



LCD MODULE SPECIFICATIONS

Customer:
Customer Part No.:
Highlystar Model Name: HSG-12864KV40-FS6L2C
Release Date: 2023/6/27
Customer Approval:
Date:
The above signature represents that the product specifications, testing regulation, and warranty in the specifications are accepted.

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1. BASIC SPECIFICATION

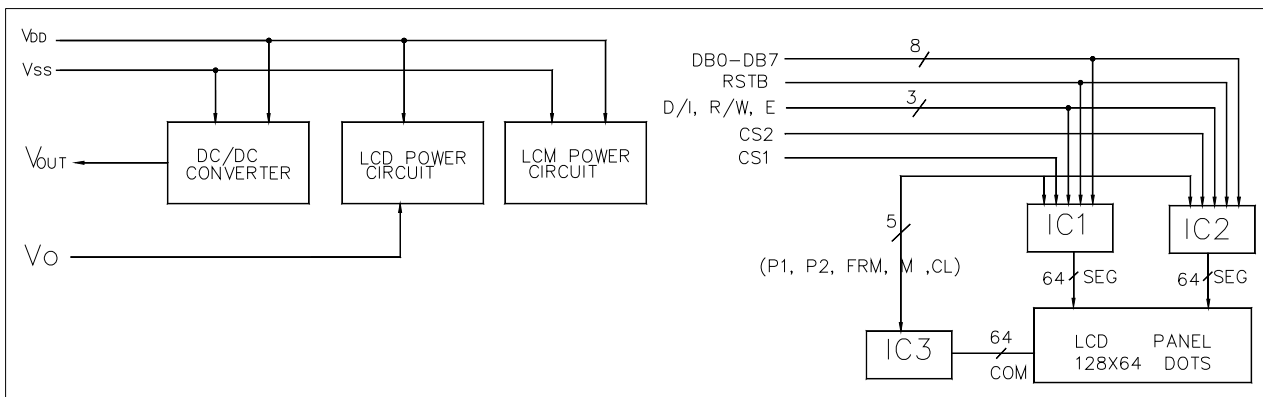
1.1 THE FEATURE OF LCD MODULE ARE AS FOLLOWS.

- . DISPLAY MODE : FSTN-TRANSFLECTIVE-POSITIVE
- . COLOR : DISPLAY DOT: BLACK
DISPLAY BACKGROUNDND: GRAY
- . DISPLAY FORMAT : 128×64 DOTS
- . INPUT DATA : 8-BITS PARALLEL DATA INPUT FROM A MPU
- . MULTIPLEXING : 1/64 DUTY
- . VIEWING DIRECTION : 6 O’CLOCK
- . DRIVED IC : AIP31107 (OR EQV), AIP31108 (OR EQV)
- . BUILT IN DC-DC CONVERTER : 7660
- . BACK LIGHT : LED BACKLIGHT
- . BEZEL : 0.6T

1.2 MECHANICAL SPECIFICATION

ITEM	SPECIFICATIONS	UNIT	REMARK
DIMENSIONAL OUTLINE	93.0(W)×70.0(H)×13.0MAX.(T)	Mm	*REFERENCE DIMENSIONAL OUTLINE
VIEW AREA	71.7(W)×39.0(H)		
EFFECTIVE V/AREA	66.52(W)×33.24(H)		
NUMBER OF DOTS	128 DOTS×64 DOTS	--	
DOT PITCH	0.52(W)×0.52(H)	mm	
DOT SIZE	0.48(W)×0.48(H)	mm	

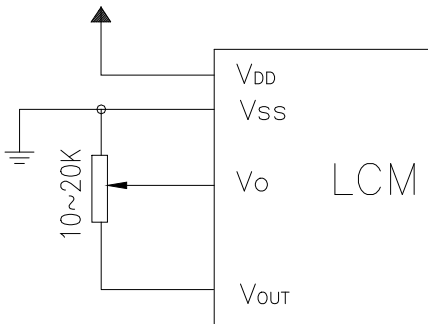
1.3 BLOCK DIAGRAM



1.4 TERMINAL FUNCTIONS

PIN NO.	SYMBOL	LEVEL	FUNCTION
1	V _{SS}	0V	Power supply(GND)
2	V _{DD}	3.0V	Power supply
3	V _o	—	Contrast Adjust
4	D/I(RS)	H/L	H: Display data L: Instruction code
5	R/W	H/L	H: Data/status read L: Data/instruction write
6	E	H, H/L	Chip enable signal
7~14	DB0-DB7	H/L	Data bus line
15	CS1	H	Chip selection for IC1
16	CS2	H	Chip selection for IC2
17	RSTB	L	Reset Signal
18	V _{OUT}	-	Negative Voltage Output
19	LED+	-	Power Supply for LED Back Light +
20	LED-	-	Power Supply for LED Back Light -

