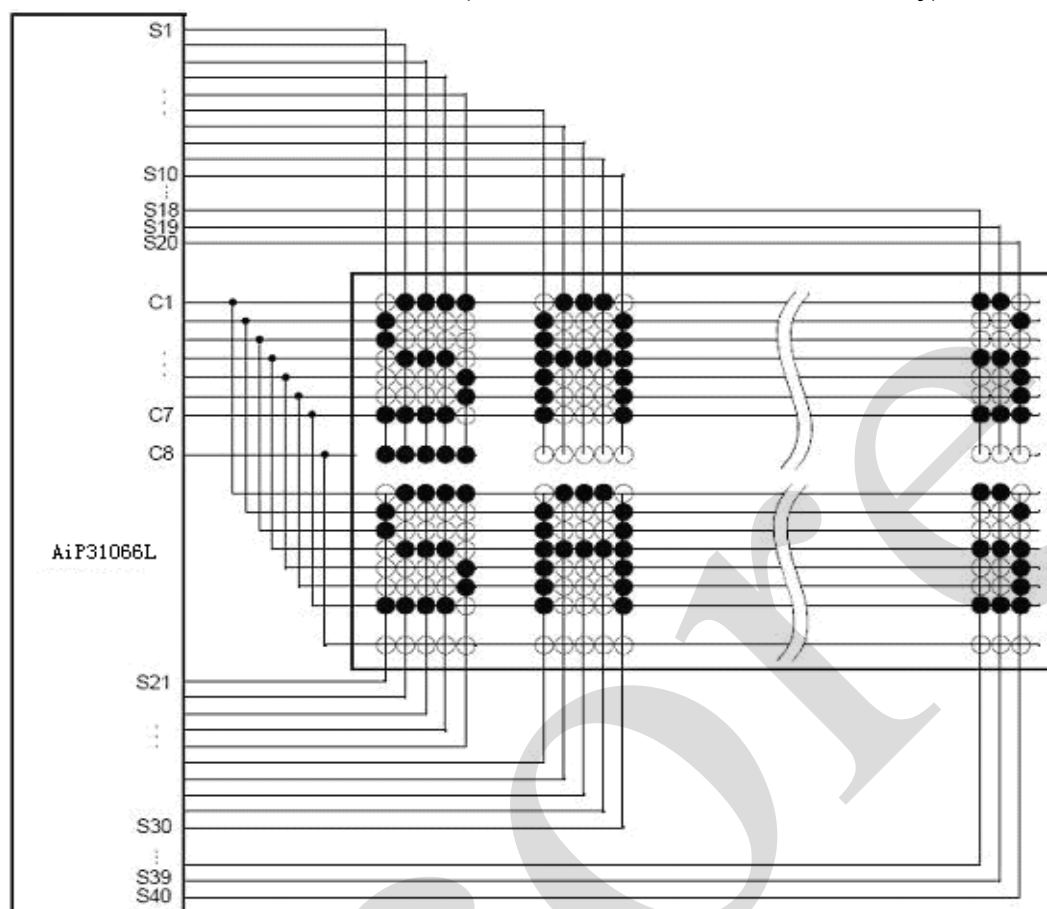


4) LCD Panel:16 characters×1-line format (5×7 dots+1cursor line,1/5 bias,1/16 duty)



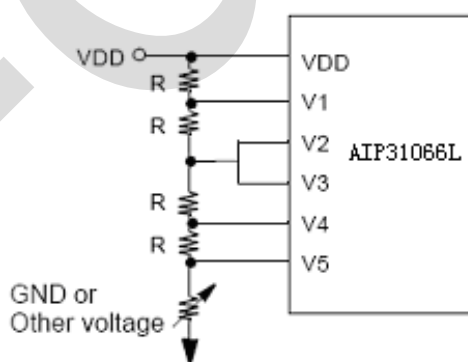


5) LCD Panel:4 characters×2-line format (5×7 dots+1cursor line,1/4 bias,1/8 duty)