1-5 POWER SUPPLY CIRCUIT AND CONTRAST ADJUST



Recommended voltage: $V_{DD}-V_o = 9.1V$

2. ABSOLUTE MAXIMUM RATINGS ($T_a=25\text{ }^\circ\text{C}$, $V_{SS}=0V$)

PARAMETER	SYMBOL	RATINGS			UNITS
		MIN.	TYP.	MAX.	
POWER SUPPLY FOR LOGIC	$V_{DD}-V_{SS}$	0	-	6.0	V
POWER SUPPLY FOR LCD DRIVER	$V_{DD}\sim V_o$	0	-	16.0	V
INPUT VOLTAGE	V_{IN}	V_{SS}	-	V_{DD}	V
OPERATING TEMPERATURE	T_{opr}	-20	-	70	$^\circ\text{C}$
STORAGE TEMPERATURE	T_{stg}	-30	-	80	$^\circ\text{C}$

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3. ELECTRICAL CHARACTERISTICS

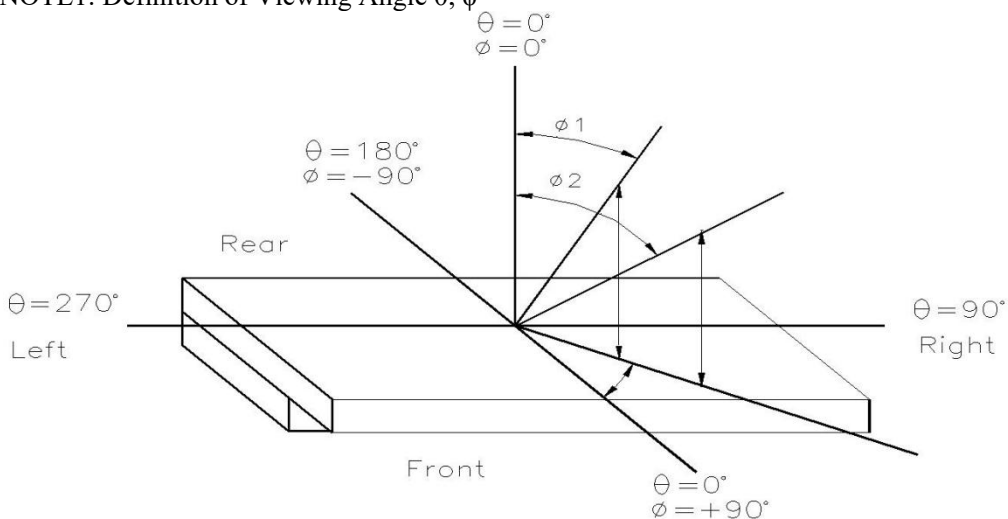
3.1 ELECTRICAL CHARACTERISTICS (Ta=25 °C)

ITEM	SYMBOL	CONDITION	MIN	TYPE	MAX.	UNIT	NOTE
LOGIC CIRCUIT POWER SUPPLY VOLTAGE	V _{DD} -V _{SS}	-----	2.8	3.0	3.3	V	
INPUT VOLTAGE	V _{IH}	-----	0.8V _{DD}	—	V _{DD}	V	
INPUT VOLTAGE	V _{IL}	-----	GND	—	0.2V _{DD}	V	
LOGIC CIRCUIT POWER SUPPLY CURRENT	I _{DD}	V _{DD} -V _{SS} =3.0	---	—	12.0	mA	
RECOMMENDED LCD DRIVING VOLTAGE	V _{LCD} Φ=0 θ=0	Ta=25 °C	8.3	8.5	8.7	V	

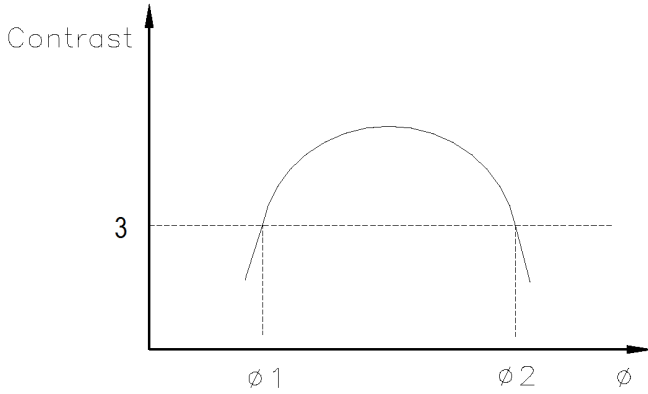
3.2 ELECTRO—OPTICAL CHARACTERISTICS (Ta=25 °C V_{DD}=3.0±0.2V)

ITEM	SYMBOL	CONDITION	MIN	TYPE	MAX	UNIT	NOTE
VIEW ANGLE	φ ₂ -φ ₁	K≥3	—	40	—	DEG	NOTE1,NOTE2
CONTRAST	K	φ=0° ,θ=0°	3	5	—	—	NOTE3
FRAME FREQUENCY				80		Hz	
RESPONSE TIME	Tr(rise)	φ=0° ,θ=0°	—	250	350	ms	
	Tf(fall)	φ=0° ,θ=0°	—	250	350	ms	NOTE4

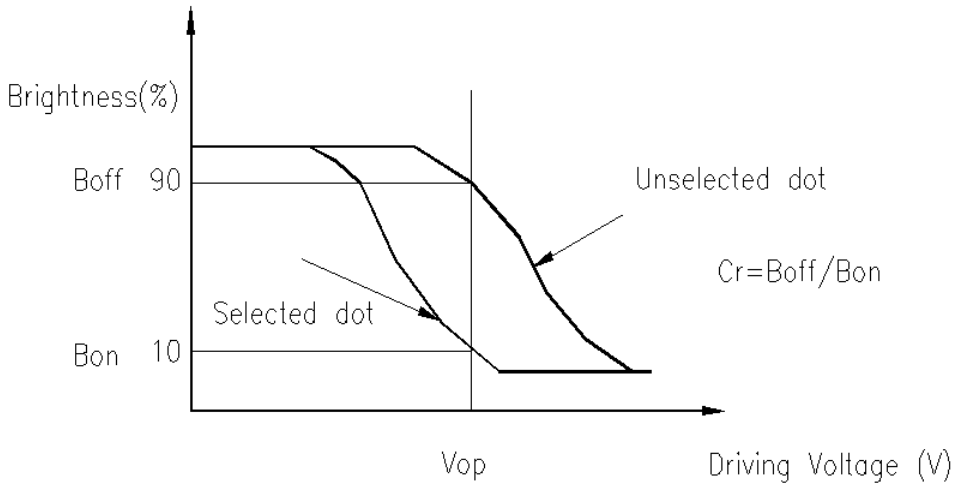
NOTE1: Definition of Viewing Angle θ, φ



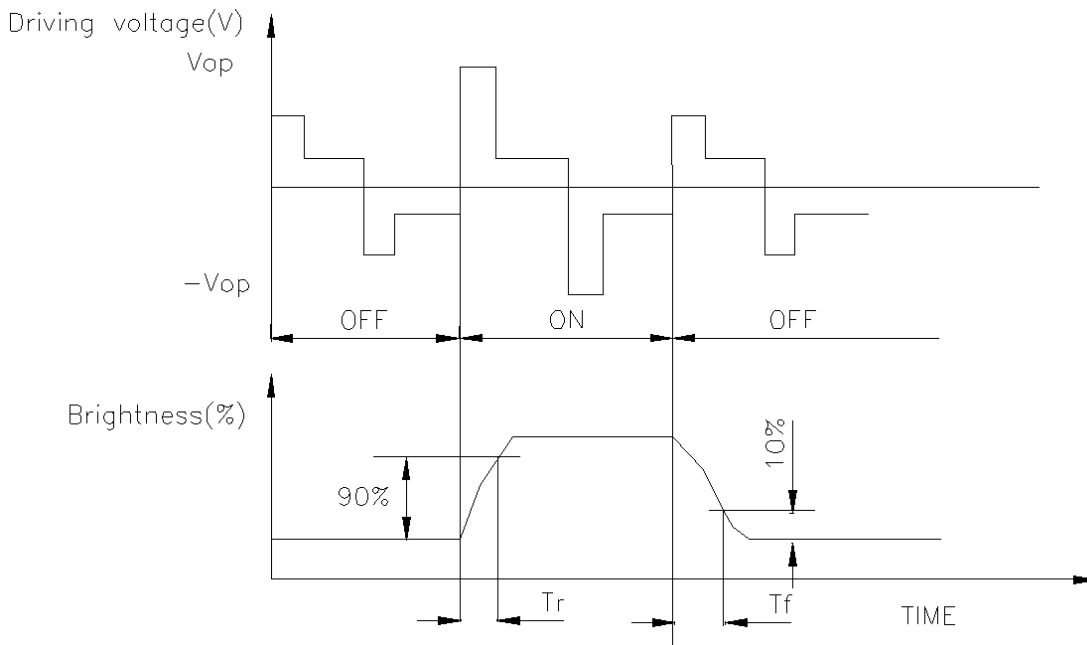
NOTE2: Definition of viewing Angle Range: $\Delta\phi=|\phi 2-\phi 1|$