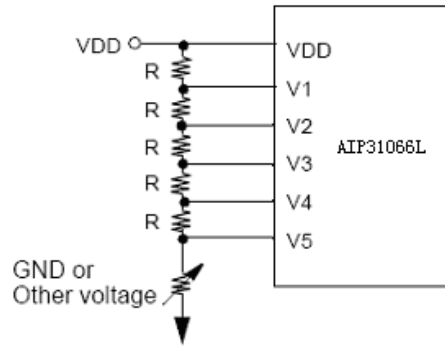
6.2、 Bias Voltage Divide Circuit

- 1/4 bias,1/8 or 1/11 duty



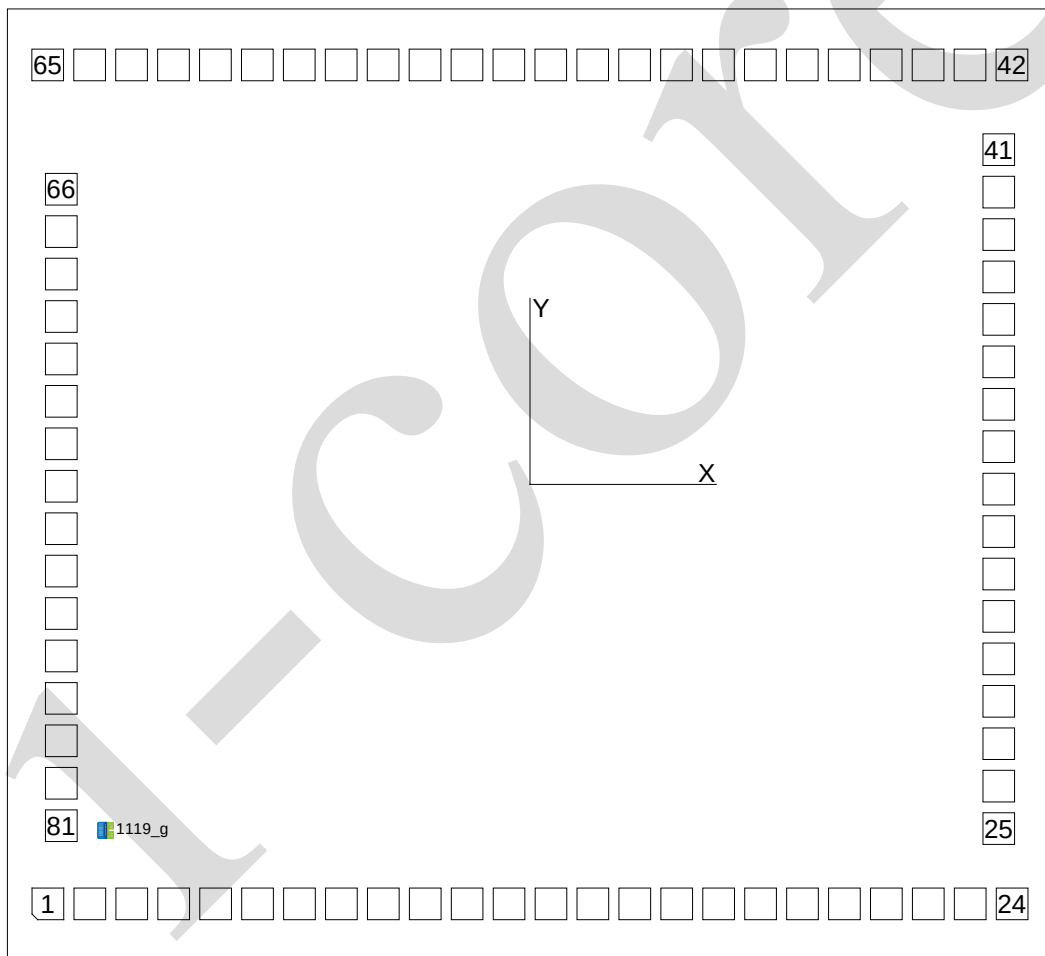


- 1/5 bias, 1/16 duty



7、PAD Diagram And PAD Location

7.1、PAD Diagram



Chip Size: 2805×2555(um×um)

PAD Size: 85×85(um×um)