NOTE3: Definition of Contrast



NOTE4: Definition of Response Time



3.3 LED BACK-LIGHT SPECIFICATION

3.3.1 ABSOLUTE MAXIMUM RATINGS(Ta=25 °C)

ITEM	SYMBOL	RATINGS	UNIT
PEAK FORWARD CURRENT	IF	60	mA
REVERSE VOLTAGE	VR	4	V
POWER DISSIPATION	Po	--	W

3.3.2 ELECTRICAL/OPTICAL SPECIFICATIONS:

ITEM	SYMBOL	STANDARD VALUE			UNIT	CONDITIONS
		MIN.	TYP.	MAX.		
FORWARD CURRENT	IF	36	45	54	mA	VF =4.2V Ta=25 °C Luminous is not through the LCD
LUMINOUS INTENSITY	IV	400		-	cd/m2	
COLOR RANGE		WHITE X=0.25-0.31, Y=0.25-0.31				
BRIGHTNESS UNIFORMITY	△%	75%				
REVERSE CURRENT	IR	-	-	0.15	mA	VR=4V

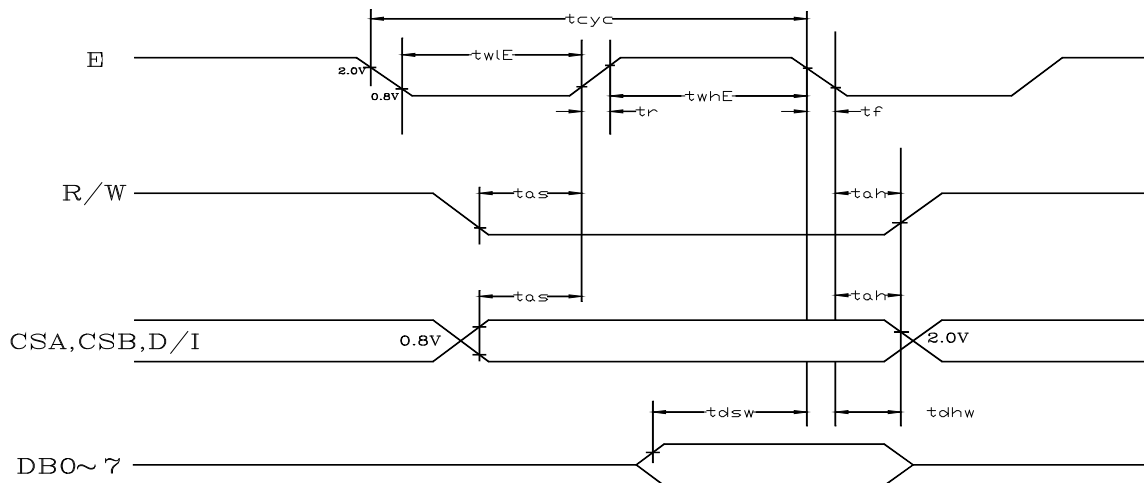
3.3.3 There is a resistor on the LCM PCB, so you can add a +5v on pin19 and pin20 to light the LED.

4 BUS TIMING CHARACTERISTICS

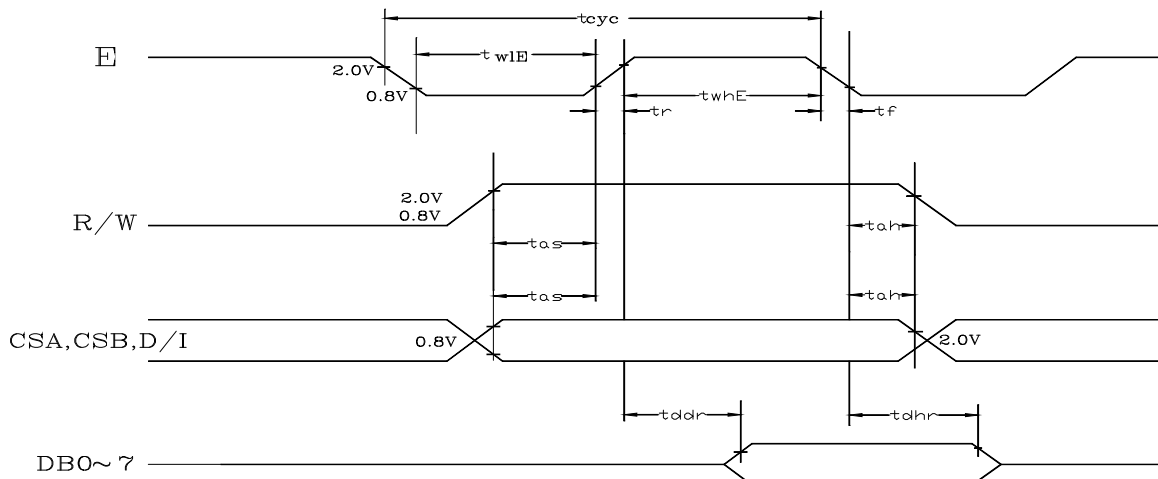
4.1 SIGNAL TIMING DAIGRAM

Characteristic	Symbol	Min.	Typ.	Max.	Unit
E cycle	t_{cyc}	1000	---	---	ns
E high level width	t_{whE}	450	---	---	ns
E low level width	t_{wlE}	450	---	---	ns
E rise time	t_r	---	---	25	ns
E fall time	t_f	---	---	25	ns
Address set-up time	t_{as}	140	---	---	ns
Address hold time	t_{ah}	10	---	---	ns
Data set-up time	t_{dsw}	200	---	---	ns
Data delay time	t_{ddr}	----	---	320	ns
Data hold time(write)	t_{dhw}	10	---	---	ns
Data hold time(read)	t_{dhr}	20	---	---	ns

MPU Write Timong



MPU Read Timong



5. OPERATING PRINCIPLES & METHODES

5.1 I/O Buffer

Input buffer controls the status between the enable and display of chip. Unless the CSA or CSB is in active mode, input or output of data and instruction do not execute. Therefore internal state is not change.

5.2 Input Register

Input register is provided to interface with MPU which is different operating frequency. Input register store the data temporarily before writing it into display data RAM.

When CSA or CSB is in the active mode, R/W and D/I select the input register. The data from MPU is written into input register and then write it into display data RAM. Data is latched when falling of the E signal and written automatically into the display data RAM by internal operation.

5.3 Output Register

Output register stores the data temporarily from display data RAM when CSA or CSB is in active mode and R/W and D/I=H. Store data in display data RAM is latched in output register. When CSA or CSB is in active mode and R/W=H, D/I=L, status data (busy check) can be read out.

To read the contents of display data RAM, twice access of read instruction is needed. In first access, data in display data RAM is latched into output register. In second access, MPU can read data which is latched. That is, to read the data in display data RAM, it needs dummy read. But status read does not need dummy read.

D/I	RW	Function
0	0	Instruction
	1	Status read (busy check)
1	0	Data write (from input register to display data RAM)
	1	Data read (from display data RAM to output register)

5.4 Reset

System reset can be initialized by setting RSTB terminal at low level when turning power on, receiving instruction from MPU. When RSTB becomes low, following procedure is occurred.

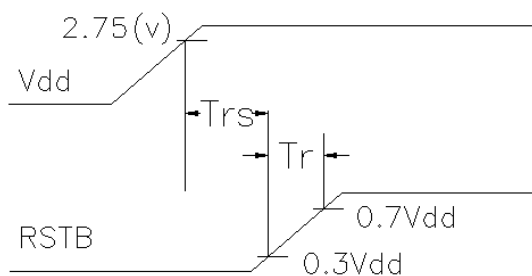
1. Display off
2. Display start line register become set by 0.(Z-address 0)

While RSTB is low level, no instruction except status read can be accepted. Reset status appears at DB4. After DB4 is low, any instruction can be accepted.

The Conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

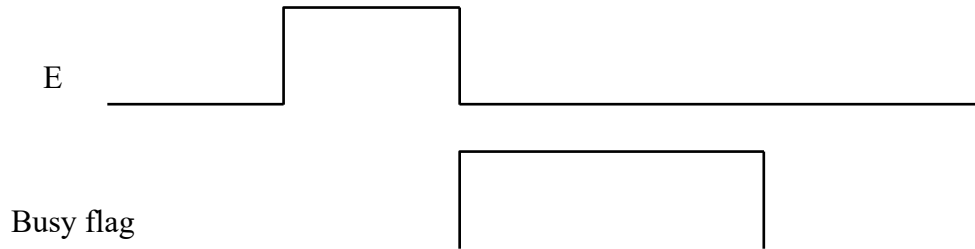
Item	Symbol	Min.	Typ.	Max.	Unit
Reset time	tRSTB	1.0	---	---	us
Rise time	tr	---	---	200	us



5.5 Busy Flag

Busy flag indicates that AIP31108 is operating or not operating. When busy flag is high, AIP31108 is in internal operating. When busy flag is low, AIP31108 can accept the data or instruction.

DB7 indicates busy flag of the AIP31108.



5.6 Display On/Off Flip-Flop

The display on/off flip-flop makes on/off the liquid crystal display. When flip-flop is reset (logical low), selective voltage or non selective voltage appears on segment output terminals. When flip-flop is set (logical high), non selective voltage appears on segment output terminals regardless of display RAM data.

The display on/off flip-flop can change status by instruction. The display data at all segments disappear while RSTB is low. The status of the flip-flop is output to DB5 by status read instruction.