7.2、PAD Location

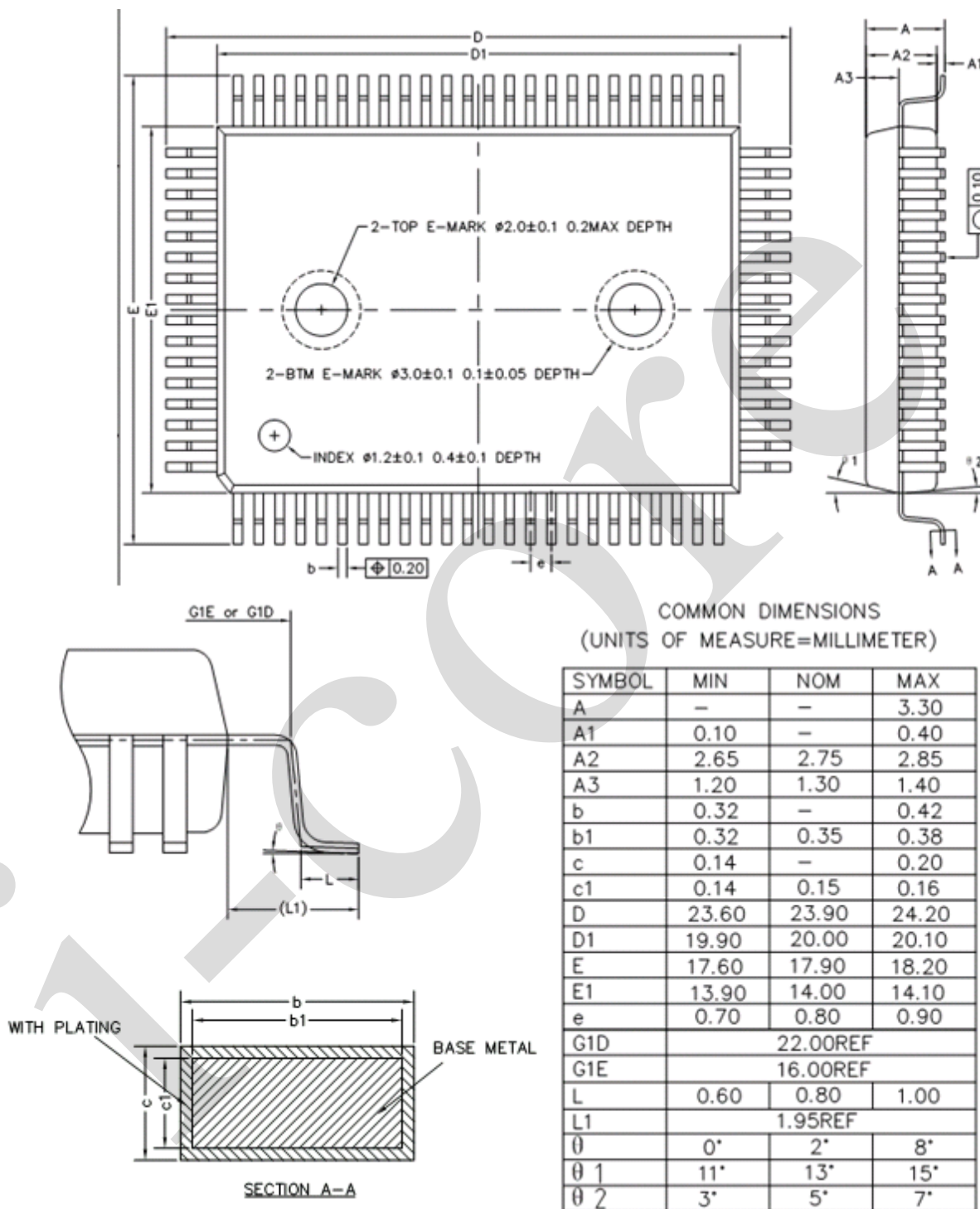
PAD No.	PAD Name	X	Y	PAD No.	PAD Name	X	Y
1	S22	-1293.75	-1126.9	42	DB2	1293.25	1126.9
2	S21	-1181.25	-1126.9	43	DB3	1180.75	1126.9
3	S20	-1068.75	-1126.9	44	DB4	1068.25	1126.9
4	S19	-956.25	-1126.9	45	DB5	955.75	1126.9
5	S18	-843.75	-1126.9	46	DB6	843.25	1126.9
6	S17	-731.25	-1126.9	47	DB7	730.75	1126.9
7	S16	-618.75	-1126.9	48	C1	618.25	1126.9
8	S15	-506.25	-1126.9	49	C2	505.75	1126.9
9	S14	-393.75	-1126.9	50	C3	393.25	1126.9
10	S13	-281.25	-1126.9	51	C4	280.75	1126.9
11	S12	-168.75	-1126.9	52	C5	168.25	1126.9
12	S11	-56.25	-1126.9	53	C6	55.75	1126.9
13	S10	56.25	-1126.9	54	C7	-56.75	1126.9
14	S9	168.75	-1126.9	55	C8	-169.25	1126.9
15	S8	281.25	-1126.9	56	C9	-281.75	1126.9
16	S7	393.75	-1126.9	57	C10	-394.25	1126.9
17	S6	506.25	-1126.9	58	C11	-506.75	1126.9
18	S5	618.75	-1126.9	59	C12	-619.25	1126.9
19	S4	731.25	-1126.9	60	C13	-731.75	1126.9
20	S3	843.75	-1126.9	61	C14	-844.25	1126.9
21	S2	956.25	-1126.9	62	C15	-956.75	1126.9
22	S1	1068.75	-1126.9	63	C16	-1069.25	1126.9
23	GND	1181.25	-1126.9	64	S40	-1181.75	1126.9
24	OSC1	1293.75	-1126.9	65	S39	-1294.25	1126.9
25	OSC2	1258	-924.7	66	S38	-1257.9	793.1
26	V1	1258	-810.7	67	S37	-1257.9	679.1
27	V2	1258	-696.7	68	S36	-1257.9	565.1
28	V3	1258	-582.7	69	S35	-1257.9	451.1
29	V4	1258	-468.7	70	S34	-1257.9	337.1
30	V5	1258	-354.7	71	S33	-1257.9	223.1
31	CLK1	1258	-240.7	72	S32	-1257.9	109.1
32	CLK2	1258	-126.7	73	S31	-1257.9	-4.9
33	VDD	1258	-12.7	74	S30	-1257.9	-118.9
34	M	1258	101.3	75	S29	-1257.9	-232.9
35	D	1258	215.3	76	S28	-1257.9	-346.9
36	RS	1258	329.3	77	S27	-1257.9	-460.9
37	R/W	1258	443.3	78	S26	-1257.9	-574.9
38	E	1258	557.3	79	S25	-1257.9	-688.9
39	NC	1258	671.3	80	S24	-1257.9	-802.9
40	DB0	1258	785.3	81	S23	-1257.9	-916.9
41	DB1	1258	899.3				