5.7 X Page Register

X page register designates page of the internal display data RAM. It has not count function. An address is set by instruction.

5.8 Y Address Counter

Y address counter designates address of the internal display data RAM. An address is set by instruction and is increased by 1 automatically by read or write operations of display data.

5.9 Display Data RAM

Display data RAM stores a display data for liquid crystal display. To express on state of dot matrix of liquid crystal display, write data 1. The other way, off state write 0.

5.10 Display Start Line Register

The display start line register indicates address of display data RAM to display top line of liquid crystal display. Bit data (DB<0:5>) of the display start line set instruction is latched in display start line register. It is used for scrolling of the liquid crystal display screen.

6. DISPLAY CONTROL INSTRUCTION

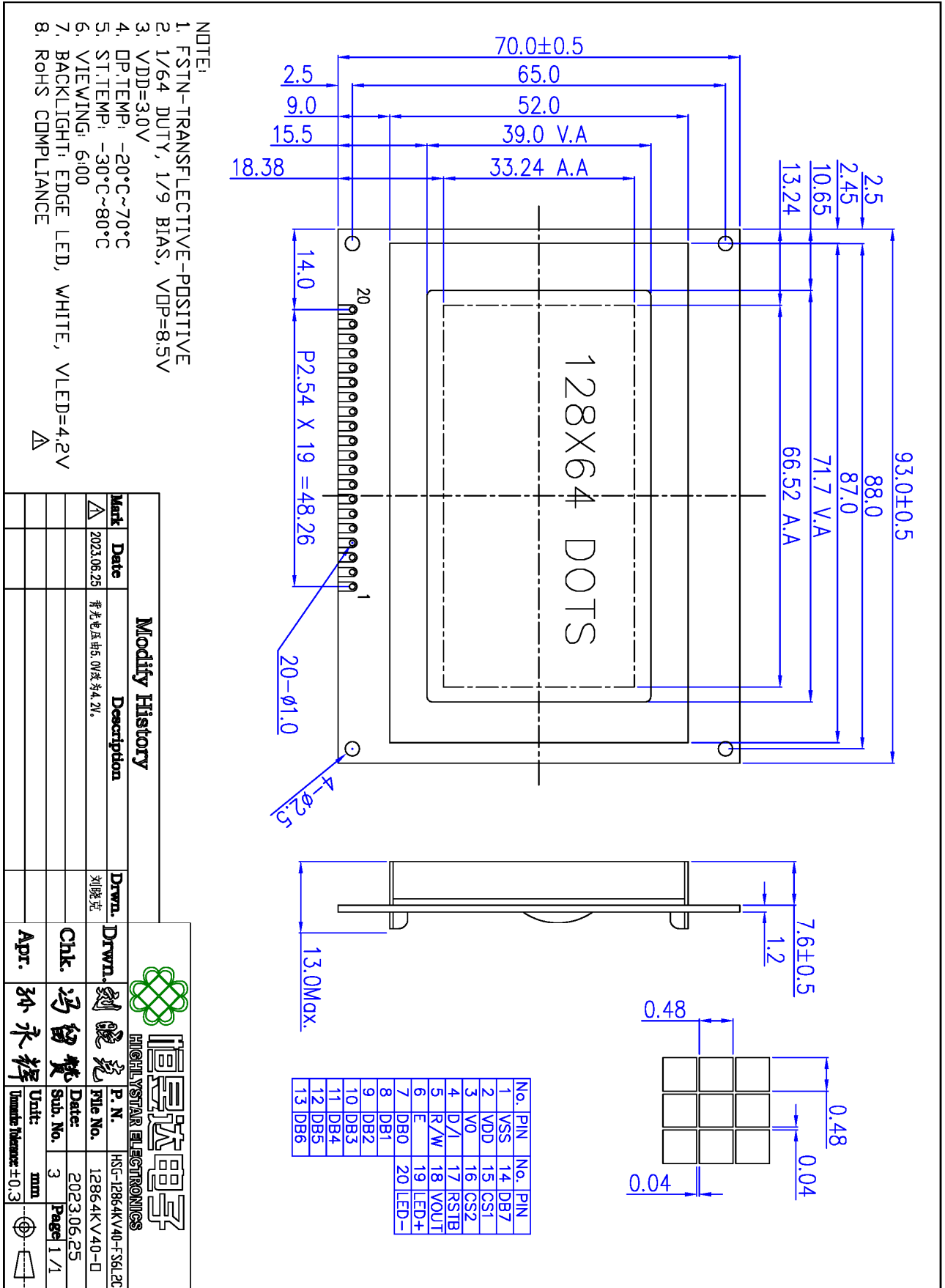
The display control instructions control the internal state of the AIP31108. Instruction is received from MPU to AIP31108 for the display control. The following table shows various instructions.