(Unit:um)



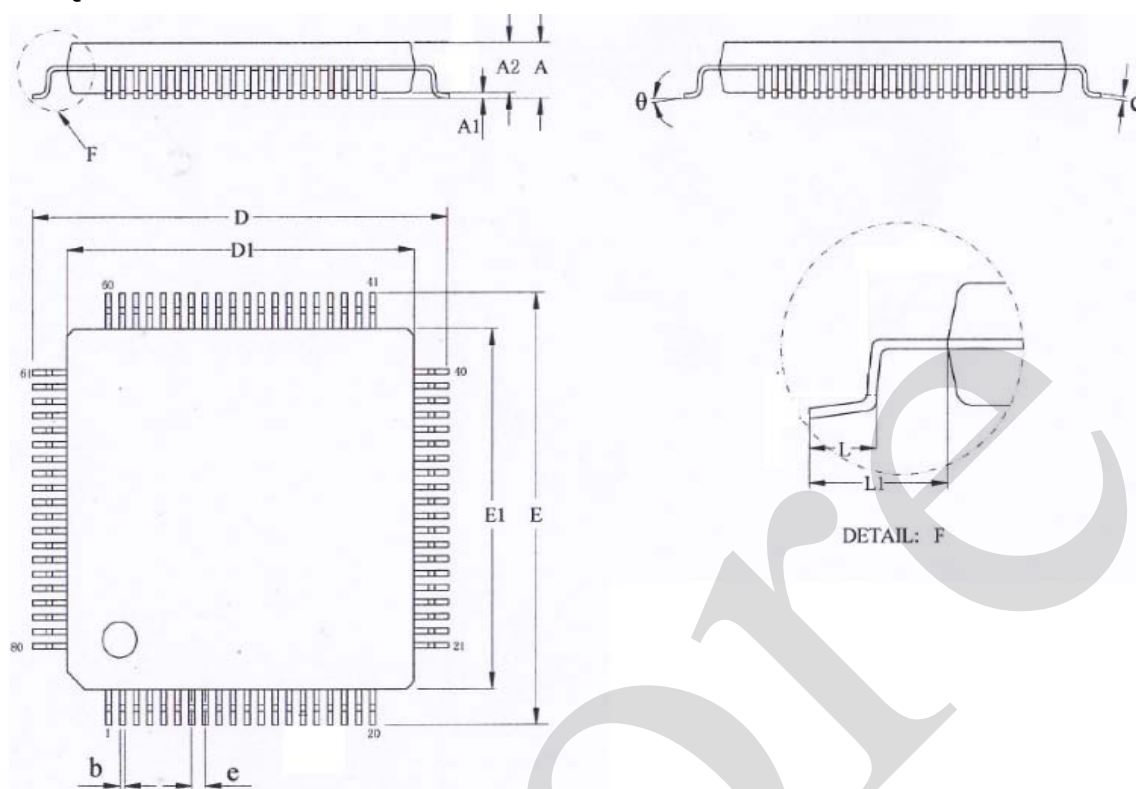
8、Package Information

8.1、QFP80





8.2、LQFP80



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.60
A1	0.05	0.15
A2	1.35	1.45
b	0.14	0.22
c	0.13	0.17
D	11.80	12.20
D1	9.90	10.10
E	11.80	12.20
E1	9.90	10.10
e	0.40	
L	0.45	0.75
L1	1.00	
θ	0°	7°