Instruction	D/I	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display ON/OFF	0	0	0	0	1	1	1	1	1	0/1	Controls the display on or off. Inter status and display RAM data are not affected.
Set Address	0	0	0	1	Y address (0-63)					Sets the Y address in the Y address counter.	
Set Page (X address)	0	0	1	0	1	1	1	Page (0-7)		Sets the X address at the X address register.	
Display Start Line	0	0	1	1	Display start line (0-63)					Indicates the display data RAM displayed at the top of the screen.	
Status Read	0	1	B U S Y	0	O N / O F F	R E S E T	0	0	0	0	Read status. BUSY 0: Ready 1: In operation ON/OFF 0: Display ON 1: Display OFF RESET 0: Normal 1: Reset
Write Display Data	1	0	Display Data								Writes data (DB0:7) into display data RAM. After writing instruction , Y address is increased by 1 automatically.
Read Display Data	1	1	Display Data								Read data (DB0:7) from display data RAM to the data bus.

7 DISPLAY DATA RAM ADDRESS MAP

PAGE ADDRESS	DISPLAY DATA	1ST AIP31108					2ND AIP31108					LINE ADDRESS	COMMON
B8	D0											C0	COM0
	D1											C1	COM1
	D2											C2	COM2
	D3											C3	COM3
	D4											C4	COM4
	D5											C5	COM5
	D6											C6	COM6
	D7											C7	COM7
B9	D0											C8	COM8
	D1											C9	COM9
	D2											CA	COM10
	D3											CB	COM11
	D4											CC	COM12
	D5											CD	COM13
	D6											CE	COM14
	D7											CF	COM15
BA	D0											D0	COM16
	D1											D1	COM17
	D2											D2	COM18
	D3											D3	COM19
	D4											D4	COM20
	D5											D5	COM21
	D6											D6	COM22
	D7											D7	COM23
BB	D0											D8	COM24
	D1											D9	COM25
	D2											DA	COM26
	D3											DB	COM27
	D4											DC	COM28
	D5											DD	COM29
	D6											DE	COM30
	D7											DF	COM31
BC	D0											E0	COM32
	D1											E1	COM33
	D2											E2	COM34
	D3											E3	COM35
	D4											E4	COM36
	D5											E5	COM37
	D6											E6	COM38
	D7											E7	COM39
BD	D0											E8	COM40
	D1											E9	COM41
	D2											EA	COM42
	D3											EB	COM43
	D4											EC	COM44
	D5											ED	COM45
	D6											EE	COM46
	D7											EF	COM47
BE	D0											F0	COM48
	D1											F1	COM49
	D2											F2	COM50
	D3											F3	COM51
	D4											F4	COM52
	D5											F5	COM53
	D6											F6	COM54
	D7											F7	COM55
BF	D0											F8	COM56
	D1											F9	COM57
	D2											FA	COM58
	D3											FB	COM59
	D4											FC	COM60
	D5											FD	COM61
	D6											FE	COM62
	D7											FF	COM63
	COLUMN ADDRESS	40	41	42	---	7F	40	41	42	---	7F		
	SEGMENT	SEG1	SEG2	SEG3	---	SEG64	SEG1	SEG2	SEG3	---	SEG128		

8. DIMENSIONAL OUTLINE



- NOTE:
1. FSTN-TRANSFLECTIVE-POSITIVE
 2. 1/64 DUTY, 1/9 BIAS, VDP=8.5V
 3. VDD=3.0V
 4. DP.TEMP: -20°C~70°C
 5. ST.TEMP: -30°C~80°C
 6. VIEWING: 6:00
 7. BACKLIGHT: EDGE LED, WHITE, VLED=4.2V
 8. ROHS COMPLIANCE

Modify History

Mark	Date	Description	Drawn	Drwn.	Apr.
△	2023.06.25	背光电压由5.0V改为4.2V.	刘晓亮	刘晓亮	



P. N.	HSG-12864KV40-FS6L2C
File No.	12864KV40-0
Date:	2023.06.25
Sub. No.	3
Unit:	mm
Units Tolerance	±0.3
Page:	1/1

The tolerance unless specified: ±0.3mm

9.QUALITY SPECIFICATION

9-1.ACCEPTABLE QUALITY LEVEL

Inspection items	Sampling procedures	AQL
Visual-operating (Electro-optical)	GB2828.1-2012 Inspection level II Normal inspection Single sample inspection	0.65
Visual-not operating	GB2828.1-2012 Inspection level II Normal inspection Single sample inspection	1.5
Dimension measurement	GB2828.1-2012 Inspection level II Normal inspection Single sample inspection	1.5

9-2. INSPECTION CONDITIONS

9-2-1. THE ENVIRONMENTAL

-Room temperature: 25 ± 3 °C

-Humidity: 65 ± 20 %RH

9-3. INSPECTION STANDARDS

9-3-1. VISUAL WHILE OPERATING

Items to be inspected	Inspection standard
. No display	. If any pattern is not active at all, they can be rejected.
. Irregular operating	. No irregular operating are allowed . Appeared different display, which they should be chosen in the pattern, or appeared in different position where they should be chosen.
.Irregular display	. Any segment doesn't active, they can be rejected.
. Over current	. The total current required to activate the module should not be exceed the MAX current in specification.
.View angles	. Valves that don't meet the minimum value noted in the specification. they can be rejected.
.Contrast	. Valves that don't meet the minimum value noted in the specification, they can be reject.
.LCD operate voltage	. Meet the specification.

9-3-2. Visual while not operating

Module dimension	. Meet the module outline drawing, not exceed the tolerance.
LCD panel scratch	.Following scratches inside the effective viewing area considered as the defects when their width & length are larger than the following combinations. Number: one or more Width: 0.1 length: 3.0 three or more Width: 0.05 length: 2.0 three or more Width: 0.03 length: 3.0 When the defects exceed this, it can be rejected.

10.RELIABILITY

Standard Specification for Reliability of General-purpose LCM

Test Item	Test Condition	Note
High Temperature Store	80 °C,12hr.	2
Low Temperature Store	-30 °C,4hr	2
Humidity Store	40 °C,90%RH,96hr	1,2
High Temperature Operation	70°C,typical operating conditions,48hr	
Low Temperature Operation	-20°C,typical operating conditions,48hr	
Shock	Acceleration: 100m/s ² , Pulse time: 11ms, 6 times in each direction of XYZ	
Mechanical Vibration	10~55Hz sweep, 3G, ampl.=0.75mm(max) XYZ for 20 min, each.	

Note 1: Condensation of water is not permitted on the module.

Note 2: The module should be inspected after 1 hour storage in normal conditions (15~35 °C,45~65%RH)

11. HANDLING PRECAUTION

11-1. MOUNTING METHOD

The panel of the LCD module consists of two thin glass plates with polarizes which easily get damaged since the module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD modules.

11-2. CAUTION OF LCD HANDLING & CLEANING

When cleaning the display surface. Use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Tri chlorotri fluoroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizes surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

11-3.CAUTION AGAINST STATIC CHARGE

The LCD modules use COMS LSI drivers. So we recommend that you connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on and ground your body. work/assembly table. And assembly equipment to protect against static electricity.

11-4.PACKAGING

-Modules use LCD elements, and must be treated as such avoid intense shock and falls from a height

-To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

11-5.CAUTION FOR OPERATION

-It is indispensable to drive LCM within the specified voltage limit since the higher voltage than

the limit shortens LCM life.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD, which will come back in the specified operating temperature range.

-If the display area is pushed hard during operation. Some font will be abnormally displayed but it resumes normal condition after turning off once.

-A slight dew depositing on terminals is a cause for Electro-chemical reaction resulting in terminal open circuit.

Under the maximum operating temperature, 50%RH or less is required

11-6 SOLDERING

-The temperature of the soldering iron tip should less than 280° C.

-The welding time should less than 3~4s.

-Do not use acidic flux.

-Do not repeat the welding more than 3 times, each repetition needs to be separated by 5 minutes.

-Wave soldering or reflow soldering is not supported.

11-7 STORAGE

In the case of storing for a long period of time (for instance, for years) for the purpose or replacement use. the following ways are recommended

-Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it, and with no desiccant.

-Placing in a dark place where neither exposure to direct sunlight nor light is, keeping temperature in the specified storage temperature range.

-Storing with no touch on polarizes surface by the anythingelse.

(it is recommended to store them as they have been contained in the inner container at the time of delivery from us.

11-8.SAFETY

-It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol, which should be burned up later.

-When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

12.PRECAUTION FOR USE

12-1.A limit sample should be provided by the both parties on an occasion when the both parties agree its necessity.

Judgement by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

12-2.On the following occasions, the handling of problem should be decided through discussion and agreement between representative of the both parties

-When a question is arisen in this specification.

-When a new problem is arisen which is not specified in this specifications.

-When an inspection specification change or operating condition change in customer is reported to HighlyStar, and some problem is arisen in this specification due to the change.

-When a new problem is arisen at the customer's operating set for sample evaluation in the customer size.

13. REVISIONS HISTORY

REVISION	DATE	DESCRIPTION
0.0	2023/2/27	Preliminary release
0.1	2023/6/27	Change the LED Backlight current limit resistor and driving voltage.