9、Character Patterns

9.1、AiP31066LC Character Patterns

upper data	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL				0	1	2	3	4	5	6	7	8	9	A	B	C
LLLH				D	E	F	G	H	I	J	K	L	M	N	O	P
LLHL				Q	R	S	T	U	V	W	X	Y	Z	[	]	^
LLHH				_	`	a	b	c	d	e	f	g	h	i	j	k
LHLL				l	m	n	o	p	q	r	s	t	u	v	w	x
LHLH				y	z	{	}	~								
LHHL																
LHHH																
HLLL																
HLLH																
HLHL																
HLHH																
HHLL																
HHLH																
HHHL																
HHHH																



9.2、AiP31066L-002 Character Patterns

upper data lower data	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL				0	1	2	3	4	5	6	7	8	9	A	B	C
LLLH			!	1	A	Q	a	7						Г	Я	Ш
LLHL			"	2	B	R	b	r						Ё	б	у
LLHH			#	3	C	S	c	s						Ж	в	ы
LHLL			\$	4	D	T	d	t						З	г	ь
LHLH			%	5	E	U	e	u						И	ё	а
LHHL			&	6	F	V	f	v						Й	ж	ю
LHHH			'	7	G	W	g	w						Л	з	я
HLLL			(	8	H	X	h	x						П	и	о
HLLH			)	9	I	Y	i	y						У	а	о
HLHL			*	:	J	Z	j	z						Ф	к	а
HLHH			+	:	K	[	k	[						Ч	л	"
HHLL			,	<	L	φ	l	φ						Ш	м	ъ
HHLH			-	=	M	]	m	]						Ъ	н	с
HHHL			.	>	N	^	n	^						Ы	п	ф
HHHH			/	?	O	_	o	_						Э	т	ё



9.3、AiP31066L-003 Character Patterns

	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL		±		Ø	Ø	P	'	F	G	E	Δ	'	Γ	Ω	β	τ
LLLH		≡	!	1	A	Q	3	7	Ü	æ	i	"	J	†	γ	U
LLHL		7	"	2	B	R	b	r	e	E	δ	*	ω	ε	δ	λ
LLHH		Δ	#	3	C	S	c	≡	Δ	δ	Ü	'	P	¶	ε	ψ
LHLL		Γ	\$	4	D	T	d	t	Δ	δ	Φ	'	4	Γ	ζ	ω
LHLH		Γ	%	5	E	U	e	u	Δ	δ	E	½	†	Δ	η	¶
LHHL		Γ	&	6	F	V	f	v	Δ	Ü	¶	¼	†	Θ	Θ	¶
LHHH		Γ	'	7	G	W	3	w	G	Ü	R	×	÷	Δ	U	¶
HLLL		Γ	(	8	H	X	h	x	E	Ü	¶	÷	÷	ε	κ	R
HLLH		Γ	)	9	I	Y	i	y	Δ	Ü	i	Δ	Γ	Π	λ	¶
HLHL		×	*	:	J	Z	j	z	E	Ü	Δ	Δ	Γ	Σ	μ	F
HLHH		Γ	+	:	K	C	k	c	i	Δ	Δ	*	L	Γ	U	¶
HHLL		=	,	<	L	\	l	l	i	Δ	Δ	*	Γ	Φ	Σ	□
HHLH		Δ	-	=	M	J	m	3	i	Δ	Δ	#	.	ψ	π	-
HHHL		E	.	>	N	^	n	~	Δ	Δ	Δ	Γ	Θ	Ω	p	Θ
HHHH		3	/	?	O	_	o	Δ	Δ	Δ	Δ	Δ	Θ	α	σ	Θ



9.4、AiP31066L-004 Character Patterns

	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HHLH	HHHH	HHLL	HHLH	HHHL	HHHH
LLLL		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E
LLLH		F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
LLHL		U	V	W	X	Y	Z	[	\	]	^	_	`	a	b	c
LLHH		d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
LHLL		s	t	u	v	w	x	y	z	{		}	~	!	"	#
LHLH		\$	%	&	'	(	)	*	+	=	>	<	>	<	>	<
LHHL		@	#	\$	%	&	'	(	)	*	+	=	>	<	>	<
LHHH		~	!	"	#	\$	%	&	'	(	)	*	+	=	>	<
HLLL		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E
HLLH		F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
HHLH		U	V	W	X	Y	Z	[	\	]	^	_	`	a	b	c
HHHL		d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
HHHH		s	t	u	v	w	x	y	z	{		}	~	!	"	#



10、Statements And Notes

10.1、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.									

10.2、Notes

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